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MORPHOLOGY AND RELATIONSHIPS OF A NEW SPECIES OF
MICROSOMYCES (ASCOMYCETES: LABOULBENIALES)
FROM ILLINOIS

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ABSTRACT

Microsomyces telephani, a new species of Laboulbeniaceae, is described from collections found on *Telephanus velox* (Coleoptera: Cucujidae) from Illinois. Features of development and maturity of the new species are illustrated with photographs and line drawings. *Microsomyces telephani* differs from the type and previously only known species of the genus, *M. psammoechi*, in its larger, more highly corticated receptacle, which bears secondary appendages, and in its larger primary appendage, which typically bears several antheridial phialides. Among known genera of Laboulbeniales, *Microsomyces* is thought to be most closely related to *Cucujomyces*.

Key words: Ascomycetes, Coleoptera, Cucujidae, fungi, Laboulbeniales, *Microsomyces*, taxonomy, *Telephanus*.

INTRODUCTION

In a recent review of the laboulbeniaceous genus *Synandromyces* Thaxter (1912), I (Benjamin 1984) presented observations on the development of the perithecium and trichogyne of *S. telephani* Thaxter (1912), which had been found in Illinois parasitizing *Telephanus velox* Hald. (Order: Coleoptera; Suborder: Polyphaga; Series: Cucujiformia; Superfamily: Cucujoidea; Family: Cucujidae [Arnett 1962]), a beetle often found in the eastern United States in decomposing plant detritus. On several occasions specimens of *T. velox*, some of which were infested with *S. telephani*, bore a few individuals of a species of *Microsomyces* Thaxter (1931), a genus of Laboulbeniales not closely related to *Synandromyces*.

Microsomyces is based on a single species, *M. psammoechi* Thaxter (1931), described from specimens taken from species of *Psammoechus* Latreille (syn. *Psammoechus* Boudier), a genus of Cucujidae closely related to *Telephanus* (Arnett 1962; Hetschko 1930; Leng 1920), collected in the Cameroons (Africa) and Sumatra. Thaxter's type collection was from the upper surface of the abdomen of a species identified as '*P. orbicollis* Grouv.,' which is not listed by Hetschko (1930) and may be a nomen nudum, from the Cameroons. Thaxter also found a young individual of what he believed to be a second species of *Microsomyces* on a specimen of '*P. orbicollis*' from the same locality, but its immaturity precluded its description.

Certain features of the vegetative morphology of *M. psammoechi* resemble those of several genera of Laboulbeniales, e.g., *Balazucia* Benjamin (1968b), *Cucujomyces* Spegazzini (1917; Benjamin 1968b), *Idiomyces* Thaxter (1893; Benjamin 1983), *Teratomyces* Thaxter (1893) and its allies (Benjamin 1968a, 1983), and even *Trenomyces* Chatton & Picard (1908; Thaxter 1926). The receptacle of the mature individual of *M. psammoechi* as described by Thaxter (1931:184-185; Pl. XXXIX, Fig. 1-2) lacks a typical blackened foot, consisting of a thick-walled basal

cell, continuous below with a relatively large lobate haustorium, which bears several stout branches that penetrate the body cavity of the host, and a corticated subbasal cell bearing one or more stalked perithecia. The primary appendage, subtended by the upper cell of the original primary receptacle, consists of one or two elongate cells terminated by a spinose antheridium. A second simple antheridium may arise laterally from the upper end of the basal cell of the appendage or the subtending receptacular cell.

The *Microsomyces* collections from Illinois resemble *M. psammoechi*, but they are distinct from the type in several ways and are being described here as a separate species. Also, Thaxter's original description of *Microsomyces* is being emended to accommodate a feature found in the new taxon that was not observed in *M. psammoechi*. The corticating cells formed by the subbasal cell of the receptacle of the new species may give rise not only to stalked perithecia but also to secondary appendages bearing terminal and, rarely, lateral antheridia. *Microsomyces* has not been recorded previously from the Western Hemisphere.

MATERIALS AND METHODS

Procedures employed for mounting specimens and preparing illustrations of the *Microsomyces* species and terminology used for describing its structural characteristics were the same as those given previously (Benjamin 1984:491).

