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Richard K. Benjamin
Rancho Santa Ana Botanic Garden

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AUTOPHAGOMYCES, BORDEA, AND A NEW GENUS, ROSSIOMYCES, (LABOULBENIALES)

RICHARD K. BENJAMIN

Rancho Santa Ana Botanic Garden
1500 North College Avenue
Claremont, Calif. 91711-3157 USA
e-mail: Richard.Benjamin@cgu.edu

ABSTRACT

A revision of *Autophagomyces* (Laboulbeniales) was made based on a comparative morphological study of new collections and 16 species included in the genus by Thaxter in the final volume of his monograph published in 1931 and by others more recently. The concept of *Autophagomyces* (species on Anthicidae, Phalacridae, and Scapidiidae [Coleoptera]) was narrowed and comprises 12 species, four of them new, i.e., *A. hammondii*, *A. mexicanus*, *A. protuberans*, and *A. ramosus*. The genus *Bordea* (species on Pselaphinae, Staphylinidae [Coleoptera]), which had been included in *Autophagomyces* by Thaxter, was reinstated and comprises 14 species, seven new, i.e., *B. allenii*, *B. gigantea*, *B. neocoronata*, *B. retroflexa*, *B. spiniger*, *B. thaxteri*, and *B. weirii*, and six new combinations, i.e., *B. bryaxalis*, *B. castelini*, *B. formosana*, *B. platensis*, *B. strangulata*, and *B. tiwaiensis*. *Bordea formosana* had earlier been incorrectly placed in the genus *Porophoromyces*. A new genus, *Rossiomyces*, was described based on *Autophagomyces falcatus*. Keys to the species were given, and all species were described and illustrated with line drawings.

Key words: Ascomycetes, *Autophagomyces*, *Bordea*, Coleoptera, fungi, insect parasites, Laboulbeniales, morphology, *Rossiomyces*, taxonomy.

INTRODUCTION

Until recently, *Autophagomyces* Thaxt. (Thaxter 1912, emended 1931) included 21 taxa (see Benjamin 1999: 71). *Autophagomyces platensis* Thaxt., the type species, *A. nigripes* Thaxt., *A. kamerunensis* Thaxt., *A. guatemalensis* Thaxt., *A. longicaulis* Thaxt., and *A. subfuscatus* Thaxt. parasitize Anthicidae (Coleoptera; Cucujiformia; Tenebrionoidea). Other species, also on Coleoptera, recognized by Thaxter include *A. gracilis* Thaxt. and *A. grenadinus* Thaxt. on Phalacridae (Coleoptera; Cucujiformia; Cucujoidea); *A. sarawakensis* Thaxt. and *A. peyerimhoffii* (Maire) Maire ex. Thaxt. (= *Cryptandromyces peyerimhoffii* Maire) on Corylophidae (Cucujoidea); and *A. bryaxalis* Thaxt., *A. coronatus* (Maire) Maire ex Thaxt. (= *Bordea coronata* Maire), *A. decarthricola* (Speg.) Thaxt. (= *Acompso myces [Bordea] decarthricola* Speg.), *A. spegazzinii* Thaxt. (= *Acompso myces [Bordea] platensis* Speg.), and *A. strangulatus* Thaxt. on Staphylinidae, subfam. Pselaphinae (Coleoptera; Staphyliniformia; Staphylinoidae) (see Newton and Thayer 1995). Thaxter also described *A. microveliae* Thaxt. from an unrelated host, a water strider of the family Veliidae (Heteroptera; Gerromorpha; Gerroidea).

Species of *Autophagomyces* described in the post-Thaxter era include *A. castelini* W. Rossi (Rossi 1982) and *A. tiwaiensis* W. Rossi (Rossi 1990), on Pselaphinae; *A. sericoderi* Santam. (Santamaria 1993) on Corylophidae; *A. falcatus* Majewski (Majewski 1973) on Cryptophagidae (Cucujoidea); and *A. poissonii* R. K.

Benj. (Benjamin 1970) on Mesoveliidae (Heteroptera; Gerromorpha; Mesovelioidae).

During my continuing studies of *Autophagomyces* sensu lato, I transferred several of the above taxa to other genera as follows: *Autophagomyces poissonii* and *Dioicomyces mesoveliae* R. K. Benj. (Benjamin 1970) to *Triceromyces* T. Majewski (Majewski 1981) as the monoecious and dioecious morphs of *T. poissonii* (R. K. Benj.) R. K. Benj. (Benjamin 1986); *A. sarawakensis*, *A. peyerimhoffii*, and *A. sericoderi* to the new genus *Corylophomyces* R. K. Benj. (Benjamin 1995); and *A. microveliae* to the new genus *Monandromyces* R. K. Benj. (Benjamin 1999).

The purpose of this paper is (1) to circumscribe *Autophagomyces* in a more limited sense than that of Thaxter (1931) and Tavares (1985), (2) to reinstate *Bordea* Maire (1916), and (3) to propose a new genus to accommodate *Autophagomyces falcatus*. All of the species are described and illustrated with line drawings.

MATERIALS AND METHODS

Persons providing infected hosts or slide mounts of specimens other than types, isotypes, or paratypes (see below) are listed in the text. Parasites removed from insects stored in fluid (typically 70% ethyl alcohol) were mounted on slides in glycerine using methods described previously (Benjamin 1971: 101–102 [up to step e]; 1986: 247; 1993: 560). Observations pertinent to preparing the descriptions and illustrations were

made using a Leitz Dialux microscope having differential interference contrast optics.

Loans of the slides were arranged as follows: Dr. Donald H. Pfister, Curator of the Farlow Herbarium, Harvard University, Cambridge, Massachusetts, for Thaxter's types of *Autophagomyces* spp. and *Porophoromyces tmesiphori* Thaxt.; Dr. Angélica M. Arambari, Director of Instituto de Botánica "C. Spegazzini," La Plata, Argentina, for Spegazzini's types of *Acompsomyces (Bordea) platensis* and *Acompsomyces (Bordea) decarthricola*; Dr. Tomasz Majewski, Department of Plant Pathology, Warsaw Agricultural University, Warsaw, Poland, for the type of *Autophagomyces falcatus*; Dr. Walter Rossi, Dipartimento di Scienze Ambientali, Università degli Studi dell'Aquila, L'Aquila, Italy, for the types of *Autophagomyces castellanii* and *A. tiwaiensis*; and Dr. Keiichi Sugiyama, Shizuoka University, Shizuoka, Japan, for paratypes of *Porophoromyces formosanus* K. Sugiy.

Terminology and abbreviations used in describing the ascoma (used here for the entire perithecium-bearing thallus) are defined in the text or in a separate key to labeling preceding the first set of legends for figures, and, with a few exceptions, are those outlined by Tavares (1985: 431–434).

Ascomata of all of the taxa discussed in this paper are bilaterally symmetrical and usually are oriented on slides so that they can be viewed only laterally. Thus, descriptions and measurements of thalli were based mostly on study of specimens as seen from one side or the other. When thalli are mounted on slides, the true relationship of the perithecium relative to the receptacle and appendage may, at times, be \pm altered. This occurs when the perithecial stalk cell twists one way or the other when the cover glass is applied. Effort was made to interpret correctly such distortions in preparing the descriptions.

Contents of cells and perithecia of fungi removed from insects that had been air dried or fixed in alcohol often are \pm altered. Also, when thalli are mounted on slides, weight of the cover glass often compresses perithecia somewhat so that their outer wall cells may separate slightly, especially longitudinally. Because such artifacts are typical of mounted specimens of Laboulbeniales, they have been depicted in the drawings.

In referring to the perithecium and receptacle, anterior (or forward) is in the direction away from the appendage whereas posterior (or backward) is in the direction toward the appendage. In referring to cells of the receptacle, stalk and basal cells of the perithecium, and cells of the appendage, inner (inward or inside) is in the direction of the longitudinal axis of the ascoma, outer (outward or outside) is in the direction away from the axis. In all measurements, length (height) precedes width (breadth). Total length of the thallus, where in some instances the receptacle or perithecium

may be \pm curved, bent, or reflexed, was measured along the median axis. Occasionally, length is the only dimension given for cells where orientation made meaningful determination of width uncertain, e.g., cell VII, cells *m*, *n*, *n'*, and outer wall cells. Perithecial basal cell *n* gives rise to two vertical rows of outer wall cells instead of only one row each as do basal cells *m* and *n'*. The relationship of a cell (cells) of one of the *n*-basal-cell-derived rows of outer wall cells to those derived from basal cells *m* or *n'* is given as *ex n adj. m* or *ex n adj. n'*, i.e., adjacent to the *m*- or *n'*-basal-cell-derived row of outer wall cells.

TAXONOMY

AUTOPHAGOMYCES Thaxt., *Proc. Amer. Acad. Arts* 48: 172, 1912; emend. Thaxt., *Mem. Amer. Acad. Arts* 16: 90, 1931; emend. R. K. Benj.

Receptacle consisting of three cells (I, II, III); basal and suprabasal cells (I, II) superposed, separated by a \pm transverse cross wall; terminal cell (III) united laterally in whole or in part on the inside with cell II, its base often approaching or united with cell I, rarely united in part distally on the inside with cell VI of the perithecium; cell II subtending a single, stalked perithecium; cell III subtending one or more appendages. Appendages simple or branched, consisting of one to several superposed cells bearing simple antheridia terminally or laterally. Perithecium with a primary stalk cell (VI), secondary stalk cell (VII), three persistent basal cells (*m*, *n*, *n'*), and four vertical rows of outer wall cells of five cells each. Trichogyne unbranched, consisting of two, rarely three, cells; basal cell small, medianly constricted, the upper cell or cells forming an elongate \pm cylindrical body; trichogynic remnant rarely evident. Ascogenic cell single. Ascospore 1-septate.

Type species.—*Autophagomyces platensis* Thaxt.

When he described *Autophagomyces*, Thaxter (1912) believed the genus to be dioecious, with the male growing parasitically on the female. He based this on [using present-day terminology] the unusual position of cell III—always called the basal cell or stalk cell of the appendage by Thaxter—of the receptacle at the base of the suprabasal cell (II) in the two species then available for study, *A. platensis* (Fig. 4) and *A. nigripes* (Fig. 6). Long before his later revision of *Autophagomyces*, Thaxter (1931) realized that in these species the dark suffusion of the foot, formed by cell I, usually obscures the base of cells II and III and conceals the true relationship of the three cells of the receptacle. He recognized that these species and others found in the meantime are monoecious. However, the name *Autophagomyces* had to stand.

Thaxter (1931) adopted a broad concept of *Auto-*

phagomyces and included in the genus a number of taxa having characteristics that clearly distinguish them from the type species. Some of these taxa have been assigned to other genera, and *Bordea* is being resurrected in the present study (see Introduction above).

I am here limiting the concept of *Autophagomyces* to taxa having a combination of most or all of the following characteristics. (1) Cell III of the receptacle is separated from cell II by a strongly diagonal or vertical cross wall. In nine of the twelve species included in the genus, cell III is positioned near to or at the base of cell II, which often extends well beyond the distal end of cell III. In 11 of these species, the base of cell III approaches or even contacts cell I. (2) Cells I and II are separated by a transverse or, rarely, slightly diagonal cross wall. (3) One or more (up to three known thus far) free, slender appendages are borne by cell III. These may be simple or branched, consist of a small but variable number of superposed cells, and bear elongate, slender, terminal or lateral, simple antheridia. Not infrequently, primary antheridia abort and may be subtended by similar secondary antheridia. (4) A spine is lacking either on an antheridium or a cell of an appendage. (5) The trichogyne (observed on immature thalli of six of the 12 species studied here) consists of two, rarely three, cells; the lower cell is short and constricted \pm medianly; the upper cell(s) forms an elongate, unbranched, cylindrical body. (6) Except for *A. hammondii*, a trichogynic remnant on mature perithecia typically is not discernible. (7) Perithecium with five tiers of outer wall cells. In my experience, except in one species (i.e., *A. hammondii*), the distinction between a fourth and a fifth tier is not clearly defined.

KEY TO THE SPECIES OF *AUTOPHAGOMYCES*

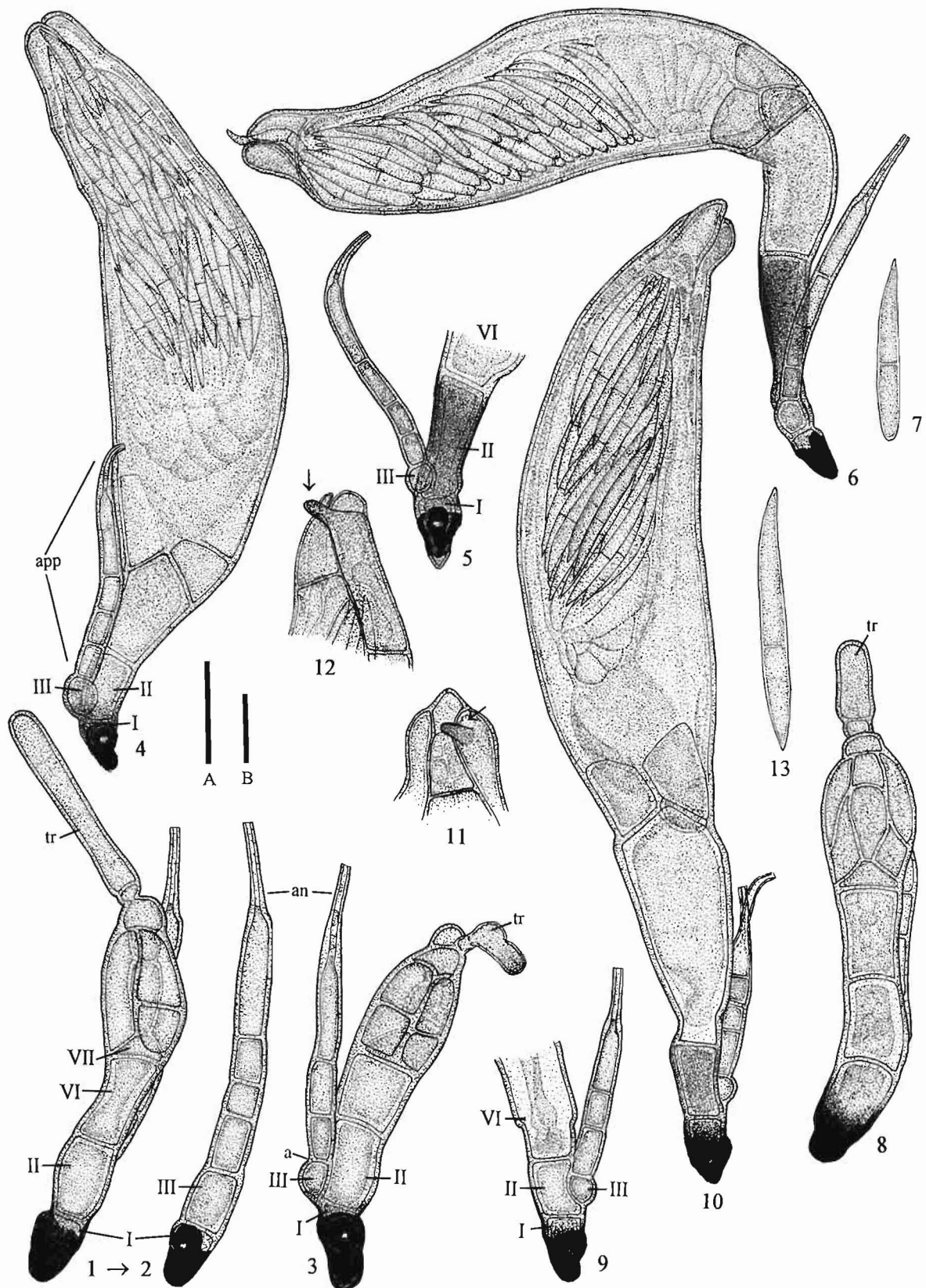
- A. Cell I relatively short, often \pm obscured by the blackened foot; cell III small, united on the inside at or near the base of cell II, which may extend upward well beyond the distal end of cell III, forming a \pm free basal extension of the perithecial stipe (on Anthicidae) B
 – Cell I elongate, body extending well beyond the blackened foot; cell III broadly united on the inside below with cell II and above with the base of cell VI; cell II not extending beyond the distal end of cell III J
 B. Cell II partially or almost wholly deeply suffused with dark brown or brownish black C
 – Cell II at the most \pm pale yellowish E
 C. Cell II about twice as long as broad, only moderately suffused with brown 3. *A. kamerunensis*
 – Cell II about 3–4 times as long as broad, deeply suffused with brown or brownish black D
 D. Total length of thallus ca. 150–190 μ m 2. *A. nigripes*
 – Total length of thallus ca. 230–320 μ m 6. *A. subfuscatus*
 E. Cell VI about as long as body of perithecium including basal cells, with closely spaced transverse grooves extending from just above its base to just below its apex 5. *A. longicaulis*
 – Cell VI without transverse grooves F

- F. Posterior terminal outer wall cell forming an elongate, broad, terminally rounded protuberance 8. *A. protuberans*
 – Not as above G
 G. Appendages 1(–2), bearing single terminal antheridia, which may abort and be subtended by secondary antheridia. H
 – Appendages 2–3, simple or branched, bearing terminal or lateral antheridia, which may abort and be subtended by secondary antheridia 7. *A. ramosus*
 H. Thallus ca. 210–230 μ m long 9. *A. mexicanus*
 – Thallus between ca. 125 and 170 μ m I
 I. Thallus curved; perithecial body broadened near base, strongly narrowed distally, apex straight 1. *A. platensis*
 – Thallus \pm sigmoid; perithecial body not strongly narrowed distally; apex abruptly narrowed, turned outward slightly 4. *A. guatemalensis*
 J. Cell III in \pm broad contact with cell I; perithecial basal cells (*m*, *n*, *n'*) and cell VII elongate, forming part of an elongate perithecial stipe (on Phalacridae) K
 – Cell III not in contact below with cell I; perithecial basal cells and cell VII not elongate, forming only the rounded base of the perithecial body (on Scaphidiidae) 12. *A. hammondii*
 K. Suprabasal cell of appendage with a blunt, subterminal, upwardly directed, projection 10. *A. gracilis*
 – Suprabasal cell of appendage unmodified 11. *A. grenadinus*

1. *AUTOPHAGOMYCES PLATENSIS* Thaxt., *Proc. Amer. Acad. Arts* 48: 172, 1912; emend., *Mem. Amer. Acad. Arts* 16: 92, 1931. Fig. 1–4

Ascoma: Slightly curved backward, hyaline to pale yellow. Length from tip of foot to tip of perithecium 124–169 μ m. *Receptacle*: Relatively short, 21–24 μ m long from tip of foot to junction of cell II with cell VI of perithecium; cells I and II subequal, slightly longer than broad; cell I tapered downward to tip of blackened foot, often completely obscured by the suffusion, which may extend upward to lower part of cells above, 10–13 \times 7–10 μ m; cell II with nearly parallel sides, 10–13 \times 8–11 μ m; cell III only slightly longer than broad, 6–8 \times 5–7 μ m, \pm rounded on the outside, united on the inside to the base of cell II. *Appendages*: One (–two), free, slender, simple, rarely branched, 30–55 μ m long; body consisting of 1–3 cylindrical superposed cells 5–10 \times 4–5(–6) μ m; antheridium 25–35 μ m long, venter 4–5 μ m wide, efferent tube ca. 10–20 \times 1.5 μ m. *Perithecium*: Cell VI 13–23 μ m long, broadest distally, 8–11 μ m wide at base, 12–20 μ m wide at junction with basal cells; cell VII ca. 8–11 μ m high, closely associated with basal cells (*m*, *n*, *n'*), and together with these comprising ca. 15% of total length of perithecial body above cell VI; body elongate, 94–137 μ m long including basal cells, posterior margin \pm concave, anterior margin \pm strongly convex, broadest below the middle, 31–40 μ m wide, then tapered gradually to the subtruncate or rounded apex. Ascospores est. ca. 25–30 \times 3 μ m (inside perithecium).

Specimens examined.—ARGENTINA. BUENOS AIRES PROV.: Lavallol, Escuela Regional de Santa Catalina, Apr 1906, R. Thaxter coll., on elytra of *Tomoderus forticornis* Pic, Thaxter 1982 (FH Acc. #s 4031 [HOLOTYPE & ISOTYPES], 4032, 4033, 4034, and 4035 [ISO-



Key to labeling of the figures: I, basal cell of receptacle; II, suprabasal cell of receptacle; III, terminal cell of receptacle; VI, primary stalk cell of perithecium; VII, secondary stalk cell of perithecium; *a*, original septum of spore (also its position in a developing thallus); *an*, antheridium; *app*, appendage; *bc*, an unidentified cell cut off from cells VI or VII that has not yet divided and formed a true basal cell (*m*, *n*, or *n'*); *d*, perithecial initial; *ha*, haustorium, or part thereof; *m*, perithecial basal cell derived from cell VI, gives rise to one vertical row of wall cells; *n*, one of two perithecial basal cells derived from cell VII, gives rise to two vertical rows of wall cells; *n'*, the other perithecial

TYPES)).—Same collection data, *Thaxter 1982* (duplicate host), *RKB 1655A* (slide in RSA).

Notes.—Three of Thaxter's five slides (FH 4031–4033) must represent his first mounts of *A. platensis*. Data recorded on the labels of these were handwritten in red, and, interestingly, Thaxter provisionally named the fungus "Oxandromyces platensis." The stem of this tentative generic name, which he never formally accepted, undoubtedly derived from *Oxys* (fr. L., fr. Gk.: sharp, keen pointed, acute) in reference to the shape of the antheridial appendage. The other two slides (FH 4034, 4035) must have been prepared some time later when he had settled on the name "Autophagomyces platensis"; data on the labels were written in black ink. At this time, apparently, he overwrote, in black ink, *Oxandromyces* on the first three slides with "Autophagomyces" and added the host name.

Measurements given in the above description of *A. platensis* were gleaned from 14 mature individuals found on the five preparations cited above. This species most closely resembles *A. guatemalensis*, differing in its longer perithecial body with its straight, uniformly tapered rather than outturned apex.

2. *AUTOPHAGOMYCES NIGRIPES* Thaxt., *Proc. Amer. Acad. Arts* 48: 173, 1912; emend., *Mem. Amer. Acad. Arts* 16: 91, 1931. Fig. 5–7

Ascoma: More or less strongly bent at an angle above cell VI, hyaline to pale yellow except for the dark blackish brown basal and suprabasal cells (I, II) of receptacle. Length from tip of foot to tip of perithecial body 153–190 μm . *Receptacle*: Elongate, 36–50 μm long from tip of foot to junction of cell II with cell VI of perithecial body; cell I slightly longer than broad, 10–15 \times 7–9 μm , \pm hyaline distally, tapered downward to tip of blackened foot; cell II elongate, \pm suffused with blackish brown, often nearly opaque, 25–35 μm long, broadest above, 10–13 μm wide distally, 6–9 μm wide near base; cell III isodiametric, 6–7 \times 6–7 μm , \pm rounded on the outside, united on the inside to the base of cell II. *Appendages*: One (–three), free, slender, simple, 30–60 μm long; body consisting

of 1–3 cylindrical superposed cells 6–11 \times 4–5 μm ; antheridium 23–35 μm long, venter 4–5 μm wide; efferent tube ca. 12–18 \times 2–2.5 μm . *Perithecial body*: Cell VI \pm curved, longer than wide, 23–30 μm long, broadest distally, 15–20 μm wide at junction with basal cells, 9–13 μm wide at base; cell VII small, 6–12 \times 8–11 μm , closely associated with basal cells (*m*, *n*, *n'*), and together with these comprising ca. 15% of total length of perithecial body above cell VI; body elongate, 91–125 μm long including basal cells, slightly sigmoid, margins \pm convex, broadest near the middle, 30–38 μm wide, then tapered gradually upward, abruptly narrowed below the broadly rounded, slightly oblique apex. Ascospores est. ca. 24–30 \times 3 μm (inside perithecial body).

Specimens examined.—ARGENTINA. BUENOS AIRES PROV.: Lavallol, Escuela Regional de Santa Catalina, Apr 1906, R. Thaxter coll., on inferior surface of abdomen of *Tomoderus forticornis*, *Thaxter 1983* (FH Acc. #s 4026 [HOLOTYPE & ISOTYPES], 4028, and 4029 [ISOTYPES]).—Collection data as for *A. platensis*, *Thaxter 1982*, at base of right leg of *Tomoderus forticornis* (FH Acc. # 4027 [PARATYPES]).—Same collection data, on rear legs of *T. forticornis*, *Thaxter 1982* (duplicate host), *RKB 1655B* (RSA).

Notes.—As with *A. platensis*, the data on the labels of Thaxter's first three slides of *A. nigripes* (FH 4026, 4028, 4029) are written in red ink. He also provisionally penned the generic name "Oxandromyces" on these; however, he used "geniculatus" as a possible specific epithet. Subsequently, using black ink, he added the host name and overwrote both of the above names in black ink with "Autophagomyces nigripes." The label for the fourth slide (FH 4027), prepared from another specimen of the same lot of hosts, is scripted in black ink with the fungus identified as "Autophagomyces nigripes."

