A Taxonomic Summary and Revision of
Rhizophydiun (Rhizophydiales,
Chytridiomycota)

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PREFACE

For more than 150 years the concept of *Rhizophydium* has been based on thallus morphological features. Although the use of ultrastructural and molecular characters in systematic analyses of chytrid diversity has revolutionized our understanding of these fungi, ready access to summaries of established taxa based on morphological characters is still important for modern systematic decisions. The last monographic treatment of Chytridiomycota was Frederick K. Sparrow’s *Aquatic Phycomycetes* published in 1960. Subsequently, Joyce Longcore summarized the names and references of new taxa since Sparrow’s monograph. Thus, with the most recent monographic treatment of the majority of chytrid genera over 60 years old, there is a critical need for updated monographic summaries of chytrid genera.

Described in the mid-1800s, *Rhizophydium* is one of the older and larger genera of chytrids. As the name of the type species indicates, *Rhizophydium globosum* was characterized by its spherical sporangium. Since then over 220 additional species of *Rhizophydium* have been described with a wide range of sporangial shapes, substrates, hosts, and habitats, greatly changing the concept of the genus. The purpose of this book is to summarize the species of the genus *Rhizophydium*, bringing together descriptions, keys and illustrations. As a matter of record incompletely known taxa are also described and illustrated. In a final section, taxa that have been transferred, synonymized, rejected and excluded are listed. The genus *Rhizophydium* is currently recognized as more diverse than classically viewed, and ultrastructural and molecular analyses of members of the genus have lead to delineation of numerous families and genera in the order Rhizophydiales. As chytrid systematics are revised, it is our aim that this summary facilitate recognition of previously described taxa within *Rhizophydium* and serve as a guide when new taxa are discovered.

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INTRODUCTION

The genus *Rhizophydium* Schenk (1858) is among the oldest of Chytridiomycota genera, preceded only by *Chytridium* A. Br. (Braun 1851) and *Rhizidium* A. Br. (Braun 1856b, 1856c). *Rhizophydium* was established to accommodate inoperculate members of *Chytridium*, and the genus was formally described by Rabenhorst (1868). Based on the type *Rhizophydium globosum* (Clements & Shear 1931), the morphological concept is of a simple thallus composed of a monocentric, epibiotic, spherical, multipored sporangium bearing a single rhizoidal axis that branches, and an epibiotic resting spore. Despite the relative simplicity of morphological characters defining the genus, 235 species have been described, many having been delineated on the basis of habitat and/or substrate utilization. Karling (1977) merged *Phlyctidium* Rabenh. with *Rhizophydium*, because differences in the endobiotic portion of the eucarpic thallus were not distinctive enough to warrant generic delineation. As well, *Phlyctidium* was not a valid genus because the name had been used previously for a genus of Ascomycetes. Within this concept of *Rhizophydium*, 146 species are sufficiently described and are considered to be valid, while 89 other species are either: (1) incompletely known, (2) rejected as valid because their limited descriptions preclude placement in *Rhizophydium*, (3) are properly in synonymy in other genera, or (4) have been removed to recently circumscribed genera.

We consider a species to properly be included in the genus when information regarding its sporangium, rhizoidal system, and zoospore has been provided. Most species have not been brought into pure culture where they can be studied extensively under controlled conditions, but rather have been studied via microscopic observations in situ. Thus, the degree of morphological information provided varies among taxa.

With the inclusion of *Phlyctidium* in *Rhizophydium* (Sparrow 1943, 1960, Karling 1977, and others), in species descriptions we distinguish between a rhizoidal system and a haustorium as the endobiotic portion of the eucarpic thallus; both are organs of attachment and absorption of nutrients. Although difficult to define precisely, a rhizoid is a taproot-like, often tapering structure consisting of anucleate filaments of a saprobic organism, while a haustorium is a specialized absorptive organ, generally of a parasitic organism.

It is probable that most chytridiaceous fungi have a resting spore stage because of the advantage conferred in being able to survive unfavorable environmental conditions in a resistant condition. Thick-walled resting spores filled with storage contents are commonly, but not universally, reported among species of *Rhizophydium*. Resting spores may arise either vegetatively...
or sexually. Sexual recombination is less commonly reported and has been found mostly among aquatic-inhabiting species. Although variation exists in what type of cells are involved, typically the contents of one gametangium is transferred to an adjacent gametangium that develops into a resting spore functioning as a zygote (Couch 1935, Sparrow 1935).

The purposes of this taxonomic summary and revision are to assemble descriptions, illustrations, and information pertaining to habitats, substrates, and geographical locations, of all completely and incompletely known species, and to summarize species that have been rejected, synonymized, or removed from Rhizophydium. This assembly updates the most recent monograph (Sparrow 1960) and listing of names (Longcore 1996). Figures have been redrawn from original literature, or adapted from descriptions when figures were not obtainable.

Taxonomy of accepted species of Rhizophydium: Seven Sections
Morphological identification of Rhizophydium species relies on seven sections, each section representing a predominant sporangial shape:

Section 1. Sporangium predominantly spherical or subspherical throughout development.

Section 2: Sporangium predominantly spherical at first, then urceolate (urn-shaped) after discharge.

Section 3: Sporangium spherical at first, then angular and upright at maturity, or angular throughout development.

Section 4: Sporangium predominantly pyriform (pear-shaped, the part of the sporangium proximal to the substrate being broadest), conical, or pyramidal.

Section 5: Sporangium predominantly ovoid, obovate, or obpyriform (the part of the sporangium distal to the substrate being broadest).

Section 6: Sporangium predominantly citriform (lemon-shaped) or saddle-shaped, ovoid, or oblong; the long axis of the sporangium parallel with the surface of the substratum.

Section 7: Sporangium predominantly cylindrical, fusiform, broadly or narrowly ellipsoidal, the long axis frequently at a right angle or slightly inclined to that of the substrate.

For each Section, a key to the species in that section is presented, followed by the species descriptions in alphabetical order, with descriptions and illustrations of those species. Following the seven sections are alphabetical listings of (1) incompletely known species (with illustrations), (2) excluded species, (3) taxonomic synonymies, and (4) species removed to other genera in Rhizophydiales.
**Section 1: Key.** Sporangium predominantly spherical or subspherical throughout development.

1a. Principally from a terrestrial (soil and submersed mud) habitat .......................... 2  
1b. Principally from an aquatic (freshwater or marine) habitat ............................... 24

2a (1a). Zoospores discharged in a vesicle .................................................................. 3  
2b. Zoospores discharged singly, consecutively, but not in a vesicle ........................... 6

3a (2a). Discharge apparatus one or more papillae .................................................. 4  
3b. Discharge apparatus a pore with a recurved rim ...................... *R. lenelangeae*

4a (3a). Discharge apparatus 1–5 papillae, sporangium with conspicuous concentric halos .......................................................... *R. coronum*

4b. Discharge apparatus 1 apical or lateral papilla, sporangium without halos ......... 5

5a (4b). Rhizoids sparse, branched, thalli numerous (up to 14) on host cell ..............  
5b. Rhizoid unbranched, an intramatrical peg or foot ...................... *R. aphanomycis*

6a (2b). Discharge apparatus one or more papillae or pores ................................... 7  
6b. No papillae or pores present; zoospores released when sporangial wall dissolves or collapses .......................................................... *R. patellarium*

7a (6a). Discharge apparatus one or more papillae .................................................. 8  
7b. Discharge apparatus one or more pores ............................................................ 19

8a (7a). Discharge apparatus a single papilla ............................................................. 9  
8b. Discharge apparatus multiple papillae ............................................................... 10

9a (8a). Discharge apparatus one apical or lateral papilla, zoospores released singly ...  
9b. Discharge apparatus one apical papilla, zoospores released simultaneously ........  
.............................................................................................................................. *R. ellipsoideum*  
.............................................................................................................................. *R. aureum*

10a (8b). Organism parasitic on *Nowakowskiiella* ...................... *R. rarotonganense*  
10b. Organism saprophytic on pollen, chitin, or keratin ......................................... 11

11a (10b). Organism saprophytic on chitin or keratin .......................................... 12  
11b. Organism saprophytic on pollen ................................................................. 16
12a (11a). Organism saprophytic on chitin ........................................ R. signyense
12b. Organism saprophytic on keratin ...................................................... 13

13a (12b). Sporangium stalked ................................................................. R. stipitatum
13b. Sporangium sessile ........................................................................... 14

14a (13b). Discharge apparatus 5–10 papillae, sporangial wall ornamented .......... 
........................................................................................................ R. keratinophilum
14b. Discharge apparatus 2–30 papillae, sporangial wall ornamented ............... 15

15a (14b). Discharge apparatus 1–30 (av. 16) papillae, zoospores 2–3µm diam., 
discharged simultaneously from several papillae................................. R. condylosum
15b. Discharge apparatus 5–10 papillae, zoospores 5–7 µm diam., discharged from one or two papillae ................................................... R. piligenum

16a (11b). From saline soils ........................................................................ 23
16b. Not from saline soils ........................................................................... 17

17a (16b). Discharge apparatus 2–5 papillae, sporangial wall distinctly double-contoured ................................................................. R. sphaerosteca
17b. Discharge apparatus 3–many papillae, sporangial wall not double-contoured .. 18

18a (17b). Discharge apparatus 3–12 papillae, rhizoids hair-like ........ R. capillaceum
18b. Discharge apparatus multiple papillae, rhizoids originate as multiple robust, 
closely spaced axes on base of sporangium ................................... R. brooksianum

19a (7b). Discharge apparatus a single pore ............................................. R. marshallense
19b. Discharge apparatus multiple pores .................................................... 20

20a (19b). Sporangial wall ornamented with 3–50 elongate, flexible, unbranched hairs ................................................................. R. hispidulosum
20b. Sporangial wall not ornamented ......................................................... 21

21a (20b). Thalli numerous (up to 80) on host, primarily parasitic on Rhizophlyctis rosea and other chytrids ...................... R. hyperparasiticum
21b. Thalli single or few on host ................................................................. 22

22a (21b). Organism saprophytic on cellulosic substrata .............. R. polystomum
22b. Organism saprophytic on pollen ......................................................... R. bullatum

23a (16a). Sporangium 23–42 µm diameter ............................................. R. aestivali
23b. Sporangium 60-80 µm diameter .................................................. R. halophilum

24a (1b). From marine habitat ................................................................. 25
24b. From freshwater habitat ................................................................. 29

25a (24a). Discharge apparatus 1 or more papillae .................................. 26
25b. Discharge apparatus 1–several pores, or a large, lateral, irregular aperture ..... 28

26a (25a). Discharge apparatus a single apical or lateral papilla ..................... .......................................................... R. brevipes var. marinum
26b. Discharge apparatus 2–16 papillae ................................................... 27

27a (26b). Discharge apparatus 2–3 low papillae, parasitic on Bryopsis and Codium ...
........................................................................ R. litoreum
27b. Discharge apparatus 5–16 papillae, parasitic on Spongomonora, Acrosiphonia and Polysiphonia .................................................. R. distinctum

28a (25b). Discharge apparatus 1–several pores, sporangium 30-60 µm diameter ......
.................................................................................................................. R. subglobosum
28b. Discharge apparatus a large, lateral, irregular aperture, sporangium 16–24 µm diameter .......................................................... R. codicola

29a (24b). Zoospores discharged in a vesicle ............................................ R. planktonicum
29b. Zoospores discharged singly, consecutively, or as a group, but not in a vesicle. 30

30a (29b). Discharge apparatus 1–5 low papillae ................................. R. macrosporum
30b. Discharge apparatus a single apical pore, or sporangial apex deliquesces ...... 31

31a (30b). Discharge apparatus a tube, or 1 or more pores, papillae, or beaks ......... 32
31b. No discharge apparatus; sporangial wall deliquesces to release zoospores ...... 65

32a (31a). Discharge apparatus 1–2 sub-apical beaks ............................... R. rostellatum
32b. Discharge apparatus a tube, or 1 or more pores or papillae .......................... 33

33a (32b). Discharge apparatus a tube ........................................................ 34
33b. Discharge apparatus 1 or more pores or papillae .................................. 35

34a (33a). Sporangium 6–8 µm diameter, discharge tube 4–5 µm long by 2 µm diameter ................................................................. R. ampullaceum
34b. Sporangium 32–58 µm diameter, discharge tube 6 µm long by 4.5 µm diameter .... R. deformans
35a (33b). Discharge apparatus 1 or more papillae ................................................. 36
35b. Discharge apparatus 1 or more pores ................................................................. 48

36a (35a). Discharge apparatus a single papilla ......................................................... 37
36b. Discharge apparatus 1–5 (usually multiple) papillae ........................................ 41

37a (36a). Discharge papilla apical, prominent, slightly oblique .... R. asymmetricum
37b. Discharge papilla apical or subapical, not oblique ............................................. 38

38a (37b). Sporangium small, up to 7 µm diameter ............................................. R. Schroeteri
38b. Sporangium larger, 10–33 µm diameter ............................................................... 39

39a (38b). Sporangium 10–13 µm diameter, endobiotic part a lobate, sac-like
haustorium ................................................................................................................ 39
39b. Sporangium 10–33 µm diameter, endobiotic part a branched rhizoid ............... 40

40a (39b). Sporangium 10–33 µm diameter, discharge papilla apical .................... R. mammillatum
40b. Sporangium 10–20 µm diameter, discharge papilla lateral ....................... R. Punctatum

41a (36b). Sporangia proliferate internally ............................................. R. proliferum
41b. No internal proliferation of sporangia ................................................................. 42

42a (41b). Thalli numerous (up to 20) on host ........................................ R. chytriomycetis
42b. Thalli few on host ................................................................................................. 43

43a (42b). Organism saprophytic on pollen ................................................................. 44
43b. Organism parasitic ............................................................................................... 45

44a (43a). Sporangium 8–15 µm diameter, with usually 2 or more subapical papillae .. R. squamosum
44b. Sporangium 22–35 µm diameter, with 1–5 variously placed papillae R. porosum

45a (42b). Organism parasitic on Pythium or Vampyrella ........................................ 46
45b. Organism parasitic on algae .............................................................................. 47

46a (45a). Organism parasitic on Pythium ................................................................. R. pythii
46b. Organism parasitic on Vampyrella ................................................................. R. vampyrellae

47a (45b). Resting spore sexually formed ................................................................. R. couchii
47b. Resting spore asexually formed .................................................. *R. globosum*

48a (35b). Zoospores form a loose mass (but are not enclosed in a vesicle) at or outside discharge pore ........................................ 49

48b. Zoospores discharge singly or consecutively, but do not remain as a loose mass ...

49a (48a). Sporangium 6–8 µm diameter, zoospores form a loose mass at the apical pore, attached to the pore by the tips of the flagella .......... *R. constantineanui*

49b. Sporangium 12 µm diameter, zoospores form a loose mass outside the sub-apical or lateral pore .................................................. *R. algavorum*

50a (48b). Discharge apparatus a single apical, subapical, or lateral pore .......... 51

50b. Discharge apparatus 2–5 (rarely single) pores .................................. 59

51a (50a). Discharge apparatus a single lateral pore ....................... *R. canterae*

51b. Discharge apparatus a single apical or subapical pore ..................... 52

52a (51b). Sporangium wall double-contoured ........................................ 53

52b. Sporangium wall not double-contoured ...................................... 54

53a (52a). Organism saprophytic on pollen, rhizoid extensively branched ......................

53b. Organism parasitic on *Spirogyra*, haustorium a short, blunt, peg-like tube ..........

54a (52b). Sporangium wall ornamented .................................................. 55

54b. Sporangium wall smooth, not ornamented ...................................... 56

55a (54a). Wall covered with conspicuous spines, rhizoids branched, organism saprophytic on pollen........................................... *R. echinocystoides*

55b. Wall covered with short, sharp spines, haustorium a single, unbranched, slightly inflated tube, organism parasitic on *Cladophora* .................. *R. spinulosum*

56a (54b). Sporangium small, 5–7.6 µm diameter ......................... *R. mougeotiae*

56b. Sporangium larger, 10–20 µm diameter .......................................... 57

57a (56b). Wall of sporangium distinctly thickened on lower part to form a cup-like base................................................................. *R. tenue*

57b. Wall of sporangium not thickened on lower part ................................ 58
58a (57b). Sporangium 10–15 µm diameter, rhizoid simple, filamentous, short; organism parasitic on *Cladophora* ...........................................  R. *cladophorae*

58b. Sporangium 16–20 µm diameter, rhizoid delicate, unbranched, short or up to 180 µm long; organism parasitic on *Oscillatoria* .......  *R. oscillatoriae-rubescentis*

59a (59b). Organism saprophytic on pollen ......................................................  60

59b. Organism parasitic on various hosts ..............................................................  61

60a (59a). Sporangial wall smooth, single-layered, resting spore with an undulate outer wall.................................................................  *R. undatum*

60b. Sporangial wall compound, outer wall a thin, undulating veil .....  *R. undulatum*

61a (59b). Sporangial wall partially deliquesces prior to, or collapses after, zoospore discharge ...............................................................................  62

61b. Sporangial wall remains intact after discharge ..............................................  *R. fugax*

62a (61a). Sporangial wall deliquesces to form multiple openings .......................  63

62b. Sporangial wall collapses after discharge ......................................................  *R. cyclotellae*

63a (62a). Quartets of zoospores formed within sporangium, sporangial wall deliquesces to form multiple openings; organism parasitic on *Asterionella* ..... .................................................................  *R. tetragenum*

63b. Zoospores not delineated in quartets; sporangial wall deliquesces to form 1–3 openings ..............................................................................  64

64a (63b). Four–60 zoospores delineated, sporangial wall deliquesces to form 1–3 openings; organism parasitic on *Eudorina* ......................  *R. contractophilum*

64b. Three–20 zoospores delineated, sporangial wall deliquesces to form 1–3 openings; organism parasitic on *Fragilaria* ..............................  *R. fragilariae*

65a (31b). Sporangial wall ruptures to release zoospores ............  *R. chytriophagum*

65b. Sporangial wall partially or entirely deliquesces to release zoospores ..........  66

66a (65b). Sporangial wall partially deliquesces to form 1–3 openings ....  *R. persicum*

66b. Sporangial wall entirely deliquesces ...............................................................  67

67a (66b). Sporangium small, 3.5–4.5 µm diameter; organism parasitic on *Achnanthes* ...........................................................................  *R. achnanthis*

67b. Sporangium larger, 5–20 µm diameter ............................................................  68

68a (67b). Sporangium stalked, 11–18 µm diameter; organism parasitic on *Melosira* ..
Section 1: Species descriptions.

**Rhizophydium achnanthis** Friedmann  

“Sporangium sessile, or borne at the tip of a more or less elongate extramatrical, delicate stalk; spherical, 3.5–4.5 μm diameter, or ovoid to transversely ovoid, 3.3–4.0 by 4.7–6.7 μm; wall smooth, colorless, deliquescing completely upon discharge of the zoospores. Rhizoidal system arising directly from the base of the sporangium or as a continuation of the extramatrical sporangial stalk, composed of delicate, sparingly branched rhizoids or a single unbranched one. Zoospores spherical, 2.5 μm diameter, with an eccentric colorless globule and long flagellum. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; parasitic on *Achnanthes affinis*; Austria.

Note — Type material not designated: Friedmann’s illustration (fig. 1, l–v, Oesterr. Bot. Z. 99: 176. 1952) of *R. achnanthis* Friedmann is accepted as the type.

**Rhizophydium aestuarii** (Ulken) Amon ex Letcher  
Mycologia 76: 138, fig. 6, q–s. 1984.


Sporangium spherical to sub-spherical, 23.4–41.5 μm by 23.4–40 μm diameter, with 5–16 conical papillae, 2.9–4.3 μm at the base and 2 μm at the tip; the number of papillae perhaps relative to the diameter of the sporangium. Rhizoidal system richly branched, beginning at an apophysis either intramatrical and spherical or extramatrical and beet-shaped, 7 μm in diameter and 8–9 μm long; rhizoids tapering. Zoospores spherical to somewhat ovoid, 3–4 μm diameter, with a single globule; flagellum 13–17.4 long. Resting spore not observed (Ulken 1984).

Habitat/Substrate/Location — From submersed aestuary soil; on pollen; Germany (Ulken 1984).

Note — In accordance with Art. 36, ICBN (McNeill et al. 2006), this taxon is
validated with the following Latin description based on Ulken’s German description:


The zoospore ultrastructure of *R. aestuarii* has been described (Lange and Olson 1977).

**Rhizophydium algavorum** B.V. Gromov, Plujusch, & K.A. Mamkaeva

Protistologica 1: 64, fig. 1, a–f. 1999.

“SPORANGIUM sessile, spherical, about 12 µm diameter; wall thin, smooth, colorless, with a single lateral discharge pore. RHIZOIDAL SYSTEM composed of fairly developed dividing tubular rhizoids originating from a single axis that is no thicker than the remainder of the rhizoids. ZOOSPORES elongate, 5 by 2 µm, with a single refractory globule, flagellum 15 µm long. RESTING SPORE not observed” (Gromov, Plujusch, and Mamkaeva 1999).

HABITAT/SUBSTRATE/LOCATION — Aquatic; obligately parasitic on algae, *Chlorococcales* and *Tribonema gayanum*; Russia (Gromov, Plujusch, and Mamkaeva 1999).

NOTE — Type material not designated; Gromov, Plujusch, and Mamkaeva’s illustration (fig. 1, a–f, Protistologica 1: 64. 1999) of *R. algavorum* B.V. Gromov, Plujusch, & K.A. Mamkaeva is accepted as the type.

**Rhizophydium amoebae** Karling

Amer. J. Bot. 33: 331, figs. 5–8. 1946.

“SPORANGIUM sessile, spherical, 8–20 µm diameter with a low apical exit papilla and a thick, brown, smooth wall; sporangia gregarious, up to 14 on a host cell. RHIZOIDAL SYSTEM relatively sparse but frequently branched. ZOOSPORES oval, 2 by 3 µm, with a minute, 0.5–1 µm diameter, somewhat laterally located refractive globule. RESTING SPORE spherical, 8–14 µm diameter, with a thick, dark brown wall and one to several large refractive globules; functioning as a prosporangium in germination” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION—Moist soil; “parasitic on *Amoeba terricola* and saprophytic on insect exuviae; Brazil” (Sparrow 1960).

NOTE — Type material not designated; Karling’s illustration (figs. 5–8, Amer. J. Bot. 33: 330. 1946) of *R. amoebae* Karling is accepted as the type.
**Rhizophydium ampullaceum** (A. Br.) A. Fisch.  

“**SPORANGIUM** sessile or, rarely, on a short stalk, spherical, 6–8 µm diameter, with an apical discharge tube 4–5 µm long by 2 µm in diameter; wall thin, smooth, colorless. **RHIZOIDAL SYSTEM** feebly developed, rhizoids branched. **ZOOSPORES** with a single globule and a posterior flagellum, discharged through the somewhat flaring funnel-like apex of the opened discharge tube. **RESTING SPORE** not observed” (Sparrow 1960).  

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “clustered on filaments of various algae (*Oedogonium, Spirogyra, Cladophora, Mougeotia*) and pine pollen; Africa, Germany, Great Britain, Latvia, Russia, United States” (Sparrow 1960).  

**NOTE** — Type material not designated; Braun’s illustration (pl. V, figs. 24–27, Abhandl. Berlin Akad. 1855: 66. 1856) of *C. ampullaceum* A. Br. is accepted as the type of *R. ampullaceum* (A. Br.) A. Fisch.

**Rhizophydium annulatum** Sparrow  

“**SPORANGIUM** sessile, spherical, 12–27 µm diameter, wall smooth, colorless, double-contoured, with a single, 3–5 µm diameter, strongly protruding apical to lateral discharge papilla elevated on a distinct 1.5–2.5 µm high collarette. **RHIZOIDAL SYSTEM** branched, fairly extensive, arising from a narrow isodiametric stalk. **ZOOSPORES** few, usually 4–12, rarely up to 16, spherical, 5–7 µm diameter with a proportionately large, 3–4 µm diameter colorless globule and 17–20 µm long flagellum; escaping individually upon deliquescencense of the discharge papilla. **RESTING SPORE** not observed” (Sparrow 1977).  

**HABITAT/SUBSTRATE/LOCATION** — Aquatic (?); on pine pollen, Florida, USA.  

**NOTE** — This chytrid was observed on pollen during a pine “pollen shower” in mid-winter, but the author goes no further in habitat description such that this organism might be considered either primarily aquatic or terrestrial in habitat. Sparrow’s illustration (figs. 1–6, Canad. J. Bot. 55: 1503. 1977) was designated as the type.
**Rhizophydium aphanomycis** Karling


“Sporangium” predominantly spherical, 10–40 µm diameter, hyaline, with a thin smooth wall and a broad exit papilla. **Rhizoidal System** a short tube that penetrates the host wall and develops into a tapering peg or slightly enlarged foot. Zoospores spherical, 2.8–3.2 diameter, with a small, hyaline, refractive globule; often swarming in a vesicle at release. Resting spore predominantly spherical, 12–32 µm, with grayish-granular content, functioning as a prosporangium upon germination” (Karling 1976a).

**Habitat/Substrate/Location** — Soil; “parasitic on Aphanomyces sp.; from the Ngorongora Crater, Tanzania” (Karling 1976a).

**Note** — Karling’s illustration (pl. 1, figs. 12–19, *Nova Hedwigia* 27: 765. 1976) was designated as the type.

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**Rhizophydium asymmetricum** (P.A. Dang.) Minden


“Sporangium” sessile, ovoid, 16 µm high by 10 µm diameter, with a prominent, slightly oblique apical papilla; wall stout, smooth, colorless. **Rhizoidal System** composed of delicate, branched rhizoids arising from a short slender main axis. Zoospores small, spherical, with an eccentric colorless globule and a long flagellum, emerging through a pore formed upon the deliquescence of the papilla. Resting spore not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “parasitic on *Tribonema bombycina* var. minor; France” (Sparrow 1960).

**Note** — The characteristically tilted discharge papilla serves to separate this species from the morphologically similar *R. mammillatum* (A. Br.) A. Fisch. (Sparrow 1960).

Type material not designated; Dangeard’s illustration (pl. 17, fig. 1, *Le Botaniste* 2: 243. 1890–91) of *C. asymmetricum* P.A. Dang. is accepted as the type of *R. asymmetricum* (P.A. Dang.) Minden.

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**Rhizophydium aureum** K. Konno


“Sporangium” spherical, subspherical, 21–92 µm diameter; wall smooth, yellow-brown or golden brown, 1–1.5 µm in thickness, with a low, broad, apical exit papilla, 4–8 µm in height by 8–20 µm diameter at base. **Rhizoidal System** arising from a single point at the base of the sporangium, main axis up to 8 µm or more diameter, rhizoids branched, tapering toward
the end, extending up to 100 µm or more in length. Zoospores spherical, colorless, 4–5 µm diameter, with a hyaline refractive globule 1–2 µm diameter; flagellum 23–28 µm in length, matured zoospores emerging after deliquescence of the papilla. RESTING SPORE not observed” (Konno 1972).

HABITAT/SUBSTRATE/LOCATION — Soil; “saprophytic on keratin (snake skin, bee wings, and cicada wings); Japan” (Konno 1972).

NOTE — “This species is characterized by the golden-brown sporangial wall and large thalli. It differs from Rhizophydidium chitinophilum Antik. in the sporangial coloration and shape, and substrate. It resembles Chytriomyces aureus Karling in its chitinophilic habitat, sporangial shape and color, but is inoperculate” (Konno 1972). Type material not designated; Konno’s illustration (pl. 3, figs. A–D, Sci. Rep. Tokyo Daigaku, B. 14: 283. 1972) of R. aureum Konno is accepted as the type.

**Rhizophydidium brevipes** G.F. Atk.  
Bot. Gaz. 48: 322, fig. 2. 1909.  

“SPORANGIUM sessile, ovoid or spherical, 10.2–24 µm diameter, with a protruding apical papilla; wall smooth, colorless, double-contoured. HAUSTORIUM consisting of a short, blunt peg-like tube which projects only slightly beyond the inner face of the algal wall. Zoospores ovoid, about 3 µm diameter, with a colorless globule, escaping through an apical pore about 4 µm in diameter formed upon the deliquescence of the papilla. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on gametangia of *Spirogyra varians* and vegetative cells of *Oedogonium* sp. and *Spirogyra* sp.; Japan, United States” (Sparrow 1960).

NOTE — Type material not designated; Atkinson’s illustration (fig. 2, Bot. Gaz. 48: 323. 1909) of *R. brevipes* G.F. Atk. is accepted as the type.

**Rhizophydidium brevipes v. marinum** (Kobayasi & M. Ōkubo) Karling  

“SPORANGIUM solitary, sessile, globose, subglobose or ovoid, 25–34 µm high, 20–30 µm diameter (commonly 34 by 30 µm); wall hyaline, smooth, 2–3 µm thick, with a broad apical or subapical papilla. HAUSTORIUM simple, short, thick and peg-like, projecting only slightly beyond the inner face of the host wall. Zoospores spherical, about 4–5 µm diameter, with a globule and a 15
µm long posterior flagellum; emerging one by one through a pore after deliquescence of the papilla. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — “Marine; on Bryopsis sp.; Japan” (Sparrow 1960).

NOTE — Type material not designated; Kobayasi and Ôkubo’s illustration (fig. 1, Bull. Natl. Sci. Mus. Tokyo 35: 62. 1954) of P. brevipes v. marinum Kobayasi and Ôkubo is accepted as the type of R. brevipes v. marinum (Kobayasi & M. Ôkubo) Karling.

Rhizophydium brooksianum Longcore


“Sporangium spherical, up to 80 µm diameter, with multiple, evenly distributed discharge pores 4–10 µm diameter, number depending on size of sporangium, and appearing as lenticular protrusions before discharge. RHIZOIDAL SYSTEM composed of with many closely spaced and highly branched rhizoidal axes on the base of the sporangium; rhizoids extending to 1.75X the diameter of the mature sporangium. Zoospores spherical, 4–5 µm diameter with one visible lipid globule; flagellum length about 27 µm in length. RESTING SPORE smooth-walled, 12–17 µm diameter with one large refractive globule” (Longcore 2004).

HABITAT/SUBSTRATE/LOCATION — From soil; on pollen; Maine, United States (Longcore 2004).

NOTE — Type material designated (figs. 1–21, Mycologia 96: 163. 2004). Zoospore ultrastructure for R. brooksianum Longcore has been described (Longcore 2004).

Rhizophydium bullatum Sparrow

Mycologia 44: 762, fig. 1 h, i. 1952.

“Sporangium sessile, in groups, spherical, 6.6–15.4 µm diameter, with a smooth, double-contoured wall. RHIZOIDAL SYSTEM very delicate, much branched. Zoospores numerous, spherical, 3 µm diameter, with a single basal colorless globule and long posterior flagellum; escaping through two to five sessile pores. RESTING SPORE spherical, 6.6–11 µm diameter, sessile, occurring in groups or occasionally singly, with a thickened brownish wall beset with coarse bullations; contents bearing a single large globule; germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; “on pine-pollen bait; Michigan, United States” (Sparrow 1960).

NOTE — “Rhizophydium bullatum resembles R. sphaerotheca Zopf in sporangial morphology. No resting spores have been definitely associated
with *R. sphaerotheca*, but in *R. bullatum* abundant resting spores were formed soon after sporangial development. The resting spores of *R. bullatum* are like those of *Phlyctochytrium closterii* (Karling) Sparrow, but sporangia of the two are different” (Sparrow 1960). Type material not designated; Sparrow’s illustration (fig. 1, h–i, Mycologia 44: 761. 1952) of *R. bullatum* Sparrow is accepted as the type.

**Rhizophydium canterae** Sparrow


“**Sporangium** sessile, spherical, 7.5–34.3 µm diameter with a smooth, thin, colorless wall, the larger sporangia occurring singly on the abnormally curved host cell, the smaller ones gregarious, up to fourteen on a single cell. **Rhizoidal System** sparingly branched, rhizoids arising from a short, rarely slightly inflated main axis. **Zoospores** elongate, 4 µm long by 2 µm diameter, lacking a conspicuous globule but bearing one or two minute, highly refractive granules laterally placed near the point of attachment of the single posterior flagellum; escaping upon the deliquescence of a single, conspicuous lateral papilla. **Resting Spore** spherical, asexually formed, 21.4–35 µm diameter, with a 2 µm thick, smooth wall, contents oily, rhizoids and germination not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “parasitic on sporelings of *Oedogonium* sp.; Great Britain, Hungary” (Sparrow 1960).

**Note** — Type material not designated; Canter’s illustration (text figs. 2, 3, Trans. Brit. Mycol. Soc. 31: 97. 1947) of *Rhizophydium* sp. is accepted as the type of *R. canterae* Sparrow.

**Rhizophydium capillaceum** D.J.S. Barr


“**Sporangium** sessile, spherical, 10–30 µm diameter with 3–12 slightly raised papillae. **Rhizoidal System** occasionally apophysate, rhizoids arising from one to several points in close proximity on the sporangium, delicate, 0.5 µm diameter, short and sparingly branched. **Zoospores** mostly spherical, 2–3 µm diameter, flagellum 9.5–13.0 µm long. **Resting Spore** not observed” (Barr 1969).

**Habitat/Substrate/Location** — Soil; “saprophytic on pine pollen and grass leaves; Ottawa, Canada” (Barr 1969).

**Note** — “This fungus differs from other species saprophytic on pine pollen in the morphology of its rhizoidal system. As with *R. sphaerotheca* Zopf and *R. racemosum* A. Gaertn., the rhizoids are delicate, but arise from more than one point on the sporangium. They are also short and sparingly branched in contrast to rhizoids of *R. sphaerotheca*, which are openly branched.
*Rhizophydium racemosum* has sporangia that are more angular than spherical, and have fewer papillae than sporangia of *R. sphaerotheca*, although sporangium size is similar for both species (Barr 1969). The epithet “capillaceum” refers to the hair-like nature of its rhizoid system when viewed at low magnification (Barr 1969). Barr’s illustration (pl. 2, figs. 12–22, Canad. J. Bot. 47: 997. 1969) was designated as the type. The zoospore ultrastructure of *R. capillaceum* has been described (Barr and Hadland-Hartmann 1978).

*Rhizophydiun chytriomycetis* Karling

**PLATE 4, FIGS. 13–20**

Mycologia 38: 105, figs. 1–8. 1946 (as *R. Chytriomycetis*).

“Sporangium hyaline, smooth, sessile or stalked, spherical, 8–30 µm diameter, with one to three exit papillae; usually numerous (up to 20) on one host sporangium. Rhizoidal system composed of finely branched rhizoids, main axis up to 3 µm diameter. Zoospores hyaline, spherical, 2–2.8 µm diameter, with a minute hyaline refractive globule. Resting spore dark brown, spherical, 7–18 µm diameter, with one or more large refractive globules; functioning as a prosporangium in germination” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION —** Aquatic; “parasitic on *Chytriomyces hyalinus* Karling and *Chytriomyces aureus* Karling; Connecticut, United States” (Sparrow 1960).

**NOTE —** “This species is separable from *R. hyperparasiticum* Karling on the basis of differences in the host” (Sparrow 1960). Type material not designated; Karling’s illustration (figs. 1–8, Mycologia 38: 104. 1946) of *R. chytriomycetis* Karling is accepted as the type of *R. chytriomycetis* Karling.

*Rhizophydiun chytriophagum* Ajello

**PLATE 4, FIGS. 21–28**


“Sporangium spherical, 10–30 µm diameter, hyaline, smooth-walled. Haustorium 4.2–7.3 µm long, 2.2 µm wide, with short lateral extensions 1.5 µm long. Zoospores spherical, 2.2–2.9 µm diameter with a single posterior flagellum 15 µm long, and a centrally located refractive globule; zoospores liberated after the sporangium wall ruptures, rather than forming a discreet pore. Resting spore spherical, 6–15 µm diameter, wall 1.4 µm thick, golden-brown in color, at germination functioning as a prosporangium” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION —** Aquatic; “parasitic upon *Phlyctochytrium aureliae* Ajello; United States” (Sparrow 1960).

**NOTE —** Type material not designated; Ajello’s illustration (figs. 14–28, Mycologia 37: 114. 1945) of *R. chytriophagum* Ajello is accepted as the type.
**Rhizophydium cladophorae** (Kobayasi & M. Ôkubo) Sparrow  PLATE 5, FIGS. 1–5


“Sporangium epibiotic, sessile, globose or subglobose, 10–15 µm diameter, hyaline, smooth, thin-walled, with a broad apical or rarely sub-lateral pore. HAUSTORIUM simple, filamentous, short. ZOOSpORES produced 10–20 in one sporangium, globose, 2–3 µm diameter, with a single globule and a posterior, 10 µm long flagellum; zoospores swarming in sporangium and then darting away through pore. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Marine; on *Cladophora* sp.; Japan (Sparrow 1960).

NOTE — Type material not designated; Kobayasi and Ôkubo’s illustration (fig. 2, Bull. Natl. Sci. Mus. Tokyo 35: 63. 1954) of *P. cladophorae* Kobayasi and Ôkubo is accepted as the type of *R. cladophorae* (Kobayasi & M. Ôkubo) Sparrow.

**Rhizophydium codicola** Zeller  PLATE 5, FIGS. 6–8


“Sporangium sessile, spherical to almost obpyriform, 16–24 µm diameter, with a smooth colorless relatively thick wall. RHIZOIDAL SYSTEM a stout irregularly expanded somewhat lobed main axis from which arise extensive, coarse, much branched, ultimately delicate rhizoids. ZOOspores spherical, 2.5–3 µm diameter, with a colorless basal globule and a long flagellum, emerging through a large lateral irregular aperture or tear in the sporangium wall. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Marine; “on *Codium mucronatum*; United States” (Sparrow 1960).