Host data are given below following the description of the new species.

Photographs were taken on 4 in. × 4 in. Kodak Technical Pan Film #2415 and developed in Kodak HC-110 appropriately diluted to accommodate an ASA value of 100.

DESCRIPTIONS

MICROSOMYCES Thaxt., Mem. Amer. Acad. Arts Sci. 16:184, 1931, emend. R. K. Benjamin.

Receptacle consisting of three cells: a basal cell (I), which is continuous below with a branched rhizoidal apparatus that penetrates the host; a subbasal cell (II), which becomes more or less corticated by smallish cells, some of which give rise to stalked perithecia or simple, few-celled secondary appendages bearing terminal and sometimes lateral flask-shaped antheridia; and a terminal cell (III), which subtends a simple, several-celled primary appendage ending in a spinose, flask-shaped antheridium and often bearing one or more antheridia laterally. Perithecium with well-defined stalk and basal cells and four tiers of outer wall cells; ascogonic cells proliferating and forming an extensive ascigerous layer from which large numbers of asci arise. Ascospores once septate.

Type species: Microsomyces psammoechi Thaxter.

A KEY TO THE SPECIES

- A. Corticating cells of subbasal cell of receptacle few, giving rise only to perithecia *M. psammoechi*
- Corticating cells many, giving rise to perithecia and secondary antheridial appendages *M. telephani*

Microsomyces telephani R. K. Benjamin, sp. nov.

Receptaculum prope hyalinum, globosum vel aliquanto turbinatum, 22–38 μm altum, 23–56 μm latum. Cellula basalis (I) 14–28 μm alta, 17–40 μm lata, muro 3.5–7.5 μm crasso. Cellula subbasalis (II) cellulis parvis numerosis corticata, 1–2(–4) perithecia pedicellata et usque ad 12 appendices secundarias producents. Cellula terminalis (III) 14–24 $\times$ 5–7 μm , appendicem primariam subtenens. *Appendix primaria* (cum cellula III receptaculo) 55–100 μm longa; corpus (2–)3(–4) cellularum, 10–18 $\times$ 5–7 μm , constans, antheridio spinoso terminali; spina 10–12 μm longa. Cellulae corporis 1–2 antheridia lateralia producentes. Antheridia 15–23 $\times$ 3–5 μm . *Appendices secundariae* simplices, 25–70 μm longae, 1–2(–5) cellulae constantes, antheridio terminali 12–33 $\times$ 3–5 μm ; antheridia lateralia raro. *Perithecium* saepe dilute aurantioflavum vel ochraceoaurantiacum. Cellula VI variabilis, 25–380(–630) μm longa, basi constricta 7–14 μm lata, apice 20–40 μm lata. Cellula VII et cellulae basales (*m*, *n*, *n'*) parvae, catervam compactam cellularum 48–80 $\times$ 25–38 μm formantes. Corpus perithecii (cum cellulis basilaribus) 150–300 $\times$ 65–105 μm , fere symmetricum, a basi ad medium latum et convexum, a medio ad apicem elongatum et concavum, collum elongatum gracile faciens; apex prope truncatum. Ascosporae 40–45 $\times$ 2.5–3.0 μm . Totus fungus 210–510(–865) μm longus. Typus RKB 1338 (RSA).