My measurements given for *A. nigripes* were based on examination of 10 mature individuals found on the five slides studied. This species differs from the African species, *A. subfuscatus*, which also has a darkly pigmented cell II, in the shorter broader habit of its perithecial body.

basal cell derived from cell VII, gives rise to one vertical row of wall cells; *o*, a primordial outer wall cell, which divides and gives rise below to a true outer wall cell and above to another primordial wall cell; ultimately it becomes the terminal outer wall cell; *psx*, propine, spinelike tip of upper cell of ascospore, will become *sx*; *sx*, indurate original spore apex; *tc*, trichophoric cell, lies between carpogenic cell and trichogyne; *tr*, trichogyne (also trichogynic remnant); *w*^{1–5}, tiers of outer wall cells, 1 (basal) to 5 (terminal) (also position of a cell in a vertical row of outer wall cells).

Fig. 1–13.—1–4. *Autophagomyces platensis* (Thaxter 1982).—1. Juvenile individual with trichogyne; cell III and appendage on far side.—2. Drawing showing appendage, cell I, and cell III as they appear when focus is on far side of individual depicted in Fig. 1.—3. Another juvenile in lateral view showing relationship of cells I–III, appendage, and trichogyne.—4. Mature individual (isotype).—5–7. *A. nigripes* (5, *RKB 1655B* [=Thaxter 1982]; 6, 7, *Thaxter 1983*).—5. Receptacle and appendage.—6. Mature individual (isotype).—7. Ascospore (as viewed inside perithecial body).—8–13. *A. kamerunensis*. (8–10, 13, *Thaxter 2590*; 11, 12, *Thaxter 2483*).—8. Juvenile with trichogyne.—9. Receptacle and appendage.—10. Mature individual (isotype).—11, 12. Two views of perithecial apex showing divergent prominence near tip of terminal outer wall cell *ex n. adj. m* (arrows).—13. Ascospore (outside perithecial body). (Bars. A = 20 μm , Fig. 4–6, 9, 10; B = 10 μm , Fig. 1–3, 7, 8, 11–13.)

3. AUTOPHAGOMYCES KAMERUNENSIS Thaxt., *Mem. Amer. Acad. Arts* 16: 91, 1931. Fig. 8–13

Ascoma: Hyaline, becoming pale yellowish, tinged with brown, except basal and suprabasal cells (I, II) of receptacle \pm suffused with blackish brown above blackened foot. Total length 175–210 μ m. *Receptacle*: Relatively short, 22–27 μ m long from tip of foot to junction of cell II with cell VI of peritheci-um; cells I and II subequal, longer than broad; cell I 11–18 \times 7–10 μ m, \pm suffused distally, tapered downward to tip of blackened foot; cell II (7–)10–15 μ m long, slightly broader distally, 7–10 μ m wide, \pm suffused; cell III slightly longer than broad, 6–8 \times 5–6 μ m, rounded on the outside, united on the inside to the base of cell II. *Appendages*: One(–two), free, slender, simple, 35–45 μ m long; body consisting of 2(–3) cylindrical superposed cells 5–10 \times 5 μ m; antheridium 23–28 μ m long, venter 4.5–5 μ m wide, efferent tube 12–18 \times 2 μ m. *Peritheci-um*: Cell VI 38–50(–60) μ m long, broadest distally, 18–22 μ m wide near junction with basal cells, 7–11 μ m wide at base, abruptly narrowed near base, forming a parallel-sided constriction 5–6 μ m long; cell VII small, 10–12 μ m high, closely associated with basal cells (*m*, *n*, *n'*), and together with these comprising ca. 15% of total length of perithecial body above cell VI; body elongate, 111–140 μ m long including basal cells, anterior margin convex, posterior margin nearly straight, broadest near the middle, 26–39 μ m wide, then tapered gradually upward; apex bluntly rounded; terminal outer wall cell *ex m* projecting slightly beyond other three; terminal outer wall cell *ex n adj. m* bearing a short, divergent prominence 5–6 \times 2 μ m distally. Ascospores est. ca. 30 \times 3 μ m (inside peritheci-um).

Specimens examined.—AFRICA. CAMEROON [as KAMERUN]: date?, coll. ?, on right side of head of *Tomoderus kraatri* Pic, Thaxter 2590 (FH Acc. #s 4020 [HOLOTYPE & ISOTYPES] and 4021 [ISOTYPES]); 1913, Schwab coll., on posterior surface of prothorax of *T. kraatri*, Thaxter 2483 (FH Acc. #4022 [PARATYPES]).

Notes.—Measurements given in the above description of *A. kamerunensis* were obtained from 12 mature specimens found on the three slides cited. Data on labels are written in black ink, and only on FH 4022 were the collector and year of collection given (i.e., “Schwab 1913”); however, because George Schwab long collected insects in Cameroon for Thaxter one can presume that he was the source for FH 4020 and 4021 as well.

This species can be distinguished from *A. mexicanus*, especially, which it most closely resembles, by the brownish suffusion of cell II and the small, slender, divergent protuberance near the tip of the terminal outer wall cell *ex n. adj. m* (Fig. 11, 12).

4. AUTOPHAGOMYCES GUATEMALENSIS Thaxt., *Mem. Amer. Acad. Arts* 16: 90, 1931. Fig. 14–17

Ascoma: Pale yellowish, becoming tinged with brown, arcuate to \pm subsigmoid. Length from tip of foot to tip of peritheci-um 125–135 μ m. *Receptacle*: Relatively short, 19–23 μ m long from tip of foot to junction of cell II with cell VI of peritheci-um; cell I slightly longer than broad, 12–15 \times 7–9 μ m, hyaline distally, otherwise obscured by the blackened foot; cell II hyaline, nearly isodiametric, 6–9 \times 7–10 μ m; cell III slightly longer than broad, 6–7 \times 4 μ m, straight or slightly convex on the outside, adnate on the inside to nearly the total length of cell II. *Appendages*: One to two, free, slender, simple, 25–30(–42) μ m long; body consisting of a single cell or two superposed cells, 5–7 \times 4–5 μ m, these externally parallel-walled or slightly convex; antheridium 19–20 μ m long, venter 4–5 μ m wide, efferent tube 10–12 \times 2 μ m. *Peritheci-um*: Cell VI 27–28 μ m long, broadest distally, ca. 18 μ m wide at junction with basal cells, ca. 8 μ m wide at base, abruptly narrowed near base and forming a short constriction 4–5 μ m long; cell VII small, 7–8 μ m high, closely associated with basal cells (*m*, *n*, *n'*), and together with these constituting ca. 15% of total length of perithecial body above cell VI; body elongate, 95–96 μ m long including basal cells, anterior margin strongly convex, posterior margin nearly straight, broadest below the middle, 28–33 μ m wide, then tapered gradually upward; apex short, broad, flat, abruptly bent forward, terminal outer wall cells prominent, broadly rounded distally. Ascospores est. ca. 30 \times 4 μ m (inside peritheci-um).

Specimens examined.—GUATEMALA. Isobal, Feb 1908, W. A. Kellerman coll., on lower surface of abdomen of *Tomoderus brevicornis* Champ. [as *T. forticornis*], Thaxter 1633 (FH Acc. #s 4013 [HOLOTYPE & ISOTYPES] and 4014 [ISOTYPES]).

Notes.—Material of *A. guatemalensis* available for study was limited to that on the two slides listed above. An additional slide must have existed, for Thaxter (1931: 90) stated that the specimen represented in his Fig. 4 had unfortunately been destroyed. My measurements incorporate some of those given by Thaxter in his description; these are supplemented by data from but two mature individuals (Fig. 14, 15), one lacking an appendage, two mature receptacles bearing appendages, and a mature receptacle with appendages, but having an immature peritheci-um (cf. Thaxter 1931, fig. 5 [Note: The position of the specimen on the slide is in reverse to that shown in Thaxter's illustration]). The appendages of another immature individual, shown, in part, in Fig. 16, were badly oriented and could not be measured.

Thaxter inadvertently listed the host of *A. guatemalensis* as *Tomoderus forticornis* rather than *T. brevicornis* as given on his slides. The latter also is the

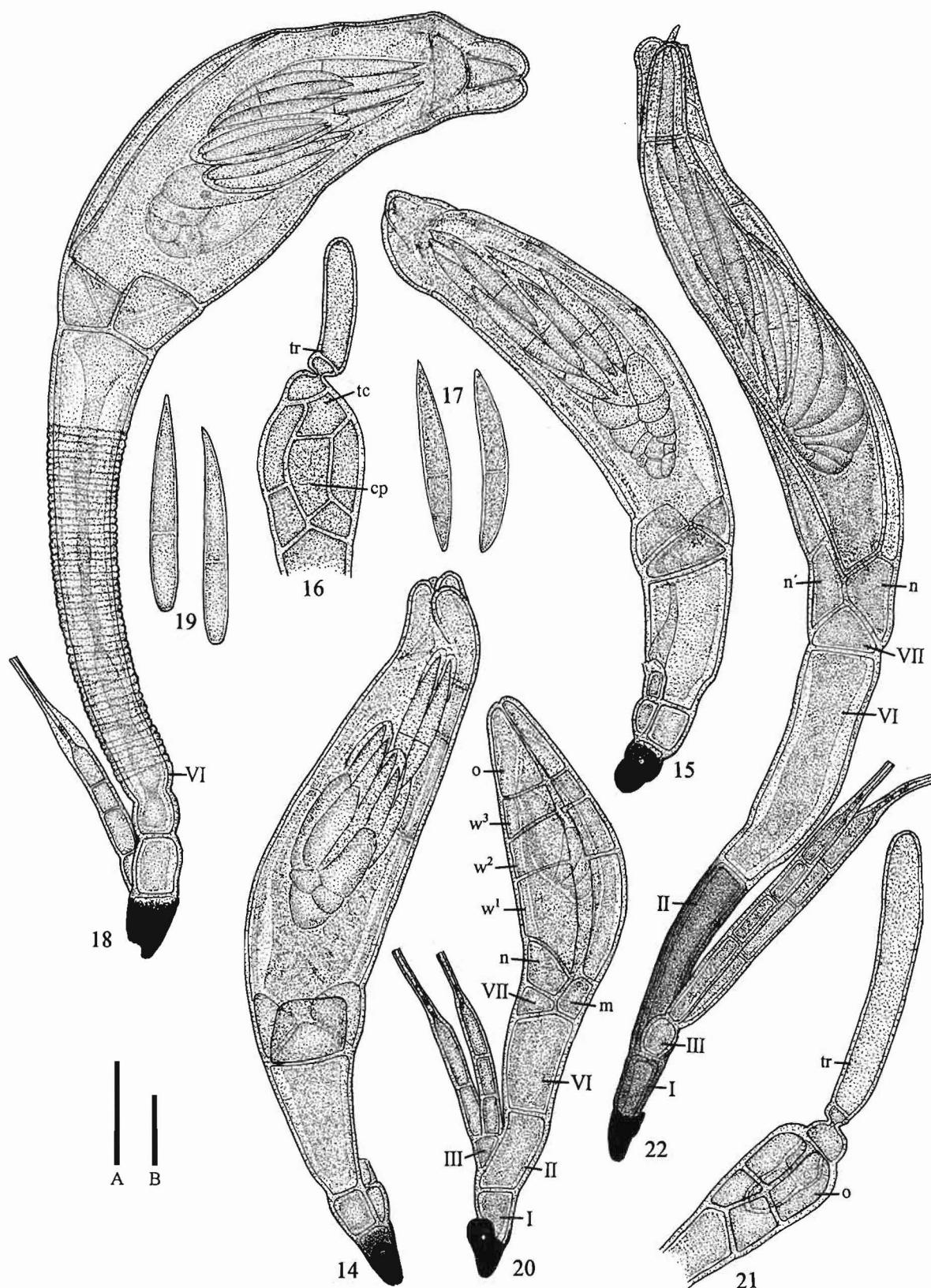


Fig. 14–22.—14–17. *Autophagomyces guatemalensis* (Thaxter 1633).—14, 15. Two mature individuals (isotypes).—16. Terminal part of young perithecium with trichogyne.—17. Two ascospores (as viewed inside perithecium).—18, 19. *A. longicaulis* (Thaxter 1633).—18. Mature individual (isotype); note location of transverse grooves on primary perithecial stalk cell.—19. Two ascospores (as viewed inside perithecium).—20–22. *A. subfuscatus* (Thaxter 2590).—20. Juvenile at four-outer-wall-cell stage of perithecial development.—21. Terminal part of young perithecium at one outer wall stage with trichogyne.—22. Mature individual (holotype). (Bars: A = 20 μ m, Fig. 14, 15, 18, 20, 22; B = 10 μ m, Fig. 16, 17, 19, 21.)

host of *A. longicaulis*, which occurred on the same insect as *A. guatemalensis* (Thaxter 1931: 91).

5. *AUTOPHAGOMYCES LONGICAULIS* Thaxt., *Mem. Amer. Acad. Arts* 16: 91, 1931. Fig. 18, 19

Ascoma: Very pale yellow, strongly curved forward, body of perithecium including basal cells subequal in length to that of cell VI of perithecium. Total length from tip of foot to tip of perithecium 224–230 μm . *Receptacle*: Short, 23–26 μm long from tip of foot to junction of cell II with base of cell VI; cell I only slightly longer than broad, $13\text{--}14 \times 10 \mu\text{m}$, hyaline distally immediately below cell II, otherwise obscured by the blackened foot; cell II hyaline, nearly isodiametric or only slightly longer than broad, $9\text{--}13 \times 10 \mu\text{m}$, slightly narrowed at juncture with cell VI; cell III small, slightly longer than broad, ca. $7 \times 4 \mu\text{m}$, slightly convex on the outside, adnate on the inside to cell II. *Appendage*: Single, free, simple, 43–45 μm long; body consisting of two superposed cylindrical cells, $6\text{--}11 \times 5 \mu\text{m}$; antheridium 26–30 μm long, venter 5 μm wide, efferent tube $16\text{--}20 \times 2 \mu\text{m}$. *Perithecium*: Cell VI 93–98 μm long, broadest distally, ca. 18–20 μm wide at junction with basal cells, gradually narrowed downward, 10 μm wide at base, slightly narrowed near base and forming a short constriction 6–8 μm long, which is slightly convex externally, with distinct, closely spaced transverse grooves that extend from ca. 10–12 μm above base to ca. 15–20 μm below junction with basal cells; cell VII small, closely associated with basal cells (*m*, *n*, *n'*), and together with these comprising ca. 15% of total length of perithecial body above cell VI; body elongate, curved forward, 107–110 μm long including basal cells, posterior margin strongly convex, anterior margin convex below, broadest below the middle, 36–39 μm wide, then tapered upward; apex broad, slightly asymmetric. Ascospores est. ca. $29\text{--}30 \times 4 \mu\text{m}$ (inside perithecium).

Specimens examined.—GUATEMALA. Isobal, Feb 1908, W. A. Kellerman coll., on lower surface of abdomen of *Tomoderus brevicornis*, Thaxter 1633 (FH Acc. # 4025 [HOLOTYPE & ISOTYPES]).

Notes.—The single slide mount of *A. longicaulis* bears three specimens, the type and two isotypes, all in excellent condition. The label on the left end of the slide is annotated “remounted Feb. 11, 1928.” Thaxter’s original mount apparently included four specimens, for in his brief commentary on the species he states “The appendage, in the four mature types, is simple. . .” One individual must have been lost during preparation of the remount.

This species is most clearly distinguished by the closely spaced, transverse grooves adorning the perithecial stalk cell (Fig. 18). Thaxter did not mention these grooves, which undoubtedly would have been difficult to resolve using ordinary illumination avail-

able to him at the time. They stand out clearly when viewed with differential interference contrast optics.

6. *AUTOPHAGOMYCES SUBFUSCATUS* Thaxt., *Mem. Amer. Acad. Arts* 16: 92, 1931. Fig. 20–22

Ascoma: Elongate, slender, \pm sigmoid, nearly hyaline above the dark brownish black basal and supra-basal cells of receptacle. Total length from tip of foot to tip of perithecium 229–316 μm . *Receptacle*: Elongate, 58–87 μm long from tip of foot to junction of cell II with base of cell VI of perithecium; cell I longer than broad, $17\text{--}24 \times 7\text{--}9 \mu\text{m}$, \pm deep brownish black above blackened foot; cell II elongate, 38–79 μm long, slightly broader above, 9–10 μm wide distally, 7–8 μm wide at base; cell III suffused, isodiametric, $6\text{--}8 \times 6\text{--}8 \mu\text{m}$, rounded on the outside, adnate on the inside to the base of cell II. *Appendages*: Two, free, simple, 67–85 μm long; body consisting of three cylindrical cells, lowermost cell $14\text{--}30 \times 4\text{--}5 \mu\text{m}$, somewhat longer than the two upper cells, which are $10\text{--}17 \times 4\text{--}5 \mu\text{m}$; antheridium 28–37 μm long, venter 4–5 μm wide, efferent tube $12\text{--}22 \times 2 \mu\text{m}$. *Perithecium*: Cell VI 48–69 μm long, slightly broader distally than basally, ca. 13–19 μm wide at junction with basal cells, 8–10 μm wide at base, slightly abruptly narrowed near base and forming a short constriction 6–8 μm long; cell VII small, 8–10 μm high, ca. 12–13 μm wide, closely associated with basal cells (*m*, *n*, *n'*), and together with these comprising ca. 15% of total length of body of perithecial body above cell VI; body elongate, slender, curved forward, 163–218 μm long including basal cells, posterior margin convex, anterior margin slightly concave, broadest slightly below the middle, 23–31 μm wide, then tapered gradually upward to the slightly narrowed apex, which is tipped slightly backward; apex broad, terminal outer wall cell *ex n'* projecting slightly beyond other three. Ascospores est. ca. $30\text{--}32 \times 3\text{--}4 \mu\text{m}$ (inside perithecium).

Specimens examined.—AFRICA. CAMEROON: date?, coll.?, on right side of head and at base of middle legs of *Tomoderus kraatii*, Thaxter 2590 (FH Acc. #s 4044 [HOLOTYPE & ISOTYPES] and 4045, 4046, and 4047 [ISOTYPES]).

Notes.—The four slides cited above provide 14 mature individuals of *A. subfuscatus* (of which ten are unbroken); there are three immature individuals (cf. Fig. 20), two bearing a trichogyne (cf. Fig. 21); and there are several fragments consisting of receptacles with or without appendages. Thaxter wrote neither the date of collection nor the name of the collector on the labels; however, all specimens of the species were taken from the same host (Thaxter 2590) as the type of *A. kamerunensis*, and they undoubtedly were collected by George Schwab, probably in 1913.

This species (Fig. 22) is distinguished by its elongate, slender, \pm sigmoid habit coupled with the black-

ish suffusion of cells I and II of the receptacle. In all instances cell III subtends two elongate, simple appendages.

7. **Autophagomyces ramosus** R. K. Benj., sp. nov.
Fig. 23–28

Ascoma: Hyalinum, leuteolescens, fortiter retrocurvatum. Thallus totus 155–180 μm longus ad apicem peritheci. *Receptaculum*: Relative parvum, 25–30 μm longum ex apice pedis usque ad juncturam cellulae II basi cellulae VI; longitudines cellularum I et II subaequalia; cellula I ca. $15 \times 10 \mu\text{m}$, decrescens ad pedem denigratum; apice plus minusve atrosuffusus; cellula II cylindracea, $10\text{--}15 \times 10\text{--}12 \mu\text{m}$; cellula III ad basin cellulae II unita, $9\text{--}10 \times 6\text{--}9 \mu\text{m}$, extra plus minusve rotundata. *Appendices*: Duae, raro tres, liberae, 35–55 μm longae, simplices vel semel ramosae supra cellulam infimae; cellulae infimae $6\text{--}10 \times 4\text{--}6 \mu\text{m}$; 1–3 cellulae superae $5\text{--}10 \times 3\text{--}5 \mu\text{m}$; antheridia terminalia vel lateralia, 25–30 μm longa; venteres 3–5 μm lati; tubi $7\text{--}13 \times \text{ca. } 2 \mu\text{m}$. *Perithecium*: Cellula VI 20–45 μm longa; apice 20–25 μm in latitudinem, basi 10–12 μm in latitudinem, marginibus plus minusve convexis; cellula VII 9–12 μm longa; cellula VII et cellulae *m*, *n*, et *n'* combinatae prope 1/6 corporis peritheci in tota longitudine supra cellulam VI formantes; corpus peritheci arcuatum, 107–124 μm longum cum cellulis basilaribus, margine antica fortiter convexa, margine postica plus minusve concava, ad medio ca. 40–45 μm latum, a medio ad apicem decrescenti; apex latus; duo cellulae terminalis alternae late rotundatae et leviter projectae. Ascospores $33\text{--}35 \times 3.5\text{--}4 \mu\text{m}$. Typus *RKB 797* (RSA).

Ascoma: Hyaline, becoming faintly tinged with yellow, strongly curved backward. Total length from tip of foot to tip of perithecium 155–180 μm . *Receptacle*: Relatively small, 25–30 μm long from tip of foot to junction of cell II with base of cell VI; cells I and II subequal in length; cell I ca. $15 \times 10 \mu\text{m}$, tapered downward to tip of blackened foot, \pm suffused with black distally; cell II cylindrical, $10\text{--}15 \times 10\text{--}12 \mu\text{m}$; cell III united on the inside to the base of cell II, only slightly longer than broad, $9\text{--}10 \times 6\text{--}9 \mu\text{m}$, \pm rounded on the outside. *Appendages*: Two, rarely three, free, 35–55 μm long, simple or once branched above lowermost cells, which are $6\text{--}10 \times 4\text{--}6 \mu\text{m}$ and slightly broader, especially distally, than the 1–3 succeeding cells, which are $5\text{--}10 \times 3\text{--}5 \mu\text{m}$; antheridia terminal or lateral, 25–30 μm long, venters 3–5 μm wide, efferent tubes $7\text{--}13 \times \text{ca. } 2 \mu\text{m}$. *Perithecium*: Cell VI 20–45 μm long, 20–25 μm wide distally, 10–12 μm wide at base, margins \pm convex; cell VII 9–12 μm long, closely associated with the relatively short basal cells (*m*, *n*, *n'*), and together with these forming ca. 15% of total length of perithecial body above cell VI;

body arcuate, 107–124 μm long including basal cells, anterior margin strongly convex, posterior margin \pm concave, broadest near the middle, ca. 40–45 μm wide, then tapered upward to the broad apex; two of the four terminal outer wall cells broadly rounded and projecting slightly beyond the other two smaller and less prominent cells, with which they alternate. Ascospores $33\text{--}35 \times 3.5\text{--}4 \mu\text{m}$.

Etymology.—From *ramosus* (L.), branched, in reference to the branched appendages.

Holotype.—USA. ILLINOIS: **Fayette Co.**, Farina, 17 Sep 1950, R. K. Benjamin coll., on the median surface of the left elytron of *Tomoderus* sp., *RKB 797* (designated slide; RSA).

Isotypes.—Data as for the holotype, *RKB 797* (designated slides; RSA).

Paratypes.—USA. ILLINOIS: **Pope Co.**, Eddyville, 5 Apr 1948, Burks and Stannard coll., on the elytra of *Tomoderus* sp., *RKB 1129* (designated slides; RSA).

Notes.—Accession *RKB 797* consists of four slides, each bearing one mature individual. None of the specimens is in the best of condition, being \pm flattened by the cover glass. The best of these, the holotype, is depicted in Fig. 26; the well-developed appendage of another is depicted in Fig. 25. Hopefully, collections of the species will be made in the future that can provide more precise measurements of lateral dimensions, especially of the perithecium, than those given in the description. None of the 23 specimens on the five slide mounts of *RKB 1129* is mature, but some of these give information on juveniles (Fig. 23, 24) and the nature of the trichogyne (Fig. 27). The species is distinguished by its strongly arcuate perithecium with its broad apex, and especially by the often acropetal branching of its appendages, which results in the production of successive functional antheridia (Fig. 25).