NOTE — Type material not designated; Zeller’s illustration (pl. 20, figs. 1–4, Publ. Puget Sound Biol. Sta. 2: 125. 1918) of *R. codicola* Zeller is accepted as the type.

**Rhizophydium condylosum** Karling  PLATE 5, FIGS. 9–14

Arch. Mikrobiol. 61: 118, fig. 2 A–X. 1968.

“Sporangium predominantly spherical, 7–48 µm diameter, ovoid, 8–20 µm by 15–38 µm, almost hemispherical and flattened at the base, angular when crowded, to oblong with 1–30 (average 16) exit papillae, 3–5 µm high by 2.8–4.5 µm broad, which may sometimes elongate and become straight or with curved necks up to 11 µm long; wall hyaline, smooth, fairly thick and persistent; numerous papillae imparting a somewhat knobby appearance to
the sporangia. RHIZOIDAL SYSTEM arising from 1–4 points at the base of the sporangium, main axes up to 4 µm diam, branches extending for distances up to 60 µm. ZOOSPORES usually emerging from several papillae simultaneously, elongate at first, becoming spherical, 2–2.8 µm diameter, grayish-granular in appearance, agglutulate; flagellum approximately 8–10 µm long. RESTING SPORE small, spherical, 7–16 µm diameter, ovoid, 8–12 µm by 10–14 µm, almost hemispherical with flattened base, angular when crowded to irregular with hyaline smooth, moderately thick wall, and coarsely granular content which usually includes a clear central area; spores sometimes bearing an aborted exit papilla; germination unknown” (Karling 1968).

HABITAT/SUBSTRATE/LOCATION — Soil; “saprophytic on human hair and snake skin; Aitutaki, Cook Island; Viti Levu, Fiji; Pitcairn Island, South Pacific” (Karling 1968).

NOTE — Type material not designated; Karling’s illustration (fig. 2, A–X, Arch. Mikrobiol. 61: 120. 1968) of R. condylosum Karling is accepted as the type.

Rhizophydium constantineanui Sacc. & D. Sacc. PLATE 5, FIGS. 15–19
Sylloge fungorum 17: 512. 1905 (as R. Constantineani).


“Sporangium sessile, spherical or subspherical, 6–8 µm diameter, wall smooth, colorless. Rhizoidal system very delicate, consisting of a few short branches which arise from a main axis. Zoospores from four to six, spherical, 3.5 µm diameter, with a colorless, eccentric globule, escaping through a small apical pore and forming a temporary group attached to the pore by the tips of the flagella. Resting spore not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on filaments of Vaucheria sp., Oedogonium sp., Cosmarium sp.; Great Britain, Rumania” (Sparrow 1960).

NOTE — The zoospore ultrastructure of R. constantineanui has been described (Barr and Hadland-Hartmann 1978). Type material not designated; Constantineanui’s illustration (fig. 81, Rev. Gen. Bot. 13: 380. 1901) of R. vaucheriae Const. is accepted as the type of R. constantineanui Sacc. & D. Sacc.

Rhizophydium contractophilum Canter PLATE 6, FIGS. 1–7

“Sporangium spherical, 4–10 µm diameter, or slightly oval, 6 by 4–5 – 9 by 6 µm, containing from 4–60 zoospores. Rhizoidal system a single bifurcated rhizoid or a few short branches. Zoospores 2 µm diameter, with a
small bright globule in the median lateral position and less dense protoplasm in the central region, flagellum 10 µm long; escaping fully formed through one or more subapical or lateral openings (usually 1–3) after deliquescence of the wall. Sporangial wall collapses soon after dehiscence and for the most part disappears. RESTING SPORE sexually formed borne as sporangium; oval 6.5 by 4–11.5 by 7 µm, wall thick, smooth, colorless, contents yellowish and oily composed of many small globules of equal size mostly peripheral with one or two clearer central areas; rhizoid as sporangium; male thallus 2 µm diameter, connected to female by a narrow conjugation tube practically adnate or up to 9 µm long” (Canter 1959).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Eudorina spp. in the plankton of Lake Windermere and Virginia Water, Surrey, England” (Canter 1959).

NOTE — Type material not designated; Canter’s illustration (figs. 1–4, Trans. Brit. Mycol. Soc. 42: 186. 1959) of R. contractophilum Canter is accepted as the type.

**Rhizophydium coronum** A.M. Hanson

Torreya 44: 31. 1944.

“SPORANGIUM hyaline, spherical, 11–49 µm diameter, ovoid 10–48 by 14–54 µm, with laminated walls, outer lamina often disintegrating around the upper half of the sporangium; one to five exit papillae, 3–3.7 by 9–11 µm; one to several concentric halos surrounding the developing sporangia, reduced to one at maturity, which generally deliquesces before spore discharge begins. RHIZOIDAL SYSTEM composed of fairly rigid rhizoids, with 1.5–4.5 µm, thick walls, straight, coiled, sparingly or richly branched, one rhizoid often predominant and very prolonged, up to 500 µm in length. ZOOSPORES hyaline, spherical, 3.7–4.5 µm diameter, with one large refractive globule 1.5 µm diameter, the first zoospores emerging as a coherent mass, separating after 6–14 minutes, the remainder swimming in the sporangium and emerging singly. RESTING SPORE spherical or sub-spherical, 22–35 µm diameter, with a lamellated wall like that of the sporangium, 0.7–1.3 µm, thick, with a faint golden tint; contents of resting spore consisting of one or more large central globules surrounded by a peripheral layer of smaller globules; enveloped like the sporangium by one or several halos, acting like a prosporangium upon germination, giving rise to a hyaline sporangium 29–37 µm diameter, which in turn is enveloped by a halo” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; “saprophytic on grasses, bleached corn leaves, and cellophane, United States” (Sparrow 1960).

NOTE — “The curious "halo" developed by this species is indeed remarkable and bears some resemblance to the gelatinous hull formed by the
incompletely known *Rhizophydi um gelatinosum* Lind and the planktonic parasite *R. difficile* Canter. The developmental morphology and the cytology are discussed and the species is figured in Hanson (1945)” (Sparrow 1960).

Type material not designated; Hanson’s illustration (figs. 1-61, Amer. J. Bot. 32: 480. 1945) of *R. coronum* A.M. Hanson is accepted as the type.

**Rhizophydi um couchii** Sparrow

Plate 7, Figs. 1–6

Aquatic Phycomycetes: 167, Fig. 2, G–I. 1943.

“SPORANGIUM sessile, spherical, slightly subspherical, or somewhat ellipsoidal, with from one to three protruding discharge papillae, 11–30µm. diameter, wall of variable thickness (up to 2 µm), smooth, colorless. RHIZOIDAL SYSTEM extensive, much branched, arising from a more or less prolonged, sometimes slightly inflated main axis. ZOOSPORES spherical or slightly ovoid, 2–5 µm diameter, with a small eccentric colorless globule and a long flagellum, escaping slowly, often amoeboidly, through one apical pore or through from two to three apical, subapical, and lateral pores formed upon the deliquescence of the papillae, movement hopping. RESTING SPORE spherical or somewhat ellipsoidal, 10–14 µm diameter, with a thick smooth colorless wall which is occasionally surrounded by an irregular brownish incrustation, contents with a large oil globule, rhizoidal system branched, germination not observed; contributing thallus spherical, thin-walled, 5 µm in diameter, adnate to the receptive plant, sessile, rhizoidal system rudimentary if present” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on *Spirogyra* sp., *Mougeotia* sp.; France, United States” (Sparrow 1960); *Closterium aciculare* (Fernández et al. 2011).

NOTE — “The species was described by Couch (1932) under the name *Rhizophydi um globosum* (A. Br.) Rabenh. and by Sparrow (1933) as *Rhizophydi um* sp. It differs from *R. globosum* in several features, as Couch pointed out. Most important of these is that the resting spore is smaller (10–14 µm), smooth-walled, and sexually formed. Only one (apical) pore was observed in the sporangia of Sparrow’s material, whereas Couch reports one or several in his fungus. This difference is not considered of great significance in view of the striking similarities which are otherwise apparent in the two fungi” (Sparrow 1960). Type material not designated; Couch’s illustration (pl. 14, figs. 1–19, J. Elisha Mitchell Sci Soc. 47: 246. 1932) of *R. globosum* (A. Br.) Rabenh. is accepted as the type of *R. couchii* Sparrow.
Rhizophydium cyclotellae Zopf

“Sporangium sessile, single or in groups, subspherical or broadly obpyriform, up to 12 µm diameter, with a smooth delicate wall which collapses and disappears after discharge. Rhizoidal system well developed, extremely delicate, with branches arising from a main axis. Zoospores spherical, 1.8–2.5 µm diameter, with a relatively large eccentric colorless globule and a delicate flagellum, escaping through from one to three very small sessile pores; zoospores capable of amoeboïd movement. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “parasitic on Cyclotella sp.; Germany, Hungary” (Sparrow 1960).

Note — “Infection always took place along the silica-free region between the girdle band and valve, obviating the necessity for penetration of the siliceous wall of the diatom. The contents of the latter, with the exception of the brown remains of the chromatophores, were all consumed” (Sparrow 1960). Type material not designated; Zopf’s illustration (pl. 2, figs. 13–22a, Abh. Naturf. Ges. Halle 17: 94. 1887) of R. cyclotellae Zopf is accepted as the type.

Rhizophydium deformans Jaag & Nipkow

“Sporangium sessile, spherical or elongate, with a broad apical papilla; wall thin, smooth, hyaline, surrounded by an ellipsoid or broadly discoid gelatinous vesicular host mass, 32–58 µm, diameter. Rhizoidal system delicate, simple or sparingly branched, undulate. Zoospores spherical, 2.5–3.5 µm diameter, with a hyaline globule and long flagellum, emerging through a discharge tube 6 µm long by 4.5 µm wide, formed by the deliquescence of a papilla penetrating through the gelatinous material; zoospores at once motile. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “parasitic on the planktonic alga Oscillatoria rubescens, Switzerland” (Sparrow 1960).

Note — “Although not particularly morphologically distinguishable, this species is remarkable in the reaction it produces on the host. Infected trichomes secrete large amounts of slime and eventually curl up to form a tight slimy capsule completely hiding the fungus. The authors suggest the term "ring disease" ("Ringelkrankheit") for the epidemic” (Sparrow 1960). Type material not designated; Jaag and Nipkow’s illustration (pl. 11, 12, Ber. Schweiz. Bot. Ges. 61: 483. 1951) of R. deformans Jaag & Nipkow is accepted as the type.
Rhizophydium difficile  Canter


“SPORANGIUM epibiotic, spherical, 12–20 µm diameter, formed by enlargement of the zoospore, containing up to ninety zoospores; entire wall of sporangium dissolves on dehiscence. RHIZOIDAL SYSTEM branched and of limited extent. ZOOSPORES spherical, 2.5 µm diameter, with a large posterior globule (1–1.35 µm) and a flagellum 12 µm long; movement smooth gliding. RESTING SPORE spherical, 8–13.6 µm diameter, formed after fusion of a small male with a larger female cell; male cell directly adherent to wall of female cell; wall thick, smooth, brownish, surrounded by a halo or beset with strands of mucilaginous material; contents numerous small globules; rhizoidal system as for sporangium; germination unknown” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on the planktonic desmids Staurastrum jaculiferum and Arthrodesmus sp., Great Britain” (Sparrow 1960).

NOTE — “As in Rhizophydidium sphaerocystidis Canter, the entire sporangial wall disappears. In this species, however, the zoospores are mature when liberated. Although no evidence of the sporangium remains after discharge, infected host cells are readily recognized by their reddish content, the remains of the chytrid rhizoidal system, and a slight thickening of the desmid wall at the point of infection. The curious gelatinous halo around the sexually formed resting spore recalls R. coronum Hanson” (Sparrow 1960). Type material not designated; Canter’s illustration (text figs. 4, 5 and pl. 3, fig. 4, Trans. Brit. Mycol. Soc. 37 :119. 1954) of R. difficile Canter is accepted as the type.

Rhizophydidium distinctum  H. E. Petersen

“SPORANGIUM sessile, at first spherical or subspherical, becoming somewhat angular with the formation at maturity of one or two subapical or lateral papillae, 8–30 µm diameter, resting on a broad base, wall smooth, colorless, thick (1–2 µm or more). RHIZOIDAL SYSTEM stout, irregular and branched, often terminating in slender rhizoidal threads. ZOOSPORES 3 µm in diameter, with a sigle lipid globule and posterior flagellum, upon discharge emerging in clusters from one or more papillae” (Johnson 1966). RESTING SPORE not observed (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Spongomorpha vernalis, Acrosiphonia incurva, Ceramium diaphanum, Polysiphonia sp.; Denmark, Norway, United States, Sweden” (Sparrow 1960).

NOTE — Petersen (1905) did not observe zoospore flagellation, the mode of
discharge, or the rhizoidal system. Observations by Johnson (1966) revealed these features. As typified by Dick (2001, p. 360), Petersen’s illustration (fig. XI, 1–3, Oversigt. Kongel. Danske Vidensk. Selsk. Forh.: 484. 1905) of R. discinctum H. E. Petersen is accepted as the type.

*Rhizophydium echinocystoides* Sparrow


“Sporangium sessile, ovoid, the pale-amber wall covered by fairly conspicuous spines; 15–25 µm high by 10–22 µm in diameter. Rhizoidal system moderately branched, arising from the tip of a short main axis. Zoospores spherical, 3–3.5 µm in diameter, with a single basal, colorless droplet and posterior flagellum; emerging through a single apical pore 3–4 µm in diameter formed upon the deliquescence of a prominent papilla. Resting spore(?) epibiotic, spherical, 12–15 µm in diameter, with a moderately thick wall covered with low spines; contents with a large oil globule, germination not observed” (Sparrow 1968).

Habitat/Substrate/Location — Sphagnum bog; on pine pollen; California, USA.

Note — Type material not designated; Sparrow’s illustration (figs. 15–18, J. Elisha Mitchell Sci. Soc. 84: 63. 1968) of *R. echinocystoides* Sparrow is accepted as the type.

*Rhizophydium ellipsoideum* (M. Ōkubo & Kobayasi) Karling

PLATE 8, FIGS. 1–5

Chytridiomycetarum Iconographia: p. 64. 1977.

*Phlyctidium keratinophilum* M. Ōkubo & Kobayasi, Nagaoa 5: 1, fig. 1. 1955.

“Sporangium at first imbedded in the cortex of hairs, at maturity the upper half emerging from the bursting place, globose, ellipsoid or pyriform, papillately or conically elongated at the base, smooth, thin-walled, colorless, apically or laterally with one papilla (5–10 µm high), containing 20–30 zoospores. Haustorium short, peg-like. Zoospores ellipsoid or pyriform, 3–4 by 3.5–5 µm, containing several oil drops at their anterior part and with one refracting body at posterior part, swimming away one by one through the pore of papilla. Resting spore imbedded in hair, then emerging; globose or subglobose with thick and rough wall, 17–25 µm diameter, containing one large oil globule; germination not observed” (Sparrow 1960).

Habitat/Substrate/Location — Soil; “on human hair (as bait); Japan” (Sparrow 1960).

Note — Type material not designated; Ōkubo and Kobayasi’s illustration (fig. 1, Nagaoa 5: 1. 1955) of *P. keratinophilum* M. Ōkubo & Kobayasi is accepted as the type of *R. ellipsoideum* (M. Ōkubo & Kobayasi) Karling.
**Rhizophydium fragilariae** Canter


“SPORANGIUM epibiotic, spherical to subspherical, 3–10 μm diameter, containing three to twenty zoospores; sporangium wall deliquescing at maturity, forming one to three openings through which the zoospores emerge. RHIZOIDAL SYSTEM a short unbranched or once-branched thread. ZOOSPORES spherical, 2–2.4 μm diameter, with a conspicuous anterior globule and single posterior flagellum. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on the planktonic diatom *Fragilaria crotonensis*; Great Britain” (Sparrow 1960).

NOTE — Type material not designated; Canter’s illustration (fig. 9, *Ann. Bot. (Oxford)* 14: 276, 1950) of *R. fragilariae* Canter is accepted as the type.

**Rhizophydium fugax** Canter


“SPORANGIUM spherical, 11–23 μm diameter, containing 100+ zoospores. RHIZOIDAL SYSTEM consisting of a short tuft of thin, branched non-tapering threads up to 12 μm long arising from a single axis. ZOOSPORES spherical, 3 μm diameter, with a refractive globule and small granule, flagellum 11.5 μm long including a fine whip-lash portion 3 μm long. Empty sporangia possess 2–4 sub-terminal exit pores. RESTING SPORE asexually formed, spherical, 6–12 μm diameter, wall thick, smooth, containing numerous small globules plus several larger globules” (Canter 1968a).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on *Cryptomonas* spp., embedded in mucilage, in the plankton of Esthwaite Water and other lakes in the English Lake District, England” (Canter 1968a).

NOTE — Type material not designated; Canter’s illustration (fig. 1 and pl. 57, A–M, *Trans. Brit. Mycol. Soc.* 51: 699, 1968) of *R. fugax* Canter is accepted as the type.

**Rhizophydium globosum** (A. Br.) Rabenh.


“SPORANGIUM sessile, completely spherical, 12–50 μm diameter or greater, wall double-contoured, smooth, colorless, with from two to four protruding
discharge papillae on the upper half. **Rhizoidal system** branched, fairly extensive, arising from a short stalk or directly from the tip of the penetration tube. **Zoospores** very numerous, somewhat ellipsoidal, 2–3 µm diameter, with a flagellum about 20 µm long, escaping individually through one apical pore or through from two to four sessile or slightly elevated pores on the upper half of the sporangium and swimming immediately away. **Resting spore** sessile, spherical, 25–30 µm in diameter, with a thick brownish wall, outer surface covered with small spines, germination not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; parasitic on a variety of substrates including, but not limited to, “*Closterium* spp., *Navicula* sp., *Sphaeroplea annulina*, vegetative cells of *Oedogonium rivulare, Melosira varians, Eunotia amphioxys*, germlings of *O. tumidulum, Penium digitus*, and *Pinnularia viridis*; Egypt, Finland, France, Germany, Great Britain, Hungary, Japan, Latvia, United States, Northwest Africa, West Africa, Equatorial East Africa, South Africa” (Sparrow 1960); saprophytic on pollen and keratin (Letcher et al. 2006).

**Note** — “Though spherical sporangia of this species were observed by Braun on several hosts, it was Cohn who reported the nonsexual reproduction and the branched rhizoids. Cohn also observed the penetration of the germ tube of the zoospore and the formation of the rhizoids within the alga” (Sparrow 1960).

**Rhizophydium globosum** (A. Br.) Rabenh. is the type for the genus, and although the species is a difficult one to delimit morphologically, an epitype has been designated to facilitate delineation of the genus in the context of broader systematic surveys (Letcher et al. 2006, 2008). The species is now defined on the basis of thallus morphology, zoospore ultrastructure and molecular sequences. It has been reported on numerous occasions from a variety of hosts and substrates, but many reports have been discounted, most often on the basis of an incomplete description (see Sparrow 1960).

Braun’s illustration (p. 2, figs. 14–18, Abhandl. Berlin Akad. 1855:34. 1856) of *C. globosum* A. Br. is accepted as the type of **Rhizophydium globosum** (A. Br.) Rabenh. (Letcher et al. 2006). An epitype has also been designated (figs. 3, K–P, 907, fig. 7, 911, Mycol Res. 110. 2006). Zoospore ultrastructure for *R. globosum* has been described (Letcher et al. 2006).
**Rhizophydium halophilum** Uebelm. ex Letcher

Arch. Mikrobiol. 25: 312, fig. 2. 1956.

“Sporangium spherical, 60–80 µm diameter, with twenty-five to thirty regularly arranged hyaline papillae 5–6 µm high by 4 µm in diameter. Rhizoidal System a well-developed single main axis with lateral branches. Zoospores spherical, 5.5–6 µm diameter, contents finely granular with a half-moon-shaped refractive posterior area, lacking a globule, flagellum 30 µm long escaping singly through pores formed upon the deliquescence of the papillae. Resting Spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Saline soil; pine-pollen bait; Italy, North Sea, Baltic Sea, Mediterranean, United States (Sparrow 1960).


**Rhizophydium hispidulosum** R.L. Seymour


“Sporangium sessile, hyaline, spherical, 14–22 µm diameter, with 1 (rarely 2) inconspicuous exit papilla, wall 3-6 µm wide, ornamented with 3–50 elongate, slender, flexible, unbranched hairs up to 40 µm in length. Rhizoidal System delicate with one to several main axes that frequently disappear before sporangium matures, rhizoids branched or unbranched, up to 28 µm in length. Zoospores oval, 3–3.5 by 5–5.5 µm with a conspicuous, eccentric, refractive lipid globule and a single posterior flagellum; emerge singly upon deliquescence of exit papillae, 3–6 µm wide. Resting Spore sessile, epibiotic, spherical, 10–22 µm diameter; wall thick, amber to brown, ornamented with numerous spines or pegs, blunt to sharp pointed, conical, frequently curved or hooked at tip, occasionally elongated into a hairlike process; contents evenly granular with an eccentric, refractive globule; germination not observed” (Seymour 1970).

Habitat/Substrate/Location — Soil; “saprobic on cockroach-wing bait; North Carolina, United States” (Seymour 1970).

Note — Type material not designated; Seymour’s illustration (figs. 1–16, J. Elisha Mitchell Sci. Soc. 86: 188. 1970) of *R. hispidulosum* R.L. Seymour is accepted as the type.
**Rhizophydium hyperparasiticum** Karling  

“Sporangium sessile, hyaline, smooth, spherical, 7–42 µm diameter, oval or slightly flattened (7–15 by 10–24 µm), with one to several low exit papillae; numerous, up to 80 on a host sporangium. Rhizoidal system richly branched; coarseness, degree of branching, and length dependent to some degree on size of host sporangia. Zoospores spherical, 2.5–3.5 µm diameter, with a minute refractive globule; emerging from one or more of the exit papillae. Resting spore smooth, hyaline, spherical, 5–10 µm diameter, oval or slightly angular, with one or more large refractive globules; germination unknown” (Sparrow 1960).

Habitat/Substrate/Location — Soil; “parasitic on the sporangia and resting spores of *Rhizophlyctis rosea* (de Bary and Woronin) A. Fisch. and *Karlingiomyces granulatus* (Karling) Sparrow and on the sporangia of *Septochytrium macrosporum* Karling and *S. plurilobulum* Johanson, pine pollen; Brazil, South Africa” (Sparrow 1960).

Note — “This species is scarcely separable from *R. chytriomycetis* Karling save on the basis of differences in the host. With respect to this species, Karling stated that the parasites found on *Septochytrium* differ somewhat from those on *Rhizophlyctis* and *Karlingiomyces*. Hence, it is not absolutely certain that they all belong to the same species” (Sparrow 1960). Type material not designated; Karling’s illustration (figs. 1–4, 9–13, Amer. J. Bot. 33: 330. 1946) of *R. hyperparasiticum* Karling is accepted as the type.

**Rhizophydium keratinophilum** Karling  
Amer. J. Bot. 33: 753, figs. 1–43. 1946.

“Sporangium sessile, hyaline, predominantly spherical, 7–50 µm diameter with 2–5 fairly prominent exit papillae, 3–4 µm by 4–6 µm broad; wall ornamented with short, simple bifurcate or dichotomously branched spines (2–6 µm high) or long (15–45 µm), simple or branched threads. Rhizoidal system fairly extensive (up to 120 µm) and richly branched; main axis up to 5 µm diameter. Zoospores spherical, 2.5–3 µm diameter with a minute, spherical (0.3–0.5 µm), hyaline, refringent globule; flagellum 10–13 µm long. Resting spore spherical (7–15 µm) or oval (5–6 by 7–14 µm) with a thick (2–3.5 µm) brown, prominently warted wall; content coarsely but evenly granular, growing out to form a superficial sporangium during germination” (Sparrow 1960).

Habitat/Substrate/Location — “Soil; saprophytic on keratinized tissues (human hair, skin, feathers), pine pollen; Brazil, Ireland, Holland, United States, Egypt, Northwest Africa, West Africa, Equatorial East Africa, South Africa, Sweden, Great Britain” (Sparrow 1960).
NOTE — Type material not designated; Karling’s illustration (figs. 1–43, Amer. J. Bot. 33: 752. 1946) of *R. keratinophilum* Karling is accepted as the type.

**Rhizophydium lenelangeae** Sparrow

PLATE 10, FIGS. 1–4

Canad. J. Bot. 55: 1502, figs. 7–15. 1977, as *lenelangei*.

“**Sporangium** sessile, somewhat spherical, subspherical, or occasionally ovate and procumbent, 12–27 µm diameter, ovate ones 30–35 by 20–25 µm, wall double-contoured, smooth, pale-amber colored, with a single conspicuous 10 µm high by 5 µm broad lateral, basal, or occasionally apical discharge papilla. **Rhizoidal system** a more or less prolonged isodiametric stalk from which arise moderately complex rhizoids. **Zoospores** very numerous, spherical, 2.5–3.0 µm diameter with a basal, 1.5–2.0 µm in diameter, colorless globule and anteriorly with a dull arc-like body and occasionally a single lateral granule; flagellum 18–20 µm long; upon discharge forming a large mass of quiescent bodies in a matrix of mucus which quickly disassociates into individuals which swim away; rim of sporangium slightly raised and reflexed. **RESTING spore not observed**” (Sparrow 1977).

HABITAT/SUBSTRATE/LOCATION — “River bank soil; on pine pollen bait; Izabal Province, Guatemala” (Sparrow 1977).

NOTE — Sparrow’s illustration (figs. 5–7, Canad. J. Bot. 55: 1502. 1977) was designated as the type.

**Rhizophydium littoreum** Amon

PLATE 10, FIGS. 5–8


“**Sporangium** spherical or subspherical, 13.8–26.5 µm diameter when on *Bryopsis*, with 1–(1–2) papillae, approximately 80–120 µm diameter when on nutrient agar, with 1–10 papillae. **Rhizoidal system** on agar moderately branched, often lacking apophysis and extending about 1.5 times diameter of sporangium. **Zoospores** spherical to ovoid, about 2.7–3.6 µm diameter, flagellum about 24 µm long, photo-tactic. **Mass culture** pale yellow. **RESTING spore not observed**” (Amon 1984).

HABITAT/SUBSTRATE/LOCATION — “Marine, obligately halophytic; on siphonaceous algae *Bryopsis plumosa* and *Codium* sp., and pollen, eastern coast, United States” (Amon 1984).

NOTE — Type material (pl. 1, figs. 1–32, Canad. J. Bot. 50: 500 in Kazama [1972], figs. 2-10, Mycologia 68: 474 in Amon [1976], and fig. 12, Mycologia 76: 135 in Amon [1984]) was designated by Amon (1984). The zoospore ultrastructure of *R. littoreum* has been described (Amon 1984).
Rhizophydium macrosporum Karling ex Letcher

“SPORANGIUM hyaline, smooth, predominately spherical, 22–110 μm diameter, oval, broadly pyriform, and urceolate with 1 to 5, usually 2 or 3, low inconspicuous exit papillae; usually numerous and gregarious. RHIZOIDAL SYSTEM usually extensively developed, coarse, branched, main axis occasionally 6 μm diameter; delimited from the sporangia by a cross wall at maturity; arising from a single point or rarely from several places at the base of the sporangium. ZOOSPORES spherical, 4.5–6 μm diameter, hyaline, with an unusually large, 3–4 μm clear refractive globule and a 25–35 μm long flagellum; occasionally becoming amoeboid; spores initially emerging in a small globular mass surrounded by a hyaline matrix and lying quiescent for a few moments before separating; the remainder becoming active within the sporangium and emerging usually one by one. RESTING SPORE hyaline, smooth, spherical, 15–30 μm, oval, 18 by 20–33 by 36 μm, or slightly irregular with a wall 1.5–2 μm thick, and one or more large refractive globules; germination unknown” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on cooked ground beef, dead cells of Cladophora glomerata, Pithophora sp., Nitella flexilis, Chara coronata, root tips of Allium cepa and Narcissus; United States” (Sparrow 1960).


Rhizophydi um mammillatum (A. Br.) A. Fisch. 


“SPORANGIUM sessile, long-ovoid or narrowly to somewhat broadly citriform, with a more or less prominent apical papilla, 10–33 μm high by 10–22 μm diameter, wall smooth, colorless, slightly thickened. RHIZOIDAL SYSTEM composed of delicate, branched, short rhizoids arising from a slender main axis. ZOOSPORES spherical or somewhat ovoid, 2–4 μm diameter, with a minute eccentric globule and a long flagellum, emerging through an apical pore. RESTING SPORE not observed” (Sparrow 1960).
HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Coleochaete pulvinata, swarm spores of Stigeoclonium sp., Draparnaldia spp., Tribonema bombycina, oogonia of Oedogonium sp., Spirogyra maxima, Ulothrix sp., Cladophora sp.; Germany, France, Belgium, Russia, Bulgaria, United States, Hungary, Great Britain” (Sparrow 1960).

NOTE — Type material not designated; Braun’s illustration (pl. 2, figs. 9–12, Abhandl. Berlin Akad. 1855: 32. 1856) of C. mammillatum A. Br. is accepted as the type of R. mammillatum (A. Br.) A. Fisch.

Rhizophydidum marshallense Sparrow

PLATE 9, FIGS. 17–20


“SPORANGIUM sessile, spherical, 10-12 µm diameter, colorless, smooth-walled. RHIZOIDAL SYSTEM composed of slender, at least once-branched rhizoids. ZOOSPORES somewhat ovoid, 2 µm or less diameter, each with a single hyaline, minute refractive globule and a posterior flagellum, escaping through a minute, variously placed pore. RESTING SPORE spherical, 10–15 µm diameter, faintly golden and densely covered with prominent knob-like bululations, endobiotic part like that of the sporangium; germination not observed” (Sparrow 1960).


NOTE — Type material not designated; Sparrow’s illustration (figs. 13, 15–17, Mycologia 40: 451. 1948) of R. marshallense Sparrow is accepted as the type.

Rhizophydidum melosirae Friedmann

PLATE 11, FIGS. 7–12


“SPORANGIUM usually borne at the tip of a more or less elongate extramatrical, delicate stalk, spherical, 11–18.3 µm diameter, wall thin, smooth, colorless, deliquescing completely upon discharge of the zoospores. RHIZOIDAL SYSTEM composed of a delicate, sparingly branched tuft of rhizoids, arising as a continuation of the extramatrical sporangia stalk which penetrates between the valves of the host. ZOOSPORES nearly spherical, 2.4–3.0 µm diameter, with an eccentric, colorless globule, the single flagellum 8 µm long, liberated upon the deliquescence of the sporangium wall. RESTING SPORE (?) irregularly spherical, 12.5–15.0 µm diameter, with a thick smooth wall, rhizoids and germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Melosira varians;
Austria” (Sparrow 1960).

NOTE — “The species is found continuously during the cooler months of the year, but only reaches epidemic proportions as the temperature increases. Friedmann determined that some component of light (very likely the yellow wavelengths) inhibited dissolution of the sporangium wall and, hence, zoospore discharge. From this he conjectured that under natural conditions zoospore discharge occurs only at night” (Sparrow 1960).

Type material not designated; Friedmann’s illustration (fig. 1, a–k, Oesterr. Bot. Z. 99: 176. 1952) of R. melosirae Friedmann is accepted as the type.

**Rhizophydium mougeotiae** Pongratz  
Schweiz. Z. Hydrol. 28: 120, fig. 2. 1966.

**Sporangium** sessile, spherical to subspherical, 5–8 µm diameter, thin-walled, hyaline, with a single apical papilla; infection causing the host cell to deform and bend. **Rhizoidal system** composed of sparsely branched rhizoids emanating from a main axis. **Zoospores** 1.5–2 µm diameter, containing a single refractive globule; zoospores liberated upon deliquescence of an apical papilla. **Resting spore** spherical, 5–6 µm diameter, wall thick and smooth, containing one large and several smaller globules (Pongratz 1966).

**Habitat/Substrate/Location** — Aquatic; from plankton in Lake Léman, parasitic on *Mougeotia gracillima*; France (Pongratz 1966).

NOTE — Type material not designated; Pongratz’ illustration (fig. 2, Hydrologie 28: 119. 1966) of *R. mougeotiae* Pongratz is accepted as the type.

**Rhizophydium oscillatoriae-rubescents** Jaag and Nipkow  

“**Sporangium** sessile, usually lateral on the trichome, globose or broadly ellipsoidal or pyriform, about 16–20 µm, diameter, with broad rounded apex, finally subangular, with a papilla, wall smooth, hyaline. **Rhizoidal system** composed of very delicate, unbranched rhizoids, short or up to 180 µm long. **Zoospores** spherical, about 2.5–3.5 µm diameter with a basal hyaline globule and long flagellum. **Resting spore** (?) spherical, thick-walled, 8–12 µm diameter with a spherical male cell 4 µm diameter adherent to it” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “parasitic on the planktonic alga *Oscillatoria rubescens*; Switzerland” (Sparrow 1960).

NOTE — “In contrast to *Rhizophydium deformans* Jaag and Nipkow, also a parasite of *Oscillatoria*, no contortion of the host trichome is caused by this species. The resting spore described was not associated with certainty with the sporangial stage. Jaag and Nipkow believed this fungus to be closely
related to *Rhizophydium sciadii* Zopf but to differ from it in having an unbranched rather than branched rhizoid" (Sparrow 1960). Type material not designated; Jaag and Nipkow’s illustration (pl. 13, figs. 20–25, Ber. Schweiz. Bot. Ges. 61: 485. 1951) of *R. oscillatoriae-rubescentis* Jaag and Nipkow is accepted as the type.

**Rhizophydium patellarium** Erh. Scholz ex Letcher

Arch. f. Mikrobiol. 29: 359, fig. 2. 1958.


**Rhizophydium persicum** Kiran & Dayal ex Letcher, nom. nov.


**Rhizophydium persicum** Kiran & Dayal ex Letcher, nom. nov.

*Mycobank no.: MB 519674*


“**Sporangium** peach in color, spherical to subspherical, 12–16 μm diameter. **Rhizoidal system** delicate, portions of the wall of the sporangium...
deliquesce after maturation, forming 1–3 openings through which the zoospores are liberated. **Zoospores** spherical with a single eccentric globule, 3 \( \mu \text{m} \) in diameter, moving away in some cases and in others germinating *in situ*. **Resting spore** developed asexually” (Kiran and Dayal 1991).

**Habitat/Substrate/Location** — Aquatic; “from decomposing *Eichhornia* leaves; India” (Kiran and Dayal 1991).

**Note** — The specific epithet “*persicum*”, Latin for “peach”, is derived from the peach color of the sporangium. “In this species definite visible exit papillae were seen, but zoospore liberation did not take place through them, which makes this isolate different from any other described species of *Rhizophydium*” (Kiran and Dayal 1991). Type material not designated; Kiran and Dayal’s illustration (pl. 1, figs. 1–4, Indian Phytopathol. 44: 32. 1991) of *R. dubium* Kiran and Dayal is accepted as the type of *R. persicum* Kiran & Dayal ex Letcher.

**Rhizophydium piligenum** M. Ôkubo & Kobayasi

Plate 12, Figs. 12–15

*Nagaoa* 5: 3, fig. 2. 1955.

“Sporangium sessile, globose or subglobose, 45–50 \( \mu \text{m} \) diameter, thin-walled, colorless, with 5–10 papillae, one or two of them becoming somewhat cylindrical, 10–13 \( \mu \text{m} \) diameter, ca. 10 \( \mu \text{m} \) high, perforated. **Rhizoidal System** arising from the base of sporangium, rhizoids forked, very obscure. **Zoospores** formed in large numbers, ellipsoid or subglobose, 5-7 \( \mu \text{m} \) in length, posteriorly containing one globule and with a posterior flagellum, 16–17 \( \mu \text{m} \) in length. **Resting spore** not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Soil; “human hair and nails; Japan” (Sparrow 1960).

**Note** — Type material not designated; Ôkubo and Kobayasi’s illustration (fig. 2, Nagaoa 5: 3. 1955) of *R. piligenum* M. Ôkubo & Kobayasi is accepted as the type.

**Rhizophydium planktonicum** Canter

Plate 13, Figs. 1–7

*New Phytol.* 47: 259, figs. 10, 11. 1948 [Canter and Lund 1948].

“Sporangium spherical, sessile or stalked, 4.5–9.3 \( \mu \text{m} \) in diameter, containing 4–15 zoospores. **Rhizoidal System** intramatrical, unbranched or once branched, not tapering. **Zoospores** spherical 3-3.7 \( \mu \text{m} \) diameter, uniguttulate, posteriorly uniflagellate, emerging in a mass upon gelatinization of the apex of the sporangium wall. **Resting spore** spherical 4–7 \( \mu \text{m} \) diameter, wall smooth, the content with numerous small oil globules; arising from fusion of the contents of a small male with a larger female cell, the former remaining as an appendage to the mature resting spores; germination unknown” (Sparrow 1960).
HABITAT/substrate/location — Aquatic; “parasitic on the planktonic diatom Asterionella formosa; Great Britain” (Sparrow 1960).

Note — “Canter noted that this species was almost always present if the host is. She said, however, that the greater part of the year its frequency was too low to appreciably affect the number of Asterionella cells. At certain times, particularly in autumn and winter, the Rhizophydium multiplied rapidly to epidemic proportions” (Sparrow 1960). Type material not designated; Canter’s illustration (figs. 10, 11, New Phytol. 47: 257, 258. 1948) of R. planktonicum Canter is accepted as the type.

**Rhizophydium polystomum** Karling

Plate 13, figs. 8–10


“Sporangium predominantly spherical, 20–115 µm diameter, with a thin, hyaline, smooth wall and up to 28 low, barely perceptible, exit papillae; exit orifices in empty sporangium, 3–4 by 5–6 µm. Rhizoidal system arising from base of sporangium, main axes coarse, up to 10 µm diameter, often constricted at intervals, and extending for distances up to 125 µm or more. Zoosporangia spherical, 2.4–2.8 µm diameter, with a very minute hyaline refractive globule, emerging from several papillae simultaneously, flagellum 12–15 µm long. Resting spore unknown” (Karling 1967).