Receptacle: Nearly hyaline, globoid to somewhat turbinate, 22–38 μm high, 23–56 μm wide. Basal cell (I) 14–28 μm high, 17–40 μm wide, its wall 3.5–7.5 μm thick; constricted below where it enters the host; lumen continuous with a well-developed hyaline haustorium, which forms 2–3 laterally or upwardly directed lobes, 10–30 $\times$ 12–18 μm , immediately below the host integument and one or more ramified branches 8–10 μm wide and exceeding 100 μm long. Subbasal cell (II) cutting off peripheral cells and becoming corticated by numerous smallish cells, which give rise to the stalk cells of perithecia or secondary appendages, or remain undeveloped. Terminal cell (III) about three times longer than wide, 14–24 $\times$ 5–7 μm , subtending the primary appendage. *Primary appendage*: Body consisting of (2–)3(–4) elongate cells, 10–18 $\times$ 5–7 μm , terminated by a spinose antheridium; antheridial spine 10–12 μm long; 1–2 antheridia usually formed from the upper angles of each lower cell; antheridia 15–23 $\times$ 3–5 μm ; combined length of appendage, including terminal antheridium, and cell III, 55–100 μm . *Secondary appendages*: Simple, variable in length, 25–70 μm , consisting of 1–2(–5) superposed, elongate cells resembling those of the primary appendage; terminated by an antheridium; rarely forming a second antheridium on a lower cell; antheridia 12–23 $\times$ 3–5 μm . *Perithecium*: Pale Orange-Yellow to Ochraceous-Orange (Ridgway 1912). Stalk cell (VI) highly variable in length, 25–380(–630) μm , constricted at the base, which is 7–10 μm wide, abruptly widened and then gradually tapered to 20–40 μm wide immediately below the basal cell region. Secondary stalk cell (VII) relatively small, 10–14 μm high. Basal cell region (cells *m*, *n*, *n'*) together with secondary stalk cell, broader than high, 48–80 μm wide distally, 25–38 μm high. Body of the perithecium, including basal cells, 150–300 $\times$ 65–105 μm , nearly symmetrical, broadly inflated below, widest in the mid-region of the basal tier of outer wall cells, which may be externally sculptured with fine transverse irregular striations; subbasal tier of outer wall cells longer than basal tier, abruptly narrowed above the basal tier and together with the much shorter, nearly equal subterminal and terminal tiers of outer wall cells forming an elongate, slender neck; tip undistinguished, somewhat truncate. Ascospores 40–45 $\times$ 2.5–3.0 μm . Total length from base of receptacle to tip of perithecium 210–510(–865) μm .

Etymology.—Named for the host genus, *Telephanus*.

Holotype.—ILLINOIS. Champaign County: Brownfield Woods, 3 mi NE of Urbana, 28 Oct. 1950, R. K. Benjamin coll. On the upper surface of the abdomen near the tip of *Telephanus velox* (Coleoptera: Cucujidae); *RKB 1338* (Fig. 6); slide in RSA.

Other specimens examined.—ILLINOIS. Champaign County: Brownfield Woods, 30 Oct. 1949 (*RKB 1752B*), 12 May 1950 (*RKB 3038B*); Trelease Woods, 4 mi E of Urbana, 21 Sept. 1950 (*RKB 1750A*); Champaign, 23 Oct. 1949 (*RKB 311A*), 30 Sept. 1950 (*RKB 1339*); Urbana, M. W. Sanderson coll., Sept. 1958 (*RKB 2081B*); Busey's Woods, Urbana, R. B. Selander coll., 15 Nov. 1951 (*RKB 3040*).—Ogle County: White Pines Forest, H. H. Ross and M. W. Sanderson coll., 6 Dec. 1949 (*RKB 1751*). All on the upper or lower surface of the abdomen near the tip of *Telephanus velox*. Slides in RSA.

OBSERVATIONS AND COMMENTS

Ascospores

Ascospores of *Microsomyces telephani* (Fig. 1) are relatively long and slender, with the longer, upper cell attenuate. The tip of the shorter, lower cell is more acute and is surrounded by the conspicuously inflated hyaline spore sheath. Spores of this species resemble the one figured by Thaxter (1931: Pl. XXXIX, Fig. 7) for *M. psammoechi* except for the sheath, which in the latter species is not so abruptly constricted above the tip of the spore body but narrows gradually as it approaches the surface of the spore a bit below the level of the cross wall.

Early Development of the Thallus

The youngest individual of *M. telephani* observed is shown in Figure 2. Like other very immature thalli found on the bits of host integument mounted for microscopic examination (Fig. 3, 11, 12) this specimen appeared to have been lying on the surface of the host with the lowermost cell (I) closely appressed to the integument. Divisions of the lower segment of the original spore had produced the primary receptacle consisting of three cells: the basal cell, I; the subbasal cell, II; and the terminal cell, III. Divisions of the upper spore segment had given rise to a simple three-celled primary appendage separated from the receptacle by the original spore septum (*a*). The terminal cell of the appendage had not yet been converted into an antheridium.