8. **Autophagomyces protuberans** R. K. Benj., sp. nov.
Fig. 29–31

Ascoma: Hyalinum, luteolescens, prope rectum. Thallus totus 143–166 μm longus ad apicem peritheci. *Receptaculum*: Relative parvum, 22–30 μm longum ex apice pedis usque ad juncturam cellulae II basi cellulae VI; cellula I $12\text{--}16 \times 8\text{--}11 \mu\text{m}$, apice dilatatus et plus minusve atrosuffusus, decrescens ad pedem denigratum; cellula II cylindracea, $10\text{--}18 \times 10\text{--}15 \mu\text{m}$; cellula III ad basin cellulae II unita, $8\text{--}10 \times 5\text{--}7 \mu\text{m}$, extra leniter convexa. *Appendices*: Duae, liberae, 25–28 μm longae, simplices, 1–2(–3) cellulae, $5\text{--}7 \times 4\text{--}5 \mu\text{m}$, superpositi constantes; antheridium 17–22 μm longum; venter 4–5 μm latus; tubus $8\text{--}12 \times \text{ca. } 2 \mu\text{m}$. *Perithecium*: Cellula VI 20–32 μm longa, apice 18–26 μm in latitudinem, a apicem ad basi gradatim decrescens, prope basin plus minusve abrupte constricta,

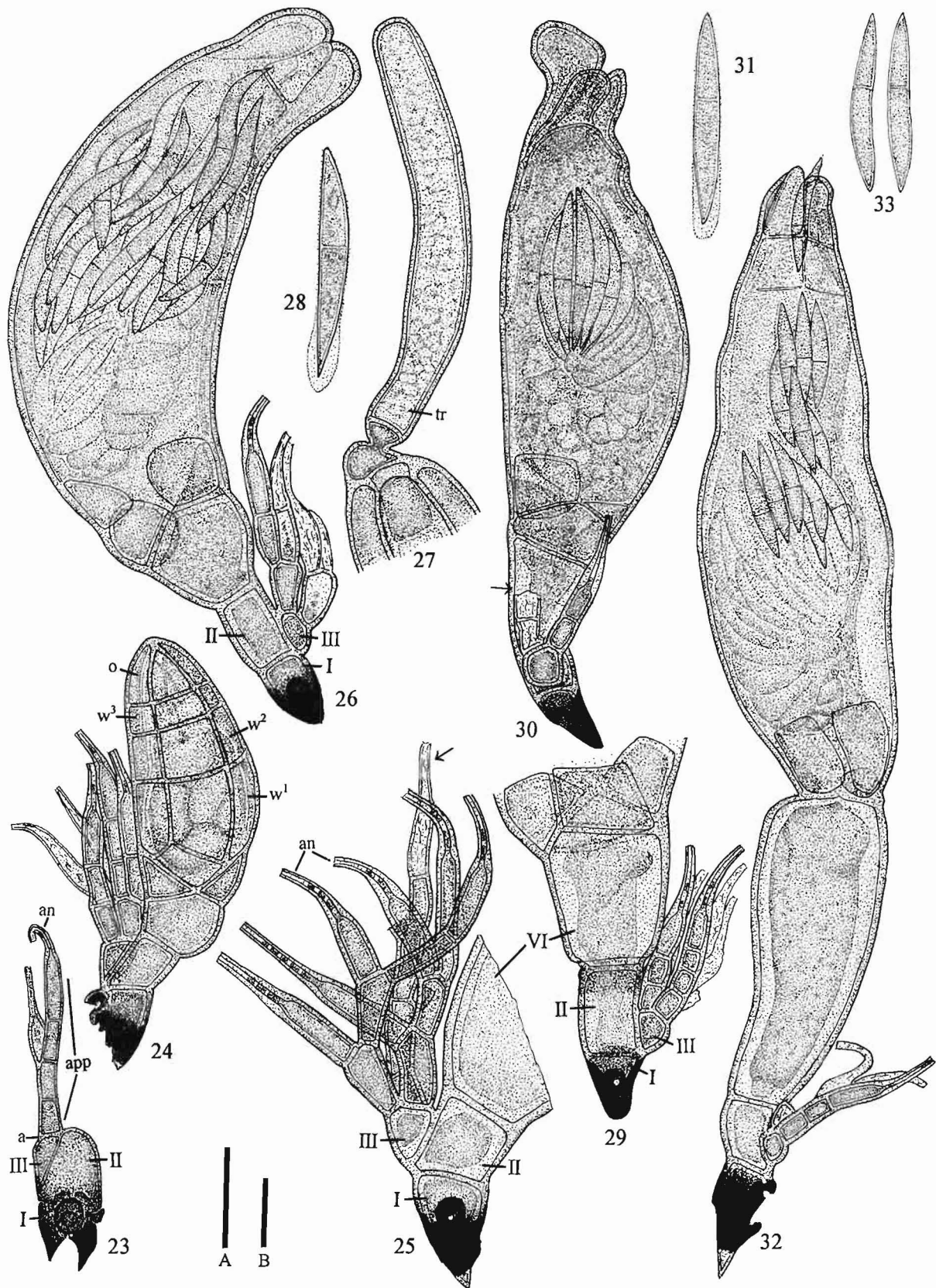


Fig. 23–33.—23–28. *Autophagomyces ramosus* (25, 26, 28, RKB 797; 23, 24, 27, RKB 1129).—23. Very young individual showing relationship of receptacular cells I–III derived from the lower cell of the ascospore. The first antheridium formed by the first-formed appendage aborted and was bypassed by upward growth of appendage, which produced a secondary terminal antheridium.—24. Juvenile with perithecium at four-outer-wall-cell stage of development.—25. Receptacle showing relationship of three appendages, which are subtended

basi 10–14 μm lata; cellula VII 9–12 μm longa; cellula VII et cellulae *m*, *n*, et *n'* combinatae prope 1/6 corporis peritheci in tota longitudine supra cellulam VI formantes; corpus peritheci prope rectum, 90–115 μm longum cum cellulis basilaribus, margine antica fortiter convexa, margine postica prope recta vel leniter convexa, ad medio 33–38 μm latum, a medio ad apicem decrescenti, apex latus; cellula terminalis postica elongata cum apice lato tholiformi, 9–10 \times 12 μm , cellulae terminales anticae et laterales breviores cum apicibus angustatis rotundatis. Ascospores 26–35 \times 3.5–4 μm . Typus *RKB 1529A* (RSA).

Ascoma: Hyaline, becoming faintly tinged with yellow, nearly straight. Total length from tip of foot to tip of peritheci 143–166 μm . *Receptacle*: Relatively small, 22–30 μm long from tip of foot to junction of cell II with base of cell VI; cell I 12–16 \times 8–11 μm , broadest above, tapered downward to tip of blackened foot, \pm suffused with black distally; cell II cylindrical, 10–18 \times 10–15 μm ; cell III united on the inside to the base of cell II, slightly convex on the outside, longer than broad, 8–10 \times 5–7 μm . *Appendages*: Two, free, 25–38 μm long, simple, consisting of 1–2, rarely 3, superposed cells below terminal antheridium; lowermost cell 5–7 \times 4–5 μm , succeeding cell or cells 5–6 \times 4–5 μm ; antheridium 17–22 μm long, venter 4–5 μm wide, efferent tube 8–12 \times ca. 2 μm . *Peritheci*: Cell VI 20–32 μm long, 18–26 μm wide distally, tapered downward gradually, \pm abruptly slightly constricted near base, which is 10–14 μm wide; cell VII 9–12 μm long, closely associated with the relatively short basal cells (*m*, *n*, *n'*) and together with these forming ca. 15% of total length of perithecial body above cell VI; body nearly straight, 90–115 μm long including basal cells, anterior margin strongly convex, posterior margin nearly straight to slightly convex, broadest near the middle, 33–38 μm wide, then tapered upward to the broad tip, terminal outer wall cells distinguished, posterior cell protrudent, its apex broad, 9–10 \times 12 μm , projecting well beyond the other three cells, which are narrow and bluntly rounded distally. Ascospores 26–35 \times 3.5–4 μm .

Etymology.—From *protuberans* (L.), bulging, swollen, in reference to the prominent posterior terminal outer wall cell.

Holotype.—MEXICO. QUINTANA ROO: Cozumel, 14 Jul 1952, L. J. Stannard coll., on legs of *Tomoderus* sp., *RKB 1529A* (designated slide; RSA).

Isotypes.—Data as for the holotype, *RKB 1529A* (designated slides; RSA).

Notes.—Eight mature individuals of *A. protuberans* are included on three slides representing the above accession. There are no juveniles. As with *A. ramosus*, some individuals are slightly flattened, and where this was considered excessive, especially regarding the width of the peritheci, lateral measurements were not included in the description. The distinctive modification of the posterior terminal outer wall cell (Fig. 30) and the abrupt constriction near the base of cell VI (Fig. 29) serve to distinguish the species from all others found on *Tomoderus*.

9. *Autophagomyces mexicanus* R. K. Benj., sp. nov. Fig. 32, 33

Ascoma: Luteolum, prope rectum. Thallus totus 209–230 μm longus ad apicem peritheci. *Receptaculum*: Relative breve, 30–42 μm longum ex apice pedis usque ad juncturam cellulae II basi cellulae VI; cellula I 20–22 μm longa, apice 10–12 μm latus, decrescens ad pedem, plus minusve atrosuffusus praeter apicem brevem acicularem hyalinum; cellula II 10–20 \times 12 μm , margine antica plus minusve convexa; cellula III ad basin cellula II unita, ca. 8–9 \times 6 μm , extra plus minusve convexa. *Appendices*: Una(?) vel duae, liberae, simplices, ca. 35 μm longae, constans ex cellularum duarum superpositarum et antheridii singulas terminalis; cellula infima 6–7 \times 5 μm , cellula supera 5 \times 5 μm ; antheridium ca. 23 μm longum; venter 4 μm latus; tubus ca. 10 \times 2 μm . *Peritheci*: Cellula VI elongata, relative lata, margines plus minusve convexae, 50–70 μm longa, apice 25–26 μm in latitudinem et fortiter constricta, a apicem ad basi decrescens, basi 12–14 μm lata; cellula VII parva, 8–10 μm longa; cellula VII et cellulae *m*, *n*, et *n'* combinatae prope 1/6 corporis peritheci in tota longitudine supra cellulam VI formantes; corpus peritheci prope rectum, 119–129 μm longum cum cellulis basilaribus, ad medio 39–41 μm latum, margines plus minusve convexae leniter undulatae, ad apicem decrescenti; apex latus; cellulae terminales plus minusve aequales in longitu-

by cell III. Note acropetal branching of appendages, which bear several antheridia, and an aborted antheridium (arrow).—26. Mature individual (holotype) with two appendages; several antheridia have aborted.—27. Tip of young peritheci with trichogyne.—28. Ascospore.—29–31. *A. protuberans* (*RKB 1529A*).—29. Base of mature individual showing receptacle, appendages with several aborted antheridia, and basally constricted cell VI.—30. Mature individual (holotype). Distal part of one of the two appendages is missing (arrow); the intact appendage is extending towards the anterior side of peritheci.—31. Ascospore.—32, 33. *A. mexicanus* (*RKB 1529B*).—32. Mature individual (holotype).—33. Two ascospores (as viewed inside peritheci). (Bars: A = 20 μm , Fig. 23, 24, 26, 29, 30, 32; B = 10 μm , Fig. 25, 27, 28, 31, 33.)

dines, apicibus rotundatis. Ascospores ca. $23\text{--}25 \times 3.5\text{--}4 \mu\text{m}$. Typus *RKB 1529B* (RSA).

Ascoma: Pale yellow, nearly straight. Total length from tip of foot to tip of perithecium $209\text{--}230 \mu\text{m}$. *Receptacle*: Relatively short, $30\text{--}42 \mu\text{m}$ long from tip of foot to junction of cell II with base of cell VI; cell I only slightly longer than cell II; cell I $20\text{--}22 \mu\text{m}$ long, broadest distally, $10\text{--}12 \mu\text{m}$ wide, tapered downward and \pm suffused with black except for the short, acuminate hyaline tip; cell II $10\text{--}20 \times 12 \mu\text{m}$, anterior margin \pm convex; cell III united on the inside to the base of cell II, ca. $8\text{--}9 \times 6 \mu\text{m}$, \pm rounded on the outside. *Appendage*: One(?) or two, free, simple, ca. $35 \mu\text{m}$ long, consisting of two superposed cells below terminal antheridium; lower cell $6\text{--}7 \times 5 \mu\text{m}$; upper cell nearly isodiametric, $5 \times 5 \mu\text{m}$; antheridium ca. $23 \mu\text{m}$ long, venter $4 \mu\text{m}$ wide, efferent tube ca. $10 \times 2 \mu\text{m}$. *Perithecium*: Cell VI elongate, relatively broad, margins \pm convex, $50\text{--}72 \mu\text{m}$ long, $25\text{--}26 \mu\text{m}$ wide distally below a marked constriction at its junction with the basal cell region, tapered downward, $12\text{--}14 \mu\text{m}$ wide at base; cell VII small, $8\text{--}10 \mu\text{m}$ long, closely associated with the relatively short basal cells (*m*, *n*, *n'*), and together with these forming ca. 15% of total length of perithecial body above cell VI; body nearly straight, $119\text{--}129 \mu\text{m}$ long including basal cells, broadest near the middle, $39\text{--}41 \mu\text{m}$ wide, margins \pm convex, appearing undulate from slightly concave intervals between successive tiers of outer wall cells; tapered upward to the broad tip; terminal outer wall cells \pm equal in length, bluntly rounded distally. Ascospores est. ca. $23\text{--}25 \times 3.5\text{--}4 \mu\text{m}$ (inside perithecium).

Etymology.—Named for the country Mexico.

Holotype.—MEXICO. QUINTANA ROO: Cozumel, 14 Jul 1952, L. J. Stannard coll., on lower surface of abdomen of *Tomoderus* sp., *RKB 1529B* (designated slide; RSA).

Isotype.—Data as for the holotype, *RKB 1529B* (designated slide; RSA).

Notes.—Four mature specimens, representing two pairs of individuals, mounted on separate slides, were recovered for study. The species resembles *A. kamerunensis*, differing in its slightly larger thallus; the pronounced abrupt constriction between cell VI and the perithecial basal cells; the slightly undulate perithecial margins; and especially the absence of a divergent prominence on a terminal outer wall cell (Fig. 32).

10. AUTOPHAGOMYCES GRACILIS Thaxt., *Mem. Amer. Acad. Arts* 16: 93, 1931. Fig. 34–36

Ascoma: Elongate, slender, \pm strongly curved to slightly sigmoid; receptacle and lower two cells of ap-

pendage, especially outwardly, blackish brown; body of perithecium brownish yellow, otherwise nearly hyaline. Total length from tip of foot to tip of perithecium $243\text{--}298 \mu\text{m}$. *Receptacle*: Elongate, slender, $39\text{--}48 \mu\text{m}$ long from tip of foot to base of appendage; cell I slender, $30\text{--}38 \mu\text{m}$ long, $7\text{--}9 \mu\text{m}$ wide distally, tapered downward gradually to tip of blackened foot; cells II and III subequal, separated by a strongly diagonal cross wall; cell II $6\text{--}10 \times 5\text{--}8 \mu\text{m}$; cell III $6\text{--}10 \times 4\text{--}6 \mu\text{m}$, united distally on the inside with the base of cell VI. *Appendage*: Simple, free, curved outward slightly distally, $51\text{--}60 \mu\text{m}$ long; body consisting of three cells; lowermost cell nearly cylindrical, longer than wide, $7\text{--}12 \times 5\text{--}6 \mu\text{m}$; middle cell broadest below, $7\text{--}10 \mu\text{m}$ long, $5\text{--}6 \mu\text{m}$ wide near base, bearing a bluntly rounded projection on the outside immediately below the narrow hyaline distal part; upper cell relatively elongate, $10\text{--}16 \times 4 \mu\text{m}$; antheridium $20\text{--}33 \mu\text{m}$ long, venter ca. $4 \mu\text{m}$ wide, efferent tube $8\text{--}13 \times 2 \mu\text{m}$. *Perithecium*: Cell VI $66\text{--}69 \mu\text{m}$ long, $11\text{--}13(19) \mu\text{m}$ wide distally, gradually narrowed downward, $6\text{--}7 \mu\text{m}$ wide at base, slightly narrowed above base and forming a short constriction ca. $8 \mu\text{m}$ long; cell VII $40\text{--}59 \mu\text{m}$ long, closely associated with the relatively elongate basal cells (*m*, *n*, *n'*), these cells together with cell VI forming a perithecial stipe that often exceeds the ascigerous part of the perithecial body in total length; basal cells together with cell VII comprising ca. 40% of perithecial body above cell VI; body above cell VI $134\text{--}180 \mu\text{m}$ long; body above stipe $91\text{--}104 \mu\text{m}$ long, broadest near the middle, $25\text{--}35 \mu\text{m}$ wide, subfusiform to subclavate, often slightly more convex on one side than on the other, with slight elevations at junctures of some of the successive tiers of outer wall cells, narrowed toward the apex; tip slightly oblique or subsymmetrically rounded. Ascospores est. ca. $28\text{--}35 \times 3.5\text{--}4 \mu\text{m}$ (inside perithecium).

Specimens examined.—INDONESIA. SUMATRA: Sumatra Barat Prov., Fort de Kock, ca. 75 km N of Padang, date ?, E. Jacobson coll., on tips of elytra of Phalacridae gen. et sp. indet., *Thaxter 3179* (FH Acc. #s 4002 [HOLOTYPE & ISOTYPES] and 4003 [ISOTYPE]). LESSER ANTILLES. GRENADA: St. George, 1913, collector ?, on tips of elytra of ? *Phalacrus* 1. sp. (Phalacridae), *Thaxter 2770* (FH Acc. #4004 [PARATYPES]). MALAYSIA. SARAWAK: Kuching, 1912, J. C. Moulton coll., on margin of right elytron of Phalacridae gen. et sp. indet., *Thaxter 2375*, (FH Acc. #s 4005, 4006, and 4007 [PARATYPES], none mature). AFRICA. CAMEROON: ? 1913, ? George Schwab coll., on inner margins of elytra of ? *Olibrus* sp. (Phalacridae), *Thaxter 2570* (FH Acc. #4008 [PARATYPES]). PANAMA. CANAL ZONE (Headquarters): 15 Dec 1956, R. M. Altman, on tip of left elytron of Phalacridae gen. et sp. indet., *RKB 2813B* (RSA).

Notes.—As shown above, specimens of *A. gracilis* in the Thaxter collection came from widely separated regions in both the New World and Old World. Much of the material (Thaxter 1931: 93) is immature, as is that in my collection from the Canal Zone, which includes only one mature individual. Nevertheless, a

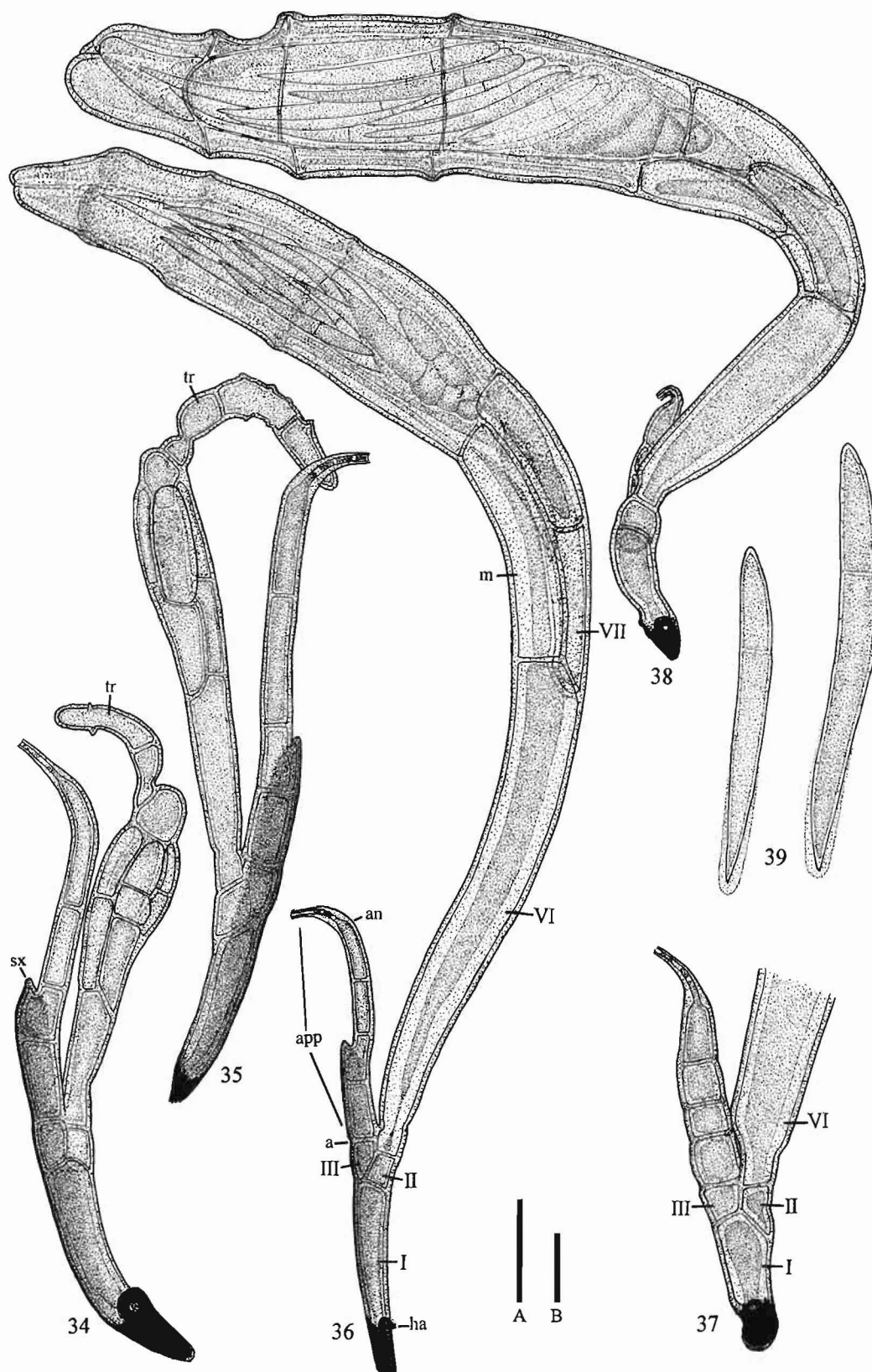


Fig. 34–39.—34–36. *Autophagomyces gracilis* (34, Thaxter 2375; 35, RKB 2813B; 36, Thaxter 2578).—34, 35. Two juveniles with trichogynes.—36. Mature individual (paratype).—37–39. *A. grenadinus* (37, RKB 1811; 38, Thaxter 2770; 39, Thaxter 2770 [left], RKB 1811 [right]).—37. Receptacle and appendage.—38. Mature individual (holotype).—39. Two ascospores. (Bars: A = 20 μ m, Fig. 36–38; B = 10 μ m, Fig. 34, 35, 39.)

comparison of the available specimens, both mature and immature, suggests that a single, wide-ranging species is involved. My description is based on measurement of seven mature individuals supplemented by several mature receptacles with appendages. This species (Fig. 36) and *A. grenadinus* (Fig. 38), with which it may occur on the same host in the New World, differ from the species on Anthicidae and Scaphidiidae, in having elongate cells VII, *m*, *n*, and *n'*, which, together with cell VI, result in a relatively long perithecial stipe. The appendage of *A. gracilis* is unique among the known species of *Autophagomyces* in having a distinct, external, blunt, subterminal projection on the suprabasal cell (Fig. 34, 35). This undoubtedly represents the apex of the upper cell of the ascospore, the only indication of the spore apex on the appendage of any species in the genus. The trichogyne of *A. gracilis* (Fig. 34, 35) resembles that of other species in the genus where it has been observed (Fig. 1, 8, 16, 21, 27); however, the part above the medianly constricted basal cell may consist of more than one cell and it bears slightly raised, acute prominences.

11. *AUTOPHAGOMYCES GRENADINUS* Thaxt., *Mem. Amer. Acad. Arts* 16: 93, 1931. Fig. 37–39

Ascoma: Elongate, slightly sigmoid to variably arcuate above receptacle, often strongly so; pale yellowish, perithecium becoming faintly tinged with brown. Total length from tip of foot to tip of perithecium 242–291 μm . *Receptacle*: Relatively small, 30–35 μm long from tip of foot to base of appendage, 10–12 μm wide distally; cell I 20–28 μm long, 9–11 μm wide distally, tapered downward gradually to tip of blackened foot; cell II 5–9 \times 6–7 μm , separated below from cell I by a strongly diagonal cross wall and on the inside from cell III by a nearly vertical cross wall; cell III 6–8 \times 7–9 μm , separated below from cell I by a slightly diagonal cross wall. *Appendage*: One(–two), simple, free, nearly straight, 42–50 μm long; body consisting of three superposed cells; lowermost cell slightly longer than broad, 8–10 \times 7–9 μm ; median cell slightly broader than long, 5–7 \times 7–9 μm ; upper cell only slightly longer than broad, 6–10 \times 7–9 μm ; antheridium 18–25 \times 5–7 μm , venter broadest at base, median width 5–7 μm , efferent tube 9–13 \times ca. 2 μm (near tip). *Perithecium*: Cell VI 32–66 μm long, 15–19 μm wide distally, margins slightly convex, gradually narrowed downward, 6–9 μm wide at base, abruptly narrowed above base and forming a short constriction 4–8 μm long; cell VII 30–35 μm long, closely associated with the relatively elongate basal cells (*m*, *n*, *n'*), these cells together with cell VI forming a perithecial stipe nearly as long as the ascigerous part of the perithecial body; basal cells together with cell VII comprising ca. 25% of perithecial body above

cell VI; body above cell VI 163–194 μm long; body above stipe 119–145 μm long, broadest near middle, 30–35 μm wide; junctions between successive tiers variably abruptly protuberant; apex broad, asymmetrically rounded, one terminal outer wall cell (*ex n'*) projecting slightly beyond other three. Ascospores 50–60 \times 5–6 μm .

Specimens examined.—LESSER ANTILLES. GRENADA: St. George, 1913, collector ?, on lower surface of abdomen of ? *Phalacrus* sp. (Phalacridae), Thaxter 2770 (FH Acc. #s 4010 [HOLOTYPE & ISOTYPES] and 4011 [ISOTYPE]). USA. ARIZONA: Pima Co., Browns Canyon, E side of Boboquivari Mts., 30 July 1952, H. B. Leech coll., on lower surface of abdomen of Phalacridae gen. et sp. indet., RKB 1811 (RSA). PANAMA. CANAL ZONE (Headquarters): 15 Dec 1956, R. M. Altman, on tip of left elytron of Phalacridae gen. et sp. indet., RKB 2813A (RSA).