Habitat/substrate/location — Soil; “saprophytic on bleached corn leaves; New Zealand” (Karling 1967).

Note — Type material not designated; Karling’s illustration (figs. 26–29, Sydowia 20: 78. 1967) of R. polystomum Karling is accepted as the type.

**Rhizophydium porosum** Sparrow & L. Lange

Plate 12, figs. 16–20


“Sporangium sessile, spherical, 22–35 µm diameter with a 1.0 µm thick, pale brown wall densely beset with minute but distinct punctuations which appear prismatic in optical section; with one to five slightly elevated, variously placed discharge papillae. Rhizoidal system poorly developed, composed of two widely diverging main branches arising from a short, narrow isodiametric axis. Zoosporangia spherical, 5 µm diameter, some with a single large (ca. 2.5 µm in diameter), colorless globule, others with a minute one, and single 25 µm long posterior flagellum; discharged consecutively through one to five slightly elevated discharge pores formed upon deliquescence of the papillae. Resting spore not observed” (Sparrow and Lange 1977).

Habitat/substrate/location — Sphagnum bogs; “on pine pollen bait; Michigan, United States” (Sparrow and Lange 1977).
NOTE — Sparrow and Lange’s illustration (figs. 1-5, Canad. J. Bot. 55: 1881. 1977) was designated as the type material.

*Rhizophydium proliferum* J.S. Knox & R.A. Paterson  
*PLATE 14, FIGS. 1–6*  

“Sporangium ovate when immature and spherical at maturity, 7–21 µm diameter, with 4–10 sessile exit pores; sporangia proliferate internally for up to three generations. Rhizoidal system a single axis, with limited, branched rhizoids. Zoosporangia spherical, 2 µm diameter with a single refractive globule and a flagellum about 13 µm long. Resting spore not observed” (Knox and Paterson 1973).

Habitat/Substrate/Location — Soil; “on pollen; Victoria Land, Antarctica” (Knox and Paterson 1973).

NOTE — Type material not designated; Knox and Paterson’s illustration (figs. 6–10, Mycologia 65: 378. 1973) of *R. proliferum* J.S. Knox & R.A. Paterson is accepted as the type.

*Rhizophydium punctatum* Golubeva  
*PLATE 13, FIGS. 11, 12*  

Sporangium spherical, 10–20 µm diameter, wall thin, hyaline, with a single lateral pore. Rhizoidal system composed of thin, branched rhizoids, originating from a single axis. Zoosporangia spherical, 5–6 µm diameter, with a large lipid globule; zoospore discharge singular or as a large passive mass. Resting spore 20–30 µm diameter, with a single lipid globule, wall with regular thickenings and a verrucose surface (Golubeva 1988).

Habitat/Substrate/Location — Aquatic; saprophytic on pine pollen, Lake Telelkoje, Russia (Golubeva 1988).

NOTE — Type material not designated; Golubeva’s illustration (fig. 1, Novosti Sist. Nizh. Rast. 25: 83. 1988) of *R. punctatum* Golubeva is accepted as the type.

*Rhizophydium pythii* De. Wild.  
*PLATE 14, FIGS. 7–9*  

“Sporangium sessile, spherical, with one short papilla (occasionally two), of varying size, wall smooth, colorless. Rhizoidal system composed of very delicate, branched rhizoids arising from a short main axis. Zoosporangia spherical, with a small centric globule and a long flagellum, escaping through pores formed upon the dissolution of the papillae. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Soil; “parasitic on the oospores (and sporangia?) of *Pythium monospermum*, France” (Sparrow 1960).
NOTE — “Although the sporangia are said to be spherical, the figures show such wide variations that it is difficult to decide just what shape is to be considered typical” (Sparrow 1960). Type material not designated; De Wildeman’s illustration (pl. 1, figs. 10–17, Ann. Soc. Belge Micro. (Mém.) 21: 12. 1897) of *R. pythii* De. Wild. is accepted as the type.

**Rhizophydium rarotonganense** Karling  
*Arch. Mikrobiol.* 61: 114, fig. 1 A–L. 1968 (as *rarotonganensis*).

“**Sporangium** hyaline, smooth, subspherical, 15–35 µm diameter, ovoid, 18–27 by 32–36 µm, to citriform, with 2–5 short exit papillae in small sporangia, usually 5. **Rhizoidal System** composed of tuft-like rhizoids at base of sporangium, rarely peg-like. **Zoospores** spherical, 2.8–3.3 µm diameter, grayish-granular in appearance, refractive globule lacking; flagellum 14–16 µm long; usually emerging simultaneously from several papillae. **Resting Spore unknown**” (Karling 1968).

**Habitat/Substrate/Location** — Soil; “parasitic on *Nowakowskiiella profusa* Karling; Rarotonga, Cook islands, causing marked local hypertrophy of the tenuous portions of the host rhizomycelium” (Karling 1968).

NOTE — Type material not designated; Karling’s illustration (fig. 1, A–L, *Arch. Mikrobiol.* 61: 115. 1968) of *R. rarotonganensis* Karling is accepted as the type.

**Rhizophydiun rostellatum** (De Wild.) A. Fisch.  
*Plate 14, Figs. 15–20*  

*Chytridium rostellatum* De Wild., *Ann. Soc. Belge Micro.* (Mém.) 14: 19, fig. 6. 1890.

“**Sporangium** sessile, ovoid, with a single subapical beak-like prolongation or, more often, with two opposite diverging ones, wall thin, smooth, colorless. **Rhizoidal System** delicate, branched, arising from a short thin main axis. **Zoospores** spherical, with a large globule, escaping through a pore formed at the tip of each beak of the sporangium. **Resting Spore** not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; on *Spirogyra crassa*, Belgium.

NOTE — “Resembling somewhat *Rhizophydiun biporosum* (Couch) D.J.S. Barr, but differing in the more pronounced beaks and in the nature of the rhizoidal system” (Sparrow 1960). Type material not designated; De Wildeman’s illustration (fig. 6, *Ann. Soc. Belge Micro.* (Mém.) 14: 19. 1890) of *C. rostellatum* De Wild. is accepted as the type of *R. rostellatum* (De Wild.) A. Fisch.
Rhizophydium schroeteri De. Wild.


“Sporangium sessile, occasionally borne on a short needle-like stalk, spherical, ellipsoidal, or ovoid, up to 7 µm diameter, with a prominent apical or subapical papilla, wall smooth, colorless. Rhizoidal system very delicate, consisting of an unbranched or once-branched rhizoid. Zoosporae rarely more than twelve, spherical, about 1 µm diameter, with an eccentric globule, escaping upon the dissolution of the papilla, the wall of the empty urceolate sporangium disintegrating after discharge. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “on the planktonic diatom Asterionella gracillima; Switzerland” (Sparrow 1960).

Note — Type material not designated; De Wildeman’s illustration (fig. 3, Bull. Acad. Roy. Belg. (Sci.) 17: 289. 1931) of R. schroeteri De. Wild. is accepted as the type.

Rhizophydium signyense Willoughby


“Sporangium usually ovate, 19–25 µm long by 15–17 µm wide, occasionally spherical, with one to many discharge papillae 3–4 µm across; papillae deliquesce to liberate zoospores. Rhizoidal system branched, attached at a single point. Zoosporae observed (not described). Resting spore spherical or obspherical, usually tuberculate on outer surface, but occasionally smooth-walled, 20–24 µm diameter, sometimes fused together, with a yellow layered wall and a single large oil globule, 9.5–15 µm diameter” (Willoughby 1971).

Habitat/Substrate/Location — Soil; “saprophytic on chitin; Signy Island, Antarctica” (Willoughby 1971).

Note — Type material not designated; Willoughby’s illustration (pl. 2, m–t, pl. 4, e, f, Nova Hedwigia 22: 472. 1971) of R. signyense Willoughby is accepted as the type.

Rhizophydium skujai (Skuja) Karling

Chytridiomycetarum Iconographia: 64. 1977.


“Sporangium sessile, erect, globose to broadly ovate, with an acuminate papillate apex, 10–13 µm diameter or 10–14 µm wide by 12–15 µm, long, wall moderately thin, smooth, colorless. Haustorium irregularly lobate, transversely elongate, sac-like. Zoosporae thirty-two or more, globose or
broadly ovate, 1.5–2 µm diameter, with a basal colorless globule and long flagellum, escaping upon the deliquescence of the apical papilla. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on resting spores of the phytoplankton *Aphanizomenon flos-aquae* (1 per cent of filaments infected); Sweden” (Sparrow 1960). Skuja’s illustration (pl. 63, figs. 1–5, Nova Acta Reg. Soc. Sci. Upsaliensis, Ser. IV, 16 (3): 367. 1956) of *P. globosum* Skuja was designated as the type, and is accepted as the type of *R. skujai* (Skuja) Karling.

**Rhizophydium sphaerotheca** Zopf

“SPORANGIUM sessile, single or in groups, spherical or subspherical, 4–5 µm diameter (largest seldom exceeding 22 µm) with from two to five protruding papillae (one in smallest sporangia); wall smooth, colorless, distinctly double-contoured. RHIZOIDAL SYSTEM a main axis, from which arise much branched rhizoids. ZOOSPORES few in small sporangia, up to three hundred in large ones, spherical or ellipsoidal, 2.5–3 µm, diameter, with a relatively large eccentric colorless globule 0.9–1.2 µm diameter, a minute shining granule, and a delicate flagellum; emerging from the sporangium through comparatively large, circular, occasionally slightly protruding pores formed upon the deliquescence of the papillae, movement amoeboid as well as swimming. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; “on fern microspores (*Isoetes* spp)
gymnospermous pollen of *Pinus* spp., *Pseudotsuga mucronata*, and *Typha* pollen; Germany, United States, Great Britain, Brazil, Cuba, Egypt, Northwest Africa, West Africa, Equatorial East Africa, South Africa, Sweden” (Sparrow 1960).

**Rhizophydiun spinulosum** (Sparrow) Karling  
*Chytridiomycetarum Iconographia*: 65. 1977.

*Phlyctidium spinulosum* Sparrow, Mycologia 25: 516, figs. 1, 2. 1933.

“**Sporangium** sessile, spherical or slightly ovoid, colorless, generally about 10 µm diameter, wall covered with short sharp spines 2 µm high. **Haustorium** a single unbranched slightly inflated tube, 10 µm long by 3 µm diameter. **Zoospores** (usually about eight) 3 µm diameter, with a single globule and flagellum, escaping through a subapical pore. **Resting spore** not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “parasitic on *Cladophora* sp.; United States (rare, occurring with *Phlyctochytrium quadricorne* (de Bary) Schroeter)” (Sparrow 1960).

**Note** — Type material not designated; Sparrow’s illustration (figs. 1, 2, Mycologia 25: 514. 1933) of *P. spinulosum* Sparrow is accepted as the type of *R. spinulosum* (Sparrow) Karling.

**Rhizophydiun squamosum** Golubeva  

**Sporangium** spherical, 8–15 µm diameter, with 1–2 apical or lateral discharge papillae. **Rhizoidal system** composed of thin, branched rhizoids arising from one to several axes originating at the base of the sporangium. **Zoospores** spherical, 3–4 µm diameter with a small lipid globule, swimming in sporangium prior to individual discharge through papillae. **Resting spore** 8–15 µm diameter, with a single large lipid globule, wall golden, thin, squamose, with minute teeth on the exterior surface (Golubeva 1988).

**Habitat/Substrate/Location** — Aquatic; saprophytic on pine pollen, Lake Telelkoje, Russia (Golubeva 1988).

**Note** — Type material not designated; Golubeva’s illustration (fig. 2, *Novosti Sist. Nizsh. Rast.* 25: 84. 1988) of *R. squamosum* Golubeva is accepted as the type.
**Rhizophydium stipitatum** Sparrow


“Sporangium generally terminating a stalk up to 40 µm in length by 16 µm diameter, occasionally sessile, spherical, 55–107 µm diameter, becoming somewhat angular upon the formation of 6–8 or more 12–20 µm broad by 5 µm high papillae which are scattered over the surface; wall smooth, colorless. Rhizoidal system arising from the base of the stalk (or sporangium in sessile forms), running along surface of substratum as well as imbedded in it, coarse, up to 16 µm diameter, much branched. Zoospores spherical, 5 µm diameter, with a small basal colorless globule and long posterior flagellum, very numerous, emerging through broad sessile or somewhat elevated pores formed upon the deliquescence of the discharge papillae. Resting spore not observed‖ (Sparrow 1957).

Habitat/Substrate/Location — Soil; “saprophytic on snakeskin; England and Scotland‖ (Sparrow 1957); pollen (pers. observation); VA, NC, AL, United States.

**Note** — Type material not designated; Sparrow’s illustration (fig. 1, A-C, *Trans. Brit. Mycol. Soc.* 40: 526. 1957) of *R. stipitatum* Sparrow is accepted as the type.

**Rhizophydium subglobosum** Kobayasi & M. Ôkubo


“Sporangium sessile, globose, subglobose or ovoid, 30–60 µm diameter, sending a short (9–10 µm) stalk-like penetration tube through host-wall; wall smooth, hyaline, and somewhat thick, with one apical broad pit or laterally with several pits. Rhizoidal system 3–5 branches just beneath the penetration tube, each branchlet moreover dichotomously branched. Zoospores numerous, swimming away one by one through pores, spherical, about 6 µm diameter, with one posterior flagellum and one small globule. Resting spore not observed‖ (Sparrow 1960).

Habitat/Substrate/Location — Marine; on *Bryopsis* sp.; Japan.

**Note** — “The species is distinct from *R. globosum* (A. Br.) Rabenh. in its greater number of zoospores and more extensive rhizoidal system, and from *R. marinum* De Wild. in the larger size of its sporangia‖ (Sparrow 1960). Type material not designated; Kobayasi and Ôkubo’s illustration (fig. 3, *Bull. Natl. Sci. Mus.* Tokyo 35: 64. 1954) of *R. subglobosum* Kobayasi & M. Ôkubo is accepted as the type.
**Rhizophydium tenue** (Sparrow) Karling  
*Phlyctidium tenue* Sparrow, *Mycologia* 44: 760, fig. 1. a–g. 1952.

“SPORANGIUM sessile, somewhat hemispherical, 15–16 µm diameter by 12–14 µm high; wall smooth, colorless, distinctly thickened on the lower part of the sporangium so as to form a cup-like base. HAUSTORIUM slender, double-contoured, usually straight, unbranched, isodiametric, of variable length. ZOOSPORES numerous, oblong, 5 µm long by 2.5 µm wide, with a centric, colorless refractive globule and a single posterior flagellum 15 µm long, escaping through a single apical pore after which the sporangium wall collapses. RESTING SPORE epibiotic, sessile, spherical, and 13–15 µm diameter, or ellipsoidal and 10 by 12 µm, with a slightly thickened wall, large central colorless oil globule, and an unbranched endobiotic haustorium, possibly sexually formed, the adnate contributing thallus 3 µm diameter, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on moribund vegetative cells of *Zygnema* sp.; United States” (Sparrow 1960).

NOTE — This species is similar to *R. collapsum* Karling and *R. patellarium* Scholz “in the basal thickening of the otherwise delicate sporangium wall” (Sparrow 1960). Type material not designated; Sparrow’s illustration (fig. 1, a–g, *Mycologia* 44: 761. 1952) of *P. tenue* Sparrow is accepted as the type of *R. tenue* (Sparrow) Karling.

**Rhizophydium tetratum** Pongratz  

SPORANGIUM epibiotic, sessile, encapsulated, 5–7 µm, containing 16–32 zoospores, which at maturity is “sarcina”-shaped (pack-shaped), and which entirely deliquesces to release zoospores. RHIZOIDAL SYSTEM rudimentary. ZOOSPORES in sporangium ≤ 1 µm diameter; zoospore discharge and swimming zoospores not observed. RESTING SPORE spherical, with a thick, pleated double wall (Pongratz 1966).

HABITAT/SUBSTRATE/LOCATION — Aquatic; from plankton in Lake Léman, parasitic on *Asterionella formosa*; France (Pongratz 1966).

NOTE — Type material not designated; Pongratz’ illustration (fig. 1, *Hydrologie* 28: 116. 1966) of *R. tetratum* Pongratz is accepted as the type.

**Rhizophydium undatum** Golubeva  

SPORANGIUM spherical, 30–40 µm diameter, wall golden with multiple discharge pores approximately 5 µm in diameter. RHIZOIDAL SYSTEM composed of thin rhizoids originating from a swollen axis. ZOOSPORES
spherical, 3–4 µm diameter with a small lipid globule, swimming in sporangium prior to individual discharge through pores. **RESTING SPORE** 40–50 µm diameter, with a single large lipid globule, double-walled, inner wall thin, golden; outer wall thick with an undulating surface (Golubeva 1988).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; saprophytic on pine pollen, Lake Telelkoje, Russia (Golubeva 1988).

**NOTE** — Type material not designated; Golubeva’s illustration (fig. 3, Novosti Sist. Nizh. Rast. 25: 85. 1988) of *R. undatum* Golubeva is accepted as the type.

**Rhizophydium undulatum** Sparrow & L. Lange

PLATE 17, FIGS. 12–15


“**SPORANGIUM** sessile, spherical, 25–30 µm diameter with a light brown wall consisting of a basal or inner layer surrounded by a delicate, undulating veil which at maturity is irregularly attached to the basal layer and otherwise discontinuous with it; with one or two nearly sessile, 3–4 µm diameter, subapical to nearly basal discharge papillae. **RHIZOIDAL SYSTEM** consisting of a short isodiametric stalk from which arise several rhizoidal branches which appear to disintegrate soon after zoospore discharge. **ZOOSPORES** spherical, about 4.5 µm diameter, with a single very small colorless basal globule; uniflagellate; discharged consecutively through one or two almost sessile discharge pores. **RESTING SPORE** (?) spherical, with a thick wavy brownish wall; germination not seen” (Sparrow and Lange 1977).

**HABITAT/SUBSTRATE/LOCATION** — “Sphagnum bog; on pine pollen bait; Michigan, USA” (Sparrow and Lange 1977).

**NOTE** — Sparrow and Lange’s illustration (figs. 9–11, Canad. J. Bot. 55: 1881. 1977) was designated as the type.

**Rhizophydium vampyrellae** (P.A. Dang.) Minden

PLATE 17, FIGS. 16–21


“**SPORANGIUM** sessile, spherical, with a thickened smooth wall and several subapical discharge papillae. **RHIZOIDAL SYSTEM** composed of branched rhizoids arising from a central, somewhat thickened main axis. **ZOOSPORES** very narrowly ellipsoid or ovoid when escaping through the pores formed upon the deliquescence of the papillae, the conspicuous colorless globule anterior or basal, the flagellum of moderate length. **RESTING SPORE** (?) spherical, with a thick smooth wall and an apparently unbranched rhizoid, germination not observed” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “on cysts of *Vampyrella* parasitizing colonies of *Gloeocystis vesiculosa*; France” (Sparrow 1960).
NOTE — Type material not designated; Dangeard’s illustration (pl. 3, figs. 14–16, Le Botaniste 1: 63. 1889) of C. vampyrellae P.A. Dang. is accepted as the type of R. vampyrellae (P.A. Dang.) Minden.
PLATE 1

Fig. 1. Motile zoospores.
Fig. 2. Germling on *Achnanthes affinis*.
Fig. 3. Immature sporangia, borne at the tip of an extramatrical stalk.
Fig. 4. Mature sporangium.
Fig. 5. Early deliquescence of sporangial wall.
Fig. 6. Zoospore discharge upon deliquescence of entire sporangium.

Fig. 7. Motile zoospores, and an encysted zoospore on pollen grain.
Fig. 8. Immature sporangium.
Fig. 9. Immature (L) and mature (R) sporangia, each with a small apophysis.
Fig. 10. Two mature, multipapillate sporangia.

Fig. 11. Motile zoospores, and encysted zoospore on *Tribonema gayanum*.
Fig. 12. Mature sporangium with a single lateral discharge papilla.

Fig. 13. Motile zoospores, and an encysted zoospore on *Amoeba terricola*.
Fig. 14. Immature (L) and mature (R) sporangia, the mature sporangium with a low apical exit papilla.
Fig. 15. Mature sporangium discharging zoospores.
Fig. 16. Resting spores.
Fig. 17–22. *Rhizophydium ampullaceum* (A. Br.) A. Fisch.; after Braun (1856a).
Fig. 17. Zoospores.
Fig. 18. Encysted zoospore and germling on *Oedogonium* sp.
Fig. 19. Immature (L) and mature (R) sporangia with an acute, slightly tilted prolongation of the discharge tube.
Fig. 20. Zoospores discharged individually through the discharge tube.
Fig. 21. Empty sporangium.
Fig. 22. Multiple sporangia on *Mougeotia* sp.

Scale bar values in micrometers
PLATE 2

Figs. 1–3. **Rhizophydium annulatum** Sparrow; after Sparrow (1977).
Fig. 1. Immature sporangium on pollen grain.
Fig. 2. Mature sporangia with double-contoured wall, with an apical papilla (L.) and lateral papilla (R.).
Fig. 3. Zoospore discharge, with zoospores escaping individually.

Figs. 4–9. **Rhizophydium aphanomyces** Karling; after Karling (1976a).
Fig. 4. Two motile zoospores, and an encysted zoospore on *Aphanomyces* sp.
Fig. 5. Immature sporangia.
Fig. 6. Mature sporangium with a broad apical exit papilla.
Fig. 7. Zoospore discharge, in which zoospores swarm in a vesicle at release.
Fig. 8. Resting spore.
Fig. 9. Resting spore functioning as a prosporangium, germinating to produce a sporangium.

Figs. 10–15. **Rhizophydium asymmetricum** (P.A. Dang.) Minden; after Dangeard (1890–91).
Fig. 10. Motile zoospores.
Fig. 11. Germlings on *Tribonema bombycina* v. minor.
Fig. 12. Immature sporangium with a slightly oblique apical papilla.
Fig. 13. Mature sporangium.
Fig. 14. Zoospore discharge, emerging individually upon deliquescence of the papilla.
Fig. 15. Empty sporangium.

Fig. 16. Immature sporangium with a single, broad, low apical papilla and thick wall.
Fig. 17. Mature sporangium.
Fig. 18. Zoospore discharge after deliquescence of the papilla.
Fig. 19. Empty sporangium.

Scale bar values in micrometers
PLATE 3


Fig. 1. Mature sporangium with double-contoured wall, a single, apical papilla, and a short, blunt, peg-like haustorium only slightly projecting into the host protoplasm, on *Spirogyra* sp.

Fig. 2. Zoospore discharge, with zoospores escaping individually upon deliquescence of the papilla.

Fig. 3. Empty sporangium after discharge, with two non-discharged zoospores germinating in situ.

Fig. 4. Immature sporangium on *Spirogyra* sp.

Fig. 5. Mature sporangium.

Fig. 6. Two empty sporangia.


Fig. 7. Thick-walled, immature sporangium on *Bryopsis* sp., marine habitat.

Fig. 8. Mature sporangium with a single, broad, slightly subapical papilla.

Fig. 9. Zoospore discharge, with zoospores emerging singly after deliquescence of the papilla.

Fig. 10. Empty sporangium.


Fig. 11. Encysted zoospore and immature sporangium on pollen grain.

Fig. 12. Mature sporangia, the larger sporangium multipapillate, the smaller with single papillae.

Fig. 13. Zoospore discharge through multiple discharge pores.

Fig. 14. Resting spore.


Fig. 15. Immature (L) and mature (R) sporangia with double-contoured walls, on pollen grain.

Fig. 16. Zoospore discharge through multiple pores.

Fig. 17. Resting spores beset with coarse bullations.

Scale bar values in micrometers

48
Figs. 1–7. *Rhizophydium canterae* Sparrow; figs. 1–6 after Canter (1947a), fig. 7 after Scherffel (1926a).
Fig. 1. Two elongate motile zoospores.
Fig. 2. Germling on sporeling of *Oedogonium* sp.
Fig. 3. Immature sporangium.
Fig. 4. Mature sporangia, with a single lateral discharge papilla (L), and discharge papilla with a plug of refractive material (R).
Fig. 5. Empty sporangium.
Fig. 6. Resting spore.
Fig. 7. Mature sporangia on sporelings of *Oedogonium* sp.

Fig. 8. Motile zoospores, and an encysted zoospore on pollen.
Fig. 9. Immature sporangium.
Fig. 10. Mature, multi-papillate sporangium.
Fig. 11. Zoospore discharge.
Fig. 12. Empty sporangium.

Fig. 13. Motile zoospores.
Fig. 14. Encysted zoospore and germling, parasitizing *Chytriomyces hyalinus*.
Fig. 15. Immature sporangium.
Fig. 16. Mature sporangium.
Fig. 17. Zoospore discharge.
Fig. 18. Resting spore, functioning as a prosporangium, in early stage of germination.
Fig. 19. Resting spore with mature sporangium.
Fig. 20. Resting spore with discharging sporangium.

Fig. 21. Motile zoospores.
Fig. 22. Germlings parasitizing *Phlyctochytrium aureliae* Ajello.
Fig. 23. Two immature sporangia.
Fig. 24. Mature sporangium.
Fig. 25. Zoospore discharge.
Fig. 26. Empty sporangium.
Fig. 27. Resting spore.
Fig. 28. Resting spore, functioning as a prosporangium, with an attached mature sporangium.

Scale bar values in micrometers
PLATE 5


Fig. 1. Motile zoospores.
Fig. 2. Encysted zoospore on *Cladophora* sp.
Fig. 3. Immature sporangium, with a simple, filamentous, short haustorium.
Fig. 4. Zoospore discharge, with zoospores darting away after swarming in sporangium.
Fig. 5. Empty sporangia, each with a broad sub-lateral pore.

Fig. 6. Immature, sessile, spherical sporangium, from marine habitat on *Codium macronatum*.
Fig. 7. Mature, slightly obpyriform sporangium.
Fig. 8. Zoospore discharge, in which zoospores emerge through a large, lateral, irregular aperture in the sporangial wall.

Fig. 9. Aguttulate motile zoospores, elongate at first, then becoming spherical.
Fig. 10. Encysted zoospore and germling on human hair.
Fig. 11. Two immature sporangia with multiple, elongate (R) exit papillae
Fig. 12. Mature sporangium.
Fig. 13. Zoospore discharge, in which zoospores emerge from several papillae simultaneously.
Fig. 14. Morphologically diverse resting spores, with coarse granular contents and a clear central area.

Fig. 15. Motile zoospores, and an encysted zoospore on *Vaucheria* sp.
Fig. 16. Germling, with typical delicate rhizoidal system.
Fig. 17. Stages of zoospore discharge from a mature sporangium, in which zoospores form a temporary group attached to the discharge pore by the tips of the flagella.
Fig. 19. Empty sporangium.

Scale bar values in micrometers.

Fig. 1. Motile zoospores, and an encysted, germinating zoospore on *Eudorina* sp.

Fig. 2. Zoospore germination, in which the zoospore produces a thread-like structure that extends through the host colony mucilage, and by contraction of the thread the zoospore body is drawn to the interior of the host colony.

Fig. 3. Sporangial development.

Fig. 4. Zoospore discharge and release through the diffluent mucilage.

Fig. 5. Empty, multipored sporangium.

Fig. 6. Sexual formation of the resting spore.

Fig. 7. Mature sporangium with typical branched rhizoidal system.


Fig. 8. Multipored, mature sporangium on pollen grain, discharging zoospores.

Fig. 9. Resting spore, the thick outer wall with an undulating surface.

Figs. 10–16. *Rhizophydium coronum* Hanson; after Hanson (1944).

Fig. 10. Motile zoospore.

Fig. 11. Germling.

Fig. 12. Immature sporangium with early stage of multi-layered gelatinous hull.

Fig. 13. Mature sporangium with two exit papillae, the sporangium surrounded by gelatinous hull.

Fig. 14. Mature sporangium discharging zoospores, the spore mass surrounded by a filmy remnant of the gelatinous hull.

Fig. 15. Empty sporangium.

Fig. 16. Resting spore.


Fig. 17. Encysted zoospores and immature sporangia parasitic on *Cyclotella* sp.

Fig. 18. Mature sporangia.

Fig. 19. Zoospore discharge through multiple, very small sessile pores.

Scale bar values in micrometers
PLATE 7

Figs. 1–6. *Rhizophydi um couchii* Sparrow; after Couch (1932).
Fig. 1. Motile zoospores, and an encysted zoospore and germling on *Spirogyra sp.*
Fig. 2. Immature sporangium.
Fig. 3. Mature, multi-papillate sporangium.
Fig. 4. Zoospore discharge, in which zoospores escape individually and slowly through one or more pores.
Fig. 5. Empty sporangium with multiple discharge pores.
Fig. 6. Sexual development of the resting spore.

Fig. 7. Motile zoospores.
Fig. 8. Encysted zoospore and germling, parasitic on the planktonic alga *Oscillatoria rubescens*, and encased by the gelatinous host coating.
Fig. 9. Developing sporangium with a single apical papilla.
Fig. 10. Mature sporangium.
Fig. 11. Zoospore discharge through a discharge tube.
Fig. 12. Empty sporangium.

Fig. 13. Motile zoospores, and an encysted zoospore parasitic on *Staurastrum jaculiferum*.
Fig. 14. Mature sporangium.
Fig. 15. Mass of zoospores following dissolution of entire sporangial wall.
Fig. 16. Sexual development of the resting spore.
Fig. 17. Resting spore, surrounded by a halo of strands of mucilaginous (?) material.

Fig. 18. Mature sporangium with a single apical discharge papilla; on pollen.
Fig. 19. Mature sporangium and dissolution of the apical papilla prior to zoospore release.
Fig. 20. Zoospore discharge.
Fig. 21. Resting spore.

Scale bar values in micrometers
Fig. 1. Motile zoospores, and zoospore attaching to human hair substrate.
Fig. 2. Immature, developing sporangia embedded in the cortex of a hair.
Fig. 3. Developing sporangium (L) and mature sporangium (R) with a single, slightly lateral papilla.
Fig. 4. Zoospore discharge.
Fig. 5. Resting spores imbedded in hair.

Figs. 6–9. *Rhizophydium fragilariae* Canter; after Canter (1950b).
Fig. 6. Sporangia in various stages, parasitic on the planktonic diatom *Fragilaria crotonensis*.
Fig. 7. Mature sporangia of variable size.
Fig. 8. Empty sporangium and its rhizoid.
Fig. 9. Empty sporangia showing variation in size and number of discharge pores.

Fig. 10. Motile zoospores, and an encysted zoospore and germling parasitic on *Cryptomonas* sp.
Fig. 11. Developing sporangium.
Fig. 12. Mature sporangium.
Fig. 13. Empty, multipored sporangium.
Fig. 14. Resting spores.

Figs. 15–18. *Rhizophydium globosum* (A. Br.) Rabenh.; after Braun (1856a).
Fig. 15. Immature sporangium with double-contoured wall, on *Closterium* sp.
Fig. 16. Mature, multi-papillate sporangium
Fig. 17. Zoospore discharge, with zoospores escaping individually.
Fig. 18. Resting spore, the outer surface covered with small spines.

Scale bar values in micrometers
Fig. 1. Germling on pollen grain.
Fig. 2. Immature, multi-papillate sporangium.
Fig. 3. Mature sporangium.
Fig. 4. Zoospore discharge, with zoospores escaping singly.
Fig. 5. Motile zoospores, and an encysted zoospore on chitin.
Fig. 6. Immature sporangia, with wall ornamentation of elongate, slender, flexible, unbranched hairs.
Fig. 7. Mature sporangium with a single, apical papilla.
Fig. 8. Zoospore discharge, with zoospores emerging singly after dissolution of the papilla.
Fig. 9. Empty sporangium.
Fig. 10. Resting spores, ornamented with numerous spines or pegs.
Fig. 11. Motile zoospores, and an encysted zoospore parasitic on *Rhizophlyctis rosea*.
Fig. 12. Immature sporangium.
Fig. 13. Mature sporangium with two discharge papillae.
Fig. 14. Zoospore discharge, with zoospores emerging as a vesicular mass.
Fig. 15. Zoospores discharged through multiple papillae.
Fig. 16. Resting spore.
Fig. 17. Immature sporangium on *Rhizophlyctis* sp.
Fig. 18. Zoospore release through a minute, variously placed pore.
Fig. 19. Empty sporangium.
Fig. 20. Resting spores covered with prominent knob-like bullations.
Fig. 21. Motile zoospores, and encysted zoospore on hair.
Fig. 22. Developing sporangia, their walls ornamented with short, simple or dichotomously branched spines and long, simple or branched threads.
Fig. 23. Mature sporangium.
Fig. 24. Zoospore release.
Fig. 25. Resting spores with prominently warty wall.
Fig. 26. Resting spore functioning as a prosporangium, with a mature sporangium.
Fig. 27. Resting spore with an empty sporangium.
Scale bar values in micrometers
PLATE 10

Fig. 1. Maturing sporangium, with double-contoured wall, on pollen grain.
Fig. 2. Mature sporangium with a single, conspicuous sub-lateral discharge papilla.
Fig. 3. Mature sporangium with a lateral discharge papilla, just prior to zoospore release.
Fig. 4. Zoospore release; zoospores form a large mass of quiescent bodies in a matrix of mucus before dispersal.

Fig. 5. Encysted zoospore and apophysate germling on pollen grain.
Fig. 6. Immature (L) and mature (R) sporangia.
Fig. 7. Mature sporangium as papillae formation begins.
Fig. 8. Mature sporangium with fully formed discharge papillae.

Figs. 9–14. *Rhizophydidium macrosporum* Karling; after Karling (1938)
Fig. 9. Motile zoospores, with an unusually large lipid globule.
Fig. 10. Germlings.
Fig. 11. Immature, multi-papillate sporangium with three rhizoidal axes.
Fig. 12. Mature sporangium with typical rhizoidal structure.
Fig. 13. Zoospore discharge, with zoospores emerging in a small globular mass surrounded by a hyaline matrix, and lying quiescent for a few moments before dispersing.
Fig. 14. Resting spores of variable morphology.

Scale bar values in micrometers
PLATE 11

Fig. 1. Encysted zoospore on *Coleochaete* sp.
Fig. 2. Immature sporangium.
Fig. 3. Maturing sporangium with a single apical papilla.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore release through an apical pore.
Fig. 6. Empty sporangium.

Fig. 7. Motile zoospores, and an encysted zoospore parasitic on *Melosira varians*.
Fig. 8. Immature sporangium.
Fig. 9. Mature sporangium.
Fig. 10. Zoospore release, in which the entire sporangial wall deliquesces.
Fig. 11. Zoospore dispersal following dissolution of the sporangial wall.
Fig. 12. Resting spore.

Fig. 13. Motile zoospores, and an encysted zoospore parasitic on *Mougeotia* sp.
Fig. 14. Germling.
Fig. 15. Immature sporangium.
Fig. 16. Mature sporangium with a single apical papilla.
Fig. 17. Zoospore release.
Fig. 18. Empty sporangium.
Fig. 19. Resting spore.

Figs. 20–24. *Rhizophydidum discinctum* Petersen; figs. 20, 21, 24 after Petersen (1905), figs. 22, 23 after Johnson (1966).
Fig. 20. Developing sporangium on *Spongomorpha vernalis*.
Fig. 21. Mature sporangium with a single lateral discharge papilla.
Fig. 22. Mature sporangium with multiple discharge papillae.
Fig. 23. Zoospore release, with zoospores emerging as a cluster.
Fig. 24. Empty sporangium.

Fig. 25. Motile zoospores, and an encysted zoospore parasitic on *Oscillatoria rubescens*.
Fig. 26. Immature sporangium, with a broad apex (L) and early papilla formation (R).
Fig. 27. Mature sporangium.
Fig. 28. Zoospore release.
Fig. 29. Resting spore (not known with certainty to belong to this species) with small, spherical male cell adherent to it.

Scale bar values in micrometers
PLATE 12

Fig. 1. Motile zoospores, and an encysted zoospore on pollen grain.
Fig. 2. Immature sporangium.
Fig. 3. Mature sporangium.
Fig. 4. Zoospore release, in which a major portion of the sporangial wall deliquesces prior to release.
Fig. 5. Basal, plate-like portion of sporangial wall (*patella*) remaining after zoospore release.
Fig. 6. Resting spore.
Fig. 7. Resting spore functioning as a prosporangium, with empty sporangium attached.
Fig. 8. Motile zoospores, and an encysted zoospore on cellulose (decomposing *Eichhornia* sp. leaf).
Fig. 9. Immature sporangium.
Fig. 10. Mature sporangium with multiple papillae.
Fig. 11. Zoospore release, in which zoospores are liberated not via papillae, but through one to three torn, lateral openings in the sporangial wall.
Fig. 12. Immature, multi-papillate sporangium on human hair.
Fig. 13. Mature sporangium.
Fig. 14. Zoospore release through a cylindrical, perforated papilla.
Fig. 15. Empty sporangium.
Fig. 16. Immature sporangium on pollen grain, with a thick wall beset with minute, distinct, refractive punctations.
Fig. 17. Mature sporangium with multiple discharge papillae.
Fig. 18. Early stage of zoospore release.
Fig. 19. Zoospore release through slightly elevated discharge pores.
Fig. 20. Empty sporangium.

Scale bar values in micrometers
PLATE 13

Fig. 1. Motile zoospores, and an encysted zoospore on *Asterionella formosa*.
Fig. 2. Germling and immature sporangia.
Fig. 3. Mature sporangium with a single apical papilla.
Fig. 4. Zoospore discharge, in which zoospores emerge in a mass.
Fig. 5. Empty sporangia.
Fig. 6. Sexual formation of the resting spore.
Fig. 7. Resting spore, with remains of small male cell adherent to female cell.