In a slightly older individual (Fig. 11), the receptacle consisted of four cells. The triangular basal cell (I) was laterally adherent to the host surface and appeared much like the foot of many Laboulbeniales at a similar stage of development. Near its lower end, cell I was continuous, via a small pore in the host integument, with a small, lobate haustorium (arrow)—hardly visible in the photograph (but see Fig. 12). The subbasal cell (II) already had cut off the first of the succession of primary corticating cells (*cc*) it would have formed if growth had continued. The slender, elongate terminal cell (III) was separated by the original spore septum (*a*) from the primary appendage, which consisted of two elongate, nearly equal cells and a terminal flask-shaped antheridium (*an*) bearing the conspicuous spinose prolongation of what had been the tip of the ascospore. Thaxter's figure 4 (1931:

Pl. XXXIX) shows an individual of *M. psammoechi* at a nearly identical stage of development.

In the young individual shown in Figure 3, cell I resembled the one shown in Figures 11 and 12 and was continuous with a small, somewhat inflated haustorium (*ha*). Cell II had cut off three primary corticating cells (*cc*). The basal cell of the primary appendage (*pa*) had produced a second antheridium laterally from near its upper end.

A still older individual is shown in Figure 4. Cell I had enlarged considerably and was much constricted at the base where it connected with the haustorium (*ha*), which consisted of a bulbous enlargement immediately below the host surface and a single, robust branch extending downward. The tip of the haustorial branch was missing, having been broken off when the fragment of integument bearing the specimen was removed from the host. The enlarged cell I had rotated so that the young thallus probably had assumed a more or less vertical position relative to the host surface. Cell II was surrounded by the primary corticating cells (*cc*) it had produced; these cells had begun to proliferate above and form secondary corticating cells. Two of the latter had given rise to short secondary appendages (*sa*) bearing single terminal antheridia. The primary appendage (*pa*), supported by cell III, consisted of three cells and a terminal, spinose antheridium. A second antheridium had arisen distally from the basal cell.

One young individual of *M. telephani* at a stage of development comparable to that shown in Figure 11 had formed a single flask-shaped antheridium from the upper end of cell III. Similar production of an antheridium from the upper cell of the receptacle was shown by Thaxter (1931: Pl. XXXIX, Fig. 3, 5, 7) for *M. psammoechi*. I did not observe antheridia on the upper cell of the receptacle of any other specimen of *M. telephani* studied and, though possible, antheridial production by cell III must occur rarely in this species.

Mature Receptacle and Secondary Appendages

As growth of the thallus continued, cell I enlarged, becoming globoid to turbate (Fig. 8, 10). Eventually its wall thickened (Fig. 10), often to as much as 7.5 μm , and its crown of corticating cells derived from cell II proliferated by continued divisions. Upgrowths of some of the corticating cells produced a variable number of secondary appendages (Fig. 8, 10), and as many as 12 were counted on some mature receptacles. Most of these appendages consisted of only one or two cells terminated by an antheridium, but in a few instances the body of an appendage consisted of from three to five cells. Branched secondary appendages were not found.

There typically was little or no darkening of cell I. However, in a few young individuals the tip of this cell (Fig. 12) was somewhat blackened. This could account for instances in which the extreme lower part of cell I was darkly pigmented and nearly opaque around the point of entry of the haustorium into the host (Fig. 10).

Haustrorium

The haustorium of *M. telephani*, like that of *M. psammoechi*, grows deeply into tissues of the host underlying the integument, and it was not possible to remove

maturing or mature parasites, along with bits of the host body, without breaking this organelle and separating the upper part from its lower extremities. The longest branches of haustoria still attached to the main thallus—all with broken tips—found in my preparations did not exceed 125 μm . They doubtless were much longer, as evidenced by isolated segments found here and there in the disrupted host tissues.

Thaxter illustrated conspicuous, laterally directed, lobate outgrowths of the uppermost part of the haustorium of *M. psammoechi* (Thaxter 1931: Pl. XXXIX, Fig. 2, 3, 5, 7), and the distal enlargement of the haustorium of *M. telephani* is similarly modified (Fig. 7, 8, 10). These outgrowths often curve upward and probably were in firm contact with the basement membrane of the host integument. In addition to their presumed absorptive function, they probably aided also in securely anchoring the mature fungus to the host.