Notes.—Collections of insects in Grenada and the Canal Zone demonstrate that *A. grenadinus* (Fig. 38) and *A. gracilis* (Fig. 36) may parasitize the same individual of a susceptible host. Although similar in thalloid size and perithecial structure, these species differ greatly in the conformation and pigmentation of their appendages, with *A. grenadinus* (Fig. 37) being more like other species of the genus than is *A. gracilis* (Fig. 34, 35). Thaxter's two slide mounts of *A. grenadinus* include seven mature individuals, two lacking a foot and another lacking both foot and appendage. Five of these thalli together with nine from the Canal Zone and Arizona provided the data used in preparing the above description of *A. grenadinus*. Thaxter stated that he observed two appendages on two of the individuals he studied; I found only one thallus with two appendages on his slides; all of the thalli in my collections from the Canal Zone and Arizona bear but one appendage.

12. *Autophagomyces hammondii* R. K. Benj., sp. nov. Fig. 40–43

Ascoma: Hyalinum; paulo sigmoideum; receptaculo leniter retrocurvato, perithecio ad apicem obstipum. Thallus totus 250–455 μm longus ad apicem peritheci. *Receptaculum*: Elongatum, 50–54 μm longum ex apice pedis usque ad basin appendicis, latitudo distalis 15–20 μm ; cellula I ca. 33 μm longa, latitudo distalis 10–12 μm , decrescens ad pedem denigratum; cellula II 15–20 \times 11–12 μm , margine antica fortiter convexa; cellula III 15–17 \times 7–8 μm , margine externa fortiter convexa, paries inter cellulam II et cellulam III fortiter obliquus. *Appendix*: Una, libera, simplex, gracilis, 63–78 μm longa, gradatim decrescens usque ad apicem antheridii; corpus 3–4 cellularum cylindricarum constans, cellula infra 11–15 \times 6–7 μm , cellulae supra 8–10 \times 4–6 μm ; antheridium 30–38 μm longum; venter 4–5 μm latus; tubus 12–18 \times ca. 2 μm . *Perithecium*: Cellula VI gracilis, longitudine variabili, 60–226 μm longa, 15–18 μm lata, prope basin abrupte angustata, constrictionem brevam 8–10 \times 7–9 μm for-

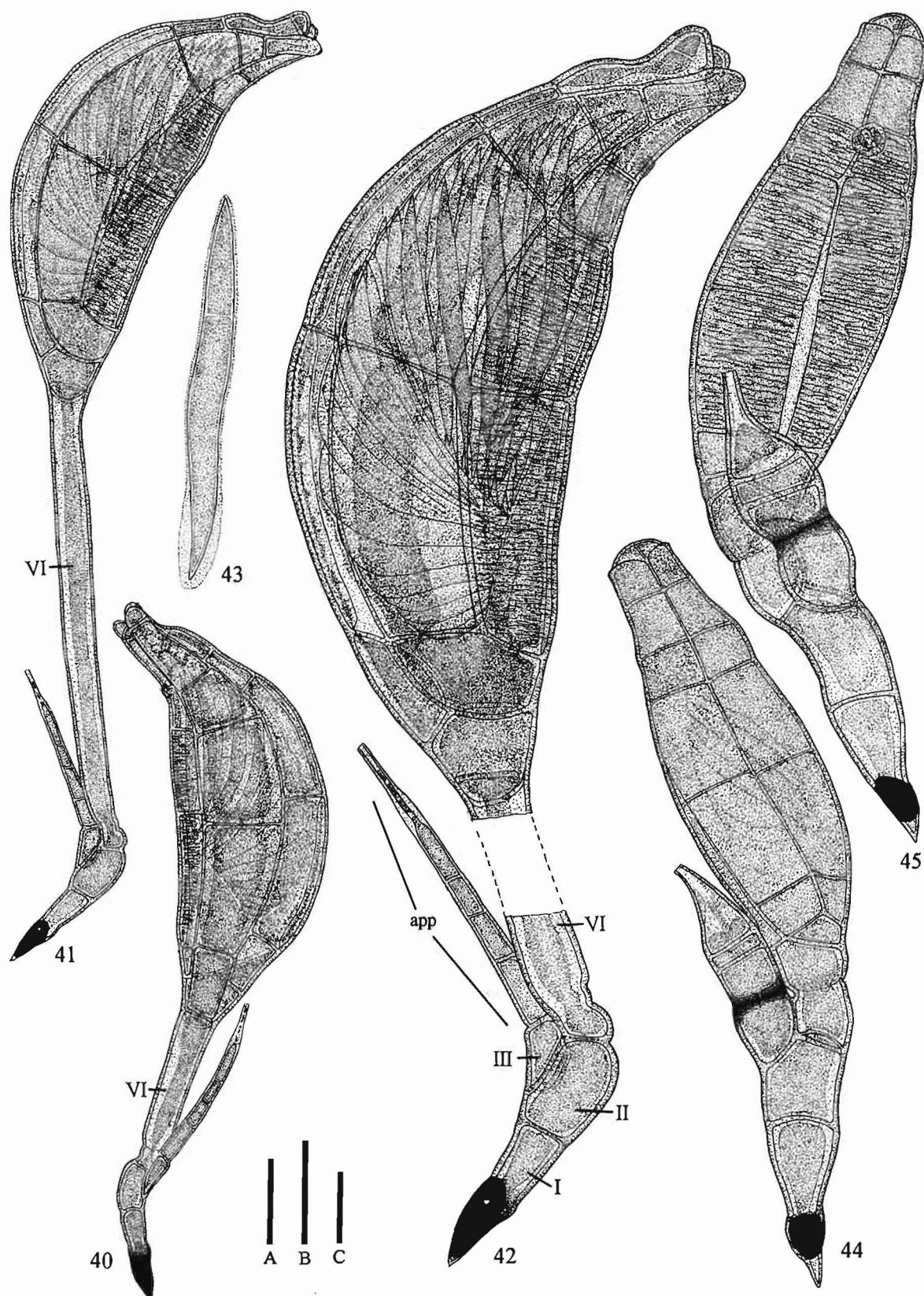


Fig. 40–45.—40–43. *Autophagomyces hammondii* (AW 355).—40. Mature individual with relatively short cell VI (isotype).—41. Another individual with elongate cell VI (holotype).—42. Individual shown in Fig. 41 enlarged; missing segment of cell VI = ca. 130 μm.—43. Ascospore.—44, 45. *Bordea formosana* (K-S-2526b), two mature individuals (paratypes). (Bars: A = 30 μm, Fig. 40, 41; B = 20 μm, Fig. 42, 44, 45; C = 10 μm, Fig. 43.)

mans; cella VII parva, 17–20 μm longa, apice 17–20 μm in latitudinem; cellula VII et cellulae *m*, *n*, et *n'* combinatae prope 1/5 corpus peritheci in tota longitudine supra cellulam VI formantes; corpus peritheci arcuatum, latum, 150–174 μm longum cum cellulis basilaribus, margine postica fortiter convexa, margine antica prope recta, ad medio 53–61 μm latum, a medio ad apicem decrescenti; apex truncatus; cellulae strati terminalis apicibus rotundatis et separatis; cellulae ex *n adj. m* stratorum basilarium et suprabasilarium striis angustis transversis. Ascospores 52–58 \times 5 μm . Typus AW 355 (K).

Ascoma: Hyaline, somewhat sigmoid; receptacle curved backward slightly; peritheciium bent forward distally. Total length from tip of foot to tip of peritheciium 250–455 μm . *Receptacle*: Elongate, 50–54 μm long from tip of foot to base of appendage, 15–20 μm wide distally; cell I ca. 33 μm long, 10–12 μm wide distally, tapered downward to acuminate tip of blackened foot; cell II 15–20 \times 11–12 μm , its anterior margin strongly convex; cell III 15–17 \times 7–8 μm , separated from cell II by a strongly diagonal cross wall, its outer margin nearly straight. *Appendage*: Single, free, simple, slender, 63–78 μm long, tapered upward gradually to tip of antheridium; body consisting of 3–4 cylindrical cells; lower cell 11–15 \times 6–7 μm ; succeeding cells slightly shorter and narrower, 8–10 \times 4–6 μm ; antheridium 30–38 μm long, venter 4–5 μm wide, efferent tube 12–18 \times ca. 2 μm . *Peritheciium*: Cell VI slender, variable in length, 60–225 μm long, 15–18 μm wide, except abruptly narrowed near base, forming a short constriction 8–10 \times 7–9 μm ; cell VII small, 17–20 \times 17–20 μm , closely associated with the relatively short basal cells (*m*, *n*, *n'*) and together with these comprising ca. 20% of total length of perithecial body above cell VI; body arcuate, broad, 150–174 μm long including basal cells, posterior margin strongly convex, anterior margin nearly straight, widest near the middle, 53–61 μm wide, tapered upward to the broad, truncate tip; terminal outer wall cells bluntly rounded and separated from one another distally, tier one and tier two outer wall cells ex *n adj. m* with closely spaced, narrow, transverse striae. Ascospores 52–58 \times 5 μm .

Etymology.—Named for Peter M. Hammond, entomologist, The Natural History Museum, London, UK, who collected the infected host.

Holotype.—INDONESIA. SULAWESI: Sulawesi Utara Prov., Dumoga Bone Nat. Park, lowland forest, ca. 200 m, in ground litter, 10 Feb 1985, P. M. Hammond coll., on elytra and pronotum of Saphidiidae (Coleoptera; Staphyliniformia; Staphylinioidea) gen. et sp. indet. (B. M. Code #31.9), AW 355 (designated slide; K [with isotypes]).

Isotypes.—Data as for holotype, AW 355 (designated slide; K).

Notes.—*Autophagomyces hammondii* (Fig. 40–42) parasitizes a host belonging to a family of beetles classified in a major group, i.e., series Staphyliniformia, rather distantly related to the one, i.e., series Cucujiformia, that contains the two families with insects bearing the other species of the genus. However, characteristics of the receptacle, appendage, and peritheciium of *A. hammondii* led me to conclude that for the present it seems best to place this species in *Autophagomyces*. The specimens of *A. hammondii* available for study, mounted on two slides, include six mature thalli, two without a foot, and a mature peritheciium lacking a receptacle and appendage. Unfortunately, there are no juveniles that might or might not lend support to my taxonomic decision. This species is the only one of all twelve species of *Autophagomyces* studied in which a small, rather inconspicuous trichogynic remnant is present on the outer wall of the peritheciium.

EXCLUDED SPECIES

AUTOPHAGOMYCES DECARTHICOLA (Speg.) Thaxt., *Mem. Amer. Acad. Arts* 16: 95, 1931.

=*Acompsomyces* (Bordea) decarthricola Speg., *Anales Mus. Nac. Hist. Nat. Buenos Aires* 29: 462, 1917 (BASIONYM).

Based on Spegazzini's description and illustration of *Acompsomyces* (Bordea) decarthricola (Spegazzini 1917: 462, fig. 2), Thaxter (1931), without seeing Spegazzini's specimens, transferred the taxon to *Autophagomyces*. For the present study, I obtained four slide mounts from the Instituto de Botánica "C. Spegazzini" [LPS], Universidad Nacional de La Plata, purporting to bear the types of this species, on *Decarthron rubripenne* Raffr. [as *rufipennis*], and *Acompsomyces* (B.) platensis (see *Bordea platensis* below). My detailed examination of every thallus, mature and immature, on these slides revealed only an associated pair of specimens resembling Spegazzini's figure illustrating *A. (B.) decarthricola*. Both specimens consist of a receptacle with appendage. One lacks a peritheciium, which had at some point broken off, leaving only a fragment of cell VI on the distal inner surface of cell II. The other, shown in Fig. 61, bears an immature peritheciium that appears to have developed from cell II below the remnant of the stalk cell of an earlier-formed peritheciium. Such a remnant was mentioned by Spegazzini in his description. All of the other thalli on Spegazzini's four slides can be referred only to *A. (B.) platensis* as described and illustrated by Spegazzini (1917: 463, fig. 3).

Because there is neither an unequivocal holotype nor a specimen that can serve as a lectotype of *Autophagomyces decarthricola* (actually a *Bordea*), the sta-

tus of the taxon as a valid species is doubtful and it is here excluded.

BORDEA Maire, *Bull. Soc. Hist. Nat. Afrique N.* 7: 13, 1916; emend.

Receptacle consisting of three \pm in-line superposed cells: a basal cell (I); a suprabasal cell (II), which on one side bears a stalked perithecium and on the other side subtends the terminal cell (III); cell III subtending a simple, free appendage consisting of two superposed cells and a terminal, usually spinose, flask-shaped antheridium. Perithecium with a primary stalk cell (VI), a secondary stalk cell (VII), three persistent basal cells (*m*, *n*, *n'*), and four vertical rows of outer wall cells of five cells each. Trichogyne robust, elongate, consisting of two cells; basal cell relatively short, with a broad base; terminal cell once or twice branched; trichogynic remnant well defined, broad, conspicuous. Ascogenic cell single. Ascospores 1-septate.

Type species.—*Bordea coronata* Maire.

Subsequent to Maire's description of *Bordea* (Maire 1916), Thaxter apparently, and for some time, accepted the genus and tentatively assigned the name to several of the still-undescribed fungi in his collection. However, despite a number of characteristics peculiar to the type species of *Bordea* as described by Maire, Thaxter decided to incorporate this genus into his final broad concept of *Autophagomyces* (Thaxter 1931). He did not see material representing *B. coronata*, but, through correspondence, Maire agreed that, under his name, Thaxter should transfer the species to *Autophagomyces* (Thaxter 1931: 95).

The concept of *Bordea* is here limited to taxa having most or all of the following combination of characteristics. (1) Cell III of the receptacle, which is separated from cell II by a \pm diagonal cross wall, always is well separated by cell II from the upper end of cell I. Cell II never extends upward beyond the distal end of cell III. (2) Cells I and II separated by a transverse or slightly diagonal cross wall. (3) Cell III subtends but one \pm broad-based appendage consisting of two superposed cells bearing a single, broad, terminal antheridium having a relatively short, \pm abruptly narrowed efferent tube. (4) With a single exception, a prominent spine typically is present on the inner margin of the antheridium. Where detailed observations on ascospores that had been liberated from the perithecium could be made, a distinctive modification of the apex of the shorter of the two cells of the spore is evident. The tip of this cell, which develops into the appendage, is hyaline, devoid of cytoplasm, and clearly represents a *prospine* that ultimately becomes the antheridial spine. (5) The trichogyne (observed intact on immature thalli of three of the 14 taxa studied here)

consists of two superposed cells; the lower cell is relatively short and with or without a slight median constriction; the terminal cell is elongate and may branch once or twice distally. (6) A persistent, broad-based, circular (in face view) trichogynic remnant is present on mature perithecia. It usually is located distally on the surface of the tier-three outer wall cell *ex m*, often overlapping the vertical suture between this cell and the adjacent tier-three outer wall cell *ex n adj. m*. (7) Perithecium with five clearly defined tiers of outer wall cells.

Resumption of sexual function, i.e., spermatial production, of aging, seemingly senescent antheridia appears to be by internal regeneration of the venter, which results in the formation of secondary walls delimiting a new terminal orifice through which spermatia pass into the efferent tube (Fig. 56, 60, 77).

All of the known species of *Bordea* parasitize only beetles belonging to subfamily Pselaphinae (Staphylinidae) (Newton and Thayer 1995).

KEY TO THE SPECIES OF BORDEA

- A. Terminal outer perithecial wall cells forming a suprabasal crown of eight slightly divergent, terminally rounded papillae, two from each cell B
 - Terminal outer wall cells not forming a crown of papillae C
- B. Lower and upper cells of body of appendage concolorous, separated by a transverse cross wall; papillae ca. 3 μ m wide 2. *B. coronata*
 - Upper cell of body of appendage suffused with dark brown, separated from lower cell by a diagonal, blackened cross wall; papillae ca. 2 μ m wide 3. *B. neocoronata*
- C. Thallus strongly reflexed, perithecium bent backward over appendage at an angle of ca. 90°; antheridium without a spine 12. *B. retroflexa*
 - Thallus nearly straight, arcuate, or \pm geniculate; antheridium typically with a spine D
- D. Thallus ca. 450–500 μ m long from tip of foot to tip of perithecium 7. *B. gigantea*
 - Thallus less than ca. 300 μ m long E
- E. Lateral and posterior walls of cell III strongly convex, greatly thickened, up to 5–6 μ m thick 11. *B. weirii*
 - Lateral and posterior walls of cell III nearly straight or only slightly convex, not greatly thickened F
- F. Lower cell of body of appendage ca. two times longer than upper cell 1. *B. formosana*
 - Lower and upper cells of body of appendage subequal ... G
- G. Thallus straight; perithecial body uniformly inflated, margins equally convex 8. *B. castellanii*
 - Thallus geniculate or \pm arcuate H
- H. Thallus geniculate 6. *B. platensis*
 - Thallus \pm arcuate I
- I. Receptacle relatively short and broad, up to ca. 28 μ m long to base of appendage; posterior surface of receptacle and appendage deeply suffused with black 9. *B. tiwaiensis*
 - Receptacle longer, exceeding ca. 40 μ m long to base of appendage; receptacle and appendage not suffused with black J
- J. Cell VI abruptly narrowed near base, forming a short, parallel-sided constriction 10. *B. strangulata*

- Cell VI gradually narrowed toward base but not abruptly constricted K
- K. Basal cells and lower three tiers of outer wall cells of perithecia becoming transversely striate in age L
- Transverse perithecial striae, if present, not distributed as above M
- L. Body of perithecium ca. two thirds total length of thallus; antheridial spine 11–16 μm long 13 *B. allenii*
- Body of perithecium ca. one half total length of thallus; antheridial spine 3–4 μm long 5. *B. thaxteri*
- M. Perithecial body relatively slender, slightly sigmoid; antheridial spine 2–3 μm long 4. *B. bryaxialis*
- Perithecial body relatively wide, nearly straight; antheridial spine 6–9 μm long 14 *B. spinigera*

1. ***Bordea formosana*** (K. Sugiy.) R. K. Benj., comb. nov. Fig. 44, 45

=*Porophoromyces formosanus* K. Sugiy., *Trans. Mycol. Soc. Japan* 23: 241, 1982. (BASIONYM).

Ascoma: Slightly reflexed backward; pale brown except for blackened foot and cross wall separating cell III of receptacle from lower cell of appendage. Total length from tip of foot to tip of perithecium 150–175 [155–178] μm . **Receptacle:** Relatively large, elongate, 55–65 [61–76] μm long from tip of foot to base of appendage, ca. 20 μm wide distally; cell I 28–30 \times 14–15 [28–30 \times 14–15] μm , tapered downward to hyaline, aciculate tip of foot; cell II 18–25 \times 15–16 [14–25 \times 14–25 (sic)] μm , separated from cell I by a nearly transverse cross wall; cell III 13–15 \times 12–15 [13–15 \times 14–16] μm , adnate on the inside with the base of stalk cell VI, separated from cell II by a diagonal cross wall, outer margin slightly convex. **Appendage:** Single, free, simple, 30–40 μm long; lower cell 9–12 \times 12–14 [12–13 \times 13–15] μm ; upper cell shorter, 5–6 \times 12–14 [5–6 \times 13–15] μm ; antheridium 16–20 [15–16] μm long, venter 12–14 [13–15] μm wide, efferent tube 10–12 μm long, tapered upward, ca. 2 μm wide at tip. **Perithecium:** Cell VI with a prominent \pm median constriction, 20–25 μm long, 13–15 μm wide distally, 10 μm wide at base; cell VII relatively small, closely associated with the short basal cells (*m*, *n*, *n'*) and together with these comprising est. ca. 15% of total length of perithecial body above cell VI; body straight, 88–95 μm long including basal cells, uniformly inflated, broadest near the middle, 30–38 [30–35] μm wide, tapered upward to the broad, slightly rounded apex, each terminal outer wall cell slightly divergent immediately below apex; tiers one to three outer wall cells with closely spaced transverse striae, trichogynic remnant 7–8 μm wide. Ascospores not observed. [Note: In this description, measurements shown in brackets are those given by Sugiyama in his original description of *Porophoromyces formosanus*.]

Specimens examined.—TAIWAN (FORMOSA). Nantou hsien, Sun-Moon Lake, 31 May 1978, K. Sugiyama leg., on gen. indet. nr. *Lasinus* (Pselaphinae; Ctenistini; Centrophthalmina), K-S-2526b (paratypes).

Notes.—Dr. Sugiyama sent me one slide bearing four paratypes of *Porophoromyces formosanus*; two of these are illustrated in Fig. 44, 45 (cf. Sugiyama 1982, fig. 1, 4). The mounting medium, not identified by Sugiyama, has cleared the specimens to such a degree that resolution of structural detail is difficult, even when using differential interference contrast microscopy. Thus, my drawings depict only thalloid surface details and cellular arrangement. Close examination of Sugiyama's fungus shows clearly that it is a *Bordea* as here defined—in 1982 it should have been placed in *Autophagomyces* in the sense of Thaxter (1931). Sugiyama's characterization of *P. formosanus* includes several inaccuracies, especially the nature of the receptacle, which he interprets as consisting of five rather than three cells. He regards what in reality are the lower and upper cells of the body of the appendage in *Bordea* as comprising part of the receptacle of his fungus. The terminal antheridium in *P. formosanus* clearly is simple, not compound as in a true *Porophoromyces*. Actually, like *Bordea*, the true receptacle in *Porophoromyces* is three celled, subtending an appendage consisting of a \pm flattened cell, which supports a well-developed, spinose compound antheridium (cf. Thaxter 1926, Pl. XXIV, fig. 417, 418; Rossi 1994, fig. 13, 14). In this study, I examined specimens of the only known species of *Porophoromyces*, *P. tmesiphori* as follows: (1) on *Tmesiphorus* sp., AFRICA, CAMEROON, Thaxter 2847 (FH Acc. #s 2315 [HOLOTYPE & ISOTYPES], 2316, 2317, 2318 [ISOTYPES]); (2) specimens from the collection of Walter Rossi, all from AFRICA, on *Centrophthalmus grandis* Reitter, SIERRA LEONE, Rossi 1376, 1377, 1378 (all FI); on *C. pinguis* Jeannel, ZAIRE, Rossi 1610 (FI); on *C. chelifer* (Jeannel), ZAIRE, Rossi 1611 (FI); and on *C. chalcus* Castellini, KENYA, Rossi 2109 (FI); and (3) specimens from my collection on *Tmesiphorus* sp., MALAYSIA, MALAYA, Selangor, leg. M. W. Sanderson, RKB 2434 (RSA).

2. ***BORDEA CORONATA*** Maire, *Bull. Soc. Hist. Nat. Afrique N.* 7: 16, 1916. Fig. 46–48

=*Autophagomyces coronatus* (Maire) Maire in Thaxt., *Mem. Amer. Acad. Arts* 16: 95, 1931.

Ascoma: Nearly straight; pale yellowish brown except for the blackened foot and the cross wall separating cell III of receptacle from lower cell of appendage, which is deeply suffused with blackish brown. Total length from tip of foot to tip of perithecium 115–175 μm . **Receptacle:** Elongate, 33–48 μm long from tip of foot to base of appendage, 12–16 μm wide distally; cell I 19–28 μm long, 8–12 μm wide distally, tapered downward to the often hyaline tip of foot; cell II 9–17 \times 10–14 μm , separated from cell I by a slightly diagonal cross wall; cell III 10–15 \times 8–11 μm ,

separated from cell II by a strongly diagonal cross wall, adnate on the inside with the base of cell VI, outer margin \pm convex. *Appendage*: Lower cell nearly isodiametric, $7-11 \times 8-10 \mu\text{m}$; upper cell wider than high, $5-8 \times 8-10 \mu\text{m}$; antheridium $14-18 \mu\text{m}$ long, venter $8-9 \mu\text{m}$ wide, efferent tube $8-12 \mu\text{m}$ long, abruptly tapered upward above venter, ca. $2 \mu\text{m}$ wide at tip, bearing a hyaline spine $5-7 \mu\text{m}$ long on its inner margin about midway down from tip. Total length $26-35 \mu\text{m}$. *Perithecium*: Cell VI relatively short, $15-25(-30) \mu\text{m}$ long, $10-18(-22) \mu\text{m}$ wide distally, tapered downward, $5-7(-8) \mu\text{m}$ wide at base, often abruptly narrowed above base, forming a short constriction $5-8 \mu\text{m}$ long; cell VII relatively small, $5-10 \mu\text{m}$ high, closely associated with the short basal cells (*m*, *n*, *n'*) and together with these comprising ca. 15% of total length of perithecial body above cell VI; body straight, $65-110 \mu\text{m}$ long including basal cells, anterior margin slightly more convex than posterior margin, widest at or slightly below the middle, $22-40 \mu\text{m}$ wide, tapered upward, each terminal outer wall cell bearing, side by side, a pair of short divergent outgrowths ca. $4 \times 3 \mu\text{m}$ near the base, these forming a well-defined encircling crown of eight papillae below the domelike apex, which is ca. $8-12 \times 9-10 \mu\text{m}$; trichogynic remnant $7-9 \mu\text{m}$ in diameter. Ascospores $35-40 \times 3.5 \mu\text{m}$; tip of the upper cell forming a hyaline prospine $5-7 \mu\text{m}$ long.