Fig. 8. Mature sporangium with numerous barely perceptible exit papillae.
Fig. 9. Zoospore release from several papillae simultaneously.
Fig. 10. Empty sporangium, with stout rhizoidal axis constricted at intervals.

Fig. 11. Mature sporangium with a prominent single, lateral papilla.
Fig. 12. Resting spore with a wall with regular thickenings and a verrucose surface.

Scale bar values in micrometers

Fig. 1. Motile zoospores.

Fig. 2. Germling (L) and immature sporangium (R) on pollen grain.

Fig. 3. Maturing sporangium with multiple discharge papillae.

Fig. 4. Mature sporangium.

Fig. 5. Zoospore discharge.

Fig. 6. Empty sporangium with internal sporangial proliferation; here, two generations.

Figs. 7–9. *Rhizophydium pythii* De. Wild.; after Wildeman (1897).

Fig. 7. Immature sporangia parasitic on the oospore of *Pythium monospermum*.

Fig. 8. Mature sporangia, with two papillae (L, occasionally) and a single papilla (R, predominantly).

Fig. 9. Zoospore discharge.


Fig. 10. Aguttulate, motile zoospores, and encysted zoospore on *Nowakowskiiella profusa*.

Fig. 11. Immature sporangium.

Fig. 12. Mature sporangium with multiple exit papillae.

Fig. 13. Zoospore release, with zoospores emerging simultaneously from several papillae.

Fig. 14. Empty sporangium.


Fig. 15. Motile zoospores.

Fig. 16. Encysted zoospore on *Spirogyra crassa*.

Fig. 17. Immature sporangia, with one (R) developing an elongate apical papilla.

Fig. 18. Mature sporangia, each with a single apical (L) or sub-apical (R) beak-like prolongation.

Fig. 19. Mature sporangium with two opposite diverging beak-like prolongations.

Fig. 20. Zoospore release.

Scale bar values in micrometers
Figs. 1–5. *Rhizophydidium schroeteri* De. Wild.; after Wildeman (1900).
Fig. 1. Motile zoospores, and an encysted zoospore and immature sporangia parasitic on *Asterionella gracillima*.
Fig. 2. Immature sporangia, each with a prominent apical papilla.
Fig. 3. Mature sporangium.
Fig. 4. Zoospore release.
Fig. 5. Empty sporangia, in which the wall disintegrates after discharge.
Figs. 6, 7. *Rhizophydidium spinulosum* (Sparrow) Karling; after Sparrow (1933).
Fig. 6. Immature sporangium bearing a series of tenuous radiating hairs on the outer surface; parasitic on *Cladophora* sp.
Fig. 7. Mature sporangium with the wall covered with short sharp spines.
Fig. 8. Motile zoospores and encysted zoospore.
Fig. 9. Immature sporangia.
Fig. 10. Mature, multi-papillate sporangium.
Fig. 11. Zoospore release.
Fig. 12. Empty sporangium.
Fig. 13. Resting spores.
Fig. 14. Four resting spores fused together.
Fig. 15. Immature sporangium (L) with an acuminate, papillate apex, and mature sporangium (R) with a lateral papilla; parasitic on *Aphanizomenon flos-aquae*.
Fig. 16. Mature sporangium.
Fig. 17. Zoospore release.
Figs. 18–23. *Rhizophydidium sphaerocystidis* Canter; after Canter (1950b).
Fig. 18. Motile zoospores.
Fig. 19. Germling (L) and immature sporangium (R) on *Sphaerocystidis schroeteri*.
Fig. 20. Mature sporangium.
Fig. 21. Dehiscing sporangium, in which the entire wall deliquesces.
Fig. 22. Zoospore mass, following sporangial wall dissolution, and before dispersal.
Fig. 23. Sexual production of the resting spore.

Scale bar values in micrometers
PLATE 16
Fig. 1. Encysted zoospore on pollen grain.
Fig. 2. Immature sporangia.
Fig. 3. Mature sporangia with distinct double-contoured wall.
Fig. 4. Mature sporangium with multiple discharge papillae.
Fig. 5. Zoospore release.
Figs. 6, 7. *Rhizophydiurn squamosurn* Golubeva; after Golubeva (1988).
Fig. 6. Sporangia on pollen grain.
Fig. 7. Resting spore with a squamose outer wall.
Fig. 8. Nearly mature stalked sporangium with multiple discharge papillae.
Fig. 9. Mature sporangium.
Fig. 10. Zoospore discharge through multiple elevated pores.
Fig. 11. Mature sporangium.
Fig. 12. Zoospores being discharged individually through multiple pores.
Fig. 13. Zoospore discharge through a single, wide, apical pore.
Fig. 14. Empty sporangium.

Scale bar values in micrometers
PLATE 17

Fig. 1. Mature sporangium, the wall distinctly thickened and forming a cup-like base.
Fig. 2. Mature sporangium and initial zoospore release.
Fig. 3. Zoospore release.
Fig. 4. Empty sporangium, in which the wall collapses after discharge.
Fig. 5. Resting spore.

Fig. 6. Resting spore, possibly sexually formed, with adnate contributing thallus.
Fig. 7. Zoospore release through multiple sub-apical papillae.
Fig. 8. Empty sporangium.
Fig. 9. Resting spore.

Fig. 12. Motile zoospore with a conspicuous anterior globule.
Fig. 13. Encysted zoospore on cysts of *Vampyrella* sp. parasitizing colonies of *Gloeocystis vesiculosa*.
Fig. 14. Immature (L) and mature (R) sporangia.
Fig. 15. Zoospore release through multiple sub-apical papillae.

Scale bar values in micrometers
**Section 2: Key.** Sporangium predominantly spherical at first, and urceolate (urn-shaped) after discharge.

1a. Saprophytic on pollen ................................................................. 2
1b. Parasitic on various hosts ............................................................. 3

2a (1a). Sporangia proliferate internally .......................................... \textit{R. novozelandiense} 2
2b. Internal proliferation of sporangia absent, zoospores released as upper part of sporangial wall splits, shrinks, or deliquesces ................. \textit{R. sibyllinum}

3a (1b). Sporangium with an apical collar and/or 4 prominent, plain teeth; parasitic on \textit{Coleochaete} ........................................................................... \textit{R. brebissonii}
3b. Sporangium without an apical collar or prominent teeth ................ 4

4a (3b) Sporangium small, 5–15 µm diameter ........................................ 5
4b. Sporangium larger, 15–50 µm diameter ............................................. 7

5a (4a). Sporangium 5–8 µm diameter; parasitic on \textit{Scenedesmus} ........ \textit{R. scenedesmi}
5b. Sporangium 3–13 µm diameter; parasitic on \textit{Gemellicystis} .............. \textit{R. uniguttulum}

6a (5b). Sporangium 3-13 diameter; parasitic on \textit{Gemellicystis} .......... \textit{R. uniguttulum}
6b. Sporangium approximately 15 diameter; parasitic on \textit{Spirogyra} ...... \textit{R. spirogyrae}

7a (4b) Zoospores discharged and liberated successively, or forcibly as a loose mass 8
7b. Zoospores discharged in a vesicle ..................................................... 9

8a (7a) Zoospores discharged and liberated successively; parasitic on oogonia of \textit{Vaucheria} ............................................................................. \textit{R. vaucheriae}
8b. Zoospores ejected forcibly as a loose mass; parasitic on wheat roots . \textit{R. graminis}

9a (7b). Rhizoid branched; parasitic on \textit{Ceratium hirundinella} ............... \textit{R. nobile}
9b. Rhizoid unbranched ........................................................................ 10

10a (9b) Rhizoid broad, tubular; parasitic on \textit{Closterium} ................. \textit{R. tubulatum}
10b. Rhizoid slender, thread-like; parasitic on \textit{Anguillula} ......................... \textit{R. vermicola}

**Section 2: Species descriptions.**

\textit{Rhizophydium brebissonii} (P.A. Dang.) A. Fisch. .......................... PLATE 18, FIGS. 1–7
Rabenhorst. Kryptogamen-Fl. 1: 97. 1892.

\textit{Phlyctidium brebissonii} (P.A. Dang.) Sparrow, Aquatic Phycomycetes: 149. 1943.

\textit{Chytridium brebissonii} P.A. Dang., Le Botaniste 1: 59, pl. 3, fig. 17. 1889.

“\textit{Sporangium} sessile, 10–12 µm broad, broadly urceolate or broadly ovoid, with an apical collarette of from four to eight prominent plain teeth, wall fairly stout, smooth, colorless. \textit{Haustrum} a broad, nearly isodiametric, apparently unbranched filament. \textit{Zoospores} numerous (one hundred or more), ovoid, 2.7 µm diameter, with a colorless eccentric globule and a long
flagellum, emerging in a compact mass through a large apical pore. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Coleochaete scutata in culture dishes; France” (Sparrow 1960).

NOTE — Type material not designated; Dangeard’s illustration (pl. 3, fig. 17, Le Botaniste 1: 59, 1889) of *C. brebissonii* P.A. Dang. is accepted as the type of *R. brebissonii* (P.A. Dang.) A.Fisch.

**Rhizophydium graminis** Ledingham


“SPORANGIUM 10–75 μm diameter, globose to ellipsoid, with smooth walls; solitary or gregarious. RHIZOIDAL SYSTEM composed of fine rhizoids that ramify within the host cell. ZOOSPORES 3 by 1.8 μm, uniguttulate and uniflagellate, the flagellum 12 μm in length, liberated in large numbers by the rupturing of the apex of the sporangium. RESTING SPORE 6–12 μm diameter, globose with smooth inner wall and rough outer wall, and oily protoplasmic contents, sexual fusion occurring between rhizoids of two thalli; germination of the resting spore takes place by extrusion of the cell contents to form a thin-walled sporangium” (Ledingham 1936).

HABITAT/SUBSTRATE/LOCATION — Soil; parasitic on the roots of *Triticum* and *Panicum* spp., (Ledingham 1936), *Nicotiana debneyi*, *Chenopodium* sp. *Stellaria media* (Mcfarlane 1970); Ontario, Canada (Barr 1973a) and Massachusetts, United States, Great Britain.

NOTE — Macfarlane (1970) observed that following zoospore discharge, on some sporangia a portion of wall material remains attached like a lid. Type material not designated; Ledingham’s illustration (pl. 1, figs. 1-15, Canad. J. Res., Sect. C, Bot. Sci. 14: 120. 1936) of *R. graminis* Ledingham is accepted as the type.

**Rhizophydium nobile** Canter


“SPORANGIUM broadly ovoid (rarely oval), 7.5–40 μm high by 6–32 μm broad. RHIZOIDAL SYSTEM arising as branches of a single clavate main axis, extremities much branched, narrowed and blunt-ended. ZOOSPORES spherical, 4–5 μm diameter, with a conspicuous single lateral globule, two or three vacuoles, and a nucleus bound by a thin nuclear cap, flagellum up to 36 μm; when swimming body of zoospore bent in relation to flagellum, zoospores fully formed in sporangium; on dehiscence, part of the sporangium contents flow out surrounded by a vesicle which finally bursts liberating the zoospores. Sporangium wall persistent, portions of vesicle left as thin walled apical extensions. RESTING SPORE spherical, 13–16 μm diameter, wall thick,
smooth, colorless, contents several small globules” (Canter 1968b).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on resting spores of Ceratium hirundinella” (Canter 1968b); England. Type material not designated; Canter’s illustration (text fig. 1 and pl. 1, figs. 1-7, Proc. Linn. Soc. Lond. 179: 198. 1968) of R. nobile Canter is accepted as the type.

**Rhizophydium novozylandiens**e (Karling) Karling **PLATE 18, FIGS. 15–21**

Chytridiomycetarum Iconographia: 65. 1977 (as novae-zylandiensis).


“SPORANGIUM broadly ovoid to spherical and subspherical, 16–30 µm diameter, with a hyaline, smooth, fairly thick and persistent wall, and a broad apical or subapical exit papilla 13–20 µm diameter. HAUSTORIUM a broad intramatrical peg. ZOOSPORES spherical, 2–2.5 µm diameter, with a conspicuous hyaline refractive globule; flagellum 12–14 µm long. RESTING SPORE spherical, 10–21 µm diameter, with a 2–2.4 µm thick, hyaline smooth wall and coarsely granular or globular content; germination unknown” (Karling 1967).

HABITAT/SUBSTRATE/LOCATION — “Beach sand and sea water; saprophytic on Pinus sylvestris pollen; New Zealand” (Karling 1967).

NOTE — Type material not designated; Karling’s illustration (figs. 1-8, Sydowia 20: 74. 1967) of P. marinum Karling is accepted as the type of Rhizophydium novae-zylandiensis (Karling) Karling.

**Rhizophydium scenedesmi** Fott **PLATE 19, FIGS. 9–16**


“SPORANGIUM spherical, subspherical, or oval, 4.6–8 µm diameter. HAUSTORIUM a scarcely visible apophysis, 2 µm diameter; no rhizoids observed. ZOOSPORES spherical, 2 µm diameter, with a minute colorless globule, discharged on deliquescence of the sporangium apex, or subapically. RESTING SPORE spherical, arising from the sporangium” (Fott 1967).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Scenedesmus quadricauda; Czechoslovakia” (Fott 1967).

NOTE — Type material not designated; Fott’s illustration (pl. 1, figs. 1-16, Z. Allg. Mikrobiol. 7: 100. 1967) of R. scenedesmi Fott is accepted as the type.

**Rhizophydium sibyllinum** Sparrow **PLATE 19, FIGS. 17–20**


“SPORANGIUM sessile, completely spherical, the smooth wall slightly thicker near the base, 14–32 µm, mostly 25–32 µm diameter, without discharge papillae. RHIZOIDAL SYSTEM delicate, very limited in extent and branching
from a short stalk. Zoospores very numerous, spherical 2.5 µm diameter, with a small colorless globule and moderately long flagellum (10 µm), liberated in a coherent mass without individual motility after splitting, shrinking and some deliquescence of the upper part of the sporangium wall, assuming individual flagellar motion several minutes after discharge, movement a rapid darting. Resting spore not observed” (Sparrow 1974).

Habitat/Substrate/Location — Soil; saprophytic on pine pollen; Delphi, Greece.

Note — Sparrow’s illustration (figs. 1–9, Proc. Iowa Acad. Sci. 81: 2. 1974) was designated as the type.

**Rhizophydium spirogyrae** (Sparrow) Letcher, nom. nov. Plate 18, fig. 8

Mycobank No.: MB 519678


*Phlyctidium olla* Sparrow, Mycologia 25: 517; fig. 14. 1933.

“Sporangium sessile, urn-shaped, smooth-walled, 13–15 µm high by 15–17 µm diameter, with a broad apical papilla. Haustorium unbranched, inflated about 2 µm diameter by about 12 µm long. Zoospores ovoid 5 µm long by 3 µm diameter, with a posterior flagellum and single refractive globule. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; parasitic on *Spirogyra* sp., New York, United States.

Note — Type material not designated; Sparrow’s illustration (fig. 14, Mycologia 25: 514. 1933) of *P. olla* Sparrow is accepted as the type of *R. spirogyrae* (Sparrow) Letcher.


“Sporangium epi-endobiotic, smooth, spherical, 20-28 µm diameter, or ovoid, urn-shaped after discharge 24 µm high by 34 µm wide, base partly embedded in the host cell matrix; discharge pore apical, about 20 µm diameter, formed by dissolution of the distal part of the sporangial surface; empty sporangium persistent; functional zoospore cyst persists in some sporangia. Haustorium an apophysis at the basal end of the sporangium spherical, 8-10 µm diameter, broadly spindle-shaped, 10-15 µm high by 10-12 µm wide; rhizoid functioning as a haustorium formed as an extension of the basal end of the apophysis, continuous with it and rarely forming a septum, cylindrical, inflated, unbranched, 2.2-6.5 µm diameter, terminal end
indiscernible in dense cell content, longest observed 60 µm. Zoospores emerge in a mass enveloped in a slimy sheath. Resting spore not observed” (Dasgupta and John 1988).

Habitat/substrate/location — Aquatic; parasitic on Closterium sp.; India (Dasgupta and John 1988).

Note — Type material not designated; Dasgupta and John’s illustration (figs 31–33, Bull. Bot. Surv. India 30: 27. 1988) of R. tubulatum S.N. Dasgupta & R. John is accepted as the type.

Rhizophydium uniguttulum Canter Plate 19, figs. 21–26

“Sporangium broadly ovoid, oval or globose, 3–13 µm broad and 4.5–15.5 µm high, developed by direct enlargement of the zoospore; dehiscing by deliquescence of the apex. Rhizoidal system meager, branched. Zoospores spherical, 2–2.5 µm diameter, with a single basal refractive globule and posterior flagellum 12 µm long. Resting spore formed after sexual fusion of a small male cell (an encysted zoospore) which settles on and makes contact directly or via a short tube with a slightly larger, spherical female cell (5.5–9.5 µm diameter), wall smooth, thick, surrounded by mucilaginous envelope; contents one large and a few smaller globules; germination not observed” (Sparrow 1960).

Habitat/substrate/location — Aquatic; “parasitic on Gemellicystis neglecta in the plankton; Great Britain” (Sparrow 1960).

Note — Type material not designated; Canter’s illustration (test figs. 1, 2, pl. 3, figs. 1, 2. Trans. Brit. Mycol. Soc. 37: 113. 1954) of R. uniguttulum Canter is accepted as the type.

Rhizophydium vaucheriae De Wild. Plate 20, figs. 3–9

“Sporangium sessile, spherical, 26–50 µm diameter, with a broad prominent apical papilla, wall somewhat thickened, colorless, smooth. Haustorium an unbranched rhizoid. Zoospores spherical, 1.5 µm diameter, with a conspicuous colorless globule, escaping successively through a large apical pore formed upon the dissolution of the apical papilla, the empty sporangium strongly urceolate, the irregular discharge pore with a slightly recurved margin. Resting spore not observed” (Sparrow 1960).

Habitat/substrate/location — Aquatic; “parasitic, often in large numbers, on the oogonia of Vaucheria sessilis; Belgium” (Sparrow 1960).
NOTE — “Further observations on the process of zoospore discharge are necessary. Typically, the conspicuous papilla is dissolved, but on rare occasions it is said to persist and to be thrown back as a sort of operculum. De Wildeman believes dissolution of this cap occurs at a varying rate, depending upon conditions in the medium” (Sparrow 1960). Type material not designated; De Wildeman’s illustration (fig. 1, 1-10, Bull. Acad. Roy. Sci. Belgique 17: 285. 1931) of *R. vaucheriae* De Wild. is accepted as the type.

*Rhizophydium vermicola* Sparrow

Aquatic Phycomycetes: p. 188, fig. 11 N. 1943.

“SPORANGIUM sessile, spherical, urceolate after discharge, 15–20 µm diameter, with a broad apical papilla; wall thin, smooth, colorless. HAUSTORIUM slender, unbranched or sparsely branched. ZOOSPORES spherical, about 4–5 µm diameter, with a colorless eccentric globule and a long flagellum, emerging apparently imbedded in a gelatinous matrix or surrounded by a vesicle through a wide apical pore formed upon the deliquescence of the papilla, soon assuming individual motility and swimming away. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil (?); “on *Anguillula* infected by other fungi; United States, Great Britain” (Sparrow 1960).

NOTE — Type material not designated; Sparrow’s illustration (fig 11 N, Aquatic Phycomycetes: 188. 1943) of *R. vermicola* Sparrow is accepted as the type.
PLATE 18

Fig. 1. Motile zoospores.
Fig. 2. Encysted zoospore, parasitic on *Coleochaete scutata*.
Fig. 3. Germling (L) and immature sporangium (R).
Fig. 4. Mature sporangium with an apical collarette of prominent plain teeth.
Fig. 5. Zoospore release.
Figs. 6, 7. Empty sporangia.
Fig. 8. *Rhizophydyum spirogyrae* (Sparrow) Letcher, nom. nov.; after Sparrow (1933).
Discharging sporangium on *Spirogyra* sp.
Fig. 9. Motile zoospores.
Fig. 10. Encysted zoospore parasitic on the resting spore of *Ceratium hirundinella*.
Fig. 11. Immature sporangium.
Fig. 12. Mature sporangia.
Fig. 13. Zoospore discharge as a vesicular mass.
Fig. 14. Empty sporangium with thin-walled remains of the vesicle.
Fig. 15. Resting spore.
Fig. 15. Motile zoospores.
Fig. 16. Encysted zoospore on pollen grain.
Fig. 17. Immature sporangia.
Fig. 18. Mature sporangium with a broad apical exit papilla.
Fig. 19. Zoospore discharge as a vesicular mass.
Fig. 20. Resting spore.
Fig. 21. Empty sporangium with internal sporangial proliferation; here, one (L) and two (R) generations.

Scale bar values in micrometers
**PLATE 19**

Fig. 1. Motile zoospores.
Fig. 2. Encysted zoospore, parasitic on roots of *Triticum* and *Panicum* spp.
Fig. 3. Immature sporangia.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore release as the sporangium bursts and forcibly ejects the zoospores.
Fig. 6. Empty, cup-shaped basal wall of the sporangium with its irregularly torn upper margin.
Fig. 7. Sexual formation of the resting spore.
Fig. 8. Germinating resting spore.
Fig. 9. Encysted zoospore, parasitic on *Scenedesmus quadricauda*.
Fig. 10. Immature sporangium.
Fig. 11. Mature sporangium with an apical papilla.
Fig. 12. Zoospore discharge.
Fig. 13. Empty sporangia.
Fig. 14. Empty sporangium with elongate discharge aperture.
Fig. 15. Resting spore.
Fig. 16. Resting spore sitting at the top of thin-walled sporangium.
Fig. 17. Mature sporangium on pollen.
Fig. 18. Early zoospore discharge
Fig. 19. A mass of quiescent zoospores bulges out of the sporangium.
Fig. 20. Empty sporangium showing nature of wall tears from discharge.
Fig. 21. Encysted zoospore on *Gemellicystis neglecta*.
Fig. 22. Immature sporangium containing a single refractive globule.
Fig. 23. Mature sporangium.
Fig. 24. Zoospore discharge.
Fig. 25. Empty sporangium.
Fig. 26. Sexual formation of resting spore.

Scale bar values in micrometers
PLATE 20

Fig. 1. Mature sporangia with tubular rhizoids, parasitic on *Closterium* sp.
Fig. 2. Zoospore discharge as a vesicular mass.

Figs. 3–9. *Rhizophydiun vaucheriae* De. Wild.; after Wildeman (1900).
Fig. 3. Motile zoospores.
Fig. 4. Encysted zoospores, parasitic on *Vaucheria sessilis*.
Fig. 5. Immature sporangium.
Fig. 6. Mature sporangium with a prominent, broad apical papilla.
Fig. 7. Mature sporangium approaching zoospore discharge as apical pore dissolves.
Fig. 8. Urceolate empty sporangium, with persistent papilla thrown back as a sort of operculum.
Fig. 9. Empty sporangia; the irregular discharge pores each with a slightly recurved margin.

Fig. 10. Motile zoospores.
Fig. 11. Encysted zoospore on *Anguillula* sp.
Fig. 12. Immature sporangium.
Fig. 13. Mature sporangium with a broad apical papilla.
Fig. 14. Zoospore discharge with zoospores embedded in a gelatinous matrix.
Fig. 15. Empty sporangium.

Scale bar values in micrometers
Section 3: Key. Sporangium spherical at first, then angular and upright at maturity, or angular throughout development.

1a. On pollen ................................................................. 2
1b. Not primarily on pollen ................................................... 3

2a (1a). Sporangium 8–25 µm diameter ............................... R. racemosum
2b. Sporangium 80–100 µm diameter ................................. R. utriculare

3a (1b). On algae or rotifers ..................................................... 4
3b. On keratin .................................................................. 6

4a (3a). Sporangium angular, with 1–4 discharge papillae .............. 5
4b. Sporangium gibbose, with 1 broad, terminal discharge papilla ........ R. gibbosum

5a (4a). Sporangium with 1–4 projecting discharge papillae .......... R. megarrhizum
5b. Sporangium with 2 broad, opposite discharge papillae, parasitic on various algae .. .................................................. R. biporosum

6a (3b). From aquatic habitat .................................................. R. nodulosum
6b. From soil habitat ................................................................... 7

7a (6b). Sporangium angular throughout development ..................... R. angulosum
7b. Sporangium spherical at first, then angular at maturity ............... 8

8a (7b). Sporangium largest diameter 25 µm, 2–5 exit pores ............ R. elyense
8b. Sporangium largest diameter 90 µm, 3–25 exit pores ................. R. venezuelense

Section 3: Species descriptions.

**Rhizophydium angulosum** Karling

Arch. Mikrobiol. 61: 116, fig. 1, M–X. 1968.

“Sporangium occurring singly or in aggregates, predominantly angular in shape, 12–38 µm in greatest diameter, subspherical, 14–36 µm diameter, irregularly clavate when aggregated, 15–32 µm high by 18–22 µm in diameter, sometimes almost stellate, ovoid, pyriform, to citriform; rarely stalked; exit orifices apical, subapical to lateral, up to 5 µm diameter. Rhizoidal system composed of abundant and finely branched rhizoids. Zoosporangia spherical, 2–2.8 µm diameter, with a minute hyaline refractive globule, flagellum 9–11 µm long. Resting spore unknown” (Karling 1968).

Habitat/Substrate/Location — Soil; “on bleached corn leaves and pollen; Cook Islands, Fiji Islands, and Samoa, south Pacific” (Karling 1968).
NOTE — Type material not designated; Karling’s illustration (fig. 1, M–X, Arch. Mikrobiol. 61: 115. 1968) of R. angulosum Karling is accepted as the type.

**Rhizophydium biporosum** (Couch) D.J.S. Barr

Plate 21, Figs. 6–11


“SPORANGIUM sessile, spherical or ovoid at first, becoming truncated and angular in outline upon the formation of two broad oppositely placed apical sessile or slightly elevated discharge papillae, 10–12 µm high by 8–13 µm diameter, wall delicate, disappearing soon after zoospore discharge, smooth, colorless. RHIZOIDAL SYSTEM composed of somewhat broad, unbranched or branched rhizoids, slightly expanded immediately beneath the host wall. ZOOSPORES spherical or somewhat ovoid, 2–2.6 µm diameter, with a minute refractive basal granule and a long flagellum, emerging through two pores formed upon the deliquescence or bursting of the two discharge papillae, movement amoeboid or swimming. RESTING SPORE not observed” (Sparrow 1960).


NOTE — Type material not designated; Couch’s illustration (pl. 17, figs. 52–65, J. Elisha Mitchell Sci. Soc. 47: 254. 1932) of *P. biporosum* Couch is accepted as the type of *R. biporosum* (Couch) D.J.S. Barr. The zoospore ultrastructure of *R. biporosum* has been described (Barr and Hadland-Hartmann 1978).

**Rhizophydium elyense** Sparrow

Plate 21, Figs. 17–21


“SPORANGIUM sessile, somewhat spherical at first but soon becoming distinctly and irregularly polygonal, 25–34 µm largest diameter, wall thin, smooth, colorless and rigid. RHIZOIDAL SYSTEM composed of a main axis and delicate, moderately well developed, branched rhizoids. ZOOSPORES with an eccentric globule and posterior flagellum, passively emerging through 2–5 pores formed upon the deliquescence of scarcely visible papillae, initiating individual movement out in the water. RESTING SPORE not observed” (Sparrow 1957).
**Habitat/Substrate/Location** — Soil; “saprophytic on snakeskin; soil; Isle of Ely, England” (Sparrow 1957).

**Note** — Type material not designated; Sparrow’s illustration (fig. 2, I-M. Trans. Brit. Mycol. Soc. 40: 527. 1957) of *R. elyensis* Sparrow is accepted as the type. The zoospore ultrastructure of *R. elyensis* has been examined (Lange and Olson, 1979).

**Rhizophydium gibbosum** (Zopf) A. Fisch.  

“Sporangium sessile, occasionally stalked, ovoid, pyriform, or fusiform, with several or many hump-like lobes which give an irregular gibbose appearance to the whole structure; sporangia, when few on a cell, up to 25–45 μm long by 10–20 μm diameter, when many, 11 μm long by 8 μm diameter, upright or somewhat tilted, with a single terminal broad papilla, wall colorless, fairly stout. Rhizoidal system composed of a main axis that is occasionally slightly swollen, and profusely branched rhizoids. Zoospores spherical, small, 2.5–3.9 μm diameter, with a delicate flagellum and a few small colorless globules, escaping upon the deliquescence of the papilla. Resting spore extramatrical, irregular in shape, 6–12 μm diameter, hyaline, smooth, with one to several large refractive globules in the cytoplasm, germination not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “parasitic on *Penium, Cylindrocystis, Phycastrum*, palmellaceans, pinnularians, rotifer eggs, *Spirogyra* sp., nematodes; Germany, Hungary, United States, Brazil” (Sparrow 1960).

**Note** — As typified by Dick (2001, p. 425), Zopf’s illustration (pl. 20, figs. 8–20, *Nova Acta Acad. Leop.-Carol.* 52: 344. 1888) of *Rhizophyton gibbosum* Zopf is accepted as the type of *Rhizophytyum gibbosum* (Zopf) A. Fisch.

**Rhizophydium megarrhizum** Sparrow  

“Sporangium sessile, spherical, broadly ellipsoidal, or obpyriform, with a broad rounded apex, 9–25 μm diameter, becoming somewhat angular upon the formation of from one to four projecting discharge papillae, wall smooth, colorless. Rhizoidal system composed of broad, sparingly branched, often undulate rhizoids invading as many as 70 host cells, up to 150 μm long. Zoospores from ten to sixty or more, spherical, 2.5–3.5 μm diameter, with a
colorless basal globule and a long flagellum; discharged through pores formed upon the deliquescence of the papillae. RESTING SPORE asexually formed, spherical, 5.4–9 µm diameter, with a thick, smooth wall and oleaginous refractive contents, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Oscillatoria spp., Lyngbya sp.; France, Belgium, Germany, Great Britain, Switzerland, United States” (Sparrow 1960).

NOTE — “Typically sporangia parasitize apical cells of trichomes, but they may also be located elsewhere, the rhizoid then penetrating only one cell” (Sparrow 1960). Type material not designated; Sparrow’s illustration (fig. 11 c, Aquatic Phycomycetes: p. 164. 1943) of *R. megarrhizum* Sparrow is accepted as the type.

*Rhizophydium nodulosum* Kärling

PLATE 22, FIGS. 8–14

Mycologia 40: 328, figs. 1–10. 1948.

“SPORANGIUM hyaline, smooth, predominantly angular or nodular, up to 65 µm diameter, oval, 10–25 by 15–50 µm, spherical, 10–35 µm, oblong, pyriform or irregular with 1–15 prominent exit papillae, 4–8 µm high by 8–15 µm broad at the base. RHIZOIDAL SYSTEM well developed, composed of multiple main axes up to 7 µm diameter, arising from one to several points on the base of the sporangium, but rhizoids sparingly branched, branches extending for distances of 30–270 µm. ZOOSPORES spherical, 2.8–3.2 µm diameter, with a minute refractive globule, 0.4–0.8 µm diameter; flagellum 15–18 µm long. RESTING SPORE unknown” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — “Muck soil and fresh water; saprophytic on human hair and other keratinized substrates; United States” (Sparrow 1960).

NOTE — Type material not designated; Kärling’s illustration (figs. 1–10, Mycologia 40: 330. 1948) of *R. nodulosum* Kärling is accepted as the type.

*Rhizophydium racemosum* A. Gaertn. ex Letcher

PLATE 23, FIGS. 1–6

Arch. Mikrobiol. 21: 125, fig. 7. 1954.

“SPORANGIUM at first spherical, later irregular in form and size, 10 by 10 µm, 18 by 14 µm, 20 by 19 µm, 22 by 25 µm, with a conspicuous vacuole and irregularly sized large oil drops, at maturity with rounded corners at which the wall tears liberating the zoospores. RHIZOIDAL SYSTEM delicate, barely visible, at first unbranched, then with short bushy branches. ZOOSPORES 2–2.5 µm diameter, with a single droplet and 25 µm long flagellum, movement hopping. RESTING SPORE 7–8 µm diameter at maturity, in clusters of up to forty, adhering to one another” (Sparrow 1960).
HABITAT/SUBSTRATE/LOCATION — Soil; “pine pollen; Egypt, Equatorial Africa, South Africa” (Sparrow 1960).


Rhizophydium utriculare Uebelm. ex Letcher PLATE 21, FIGS. 12–16
Arch. Mikrobiol. 25: 314, fig. 3. 1956.

“Sporangium sac- or pear-shaped, rarely spherical, 120 µm long by 80–100 µm diameter. Rhizoidal system very delicate, little-branched. Zoospores globose, 8 µm diameter, lacking a globule, the contents granular in the anterior portion, and the remainder hyaline, with a 60–70 µm (?) long flagellum, escaping through three to seven pores formed upon the deliquescence of large prominent papillae. Resting spore spherical, 25–30 µm diameter, with a stout smooth wall, contents with small globules” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Normal and saline soil; pine-pollen bait; Australia and United States.


Rhizophydium venezuelense Karling PLATE 23, FIGS. 7–10
Nova Hedwigia 34: 646, figs. 1–9. 1981 (as venezuelensis).

“Sporangium hyaline, smooth-walled, spherical, 8–9 µm diameter, angular-ovoid, 2–20 by 24–36 µm, oblong-angular, 10–15 by 20–28 µm, often appendiculate, with 3–25 low, 4–6 µm high by 6–9 µm diameter at base, exit papillae. Rhizoidal system an axis 3–6 µm diameter with branches running out for distances of 300 µm. Zoospores spherical, 2.5–3.2 µm diameter, with a minute refractive globule and several granules, flagella 10–12 µm long; emerging individually and simultaneously from several exit pores. Resting spore unknown” (Karling 1981).

HABITAT/SUBSTRATE/LOCATION — “Soil; saprophytic on strips of cellophane,
bleached corn cotyledons, fibrin film, snake skin, human hair, corneum and fragments of hemp seed; Venezuela” (Karling 1981).

NOTE — Karling’s illustration (figs. 1–9, Nova Hedwigia 34: 646. 1981) was designated as the type.
PLATE 21

Fig. 1. Motile zoospores.
Fig. 2. Encysted zoospore on pollen grain.
Fig. 3. Immature sporangium.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore release.

Figs. 6–11. *Rhizophydiun biporosum* (Couch) D.J.S. Barr; after Couch (1932).
Fig. 6. Encysted zoospore on *Vaucheria* sp.
Fig. 7. Germling (L), and immature sporangium (R) beginning to form apical papillae.
Figs. 8, 9. Mature sporangia, with two broad oppositely placed sessile and/or slightly elevated discharge papillae.
Fig. 10. Zoospore release.
Fig. 11. Empty sporangium.

Fig. 12. Encysted zoospore and immature sporangia on pollen grain.
Fig. 15. Zoospore release.
Fig. 16. Resting spores.

Fig. 17. Motile zoospores.
Fig. 18. Encysted zoospore on keratin.
Fig. 19. Developing sporangia.
Fig. 20. Mature sporangium.
Fig. 21. Zoospore discharge through multiple papillae.

Scale bar values in micrometers
PLATE 22

Figs. 1–4. Rhizophydium gibbosum (Zopf) A. Fisch.; after Zopf (1888).
Fig. 1. Multiple immature sporangia, parasitic on Cylindrocystis sp.
Fig. 2. Mature sporangia, parasitic on Pentium sp.
Fig. 3. Zoospore discharge.
Fig. 4. Empty sporangia.

Figs. 5-7. Rhizophydium megarrhizum Sparrow; after Skuja (1956).
Fig. 5. Three mature sporangia with two (L, R) projecting discharge papillae and (center) a single discharge papilla, parasitic on Oscillatoria agardhii.
Fig. 6. Zoospore release.
Fig. 7. Resting spore.

Figs. 8–14. Rhizophydium nodulosum Karling; after Karling (1948).
Fig. 8. Motile zoospores, and encysted zoospore on human hair.
Fig. 9. Germling.
Fig. 10. Immature sporangia.
Fig. 11. Mature sporangium.
Fig. 12. Mature sporangium with several exit papillae deliquescing simultaneously.
Fig. 13. Zoospore discharge, with simultaneous release from multiple papillae.
Fig. 14. Empty sporangium with irregular or branched ingrowths from the wall of the sporangium.

Scale bar values in micrometers
PLATE 23

Fig. 1. Encysted zoospore on pollen grain.
Fig. 2. Immature sporangium.
Fig. 3. Maturing sporangia on pollen grain.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore release.
Fig. 6. Resting spores in a cluster (up to 40) adhering to one another.

Fig. 7. Two immature, angular sporangia.
Fig. 8. Mature sporangium with multiple discharge papillae.
Fig. 9. Zoospore discharge simultaneously from several exit pores.
Fig. 10. Empty sporangium.

Scale bar values in micrometers
Section 4: Key. Sporangium predominantly pyriform (the part of the sporangium proximal to the substrate is broadest), conical, or pyramidal.