The branch issuing from the lower end of the lobate enlargement of the haustorium is simple (Fig. 7, 9) or, more often, several times branched (Fig. 10).

Perithecia

Thaxter (1931) figured individuals of *M. psammoechi* bearing one or two mature perithecia, but he did not state in his description or discussion of this species whether or not more than two perithecia might be initiated on a given thallus. Nineteen individuals of *M. telephani* bearing at least one mature perithecium were observed in this study. Fourteen bore only one mature perithecium, and on 12 of these only one perithecium had been initiated; three bore two mature perithecia; one bore three and another four mature perithecia. Each of two individuals bore a combined total of five mature and immature perithecia.

Perithecia of *M. telephani* appear, as was described and illustrated by Thaxter (1931) for *M. psammoechi*, to arise from corticating cells derived from cell II. I

←

Fig. 1–10. *Microsomyces telephani*. Aspects of development and maturity. Details and terminology are given in the text.—1. Ascospore (*a*, cross wall).—2. Young individual developed from ascospore showing primary, three-celled receptacle (cells I, II, III) derived from basal spore segment, original spore septum (*a*), and young primary appendage consisting of three cells.—3. Young individual showing primary appendage (*pa*) bearing terminal, spinose antheridium and one lateral antheridium, young haustorium (*ha*), and early proliferation of cell II, which has formed three corticating cells (*cc*).—4. Young individual showing enlarging basal cell (I) connected to the distally enlarged haustorium (*ha*). Two secondary appendages (*sa*) have arisen from receptacular corticating cells (*cc*).—5. Young individual bearing immature perithecium at the three-tier stage of outer wall cell development (w^1 , w^2 , o). Each cell of the primary appendage has given rise to a single antheridium. Note position of trichogyne remnant (*tr*).—6. Young perithecium at the two-tier stage of outer wall cell development (w^1 , o) showing a greatly elongated primary stalk cell (VI), the relatively short secondary stalk cell (VII), and two of the three basal cells (*m*, *n*). The trichogyne remnant (*tr*) is appressed laterally and diagonally to the protrudent trichophoric cell (*tc*).—7. Mature individual (HOLOTYPE) showing relationship of the receptacle, the stalk cells (VI, VII), two of the three basal cells (*m*, *n'*), and the four tiers of outer wall cells (w^{1-4}).—8. Detail of the receptacle, haustorium, and appendages of the specimen shown in Figure 7.—9. Tip of the perithecium of a mature individual showing relationship of the upper end of the subbasal tier of outer wall cells (w^2), the subterminal and terminal tiers of outer wall cells (w^{3-4}), and the trichogyne remnant (*tr*).—10. Mature receptacle showing extent of development of corticating cells, primary and secondary appendages, the thick-walled basal cell, and the upper part of the branched haustorium. (Fig. 1–4, bar above Fig. 1–2 = 10 μm ; Fig. 5–6, 8–10, bar above Fig. 6 = 10 μm ; Fig. 7, bar = 50 μm .)

found only one perithecial initial the origin of which could be determined with some certainty. In this instance (Fig. 14) the primordium had arisen from a protrudent corticating cell that also bore a young, three-celled secondary appendage that had not yet delimited a terminal antheridium. Alternatively, the combination of appendage and primordium could be interpreted as a four-celled appendage with the basal cell giving rise to a perithecial initial.

Most immature perithecia found in my material of *M. telephani* had progressed in their development to stages shown in Figure 5, 6, and 13 (right). The primary stalk cell (VI), secondary stalk cell (VII), basal cells (*m*, *n*, *n'*), and two or three cells of the four rows of outer wall cells (*w*) and wall-cell primordia (*o*) had been formed. Cells *w* and *o* surround the first of the inner wall cells and the cells of the developing female sexual structure. An immature perithecium with an intact trichogyne (*tr*) is shown in Figure 13 (lower right and inset). The trichophoric cell (*tc*) protrudes well beyond the upper end of the upper, outer wall-cell initials (*o*; and see Fig. 6). The trichogyne consists of a lower part, positioned diagonally along the upper end of the trichophoric cell, and an upper, external, trilobate part. The upper part of the trichogyne disappears, but the lower part persists and forms a small flattened remnant on one side of the perithecial tip (Fig. 5, 6). This remnant eventually is positioned adjacent to the upper end of one of the subterminal outer wall cells (Fig. 9).