Specimens examined.—ITALY. BASILICATA (MT): Bosco di Policoro, 19 Jul 1984, S. Vit coll., leg. W. Rossi, on various parts of *Brachygluta perforata* (Aubé) (Rossi 1781, 1782 [=RKB 3869, (RSA)]). TOSCANA (GR): Osa, Campo Regio, 1 Aug 1998, Castellini coll., leg. W. Rossi; on abdomen of *B. perforata* (Rossi 2272 [=RKB 3986 (RSA)]).

Notes.—Maire found *Bordea coronata* on the legs and abdomen of *Brachygluta aubei* Tourn. collected near Briska, Algeria. His drawings though diagrammatic nonetheless are informative, and they correspond well with fungi collected later that have been identified with the species. However, some of the measurements Maire cites are questionable. He gives $60-75 \mu\text{m}$ as the total length of the thallus, whereas the length of the perithecium, which can be only a part of this total, is said to be $62-75 \mu\text{m}$ long. Also, he states that the appendage consists of four, rarely three, superposed cells, including the antheridium. Apparently, he must have interpreted the antheridial venter as being a cell distinct from the efferent tube, for the appendage of all specimens that I have examined consists only of three cells as in all *Bordeas*.

My study of *Bordea coronata* (Fig. 46–48) is based on abundant material from *Brachygluta perforata*, as cited above, kindly sent to me by Dr. Rossi, either as slides or infected hosts. In the description given here, thalloid length is based on the measurement of 55 mature individuals from these collections; 20 or more

measurements were made of other thalloid structures. Santamaria (1993: 410, fig. 1, 2) found three mature specimens of *B. coronata* on the anterior left leg of *Brachygluta schuppeli* Aubé collected in 1949 at Eivissa, Balearic Islands, Spain. The species probably is widespread in the Mediterranean region. It is readily distinguished from all other *Bordeas* except *B. neocoronata*, described below, by the distinctive subterminal crown of short perithecial papillae.

3. *Bordea neocoronata* R.K. Benj., sp. nov. Fig. 49

Ascoma: Prope rectum vel leniter retrocurvatum; luteolum praeter pedem denigratum et septum inter cellulas corporis appendicis denigratum; cellula supra corporis appendicis brunneola et pagina infima antheridii brunneola. Totus thallus $125-166 \mu\text{m}$ longus ad apicem perithecii. *Receptaculum*: Elongatum, relative parvum, $29-35 \mu\text{m}$ longum ex apice pedem usque ad basin appendicis; cellula I $17-22 \mu\text{m}$ longa, latitudo distalis $7-9 \mu\text{m}$, decrescens ad pedem denigratum; cellula II $7-9 \times 8-11 \mu\text{m}$, paries inter cellulam I et cellulam II fortiter diagonalis; cellula III $9-11 \times 9-11 \mu\text{m}$, intus cellulae VI adnata, e cellula II septo fortiter diagonaliter separata, margine externa plus minusve convexa. *Appendix*: Una, libera, simplex, plus minusve attenuata, $23-25 \mu\text{m}$ longa, cellula infima hyalina, $6-8 \mu\text{m}$ longa, basi $8.5-9.5 \mu\text{m}$ lata, apice $6-7.5 \mu\text{m}$ lato; cellula supra $5-6 \times 6-7.5 \mu\text{m}$, plus minusve brunneola, e cellula infima septo leniter diagonaliter separata; antheridium $13-15 \mu\text{m}$ longum, infra dilutum brunneolum; venter $6-7.5 \mu\text{m}$ latus; tubus $8-10 \mu\text{m}$ longus, abrupte attenuatus, apice ca. $2 \mu\text{m}$ lato; spina $5-6 \mu\text{m}$ longa. *Perithecium*: Cellula VI elongata, relative lata, $28-46 \mu\text{m}$ longa; apice $12-19 \mu\text{m}$ lato, mediano $14-22 \mu\text{m}$ lato, basi abrupte constricta $5-7 \mu\text{m}$ lata, constrictionis brevis $5-7.5 \mu\text{m}$ longae formans; cellula VII parva, inconspicua; cellula VII et cellulae *m*, *n*, et *n'* combinatae prope $1/5$ corpus perithecii in tota longitudine supra cellulam VI formantes; corpus perithecii $75-93 \mu\text{m}$ longum cum cellulis basilaribus, margine antica fortiter convexa, margine postica prope recta vel leniter convexa, ad medio $25-31 \mu\text{m}$ latum, sursum decrescens, cellula omnis terminalis basi papillis duobus ca. $3-3.5 \times 2 \mu\text{m}$ gignens, papillae octo coronam prope basin apicis perithecii formans; apex angustatus rotundatus, $8-9 \times 5-6 \mu\text{m}$; vestigium trichogynae $5-6 \mu\text{m}$ in diametro. Ascospores ca. $20-25 \times 2 \mu\text{m}$ (intus perithecii). Typus RKB 2167 (RSA).

Ascoma: Nearly straight to slightly curved backward; pale yellow except for the blackened foot and the cross wall separating cells of body of appendage; upper cell and proximal surface of antheridium \pm suffused with brown. Total length from tip of foot to tip of perithecium $125-166 \mu\text{m}$. *Receptacle*: Elongate, relatively small, $29-35 \mu\text{m}$ long from tip of foot to

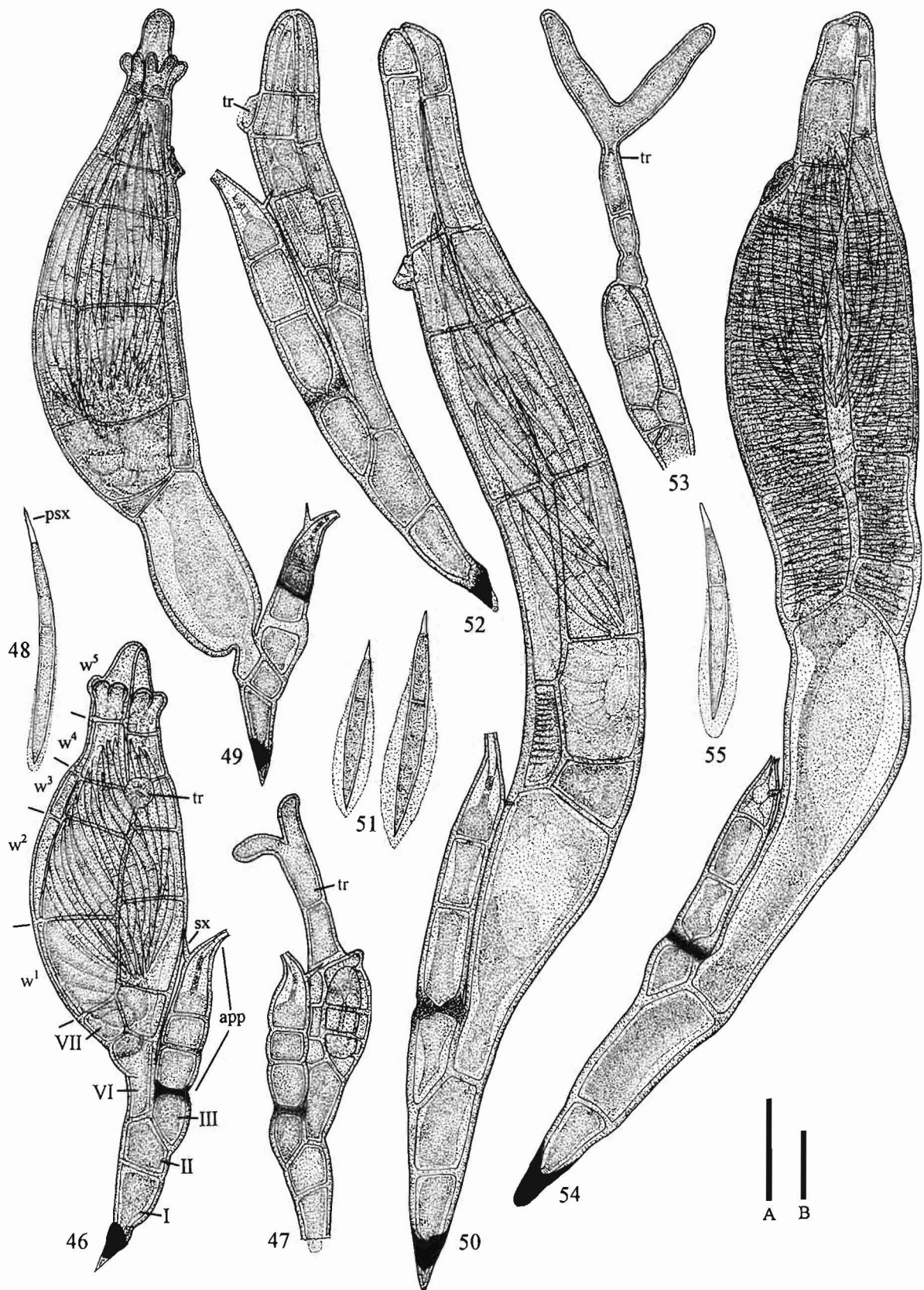


Fig. 46–55.—46–48. *Bordea coronata* (Rossi 1782).—46. Mature individual.—47. Juvenile with perithecium at two-outer-wall-cell stage of development; note trichogyne.—48. Ascospore.—49. *B. neocoronata* (RKB 2167). Mature individual (holotype).—50–53. *B. bryaxalis* (50, 52, 53, RKB 3050A; 51, RKB 532A).—50. Mature individual (from type locality).—51. Two ascospores.—52. Juvenile at four-outer-wall-cell stage with only a basal remnant of trichogyne.—53. Immature perithecium at two-outer-wall-cell stage with trichogyne.—54, 55.

base of appendage; cell I 17–22 μm long, 7–9 μm wide distally, tapered downward to the often hyaline tip of the blackened foot; cell II 7–9 \times 8–11 μm , separated from cell I by a strongly diagonal cross wall; cell III 9–11 \times 9–11 μm , separated from cell II by a diagonal cross wall, adnate below on the inside to the base of cell VI, outer margin \pm convex. *Appendage*: Single, free, simple, 23–25 μm long, \pm attenuate; lower cell hyaline, broadest below, 6–8 μm high, 8.5–9.5 μm wide below, 6–7.5 μm wide distally; upper cell 5–6 \times 6–7.5 μm , \pm suffused with brown, separated from lower cell by a slightly diagonal, blackened septum; antheridium 13–15 μm long, \pm suffused with pale brown below, venter 6–7.5 μm wide, efferent tube 8–10 μm long, abruptly tapered upward from venter, ca. 2 μm wide at tip, bearing a hyaline spine 5–6 μm long on its inner margin about midway down from tip. *Perithecium*: Cell VI elongate, relatively broad throughout most of its length, 28–45 μm long, 12–19 μm wide distally, 14–22 μm wide near middle, 5–7 μm wide at base, abruptly narrowed above base, forming a short constriction 5–7.5 μm long; cell VII small, inconspicuous, closely associated with the relatively short basal cells (*m*, *n*, *n'*) and together with these comprising ca. 20% of total length of perithecial body above cell VI; body 75–93 μm long including basal cells, anterior margin strongly convex, posterior margin nearly straight to slightly convex, widest near the middle, 25–31 μm wide, tapered upward, each terminal outer wall cell bearing a pair of short divergent papillae ca. 3–3.5 \times 2 μm near the base, these forming a well-defined encircling crown of eight papillae below the narrow, domelike apex, which is ca. 8–9 \times 5–6 μm ; trichogynic remnant 5–6 μm in diameter. Ascospores est. ca. 20–25 \times 2 μm (inside perithecium).

Etymology.—From *neo*- (in L. comp.), new, + *coronatus* (L.), crowned.

Holotype.—USA. ILLINOIS: **McHenry Co.**, in sphagnum in bog near McHenry Dam, 24 Sep 1961, D. E. Reichle and J. Wagner coll., on upper surface of abdomen, rear of center, of *Decarthron defectum* Park, *RKB 2167* (designated slide; RSA [with isotypes]).

Isotypes.—Data as for the holotype (designated slide; RSA).

Notes.—The description of *Bordea neocoronata* (Fig. 49) is based on 15 mature individuals in excellent condition. Though perhaps closely related to *B. coronata* from Europe and north Africa with which it shares a distinctive subterminal crown of perithecial papillae, *B. neocoronata* differs greatly in general habit (cf. Fig. 46 and 49), i.e., its slightly more slender thallus; its

shorter, more acute receptacle; its longer, broader cell VI; and especially its appendage, which is darkly pigmented above the diagonal, black cross wall separating the lower and upper cells. Ascospores of *B. neocoronata* are relatively small compared to those of *B. coronata*.

4. *Bordea bryaxalis* (Thaxt.) R. K. Benj., comb. nov. Fig. 50–53

= *Autophagomyces bryaxalis* Thaxt., *Mem. Amer. Acad. Arts* 16: 94, 1931 (BASIONYM).

Ascoma: Erect, \pm arcuate, relatively slender, body of perithecium curved backward over appendage; pale to dark yellowish brown, except for blackened foot and cross wall separating lower cell of appendage from cell III of receptacle. Total length from tip of foot to tip of perithecium (175–)223–270 μm . *Receptacle*: Elongate, (40–)51–64 μm long from tip of foot to base of appendage, 15–20(–21) μm wide distally; cell I (19–)21–28 μm long, 10–13(–15) μm wide distally, \pm uniformly tapered downward to the usually \pm hyaline tip of foot; cell II about half again as long as wide, slightly broader above than below, (14–)18–25 \times 12–18(–20) μm , separated from cell I by a slightly diagonal cross wall; cell III twice as long as broad, (12–)18–24 \times 8–12 μm , outer margin nearly straight to slightly convex, adnate on the inside to the base of cell VI, separated from cell II by a strongly diagonal cross wall. *Appendage*: Total length (34–)50–60 μm . Lower cell longer than upper cell, both cylindrical, separated by a transverse cross wall; lower cell (10–)17–21 \times 9–12(–13) μm ; upper cell (8–)12–17 \times 9–12(–13) μm ; antheridium 17–23 μm long, bearing on the inside a short spine ca. 2–3 μm long, venter 9–12 μm wide at base, efferent tube straight to turned outward slightly distally, (9–)10–14 μm long, tip 2–3 μm wide. *Perithecium*: Cell VI variable in length, (30–)44–63(–75) μm long, broadest distally, (16–)18–25 μm , gradually narrowing toward the base, 7–9 μm wide at contact with cell II, distal margins \pm convex; cell VII 8–16 μm high, closely associated with perithecial basal cells (*m*, *n*, *n'*) and together with these comprising ca. 20% of total length of perithecial body above cell VI; body slender, slightly sigmoid, (108–)134–165 μm long including basal cells, widest near the middle, 21–31(–36) μm wide, margins slightly convex, uniform in width from basal cell region to base of tier three outer wall cells, then gradually narrowed to the rounded, somewhat asymmetrical tip, basal cell *m* often with faint, closely spaced transverse striae; trichogynic remnant 8–10 μm wide. Ascospores 26–34 \times 3–3.5 μm ;

←

tip of the upper cell forming a hyaline prospine 3–4 μm long.

Specimens examined.—USA. ILLINOIS: **Lake Co.**, Antioch: tamarack-sphagnum bog, 7 Jun 1950, M. W. Sanderson coll., on elytra and adjacent abdominal tergites of *Reichenbachia* sp., *RKB 532A* (RSA); in sphagnum, 1 Oct 1961, D. E. Reichle coll., on abdominal tergites of *Reichenbachia* sp., *RKB 2162A, 2172A* (RSA); Wauconda: in mixed mosses in bog, 13 Aug 1961, D. E. Reichle coll., on abdominal tergites of *Reichenbachia* sp., *RKB 2161A* (RSA); Volo: Sayer Bog, in sphagnum, 20 Jun 1962, D. E. Reichle coll., on abdominal tergites of *R. borealis* Casey, *RKB 2153* (RSA), 28 Apr 1962, D. E. Reichle coll., on abdominal tergites of *R. borealis*, *RKB 2154A* (RSA), Wilson Bog, in mixed mosses on log, 7 Jun 1962, D. E. Reichle coll., on abdominal tergites of *R. borealis*, *RKB 2152A* (RSA). **McHenry Co.**, 1.5 mi. N of Fox River Grove, County Line Rd., 2 Jun 1961, W. Suter coll., on abdominal tergites of *Reichenbachia* sp., *RKB 2171A* (RSA). MAINE: **York Co.**, Kittery Point, 20 Aug 1911, R. Thaxter coll., at tips of elytra of *Reichenbachia puncticollis* (LeC.) [as *Bryaxis puncticollis* LeC.], *Thaxter 1423* (FH Acc. #s 3986 [HOLOTYPE, is with isotypes in lower row of specimens in mount], 3988 [ISOTYPES, in lower row of specimens in mount]); 8, 10 Aug 1905, on elytra of *R. puncticollis* (as *Bryaxis* sp.) *Thaxter 1425* (FH Acc. #s 3992, 3993, 3994, 3995); Sep 1908, on *Reichenbachia* sp. (as *Bryaxis* sp.), *Thaxter s. n.* (FH Acc. # 3990); probably [Aug] 1905, on pronotum of *Reichenbachia* sp. (as *Bryaxis* sp.), *Thaxter 923* (FH Acc. # 3998); Sep 1908, on *R. puncticollis* (as *B. puncticollis*), *Thaxter s. n.* (FH Acc. # 8931, in part); 1911, R. Thaxter coll., on posterior surface of elytra and adjacent abdominal tergites of *R. puncticollis*, *Thaxter s. n.*, *RKB 3050A*, from duplicate hosts in Thaxter collection (RSA). WISCONSIN: **Green Lake Co.**, Princeton, Snake Creek Tamaracks, 26 Nov 1961, in mixed mosses on log, D. E. Reichle coll., on abdominal tergites of *R. borealis*, *RKB 2125A* (RSA), on abdominal tergites of *Reichenbachia* sp., *RKB 2169* (RSA). **Walworth Co.**, Lake Beulah Tamaracks, in sphagnum, 29 Oct 1961, D. E. Reichle coll., on right side of abdominal tergites of *R. borealis*, *RKB 2126A, 2128B* (RSA).

Notes.—When Thaxter (1931) characterized *Autophagomyces bryaxialis* he described and illustrated what he believed to be only forms of a single species, one form growing on the upper surface of the host, the other growing on the lower surface and on the legs. On two slide mounts (FH 3986, the type slide; and FH 3988, an isotype slide), he separated these “forms” from one another, arranging them in two transverse rows, one above the other. Thalli from the upper surface of the host, which he regarded as “older” and “the more typical form” were arranged in the lower row. These are represented by his Plate XVII, Fig. 13 (see my Fig. 50). Thalli from the lower surface of the host, which he regarded as “younger types” were arranged in the upper row. These are represented by his Plate XVII, Fig. 14 (see my Fig. 54).

Close examination of Thaxter's collections and those that have come to hand from other localities in the United States convinced me that two distinct species of *Bordea* are involved. In all instances, thalli from the upper surface of a host conform morphologically to the thallus shown in Fig. 50; these are placed in *B. bryaxialis*. Thalli from the lower surface and legs conform to the thallus shown in Fig. 54 and are de-

scribed below as *B. thaxteri*. It is apparent, however, that the fungi depicted by Thaxter in his Fig. 14 were somewhat immature when they were mounted.

Bordea bryaxialis probably is common on *Reichenbachias* inhabiting bogs. Its long, slender, \pm sigmoid habit distinguishes it from most other species of the genus. The thallus may vary considerably in length due to variation in the length of perithecial stalk cell VI.

5. *Bordea thaxteri* R. K. Benj., sp. nov. Fig. 54, 55

Ascoma: Rectum, plus minusve arcuatum, supra appendicem retrocurvatum; luteolum vel atroluteobrunneum—aprimo corpus peritheci—praeter pedem denigratum et septum inter cellulam basalem appendicis et cellulam III receptaculi denigratum. Totus thallus 194–276 μm longus ad apicem peritheci. *Receptaculum*: Elongatum, 56–79 μm longum ex apice pedem usque ad basin appendicis; cellula I 22–31 μm longa, latitudo distalis 9–14 μm , decrescens ad pedem denigratum; cellula II 25–40 \times 12–18 μm , margines prope parallelas, e cellula I septo transverso vel leniter diagonaliter separata; cellula III 14–24 \times 9–12 μm , margine externa supra convexam, infra concavam, intus cellulae VI adnata, e cellula II septo fortiter diagonaliter separata. *Appendix*: Una, libera, simplex, 40–60 μm longa; cellula infernae et supernae subaequales, septo transversim separatae; cellula inferna 12–25 \times 8–11 μm , cellula superna 10–20 \times 8–11 μm ; antheridium 14–22 μm longum, intus spinam 3–4 μm longam gignens; venter basi 8–11 μm lato; tubus prope rectus, abrupte attenuatus, 9–16 μm longus, apice 2–3 μm lato. *Perithecium*: Cellula VI variabilis, 44–86 μm longa, latitudo prope uniformis vel sursum dilatata, apice 12–26 μm lato, basi 8–12 μm lata; cellula VII 10–18 μm alta cum cellulis *m*, *n*, et *n'* prope $\frac{1}{4}$ corpus peritheci in tota longitudine supra cellula VI formantes; corpus peritheci prope rectum, 94–125 μm longum cum cellulis basilaribus, margine postica fortiter convexa, margine antica leniter convexa, ad medio 31–44 μm latum, sursum decrescens, abrupte angustatus supra vestigium trichogynae; apex rotundatus; cellulae basales et cellulae stratorum 1–3 plerumque striis transversis; vestigium trichogynae 7–9 μm in diametro. *Ascospores* 32–38 \times 3 μm ; apex cellulae terminalis prospinam hyalinam 3–4 μm longam formans. Typus *RKB 3050B* (FH).

Ascoma: Erect, \pm arcuate, curved backward over appendage; pale yellow to dark brownish yellow—especially perithecial body—except for blackened foot and cross wall separating lower cell of appendage from cell III of receptacle. Total length from tip of foot to tip of perithecium 194–276 μm . *Receptacle*: Elongate, 56–79 μm long from tip of foot to base of appendage; cell I 22–31 μm long, 9–14 μm wide distally, tapered

downward to tip of foot, which may be \pm hyaline; cell II often more than twice as long as wide, sides nearly parallel, $25\text{--}40 \times 12\text{--}18 \mu\text{m}$, separated from cell I by a transverse or slightly diagonal cross wall; cell III longer than broad, $14\text{--}24 \times 9\text{--}12 \mu\text{m}$, outer margin slightly concave below to somewhat convex above, adnate on the inside to the base of cell VI, separated from cell II by a strongly diagonal cross wall. *Appendage*: Single, free, simple, $40\text{--}64 \mu\text{m}$ long; lower and upper cells subequal, separated by a transverse cross wall; the former $12\text{--}25 \times 8\text{--}11 \mu\text{m}$; the latter $10\text{--}20 \times 8\text{--}11 \mu\text{m}$; antheridium $14\text{--}22 \mu\text{m}$ long, bearing on the inside a \pm median spine $3\text{--}4 \mu\text{m}$ long, venter $8\text{--}11 \mu\text{m}$ wide at base, efferent tube nearly straight, abruptly tapered, $9\text{--}16 \mu\text{m}$ long, tip $2\text{--}3 \mu\text{m}$ wide. *Perithecium*: Cell VI variable, $44\text{--}86 \mu\text{m}$ long, nearly uniform in width or gradually widened upward, $12\text{--}26 \mu\text{m}$ wide distally, $8\text{--}12 \mu\text{m}$ wide at base; cell VII $10\text{--}18 \mu\text{m}$ high, closely associated with perithecial basal cells (*m*, *n*, *n'*) and together with these comprising ca. 25% of total length of perithecial body above cell VI; body nearly straight, $94\text{--}125 \mu\text{m}$ long including basal cells, posterior margin \pm strongly convex, anterior margin only slightly convex, widest at or above the middle, $31\text{--}44 \mu\text{m}$ wide; broadly inflated from basal cell region to base of tier-four outer wall cells, apex abruptly narrowed above trichogynic remnant; tip rounded; basal cells and cells of tier one to three outer wall cells often with faint, closely spaced transverse striae; trichogynic remnant $7\text{--}9 \mu\text{m}$ wide. Ascospores $32\text{--}38 \times 3 \mu\text{m}$; tip of upper cell forming a hyaline prospine $3\text{--}4 \mu\text{m}$ long.

Etymology.—Named for Roland Thaxter, noted student of Laboulbeniales

Holotype.—USA. MAINE: **York Co.**, Kittery Point, 1911, R. Thaxter coll., on femur of left rear leg of *Reichenbachia puncticollis* [as *Bryaxis puncticollis*], Thaxter s. n., RKB 3050B, from duplicate hosts in Thaxter collection (designated slide; FH [with isotypes]).

Isotypes.—Same data as for the holotype (designated slides; FH, RSA).