1a. Organism saprophytic .................................................. 2
1b. Organism parasitic ........................................................ 3

2a (1a). Organism saprophytic on chitin ................................. R. chitinophilum
2b. Organism saprophytic on Cosmarium ............................... R. ubiquetum

3a (1b). Sporangium small, diameter and height ~ 5 µm .................... 4
3b. Sporangium larger than 5 µm ............................................. 6

4a (3a). Sporangial wall collapses after discharge ..................... R. mischococi
4b. Sporangial wall does not collapse after discharge .................. 5

5a (4b). Sporangium sessile ..................................................... R. minutum
5b. Sporangium sessile and stalked ........................................ R. androdioctes

6a (3b). Sporangium conical or pyramidal ................................. R. conicum
6b. Sporangium pyriform ...................................................... 7

7a (6b). Sporangia abundant and numerous on host .................... 8
7b. Sporangia usually single or few on host ............................... 10

8a (7a). Endobiotic part a coralloid or poly-digitate haustorium ........ R. coralloidium
8b. Endobiotic part a richly branched rhizoid ................................ 9

9a (8b). Sporangia with 1–3 discharge papillae, often terminating as short tubes .......... R. apiculatum
9b. Sporangia with 1–3 discharge papillae, not terminating as short tubes .............. R. mycetophagum

10a (7b). Tip of discharge papilla attenuated ................................ 11
10b. Tip of discharge papilla not attenuated ................................ 12

11a (10a). Parasitic on Apiocystis ............................................. R. braunii
11b. Parasitic on Cryptomonas ................................................ R. simplex

12a (10b). Rhizoid extensively branched .................................... 13
12b. Rhizoid tenuous, sparsely branched ................................... 15

13a (12a). Sporangia both pyriform and variable in shape .............. R. agile
13b. Sporangia only pyriform .................................................. 14

14a (13b). Parasitic on Ophiocystium ....................................... R. sciadii
14b. Parasitic on Tribonema .................................................... R. zoophthorum

15a (12b). Sporangium usually tilted on surface of host .................. R. granulosporum
15b. Sporangium upright on surface of host .................................................. 16

16a (15b). Sporangium subtended by an isodiametric stalk ........... \textit{R. anomalum}
16b. Sporangium sessile ............................................................................. 17

17a (16b). Parasitic on \textit{Saprolegnia} and \textit{Achlya} ......................... \textit{R. carpophilum}
17b. Parasitic on \textit{Chlamydomonas} ........................................ \textit{R. acuforme}
17c. Parasitic on \textit{Eudorina} .............................................................. \textit{R. eudorinae}

Section 4: Species descriptions.

\textbf{\textit{Rhizophydium acuforme}} (Zopf) A. Fisch. \hfill \textbf{\textit{Plate 24}, figs. 1–7}
\textit{Rhizidium acuforme} Zopf, Nova Acta Acad. Leop.-Carol. 47: 209, pl. 21, figs. 33–44. 1884.

“SPORANGIUM sessile, broadly pyriform, 6–16 µm diameter, with a single apical papilla, wall thin, smooth, colorless. RHIZOIDAL SYSTEM composed of delicate, sparingly branched rhizoids arising from a main axis. ZOOSPORES about 2–2.5 µm diameter, with a single colorless globule, escaping through an apical pore formed upon the deliquescence of the papilla. RESTING SPORE sessile, spherical, generally smaller than the sporangium, with a smooth thickened wall, the contents bearing a large globule, rhizoids delicate, sparingly branched, arising from a main axis, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on moving cells of \textit{Chlamydomonas}-like alga, \textit{Chlamydomonas} sp., \textit{Palmodictyon} sp.; Germany, Belgium, United States” (Sparrow 1960).

NOTE — Type material not designated; Zopf’s illustration (pl. 21, figs. 33–44, Nova Acta Acad. Leop.-Carol. 47: 209. 1884) of \textit{Rhizidium acuforme} Zopf is accepted as the type of \textit{Rhizophydium acuforme} (Zopf) A. Fisch.

\textbf{\textit{Rhizophydium agile}} (Zopf) A. Fisch. \hfill \textbf{\textit{Plate 24}, figs. 8–12}

“SPORANGIUM occurring singly or in groups on the surface of the gelatinous sheath of the host, sessile, variable in shape, broadly pyriform, sometimes somewhat angular and blunt-cornered, usually not over 10–15 µm diameter, often having a narrow conical base, with a small nearly sessile or slightly protruding apical papilla, wall colorless, smooth, delicate, collapsing and disintegrating after spore discharge. RHIZOIDAL SYSTEM composed of richly branched rhizoids arising from the tip of a single stalk that passes through the gelatinous sheath of the host. ZOOSPORES not over fifty, spherical, with a
single slightly eccentric colorless globule and occasionally from one to two smaller ones, flagellum delicate, movement quick, in zigzag lines, or amoeboid. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Chroococcus turgidus; Germany, Russia” (Sparrow 1960).

NOTE — “The parasite caused a swelling of the gelatinous sheath and a quick discoloration of the cell contents. The latter became olive green, then dirty yellow brown. Serbinow (1907) noted that the fungus was a facultative parasite or even a true saprophyte. The sporangia figured by him are more regularly pyriform than those in Zopf’s organism, and the rhizoid is an apparently unbranched slender thread. In these characters it approaches Rhizophydia simplex (Dang.) A. Fisch.‖ (Sparrow 1960). Type material not designated; Zopf’s illustration (pl. 20, figs. 1–7, Nova Acta Acad. Leop.-Carol. 52: 343. 1888) of Rhizophytia agile Zopf is accepted as the type of Rhizophydia agile (Zopf) A. Fisch.

Rhizophydia androdiects Canter

“SPORANGIUM broadly ovate, 4.6–8 µm high by 3–6 µm wide, developed by direct enlargement of the zoospore, content uniguttulate during growth, wall delicate, dehiscence apical or subapical. RHIZOIDAL SYSTEM limited, branched. ZOOSPORES spherical, 2 µm diameter, containing a posteriorly placed refractive globule and a minute anterior pulsating vacuole, flagellum 11 µm long; from 8–17 zoospores in sporangium. RESTING SPORE sexually formed, female gamete (resembling an encysted zoospore) motile, attaching itself to a small male cell already established on the host, female nourished via male cell which it eventually exceeds in size; content from male passing into female, which becomes transformed into a resting spore; resting spore spherical, 3.8–5.5 µm diameter, wall smooth, content a large globule with sometimes another smaller one, subtended by and empty oval or subspherical male thallus 2.8–3 by 4.2 µm‖ (Canter 1971a).

HABITAT/substrate/location — Aquatic; “parasitic on Dictyosphaerium pulchellum; Scotland” (Canter 1971).

NOTE — Type material not designated; Canter’s illustration (text fig. 1, a–z, pl. 13, figs. 1–19, Trans. Br. Mycol. Soc. 56: 115. 1971) of R. androdiects Canter is accepted as the type.

Rhizophydia anomalum Canter

“SPORANGIUM flask-shaped, 3.8 µm broad by 7.7 µm high to 12.4 µm broad by 28 µm high, embedded except for the apex of the neck in the gelatinous
host sheath. RHIZOIDAL SYSTEM meager, branched. ZOOSPORES spherical, 2.6 µm diameter, uniguttulate, posteriorly unflagellate; 5–50 in a sporangium, emerging singly on deliquescence of the apex of the neck. RESTING SPORE spherical, 6–11 µm diameter with a smooth wall and a large oil globule, sexually formed. A zoospore, which later becomes the female gametangium whose contents constitute the female gamete encysts near the apex of the male thallus (the latter resembling an early stage in sporangial development), both (male?) increasing in size, especially the female which eventually receives the content of the male, expands and becomes transformed into a zygote; germination unknown‖ (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Apiocystis brauniana; Great Britain‖ (Sparrow 1960).

NOTE — Type material not designated; Canter’s illustration (figs. 1, 2, New Phytol. 49: 102. 1950) of R. anomalum Canter is accepted as the type.

**Rhizophydium apiculatum** Karling


“SPORANGIUM hyaline, smooth, fairly thick-walled, pyriform (6–10 by 14–18 µm), slightly oblclavate, flattened, or anatropous with one to three prominent exit papillae which may often become extended to short tubes, 4 by 6 µm long; numerous, up to 26 on a host. RHIZOIDAL SYSTEM richly branched. ZOOSPORES spherical, 3–3.5 µm diameter, with a small refractive globule. RESTING SPORE hyaline, smooth, spherical (8–12 µm), pyriform (10 by 14 µm), often apiculate; containing a large central refractive globule surrounded by several smaller ones; functioning as prosporangia in germination‖ (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; “parasitic on protozoa and snakeskin bait; Brazil, United States, Cuba‖ (Sparrow 1960).

NOTE — Type material not designated; Karling’s illustration (figs. 33-37, Amer. J. Bot. 33: 331. 1946) of R. apiculatum Karling is accepted as the type.

**Rhizophydium braunii** (P.A. Dang.) A. Fisch.


“SPORANGIUM sessile on the gelatinous envelope of the algal colony, narrowly pyriform or ovoid, the attenuated apex often slightly curved, wall stout, smooth, colorless. HAUSTORIUM a long slender unbranched (?) filament which penetrates the algal cells. ZOOSPORES from fifteen to twenty-five, spherical, 2 µm in diameter, with an eccentric colorless globule and a long flagellum, escaping through an apical pore formed upon the deliquescence of
a papilla. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Apiocystis brauniana; France” (Sparrow 1960).

NOTE — Type material not designated; Dangeard’s illustration (pl. 3, fig. 11, Le Botaniste 1: 57. 1889) of C. braunii P.A. Dang. is accepted as the type of Rhizophydium braunii (P.A. Dang.) A. Fisch.

**Rhizophydium carpophilum** (Zopf) A. Fisch. 


Rhizidium carpophilum Zopf, Nova Acta Acad. Leop.-Carol. 47: 200, pl. 20, figs. 8–16. 1884.

“SPORANGIUM sessile, often clustered, at first spherical or ovoid, becoming somewhat pyriform after discharge, 9.6–25.2 μm diameter, wall thin, smooth, colorless. RHIZOIDAL SYSTEM composed of tenuous, unbranched or sparingly branched rhizoids. ZOOSPORES two to forty or more, spherical or slightly ellipsoidal, 3–6 μm diameter, with a colorless eccentric globule and a very long flagellum, emerging through an apical, fairly broad slightly elevated pore, movement swimming or amoeboid. RESTING SPORE sessile, spherical, 5–9 μm diameter, with a slightly thickened smooth wall and a large colorless oil globule, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; “on oogonia and oospores of Saprolegnia sp., Achlya sp., on sporangium of Olpidiopsis saprolegniae, oospores of Monoblepharis macrandra, Dictyuchus monosporus, oospores of Monoblepharis macrandra, pine pollen; Germany, United States, Japan, Great Britain, Brazil, Cuba, Egypt, Northwest Africa, West Africa, Equatorial East Africa, South Africa, Sweden” (Sparrow 1960).

NOTE — “This fungus is a very virulent parasite and soon destroys the eggs of the host. Zopf (1884) noted that, if oospores were not already differentiated in the oogonia when the attack occurred, the contents of the infected oogonium contracted into a ball of fatty material” (Sparrow 1960). Type material not designated; Zopf’s illustration (pl. 20, figs. 8–16, Nova Acta Acad. Leop.-Carol. 47: 200. 1884) of Rhizidium carpophilum Zopf is accepted as the type of Rhizophydium carpophilum (Zopf) A. Fisch.

**Rhizophydium chitinophilum** Antik. 


“SPORANGIUM sessile, hyaline, smooth, spherical (7–69 μm), subspherical (15–66 by 17–74 μm), oval (7–66 by 11–87 μm), or pyriform (8–58 by 11–96 μm); neck of sporangium 4–17 by 11–28 μm; exit papillae one or two, low and broad, usually apical, 4–13 μm high and 7–21 μm wide, filled with a hyaline matrix. RHIZOIDAL SYSTEM composed of richly-branched rhizoids 2–
16 µm diameter, usually arising from a single point at the base of the sporangium, rarely from several points. ZOOSPORES spherical, approximately 3.6 µm diameter with a minute refractive globule less than 0.7 µm and a large somewhat refractive, granular body about 2.2 µm; flagellum 21–26 µm long. RESTING SPORE smooth, brown with coarsely granular contents; wall of resting spore 0.7 µm; on germination functioning as a prosporangium" (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; “saprophytic on chitin; United States” (Sparrow 1960).

NOTE — Type material not designated; Antikajian’s illustration (figs. 1–20, Mycologia 39: 613. 1947) of *R. chitinophilum* Antik. is accepted as the type.

**Rhizophyidium conicum** Karling

PLATE 26, FIGS. 6–10


“SPORANGIUM hyaline, smooth, conical or pyramidal (14–16 by 20–28 µm) with two to six narrow exit papillae, 2 µm diameter; numerous, up to 30 on a host. RHIZOIDAL SYSTEM well developed and richly branched. ZOOSPORES spherical (2–2.5 µm), with a minute refractive globule; emerging from one or more of the lateral papillae. RESTING SPORE conical (6–8 by 10–14 µm), or slightly irregular, hyaline and smooth with one or more large refractive globules; germination unknown” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on *Netrium* sp., Brazil” (Sparrow 1960).

NOTE — “Distinguished by cone-shaped or slightly pyramidal sporangia, with two to six narrow exit papillae, and conical, hyaline, smooth resting spores” (Sparrow 1960). Type material not designated; Karling’s illustration (figs. 23, 24, Amer. J. Bot. 33: 333. 1946) of *R. conicum* Karling is accepted as the type.

**Rhizophyidium coralloidium** Karling

PLATE 26, FIGS. 18–22


“SPORANGIUM largely pyriform, 14–24 by 50–60 µm, subspherical to spherical, 20–50 µm, ovoid, 10–20 by 15–35 µm, occasionally sub-triangular or slightly irregular, usually with one broad, up to 7 µm diameter, exit orifice. HAUSTORIUM intramatrical, rarely single, usually poly-digitate or coralloid. ZOOSPORES spherical, 2.8–3.5 µm diameter, with a minute hyaline globule; flagellum 14–18 µm long. RESTING SPORE unknown” (Karling 1976b).

HABITAT/SUBSTRATE/LOCATION — “Soil; parasitic on the sporangia and rhizoids of *Rhizophlyctis rosea*; Florida, USA” (Karling 1976b).

NOTE — Type material not designated; Karling’s illustration (figs. 1–9, Mycologia 68: 1245. 1976) of *R. coralloidium* Karling is accepted as the type.
**Rhizophydium eudorinae** Hood


*Phlyctidium eudorinae* Gisemi, Növényt. Szakosztályának 1924, 1–5. 1924.

*Rhizophydium eudorinae* (Skvrtow) Jacz., Opredelitel gribov.... I. 38. 1931.


“SPORANGIUM imbedded in the gelatinous sheath of the host colony, sessile on the cell, broadly pyriform with a prolonged neck, the broad apex extending slightly beyond the outer surface of the gelatinous sheath, 20–35 µm high by 10–17 µm diameter, wall thin, smooth, colorless. RHIZOIDAL SYSTEM composed of delicate and unbranched rhizoids. ZOOSPORES numerous, ovoid, 2 µm diameter, with a minute colorless eccentric globule and a single flagellum, emerging from the apex of the sporangium in a compact irregular mass imbedded in mucilaginous material from which, after a period of rest, they escape. RESTING SPORE within the gelatinous sheath, supported by a short stalk on the host cell, asexually formed, spherical, 10–16 µm diameter, with a thick dark rough wall, germination not observed” (Sparrow 1960).

HABITAT/substrate/location — Aquatic; “parasitic on the planktonic alga *Eudorina elegans*; Great Britain” (Sparrow 1960).

Note — Based on morphological, developmental, and host similarities, *P. eudorinae* Gisemi, *R. eudorinae* (Skvortow) Jacz., and *R. beauchampii* Hovasse are herein brought into synonymy with *R. eudorinae* Hood. Type material not designated; Hood’s illustration (figs. 1–5, Proc. Birmingham Nat. Hist. Philos. Soc. 12: 45. 1910) of *R. eudorinae* Hood is accepted as the type.

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**Rhizophydium granulosporum** Scherff.

Arch. Protistenk. 53: 44, pl. 2, figs. 81–86. 1925.

“SPORANGIUM sessile, broadly pyriform, with a broad apex, 7–14 µm high by 5–9 µm diameter, usually appearing tilted on the surface of the host, wall thin, smooth, colorless. RHIZOIDAL SYSTEM composed of delicate, feebly developed rhizoids arising from a short main axis. ZOOSPORES ovoid, 3 µm long by 2 µm diameter, with a large colorless slightly eccentric globule and a long flagellum, escaping through a broad pore formed upon the dissolution of an apical, subapical, or occasionally lateral papilla. RESTING SPORE spherical, 5–7 µm diameter, wall thick, colorless, moderately covered with short rod-like protuberances, resting on the apex or side of the companion cell, germination not observed; companion cell single (rarely two), spherical or turbinate, smooth-walled, 2.5–3 µm diameter, sessile or with a short extramatrical stalk, rhizoid unbranched” (Sparrow 1960).

Habitat/substrate/location — Aquatic; “parasitic on *Tribonema bombycina*; Hungary; United States” (Sparrow 1960).

Note — “In the American material (Sparrow 1939) both conjugating thalli
appeared to develop on the host wall, although in two instances the receptive thallus seemed to make contact only with the "male" plant. Once the "female" alone was attached to the algal cell. It was observed that the characteristic spines appeared on the receptive thallus soon after fertilization and before thickening of the wall had been initiated" (Sparrow 1960). Type material not designated; Scherffel's illustration (pl. 2, figs. 81–86, Arch. Protistenk. 53: 44. 1925) of R. granulosporum Scherff. is accepted as the type.

**Rhizophydium minutum** G.F. Atk. PLATE 27, FIGS. 7, 8
Bot. Gaz. 48: 328, fig. 4. 1909.

"Sporangium obpyriform or flask-shaped, broadly papillate, 5–6 µm diameter, sessile; apex opening by a single pore. Rhizoidal system a few slender rhizoidal filaments at the base in the host cell. Zoosporangium two to four in a sporangium, oval, 2.5 µm diameter with a single oil drop, uniciliate. Resting spore unknown" (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Spirogyra spp., pine pollen; United States, Hungary, South Africa, India” (Sparrow 1960).

NOTE — Type material not designated; Atkinson’s illustration (fig. 4, Bot. Gaz. 48: 328. 1909) of R. minutum G.F. Atk. is accepted as the type.

**Rhizophydium mischococci** Scherff. PLATE 27, FIG. 9
Arch. Protistenk. 54: 195, pl. 9, fig. 56. 1926.

"Sporangium sessile, broadly pyriform, with a thin smooth colorless wall, 5 µm high by 5 µm diameter (at the base). Rhizoidal system composed of a long, fairly thick, unbranched rhizoid. Zoosporangium four, each with a fairly large colorless globule, escaping through an apical pore, the wall of the sporangium collapsing after discharge, motile zoospores not seen. Resting spore not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Mischococcus confervicola; Hungary” (Sparrow 1960).

NOTE — Type material not designated; Scherffel’s illustration (pl. 9, fig. 56, Arch. Protistenk. 54: 195. 1926) of R. mischococci Scherff. is accepted as the type.

**Rhizophydium mycetophagum** Karling PLATE 27, FIGS. 10-14

"Sporangium sessile, hyaline, smooth, spherical (7–20 µm), broadly pyriform (8–12 by 11–19 µm), with one to three exit papillae; numerous, up to 25 on a host cell. Rhizoidal system relatively delicate but richly branched. Zoosporangia spherical (3.5–5 µm), with a conspicuous (1–1.5 µm) refractive
globule. RESTING SPORE spherical (6–14 µm) with a thick, dark brown rough wall, and one to several large refractive globules; germination unknown” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on the conidiophores and hyphae of the mucor Choanophora sp.; Brazil” (Sparrow 1960).

NOTE — “The species appeared limited in its host range and did not attack other chytrids, oomycetes, pollen grains, or algae. This and the species Pleotrichelus fulgens and P. zopfianus are the only known chytrid parasites of mucors” (Sparrow 1960). Type material not designated; Karling’s illustration (figs. 17, 18, Amer. J. Bot. 33: 329. 1946) of R. mycetophagum Karling is accepted as the type.

Rhizophydium sciadii (Zopf) A. Fisch.  

“SPORANGIUM sessile, at first spherical or somewhat flattened at the base, at maturity pyriform, with a broad blunt apex (the papilla), up to 20 µm high by 17 µm diameter, walls smooth, colorless, slightly thickened. RHIZOIDAL SYSTEM extensive, arising from one or two main axes, richly branched. ZOOSPORES as many as eighty to one hundred in the larger sporangia, spherical or ellipsoidal, 2.3–4 µm greatest diameter, with a relatively large (1–1.3 µm diameter) refractive, slightly eccentric, colorless globule and a very delicate flagellum, emerging upon the deliquescence of the thin-walled blunt apex of the sporangium. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — “Fresh and salt water; parasitic on Ophiocytium (Sciadium) arbusculum; Germany” (Sparrow 1960).

NOTE — “In attacked plants the plasma, nucleus, and chromatophore were destroyed, the residue of the latter forming yellow-brown or dirty red-brown clumps or granules in the cell. Staining was necessary to demonstrate the full extent of the rhizoidal system” (Sparrow 1960). Type material not designated; Zopf’s illustration (pl. 2, figs. 23–32, Abh. Naturf. Ges. Halle 17: 91. 1887) of Rhizophyton sciadii Zopf is accepted as the type of Rhizophydium sciadii (Zopf) A. Fisch.

Rhizophydium simplex (P.A. Dang.) A. Fisch.  
Plate 27, Figs. 15–19  

“SPORANGIUM resting directly on the host cell or on the surface of the gelatinous sheath, narrowly pyriform, 8–15 µm long by 6–7 µm diameter, prolonged apically into a slightly bent tube, wall thickened a little, smooth, colorless. RHIZOIDAL SYSTEM composed of unbranched rhizoids. ZOOSPORES
few to from thirty to forty, ellipsoidal or spherical, 1.5–3 µm diameter, with a colorless basal globule and a long flagellum, emerging through a small pore formed at the tip of the sporangium. RESTING SPORE spherical, 6–7 µm diameter, with a thick smooth colorless wall, rhizoidal system like that of the sporangium; germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on cysts of Cryptomonas sp. in culture jar, dead colonies of Pandorina, Spirogyra, Chlorococcus (?); France, United States, Great Britain” (Sparrow 1960).

NOTE — “Dangeard (1889) observed that changes in the host contents quickly occurred after infection by the fungus. The olive-colored plasma was reduced to reddish granules and the cellulose wall lost its structure and expanded. The swarmers of the alga were not attacked” (Sparrow 1960).

Type material not designated; Dangeard’s illustration (pl. 3, figs. 18-20, Le Botaniste 1: 60. 1889) of C. simplex P.A. Dang. is accepted as the type of R. simplex (P.A. Dang.) A. Fisch.

Rhizophydium ubiquetum Canter

“SPORANGIUM sessile or non-sessile, more or less pyriform, 4–14 µm broad and 5–18 µm high, with a single, broad thin-walled apical (rarely basal or lateral) papilla, containing 1–30 zoospores. RHIZOIDAL SYSTEM complex, in which on non-sessile sporangia is an epibiotic rhizoidal axis from which lateral branches may arise; other rhizoids may grow from the sporangium wall; endobiotic rhizoidal system branched. ZOOSPORES 4.5 µm diameter with a single basal oil globule and flagellum 25 µm long, emerging in a non-motile mass and almost immediately becoming motile. RESTING SPORE asexually formed, spherical, 9–15 µm diameter, with a thick smooth colorless wall; contents one large and many small refractile globules; rhizoidal system similar to that of sporangium, but no branches arising from the spore wall; germination unknown” (Canter 1961).

HABITAT/substrate/location — Aquatic; “saprophytic on Cosmarium contractum var. ellipsoideum; England” (Canter 1961).

NOTE — Type material not designated; Canter’s illustration (figs. 1, a–s, 2, a–k, and pl. 12, Trans. Brit. Mycol. Soc. 44: 163. 1961) of R. ubiquetum Canter is accepted as the type.

Rhizophydium zoophthorum (P.A. Dang.) A. Fisch.

“SPORANGIUM sessile, often in clusters, ovoid or somewhat pyriform, with a
prominent apiculus, 20–25 µm long by 15–17 µm diameter, wall thin, smooth, colorless. RHIZOIDAL SYSTEM extensive, richly branched, rhizoids arising as secondary branches from a main axis. ZOOSPORES ovoid, 3 µm (long?), with dense granular plasma, a slightly refractive colorless basal globule, and a flagellum 30 µm in length, escaping through a narrow pore formed at the tip of the apiculus. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/ SUBSTRATE/LOCATION — Aquatic; “parasitic on adults and eggs of rotifers, liver-fluke eggs; France, Ireland, Brazil” (Sparrow 1960).

NOTE — “The habitat, ovoid sporangium with prominent apiculus, and richly branched rhizoidal system are distinctive features of this species” (Sparrow 1960). As typified by Dick (2001, p. 425), Dangeard’s illustration (pl. 3, figs. 10, 21, Le Botaniste 1: 58. 1889) of C. zoophthorum P.A. Dang. is accepted as the type of R. zoophthorum (P.A. Dang.) A. Fisch.
Fig. 1. Motile zoospore.
Fig. 2. Germling (L) and immature sporangium (R), parasitic on *Apiocystis brauniana*.
Fig. 3. Mature, flask-shaped sporangium.
Fig. 4. Empty sporangium.
Fig. 5. Sexual formation of the resting spore.
Fig. 6. Resting spore with adherent male thallus.
Fig. 7. Motile zoospores.
Fig. 8. Encysted zoospore, parasitic on an unidentified protozoan.
Fig. 9. Germling.
Fig. 10. Mature sporangium with two prominent, lateral exit papillae.
Fig. 11. Zoospore discharge, as a vesicular mass.
Fig. 12. Empty, multi-papillate sporangium.
Fig. 13. Resting spore.
Fig. 14. Encysted zoospore, parasitic on *Apiocystis brauniana*.
Fig. 15. Immature sporangia.
Fig. 16. Zoospore release through an apical pore.
Fig. 17. Empty sporangium.
Fig. 18. Motile zoospores.
Fig. 19. Encysted zoospore, parasitic on *Saprolegnia* sp.
Fig. 20. Germling.
Fig. 21. Mature sporangium with an apical papilla.
Fig. 22. Zoospore discharge through a single, apical, fairly broad, slightly elevated pore.
Fig. 23. Empty sporangium.
Fig. 24. Resting spore.

Scale bar values in micrometers
Fig. 1. Germling (L) and immature sporangium (R).
Fig. 2. Mature sporangium with a single apical exit papilla.
Fig. 3. Resting spores.
Fig. 4. Germinated resting spore functioning as a prosporangium, with attached mature sporangium.
Fig. 5. Germinated resting spore with attached empty sporangium.

Fig. 6. Motile zoospores, and encysted zoospore parasitic on *Netrium* sp.
Fig. 7. Germling.
Figs. 8, 9. Mature, multipapillate, conical sporangia.
Fig. 10. Resting spores.

Fig. 11. Motile zoospores.
Fig. 12. Encysted zoospore and germlings, parasitic on *Eudorina elegans*.
Fig. 13. Developing sporangia.
Fig. 14. Mature sporangia.
Fig. 15. Zoospore release as an irregular mass.
Fig. 16. Empty sporangium.
Fig. 17. Resting spores.

Fig. 18. Motile zoospores, and encysted zoospore parasitic on *Rhizophlyctis rosea*.
Fig. 19. Immature sporangia.
Fig. 20. Mature sporangia.
Fig. 21. Zoospore release.
Fig. 22. Empty sporangium.

Scale bar values in micrometers
Fig. 1. Motile zoospores, and encysted zoospore parasitic on *Tribonema bombycina*.
Fig. 2. Immature sporangium with a single apical papilla.
Fig. 3. Mature sporangium with typical appearance of being tilted on the surface of the host.
Fig. 4. Zoospore release.
Fig. 5. Empty sporangium.
Fig. 6. Sexual production of the resting spore, with adnate sessile (L) and short-stalked companion cell.

Fig. 7. Mature sporangium with single apical papilla, on *Spirogyra varians*.
Fig. 8. Empty sporangium and motile zoospores.

Fig. 9. *Rhizophydium mischococi* Scherff.; after Scherffel (1926).
Broadly pyriform sporangium, parasitic on *Mischococcus confervicola*.

Fig. 10. Encysted zoospore, parasitic on conidiophores and hyphae of *Choanephora* sp.
Fig. 11. Developing sporangia.
Fig. 12. Zoospore discharge.
Fig. 13. Empty sporangium.
Fig. 14. Resting spore.

Fig. 15. Encysted zoospore, parasitic on *Ophiocytium (Sciadium) arbusculum*.
Fig. 16. Immature sporangium.
Fig. 17. Mature sporangium with a broad blunt apical papilla.
Fig. 18. Zoospore release.
Fig. 19. Resting spore.

Scale bar values in micrometers
Fig. 1. Ellipsoidal and spherical motile zoospores.
Fig. 2. Encysted zoospore, parasitic on cyst of *Cryptomonas* sp.
Fig. 3. Immature sporangia, prolonged apically into a slightly bent papilla.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore release.
Fig. 6. Resting spore.
Fig. 7. Motile zoospores, and encysted zoospore saprophytic on *Cosmarium contractum var. ellipsoideum*.
Fig. 8. Immature sporangium with interbiotic rhizoidal development.
Fig. 9. Mature sporangia, one (R) with an apical papilla.
Fig. 10. Mature sporangium with two basal papillae and apical rhizoids.
Fig. 11. Zoospore discharge, with zoospores emerging as a non-motile mass.
Fig. 12. Empty sporangia.
Fig. 13. Resting spore.
Fig. 14. Motile zoospores.
Fig. 15. Encysted zoospore and germling, parasitic on a rotifer egg.
Fig. 16. Developing sporangia, each with a prominent apical papilla.
Fig. 17. Zoospore discharge, as a vesicular mass.
Fig. 18. Empty sporangium.

Scale bar values in micrometers
Section 5: Key. Sporangium predominantly obovoid, obovate, or obpyriform (the part of the sporangium distal to the substrate is broadest)

1a. Sporangium born on a stalk .................................................. 2
1b. Sporangium sessile on substrate ........................................ 8

2a (1a). Stalk robust ........................................................................... 3
2b. Stalk thin .................................................................................. 4

3a (2a). Sporangium multi-pored ............................................. R. spinosum
3b. Sporangium single-pored .................................................. R. srilankaiense

4a (2b). Stalk isodiametic, short or long ................................... 5
4b. Stalk clavate ................................................................. R. pedicellatum

5a (4a). Spores discharged through 1–4 pores .................................. 6
5b. Spores released as entire sporangial wall deliquesces ........... R. piriformis

6a (5a). Apical pore opening broad, rim reflexed ...................... R. echinatum
6b. Apical pore(s) not broad, rim not reflexed ........................... 7

7a (6b). Rhizoids branched .......................................................... R. fulgens
7b. Rhizoids unbranched ...................................................... R. obpyriformis

8a (1b). Zoospore discharge through a pore ................................. 9
8b. Upper half of sporangium deliquesces to liberate zoospores .......... 11

9a (8a). Discharge pore apical ..................................................... 10
9b. Discharge pore lateral ..................................................... R. parasiticum

10a (9a). Sporangium clavate, rhizoids robust and branched ........ 12
10b. Sporangium pear-shaped or oval, rhizoid very slender .......... R. ovatum

11a (8b). Rhizoid unbranched .................................................... R. clinopus
11b. Rhizoid branched, coarse, tapering .................................. R. pelagicum

12a (10a). Rhizoidal system composed of extensive, robust, branched rhizoids .......... R. clavatum
12b. Rhizoidal system a tuft of short, unbranched rhizoids .......... R. fungicolum
Section 5: Species descriptions.

**Rhizophydium clavatum** Karling

*Sporangium* predominantly clavate, 18–33 μm high by 10–17 μm in greatest diameter, or narrowly ovoid, with a thin hyaline wall and a broad apical exit papilla. **Rhizoidal system** originating at the base of the sporangium, usually consisting of a fine, straight, sparingly branched filament which may extend for a distance of 130 μm. **Zoospores** spherical, 2–2.6 μm diameter, with a minute refractive globule; flagellum 10–13 μm long.

**Resting spore** unknown‖ (Karling 1967).

**Habitat/Substrate/Location** — Soil; “saprophytic on purified shrimp chitin; New Zealand‖ (Karling 1967).

**Note** — Type material not designated; Karling’s illustration (pl. 13, figs. 21–25, Sydowia 20: 77. 1967) of *R. clavatum* Karling is accepted as the type.

**Rhizophydium clinopus** Scherff.

*Sporangium* sessile on the raphe of the host, obovoid or obpyriform, with a broad more or less sharply defined stalk-like basal part which is usually inclined somewhat to the long axis of the main body of the sporangium, with which it is continuous, wall smooth, delicate, 11–24 μm diameter by 6–19 μm high, usually 16–18 μm diameter by 8–10 μm high. **Hautorium** unbranched, 1 μm diameter. **Zoospores** formed in large numbers, spherical, 3 μm diameter, with a colorless globule 1 μm diameter and a long flagellum, released upon the deliquescence of the entire upper half of the sporangium wall, movement hopping or amoeboid. **Resting spore** (?) sessile, subospherical, with a flattened base, 8 μm diameter, wall thick, smooth, colorless, contents with a colorless refractive oil globule, 5 μm diameter, endobiotic part enclosed in a plug of host wall material, germination not observed‖ (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “on moribund diatoms, Cymatopleura elliptica, C. solea, Nitzschia sigmoidea, Cymbella sp., Navicula sp.; Hungary, Austria” (Sparrow 1960).

**Note** — “The resting spores, found only on *Nitzschia sigmoidea*, have not been related with certainty to the sporangial stage. The species resembles *Podochytrium* in the possession of a poorly defined fertile basal region on the sporangium. It differs from *P. emmanuelsenisis* in its method of spore discharge, that is, discharge by the deliquescence of the upper part of the
sporangium, and in having a smooth-walled resting spore” (Sparrow 1960). See discussion in Blackwell et al. 2006. Type material not designated; Scherffel’s illustration (pl. 9, fig. 3, a–g, Arch. Protistenk. 73: 141. 1931) of *R. clinopus* Scherff. is accepted as the type.

**Rhizophydiun echinatum** (P.A. Dang.) A. Fisch. [Plate 29, Figs. 11–16]


*Chytridium echinatum* P.A. Dang., J. Bot. (Morot) 2: 143, pl. 5, figs. 11–15. 1888.

“SPORANGIUM sessile, very broadly opyriiform with a strongly obtuse somewhat lobed apex, urceolate at maturity, 13.5 µm high by 10.8 µm diameter (at apex?), wall thin, smooth, colorless. HAUSTORIUM an unbranched short tapering stalk. ZOOSPORES spherical, 2.5 µm diameter, with a basal colorless globule and a long flagellum, emerging through a very broad apical opening with a reflexed rim and forming a compact temporary mass surrounded by mucus. RESTING SPORE sessile, spherical or subspherical, 10 µm diameter, with a thick wall covered with somewhat long colorless stout spines, contents coarsely granular, yellowish, with a large oil globule, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on *Glenodinium cinctum*; France” (Sparrow 1960).

NOTE — “There is some question as to the method of zoospore discharge in this species. Fischer (1892) had considered it to occur inoperculately and had placed the organism in *Rhizophydiun*. Dangeard (1888) said of the discharge that the that the top of the sporangium is lifted up by the emerging spores, and the sharply defined reflexed rim of the open sporangium gives additional evidence that such has been the case. In contrast to those of most species of *Chytridium*, however, the resting spores- if indeed they belong to the fungus- are epibiotic, as in *Zygorhizidium*, but, unlike those of *Zygorhizidium*, they are apparently asexually formed” (Sparrow 1960). Type material not designated; Dangeard’s illustration (pl. 5, figs. 11–15, J. Bot. (Morot) 2: 143. 1888) of *C. echinatum* P.A. Dang. is accepted as the type of *R. echinatum* (P.A. Dang.) A. Fisch.

**Rhizophydiun fulgens** Canter [Plate 29, Figs. 17–23]


“SPORANGIUM variable in shape from obovate to oval (6 µm high by 4.5 µm broad to 10 µm high by 8 µm broad), containing from 4 to 18 zoospores. RHIZOIDAL SYSTEM an unswollen stalk-like region within the mucilage envelope of the alga, and a branched rhizoidal system inside the host cell. ZOOSPORES (2.5 µm diameter) are anteriorly uniguttulate and posteriorly uniflagellate; they escape from the sporangium via two pores formed in the
apical corners of the wall. **RESTING SPORE** asexually formed, oval in shape (6 µm high by 4.5 µm broad to 8 µm high by 6 µm broad) with a smooth, thick, colorless wall; the content contains numerous small peripheral refractive globules and one or two larger globules; on germination functioning as a prosporangium" (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “parasitic on the planktonic green alga *Gemellicystis neglecta*; Great Britain” (Sparrow 1960).

**NOTE** — “In its habit this fungus resembles *Rhizophydium sphaerocystidis* Canter which likewise infects a planktonic alga surrounded by a wide mucilage envelope. In both fungi the sporangium develops from the encysted zoospore while the germ-tube remains as a stalk-like portion. However, in the method of dehiscence and in resting-spore formation these fungi differ greatly” (Sparrow 1960). Type material not designated; Canter’s illustration (figs. 9–11, pl. 11, Ann. Bot. London 15: 144. 1951) of *R. fulgens* Canter is accepted as the type.

**Rhizophydium fungicolum** Zimm.  
PLATE 30, FIGS. 1–7  
Centralbr. Bakteriol. Z. Abth. 8: 149, fig. 2. 1902.

**SPORANGIUM** obpyriform, 30-40 µm by 30 µm diameter, broadly ellipsoidal, 40 µm diameter, with double-contoured wall and a single, prominent, often elongated apical to subapical papilla, or two oppositely placed subapical papillae; sporangia numerous on host. **RHIZOIDAL SYSTEM** a tuft of short, unbranched rhizoids. **ZOOSPORES** spherical, 4 µm in diameter, with a single globule and posterior flagellum. **RESTING SPORE** not observed (Zimmerman 1902).

**HABITAT/SUBSTRATE/LOCATION** — Terrestrial; on the mycelium of *Gloeosporium theobromae* infecting *Theobroma cacao*; Java, Indonesia (Zimmerman 1902).

**NOTE** — Type material not designated; Zimmerman’s illustration (fig. 2, Centralbr. Bakteriol. Z. Abth. 8: 149. 1902) of *R. fungicolum* Zimm. is accepted as the type.