Cell VI of the perithecium of *M. telephani* and *M. psammoechi* (Thaxter 1931) is elongated to a greater or lesser degree and constitutes most of the length of the perithecial pedicel (Fig. 7, 15). The great variability in the length of cell VI in *M. telephani* is shown by the range given in the description. This variability doubtless is influenced by the position of the fungus on the host. The extreme length of 630 μm for one stalk cell was for an individual found growing on the right margin of the abdomen of the host under the tip of the elytron. Those individuals with shorter but variable perithecial stalk cells were all growing on the more or less exposed upper or lower surface of the abdominal tip of the host.

The ascigerous part of the perithecium is broadest below and nearly symmetrical in outline (Fig. 7, 13, 15). There are four cells in each row of outer wall cells (Fig. 7, w^1 - w^4), with the lower two tiers constituting nearly 80% of the total length of the body above the basal cells. Cells of the subbasal tier (w^2) are longest, averaging about 20% longer than cells of the basal tier (w^1) and nearly 60% longer than the combined length of the cells of the upper two tiers (w^3 - w^4).

As in *M. psammoechi* (Thaxter 1931), the ascogenic cells (Fig. 13 *ac*) of *M. telephani* proliferate and form an extended layer lining the broad basal region of the perithecial venter. Asci are formed in great numbers (Fig. 15).

DISCUSSION

Microsomyces telephani and *M. psammoechi* bear a close resemblance to one another. They differ primarily in the extent of development of the receptacle, which in *M. psammoechi* is smaller than that of *M. telephani*. In *M. psammoechi* cell II produces few corticating cells, which do not proliferate to any extent but give rise directly to perithecia in the absence of secondary antheridial appendages (Thaxter 1931). An examination of Thaxter's Figure 1 (Thaxter 1931: Pl. XXXIX) suggests that the first-formed, or primary, perithecium of *M. psammoechi* may arise directly from cell II. This may be true also for *M. telephani*, but the early

Fig. 11–15. *Microsomyces telephani*. —11. Young individual showing primary, three-celled receptacle in which cell II has cut off the first corticating cell (*cc*). The original spore septum (*a*) separates the receptacle from the primary appendage, which consists of two cells terminated by a spinose antheridium (*an*). A second antheridium (upper arrow) has arisen from the basal cell of the appendage. The lower arrow points to the barely visible haustorium originating from the basal cell of the receptacle (I). —12. Basal cell of a young individual as seen in lateral view. The host integument has been penetrated and a small pore has been formed through which the foot is connected with a still small lobate haustorium (arrow). —13. A nearly mature perithecia (left) showing basal layer of ascogenic cells (*ac*). A young perithecia is shown at the lower right. The inset shows the upper end of the latter; note the relationship of the trichophoric cell (*tc*) and trichogyne (*tr*). See text for details. —14. Perithecial primordium (arrow) and immature secondary appendage arising from a corticating cell of the receptacle. —15. A mature individual showing the large perithecial venter filled with ascospores. (Fig. 11, 12, 14, bar with Fig. 11 = 10 μ m; Fig. 13, bar = 20 μ m [inset, bar = 5 μ m]; Fig. 15, bar = 50 μ m.)

proliferation of corticating cells derived from cell II obscures the early development of the primary perithecia and its exact origin could not be determined. Divisions of the corticating cells in *M. telephani* result in a relatively large number of smallish cells, which give rise not only to perithecia but also to short secondary appendages terminated by simple, flask-shaped antheridia. The primary appendage of *M. psammoechi* is relatively short, consisting of only one or two cells terminated by a spinose antheridium; a second antheridium may arise from cell

III or the lower cell of the appendage (Thaxter 1931). In *M. telephani* the primary appendage may consist of two to four cells below the terminal spinose antheridium, and one or two antheridia commonly arise from the upper angles of each cell of the appendage; cell III also may rarely give rise to an antheridium.