Paratypes.—USA. ILLINOIS: **Lake Co.**, Volo, 9 Oct 1952, in tamarack bog, H. H. Ross & M. W. Sanderson coll., on median and posterior legs of *R. borealis*, RKB 1675B (RSA); Sayer Bog nr. Volo, 28 Apr 1962, in sphagnum, D. E. Reichle coll., on femur of left rear leg of *R. borealis*, RKB 2154B (RSA); **McHenry Co.**, County Line Rd., 1.5 mi. N of Fox River Grove, 2 Jun 1961, W. Suter coll., on femur of left rear leg of *Reichenbachia* sp., RKB 2171B (RSA). MAINE: **York Co.**, Kittery Point, 20 Aug 1911, R. Thaxter coll., on *R. puncticollis* [as *B. puncticollis*], Thaxter 1423 (FH Acc. #s: 3986 and 3988, in upper rows of specimens in mounts). WISCONSIN: **Walworth Co.**, Lake Beulah Tamaracks, 29 Oct 1961, in sphagnum, D. E. Reichle coll., on tibia of left mid leg of *R. borealis*, RKB 2127A, 2128A (RSA).

Other specimens examined.—USA. MAINE: **York Co.**, Kittery Point, probably [Aug] 1905 [see Thaxter 1931: 94], R. Thaxter coll., on *R. puncticollis* [as *B. puncticollis*], Thaxter 923 (FH Acc. #s: 3996, 3997, 3999 [Note: On the label of one slide, FH 3987, the original collection number 923 later was altered by Thaxter to read 1423]); 8 Aug 1905, on the legs of *Reichenbachia* sp. [as *Bryaxis* sp.] Thaxter 1423 (FH Acc. # 3989) and Thaxter s. n. (FH Acc. # 3991); Sep 1908, on *R. puncticollis* [as *B. puncticollis*], Thaxter s. n. (FH Acc. # 8931, in part). WISCONSIN: **Green Lake Co.**, Princeton, Snake Creek Tamaracks, 26 Nov 1961, in mixed mosses on log, D. E. Reichle coll., on femur of left rear leg of *R. borealis*, RKB 2125B (RSA).

Notes.—As stated above, *Bordea thaxteri* (Fig. 54, 55) is here recognized as a species distinct from *B. bryaxialis* with which it often occurs on the same host, the former on the lower surface, the latter on the upper surface. The mature holotype of *B. thaxteri* (Fig. 54) was selected from a host collected by Thaxter at the type locality of *B. bryaxialis*, which also occurred on the same insect. The shorter, broader perithecium of *B. thaxteri* with its abruptly narrowed apex, and especially the closely spaced transverse striae on the basal cells of the perithecium and tiers one to three of the outer wall cells readily distinguish the species from *B. bryaxialis*. It should be noted, however, that the transverse striae on the perithecial wall of *B. thaxteri* are most readily observed only on darkly pigmented perithecia of fully mature individuals. However, younger individuals are readily identified by their other perithecial characteristics.

6. *Bordea platensis* (Speg.) R. K. Benj., comb. nov. Fig. 56–60

=*Acompsomyces* (*Bordea*) *platensis* Speg., *Anales Mus. Nac. Hist. Nat. Buenos Aires* 29: 463, 1917 (BASIONYM).

=*Autophagomyces* *spgazzinii* Thaxt., *Mem. Amer. Acad. Arts* 16: 95, 1931, non *A. platensis* Thaxt., *Proc. Amer. Acad. Arts* 48: 172, 1912.

Ascoma: Geniculate, bent backward more or less sharply at junction of cell VI and basal cell region of perithecial body; yellowish brown excepting blackened foot and cross wall separating cell III of receptacle and lower cell of appendage, the suffusion extending slightly downward over distal surface of cell III. Total length from tip of foot to tip of perithecium $158\text{--}198 \mu\text{m}$. *Receptacle*: Elongate, $44\text{--}58 \mu\text{m}$ long from tip of foot to base of appendage, $15\text{--}18 \mu\text{m}$ wide distally; cell I $18\text{--}24 \times 10\text{--}11 \mu\text{m}$ distally, tapered downward to hyaline, acuminate tip of foot; cell II slightly longer than wide, $15\text{--}20(\text{--}25) \times 10\text{--}15 \mu\text{m}$, separated from cell I by a slightly diagonal cross wall; cell III $13\text{--}18 \times 10\text{--}14 \mu\text{m}$, adnate on the inside with the base of cell VI, separated from cell II by a strongly diagonal cross wall. *Appendage*: Total length $30\text{--}40 \mu\text{m}$. Lower cell slightly longer than broad, $10\text{--}13 \times 8\text{--}10 \mu\text{m}$; upper cell broader than long, $6\text{--}8 \times 8\text{--}10$

μm , separated from the lower cell by a transverse cross wall; antheridium 14–19 μm long, venter 8–10 μm wide, efferent tube relatively short, 6–10 μm long, \pm abruptly tapered, tip 2–3 μm wide, bearing a subterminal spine 2.5–3 μm long on the inside. *Perithecium*: Cell VI 31–40 μm long, 11–17 μm wide distally, \pm uniformly tapered downward, 7–9 μm wide at base; cell VII short, ca. 7–10 μm high, closely associated with perithecial basal cells (*m*, *n*, *n'*) and together with these comprising ca. 15% of total length of perithecial body above cell VI; body straight, 79–111 μm long including basal cells, widest slightly below the middle, 29–38 μm wide; margins from bottom of basal cell region up to level of the base of the tier four outer wall cells \pm strongly convex, from base of tier four outer wall cells to apex gradually tapered to the broad, barely rounded tip; tier five outer wall cells each forming a small, rounded subterminal lobe; basal cells and tier one and tier two outer wall cells developing, in age, closely spaced transverse striae; trichogynic remnant 8–10 μm wide. Ascospores est. ca. 30–35 \times 4 μm .

Specimens examined.—ARGENTINA, BUENOS AIRES Prov.: **La Plata** dist., Santiago Island, nr. La Plata, 15 Jan 1916, C. Spegazzini coll., on abdomen of *Decarthron simplex* Raffr., *Speg. 411-1916* (LPS 45480; a LECTOTYPE [Fig. 60] is here chosen from among the ISOLECTOTYPES on this slide); 5 Jan 1916, on *D. rubripennis* Raffr. [as *rufipennis*, apparently written in error, for, such a species of *Decarthron* is not listed by Blackwelder (1944: 94)], *Speg. 407-1916* (LPS 45479); 21 Jan 1915, on *D. rubripennis* [as *rufipennis*], *Speg. 414-1916* (LPS 45478); on *D. simplex*, *Speg. 446-1916* (LPS 45477).

Notes.—Four slides bearing the fungi that Spegazzini described as *Acompsomyces* (*Bordea*) *decarthricola* and *A. (B.) platensis* were received on loan from Instituto de Botánica “C. Spegazzini” (LPS), Universidad Nacional de La Plata. The condition of the material on these slides indicates that the original preparations had dried out and subsequently were restored, apparently by infiltration of diaphane. Some specimens are partially obscured by debris or what resembles oily globules, some are more or less collapsed, but many are plumped to nearly the same degree as are specimens mounted in glycerine. In all, I found 29 mature individuals in which some or all of the features given in the above description of *Bordea platensis* could be measured with reasonable accuracy.

Labels on the front left end of each slide bear handwritten information, presumably scripted by Spegazzini, in ink or in pencil. A small label on the reverse of each slide gives the LPS accession number. Data

recorded on the former labels reads as follows: LPS 45477: [“446-1916 | *Acompsomyces* (*Bordea*) *platensis* | *Decarthron simplex* | Isla Santiago 22/IV/1916”]; LPS 45478: [“414-1916 | *Acompsomyces decarthricola* Speg. | Elatri | *Decarthron rufipennis* | *Pselaphido* | Isla Santiago 21/IV/1916”]; LPS 45479: [“407-1916 | *Acompsomyces decarthricola* n. sp. | et | *A. platensis* Speg. n. sp. | *Decarthron rufipennis* | Isla Santiago 5/IV/1916”]; LPS 45480: [“411-1916 | *Acompsomyces platensis* | Abdomina | *Decarthron simplex* | Isla Santiago 15/IV/1916”]. (Note: Vertical bars [|] delineate separate lines.)

Slide LPS 45477 includes one immature and eight mature specimens readily referable to *Bordea platensis* as defined above. Slide LPS 45478 is the poorest of the four preparations, all seven specimens in the mount being \pm obscured by small globulelike inclusions. Three of the specimens consist only of receptacles with appendages, and these are in such poor condition as to be worthless. There are four mature individuals, likewise somewhat obscured, but these are assignable to *B. platensis*. None could be identified with *Acompsomyces (B.) decarthricola* as defined by Spegazzini. Slide LPS 45479 includes six specimens with no mature individuals. There is a detached immature perithecium; four immature individuals, three of which are illustrated here as representing *B. platensis* (Fig. 57–59; cf. Spegazzini 1917: fig. 3, in part), and the only specimen having a vague resemblance to Spegazzini's illustration of *A. (B.) decarthricola* (Fig. 61; cf. Spegazzini 1917: fig. 2) (see above under Doubtful Species of *Autophagomyces* for further discussion). Finally, slide LPS 45480, the best of the four, includes 21 specimens, 17 mature or nearly mature (Fig. 56), the others immature or consisting only of parts of thalli. It was not possible to select specimens from any of the four slides that could with certainty be identified with the specimens figured, somewhat diagrammatically, by Spegazzini for *A. (B.) platensis* (Spegazzini 1917: fig. 3, in Part). The individual chosen for the Lectotype of *B. platensis* was selected from this slide (Fig. 60).

7. *Bordea gigantea* R. K. Benj., sp. nov. Fig. 62, 63

Ascoma: Elongatum, arcuatum, dilute olivaceum praeter pedem denigratum et septum luteobrunneum inter cellulam basalem appendicem et cellulam III receptaculi. Totus thallus 450–500 μm longus ad apicem perithecia. *Receptaculum*: Grande, ca. 100–110 μm

stalk (lower arrow) and secondary thickenings of upper wall of antheridial venter (upper arrow).—61. ? *Acompsomyces (Bordea) decarthricola* (Speg. 407-1916 [LPS 45479]). A mature receptacle and appendage with an immature secondary perithecium that had developed below the remnant of stalk of a primary perithecium, which had broken off near base of cell VI (arrow). See text under Excluded Species: *Autophagomyces decarthricola*.—62, 63. *Bordea gigantea* (RKB 527).—62. Mature individual (holotype).—63. Ascospore. (Bars: A = 30 μm , Fig. 62; B = 20 μm , Fig. 56–61; Bar C = 10 μm , Fig. 63.)

longum ex apice pedem usque ad basin appendicis, latitudo maxima ca. 45 μm ; cellula I relative parva, plus minusve triangularis, ca. 28–30 \times 16–20 μm , apex pedis hyalinus acicularis; cellula II relative grandis, ca. 58–63 μm longa, abrupte dilatata supra cellulam I, latitudo distalis ca. 45 μm , margines plus minusve fortiter convexae, e cellula I septo transverso separata, cellula III ca. 28–30 \times 25–30 μm , e cellula II septo fortiter diagonali separata, intus cellulae VI adnata, margine externa convexa. *Appendix*: Una, libera, simplex, recta, ca. 43–48 μm longa, e basi sursum uniformiter dilatata; cellula inferna ca. 20 \times 25–30 μm ; cellula superna ca. 10 \times 23 μm ; antheridium ca. 18 \times 16 μm , intus spinam 6–7 μm longam gignens; tubus ca. 10 μm longus, apice ca. 2 μm lato. *Perithecium*: Cellula VI elongata, gradatim dilatata a basi ad apicem, ca. 130–155 μm longa, ca. 35 μm lata in parte distalibus, basi ca. 15 μm lato; cellula VII parva, ca. 18 μm alta, cum cellulis *m*, *n*, et *n'* prope 1/5 corporis perithecii in tota longitudine supra cellulam VI formantes; corpus perithecii ca. 240–255 μm longum cum cellulis basilaribus, ca. 51 μm latum 1/3 sursum supra basim, gradatim et plus minusve uniformiter decrescens ad apicem; apex angustus symmetricus rotundatus; vestigium trichogynae ca. 10 μm in diametro. Ascospores 32–35 \times 3 μm ; apex cellulae terminalis prospinam hyalinam ca. 5 μm longam formans. *RKB* 527 (RSA).

Ascoma: Elongate, arcuate; pale olivaceous except for the blackened foot and the brownish yellow suffusion of cross wall separating lower cell of appendage and cell III of receptacle. Total length from tip of foot to tip of perithecium 450–500 μm . *Receptacle*: Large, ca. 100–110 μm long from tip of foot to base of appendage, greatest width ca. 45 μm ; cell I relatively small, \pm triangular, widest distally, ca. 28–30 \times 16–20 μm , tip below darkened foot hyaline, aciculate; cell II relatively large, ca. 58–63 μm long, abruptly broadened above juncture with cell I, ca. 45 μm wide distally, margins \pm strongly convex, separated from cell I by a transverse cross wall; cell III about as long as broad, ca. 28–30 \times 25–30 μm , separated from cell II by a strongly diagonal cross wall, adnate on the inside to the base of cell VI of perithecium, outer margin slightly convex. *Appendage*: Single, free, simple, straight, tip turned outward slightly, ca. 43–48 μm long, \pm uniformly tapered upward from base; lower cell ca. 20 \times 25–30 μm ; upper cell shorter, ca. 10 \times 23 μm at base; antheridium ca. 18 \times 16 μm at base, bearing a spine 6–7 μm long on the inside near the base, efferent tube ca. 10 μm long, ca. 2 μm wide at tip. *Perithecium*: Cell VI elongate, gradually narrowed from base to apex, ca. 130–155 μm long, ca. 35 μm wide distally, ca. 15 μm wide at base; cell VII small, ca. 18 μm high, together with perithecial basal cells

(*m*, *n*, *n'*) comprising ca. 15% of total length of perithecial body above cell VI; body ca. 240–255 μm long including basal cells, broadest about 1/3 up from base, ca. 55 μm wide, then gradually and \pm uniformly tapered upward to the narrow, symmetrically rounded tip; trichogynic remnant ca. 10 μm wide. Ascospores 32–35 \times 3 μm ; tip of the upper cell forming a hyaline prospine ca. 5 μm long.

Etymology.—From *giganteus* (L.), very large, in reference to size of ascoma.

Holotype.—HONDURAS. ATLÁNTIDA dept.: La Cebia, sweeping vegetation, 20 Oct 1948, E. C. Becker coll., on abdomen at base of left rear leg of a m of *Reichenbachia bicuspidata* Park; *RKB* 527 (designated slide; RSA).

Isotype.—Data as for the holotype, *RKB* 527 (designated slide; RSA).

Notes.—Only two mature individuals of *B. gigantea* (Fig. 62, 63) and one receptacle with appendage were recovered from the host. Future collections of this very distinctive species doubtless will result in refinements of the measurements given in the description. The extra large thallus required that I draw it at about one-half the magnification used for all the other mature individuals of *Bordea* spp. depicted in the figures, which, for comparison with one another, were drawn at a uniform magnification of $\times 1360$ before reduction.

8. *Bordea castellanii* (W. Rossi) R. K. Benj., comb. nov. Fig. 64, 65

= *Autophagomyces castellanii* W. Rossi., *Accad. Naz. Lincei*, Quad. No. 255, p. 10, 1982 (BASIONYM).

Ascoma: Nearly straight; pale brown except for blackened foot and \pm opaque cross wall separating cell III of receptacle from lower cell of appendage. Total length from tip of foot to tip of perithecium ca. 150 μm . *Receptacle*: Elongate, broadest above, ca. 50 μm long from tip of foot to base of appendage, ca. 20 μm wide distally; cell I triangular, ca. 25 μm wide distally, tapered downward to hyaline tip of foot; cell II barely longer than broad, ca. 15–19 \times 15 μm , separated from cell I by a diagonal cross wall; cell III elliptical, longer than broad, ca. 20 \times 12 μm , separated from cell II by a strongly diagonal cross wall. *Appendage*: Single, free, simple, ca. 48 μm long; lower and upper cells nearly equal, cylindrical, slightly longer than broad, ca. 12 \times 8 μm ; antheridium ca. 22 μm long, venter ca. 8 μm wide, efferent tube abruptly tapered upward, bearing a short spine ca. 3 μm long on its inner margin slightly below tip. *Perithecium*: Cell VI slightly longer than wide, ca. 18 \times 15 μm ; cell VII small, inconspicuous, closely associated with the relatively short basal cells (*m*, *n*, *n'*) and together with these comprising ca.

15% of total length of perithecial body above cell VI; body straight, ca. 95 μm long including basal cells, uniformly inflated, broadest near middle, ca. 35 μm wide, tapered upward to the broad rounded apex; each terminal outer wall cell medianly slightly divergent; trichogynic remnant ca. 7 μm wide. Ascospores not observed.

Specimens examined.—SIERRA LEONE. WESTERN AREA: near Newton, 6 Feb 1980, Walter Rossi coll., on elytra of *Trissemus punctipennis* (Raffray), *Rossi 1160* (HOLOTYPE; RO).

Notes.—Rossi's collection of *Bordea castellanii* consists of a single mature individual, which lacks an appendage (Fig. 64), and a broken specimen consisting of a receptacle with an appendage (Fig. 65). The material was mounted in Amman's solution, which, in this case, precluded the resolution of internal structure. Using differential interference contrast optics, I could determine cellular arrangement as depicted in Fig. 64. The nearly straight thallus with its broad, dome-shaped apex and the relatively slender, nearly straight appendage distinguish the species from other known *Bordeas*. Further collections of this species are needed to better determine its characteristics.

9. *Bordea tiwaiensis* (W. Rossi) R. K. Benj., comb. nov. Fig. 66, 67

=*Autophagomyces tiwaiensis* W. Rossi, *Accad. Naz. Lincei*, Quad. No. 265, p. 5, 1990 (BASIONYM).

Ascoma: Slightly sigmoid, strongly curved backward; pale brownish yellow except for the blackened foot the posterior surfaces of appendage and receptacle, which are deeply suffused with black. Total length from tip of foot to tip of perithecium ca. 235 μm . *Receptacle*: Relatively small and broad, ca. 28 μm long from tip of foot to base of appendage; cell I ca. 15 μm long, ca. 15 μm wide distally, abruptly tapered to tip of foot; cell II about half as high as wide, ca. 8 \times 15 μm , separated from cell I by a nearly transverse cross wall; cell III nearly isodiametric, ca. 10 \times 10 μm , separated from cell II by a diagonal cross wall, externally convex. *Appendage*: Single, free, simple, nearly straight, ca. 38–40 μm long; lower and upper cells, subequal, slightly longer than wide, each ca. 10 \times 8 μm , lower cell separated from cell III by a blackened cross wall; antheridium with pale tip, ca. 20–22 μm long, venter ca. 7–8 μm wide below, tapered, tip ca. 2 μm wide, bearing on the inside a subterminal spine ca. 5 μm long. *Perithecium*: Cell VI elongate, gradually broadening from base to apex, ca. 55 μm long, ca. 11 μm wide at base, ca. 20 μm wide distally; cell VII relatively small, ca. 18 μm high, closely associated with perithecial basal cells (*m*, *n*, *n'*) and together with these comprising ca. 20% of total length of perithecial body above cell VI; body ca. 160 μm

long including basal cells, slightly sigmoid, anterior margin strongly convex, posterior margin concave, broadest at mid level of basal tier of outer wall cells, ca. 36 μm wide, tapered upward to the abruptly narrowed, symmetrical, dome-shaped tip; trichogynic remnant ca. 7 μm wide. Ascospores ca. 35 \times 3 μm (inside perithecium).

Specimens examined.—SIERRA LEONE. SOUTHERN PROVINCE: Tiwai Island Wildlife Sanctuary, 1/4 Dec 1987, Walter Rossi coll., on edge of right elytron of *Trissemus assuetus* Castellini; *Rossi 1466* (HOLOTYPE; FI).

Notes.—Rossi's collection of *Bordea tiwaiensis* consists of a single mature individual (Fig. 66) and a broken receptacle bearing an appendage (Fig. 67). Like *B. castellanii*, it too was mounted in Amman's solution; however, unlike *B. castellanii*, it is in excellent condition. Additional collections are needed to determine the range of its dimensions. The extremely short receptacle and the dark pigmentation of the posterior surface of the receptacle and appendage distinguish the species from other *Bordeas* having a \pm slender, sigmoid habit, e.g., *B. bryaxialis*, *B. strangulatus*, and *B. weirii*.

10. *Bordea strangulata* (Thaxt.) R. K. Benj., comb. nov. Fig. 68, 69

=*Autophagomyces strangulatus* Thaxt., *Mem. Amer. Acad. Arts* 16: 96, 1931 (BASIONYM).

Ascoma: Erect, slightly arcuate backward; pale yellowish, tinged with brown except for blackened foot and the black, slightly constricted cross wall separating the lower cell of the appendage from cell III of the receptacle. Total length from tip of foot to tip of perithecium ca. 195 μm . *Receptacle*: Elongate, broadest distally, ca. 45–50 μm long from tip of foot to base of appendage, ca. 16 μm wide distally; cell I triangular, ca. 28 μm long and 14 μm wide distally, tapered downward to hyaline tip of foot; cell II about as long as broad, ca. 15 \times 15 μm , separated from cell I by a slightly diagonal cross wall; cell III longer than broad, ca. 15–16 \times 11–12 μm , separated from cell II by a strongly diagonal cross wall, adnate on the inside with the base of cell VI of perithecium. *Appendage*: Single, free, simple, the tip turned outward slightly, ca. 38 μm long; lower and upper cells cylindrical, the former slightly longer than broad, ca. 12 \times 11 μm , the latter shorter ca. 7–10 \times 11 μm ; antheridium ca. 20 μm long, venter ca. 10 μm wide, efferent tube ca. 15 μm long, tapered upward, ca. 2 μm wide at tip, bearing a hyaline spine ca. 7 μm long on its inner margin about midway down from tip. *Perithecium*: Cell VI ca. 38 μm long, broadest above, ca. 20 μm wide, gradually narrowed downward, ca. 7 μm wide at base, abruptly narrowed near base, forming a constriction ca. 10 μm long; cell VII small, together with the perithecial basal

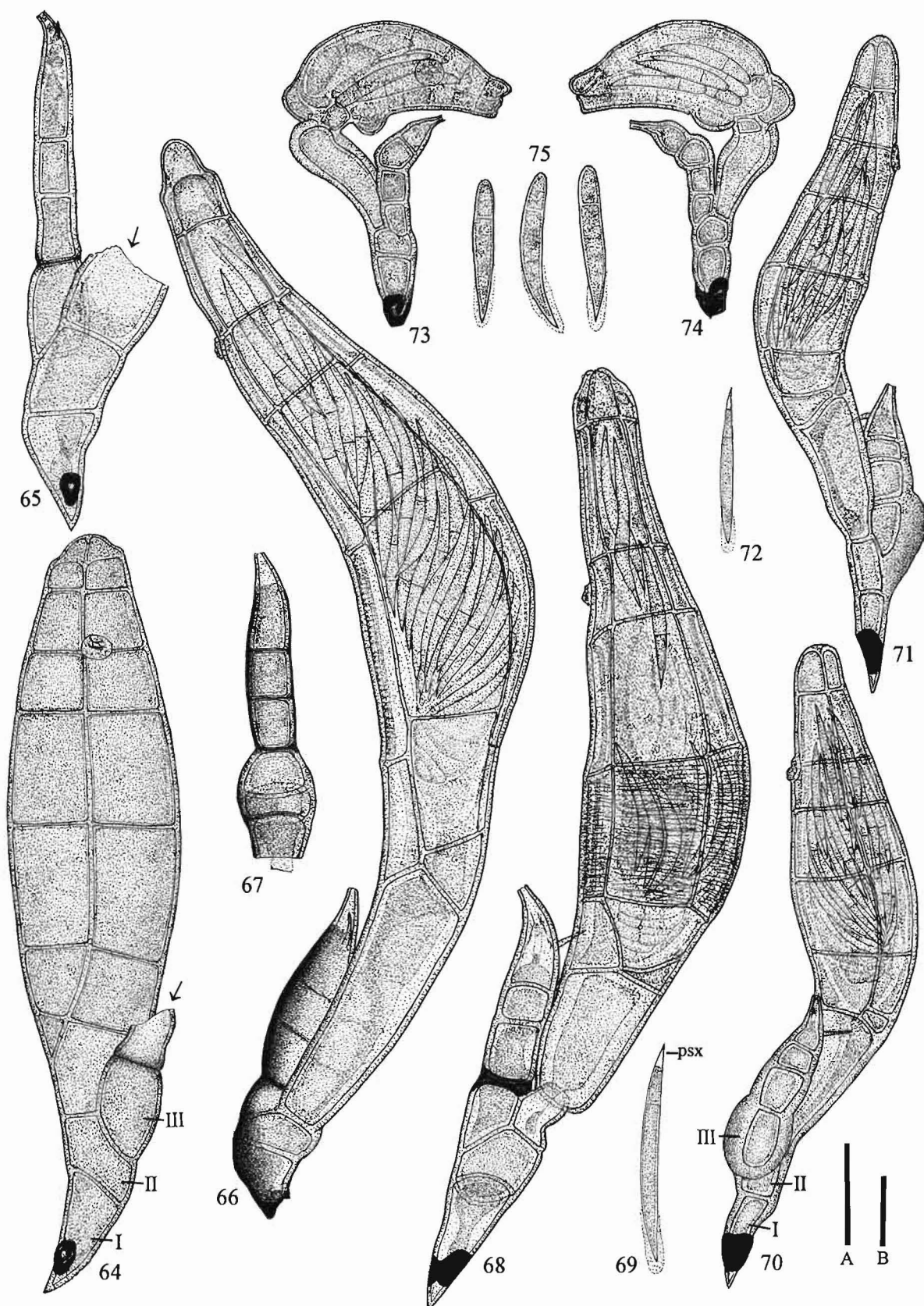


Fig. 64–75.—64, 65. *Bordea castellini* (Rossi 1160).—64. Mature individual (holotype) with missing appendage that had broken off near the base (arrow).—65. Mature receptacle and appendage with only the base of primary perithecial stalk cell (arrow).—66, 67. *B. tiwaiensis* (Rossi 1466).—66. Mature individual (holotype).—67. Receptacle (base of cell I missing) and mature appendage as viewed from the rear.—68, 69. *B. strangulata* (Thaxter 1636).—68. Mature individual (holotype).—69. Ascospore.—70–72. *B. weirii* (70, 72, Weir 759,

cells (*m*, *n*, *n'*) comprising ca. 15% of total length of perithecial body above cell VI; body ca. 120 μ m long including basal cells, slightly arcuate, posterior margin slightly concave, anterior margin strongly convex, broadest above the base, ca. 38 μ m wide, then tapered gradually to the abruptly narrowed, symmetrical, rounded tip; trichogynic remnant ca. 6 μ m wide; tier one outer wall cells with closely spaced transverse striae. Ascospores ca. 35–40 \times 3 μ m.