**Rhizophydium obpyriformis** (Karling) Karling  
PLATE 29, FIGS 3–6  
*Phlyctidium mycetophagum* Karling, Amer. J. Bot. 33: 756, figs. 44, 55. 1946.

“**SPORANGIUM** hyaline, smooth, predominantly obpyriform (8–30 µm high by 10–25 µm in greatest diameter) with a tapering or slightly inflated base, occasionally almost spherical or oval, with 1–4 low, in conspicuous, apical or subapical exit papillae. **RHIZOIDAL SYSTEM** an unbranched, usually thread-like or filamentous rhizoid, up to 8 µm long and 0.8–1.2 µm diameter, rarely knobbed at the end, or peg-like. **ZOOSPORES** spherical, 2–2.9 µm diameter,
with a minute (0.5–0.8 μm diameter) refringent, hyaline globule; flagellum 8–10 μm long. RESTING SPORE doubtful" (Sparrow 1960).


NOTE — Type material not designated; Karling’s illustration (figs. 44, 45, Amer. J. Bot. 33: 756. 1946) of P. mycetophagum Karling is accepted as the type of R. obpyriformis (Karling) Karling.

Rhizophydium ovatum Couch


“SPORANGIUM sessile, obpyriform or obovoid, broadest in the distal half, with a broad apical papilla, 8.4–16.8 by 16–30 μm (mostly 13 by 20–25 μm), wall fairly thin, smooth, colorless. RHIZOIDAL SYSTEM composed of a single rhizoid (possibly two), very short and delicate, arising from a minute bulbous main axis. ZOOスポRES somewhat ovoid, 3 by 4 μm, with a large colorless eccentric oil globule and a long flagellum, emerging with great rapidity through an apical pore formed upon the deliquescence of the papilla and swimming away. RESTING SPORE spherical, 5.4–9.6 μm (mostly 8.4 μm) diameter, with a slightly thickened smooth colorless wall and a large slightly eccentric colorless globule, sexually formed, the motile female gamete coming to rest and encysting on the upper surface of an undeveloped spherical (3.6–5 μm diameter), subspherical, or ovoid (5.4–9.6 μm diameter) male thallus, which is provided endobiotically with a small bulbous swelling and a short rhizoid, both then increasing somewhat in size, especially the more distal female structure, which eventually receives the contents of the male, expands, and becomes transformed into the resting spore, the latter germinating after a short resting period (from two to three days) to form zoospores” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Stigeoclonium sp., and Oedogonium sp.; United States and Hungary” (Sparrow 1960).

NOTE — “Couch was unable to determine whether the gametes were borne in sporangia with the zoospores or formed in separate gametangia. The species is an exceedingly interesting one, and further investigations on the nature and fate of the motile bodies produced by the germinating resting spore and on the cytological details of germination would be of greatest value” (Sparrow 1960). Type material not designated; Couch’s illustration (figs. 28–55,
Mycologia 27: 168. 1935) of *R. ovatum* Couch is accepted as the type.

**Rhizophydium parasiticum** Shen and Siang


“Sporangium epibiotic, obpyriform, 20–22 µm long, 18–20 µm wide, wall 1–1.5 µm thick, opening by a lateral pore, 5.4 µm diameter, allowing the fully formed zoospores to ooze out in the form of a globular mass. Rhizoidal system composed of very delicate, hardly visible rhizoids. Zosposes spherical, posteriorly uniflagellate, 5.4 µm diameter, containing a well defined refractive body, about 3.3 µm diameter; emptied sporangia persistent after discharge. Resting spore unknown” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “parasitic in the zygote of *Oedogonium* sp.” (Sparrow 1960); putatively on *Rhizophydidum sphaerotheca* (Booth 1971b); China, Canada.

Note — Type material not designated; Shen and Siang’s illustration (fig. 2, Sci. Rep. Natl. Tsing Hua Univ., Ser. B, Biol. Sci. 3: 181. 1948) of *R. parasiticum* Shen and Siang is accepted as the type.

**Rhizophydiulm pedicellatum** R.A. Paterson

Mycologia 48: 274, fig. 2, a–e. 1956.

“Sporangium clavate to ovate, smooth walled, 9–14.5 µm high by 7–12 µm diameter, borne on an extramatrical stalk, 3–9 µm long, usually procumbent, with the main axis and stalk parallel with the host, or erect, with the stalk more or less perpendicular to the host filament. Rhizoidal system coarse, branched and tapering. Zoospores numerous, spherical, 2–4 µm diameter with a single eccentric refractive globule, 1–2 µm diameter, a small dark granule, and a posterior flagellum 15 µm long, escaping through a single apical pore. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “parasitic on *Melosira italica*; United States” (Sparrow 1960).

Note — Type material not designated; Paterson’s illustration (fig. 2, a–e, Mycologia 48: 274. 1956) of *R. pedicellatum* R.A. Paterson is accepted as the type.

**Rhizophydiulm pelagicum** R.A. Paterson

Mycologia 50: 85, fig. 1, A–G. 1958.

“Sporangium sessile, broadly ellipsoid, smooth-walled, 11–17.5 µm long by 8–11.5 µm diameter. Rhizoidal system coarse, branched and tapering. Zoospores numerous, spherical, 3 µm diameter with a single eccentric refractive globule 1.5 µm diameter, and a posterior flagellum, 15–16 µm
long, escaping by the deliquescence of the entire upper half of the sporangial wall. **RESTING SPORE not observed** (Paterson 1958).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “parasitic on *Colacium* sp.; Michigan, USA” (Paterson 1958).

**NOTE** — Type material not designated; Paterson’s illustration (fig. 1, A–G, Mycologia 50: 85. 1958) of *R. pelagicum* R.A. Paterson is accepted as the type.

**Rhizophydium piriforme** (Fott) Karling  
PLATE 31, FIGS. 7–12

*Chytridiomycetarum Iconographia*: 65. 1977 (as *piriformis*).


Non *Rhizophydium pyriformis* Valkanov, Arch. Protistenk. 73: 363. 1931.

“**SPORANGIUM** obpyriform or lacrimoid, on a very short or a long slender stalk, wall delicate, 24 µm long. **HAUSTORIUM** a short, slender stalk that is partially or totally endobiotic in the host. **ZOOSPORES** spherical, 2–3 µm diameter, with a single oil droplet and 13–15 µm long flagellum, liberated upon the deliquescence of the entire sporangium wall” (Sparrow 1960).

**RESTING SPORE** stalked (Canter 1950b).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “parasitic on *Characium ancora*; Czechoslovakia” (Sparrow 1960).

**NOTE** — “Since partial or nearly complete deliquescence of the sporangium wall occurs in other chytrids, this character alone is not of generic significance. Because it is soon lost in the host contents, whether or not the rhizoid is unbranched is not certain” (Sparrow 1960). Type material not designated; Fott’s illustration (pl. 19, figs. 1–5, Stud. Bot. Čech. 5: 170. 1942) of *H. piriformis* Fott is accepted as the type of *R. piriformis* (Fott) Karling.

**Rhizophydium spinosum** Willoughby  
PLATE 31, FIGS. 13–19

Arch. Mikrobiol. 52: 108, fig 1, i–w. 1965.


“**SPORANGIUM** stalked, often pyriform, (6)-15–33 µm at first becoming spherical or oval at maturity; larger sporangia polyhedral in shape because of the presence of numerous (up to 7) dehiscence papillae 5.5–10 µm across; stalk up to 20 µm long. **RHIZOIDAL SYSTEM** composed of delicate, branched rhizoids. **ZOOSPORES** spherical, 3–3.5 µm diameter, with a lateral hyaline globule 1–1.5 µm diameter and posterior flagellum 17 µm long. **RESTING SPORE** stalked, stalk up to 27 µm long, at maturity a spherical, yellow-walled body 7.5–15 µm diameter with numerous internal refractive globules; simple or branched yellow spines up to 5.5 µm in length are present on the resting
spore wall” (Willoughby 1965).

HABITAT/SUBSTRATE/LOCATION — Soil; “saprophytic on cellophane bait eroded by rhizoids of Rhizophlyctis rosea; Australia” (Willoughby 1965).

NOTE — Type material not designated; Willoughby’s illustration (fig. 1, i–w, Arch. Mikrobiol. 52: 111. 1965) of R. spinosum Willoughby is accepted as the type.

Rhizophydium srilankaiense Karling ex Letcher, nom. nov. Plate 31, Figs. 20–23

MYCOBANK NO.: MB 519675


“SPORANGIUM spherical, 24–35 µm diameter, clavate, subspherical, 15–38 µm, with smooth hyaline walls, and apparently a single, apical discharge pore. RHIZOIDAL SYSTEM a stalk 3 µm diameter, and branches extending to 210 µm. ZOOSPORES spherical, 3.8–4.5 µm diameter, with a fairly conspicuous refractive globule. RESTING SPORE spherical, 10–16 µm diameter, hyaline, subspherical, ovoid, covered with finely pointed spines up to 25 µm long, germination unknown” (Karling 1981).

HABITAT/SUBSTRATE/LOCATION — Soil; “saprophytic on cellophane and bleached corn cotyledon strips in places eroded by Rhizophlyctis rosea, from a wooded roosting area of bats and birds; Sri Lanka” (Karling 1981).

NOTE — Type material not designated; Karling’s illustration (figs. 1–6, Nova Hedwigia 35: 109. 1981) of R. spinosum Karling is accepted as the type of R. srilankaiense Karling ex Letcher.
Figs. 1, 2. *Rhizophydium clavatum* Karling; after Karling (1967).
Fig. 1. Immature (left) and mature (right) clavate sporangia on chitin.
Fig. 2. Zoospore release, as a vesicular mass.
Fig. 3. Encysted zoospore and germling, parasitic on *Rhizophydidium keratinophilum*.
Fig. 4. Immature (L) and mature (R) sporangia.
Fig. 5. Zoospore discharge as a vesicular mass through a low, inconspicuous subapical papilla.
Fig. 6. Empty sporangium with two subapical discharge papillae.
Fig. 7. Two developing sporangia, saprophytic on a moribund diatom.
Fig. 8. Mature sporangia.
Fig. 9. Zoospore release upon the deliquescence of the entire upper half of the sporangium wall.
Fig. 10. Resting spore.
Fig. 11. Motile zoospores, and encysted zoospore on *Glenodinium cinctum*.
Fig. 12. Immature sporangia.
Fig. 13. Mature sporangia, each on an unbranched, tapering stalk.
Fig. 14. Zoospore discharge through a broad apical opening with a reflexed rim.
Fig. 15. Initial resting spore development.
Fig. 16. Two echinate resting spores.
Fig. 17. Encysted zoospores in the aquatic medium.
Fig. 18. Germinated zoospore and germling, parasitic on *Gemellicystis neglecta*.
Fig. 19. Mature sporangium.
Fig. 20. Zoospore release through multiple pores.
Fig. 21. Empty sporangium.
Fig. 22. Resting spore.
Fig. 23. Germinating resting spore producing a sporangium.

Scale bar values in micrometers
Fig. 1. Motile zoospores.
Fig. 2. Encysted zoospore on mycelium of *Gloeosporium* sp.
Fig. 3. Developing sporangium.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore release.
Fig. 6. Empty sporangium.
Fig. 7. Sporangia of variable morphology.
Figs. 8–14. *Rhizophydium ovatum* Couch; after Couch (1935).
Fig. 8. Motile zoospore.
Fig. 9. Encysted zoospore, on *Stigeoclonium* sp.
Fig. 10. Immature sporangium.
Fig. 11. Mature sporangium with a single apical pore.
Fig. 12. Zoospore release.
Fig. 13. Sexual production of the resting spore.
Fig. 14. Mature resting spore, with adnate male thallus.
Figs. 15–17. *Rhizophydium parasiticum* Shen & Siang; figs. 15 and 16 after Shen & Siang (1948); fig. 17 after Booth (1971b).
Fig. 15. Zoospore discharge from a mature sporangium, parasitic on the zygote of *Oedogonium* sp.
Fig. 16. Empty sporangium with single, lateral pore.
Fig. 17. Putative immature sporangium, parasitic on *Rhizophydium sphaerotheca*.
Fig. 18. Motile zoospores, and a germling parasitic on *Melosira italica*.
Fig. 19. Immature sporangia.
Fig. 20. Mature sporangium.
Fig. 21. Zoospore release.

Scale bar values in micrometers
PLATE 31
Fig. 1. Motile zoospores.
Fig. 2. Encysted zoospore (L), and germinated zoospore that produces a tube that grows through
the stalk and penetrates the host cell proper, parasitic on *Colacium* sp.
Fig. 3. Developing sporangia.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore discharge as a mass, following deliquescence of the upper half of the
sporangium.
Fig. 6. Empty sporangium.
Figs. 7–12. *Rhizophydium piriforme* (Fott) Karling; figs. 7–11 after Fott (1942), fig. 12 after
Canter (1950b).
Fig. 7. Motile zoospores.
Fig. 8. Encysted zoospore and germling, parasitic on *Caracium* sp.
Fig. 9. Developing sporangia.
Fig. 10. Mature sporangium.
Fig. 11. Motile zoospores following zoospore release, in which the entire sporangial wall
deliquesces, leaving only a short pedicel.
Fig. 12. Resting spore.
Fig. 13. Motile zoospores.
Fig. 14. Germling, on cellophane bait eroded by *Rhizophlyctis rosea*.
Fig. 15. Immature sporangia.
Fig. 16. Mature, stalked, multipored sporangia.
Fig. 17. Zoospore release.
Fig. 18. Empty sporangium.
Fig. 19. Stalked resting spores.
Fig. 20. Immature sporangium, on cellophane eroded by *Rhizophlyctis rosea*.
Fig. 21. Mature, stalked sporangium with a single, broad apical pore.
Fig. 22. Zoospore release.
Fig. 23. Resting spores.

Scale bar values in micrometers
Section 6: Key. Sporangium predominantly citriform (lemon-shaped) or saddle-shaped, ovoid, or oblong; the long axis of the sporangium parallel with the surface of the substratum.
1a. Sporangium citriform .......................................................... 2
1b. Sporangium saddle-shaped, ovoid, or broadly pyriform ............. 3

2a (1a). Resting spore spherical, outer wall smooth ...................... R. transversum
2b. Resting spore polyhedral ........................................................ R. goniosporum

3a (1b). Sporangium saddle-shaped ............................................ R. ephippium
3b. Sporangium broadly pyriform or ovoid ................................ 4

4a (3b). Sporangium broadly pyriform ....................................... R. manoense
4b. Sporangium ovoid ............................................................ 5

5a (4b). Sporangium ovoid with two discharge papillae .................. 6
5b. Sporangium ovoid with single discharge papillae ..................... 7

6a (5a). Resting spore wall thick, with columnar bands of refractive material ........... R. columnaris
6b. Resting spore wall thick but without columnar bands ............. R. oblongum

7a (5b). Endobiotic part a haustorium ...................................... R. irregulare
7b. Endobiotic part unbranched or branched rhizoids .................. R. horizontale

Section 6: Species descriptions.

Rhizophydium columnaris Canter


“Sporangium broadly ovoid, with its longer axis parallel to the host wall; wall smooth, colorless with a conical protuberance on its upper surface; large sporangia 25–63 µm broad by 16–27 µm high; dwarf sporangia 8–15 µm broad by 9–13 µm high; dehiscing by two broad, lateral, oppositely placed pores, very rarely one apical pore. Rhizoidal system branched, arising from an indistinct main axis. Zoospores spherical, 2.6 µm diameter, uniflagellate, with a conspicuous anterior oil globule and a darker area laterally; emerging singly, movement even gliding. Resting spore sexually formed, epibiotic, spherical, 10–20 µm diameter, wall up to 3 µm thick, colorless, smooth, with columnar bands of refractive material; central contents granular, germination not observed. Male thallus epibiotic, spherical, connected to the female by a narrow cylindrical conjugation tube 2 µm diameter and up to 38 µm long” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “parasitic on Spirotaenia condensata, Great Britain” (Sparrow 1960).
NOTE — “Canter noted that the fungus seemed specific to *Spirotaenia* since other associated members of the *Conjugatae* were not attacked. Her observations on sexuality in this species give further support to the idea, first proposed by her in the case of *Zygorhizidium*, that the nature of the thallus produced by the zoospores (whether asexual or sexual) is determined by the environmental conditions and not by any inherent difference in the swarvers that develop upon germination of the resting spores” (Sparrow 1960). Type material not designated; Canter’s illustration (text figs. 3, 4, pl. 11, figs. 3–5, Trans. Brit. Mycol. Soc. 31: 135. 1947) of *R. columnaris* Canter is accepted as the type.

*Rhizophydium ephippium* Canter


“SPORANGIUM saddle shaped, 8 µm broad by 4 µm high to 15 µm broad by 5 µm high, containing 8 to 30 zoospores. RHIZOIDAL SYSTEM intramatrical, composed of one or a few short threads. ZOOSPORES spherical, 2 µm diameter, uniguttulate, posteriorly uniflagellate, emerging singly after dissolution of two oppositely directed lateral papillae. RESTING SPORE oval to subspherical, 5 µm broad by 3.7 µm high to 7 µm broad by 5 µm high, arising from fusion of the content of a small male with a larger female thallus, the former remaining as an appendage to the mature resting spore; wall smooth, colorless, beset with a narrow central projecting band of wall material, content consisting of two large refractive globules, germination unknown” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on *Stylosphaeridium stipitatum*, Great Britain” (Sparrow 1960).

NOTE — “While the sporangial stage undoubtedly resembles that of *Rhizophydium transversum*, this species differs in having the resting spore sexually formed. The saddle-shaped sporangium perched on the apex of the host cell is a striking object” (Sparrow 1960). Type material not designated; Canter’s illustration (figs. 5, 6, Ann. Bot. London 14: 270, 271. 1950) of *R. ephippium* Canter is accepted as the type.

*Rhizophydium goniosporum* Scherff.

Arch. Protistenk. 53: 20, pl. 1, figs. 40–42, pl. 2, figs. 43–50. 1925.

“SPORANGIUM sessile, broadly citriform or broadly ovoid, occasionally irregular, with a slightly flattened upper surface, its long axis parallel with that of the host filament, 5–11 µm high by 7–16 µm broad, with two lateral opposite papillae (rarely one), wall thin, smooth, colorless. RHIZOIDAL SYSTEM delicate, branched. ZOOSPORES ovoid or somewhat rod-like, 3–6 µm long by 2–3 µm in diameter, with an eccentric colorless globule and a short
flagellum, escaping amoeboidly through one or two pores formed upon the deliquescence of the papillae, movement a brisk gliding. RESTING SPORE sessile, polyhedral, six- to eight-cornered in optical section, the corners often somewhat protruding, 6–7 µm in breadth, wall thick, colorless, contents with few to many refractive globules, endobiotic part consisting of a central, possibly branched, axis, germination not observed; companion cells one or two, spherical or ovoid, 3 µm in diameter, wall thin, smooth, colorless, attached directly to the receptive thallus (resting spore), into which its contents are discharged and from which after fertilization it is separated by a cross wall” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Tribonema bombycina, Zygnema sp.; Hungary, Great Britain, United States” (Sparrow 1960).

NOTE — “As pointed out by Scherffel, the sporangia of this species are like those of Rhizophydium transversum, which occurs on members of the Volvocales, and of Rhizophydium irregulare, found on Hantzschia and other diatoms. But the angular resting spore, formed after a sexual process, and the host distinguish R. goniosporum from both these species. Scherffel noted that the parasite formed rose-red products of decomposition in the host cell” (Sparrow 1960). Type material not designated; Scherffel’s illustration (pl. 1, figs. 40–42, pl. 2, figs. 43–50, Arch. Protistenk. 53: 20. 1925) of R. goniosporum Scherff. is accepted as the type.

Rhizophydium horizontale R.A. Paterson


“Sporangium sessile, ovoid, smooth-walled, 11–15 µm long by 7–10 µm diameter, usually procumbent, with its long axis parallel with the surface of the host cell. RHIZOIDAL SYSTEM unbranched or sparingly branched. ZOOSPORES numerous, spherical, 3–3.5 µm diameter, with a single eccentric refractive globule, 1.5 µm diameter, and a posterior flagellum 13 µm long, escaping through a single apical pore. RESTING SPORE not observed” (Paterson 1958).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Stephanodiscus sp. in plankton; Michigan, USA” (Paterson 1958).

NOTE — Type material not designated; Paterson’s illustration (fig. 1, H–K, Mycologia 50: 87. 1958) of R. horizontale R.A. Paterson is accepted as the type.

Rhizophydium irregulare (De. Wild.) A. Fisch. PLATE 32, FIGS. 16–20


“Sporangium citriform or ovoid, 1 1–14.5 µm broad by 8–12 µm high, the
longer axis parallel with that of the host cell, with two opposite lateral papillae (sometimes only one), 3.2–3.8 µm broad by 1.2–1.5 µm high, wall thin or somewhat thickened, smooth, colorless, resting on a short 1.2–1.5 µm thick stalk, or sessile. **HAUSTORIUM** a continuation of the sporangial stalk, tubular, unbranched, 2.7–4.0 µm diameter. **ZOOSPORES** spherical, 3.5 µm diameter, with an eccentric, colorless globule and an 8 µm long flagellum, escaping upon the dissolution of the tip of one (always?) of the discharge papillae. **RESTING SPORE** not known with certainty” (Sparrow 1960).

**HABITAT/substrate/location** — Aquatic; “parasitic on small diatoms, *Hantzschia amphioxys, Gomphonema constrictum*; Belgium, Hungary, Austria” (Sparrow 1960).

**Note** — “Friedmann (1952) has made the most complete study of this species and has seen the previously unobserved haustorium and zoospore discharge” (Sparrow 1960). Type material not designated; Friedmann’s illustration (fig. 2, o-r, Oesterr. Bot. Z. 99: 184. 1952) of *R. irregulare* is accepted as the lectotype.

**Rhizophydium manoense** Sparrow


“**Sporangium** sessile, broadly pyriform, transversely placed, the lower surface somewhat concave and clasping the host cell, 7 µm high by 12–17 µm long including the single prominent 3–4 by 4–5 µm discharge papilla at the narrower end of the body. **Rhizoidal system** consisting of a delicate, tapering unbranched (?) thread. **Zoospores** spherical, 1.5–2 µm diameter with a minute colorless globule and single flagellum, escaping upon deliquescence of the papilla and forming a temporary motionless mass before assuming individual movement. **Resting spore** not observed” (Sparrow 1965).

**Habitat/substrate/location** — Aquatic; “parasitic on (?) *Cocconeis* sp.; Honolulu, Hawaii” (Sparrow 1965).

**Note** — Type material not designated; Sparrow’s illustration (figs. 1–7, *Mycopathol. Mycol. Appl.* 25: 125. 1965) of *R. manoense* Sparrow is accepted as the type.

**Rhizophydium oblongum** Canter


“**Sporangium** oblong to oval, 3–7 µm wide and 7–24 µm long, or subspherical 4.5–9 µm wide and 5.5–9.5 µm long; on dehiscence, sporangium wall dissolves at one or both ends and owing to its delicate nature becomes invisible. **Rhizoidal system** consisting of a minute main axis bearing a tuft of short rod-like branches. **Zoospores** 2.5 µm diameter (20–60 in a
The sporangium is oval when swimming, with a flagellum and oil globule anterior but flagellum directed backwards. **RESTING SPORE** oval to subspherical, 5–9 µm long and 4–6 µm broad, with a thick, smooth wall and containing several small globules; resting spore formation preceded by fusion of unequal gametes; male attached directly or by means of a conjugation tube (up to 5 µm long) to the female; germination unknown” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “parasitic on *Dinobryon* spp. in plankton; Great Britain, Italy, Sweden” (Sparrow 1960).

**NOTE** — “The parasite rests between the lorica and protoplast of the host, and a feebly developed rhizoidal system penetrates the latter. The algal cell is at first only slightly affected, since its flagella continue to move even when a large sporangium of the parasite is maturing on it. Further observations on the structure of the zoospore are needed. If, as Canter states, confirmation is obtained of the sub-apically attached, posteriorly directed flagellum, transfer to another genus may be necessary. It is possible that many other “posteriorly uniflagellate” chytrids have a similar attachment of their flagellum” (Sparrow 1960). Type material not designated; Canter’s illustration (fig. 3, and pl. 5, fig. 4, Trans. Brit. Mycol. Soc. 37: 117. 1954) of *R. oblongum* Canter is accepted as the type.

**Rhizophydium transversum** (A. Br.) Rabenh.

Flora Europaea algarum 3: 281. 1868.


“**SPORANGIUM** sessile, at first spherical, becoming broadly ellipsoidal or fusiform, the apices strongly papillate, slightly curved at maturity, up to 16.6 µm diameter, with its long axis perpendicular to its point of insertion on the algal cell. **HAUSTORIUM** composed of a slender, unbranched rhizoid. **ZOOSPORES** ellipsoidal, with a colorless basal globule, apparently emerging through pores formed upon the deliquescence of the two opposite papillae (rarely, also, a third, apical, papilla). **RESTING SPORE** sessile, subspherical or spherical, outer wall smooth, yellowish, inner wall colorless, contents one or two large globules, upon germination forming zoospores which escape through an apical pore” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “on actively motile cells of *Chlamydomonas pulvisculus*, also possibly on *C. obtusa*, *Gonium terras*, *Chlamydomonas pulvisculus*, *Hormiscia* sp., *Chlamydomonas dillii*, pine pollen; Germany, Belgium, France, Egypt, South Africa” (Sparrow 1960).

**NOTE** — “Braun noted that the swarmers were attacked by the chytrid zoospores, up to twelve parasites being formed on a single host cell. Eventually infected swarmers came to rest and were killed by the fungus.
Dangeard (1900–1901) observed the penetration of the alga by the slender germ tube of the fungus, but was unable to determine whether or not this tube remained unbranched during the subsequent development of the parasite. Eventually the contents of the alga were reduced to an amorphous reddish mass. Although the resting spores noted by Dangeard were said to be spherical, in the figures they appear rather subspherical. *Rhizophydium goniosporum*, which has similar sporangia to this species, differs in having polygonal resting spores, sexually formed” (Sparrow 1960). Type material not designated; Braun’s illustration (pl. 4, figs. 1–6, Abhandl. Berlin Akad. 1855: 44. 1856) of *C. transversum* A. Br. is accepted as the type of *R. transversum* (A. Br.) Rabenh.
PLATE 32

Fig. 1. Mature sporangium, parasitic on *Spirotaenia condensata*.
Fig. 2. Zoospore release.
Fig. 3. Male and female thalli prior to sexual resting spore formation.
Fig. 4. Resting spore with a thick wall of columnar bands.
Figs. 5–11. *Rhizophydium ephippium* Canter; after Canter (1950b).
Fig. 5. Motile zoospore.
Fig. 6. Encysted zoospore, parasitic on *Stylosphaeridium stipitatum*.
Fig. 7. Immature sporangium.
Fig. 8. Mature sporangium.
Fig. 9. Zoospore release.
Fig. 10. Sexual formation of the resting spore.
Fig. 11. Resting spore, with a narrow projecting band of wall material.
Fig. 12. Immature sporangium, parasitic on *Tribonema bombycina*.
Fig. 13. Mature sporangia, with one papilla (L) or two lateral papillae (R).
Fig. 14. Zoospore release.
Fig. 15. Sexual production of resting spores.
Fig. 16. Motile zoospores, and encysted zoospore parasitic on *Stephanodiscus* sp.
Fig. 17. Germling.
Fig. 18. Immature sporangia.
Fig. 19. Mature sporangium.
Fig. 20. Zoospore release.
Figs. 21–24. *Rhizophydium irregulare* De. Wild.; figs. 21-23 after Friedmann (1952), fig. 24 after Scherffel (1925).
Fig. 21. Mature sporangium, parasitic on *Gomphonema constrictum*.
Fig. 22. Zoospore release.
Fig. 23. Empty sporangium.
Fig. 24. Resting spores on *Hantzschia amphioxys*.

Scale bar values in micrometers
PLATE 33
Fig. 1. Motile zoospores.
Fig. 2. Encysted zoospores, parasitic on the diatom (?) *Cocconeis*.
Fig. 3. Immature sporangium with a single papilla.
Fig. 4. Mature sporangium.
Fig. 5. Zoospore discharge as a motionless mass.
Fig. 6. Empty sporangium.
Fig. 7. Motile zoospores.
Fig. 8. Encysted zoospore, parasitic on *Dinobryon* sp.
Fig. 9. Germling.
Fig. 10. Immature and mature sporangia.
Fig. 11. Zoospore release, in which the sporangium dissolves at one or both ends, and remains of the delicate wall become invisible.
Fig. 12. Sexual production of the resting spore.
Fig. 13. Immature sporangia, parasitic on *Chlamydomonas pulvisculus*.
Fig. 14. Mature sporangium with two opposite, lateral papillae.
Fig. 15. Zoospore release.
Fig. 16. Resting spores.

Scale bar values in micrometers
Section 7: Key. Sporangium predominantly cylindrical, fusiform, broadly or narrowly ellipsoidal, the long axis frequently at a right angle or slightly inclined to that of the substrate.

1a. Sporangium fusiform ................................................................. **R. fusus**
1b. Sporangium cylindrical, obpyriform, or pyriform ................................. 2

2a (1b). Sporangium cylindrical ............................................................. 3
2b. Sporangium obpyriform or pyriform ................................................. 4

3a (2a). Sporangium large, 48–54 µm high by 17–22 µm diameter ............ **R. messanense**
3b. Sporangium small, 4.5–15.5 µm high by 2.5–5 µm diameter ........... **R. hyalobri**

4a (2b). Sporangial wall smooth ........................................................... **R. anatropum**
4b. Sporangial wall covered by warts .................................................. **R. verrucosum**

Section 7: Species descriptions.

**Rhizophydium anatropum** (A. Br.) Karling


*Chytridium anatropum* A. Br., Flora (N.S.), 14: 599. 1856; Monatsber. Berlin Akad. 588. 1856.

“SPORANGIUM sessile, procumbent or upright, irregular, broadly pyriform, ovoid, asymmetrical, strongly arched or reflexed (anatropous), rarely symmetrical, attached laterally near the narrower end to the algal cell, 5–14 µm wide by 15–33 µm (rarely 50 µm) long, wall thin, smooth, colorless. HAUSTORIUM very small, rounded or short-peg-like. ZOOSPORES elongate, 5 µm long by 2 µm wide, with a minute, inconspicuous globule and flagellum, discharged through a single pore (rarely two) formed at either of the apices and remaining in a loose cluster at the orifice before creeping away, movement strongly amoeboid, the body forming pronounced pseudopodia, swimming motion not observed. RESTING SPORE spherical or ovoid, with a smooth thick faintly brownish wall, 10 µm diameter, contents with globules, haustorium like that of the sporangium, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on *Chaetophora elegans*, *Oscillatoria* sp., *Stigeoclonium* sp. *Tribonema* sp; Germany, United States, Hungary” (Sparrow 1960).

NOTE — Type material not designated; Karling’s illustration (pl. 49, figs 4–8, Mycologia 25 : 516. 1933) of *P. anatropum* (A. Br.) Rabenh. is designated as the lectotype of *R. anatropum* (A. Br.) Karling.
**Rhizophydium fusus** (Zopf) A. Fisch.


**Rhizidium fusus** Zopf, Nova Acta Acad. Leop. -Carol. 47: 199, pl. 18, figs. 9–12. 1884.

“**Sporangium** sessile or borne on a short stalk, narrowly to broadly fusiform, usually slightly tilted, 10.4–20 µm high by 3–8 µm diameter in mid-region, wall thin, smooth, colorless. **Rhizoidal system** extensive, much branched, monophagous or polyphagous, arising from a relatively stout central axis. **Zoospores** spherical, 2–2.5 µm diameter with a colorless globule and a flagellum, emerging through a small apical, often slightly protruding pore. **Resting spore** not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “parasitic on *Synedra* sp., *Melosira* sp., *Cymbella* sp., *Gomphonema constrictum*, *Surirella* sp., *Pinnularia* sp.; Germany, Belgium, France, Hungary, United States, Japan, Great Britain, Sarawak, Sweden, Latvia” (Sparrow 1960).

**Note** — “Doubt exists as to whether or not Zopf’s (1884) species is identical with Braun’s *Chytridium lagenula* on *Melosira* (Braun 1856a). Scherffel (1926) believes that two distinct fungi were grouped under this name by Braun, one occurring on *Melosira* and the other on *Tribonema*. Since the rhizoids were not observed by Braun in either form, it is difficult to attempt an analysis of his species. Zopf’s specific name is preferred for the parasite of diatoms, because it applies to a more completely known organism. **Rhizophydium fusus** is parasitic and, as Zopf noted, consumes the nucleus and plasma of the host cells, leaving only an olive-green or brownish residue of chloroplast material. On *Melosira* the rhizoids may ramify through several (five to six) cells of the host. The sporangia described by Rohde and Skuja (Skuja 1948) are the largest yet reported for the species; they are 15–25 µm long by 5–9 µm broad. Cejp (1933) has described as *Rhizophydium lagenula* (Braun) Fischer an organism on *Mougeotia* that agrees with *R. fusus* in the fusiform shape of the sporangium, but which is larger (30 µm or more long by 8-10 µm in diameter) and which forms epibiotic spherical thick-walled resting spores, 25 µm in diameter. He considers *R. lagenula* to be identical with *R. fusus*” (Sparrow 1960). Type material not designated; Zopf’s illustration (pl. 18, figs. 9–12, Nova Acta Acad. Leop.-Carol. 47: 199, 1884) of *Rhizidium fusus* Zopf is accepted as the type of *Rhizophydium fusus* (Zopf) A. Fisch.

**Rhizophydium hyalobryonis** Canter

PLATE 34, FIGS. 12–16

Ann. Bot. (Oxford) 15: 148, figs. 12, 13. 1951 (as *hyalobryonis*).

“**Sporangium** cylindrical, 4.5 µm high by 2.5 µm broad to 15.5 µm high by 5.0 µm broad, usually with its long axis set at right angles to that of the host envelope; on dehiscence the apex of the sporangium dissolves and from 6 to
18 zoospores emerge. Rhizoidal system branched. Zoospores spherical, 2.5–3 µm diameter with a refractive globule and single posterior flagellum. Resting spore cylindrical, oval, or bean-shaped, 4.5 µm high by 3 µm broad to 9.5 µm high by 4.5 µm broad; wall, smooth, colorless, content composed of several small refractive globules; resting spore formed after fusion of the content of a small male 2.3 µm diameter, with a larger female cell; the empty male cell remains adherent to the mature resting spore; germination not observed” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “parasitic on the planktonic alga Hyalobryon polymorphum; Great Britain” (Sparrow 1960).

Note — Type material not designated; Canter’s illustration (text figs. 12, 13, Ann. Bot. London (N.S.) 15: 147, 149. 1951) of R. hyalobryonis Canter is accepted as the type.

Rhizophydium messanense Morini

Malpighia 10: 79, pl. 3, figs. 1–4. 1896.

Phlyctochytrium messanense (Morini) Minden, Kryptogamenfl. Mark Brandenburg 5: 339. 1911 (1915).

“Sporangium narrowly ellipsoidal to cylindrical, 48–54 µm high by 17–22 µm diameter, wall thin, smooth, colorless. Rhizoidal system composed of a stout main axis which is slightly expanded just beneath the host wall, and branched rhizoids. Zoospores spherical, pale rose-colored, 3.25–4 µm diameter, with an oil globule, escaping through a wide apical pore. Resting spore spherical, 21–31 µm diameter, with a thick smooth brownish-red outer wall, forming zoospores upon germination‖ (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; in Cladophora, Italy.

Note — “The slight inflation of the sub-sporangial part of the main rhizoidal axis is not of sufficient import to warrant transference of the species to Phlyctochytrium. From the figure, the resting spore upon germination appears to have cracked open and emitted the spores through a wide aperture” (Sparrow 1960). Type material not designated; Morini’s illustration (pl. 3, figs. 1–4, Malpighia 10: 79. 1896) of R. messanense Morini is accepted as the type.

Rhizophydium verrucosum Cejp

Plate 35, Figs. 1–3

Bull. Int. Acad. Sci. Boheme 42 (3): 4, pl. 1, figs. 9, 10, pl. 2, fig. 2. 1933 (separate).

“Sporangium sessile, narrowly pyriform or ovoid, almost citriform, 14–22 µm wide by 32–41 µm high, wall stout, its outer surface densely covered by warts, with a prolonged slightly curved smooth apiculus (papilla?) 12 µm long by 7 µm in diameter. Rhizoidal system delicate, composed of short branches. Zoospores spherical, 2–3 µm diameter, with a single globule, uniflagellate, undergoing a period of rest (outside?) before swarming.
RESTING SPORE subspherical, rarely irregular, 25–30 µm diameter, with a thick wall covered with coarse warts, contents with numerous oil globules, rhizoids not observed, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; on Closterium sp., Germany.

NOTE — Type material not designated; Cejp’s illustration (pl. 1, figs. 9, 10, pl. 2, fig. 2, Bull. Int. Acad. Sci. Boheme 42: 4. 1933) of R. verrucosum Cejp is accepted as the type.
PLATE 34
Figs. 1–7. Rhizophydi um anatropum (A. Br.) Karling; after Couch (1935).
Fig. 1. Encysted zoospore, parasitic on Stigeoclonium sp.
Fig. 2. Immature sporangium.
Fig. 3. Mature sporangia.
Fig. 4. Mature sporangium with a single apical papilla.
Fig. 5. Zoospore release.
Fig. 6. Empty sporangium.
Fig. 7. Resting spore.
Figs. 8–11. Rhizophydi um fusus (Zopf) A. Fisch.; fig. 8 after Zopf (1884), fig. 9 after Sparrow (1932) and Skuja (1948), figs. 10 and 11 after Skuja (1948).
Fig. 8. Immature sporangia, parasitic on Melosira varians.
Fig. 9. Mature sporangia.
Fig. 10. Zoospore release.
Fig. 11. Empty sporangium.
Figs. 12–16. Rhizophydi um hyalobri Canter; after Canter (1951).
Fig. 12. Encysted zoospore, parasitic on Hyalobryon mucicola.
Fig. 13. Immature sporangia.
Fig. 14. Zoospore release.
Fig. 15. Empty sporangium.
Fig. 16. Sexual formation of the resting spore.
Figs. 17–20. Rhizophydi um messanense Morini; after Morini (1896).
Fig. 17. Immature sporangium, parasitic on Cladophora sp.
Fig. 18. Mature sporangium.
Fig. 19. Zoospore release through a wide apical pore.
Fig. 20. Resting spore.