Thaxter (1931) alluded to the similarity between *M. psammoechi* and the female of members of the genus *Trenomyces* (Chatton and Picard 1908; see Thaxter 1926:441) as regards the cortication of their receptacles and their well-developed haustoria. Because of replication of the corticating cells, the resemblance of the receptacle of *M. telephani* to that of some species of *Trenomyces* is even more striking. However, in both sexes of members of the dioecious *Trenomyces*, the determinate one- or two-celled primary appendage is sterile, and both cells II and III of the young receptacle may proliferate and form corticating cells giving rise to stalked compound antheridia in males and stalked perithecia in females (unpubl. observations). The walls of the perithecial stalk and basal cells in *Trenomyces* become disorganized in part at maturity and their lumens become continuous with the perithecial venter, whereas the stalk and basal cells of perithecia of *Microsomyces* species are persistent in their entirety. The similarities between the receptacle of *Microsomyces* and *Trenomyces* noted by Thaxter are perhaps best regarded as the result of convergent rather than parallel evolution within the order.

Several genera that perhaps are related to *Microsomyces* have similar receptacles and share certain perithecial characteristics, i.e., well-defined stalk and basal cells and two lower tiers of elongate wall cells and two upper tiers of short wall cells. These genera include *Balazucia* (Benjamin 1968b), *Cucujomyces* (Benjamin 1968b; Thaxter 1931:173), *Idiomyces* (Benjamin 1983), and those in the *Symplectromyces-Teratomyces* complex (Benjamin 1968a, 1983). *Diplomyces* Thaxt., *Sandersoniomyces* Thaxt., *Symplectromyces* Thaxt., *Teratomyces*, and *Idiomyces* have indeterminate receptacles (Thaxter 1908; Benjamin 1983) in which cells II or III of a primary, three-celled receptacle may become variously subdivided and form few or many sterile or fertile cells or cellular axes giving rise to stalked perithecia or secondary antheridia-bearing appendages. These genera all have indeterminate primary appendages of limited extent that may (*Symplectromyces*) or may not (*Diplomyces*, *Sandersoniomyces*, *Teratomyces*, and *Idiomyces*) bear antheridia. However, what may be regarded as a fundamental difference separating *Microsomyces* from *Idiomyces* and the other four genera is the developmental fate of cells II and III of the primary receptacle. In *Teratomyces* and its close allies, *Diplomyces*, *Sandersoniomyces*, and *Symplectromyces* (Benjamin 1968a, 1983), cell II divides once and the resulting two cells undergo no further development save enlargement; it is the progeny of cell III alone that ultimately give rise to perithecia and secondary antheridial appendages. In *Idiomyces*, both cells II and III undergo divisions (Benjamin 1983) and it is progeny of cell III and only one of the three cells derived from cell II that give rise to secondary antheridial appendages and stalked perithecia. In *Microsomyces*, cell III remains essentially unchanged save for enlargement, although it may occasionally produce an antheridium; cell II alone proliferates and gives rise to perithecia or perithecia and secondary appendages.

Among known genera, *Cucujomyces* can be regarded as the one perhaps most closely related to *Microsomyces* (Thaxter 1931). Some species of *Cucujomyces*, like those of *Microsomyces*, occur on members of the Cucujidae. As in *Micro-*

somyces species only cell II of the primary receptacle of *Cucujomyces* species becomes secondarily proliferous, developing uniseriate cellular secondary receptacles of variable extent to the right and left, which may give rise to simple or branched secondary appendages bearing terminal or lateral antheridia singly or in small groups. The small, but indeterminate, primary appendage of *Cucujomyces* species, which apparently always is sterile, is subtended by an undivided cell III. In addition to secondary receptacles, cell II of *Cucujomyces* species commonly gives rise to a primary perithecium, which often is the only perithecium that matures on a given thallus. If the primary perithecium aborts or is otherwise damaged, secondary perithecia arise from the basal cells of the first-formed secondary appendages. Additional perithecial primordia commonly develop from the basal cells of successive secondary appendages, but they may remain undeveloped unless the first-formed secondary perithecia abort or are damaged.

Balazucia (Benjamin 1968b) has many of the characteristics of *Cucujomyces* and may, like the latter, be regarded as a near relative of *Microsomyces*.

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