Specimens examined.—GUATEMALA. Agua Caliente, Feb 1908, W. A. Kellerman coll., on lower surface of abdomen of small Pselaphid, *Eucomus*? [*Euconnus* sp.]; *Thaxter 1636* (FH #s 4041 [HOLOTYPE] and 4042 [ISOTYPE]).

Notes.—Thaxter's collection of *Bordea strangulata* (Fig. 68, 69) consists of but two mature specimens in relatively good condition. According to a notation on a label affixed to the left end of slide FH 4041, the type specimen was remounted in March 1928. This would account for the fact that its present position on the slide (cf. Fig. 68) is reversed relative to that shown in his illustration (Thaxter 1931, Pl. XVIII, fig. 6), which means that he must have prepared his drawing prior to 1928. The identity of the host as given by Thaxter is uncertain. There apparently is no such genus as *Eucomus* listed for New World Coleoptera (Blackwelder 1944; Arnett 1985). There is a genus of Scydmaenidae (Coleoptera), *Euconnus* Thompson, with many species in North, Central, and South America (Blackwelder 1944: 87; Arnett 1985: 299), but Thaxter (1931: 94, 96) definitely placed the host in the Pselaphidae. *Bordea strangulata* takes its name from the abruptly constricted base of perithecial stalk cell VI. Another distinctive feature of the taxon, not noticed by Thaxter, are the closely spaced transverse striae adorning the basal tier of outer wall cells (Fig. 68).

11. *Bordea weirii* R. K. Benj., sp. nov. Fig. 70–72

Ascoma: Rectum, paulo sigmoideum, plus minusve retrocurvatum; luteolum, brunneum tingens praeter pedem denigratum. Totus thallus 130–160 μ m longus ad apicem perithecii. *Receptaculum*: Elongatum, 33–40 μ m longum ex apice pedem usque ad basin appendicis, latitudo distalis 15–20 μ m; cellula I relative angusta, 16–20 μ m longa, latitudo distalis 8 μ m; apex pedis denigrati hyalinus acicularis; cellulis II angusta, 8–11 \times 8 μ m, e cellula I septo prope transverso separata; cellula III relative grandis, 15–19 \times 12–14 μ m, intus cellulae II et basi cellulae VI adnata, margines expositae fortiter convexae, parietes laterales et postici magnopere incrassati, 5–6 μ m crassi. *Appendix*: Una, lib-

era, simplex, attenuata, 23–27 μ m longa, crassities parietis basi incrassatus apicem versus decrescens; cellula infima 9–10 \times 10–11 μ m, margine leniter convexus; cellula supera 5 \times 9–10 μ m; antheridium 10–13 μ m longum, basi 7–9 μ m lato, apice ca. 1.5 μ m lato; spina ca. 5–6 μ m longa. *Perithecium*: Cellula VI 28–45 μ m longa, apice 13–17 μ m lato, basin versus gradatim decrescens, basi abrupte contracta, 6–7 μ m lata; cellula VII parva, 7–12 μ m alta, cum cellulis *m*, *n*, et *n'* prope 1/5 corporis perithecii in tota longitudine supra cellulam VI formantes; corpus perithecii 100–130 μ m longum cum cellulis basilaribus, latitudo maxima 20–23 μ m, margine antica fortiter convexa, margine postica leniter convexa, gradatim decrescens ad apicem; apex symmetricus rotundatus; vestigium trichogynae 6–7 μ m in diametro. Ascospores ca. 22–25 \times 3 μ m; apex cellulae terminalis prospinam formans. Typus AW 759 (SYRF).

Ascoma: Erect, slightly sigmoid, \pm arcuate backwards; pale yellowish, tinged with brown except for blackened foot. Total length from tip of foot to tip of perithecium 130–160 μ m. *Receptacle*: Elongate, 33–40 μ m long from tip of foot to base of appendage, relatively broad distally, 15–20 μ m wide; cell I relatively narrow, 16–20 μ m long, 8 μ m wide distally, tip of blackened foot hyaline, aciculate; cell II narrow, 10–11 \times 8 μ m, separated from cell I by a nearly transverse cross wall; cell III relatively large, 15–19 \times 12–14 μ m, adnate on the inside to cell II and the base of cell VI, its exposed margins strongly convex, its lateral and posterior walls greatly thickened, 5–6 μ m thick. *Appendage*: Single, free, simple, broadest at base, \pm evenly tapered upward, lateral wall thickest at base, gradually decreasing upward, 23–27 μ m long; lower cell nearly as long as broad, 9–10 \times 10–11 μ m, its margins slightly convex; upper cell about twice as wide as high, 5 \times 9–10 μ m; antheridium 10–13 μ m long, 7–9 μ m wide at base, ca. 1.5 μ m wide at tip, bearing a hyaline spine ca. 5–6 μ m long on its inner margin about midway down from tip. *Perithecium*: Cell VI 28–45 μ m long, broadest distally, 13–17 μ m wide, gradually narrowed downward, slightly constricted near base, which is 6–7 μ m wide; cell VII small, 7–12 μ m high, together with perithecial basal cells (*m*, *n*, *n'*) comprising ca. 15% of total length of perithecial body above cell VI; body 100–130 μ m long including basal cells, anterior margin strongly convex, posterior margin slightly convex, broadest above the base, 20–23 μ m wide, then tapered gradually to the symmetrical, rounded tip; trichogynic rem-

71, *Weir 758*).—70. Mature individual (holotype).—71. Mature individual (paratype).—72. Ascospore.—73–75. *B. retroflexa* (RKB 3048A).—73, 74. Two mature individuals (73, holotype; 74, isotype).—75. Three ascospores. (Bars: A = 20 μ m, Fig. 64–68, 70, 71, 73, 74; B = 10 μ m, Fig. 69, 72, 75.)

nant 6–7 μm wide. Ascospores ca. 22–25 \times 3 μm ; the upper cell terminating in a hyaline prospine.

Etymology.—Named for Alex Weir, mycologist, student of Laboulbeniales.

Holotype.—USA. LOUISIANA: **West Feliciana Par.**, St. Francisville, Tunica Hills Wildlife Management Area, 2 June 1995, D. Pashley coll., on *Melba* sp., *Weir 759* (SYRF).

Paratypes.—USA. LOUISIANA: **West Feliciana Par.**, St. Francisville, Tunica Hills Wildlife Management Area, 25 Aug 1995, D. Pashley coll., on sternites of *Melba thoracica* (Brendel), *Weir 758* (SYRF). NEW YORK. **Orange Co.**, West Point Military Res., 5 May 1949, Wm. Nutting coll., on tip of abdomen of *Conoplectus canaliculatus* (LeC.), *RKB 539* (designated slide; RSA).

Notes.—Five mature individuals of *Bordea weirii* (Fig. 70, 71) and three mature receptacles, each with an appendage, were taken off the three hosts from the above localities. The relatively small size of the thallus and especially the greatly thickened wall of cell III of the receptacle readily distinguishes *B. weirii* from other *Bordeas* having a \pm sigmoid habit, e.g., *B. bryaxialis*, *B. strangulata*, and *B. tiwaiensis*.

12. *Bordea retroflexa* R. K. Benj., sp. nov.

Fig. 73–75

Ascoma: Parvum; corpus peritheci fortiter retroflexus supra appendicem; luteolum praeter pedem denigratum. Totus thallus 70–85 μm longus ad apicem peritheci. *Receptaculum*: Prope rectum, 23–28 μm longum ex apice pedem usque ad basin appendicis; cellula I 15–17 \times 7–9 μm , apex pedis intacti hyalinus; cellula II 5–8 \times 8–10 μm , e cellula I septo leniter diagonaliter separata; cellula III 6–8 \times 5–8 μm , intus cellulae VI adnata, e cellula II septo diagonaliter separata. *Appendix*: Una, libera, simplex, plus minusve extrorsus flexa, 20–25 μm longa; cellula inferna prope cylindrica, 5–8 \times 6–6.5 μm ; cellula superna 5–8 \times 7–8 μm , marginibus plus minusve convexis; antheridium 9–12 μm longum; venter 6–7 μm latus; tubus ca. 1.5 μm latus. *Perithecium*: Cellula VI 16–28 μm longa, apice 8–12 μm lata, basi 5–6 μm lata, prope recta vel plus minusve sigmoidea; cellula VII parva; cellulae basales (*m*, *n*, et *n'*) breves, duo cellularum externe rotundatae; corpus peritheci axi cellulae VI prope perpendiculare, latitudo transversalis 42–45 μm , prope basin 15–21 μm , margine antica fortiter convexa, margine postica leniter concava, sursum gradatim decrescens; apex truncatus; vestigium trichogynae 6–7 μm in diametro. Ascosporae 20–23 \times 4 μm ; apex cellulae terminalis sine prosina. Typus *RKB 3048A* (RSA).

Ascoma: Small; perithecial body strongly reflexed backward over appendage, oriented at a \pm right angle to the axis of cell VI; pale yellow except for the blackened foot. Total length from tip of foot to tip of peri-

thecium 70–85 μm . *Receptacle*: Nearly straight, 23–28 μm long from tip of foot to base of appendage; cell I longer than broad, 15–17 \times 7–9 μm , tip of intact blackened foot aciculate, hyaline; cell II shorter, 5–8 \times 8–10 μm , separated from cell I by a slightly diagonal cross wall; cell III 6–8 \times 5–8 μm , adnate on the inside with the base of cell VI, separated from cell II by a diagonal cross wall. *Appendage*: Single, free, simple, \pm strongly bent outward, 20–25 μm long; lower cell nearly cylindrical, 5–8 \times 6–6.5 μm ; upper cell 5–8 \times 7–8 μm , margins \pm convex; antheridium 9–12 μm long, venter 6–7 μm wide, efferent tube \pm gradually narrowed, tip ca. 1.5 μm wide. *Perithecium*: Cell VI 16–28 μm long, 8–12 μm wide distally, 5–6 μm wide at base, nearly straight to \pm sigmoid; cell VII small, closely associated with the short perithecial basal cells (*m*, *n*, *n'*), two of which may be \pm prominently externally rounded; body nearly perpendicular to axis of cell VI, transverse length 42–45 μm , broadest near the base, 15–21 μm wide, anterior margin strongly convex, posterior margin slightly concave, tapered to the broad, truncate apex; trichogynic remnant 6–7 μm wide. Ascospores 20–23 \times 4 μm ; terminal cell without a prospine.

Etymology.—From *retro-* (L.), backward, + *flexus* (L.), bent.

Holotype.—USA. MISSISSIPPI: **Warren Co.**, 6 mi. E of Vicksburg, oak-pine woodland, 30 Dec 1966, R. T. & E. J. Allen coll., on the abdominal tergites of *Melba* sp., *RKB 3048A* (designated slide; RSA [with one isotype]). (*Note*: This slide bears a few specimens of an unidentified species of *Cryptandromyces*, which were inadvertently mounted along with *Bordea retroflexa*. The latter cannot be confused with the former.)

Isotypes.—Data as for the holotype, *RKB 3048A* (designated slide; RSA).

Paratypes.—USA. LOUISIANA: **West Feliciana Par.**, ca. 7 mi SSE of St. Francisville, 11 Aug 1995, D. Pashley coll., on abdominal tergites of *Melba* sp., *Weir 769* (SYRF).

Notes.—My description of *B. retroflexa* is based on nine mature specimens. The strongly reflexed thallus of this small species (Fig. 73, 74) readily distinguishes it from all other known *Bordeas*. It is the only species in the genus having a nonspinoso appendage. The upper cell of the ascospore is broadly rounded and unmodified (Fig. 75) unlike other species of the genus where the antheridium bears a spine derived from the aciculate tip of the upper cell of the spore, which is hyaline and spinelike from the beginning (Fig. 48, 51, 55, 63, 69, 72, 79, 82).

13. *Bordea allenii* R. K. Benj., sp. nov. Fig. 76–79

Ascoma: Plus minusve rectum; atroluteobrunneum praeter pedem denigratum et septum inter cellulam

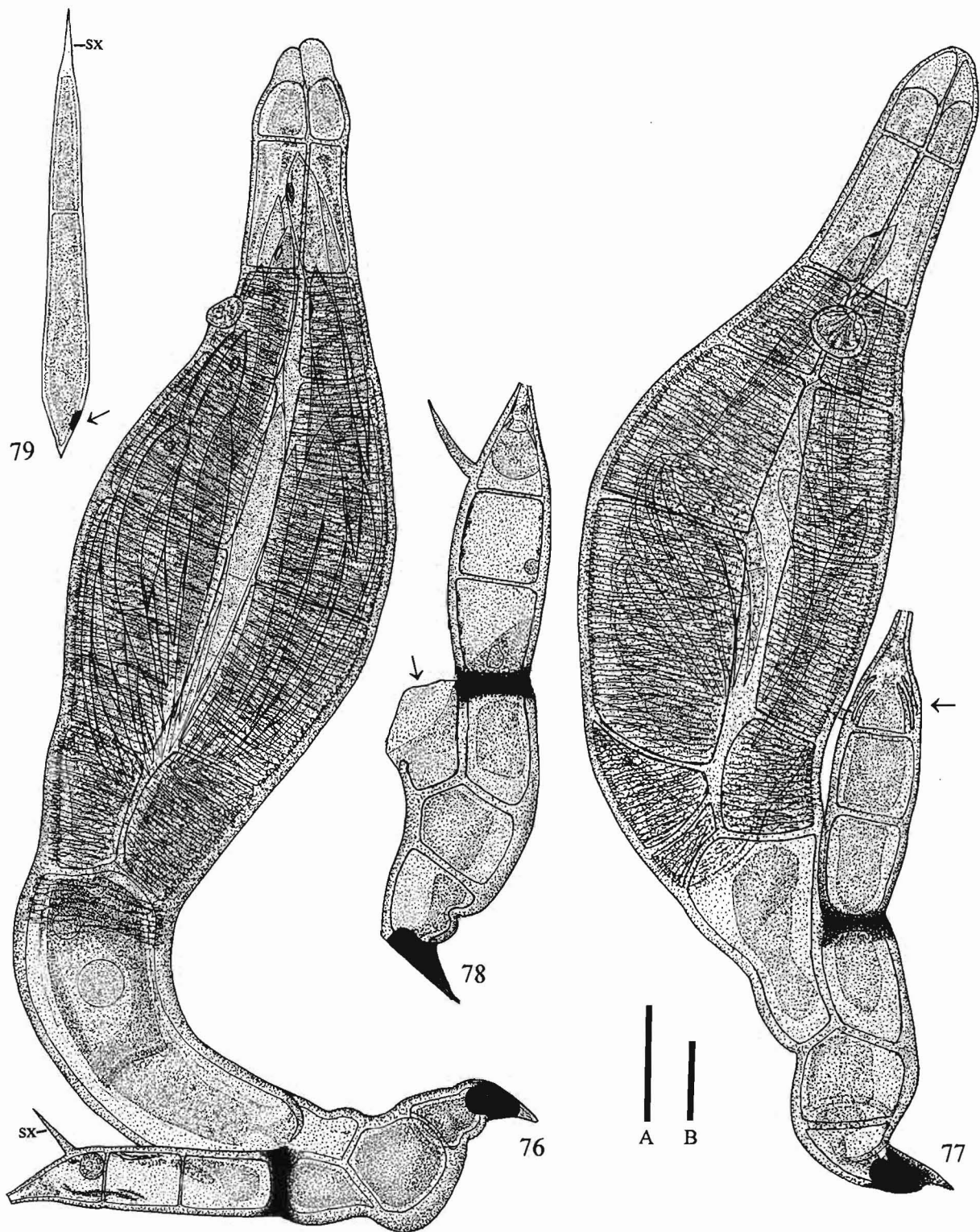


Fig. 76–79. *Bordea allenii* (RKB 2666).—76. Mature individual (holotype).—77. Mature individual (isotype); note secondary thickening of lateral and upper walls of antheridial venter (arrow).—78. Mature receptacle and appendage with perithecium missing except for base of cell VI (arrow).—79. Ascospore showing early stage of germination as evidenced by the black spot signaling the beginning of foot development (arrow). (Drawing of specimen still inside perithecium.) (Bars: A = 20 μ m, Fig. 76–78; B = 10 μ m, Fig. 79.)

basalem appendicem et cellulam III receptaculi denigratum. Totus thallus 210–215(–260) μm longus ad apicem perithecii. *Receptaculum*: Relative breve et latum, (45–)55–65 μm longum ex apice pedem usque ad basin appendicis; cellula I brevis, 22–28 μm longa, latitudo distalis 15–20 μm , apex pedis hyalinus acicularis; cellula II 12–15 \times 20–23 μm , margine postica plus minusve fortiter convexa pariete 4–6 μm crasso, e cellula I septo leniter diagonaliter separata; cellula III 15–20 \times 12–18 μm , e cellula II septo diagonaliter separata, intus basi cellulae VI adnata, margine plus minusve convexa. *Appendix*: Una, libera, simplex, recta, 50–55 μm longa, margines prope rectae vel paulo convexae; cellula inferna 16–20 \times 11–18 μm ; cellula superna 13–15 \times 11–18 μm ; antheridium 18–20 μm longum; basi 11–15 μm lato, intus prope basin spinam 11–16 μm longam gignens; tubus 12–15 μm longus, apice ca. 2 μm lato. *Perithecium*: Cellula VI 35–40(–70) μm longa, apice 30–32 μm lato, basin versus gradatim decrescens, basi 10–14 μm lata; cellula VII relative parva, ca. 10 μm alta, cum cellulis *m*, *n*, et *n'* prope 1/5 corporis perithecii in tota longitudine supra cellulam VI formantes; corpus 135–150 μm longum cum cellulis basilaribus, margines fortiter convexae, latitudo maxime ad medianum 55–60 μm , sursum decrescens et abrupte angustatum supra stratum medianum cellularum tum gradatim angustatum ad apicem symmetricum rotundatum; apex cellula VI et cellulae basilarium et cellulae stratorum 1–3 striis angustis transversis; vestigium trichogynae 10–11 μm in diametro. Ascospores est. ca. 50 \times 5 μm ; apex cellulae terminalis prospinam formans. Typus *RKB 2666* (RSA).

Ascoma: More or less erect; dark brownish yellow except for the blackened foot and the cross wall separating lower cell of appendage and cell III of receptacle. Total length from tip of foot to tip of perithecium 210–215(–260) μm . *Receptacle*: Relatively short and broad, (45–)55–65 μm long from tip of foot to base of appendage, cell I short, widest distally, 22–28 \times 15–20 μm , tip of foot hyaline, aciculate; cell II wider than high, 12–15 \times 20–23 μm , posterior margin \pm strongly convex, with wall 4–6 μm thick, separated from cell I by a slightly diagonal cross wall; cell III slightly longer than broad, 15–20 \times 12–18 μm , separated from cell II by a diagonal cross wall, adnate on the inside with the base of cell VI, its outer margin \pm convex. *Appendage*: Single, free, simple, straight, 50–55 μm long, margins nearly straight or somewhat convex; lower cell 16–20 \times 11–18 μm ; upper cell slightly shorter, 13–15 \times 11–18 μm ; antheridium 18–20 μm long, 11–15 μm wide at base, abruptly narrowed upward, bearing a hyaline spine 11–16 μm long on the inside near the base, efferent tube 12–15 μm long, ca. 2 μm wide at tip. *Perithecium*: Cell VI variable in

length, gradually narrowed downward, \pm abruptly narrowed below, 35–40(–70) μm long, 30–32 μm wide distally, 10–14 μm wide at base; cell VII relatively small, flat, ca. 10 μm high, together with perithecial basal cells (*m*, *n*, *n'*) comprising ca. 15% of total length of perithecial body above cell VI; body 135–150 μm long including basal cells, laterally strongly convex, broadest near the middle, 55–60 μm wide, then tapered upward, becoming abruptly narrowed just above median tier of outer wall cells, then gradually narrowed to the symmetrical, rounded tip; distal end of cell VI, basal cells, and tier one to three outer wall cells with closely spaced transverse striae; trichogynic remnant 10–11 μm wide. Ascospores est. ca. 50 \times 5 μm ; terminal cell forming a prospine.

Etymology.—Named for R. T. Allen, entomologist, who collected the host insect.

Holotype.—USA. LOUISIANA: **Franklin Par.**, Chase, light trap, 28 Jun 1963, R. T. Allen coll., on right upper surface of abdomen of *Cylindrartus crinifer* Casey, *RKB 2666* (designated slide; RSA).

Isotypes.—Data as for holotype except on lower surface of abdomen near base of rear legs of host, *RKB 2666* (designated slide; RSA).

Notes.—My description of *Bordea allenii* is based on study of five mature individuals (cf. Fig. 76, 77), one detached mature perithecium, and two mature receptacles with intact appendages (cf. Fig. 78). All of the specimens are aged to the point where cellular cytoplasm has \pm degenerated and perithecia contain mostly ascospores in an early stage of germination. This is evidenced by a blackened spot marking the site of haustorial emergence from the developing foot (Fig. 79, arrow). To help me obtain additional, hopefully younger material, Dr. C. E. Carlton, Dept. of Entomology, Louisiana State Univ., Baton Rouge, arranged a loan of 50 pinned specimens including *Cylindrartus crinifer* (20), *C. longipalpus* LeC. (8), *C. ludovicianus* Brendel (11), and *Cylindrartus* spp. (11). Unfortunately, none of the insects was infected with Laboulbeniales.

The perithecium of *Bordea allenii*, like several other species of the genus, e.g., *B. platensis* and *B. thaxteri*, is ornamented by closely spaced transverse striae that may extend from the upper end of cell VI up to or including the third tier of outer wall cells. As in many species of *Monandromyces* (Benjamin 1999), these striae formed on the inside rather than the outside of the wall of the cells. The antheridial spine of *B. allenii* (Fig. 76, 78) may exceed the length of any found in other species of *Bordea*.

14. *Bordea spinigera* R. K. Benj., sp. nov.