Scale bar values in micrometers
PLATE 35

Figs. 1–3. *Rhizophydium verrucosum* Cejp; after Cejp (1933).
Fig. 1. Immature sporangium with a prolonged, smooth apiculus, parasitic on *Closterium* sp.
Fig. 2. Mature sporangia.
Fig. 3. Resting spores.

Scale bar values in micrometers
Incompletely known species of *Rhizophydium*

The following *Rhizophydium* species (their names preceded by a question mark) are taxa for which some aspect of thallus morphology is unknown. Because they are incompletely described, their inclusion in *Rhizophydium* is presently uncertain.

? *Rhizophydium asterosporum* Scherff. 

Arch. Protistenk. 53: 17, pl. 1, figs. 30–39. 1925.

“SPORANGIUM sessile, short cylindrical, pouch-like, or somewhat tubular, slightly curved and attenuated at one end, its long axis parallel or nearly so with that of the host filament, wall smooth, thin, colorless. RHIZOIDAL SYSTEM not observed. ZOOSPORES (quiescent) spherical, with a small colorless globule, escaping through a broad pore formed at the narrower end of the sporangium. RESTING SPORE somewhat elongate and irregularly starlike, 12 µm long by 6–9 µm high, the outer surface of the thickened wall bearing prominent blunt conical solid refractive outgrowths 3 µm high by 3 µm broad at the base, contents with a few large or numerous smaller colorless oil globules, rhizoids (seen once) numerous, delicate; companion cell spherical, smooth-walled, 2 µm in diameter, directly attached at various points to the resting spore‖ (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on *Tribonema bombycina*; Hungary” (Sparrow 1960).

NOTE — “The resting spore, as Scherffel points out, is shaped very much like the sporangium of the incompletely known *Chytridium cornutum* Braun” (Sparrow 1960). Further observations on the nature of the rhizoidal system are needed to reliably place this fungus in *Rhizophydium*. Type material not designated; Scherffel’s illustration (pl. 1, figs. 30–39, Arch. Protistenk. 53: 17. 1925) of *R. asterosporum* Scherff. is accepted as the type.

? *Rhizophydium barkerianum* (Archer) Rabenhorst

Flora Europaea algarum 3: 281. 1868.

*Chytridium barkerianum* Archer, Quart. J. Micro. Sci. 7: 89. 1867.

“SPORANGIUM sessile, strongly flattened, with a concave upper surface from the center of which arises a slender stalk terminating in a small swelling, deeply three- to four-lobed, the lobes of equal size, with rounded apices and radiating in one plane. RHIZOIDAL SYSTEM, where observed, rootlike. ZOOSPORES escaping from the open ends of the lobes. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; on *Zygnema* sp., Ireland.

NOTE — “This curious species, said by its author to be related to *Rhizophydium cornutum* (Braun) Rabenhorst and *R. transversum*, is of
doubtful validity. The peculiar central stalk terminating in a knob is difficult to interpret unless it be the cyst of the zoospor. If so, the fungus would have a type of development unlike *Rhizophydium*" (Sparrow 1960). No illustration was provided and no type designated. If this organism became known, and illustrations provided at that time, a neotype should be designated.

**? Rhizophydium blyttiomycerum** S.N. Dasgupta & R. John  

“*Sporangium* sessile, pyriform or fusoid, 2–22 µm high by 12–14 µm wide, wall single, thin, smooth, hyaline, Rhizoidal system composed of the zoospore case (cyst?) as a persistent, small, knob-like structure at the basal axial end acting as a haustorium; rhizoid absent. Zoospores and their mode of discharge not observed; zoospores discharged through a pore formed by the dissolution of the apical end, 5.5–7.5 µm wide. Resting spore absent” (Dasgupta and John 1988).

**Habitat/Substrate/Location** — Aquatic; “parasitic both on the sporangium of *Blyttiomycetes spinosus* as well as on the zygospores of *Spirogyra* species on which *B. spinosus* is parasitic; India” (Dasgupta and John 1988).

**Note** — This species is questionable, as the endobiotic part is described as the zoospore cyst acting as a haustorium, and zoospores were not observed. Further observations will be necessary to place this fungus. Type material not designated; Dasgupta and John’s illustration (fig. 24, Bot. Surv. India 30: 18. 1988) of *R. blyttiomycerum* S.N. Dasgupta & R. John is accepted as the type.

**? Rhizophydium caudatum** (Reinsch) De Wild.  
*Sphaerostylium caudatum* (Reinsch) Berlese and de Toni, in Saccardo, Syll. fungorum 7: 309. 1888.

**Note** — “Like *Rhizophydium ampullaceum*, but larger (12–13 µm in diameter) and with thicker walls. On *Schizosiphon kerguelenensis*, Kerguelen Islands” (Sparrow 1960). No illustration was provided and no type designated. If this organism became known, and illustrations provided at that time, a neotype should be designated.

**? Rhizophydium chrysopyxidis** Scherff.  
Arch. Protistenk. 54: 174, pl. 9, fig. 12. 1926.

“*Sporangium* sessile, ovoid, 8 µm long by 6 µm diameter, with a prolonged apical beak and a narrow base, wall thin, smooth, colorless. Rhizoidal system consisting of a short fairly thick unbranched tube which terminates in a knob-shaped swelling. Zoospores not observed. Resting spore not
observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “attached to the mid-region or under part of the lorica of Chrysopyxis sp.; Hungary” (Sparrow 1960).

NOTE — Observations on the zoospore will be necessary before confirming this as a species of Rhizophydium. Type material not designated; Scherffel’s illustration (pl. 9, fig. 12, Arch. Protistenk. 54: 174. 1926) of R. chrysopyxidis Scherff. is accepted as the type.

? Rhizophydium coleochaetes (Nowak.) A. Fisch. PLATE 36, FIGS. 9–13
Chytridium coleochaetes Nowak., in Cohn, Beitr. Biol. Pflanzen 2: 80, pl. 4, figs. 5–10. 1877.

“Sporangium resting on the surface of the egg of the host but elongating within, filling the trichogyne and extending and expanding beyond it, terminating distally in a short tubular portion with a blunt rounded apex, the whole body thus being unequally spindle-shaped, up to 125 µm in length (average 80 µm by 12 µm) in greatest diameter, wall thin, smooth, colorless. Rhizoidal system not observed. Zoospores small, spherical, 2 µm in diameter, with a minute colorless refractive globule and a flagellum, emerging through a pore formed at the apex of the sporangium. Resting spore not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on oogonia of Coleochaete pulvinata, Germany” (Sparrow 1960).

NOTE — “The zoospore gains access to the oogonium by swimming down the open trichogyne. The developing fungi, of which as many as four attack a single egg, then consume the entire contents of the ooosphere, leaving only a small amount of reddish-brown residue. Whether or not this is a species of Olpidium, as Schroeter (1885) has supposed, depends upon the interpretation of the position of the sporangium and the possible absence of rhizoids. Fischer considers the body of the fungus to be extramatrical in the already opened oogonium. The apparent lack of a rhizoidal system even in nearly empty oogonia, however, appears to strengthen Schroeter’s interpretation. New observations will be necessary before a final generic disposition can be made” (Sparrow 1960). Type material not designated; Nowakowski’s illustration (pl. 4, figs. 5–10, Beitr. Biol. Pflanzen 2: 80. 1876) of C. coleochaetes Nowak. is accepted as the type of R. coleochaetes (Nowak.) A. Fisch.
? *Rhizophydium conchiforme* S.N. Dasgupta & R. John  
**Plate 36, Figs. 14–17**  

“SPORANGIUM inclined, occasionally erect, conchiform, rarely fusiform, 18–30 µm high by 13–18 µm wide, wall smooth, hyaline apical and sharply curved, apiculus pointed, base gradually tapering, terminating in a papilla of variable size; apiculus deliquesces forming a wide pore. HAUSTRORIUM an endobiotic apophysis subtending the sporangium, discoid, spherical, 10–13 µm diameter, or ellipsoidal, 9–12 µm high x 10–20 µm wide, wall thin, hyaline, isthmus wide, sporangium continuous with haustorium; rhizoid absent, rarely arising from the basal end of the haustorium, filamentous, of limited length, unbranched. ZOOSPORES spherical, 3–4 µm diameter with 1–2 µm diameter central globules, flagellum long; zoospores emerge individually through the pore, settle at the orifice, rarely discharge through a lateral slit as a compact slimy mass, remain motionless for 1–2 minutes. RESTING SPORE not observed” (Dasgupta and John 1988).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on vegetative cell of *Spirogyra* sp.; India” (Dasgupta and John 1988).

NOTE — The nature of the endobiotic part of this fungus may place it in *Phlyctochytrium*. Type material not designated; Dasgupta and John’s illustration (fig. 35, Bot. Surv. India 30: 27. 1988) of *R. conchiforme* S.N. Dasgupta & R. John is accepted as the type.

? *Rhizophydium dangeardii* Jacz.  
**Plate 36, Figs. 18–21**  
*Opredelitel gribov... I. Fikomitsety*, p. 38. 1931.  

“SPORANGIUM sessile on the prosporangium of the host, spherical or ovoid, wall smooth, colorless, two-layered, with a single small protruding papilla. RHIZOIDAL SYSTEM not observed. ZOOSPORES ovoid, about 1.5 µm long with a small globule and flagellum, escaping through a small sessile apical pore. RESTING SPORE borne like sporangium, spherical, thick-walled, the inner wall smooth, the outer wall irregularly undulate, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on the prosporangia of the chytrid *Saccomyces*; Russia” (Sparrow 1960).

NOTE — Type material not designated; Serbinow’s illustration (pl. 3, fig. 22, A–C, *Bot. Zap.* 24: 163. 1907) of *P. dangeardii* Serbinow is accepted as the type of *R. dangeardii* Jacz.
? Rhizophydium decipiens (A. Br.) A. Fisch. Plate 36, Figs. 22–26


Olpidiella decipiens (A. Br.) Lagerheim, Journ. de Botanique 2: 439. 1888.


“SPORANGIUM within the oogonium of the alga but resting on the surface of the ooplasm, spherical, subspherical, ovoid, or, if several sporangia in a cell, occasionally somewhat irregularly tubular, variable in size, up to 41 µm diameter, wall smooth, colorless, thin or slightly thickened, discharge tube broad, short-cylindrical or only slightly elevated, its apex protruding through the oogonial pore. RHIZOIDAL SYSTEM not observed. ZOOSPORES numerous, spherical or slightly elongate, 2.5–4 µm diameter, with a colorless, eccentric globule and a long flagellum, movement hopping or amoeboid. RESTING SPORE lying in the oogonium, apparently without rhizoids, ovoid or somewhat angular, rarely spheroidal, 18–36 by 20–39 µm, wall very thick (2–6 µm), colorless, often showing radial striations, contents evenly granular, without a large globule, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “in oogonia of Oedogonium spp.; Germany, France, European Russia, Asiatic Russia, Belgium, Costa Rica, Denmark, Hungary” (Sparrow 1960).

NOTE — “It is debatable whether or not this is a species of Rhizophydiwm, because no rhizoids have ever been observed” (Sparrow 1960). Type material not designated; Braun’s illustration (pl. 5, figs. 1–4, Abhandl. Berlin Akad. 1855: 54. 1856) of C. decipiens is accepted as the type of R. decipiens (A. Br.) A. Fisch.

? Rhizophydiwm dubium De. Wild. Plate 37, Figs. 1, 2


“SPORANGIUM sessile, spherical, with a protruding apical papilla, wall thin, smooth, colorless. RHIZOIDAL SYSTEM composed of branched, delicate rhizoids arising from a short central axis. ZOOSPORES not observed, apparently emerging through a wide pore formed upon the deliquescence of the papilla. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on filaments of Spirogyra; France” (Sparrow 1960).

NOTE — Observations on the zoospore will be necessary before confirming this as a species of Rhizophydiwm. Type material not designated; De Wildeman’s illustration (pl. 3, figs. 26–28, Ann. Soc. Belge Micro. (Méms.) 19: 113. 1895) of R. dubium De. Wild. is accepted as the type.
? *Rhizophydium epithemiae* Valkanov

Arch. Protistenk. 73: 362, fig. 2. 1931.

“Sporangium sessile, spherical, up to 21 µm diameter, colorless, with a prominent thick-walled subapical wart-like protrusion, wall otherwise thin, smooth. *Rhizoidal* system composed of fairly stout, short, branched rhizoids arising from a short main axis. Zoospores not observed, apparently emerging through a fairly large lateral pore. Resting spore not observed” (Sparrow 1960).

Habitat/Substrate/Location — Habitat not known; “parasitic on *Epithemia zebra*; Bulgaria” (Sparrow 1960).

Note — “The curious wart-like protrusion may possibly be the cyst of the infecting zoospore which, as in *Chytridium schenkii*, has persisted. Observations on the zoospore will be necessary before confirming this as a species of *Rhizophydium*” (Sparrow 1960). Type material not designated; Valkanov’s illustration (fig. 2, Arch. Protistenk. 73: 362. 1931) of *R. epithemiae* Valkanov is accepted as the type.

? *Rhizophydium fallax* Scherff.

Arch. Protistenk. 53: 30, pl. 2, figs. 60–62. 1925.

“Sporangium sessile, spherical, variable in size, wall smooth, colorless, fairly thick. Rhizoidal system not distinctly observed, being surrounded by a large pale reddish-brown peg-like thickening of the host wall. Zoospores narrowly ovoid, with a colorless lateral oil globule and a short slowly moving posterior flagellum attached to the narrower end of the body, emerging individually through one (or more?) minute, needle-like scarcely perceptible lateral pore, movement gliding or amoeboid, never hopping. Resting spore epibiotic, sessile, spherical, 8–10 µm diameter, with a smooth double wall 1 µm thick, contents with a large (8 µm diameter) colorless eccentric globule or with from two to three globules, endobiotic part like that of the sporangium, germination not observed; companion cells one or two, smooth-walled, 3 µm diameter, directly attached to the receptive thallus (resting spore), wall at first thin, later thickening” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “on *Mougeotia* sp., Hungary” (Sparrow 1960).

Note — “Further observations on the endobiotic system will be necessary to determine if this is a species of *Rhizophydium*” (Sparrow 1960). Type material not designated; Scherff’s illustration (pl. 2, figs. 60–62, Arch. Protistenk. 53: 30. 1925) of *R. fallax* Scherff. is accepted as the type.
? **Rhizophydium gelatinosum** Lind  

“Sporangium sessile, spherical, 20–30 µm diameter, with a short stalk-like base, wall thin, smooth, colorless, surrounded by a gelatinous hull about 3 µm thick. Rhizoidal system not observed. Zoospores not observed, apparently escaping through eight sessile pores 4–6 µm in diameter formed on the upper surface of the sporangium. Resting spore not observed” (Sparrow 1960).

**Habitat/substrate/location** — Aquatic; “on Acrosiphonia (Cladophora) pallida; Sweden” (Sparrow 1960).

**Note** — “The organism is remarkable for the number of sporangial pores formed and for the thick gelatinous sheath which surrounds the sporangia. That the structure is fungoid at all is doubtful” (Sparrow 1960). Type material not designated; Lind’s illustration (3 figs., *Ann. Mycol.* 3: 427. 1905) of *R. gelatinosum* Lind is accepted as the type.

? **Rhizophydium gonapodyanum** S.N. Dasgupta & R. John  
*PLATE 37, FIG. 7*  


“Sporangium sessile, ovoid, distal end conical, 22–33 µm high by 13 µm broad, thin-walled, hyaline, smooth; discharge pore 10 in diameter, formed by the dissolution of the apical end; empty sporangium exhibits wide open neck at the distal end, wall persistent, not deformed. Haustorium directly beneath host cell wall at the basal axial end of the sporangium, knob-shaped, 2 µm diameter; rhizoid absent. Zoospores and their mode of discharge not observed. Resting spore elliptical, 16 µm high by 19 µm wide, double-walled, outer wall thick, inner wall thin, both smooth, hyaline; male thallus small, spherical, persists adhered to the body of the resting spore; germination of resting spore not observed” (Dasgupta and John 1988).

**Habitat/substrate/location** — Aquatic; “parasitic on the sporangium of Gonapodya polymorpha; India” (Dasgupta and John 1988).

**Note** — Dasgupta and John (1988) described *R. gonapodyanum* and *R. stellatum*, both parasitic on *Gonapodya polymorpha* and from the same location. The range of sporangial size and shape, and size, shape, and development of the resting spore, overlaps between the two taxa. The outer wall of the resting spore of *R. gonapodyanum* was smooth, while that of *R. stellatum* was verrucose. The otherwise similar nature of these two taxa warrants synonymy. Further observations of the rhizoidal system and zoospores are necessary to place this organism. Type material not designated; Dasgupta and John’s illustration (fig. 23, *Bull. Bot. Surv. India* 30: 18. 1988) of *R. gonapodyanum* S.N. Dasgupta & R. John is accepted as the type.
? *Rhizophydium hormidii* Skvortzow  
Arch. Protistenk. 51: 430, fig. 5. 1925.

“*SPORANGIUM* narrowly clavate or curved and fusiform, 5.7–7 μm long by 1.5–2 μm diameter, wall thin, smooth, colorless. *RHIZOIDAL SYSTEM* delicate. *ZOOSPORES* one or two, 1 μm diameter, with an oil droplet and a single flagellum. **RESTING SPORE** not observed” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “on *Hormidium flaccidum, Mougeotia viridis*; Manchuria” (Sparrow 1960).

**NOTE** — “Neither the description nor the figures are adequate enough to characterize this species properly” (Sparrow 1960). Type material not designated; Skvortzow’s illustration (fig. 5, Arch. Protistenk. 51: 429. 1925) of *R. hormidii* Skvortzow is accepted as the type.

Arch. Protistenk. 54: 201, pl. 9, fig. 64. 1926.

“*SPORANGIUM* borne at the tip of a narrowly clavate extramatrical stalk, imbedded, with the exception of its apex, in the gelatinous sheath of the host, ovoid, 23 μm high by 22 μm diameter, apex somewhat flattened, bearing a crown of prominent, solid, somewhat incurved, plain, long (2 μm) teeth (undetermined number), wall smooth, somewhat thick, colorless. **RHIZOIDAL SYSTEM** not observed. *ZOOSPORES* spherical, with an eccentric colorless globule and a single flagellum, discharge not seen. **RESTING SPORE** not observed” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “on *Hyalotheca dissiliens*; Hungary” (Sparrow 1960).

**NOTE** — “Further observations on the nature of the endobiotic system are needed before the species can be placed with confidence in *Rhizophydium*” (Sparrow 1960). Type material not designated; Scherffel’s illustration (pl. 9, fig. 64, Arch. Protistenk. 54: 201. 1926) of *R. hyalothecae* Scherff. is accepted as the type.

Arch. Protistenk. 54: 172, pl. 9, fig. 9. 1926.

“*SPORANGIUM* sessile, very broadly pyriform, with a prominent broad conical subapical protrusion (papilla?), 24 μm high by 21 μm diameter, the protrusion 10 μm diameter at the base by 5 μm high, wall thin, smooth, colorless. **RHIZOIDAL SYSTEM** not observed. *ZOOSPORES* not observed. **RESTING SPORE** not observed” (Sparrow 1960).

**HABITAT/SUBSTRATE/LOCATION** — Aquatic; “on the zoocyst of the vampyrellan *Leptophrys vorax*, Hungary” (Sparrow 1960).
N
OTE — “Differing from *Rhizophydium vampyrellae* (Dang.) Minden in having a pyriform rather than a spherical sporangium. Further observations on the nature of the endobiotic system and zoospores are needed before the species can be placed with confidence in *Rhizophydium*” (Sparrow 1960). Type material not designated; Scherffel’s illustration (pl. 9, fig. 9, Arch. Protistenk. 54: 172, 1926) of *R. leptophrydis* Scherff. is accepted as the type.

? *Rhizophydium marinum* De. Wild. PLATE 38, FIG. 3
“SPORANGIUM sessile, spherical, 7–15 µm diameter, wall smooth, colorless. RHIZOIDAL SYSTEM composed of a few rhizoids. ZOOSPORES not observed. RESTING SPORE not observed” (Sparrow 1960).
HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Melosira sp., in marine aquarium; Belgium” (Sparrow 1960).
NOTE — Further observations on the nature of the zoospores are needed before the species can be placed with confidence in *Rhizophydium*. No illustration was provided and no type designated. If this organism became known, and illustrations provided at that time, a neotype should be designated.

? *Rhizophydium minimum* (J. Schröt.) A Fisch. PLATE 38, FIG. 4
“SPORANGIUM sessile, spherical, mostly of the same size, about 6 µm in diameter. HAUSTORIUM short, spherical. ZOOSPORES not observed. RESTING SPORE not observed” (Sparrow 1960).
HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Mougeotia pleurocarpa; Germany” (Sparrow 1960).
NOTE — Further observations on the nature of the zoospores are needed before the species can be placed with confidence in *Rhizophydium*. No illustration was provided and no type designated. If this organism became known, and illustrations provided at that time, a neotype should be designated.

? *Rhizophydium multiporum* De. Wild. PLATE 38, FIGS. 8–10
“SPORANGIUM sessile, spherical, subspherical, or somewhat ovoid, 32–52 µm diameter, with three or more prominent somewhat tubular papillae about 4 µm in diameter, wall smooth. RHIZOIDAL SYSTEM not observed. ZOOSPORES
not observed. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on oogonia of Vaucheria sessilis; Belgium” (Sparrow 1960).

NOTE — “The fungus was never found on the vegetative filaments of the alga. It could not be induced to live on the pollen of Salix or Alnus. It is distinguishable from other multi-porous species of the genus by the prominent discharge tubes. Further observations on the nature of the rhizoidal system and zoospores are needed before the species can be placed with confidence in Rhizophydium” (Sparrow) 1960). Type material not designated; Wildeman’s illustration (fig. 2, Bull. Acad. Roy. Sci. Belgique 17: 286. 1931) of R. multiporum De. Wild. is accepted as the type.

? Rhizophydium oedogonii Richter

Bibliotheca Botan. 42: 12, fig. 6. 1897.

“SPORANGIUM sessile, somewhat irregularly ellipsoidal with outgrowths which result in a spherical-tetrahedral shape, at maturity bearing two lateral opposite spines, breadth from spine to spine 28 µm, thickness 14–17 µm; occurring in groups. RHIZOIDAL SYSTEM not observed. ZOOSPORES not observed. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on filaments of Oedogonium sp.; Greenland” (Sparrow 1960).

NOTE — Further observations on the nature of the rhizoidal system and zoospores are needed before the species can be reliably placed in Rhizophydium. Type material not designated; Richter’s illustration (fig. 6, Bibliotheca Botan. 42: 12. 1897) of R. oedogonii Richter is accepted as the type.

? Rhizophydium parasitans Scherff.

Arch. Protistenk. 53: 26, pl. 2, figs. 52–56. 1925.

“SPORANGIUM sessile, spherical, 8–10 µm diameter, with a thin smooth colorless wall. RHIZOIDAL SYSTEM not observed. ZOOSPORES spherical, mostly 4 µm diameter, with a colorless eccentric globule and a posterior flagellum about 24 µm long, emerging through a wide pore at the apex of the sporangium and either forming a compact motionless group at the orifice before dispersing or escaping individually and amoeboidly, in either case assuming suddenly a lively hopping movement. RESTING SPORE sessile, spherical, 6 µm diameter, with a thick smooth colorless wall, the outer margin dark and sharply defined, contents coarsely granular, with an eccentric colorless fat globule, 2 µm diameter, germination not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on sporangia of
Rhizophydium goniosporum parasitizing Tribonema bombycina, Hungary” (Sparrow 1960).

NOTE — “A curious condition of hyperparasitism is shown by this species. Scherffel noted that certain sporangia of Rhizophydium goniosporum had within them a spherical thick-walled resting structure or "cyst" of uncertain origin. The sporangia of R. parasitans were found only on sporangia of R. goniosporum which contained the remains of these cysts. Against the hypothesis proposed by Scherffel, namely, that the epibiotic sporangia of R. parasitans were in reality sporangia formed by germination of the endogenous cysts, was the fact that epibiotic resting spores also occurred on R. goniosporum. These were never found, however, on sporangia bearing the endogenous parasite. If these facts present the correct interpretation of the structures observed by Scherffel, then the sporangial stage of the species is parasitic on the encysted stage of an unidentified organism, possibly a monad, which in turn has parasitized the sporangium of R. goniosporum, which in turn has parasitized the alga Tribonema! The resting stage of R. parasitans, on the other hand, is directly parasitic on the sporangium of R. goniosporum, or—a possibility not mentioned by Scherffel—on the feeding or "vegetative" stage of the extraneous, cyst-forming organism. Further observations, particularly on the nature of the endobiotic system and on just what structure is penetrated by the zoospore of Rhizophydium parasitans, will be necessary before this fungus can be reliably placed” (Sparrow 1960). Type material not designated; Scherffel’s illustration (pl. 2, figs. 52–56, Arch. Protistenk. 53: 26. 1925) of R. parasitans Scherff. is accepted as the type.

? Rhizophydium persimilis Scherff.

Arch. Protistenk. 54: 199, pl. 9, figs. 60, 61. 1926 (as persimilis).

“SPORANGIUM sessile, broadly pyriform, with a broad flat-arched somewhat conical apex, 20–24 µm high by 15–16.6 µm diameter, wall rather thick, smooth, colorless. RHIZOIDAL SYSTEM not observed. ZOOSPORES and method of sporangial discharge not observed. RESTING SPORE (?) sessile, spherical, 8–12 µm diameter, with a somewhat thickened wall covered on its outer surface with small wart-like granulations, contents with a large eccentric oil globule, germination not observed; male cell spherical, 4–6 µm diameter, wall smooth, thick, attached laterally to the receptive thallus (resting spore)” (Sparrow 1960).

HABITAT/substrate/location — Aquatic; “on Tribonema bombycina; Hungary” (Sparrow 1960).

NOTE — “As Scherffel suggested, the resting spore is very much like that formed by Rhizophydium granulosporum. The sporangia of the latter are, however, distinctly smaller than those associated with the present species.
Endogenous cysts belonging to an unknown parasitic organism were found in the sporangia" (Sparrow 1960). Further observations of the endobiotic component and zoospores of this organism will be necessary before it can be reliably placed. Type material not designated; Scherff's illustration (pl. 9, figs. 60, 61, Arch. Protistenk. 54: 199. 1926) of *R. persimilis* Scherff. is accepted as the type.

**? Rhizophydium poculiforme** S.N. Dasgupta & R. John


“SPORANGIUM epi-endobiotic, sessile, elliptical or subspherical, 12–28 µm wide x 10–20 µm high, wall thin, smooth, hyaline, base partially embedded in host cell matrix; discharge pore short, stout, about 3 µm high, at dehiscence the tip dissolves to form a pore 4 µm in diameter; zoospores mature inside the sporangium, numerous, emerge through the apical pore, forms a globose mass at the orifice, enveloped in a slimy sheath, remain quiescent at the rim of the orifice for 1–2 minutes, then disentangle and dart away; following discharge the wall of the epibiotic portion of the empty sporangium eventually deliquesces whereas the endobiotic portion, large, bowl-shaped, persists. HAUSTORIUM endobiotic, at the base of the sporangium, smooth-walled, subspherical, 15 µm diameter, mostly smaller than the sporangium it subtends; rhizoid absent. ZOOSPORES spherical, 2.5–4 µm diameter, hyaline with refractive granules, flagellum long. RESTING SPORE not observed” (Dasgupta and John 1988).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on species of *Closterium*; India” (Dasgupta and John 1988).

NOTE — The nature of the endobiotic part of this fungus may place it in *Phlyctochytrium*. Type material not designated; Dasgupta and John's illustration (figs. 28-30, Bot. Surv. India 30: 27. 1988) of *R. poculiforme* S.N. Dasgupta & R. John is accepted as the type.

**? Rhizophydium pseudodistomum** Scherff.

Abstracts of Communications, V Inter. Bot. Congress, Cambridge, 1930: 222; Arch. Protistenk. 73: 140, pl. 9, fig. 2 a, b. 1931.

“SPORANGIUM sessile, distinctly pyriform, with a broad convex base and a prominent apiculus, 16–20 µm high by 13–18 µm diameter, wall thin, smooth, colorless. RHIZOIDAL SYSTEM well developed, branched. ZOOSPORES not observed, apparently emerging through a discharge tube 2 µm long by 5 µm diameter which forms subapically on the sporangium, the apiculus becoming slightly lateral as a consequence. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on *Oocystis solitaria*
var. wittrockiana; Hungary” (Sparrow 1960).

NOTE — Observations on the nature of the zoospore will be necessary before this fungus can be reliably placed. Type material not designated; Scherffel’s illustration (pl. 9, fig. 2, a, b. Arch. Protistenk. 73: 140. 1931) of R. pseudodistomum Scherff. is accepted as the type.

? Rhizophydium pyriformis Valkanov

Arch. Protistenk. 73: 362, figs. 3–5. 1931.

“Sporangium sessile, narrowly pyriform with a broad rounded apex, broadly obpyriform or oblong with one constriction (rarely with two). RHIZOIDAL SYSTEM composed of branched rhizoids arising from the base of a broad penetration tube. ZOOSPORES not observed, apparently escaping through a terminal opening. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on ripe oospores of Vaucheria sp.; Bulgaria” (Sparrow 1960).

NOTE — Further observations, particularly on the nature of the zoospore, will be necessary before this fungus can be reliably placed. Type material not designated; Valkanov’s illustration (figs. 3–5, Arch. Protistenk. 73: 363. 1931) of R. pyriformis Valkanov is accepted as the type.

? Rhizophydium rhizinum S.N. Dasgupta & R. John


“Sporangium sessile, broadly pyriform, 22 µm high by 12 µm broad, distal end constricted, forming a neck 5–7 µm high by 5 µm wide, wall thin, smooth, hyaline; empty sporangium partially collapsed. RHIZOIDAL SYSTEM when present arising directly from basal surface of sporangium, from two separate, abaxial points, rhizoids thin, delicate, hyaline, unbranched. ZOOSPORES and their mode of discharge not observed; zoospores apparently discharged through large apical pore, as wide as the neck is high, 4–5.7 µm, formed by the deliquescence of apical end. RESTING SPORE not observed” (Dasgupta and John 1988).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on sporangium of Blastocladia sp.; India” (Dasgupta and John 1988).

NOTE — The similarity in sporangial size, shape, rhizoidal morphology, host, and collection data of R. reflexum to R. rhizinum warrants synonymy. Additional observations of the zoospores of this fungus are needed before it is placed with certainty. Type material not designated; Dasgupta and John’s illustration (fig. 14, Bull. Bot. Surv. India 30: 18. 1988) of R. rhizinum S.N. Dasgupta & R. John is accepted as the type.
? *Rhizophydium septocarpoides* H. E. Petersen  
PLATE 39, FIG. 13  

“Sporangium resting on a short needle-like extramatrical stalk, obpyriform, 8–16 µm high, the basal part distinctly cylindrical, wall thin, smooth, colorless. Rhizoidal system composed of poorly developed, once-branched rhizoids, arising from a main axis which is continuous with a short extramatrical stalk. Zoospores not observed. Resting spore not observed” (sparrow 1960).

Habitat/substrate/location — Aquatic; “on Closterium spp.; Denmark” (sparrow 1960).

Note — “This incompletely known species resembles a small form of *Chytridium versatile*. Until spore discharge is described it cannot be placed generically with any certainty” (sparrow 1960). Type material not designated; Petersen’s illustration (fig. 24 d. Ann. Mycol. 8: 552. 1910) of *R. septocarpoides* H. E. Petersen is accepted as the type.

? *Rhizophydium serbinovii* Jacz.  
PLATE 39, FIG. 14  
*Phlyctidium* sp. Serbinow, Bot. Zap. 24: 158, pl. 4, fig. 37. 1907.

“Sporangium at first spherical, then ovoid. Haustorium simple, expanded, rounded, and which penetrates only to the second membrane of the “*Gloeocystis*” stage. Zoospores not observed. Resting spore not observed” (sparrow 1960).

Habitat/substrate/location — Aquatic; “in “*Gloeocystis*” stage of *Euglena* sp; Russia” (sparrow 1960).

Note — Type material not designated; Serbinow’s illustration (pl. 4, fig. 37, Bot. Zap. 24: 158. 1907) of *Phlyctidium* sp. Serbinow is accepted as the type of *R. serbinovii* Jacz.

? *Rhizophydium sparrowii* S.N. Dasgupta & R. John  
PLATE 39, FIG. 15  
Indian Phytopathol. 43: 566, fig. 2. 1990.

“Sporangium sessile, thin-walled, smooth, hyaline, shape variable, spherical to obvoid, 18–25 µm high by 20–23 µm wide, arranged in a series at definite intervals on the host cell surface. Rhizoidal system consists of an endobiotic apophysis ellipsoidal, 19 µm high by 12.5 µm wide or spherical, 10 µm diameter, usually occupying the entire host cell, thin-walled, smooth, hyaline, much smaller than the sporangium, and rhizoids arising from 2–3 basal points of the apophysis, extramatrical, free-floating, main strand stout and up to 70 µm long, richly branched, branches filamentous, tips tapering. Zoospores and their mode of discharge not observed. Resting spore not observed” (Dasgupta and John 1990).
HABITAT/SUBSTRATE/LOCATION — Aquatic; “saprobic or parasitic in a filament of Ulothrix; India” (Dasgupta and John 1990).

NOTE — This species differs from all other described species of Rhizophydium in the nature of its rhizoidal system, with an endobiotic apophysis and extramatrical rhizoids. Type material not designated; Dasgupta and John’s illustration (fig. 2, Indian Phytopathol. 43: 567. 1990) of R. sparrowii S.N. Dasgupta & R. John is accepted as the type.

? Rhizophydium spinosum S.N. Dasgupta & R. John (invalid; homonym)


“Sporangium sessile, broadly pyriform, 20–22 µm high by 10 µm wide, wall thin, smooth, hyaline; apical pore 3 µm wide, formed by the deliquescence of the apical end; empty sporangium partially collapsed. Haustorium small, spherical knob-like, located at the basal end; rhizoid absent. Zoospores and their mode of discharge not observed. Resting spore epibiotic, hyaline, wall spinous, faintly brown, spherical 8 µm diameter, formed sexually, male thallus spherical, 2.3 µm in diameter, hyaline smooth, thin walled, attached to the larger female thallus, fertilizes it and the empty case remains adnate to the resting spore; germination of resting spore not observed” (Dasgupta and John 1988).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on the sporangium of Blastocladia sp.; India” (Dasgupta and John 1988).

NOTE — Observations of the zoospores of this fungus are needed before it is placed with certainty. Type material not designated; Dasgupta and John’s illustration (fig. 20, Bull. Bot. Surv. India 30: 18. 1988) of R. spinosum S.N. Dasgupta & R. John is accepted as the type.

? Rhizophydium spirotaeniae (Scherff.) Sparrow

Plate 40, Figs. 1, 2

Aquatic Phycomycetes: 216. 1943.

“Sporangium epibiotic, broadly ovoid, its longer axis parallel with that of the host cell, with a conical protuberance (papilla) eccentrically placed on the somewhat flattened upper surface, 12–14 µm diameter by 8–9 µm high, wall smooth, colorless, thin, opening with an apical or lateral pore. Rhizoidal system not observed. Zoospores not observed. Resting spore epibiotic, sessile (?), colorless, spherical, 11–20 µm, (generally 16 µm) diameter, wall of two layers, the outer densely covered with broad, blunt or pointed, straight or slightly curved, solid, refractive, ray-like protuberances 3 µm wide at the
base by 2-3 µm high, inner wall smooth, 2 µm thick, contents colorless, with numerous coarse globules (fat?), germination not observed; male cell epibiotic, sessile (always?), rounded, smooth, thin-walled, apparently without rhizoids, connected to the resting spore by a cylindrical tube 2 µm in diameter which is expanded distally to form a spherical or pyriform swelling, the tubular part sometimes lacking” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Spirotaenia condensata; Hungary” (Sparrow 1960).

NOTE — “Because of lack of data on the rhizoids, zoospores, and type of discharge, the fungus cannot be accurately placed generically” (Sparrow 1960). Type material not designated; Scherffel’s illustration (pl. 1, figs. 26–29, Arch. Protistenk., 53: 14. 1925) of C. spirotaeniae Scherff. is accepted as the type of R. spirotaeniae (Scherff.) Sparrow.


“SPORANGIUM sessile, spherical, 7 µm diameter, wall smooth, thin. RHIZOIDAL SYSTEM not observed. ZOOSPORES not observed, liberated through a broad apical pore. RESTING SPORE (?) epibiotic, spherical, 15–19 µm diameter, with a very thick (4 µm), pale ochre-yellow wall of two layers, outer wall 2.5 µm thick in surface view, covered with raised punctations, appearing prismatic in optical section, inner wall 1.5 µm thick, strongly refractive, homogeneous; germination not seen” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on oogonia of Oedogonium vaucherii; Germany, Hungary” (Sparrow 1960).

NOTE — Further observations on the nature of the rhizoidal system and zoospores are needed before the species can be reliably placed in Rhizophydium. Type material not designated; Braun’s illustration (pl. 2, fig. 13, Abhandl. Berlin Akad. 1855: 39. 1856) of C. sporoctonum A. Br. is accepted as the type of R. sporoctonum (Braun) Berlese and de Toni.

? Rhizophydium tranzschelii Jacz.


“SPORANGIUM spherical, 39 µm diameter, with a single opening. RHIZOIDAL SYSTEM not observed. ZOOSPORES 4–5 µm long. RESTING SPORE spherical, 15 µm diameter” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Habitat and substrate not known; Russia.
NOTE — Further observations on the nature of the rhizoidal system are needed before the species can be reliably placed in Rhizophyrium. No illustration was provided and no type designated. If this organism became known, and illustrations provided at that time, a neotype should be designated.

? Rhizophyrium urceolatum S.N. Dasgupta & R. John  
PLATE 40, FIGS. 6, 7  
“Sporangium sessile, lageniform, 17–29 µm high × 7–9 µm wide, neck short, 5 µm long, wall thin, smooth, hyaline; empty sporangium after zoospore discharge partially collapsed. Haustorium a small spherical structure unexpanded body of encysted zoospore, situated in the basal axial end, on which the sporangium rests or somewhat lateral; rhizoids absent. Zoospores and their mode of discharge not observed; zoospore discharge through an apical pore, 2.5 µm wide formed by the deliquescence of the apical end. Resting spore double-walled, outer layer thick, inner wall thin, smooth, hyaline, ellipsoidal, 10–12 µm wide by 8–9 µm high, formed sexually, fertilized by male thallus, spherical, small, 2 µm diameter, hyaline, smooth, thin-walled, remains adnate to the resting spore as an empty case; germination of resting spore not observed” (Dasgupta and John 1988).  
HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Blastocladia sp.; India” (Dasgupta and John 1988).  
NOTE — Morphological similarity and size range of R. urceolatum and R. lagenaria warrant synonymy. Further observations of the zoospores are necessary to place this organism. Type material not designated; Dasgupta and John’s illustration (fig. 19, Bull. Bot. Surv. India 30: 18. 1988) of R. urceolatum S.N. Dasgupta & R. John is accepted as the type.

? Rhizophyrium vonmindenii Valkanov  
PLATE 38, FIGS. 5–7  
Arch. Protistenk. 73: 363, figs. 6–8. 1931 (as v. Mindeni).  
“Sporangium spherical, with from twenty to thirty long delicate hairs radiating from the upper part, discharging its spores by means of a terminal splitting. Rhizoidal system not observed. Zoospores not observed. Resting spore unknown” (Sparrow 1960).  
HABITAT/SUBSTRATE/LOCATION — Aquatic; “on oogonia of Oedogonium sp.; Bulgaria” (Sparrow 1960).  
NOTE — Further observations on the nature of the rhizoidal system and zoospores are needed before the species can be reliably placed in Rhizophyrium. Type material not designated; Valkanov’s illustration (figs. 6-8,
Arch. Protistenk. 73: 363. 1931) of R. vonmindenii Valkanov is accepted as the type.

*? Rhizophydium sp.* Aleem

Arch. Bot. (Leipzig) 3: 15, fig. 30. 1953.

“SPORANGIUM spherical, 17 µm diameter, with a thin, smooth wall. RHIZOIDAL SYSTEM not observed. ZOOSPORES about 1 µm diameter, probably escaping through a minute pore. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Marine; “on heterocyst of Calothrix sp.; Sweden” (Sparrow 1960).

NOTE — Further observations on the nature of the rhizoidal system are needed before the species can be confidently placed in *Rhizophydidium*.

*? Rhizophydium sp.* T. Booth

PLATE 40, FIGS. 9, 10

Syesis 2: 155, figs. 3–5, 39–43. 1969.

“SPORANGIUM spherical to subglobose, 11–28 µm at greatest dimension, characterized by the presence of one to six (most commonly three) protoplasm-filled horns ranging in length from 5–9 µm; horn tips are often either slightly bifurcate or curved. RHIZOIDAL SYSTEM composed of once-branched or fascicular (branching from a common bundle) rhizoids. ZOOSPORES 2–2.5 µm diameter with a single globule, apparently discharged through the end walls of the horns, which persist after discharge. RESTING SPORE not observed” (Booth 1969).

HABITAT/SUBSTRATE/LOCATION — Halomorphic soil; on pollen; British Columbia, Canada.

NOTE — Possibly referable to *Gorgonymyces haynaldii* (Schaarschm.) Letcher (Letcher et al. 2008).

*? Rhizophydium sp.* T. Booth

PLATE 40, FIGS. 11–13


“SPORANGIUM spherical, 10–35 µm diameter, with one to five pores 5–8 µm wide; wall golden-brown, double-contoured, persisting after discharge. RHIZOIDAL SYSTEM coarse, sparingly branched rhizoids. ZOOSPORES 4–5 µm diameter, with a refractive globule 1–5 µm wide, motile in sporangium before discharge, escaping singly through wide pores. RESTING SPORE spherical, 15–22 µm diameter, thick-walled, golden-brown, bullate” (Booth 1971a).

HABITAT/SUBSTRATE/LOCATION — Freshwater marsh; on pollen; Oregon, United States.

NOTE — This organism is similar to *R. bullatum* Sparrow.
**? Rhizophydiun sp.** T. Booth

*Syringa* 4: 205, fig. 8. 1971.

“Sporangium pyriform, 10–24 µm wide but 17–31 µm high, with one to five broad discharge pores. Rhizoidal system composed of fine and meagerly branched rhizoids. Zoosporae 2.5–3.5 µm diameter, uniguttulate. Resting spore not observed” (Booth 1971c).

Habitat/Substrate/Location — Marine beaches; on pollen; British Columbia, Canada.

**? Rhizophydiun sp.** T. Booth and P. Barrett


“Sporangia subglobose, angular, 15–32 µm by 18–37 µm, with broad (1–5) discharge papillae in the angles. Rhizoidal system composed of coarse, branched rhizoids. Zoosporae spherical, 3.5–5 µm diameter, motile in sporangium prior to discharge, escaping by dissolution of papillae. Resting spore not observed” (Booth and Barrett 1971).

Habitat/Substrate/Location — Soil, “under moss; on pollen; Canadian East Arctic, Canada” (Booth and Barrett 1971).

**? Rhizophydiun sp.** T. Booth and P. Barrett


“Sporangium spherical, 14–20 µm diameter, sporangial wall basal portion may be thickened; spore release occurs upon dissolution of upper one-half to two-thirds of wall. Rhizoidal system composed of fine, branched rhizoids; occasionally only a single unbranched haustorium-like structure. Zoosporae 2.5–3.0 µm diameter, remaining motionless for a period of time after wall dissolution. Resting spore not observed” (Booth and Barrett 1971).

Habitat/Substrate/Location — Soil; “on pollen; Canadian East Arctic, Canada” (Booth and Barrett 1971).

Note — This fungus may be *R. patellarium* Scholz.

**? Rhizophydiun sp.** Canter and Lund


“Sporangium spherical, 5–13 µm diameter; spore release occurs upon dissolution of a small apical pore. Rhizoidal system not observed. Zoosporae 3.0 µm diameter, with a single posterior refractive globule and flagellum, 12 µm long. Resting spore not observed” (Canter and Lund 1953).

Habitat/Substrate/Location — Aquatic; “on Tabellaria fenestrata; Lake District, England” (Canter and Lund 1953).
NOTE — “The spherical sporangia resemble those of *R. planktonicum* Canter, and although they are somewhat larger and contain more zoospores (up to 40), this may be related to the cells of *Tabellaria* being larger than those of *Asterionella*” (Canter and Lund 1953).

**? Rhizophydium sp.** Couch


“*Sporangium* sessile, spherical, subspherical, or broadly urceolate, with an apical or subapical papilla, 5.5–10 µm diameter, wall smooth, thin, colorless. **Rhizoidal system** consisting of a tuft of poorly developed digitations which arise from a short stout main axis. Zoospores not observed, apparently emerging through a single somewhat broad apical or subapical pore. **Resting spore** epibiotic, spherical, 10 µm diameter, with a thick smooth colorless wall, rhizoids consisting of a tuft of short digitations, germination not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “on *Bumilleria* sp., *Spirogyra* sp.; United States, Great Britain” (Sparrow 1960).

NOTE — “Since the discharge of the zoospores has not been observed, the fungi of Couch and Sparrow (1936) may belong in an operculate genus. Though the sporangia of the American and British forms differ slightly in shape, the former being spherical or subspherical, the latter more urceolate, they agree in being attached to the host cell by short digitate rhizoids. Couch states that the resting spore is surrounded by a gelatinous sheath. This has been interpreted in the British fungus as wall material. Couch discussed his fungus under the name *Rhizophydium minimum* (Schroeter) Fischer, but it differs markedly from that species and from other members of the genus in the character of its endobiotic system. Further study may possibly show the fungi on *Bumilleria* and *Spirogyra* to be distinct” (Sparrow 1960).

**? Rhizophydium sp.** Karling


“*Sporangium* almost spherical (10–52 µm), slightly depressed, wedge-shaped to somewhat triangular (14 by 29 µm – 25 by 30 µm), oval and occasionally slightly irregular, with 1 to 11 exit papillae. **Rhizoidal system** composed of long, tapering, branched rhizoids arising from a single stout axis. Zoospores not observed. **Resting spore** not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “occurs saprophytically on a wide variety of dead filamentous and unicellular algae, flagellates, rhizopods, rotifers, liver fluke ova and ovarian tissue, eggs, larvae and exuviae of insects, cooked striated muscle cells and root tips of various plants; New
Jersey, United States” (Sparrow 1960).

NOTE — “The smaller sporangia may often resemble those of R. agile, R. gibbosum, R. rostellatum and R. biporosum” (Sparrow 1960).

? Rhizophydium sp. (1) Karling


“SPORANGIUM broadly or narrowly pyriform, with a single terminal discharge pore; rarely sessile, typically borne at the tip of a slender, tapering stalk 10–50 µm in length. RHIZOIDAL SYSTEM sparse. ZOOSPORES spherical with a single oil globule. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; parasitic on the soma and cysts of a stalked protozoan, angiosperm pollen bait; Brazil” (Sparrow 1960).

? Rhizophydium sp. (2) Karling


“SPORANGIUM nearly spherical, with two subapical discharge papillae. RHIZOIDAL SYSTEM much branched, arising from the tip of a central axis. ZOOSPORES globose, with coarsely granular, non-refringent contents, oil globule lacking. RESTING SPORE unknown” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Soil; on elm-pollen bait; Brazil” (Sparrow 1960).

? Rhizophydium sp. Karling


“SPORANGIUM broadly obpyriform or clavate, 15–22 by 24–30 µm, with a tapering, curved base and broad, almost flat apex. RHIZOIDAL SYSTEM composed of short, broad in diameter, branched rhizoids occasionally reduced to digitate structures. ZOOSPORES not observed. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “parasitic on Chytriumae fructicosus; United States” (Sparrow 1960).

NOTE — Further observations on the nature of the rhizoidal system are needed before the species can be placed in Rhizophyldium.

? Rhizophydium sp. Kobayasi and M. Ôkubo


“SPORANGIUM spherical or broadly obpyriform, covered by low bullations and bearing a single (?) subapical, slightly elevated discharge pore. RHIZOIDAL SYSTEM a slender, short unbranched or once-branched rhizoid. ZOOSPORES not observed. RESTING SPORE not observed” (Sparrow 1960).
HABITAT/SUBSTRATE/LOCATION — Aquatic; “on Chlamydomonas nivalis ("red snow"); Japan” (Sparrow 1960).

NOTE — Further observations on the nature of the zoospores are needed before the species can be placed in Rhizophydium (Sparrow 1960).

? Rhizophydium sp. (1) Longcore

SPORANGIUM spherical 20–50 µm diameter, with multiple discharge papillae. RHIZOIDAL SYSTEM composed of branched rhizoids arising from a single axis. ZOOSPORES elongate upon discharge, becoming spherical when active. RESTING SPORE not observed (Longcore 2005).

HABITAT/SUBSTRATE/LOCATION — “Tree-canopy detritus; on pollen; Queensland, Australia” (Longcore 2005).

NOTE — This isolate was referred to by Longcore as Rhizophydium 358.

? Rhizophydium sp. (2) Longcore

SPORANGIUM spherical, 20-30 diameter, thin-walled, usually stalked but occasionally sessile, probably with a single discharge pore; sporangium collapses after discharge. RHIZOIDAL SYSTEM composed of thread-like rhizoids arising from the base of the stalk. ZOOSPORES oval upon discharge, becoming spherical when active. RESTING SPORE not observed (Longcore 2005).

HABITAT/SUBSTRATE/LOCATION — “Tree-canopy detritus, South Island, New Zealand” (Longcore 2005).

NOTE — This isolate was referred to by Longcore as Rhizophydium 372.

? Rhizophydium sp. R.A. Paterson
Mycologia 50: 89, fig 2 A-D. 1958.

SPORANGIUM spherical, 4-6.5 µm diameter. RHIZOIDS branched distally. “ZOOSPORES not observed; discharge presumably follows dissolution of most of, if not the entire sporangial wall. RESTING SPORE spherical, 7-10 µm diameter, sexually formed” (Paterson 1958).

HABITAT/SUBSTATE/LOCATION — Aquatic; “parasitic on the diatom Rhizosolenia eriensis; Michigan, USA” (Paterson 1958).

NOTE — Paterson considered this species to be the same as that described, but unnamed, by Canter (Canter and Lund 1953, p. 31, figs. 5, A–G) as a parasite of Rhizosolenia (Paterson 1958).
? *Rhizophydium* sp. Scherff. **Plate 42, Figs. 17–19**
Arch. Protistenk. 53:28, pl. 2, figs. 57–59, 1925.

“Sporangium sessile, upright, pyriform, 8 µm high by 5 µm diameter at the base, wall smooth, colorless. Rhizoidal system not observed. Zoospores not observed. Resting spore (immature) ovoid, with a flattened base, wall thin, smooth, colorless, contents homogeneous, with one or two large oil droplets, becoming spherical at maturity; contributing thalli from one to three, small, somewhat spherical or ovoid, attached directly or by a short copulation tube to the base of the receptive thallus; other characters unknown” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “on *Tribonema bombycina*; Hungary” (Sparrow 1960).

Note — “Scherffel was not certain that the sporangial stage he observed belonged to the fungus which was forming resting spores” (Sparrow 1960). Further observations on the nature of the rhizoidal system and zoospores are needed before the species can be placed in *Rhizophydium*.

? *Rhizophydium* sp. Vegas & Teixeira **Plate 42, Figs. 20–24**
Bragantia 3: 225, pl. 3. 1943.

“Sporangium globose, hyaline, 7–9 µm diameter, with a smooth delicate wall, without discharge papillae. Rhizoidal system composed of hyaline, very delicate, tapering, irregularly branched rhizoids arising from a small, subsporangial apophysis. Zoospores 0.5–1 µm in diameter, uniflagellate. Resting spore asexually formed, 5–6 µm diameter with a smooth wall” (Sparrow 1960).

Habitat/Substrate/Location — Aquatic; “on filaments of *Spirogyra*; Brazil” (Sparrow 1960).

Note — “Although the zoospores were observed, their method of escape (whether through one or more pores) was evidently not noted. It may, possibly, be a species of *Phlyctochytrium*” (Sparrow 1960).

? *Rhizophydium* sp. Willoughby **Plate 43, Figs. 1–5**

Sporangium spherical, 7.5–26 µm diameter, with a single, apical, slightly protruding papilla. Rhizoidal system composed of robust, branched rhizoids extending up to 37 µm. Zoospores 3–4 µm diameter, with a hyaline globule. Resting spore not observed (Willoughby 1959).

Habitat/Substrate/Location — Soil; “parasitic on the eggs of the rotifer *Lecane arcuata*; Lake District, England” (Willoughby 1959).
? *Rhizophydium* sp. Willoughby  
*Plate 43, figs. 6–9*


SPORANGIUM spherical to subspherical, 23–50 µm diameter, with a yellow wall and 1–3 gelatinous exit papillae, which protruded 2–5 µm from the sporangium surface, inside was a zone of clear cytoplasm 3–5 µm deep. RHIZOIDAL SYSTEM a single axis with coarse, branched rhizoids. ZOOSPORES spherical 3 µm diameter, with a posterior-lateral hyaline globule 0.75 µm diameter and a posterior flagellum. RESTING SPORE not observed (Willoughby 1962).

HABITAT/SUBSTRATE/LOCATION — Soil (?); “on cellulose and keratin; Lake District, England” (Willoughby 1962).

? *Rhizophydium* sp. Willoughby  
*Plate 43, figs. 10–16*

Arch. Mikrobiol. 52: 109, fig. 3, n–y. 1965.

SPORANGIUM spherical, 37–120 µm diameter, wall yellow, up to 3 µm thick, with 1–12 exit pores 6.5–18 µm across; RHIZOIDAL SYSTEM extensive. ZOOSPORES spherical, 4 µm diameter, with a small (1) hyaline globule, and a posterior flagellum 23 µm long. RESTING SPORE not observed (Willoughby 1965).

HABITAT/SUBSTRATE/LOCATION — Soil; “on keratin; Victoria, Australia” (Willoughby 1965).

NOTE — The dehiscence mechanism described by Willoughby is unusual and interesting, and combines features of both operculate and inoperculate forms. This led Willoughby to speculate that the entire sporangial structure possibly represented a sporangium parasitized by a holocarpic fungus such as *Rozella* (Willoughby 1965).

Fig. 1. Immature sporangium, parasitic on *Tribonema bombycina*.

Fig. 2. Mature sporangium.

Fig. 3. Empty sporangium.

Fig. 4. Sexual production of the resting spore.

Fig. 5. Resting spores.


Fig. 6. Empty sporangium, parasitic on *Blyttionyces spinosus*.

Fig. 7. Empty sporangium, parasitic on zygospore of *Spirogyra* sp.

Fig. 8. *Rhizophydidium chrysopixidis* Scherff.; after Scherffel (1926); empty sporangium on *Chrysopixis* sp.


Fig. 9. Immature sporangium within trichogyne of the host, *Coleochaete pulvinata*.

Fig. 10. Developing sporangium.

Fig. 11. Mature sporangium.

Fig. 12. Zoospore release.

Fig. 13. Empty sporangia.


Fig. 14. Sporangia on vegetative cell of *Spirogyra* sp.

Fig. 15. Zoospore discharge through an apical pore.

Fig. 16. Zoospore discharge through a lateral slit in sporangium wall.

Fig. 17. Empty sporangium.


Fig. 18. Developing sporangium, parasitic on *Saccomyces* sp.

Fig. 19. Mature sporangium.

Fig. 20. Zoospore release.

Fig. 21. Resting spore.


Fig. 22. Motile zoospore, and encysted zoospore, on oogonium of *Oedogonium* sp.

Fig. 23. Germling on the egg cell.

Fig. 24. Mature sporangium.

Fig. 25. Zoospore release.

Fig. 26. Resting spore.

Scale bar values in micrometers
PLATE 37

Figs. 1, 2. ?Rhizophydium dubium De Wild.; after Wildeman (1895).
Fig. 1. Mature sporangium with a single, protruding apical papilla, on filament of Spirogyra sp.
Fig. 2. Empty sporangium with a wide apical pore.
Fig. 3. ?Rhizophydium epithimae Valkanov; after Valkanov (1931). Sporangium with a prominent subapical wart-like projection and a large lateral pore; parasitic on Epithemia zebra.
Figs. 4–6. ?Rhizophydium fallax Scherff.; after Scherffel (1925).
Fig. 4. Mature sporangium releasing zoospores through a minute lateral pore; on Mougeotia sp.
Fig. 5. Sexual production of resting spore.
Fig. 6. Resting spore with adnate companion cell.
Fig. 7. ?Rhizophydium gelatinosum Lind; after Lind (1905). Subspherical sporangia encased in a gelatinous hull; on Cladophora ("Acrosiphonia") pallida.
Fig. 8. Empty sporangium, parasitic on Gonapodya polymorpha.
Fig. 9. Sexually produced resting spore.
Fig. 10. Empty sporangium (R. stellatum, syn.).
Fig. 11. Sexually produced resting spore, R. stellatum.
Fig. 12. ?Rhizophydium hormidii Skvortzow; after Skvortzow (1925). Sporangia on Hormidium flaccidum.

Scale bar values in micrometers
Fig. 1. *Rhizophydiun hyalothecae* Scherff.; after Scherffel (1926); mature sporangium with a crown of prominent plain teeth, on *Hyalotheca dissiliens*.

Fig. 2. *Rhizophydiun leptophrydis* Scherff.; after Scherffel (1926); sporangium with a broad subapical protrusion, on the zoocyst of the vampyrellan *Leptophris vorax*, in *Gomphonema* sp.

Fig. 3. *Rhizophydiun marium* De Wild.; after Wildeman (1893); sporangium on *Melosira* sp.

Fig. 4. *Rhizophydiun minimum* (J. Schrö.) A. Fisch.; after Fischer (1892), sporangium with a short, spherical haustorium, on *Mougeotia pleurocarpa*.


Fig. 5. Infection of oogonia of *Oedogonium* sp.

Fig. 6. Sporangium with long delicate hairs radiating from the upper part.

Fig. 7. Empty sporangium, zoospores having been released by means of a terminal splitting of the sporangial wall.


Fig. 8. Mature sporangium, parasitic on oogonia of *Vaucheria sessilis*.

Fig. 9. Encysted zoospore and empty sporangium.

Fig. 10. Empty sporangia.

Figs. 11, 12. *Rhizophydiun oedogoni* Richter; after Richter (1897).

Fig. 11. A group of immature sporangia on filament of *Oedogonium* sp.

Fig. 12. A group of mature sporangia, each sorangium bearing two opposite lateral spines.


Fig. 13. Immature sporangium, parasitic on sporangium of *Rhizophydiun goniosporum* parasitizing *Tribonema bombycina*.

Fig. 14. Mature sporangium.

Fig. 15. Zoospore release.

Fig. 16. Resting spore.

Scale bar values in micrometers
Fig. 1. Mature sporangia on *Tribonema bombycina*.
Fig. 2. Sexual production of resting spore.
Fig. 3. Resting spore with adnate male cell.
Fig. 4. Mature sporangium, parasitic on *Closterium* sp.
Fig. 5. Zoospores discharged as a vesicular mass.
Fig. 6. Empty sporangium.
Fig. 7. Mature sporangium, parasitic on *Oocystis solitaria* v. *wittrockiana*.
Fig. 8. Empty sporangium with subapical discharge tube.
Figs. 9–11. *Rhizophydium pyriformis* Valkanov; after Valkanov (1931).
Figs. 9, 10. Immature sporangia, parasitic on ripe oospores of *Vaucheria* sp.
Fig. 11. Mature sporangium.
Fig. 12. *Rhizophydium rhizinum* S.N. Dasgupta & R. John; after Dasgupta and John (1988); empty sporangia, parasitic on *Blastocladiella* sp.
Fig. 13. *Rhizophydium septocarpoides* H.E. Petersen; after Petersen (1910); mature sporangia, each with a needle-like stalk, on *Closterium* sp.
Fig. 14. *Rhizophydium sparrowii* S.N. Dasgupta & R. John; after Dasgupta and John (1990); sporangium on *Ulothrix* sp. with extramatrical rhizoids arising from an endobiotic apophysis.
Fig. 15. *Rhizophydium serbinovii* Jacz.; after Jaczewski (1931); germlings and sporangia in “*Gloeocystis*” (pallmeloid) stage of *Euglena* sp.
Fig. 16. Empty sporangia, parasitic on *Blastocladiella* sp.
Fig. 17. Resting spore.

Scale bar values in micrometers
PLATE 40

Figs. 1, 2. *Rhizophydium spiropaeniae* (Scherff.) Sparrow; after Scherffel (1925).
Fig. 1. Mature sporangia, parasitic on *Spirotaenia condensata*.
Fig. 2. Sexual production of resting spores.

Fig. 3. Mature sporangium, on oogonium of *Oedogonium vaucherii*.
Fig. 4. Empty sporangium.
Fig. 5. Resting spore.

Fig. 6. Empty sporangium, parasitic on *Blastocladia* sp.
Fig. 7. Sexually produced resting spore.

Fig. 8. *Rhizophydium sp.*; after Aleem (1953); mature sporangium on the heterocyst of *Calothrix* sp.

Figs. 9, 10. *Rhizophydium sp.*; after Booth (1969)
Fig. 9. Developing sporangia.
Fig. 10. Sporangium with fasiculate rhizoids.

Fig. 11. Empty sporangium.
Fig. 12. Uniguttulate zoospore.
Fig. 13. Bullate resting spore.

Fig. 14. *Rhizophydium sp.*; after Booth (1971c); pyriform sporangium with multiple discharge pores.

Fig. 15. *Rhizophydium sp.* 1; after Booth and Barrett (1971); angular, mature sporangium with multiple large discharge papillae.

Figs. 16, 17. *Rhizophydium sp.* 2; after Booth and Barrett (1971).
Fig. 16. Thallus with tufted rhizoids and thickened basal wall.
Fig. 17. Persistent basal portion of sporangium wall after discharge.

Fig. 18. Motile zoospores.
Fig. 19. Encysted zoospore.
Fig. 20. Immature sporangium.
Fig. 21. Mature sporangium.
Fig. 22. Zoospore discharge through multiple pores.

Scale bar values in micrometers
PLATE 41

Fig. 1. Encysted zoospores on *Tabellaria fenestrata*.
Fig. 2. Immature sporangia, sessile (L) and with interbiotic germ tube (R).
Fig. 3. Mature sporangium.
Fig. 4. Empty sporangium, (R) illustrating dehiscence pore.
Figs. 5–9. *Rhizophydium* sp., figs. 5–7 after Sparrow (1936), figs. 8, 9 after Couch (1932).
Fig. 5. Mature sporangium, on *Spirogyra* sp.
Fig. 6. Empty sporangium.
Fig. 7. Resting spore.
Fig. 8. Three mature sporangia, on *Bumilleria* sp.
Fig. 9. Empty sporangium.
Figs. 10–12. *Rhizophydidium* sp. (1), after Karling (1946b).
Fig. 10. Developing sporangium.
Fig. 11. Zoospore discharge.
Fig. 12. Empty sporangium.
Figs. 13–16 *Rhizophydidium* sp. (2), after Karling (1946b).
Fig. 13. Motile zoospores with granular protoplasm.
Fig. 14. Germlings on elm pollen.
Fig. 15. Developing sporangium.
Fig. 16. Mature, multi-papillate sporangium.
Fig. 17. Encysted zoospore and germlings, parasitic on *Chytriomyces fructicosus*.
Fig. 18. Immature sporangium.
Fig. 19. Mature sporangium.

Scale bar values in micrometers
PLATE 42

Figs. 1, 2. *Rhizophydi um sp.*, after Kobayasi and Ōkubo (1954b).
Fig. 1. Mature, multipapillate sporangium, on *Chlamydomonas nivalis*.
Fig. 2. Empty sporangium.
Fig. 3. Immature sporangium.
Fig. 4. Mature, multipapillate sporangium.
Fig. 5. Empty sporangium.
Fig. 6. Motile zoospores.
Fig. 7. Germling.
Fig. 8. Immature sporangium.
Fig. 9. Mature sporangium.
Fig. 10. Empty sporangium.
Fig. 11. Motile zoospores.
Fig. 12. Encysted zoospore on *Rhizosolenia* sp.
Fig. 13. Immature sporangium.
Fig. 14. Mature sporangium.
Fig. 15. Remains of germ tube after zoospore discharge and deliquescence of perhaps entire sporangial wall.
Fig. 16. Resting spore.
Fig. 17. Mature sporangium, on *Tribonema bombycina*.
Figs. 18, 19. Sexual production of resting spore.
Fig. 20. Immature sporangium, on filament of *Spirogyra* sp.
Figs. 21, 22. Mature sporangium.
Fig. 23. Zoospore release.
Fig. 24. Resting spore.

Scale bar values in micrometers
PLATE 43

Fig. 1. Encysted zoospore, parasitic on rotifer egg.
Fig. 2. Germling.
Fig. 3. Immature sporangia.
Fig. 4. Mature sporangium with a slight apical papilla.
Fig. 5. Empty sporangium.

Fig. 6. Mature, multipapillate sporangia.
Fig. 7. Sporangium before and after dehiscence.
Fig. 8. Empty sporangia.
Fig. 9. Motile zoospores.

Fig. 10. Mature, multipapillate sporangium on keratin.
Fig. 11. Empty sporangium.
Fig. 12. Empty sporangium from below, showing the single rhizoidal insertion.
Fig. 13. Discharge papilla, with sporangial wall cracking.
Fig. 14. Discharge papilla with cracked wall material discarded, and protruding gelatinous plug.
Fig. 15. Zoospores moving into base of gelatinous plug.
Fig. 16. Motile zoospores.

Scale bar values in micrometers
**Species excluded from *Rhizophyrium* on the basis of thallus morphology**

The following species (indicated with an asterisk) are rejected as members of *Rhizophyrium* because one or more described morphological features are incompatible with the morphological concept of the genus, or the description is insufficient for placement in the genus.

* *Rhizophyrium blastocladianum* S.N. Dasgupta & R. John

“Sporangium sessile, hyaline, thin, smooth-walled, shape variable, broadly or narrowly pyriform, 16–38 µm high by 9–22 µm wide, apex rounded, convex, wall rigid, shape persists after discharge. Rhizoidal system absent. Zoospores and their mode of discharge not observed; zoospore discharge through pore, narrow or broad, formed by deliquescence of apical end, 5–10 µm wide. Resting spore double-walled, outer wall spinous, inner wall thin, dark brown, spherical, 10–12 µm in diameter, contents granular, formed sexually, a small male thallus double-walled, smooth hyaline, spherical 2.5–4 µm in diameter, becomes directly attached to a larger female thallus or makes contact with a short tube, fertilization giving rise to resting spore, to which the empty case of remains adnate; germination not observed” (Dasgupta and John 1988).

Habitat/Substrate/Location — Aquatic; “parasitic on Blastocladia sp.; India” (Dasgupta and John 1988).

Note—The absence of any endobiotic part places this fungus outside *Rhizophyrium*.

* *Rhizophyrium clavatum* S.N. Dasgupta & R. John (invalid; homonym),

“Sporangium epi-endobiotic, sessile, spherical or subspherical, 6 µm in diameter, thin walled, smooth, hyaline, base partially embedded in the host cell matrix; wall of the epibiotic portion of the sporangium fully deliquesces after zoospore discharge, whereas the wall of the embedded endobiotic base persists as an open bowl, attached to the apophysis. Rhizoidal system an endobiotic apophysis, abaxial, clavate, 35 µm long by 10 µm wide; rhizoid formed as an extension of the apophysis, tubular, up to 30 µm long by 3 µm in diameter, unbranched, continuous with the apophysis or sometimes partitioned by a septum. Zoospores and their mode of discharge not observed. Resting spore not observed” (Dasgupta and John 1988).

Habitat/Substrate/Location — Aquatic; “parasitic on Closterium sp.; India” (Dasgupta and John 1988).
NOTE—Dasgupta and John noted that all specimens of this organism examined were imperfect in form, in which nothing remained of the sporangium, and that no undischarged sporangia were observed (Dasgupta and John 1988). The presence of an endobiotic apophysis indicates affinity with *Phlyctochytrium*.

*Rhizophydium heimii* Motte

SPORANGIUM epibiotic, pyriform, 6–11 broad by 10–20 high, with a single, apical, inoperculate pore. RHIZOIDAL SYSTEM absent; organism holocarpic. ZOOSPORES oval to oblong, 2 by 3–4, with a basal globule and a posterior flagellum 9–12 long. RESTING SPORE not observed (Motte 1956).

HABITAT/SUBSTRATE/LOCATION — Aquatic; on *Chlamydomonas rheinhardti*; France (Motte 1956).

NOTE—The holocarpic nature of this organism places it outside *Rhizophydium*.

*Rhizophydium microsporum* (Nowak.) A. Fisch.

*Chytridium microsporum* Nowak., in Cohn, Beitr. Biol. Pflanzen 2: 81, pl. 4, fig. 11. 1877.


“SPORANGIUM sessile, more or less spherical or ovoid, 30–50 µm diameter, wall thin, colorless. RHIZOIDAL SYSTEM not observed. ZOOSPORES minute, somewhat elongate with a narrower anterior end, 2 µm long by 1/2 µm wide, with a strongly refractive anterior granule and a single fairly strong anterior flagellum, emerging in great numbers from an imperceptible orifice and quickly swimming away. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on filaments of *Mastigothrix aeruginea*, imbedded in the gelatinous sphere of *Chaetophora*; Germany” (Sparrow 1960).

NOTE—“From the anterior flagellation of the zoospore, the fungus belongs to none of the three genera to which it has been assigned. If further study confirms the observations of Nowakowski on this point it should be placed in the *Hyphochytriales*” (Sparrow 1960).
* **Rhizophydium monosporum** Maire

“**Sporangium** opening by a single pore. **Rhizoidal system** absent. **Zoospores** not observed. **Resting spore** not observed” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “on pollen grains of *Pinus*; France” (Sparrow 1960).

**Note** — This fungus is insufficiently described for generic placement (Sparrow 1960).

* **Rhizophydium rotundum** S.N. Dasgupta & R. John

“**Sporangium** sessile, smooth, ovoid, 15–22 μm diameter or subspherical; zoospore cyst present at the apical end of some spherical sporangia; discharge papilla apical, at dehiscence the tip dissolves to form a pore 4–6 μm diameter; empty sporangium retains shape after discharge. **Haustrum** an apophysis, intramatrical, formed at the basal end of the sporangium, smooth walled, spherical or subspherical, 10–18 μm diameter, some conspicuously large, cupular, subtending the sporangium; rhizoid absent. **Zoospores** numerous, spherical, hyaline with a central refractive globule, discharge as a globular mass enveloped in a vesicle. **Resting spore** endobiotic, loosely free in host cell, present in a linear series, spherical, 15–20 μm diameter, thick-walled with refractive granules, on germination forms a sporangium which emerges through the apical pore; sporangium endobiotic, spherical 8 μm diameter, thin-walled, hyaline, full of unformed zoospores, further development not observed” (Dasgupta and John 1988).

**Habitat/Substrate/Location** — Aquatic; “parasitic primarily on *Closterium* sp. and a few filaments of *Oedogonium* and *Zygnema*; India” (Dasgupta and John 1988).

**Note** — The endobiotic nature of the resting spore places this fungus outside *Rhizophydium*.

* **Rhizophydium setigerum** Scherff.
Arch. Protistenk. 53: 48, pl. 2, fig. 95. 1925.

“**Sporangium**, **Rhizoidal system** not observed. **Zoospores** not observed. **Resting spore** sessile, spherical, thick-walled, the upper part of the outer wall with a tuft of long radiating hairs” (Sparrow 1960).

**Habitat/Substrate/Location** — Aquatic; “on oospore of *Oedogonium* sp.; Hungary” (Sparrow 1960).
NOTE — “It is impossible to assign this resting spore to any genus of chytrids” (Sparrow 1960).

*Rhizophydium utriculus* Scherff.
Arch. Protistenk. 54: 173, pl. 9, fig. 11. 1926.

“SPORANGIUM sessile, consisting of an irregular more or less cylindrical short tube resting with its smaller, somewhat curved base on the substratum, 13–14 µm long by 6–8 µm in diameter, wall thin, smooth, colorless. RHIZOIDAL SYSTEM not observed. ZOOSPORES not observed, apparently emerging through the broad open apex. RESTING SPORE not observed” (Sparrow 1960).

HABITAT/SUBSTRATE/LOCATION — Aquatic; “on cyst (?) of an unidentified chrysomonad; Hungary” (Sparrow 1960).

NOTE—“The description is lacking in too many essential features for the fungus to be placed anywhere generically” (Sparrow 1960).

**Species synonymized in Rhizophydium or placed in other genera on the basis of morphology**

The following species of *Rhizophydium* have been transferred to other genera because one or more morphological features are inconsistent with the morphological concept of *Rhizophydium*, but are consistent with the morphological concept of another genus, or in the case of *R. karlingii* Sparrow and *R. vaucheriae* Const. have been synonymized in *Rhizophydium*. ≠ indicates an opinion that taxa are taxonomic synonyms (more than one name is based on different types, yet are considered the same species); ≡ indicates nomenclatural synonymy (more than one name is based on the same type, and are considered the same species).


≡*Chytridium cornutum* A. Br., Abhandl. Berlin Akad. 1855: 50, pl. 4, figs. 8-19. 1856.

Note — Oomycete.


**Rhizophydium digitatum** Scherff., Arch. Protistenk. 54: 223. 1926; synonymized by Johnson (1975, p. 251).


**Rhizophydium lagenula** (A. Br.) A. Fisch., Rabenhorst, Kryptogamen-Fl. 1: 99. 1892.

≡ *Chytridium lagenula* A Br. pro parte, Abhandl Berlin Akad. 1855: 31, pl. 2, figs. 4–5 (sensu Scherffel Arch. Protistenk. 54: 195, pl. 9, figs. 57–59. 1926.


**Rhizophydium lecythii** Ingold, Trans. Brit. Mycol. Soc. 25: 47, fig. 3, pl. 4, figs. 2-5. 1941.


**Rhizophydium mastigotrichis** (Nowak.) J. Schröt., In Cohn, Kryptogamenfl. Schlesien 3: 1–814. 1885 (1886).


**Rhizophydium minus** (C. Lacoste and Suringar) Oudem. (year of publication unknown; see http://www.mycobank.org).

Species removed from *Rhizophydium* on the bases of zoospore ultrastructure and molecular monophyly

Recent advances in chytrid systematics have utilized suites of zoospore ultrastructural characters and character states, and molecular constitution, as the bases for taxon delineation. Thus, the following species have been removed from *Rhizophydium* and placed in new genera.


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