Fig. 80–82

Ascoma: Prope rectum vel leniter retroflexum; atro-

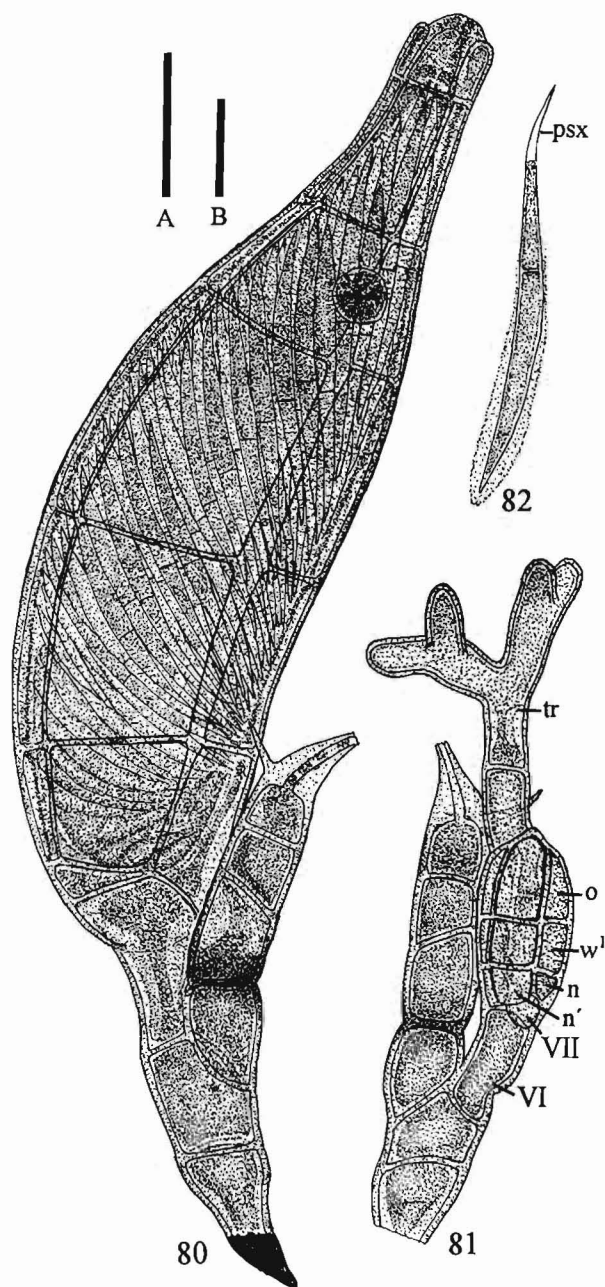


Fig. 80–82. *Bordea spinigera* (80, 81, RKB 2147; 82, RKB 2146).—80. Mature individual (holotype).—81. Juvenile at two-out-er-wall-cell stage of perithecial development showing well-developed trichogyne.—82. Ascospore. (Bars: A = 20 μ m, Fig. 80, 81; B = 10 μ m, Fig. 82.)

luteobrunneum praeter pedem denigratum et septum inter cellulam basalem appendicis et cellulam III receptaculi denigratum. Totus thallus 170–198 μ m longus ad apicem perithecii. *Receptaculum*: Elongatum, 39–54 μ m longum ex apice pedem usque ad basin appendicis; cellula I 19–25 μ m longa, latitudo distalis 10–15 μ m, decrescens ad pedem, in medio plus minusve abrupte angustata; cellula II 14–18(–21) \times 13–18 μ m, e cellula I septo prope transverso separata; cellula III 12–15 \times 9–12 μ m, intus cellulae VI adnata,

e cellula II septo fortiter diagonaliter separata. *Appendix*: Longitudo 35–41 μ m; cellula inferna 11–15 \times 8–11 μ m; cellula superna 7–12 \times 8–11 μ m, e cellula inferna septo diagonaliter separata; antheridium 15–20 μ m longum; venter 9–10 μ m latus; tubus 10–12 μ m longus, ad apicem abrupte decrescens, extrinsecus curvatus, ad apicem 1–3 μ m latus; spina 6–9 μ m longa. *Perithecium*: Cellula VI relative brevis, 16–26 μ m longa, apice 14–23 μ m lato, basin versus abrupte decrescens, basi 7–10 μ m lata; cellula VII 7–10 μ m alta, cum cellulis *m*, *n*, et *n'* prope 1/5 corporis perithecii in tota longitudine supra cellulam VI formantes; corpus rectum, 113–139 μ m longum cum cellulis basilaris, latitudo maxime ad medianum 28–42 μ m, perlate inflatum usque ad basin cellulae stratorum 3 tum plus minusve gradiatum angustatum; margine antica fortiter convexa, margine postica leniter convexa; apex latus rotundatus; vestigium trichogynae 7–9 μ m in diametro. Ascosporae 40–45 \times 3–3.5 μ m; apex cellula terminalis prospinam 6–9 μ m longam formans. Typus RKB 2147 (RSA).

Ascoma: Nearly straight to bent backward slightly; dark yellowish brown excepting blackened foot and cross wall separating cell III of receptacle and lower cell of appendage, the suffusion extending slightly above and below the cross wall. Total length from tip of foot to tip of perithecium 170–198 μ m. *Receptacle*: Elongate, 39–54 μ m long from tip of foot to base of appendage; cell I 19–25 μ m long, 10–15 μ m wide distally, tapered downward to tip of foot, \pm abruptly narrowed near middle; cell II only slightly longer than broad, 14–18(–21) \times 13–18 μ m, separated from cell I by a nearly transverse cross wall; cell III slightly longer than broad, 12–15 \times 9–12 μ m, adnate on the inside with the base of cell VI, separated from cell II by a strongly diagonal cross wall. *Appendage*: Total length 35–41 μ m; lower cell longer than broad, 11–15 \times 8–11 μ m; upper cell shorter, 7–12 \times 8–11 μ m, separated from the lower cell by a diagonal cross wall directed upward from the outside; antheridium 15–20 μ m long, venter 9–10 μ m wide, efferent tube 10–12 μ m long, abruptly tapered, bent outward slightly, 2–3 μ m wide at tip, bearing on the inside a \pm median spine 6–9 μ m long. *Perithecium*: Cell VI relatively short, 16–26 μ m long, 14–23 μ m wide distally, abruptly tapered downward, 7–10 μ m wide at base; cell VII short, greatest height 7–10 μ m, closely associated with the perithecial basal cells (*m*, *n*, *n'*) and together with these comprising ca. 15% of total length of perithecial body above cell VI; body straight, 113–139 μ m long including basal cells, widest near the middle, 28–42 μ m wide; very broadly inflated from basal cell region to base of tier three of outer wall cells, then \pm gradually narrowed, becoming nearly uniform in width up to the broad, rounded tip, anterior margin more strongly convex than posterior margin; trichogynic remnant

7–9 μm wide. Ascospores $40\text{--}45 \times 3\text{--}3.5 \mu\text{m}$; tip of the upper cell forming a hyaline prospine 6–9 μm long.

Etymology.—From *spiniger* (L.), thorn-bearing.

Holotype.—USA. MINNESOTA: Aitkin Co., Pine Lake Bog, 8 mi. S of Aitkin, 13 Aug 1962, in sphagnum, D. E. Reichle coll., on mid anterior upper surface of abdomen of *Reichenbachia spatulifer* Casey, RKB 2147 (designated slide; RSA [with isotypes]).

Paratypes.—USA. MINNESOTA: Aitkin Co., Pine Lake Bog, 8 mi. S of Aitkin, 13 Aug 1962, in sphagnum, D. E. Reichle coll., on anterior upper surface of abdomen of *R. spatulifer*, RKB 2144, 2145 (RSA); on anterior upper surface of abdomen and adjacent posterior margin of elytra of *R. spatulifer*, RKB 2146 (RSA); on mid anterior upper surface of abdomen of *R. spatulifer*, RKB 2148 (RSA); on mid surface of right elytron of *R. spatulifer*, RKB 2149 (RSA); on anterior upper surface of abdomen of *R. spatulifer*, RKB 2150A, 2151 (RSA); on mid posterior upper surface of abdomen of *R. spatulifer*, RKB 2150B (RSA). Clearwater Co., 6 mi. S of Bagley, 10 Aug 1962, in sphagnum bog, D. E. Reichle coll., on mid anterior upper surface of abdomen of *R. spatulifer*, RKB 2157 (RSA). Steele Co., 6 mi. N of Medford, 14 Aug 1962, D. E. Reichle coll., in dry sphagnum, on mid anterior upper surface of abdomen and adjacent left elytron of *R. spatulifer*, RKB 2158 (RSA). Hubbard Co., 3 mi. E of Lake Itasca on Rt. 71, 10 Aug 1962, D. E. Reichle coll., in sphagnum, on mid anterior upper surface of abdomen of *R. spatulifer*, RKB 2159 (RSA).

Notes.—All of the abundant material of *Bordea spinigera* available for study was found on just one species of host, *Reichenbachia spatulifer*, collected in sphagnum bogs in Minnesota. In the above description thalloid length is based on measurement of 31 mature individuals; up to 35 measurements were made of other structures. The thallus of *B. spinigera* (Fig. 80) bears some similarity to that of *B. platensis* (Fig. 60), differing in being \pm erect rather than geniculate, in the absence of transverse perithecial striae, in having a significantly longer antheridial spine, and especially in the strongly diagonal rather than transverse cross wall separating the lower and upper cells of the body of the appendage. With regard to the latter feature especially, the appendage of *B. spinigera* recalls that described for *Acompsomyces* (*Bordea*) *decarthricola* by Spegazzini (1917) (Fig. 61), which is here excluded for lack of definitive material on which to judge its validity.

Rossiomyces R. K. Benj., gen. nov.

Receptaculum cellularum trium constans; cellulae basilaris (I) et suprabasilaris (II) septo diagonali separatae; cellula terminalis (III) intus basi cellulae VI et pariete interiore cellulae II adnata. Appendix primaria, cellulis III subtente, cellularum trium (vel in aetate plus) superpositarum constans; cellula basilaria sterilis; cellulae successivae intus ad apicem antheridium unum vel antheridia duo formantes; cellula tertius extus spinam gignens. Perithecium, cellulis II sub-

tenta, stipite cellularum duorum (VI, VII), cellulis basilaribus tribus (*m*, *n*, *n'*) persistentibus, et cellulis parietis externis in quatuor ordinibus longitudinalibus numusquique quinque cellularum; cellula postica et cellulae laterales stratorum quinque cellularum parietium externarum paria duo prominentiarum formantes. Trichogyna cellulae unis et cellularum duarum distalis constans. Cellula ascogena unica. Ascosporae 1-septatae.

Receptacle consisting of three cells; the basal cell (I) and suprabasal cell (II) separated by a diagonal cross wall; the terminal cell (III) united above with the base of the perithecial stalk cell VI and on the inside below with the inner wall of cell II. Primary appendage, subtended by cell III, free, consisting of three (or, in age, more) superposed cells; the basal cell sterile; the successive cells forming on the inside distal antheridia singly or in pairs; the third cell spinose on the outside. Perithecium, subtended by cell II, with a primary stalk cell (VI), a secondary stalk cell (VII), three persistent basal cells (*m*, *n*, *n'*), and four vertical rows of outer wall cells of five cells each. The posterior and lateral tier-five outer wall cells forming two pairs of well-defined prominences. Trichogyne consisting of a single cell and a distal pair of cells. Ascogenic cell single. Ascospore 1-septate.

Type species.—*Rossiomyces falcatus* (T. Majewski) R. K. Benj.

Etymology.—Named for Walter Rossi, student of Laboulbeniales.

Rossiomyces falcatus (T. Majewski) R. K. Benj., comb nov. Fig. 83–95

= *Autophagomyces falcatus* T. Majewski, *Acta Mycol.* 9: 229, 1973 (BASIONYM)

Ascoma: Arcute, hyaline to pale yellowish except for blackened foot. Total length from tip of foot to tip of perithecium 100–158 μm . *Receptacle*: Short, 32–39 μm long from tip of foot to base of appendage; cell I two to three times longer than broad, 18–30 μm long, 8–10 μm wide distally, uniformly tapered downward to the usually hyaline tip that extends beyond the blackened foot, separated from cell II by a strongly diagonal cross wall, its apex on the outside \pm contacting narrowed tip of base of cell III; cell II \pm trap-ezoidal, shorter than wide, (4–)5 \times (7–)8–10 μm ; cell III ca. two times longer than wide, 9–13 \times 5–6 μm , tapered downward near the base, separated from cell II by a diagonal cross wall, adnate above on the inside with the base of cell VI. *Appendage*: One, free, 42–70 μm long, consisting of three superposed elongate cells; lowermost cell sterile, 8–11 \times 5 μm , separated from cell above by a slightly diagonal cross wall; mid-

dle cell $10\text{--}14 \times 5 \mu\text{m}$, giving rise to a single antheridium distally on the inside; upper cell $12\text{--}19 \times 4\text{--}5 \mu\text{m}$, slightly curved, usually bearing a short spine $2\text{--}3 \mu\text{m}$ long, which is variably located on its \pm convex outer margin, and giving rise distally to a pair of antheridia, outer antheridium rarely spinose at or near the base; antheridia \pm curved, elongate, slender, gradually narrowed distally, $18\text{--}27 \mu\text{m}$ long, venter ca. $3 \mu\text{m}$ wide, efferent tube, tapered, $6\text{--}10 \mu\text{m}$ long, tip $1.5\text{--}2 \mu\text{m}$ wide. *Perithecium*: Cell VI relatively short, $10\text{--}14 \mu\text{m}$ long, widest distally, tapered downward slightly, separated from cell II by a diagonal cross wall; cell VII slightly shorter than cell VI, $7\text{--}12 \mu\text{m}$ long, \pm vertically adnate on the inside with base of basal cell *m*, subtending basal cells *n* and *n'*, and together with these comprising ca. 20 % of total length of perithecial body above cell VI; body falcate, $68\text{--}114 \mu\text{m}$ long including basal cells, \pm uniformly widened upward to the middle, which is $21\text{--}31\text{--}(34) \mu\text{m}$ wide, then gradually tapered to the tip, anterior margin strongly convex, posterior margin straight to slightly concave; the anterior tier-five outer wall cell *ex n adj. n'* tapered to a narrow or broadly rounded tip; a single, short, divergent, terminally rounded prominence $3\text{--}4 \mu\text{m}$ long arising from each side of the base of the tier-five outer wall cell *ex m*; and a single, divergent, terminally rounded prominence $6\text{--}7 \mu\text{m}$ long arising distally from each of the tier-five outer wall cells *ex n adj. m* and *ex n'*. Trichogynic remnant, on the tier-four outer wall cell *ex m*, relatively small. Ascospores $32\text{--}47 \times 3 \mu\text{m}$.

Specimens examined.—POLAND. Voivod. SKIERNIEWICE: Rawa Mazowiecka county, Kurzeszyn Nowy, 11 Jul 1972. T. Majewski coll., on tips of elytra of *Cryptophagus pilosus* Gyllenhal, *TM 1043, 1044* (HOLOTYPE; KRAM); Voivod. SUWALKI: Urwitalk nr. Mikolajki, 4 Sep 1975, T. Majewski coll., on tips of elytra of *C. abietis* (Paykull), *TM 1563*. ENGLAND. CHESHIRE: Dunham Park, 26 Jun 1992, C. Johnson coll., on elytra and abdomen of *C. dentatus* Herbst, in coll. of A. Weir, *AW 56*. ITALY. Termoli (CB), 26 Mar 1991, W. Rossi coll., on tips of elytra and lower surface of abdomen of *Cryptophagus* nr. *pilosus*, W. Rossi 1638; data as for W. Rossi 1638, duplicate hosts received from Rossi, *RKB 3870* (RSA).

Notes.—The above description of *Rossiomyces falcatus* is based on study of specimens received from Majewski (*TM 1144* [six adults] and *TM 1563* [four adults]) and abundant material from Rossi (*W. Rossi 1638* [seven adults] and *RKB 3870* [51 adults]). The parasitized hosts sent by Rossi bore many immature individuals, and these provided definitive information on development of the perithecium and appendage (Fig. 84–92).

The two slides received from Alex Weir (*AW 56*) included eight mature individuals found on *Cryptophagus dentatus*. Characteristics of these were not incorporated into the description, for they show evidence of developmental anomalies due to trauma or perhaps aging. Four of the eight thalli bear a mature secondary perithecium that had arisen immediately below the

basal remnant of cell VI of a primary perithecium that either had aborted or somehow broken off (cf. Weir and Beakes 1993, fig. 14); this may account for the basal constriction of cell VI noted by Weir and Beakes (1993: 1051). One individual bears an about one-half mature secondary perithecium arising immediately below the still intact saclike body of an aborted primary perithecium.

The appendage, too, may display anomalous, secondary growth in aged or damaged thalli. In young thalli, the first-formed antheridia may abort after they have fulfilled their apparent sexual function (Fig. 92); in some instances an aborted antheridium may be replaced by a secondary antheridium. Commonly, when the perithecium has matured, antheridia may abort or become nonfunctional; however, the basic three-celled structure of the appendage persists (Fig. 93). On the other hand, phenomena that result in perithecial abortion or damage and the subsequent initiation of a secondary perithecium apparently can stimulate further development of the appendage, which results in the formation of additional cells that give rise to new antheridia (cf. Weir and Beakes 1993 fig. 10, 13). Further, instead of a secondary perithecium a secondary antheridial appendage may arise from cell II of the receptacle (cf. Weir and Beakes 1993, fig. 15 [in this instance thought by the authors to be an immature individual]) resulting in proliferation of both the primary and secondary appendages. Such secondary appendages formed on traumatized thalli have been recorded in other genera, e.g., *Laboulbenia* (Thaxter 1896, Pl. II, fig. 7, 8) and *Herpomyces* (Tavares 1965, fig. 19). Weir and Beakes (1993) suggested that their material either might represent an undescribed species or be “an unusual growth form or morph.” They chose, I think wisely, to refer it to *Autophagomyces falcatus*.

In Finland, Huldén (1983) found what he identifies as *A. falcatus* on *Cryptophagus bimaculatus* (Panzer), *C. pilosus*, and *C. setulosus* Sturm. I have not seen any of Huldén's material. He notes that the thalli of the Finnish specimens range in size from 120 to $140 \mu\text{m}$, larger than the $97\text{--}110 \mu\text{m}$ given by Majewski for the Polish specimens. These dimensions, however, are within the range given above in my description of *Rossiomyces falcatus* from Rossi's collections of *C. nr. pilosus*. Huldén illustrates what he believes is a typical specimen of *A. falcatus* (Huldén 1983: fig. 15b) that conforms to those described by Majewski. In addition, he illustrates three specimens found at the apex of an elytron that have greatly elongated cells VII and *m* (Huldén 1983: fig. 15c–e). Huldén does not state the precise point of attachment of these specimens, whether on the upper or lower surface of the elytron. Not uncommonly, the degree of curvature and length of the perithecial stalk can be influenced in some Laboulbeniales by position of growth on the host. Thalli

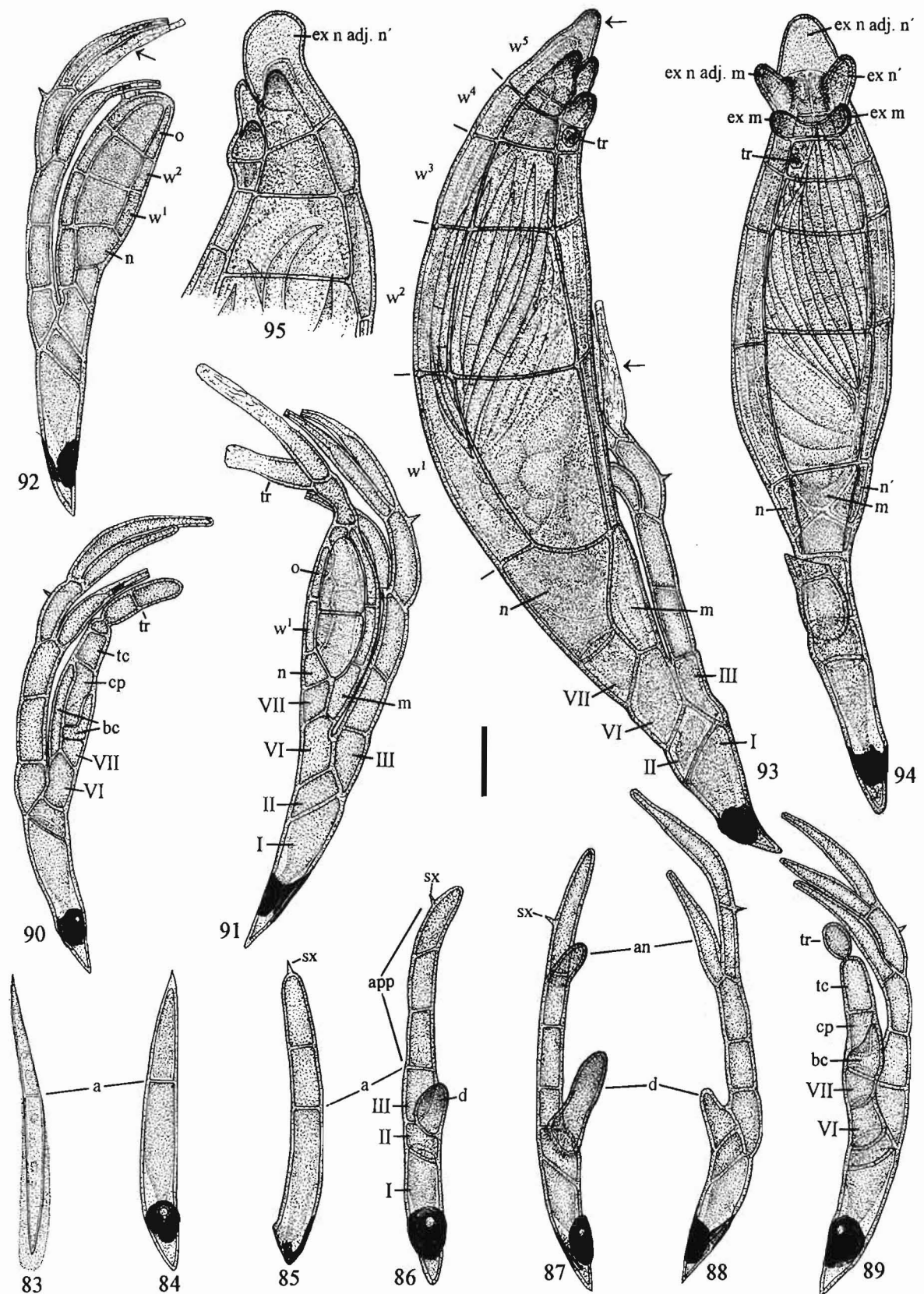


Fig. 83–95. *Rossiomyces falcatus* (83, 92–95, RKB 3870; 84–87, 89–91, Rossi 1638; 88, Majewski 1044).—83. Ascospore.—84–92. Several stages of early thaloid development.—84. The blackened foot had begun to differentiate near base of young receptacle derived from lower cell of spore; tip of young appendage, derived from upper cell of spore, already had become spinelike.—85. Appendage had become once septate; upper cell bore a terminal, well-defined, short spine.—86. Receptacle had reached its final, three-cell stage of development and the perithecial initial had arisen from the upper angle of cell II; appendage consisted of three superposed cells; note spine

attached to the lower surface near abrupt integumental margins as found at the edges of the elytra, the abdomen, the pronotum, etc., may develop abnormally elongate perithecial stalk and basal cells when they grow outward and upward around such margins (unpub. obs.).

Though they probably are more closely related to one another than to many other members of the Stigmatomycetinae sensu Tavares (1985), on the basis of the appendage alone, *Rossiomyces* cannot be regarded as congeneric with *Autophagomyces* or *Bordea* as these genera are defined in this study. When other species of *Rossiomyces* are discovered, the generic description doubtless will need emendation.

The concept of *Rossiomyces* given here, based on the type species, is limited to taxa having a combination of the following characteristics. (1) Appendage single, free, consisting of three superposed cells; the basal cell is sterile, whereas the median and terminal cells give rise to elongate, slender, phialidelike antheridia from their upper, inner angles. The structure of the appendage (Fig. 91, 92) is the primary distinguishing feature of the genus. (2) The indurate apex of the original spore, which shows no evidence of a propine as in many species of *Bordea*, does not have a precise position on the outer margin of the terminal cell (Fig. 88–93), being located anywhere from near the base to the apex of the cell. Rarely, the spine is near the base of the outer, distal antheridium. (3) Cells I and II of the receptacle are separated by a strongly diagonal cross wall. (4) Cell III of the receptacle is separated from cell II by a diagonal cross wall; its lower end approaches or may barely contact the upper, posterior end of cell I. (5) The trichogyne is simple or bifurcate, consisting of a proximal, \pm medianly constricted cell that subtends a single elongate cell or a pair of free elongate cells. (6) A small trichogynic remnant is present on the tier-four outer wall cell *ex m.* (7) Perithecium with five clearly defined tiers of outer wall cells. The distinctive precisely arranged

prominences arising from the terminal tier of outer wall cells (Fig. 93, 94) may be nothing more than specific rather than generic characteristics. The answer awaits discovery of additional species.

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on outer margin of upper cell.—87. Perithecial initial had elongated, and an antheridial initial had arisen from upper inner angle of median cell of appendage.—88. Proximal antheridium was not yet functional; a second antheridium had arisen terminally from the upper, spinose cell of the appendage.—89. Appendage was near its final stage of development, but antheridia were not yet forming spermatia. Perithecium was in an early stage of development; female organ consisted of the carpogenic cell, the trichophoric cell, and a very young trichogyne. Cell VII subtended a small cell that was beginning to grow upward around base of carpogenic cell; however, this cell had not divided and formed one of the true basal cells and a primordial wall cell.—90. Trichogyne had elongated and divided into two cells; lowermost antheridium had begun to form spermatia, but distal antheridia were not yet functional. Cells derived from stalk cells VI and VII were beginning to grow upward around carpogenic cell, but neither had yet cut off true basal cells and primordial outer wall cells.—91. Perithecium was at the -outer-wall-cell stage of development; true basal cells were clearly defined; basal tier of outer wall cells had formed, and each of these cells subtended a primordial outer wall cell. Antheridia were mature as evidenced by their open tips; trichogyne had formed a second distal branch, which, along with the first, was beginning to degenerate distally.—92. Perithecium was at three-outer-wall-cell stage and trichogyne had degenerated except for a basal remnant (partially obscured by tip of the proximal antheridium). Inner distal antheridium had deteriorated (arrow).—93, 94. Two mature individuals showing conformation of perithecial apex.—93. Thallus from upper surface of host in lateral view; note narrowly rounded tip of posterior outer wall cell (arrow). The outer, upper antheridium had deteriorated (arrow)—94. Thallus without primary appendage; apex in face view as seen from the inside; note relationship and origin of the upper and lower pair of prominences.—95. Perithecial apex typical of individuals growing on lower surface of host; note broadly rounded tip of posterior outer wall cell. (Bar = 10 μ m, all figures.)

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