

1999

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Recommended Citation

Benjamin, Richard K. (1999) "Laboulbeniales on semiaquatic Heteroptera. VIII. Monandromyces, a new genus based on Autophagomeces microveliae(Laboulbeniales)," *Aliso: A Journal of Systematic and Floristic Botany*: Vol. 18: Iss. 2, Article 14.

Available at: <https://scholarship.claremont.edu/aliso/vol18/iss2/14>

LABOULBENIALES ON SEMIAQUATIC HETEROPTERA. VIII. *MONANDROMYCES*, A NEW GENUS BASED ON *AUTOPHAGOMYCES MICROVELIAE* (LABOULBENIALES)

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ABSTRACT

A new genus of Laboulbeniales (Laboulbeniaceae: Stigmatomycetinae), *Monandromyces*, was described. Its type species, *M. hemipteralis*, was based on *Autophagomyces hemipteralis*. The latter, which parasitizes a riparian bug, a species of *Microvelia* (Heteroptera: Veliidae), was characterized by Roland Thaxter in 1931. Ten new species of *Monandromyces*—taken from members of three genera of Veliidae—were described as follows: *M. australis*, *M. falcatus*, *M. polhemorum*, *M. protuberans*, *M. tenuistipitis*, and *M. umbonatus* (on *Microvelia* spp.); *M. neoalardi* (on *Neoalardus* sp.); and *M. elongates*, *M. longispinae*, and *M. pseudoveliae* (on *Pseudovelia* spp.). Keys to the species were given and all were illustrated with line drawings.

Key words: Ascomycetes, *Autophagomyces*, fungi, Heteroptera, insect parasites, Laboulbeniales, *Monandromyces*, morphology, taxonomy, Veliidae.

INTRODUCTION

In his summary treatment of *Autophagomyces* Thaxt. (1912), Thaxter (1931) broadly defines the genus to include 16 taxa with hosts in two distinctive orders of insects. Fifteen species parasitize beetles (order Coleoptera; suborder Polyphaga [see classification in Arnett 1985: 266–267]). The type species, *A. plattensis* Thaxt. and five other species, *A. guatemalensis* Thaxt., *A. kamerunensis* Thaxt., *A. longicaulis* Thaxt., *A. nigripes* Thaxt., and *A. subfuscatus* Thaxt., occur on members of the family Anthicidae (series Cucujiformia; superfamily Tenebrionoidea); two species, *A. gracilis* Thaxt. and *A. grenadinus* Thaxt., are on Phalacridae (Cucujiformia; superfamily Cucujoidea); two species, *A. sarawakensis* Thaxt. and *A. peyerimhoffii* (Maire) Maire ex Thaxt., are on Corylophidae (Cucujoidea) (Note: Thaxter incorrectly places the host of *A. sarawakensis* in the Phalacridae [Benjamin 1995]), and five species, *A. bryaxalis* Thaxt., *A. coronatus* (Maire) Maire ex Thaxt., *A. decarthricola* (Speg.) Thaxt., *A. spegazzinii* Thaxt., and *A. strangulatus* Thaxt., are on Pselaphidae (series Staphyliniformia; superfamily Staphyloidea) (Note: I [Benjamin 1995: 41] incorrectly place the Pselaphidae in Cucujoidea). Finally, one species, *A. microveliae* Thaxt., infects a riparian bug of the family Veliidae (order Heteroptera; suborder Gerromorpha; superfamily Gerroidea [see classification in Henry and Froeschner 1988]).

Subsequent to Thaxter's treatment of *Autophagomyces*, five additional species have been described: *A. castelinii* W. Rossi (1982) and *A. tiwaiensis* W. Rossi (1990) on Pselaphidae; *A. falcatus* T. Majewski (1973)

on Cryptophagidae (Cucujoidea), *A. sericoderi* Santam. (1993) on Corylophidae; and *A. poissonii* R. K. Benj. (1970) on Mesoveliidae (Heteroptera; Gerromorpha; superfamily Mesovelioidae).

During my studies of Laboulbeniales, I have accumulated specimens and data pertaining to *Autophagomyces* sensu lato and, on the basis of new information, have revised the taxonomic status of several of the species cited above.

My early interpretation of two seemingly distinct fungi parasitizing a species of *Mesovelia* Mulsant & Rey resulted in the description of two species that I placed in separate genera, *A. poissonii* and *Dioicomyces mesoveliae* R. K. Benj. (Benjamin 1970). Later (Benjamin 1986), I discovered that these "species" are instead the monoecious and dioecious morphs of a species of *Triceromyces*, *T. poissonii* (R. K. Benj.) R. K. Benj. This phenomenon, trioecy, not previously recognized in Laboulbeniales, also is found in two other species of *Triceromyces* on Mesoveliidae, *T. biformis* R. K. Benj. and *T. bullatus* R. K. Benj. (Benjamin 1986, 1998).

Recently I described another new genus, *Corylophomyces* R. K. Benj., to accommodate *C. sarawakensis* (Thaxt.) R. K. Benj. (= *Autophagomyces sarawakensis*), *C. peyerimhoffii* (Maire) R. K. Benj. (= *A. peyerimhoffii*), and *C. sericoderi* (Santam.) R. K. Benj. (= *A. sericoderi*), along with two additional species, *C. reflexus* R. K. Benj. and *C. weirii* R. K. Benj. (Benjamin 1995). These taxa, which are dioecious, have simple males, females with distinctive two- or three-celled appendages, and all parasitize Corylophidae.

During visits to Dr. John T. Polhemus's laboratory at the Colorado Entomological Museum, Englewood, in April 1991 and May 1993, I was permitted to examine, for Laboulbeniales, accumulations of semi-aquatic Heteroptera collected by John and/or his son Dr. Dan A. Polhemus in Africa, Australia, Indonesia, and Malaysia. On species of three genera of Veliidae, *Microvelia* Westwood, *Neolardus* Distant, and *Pseudovelia* Hoberlandt, I found specimens of 10 distinctive Laboulbeniales having a combination of characteristics matching those of Thaxter's *Autophagomyces microveliae*, characters that clearly distinguish them generically from the type species of *Autophagomyces*, *A. platensis*, and its allies on Anthicidae, as well as those species parasitizing Cryptophagidae, Phalacridae, and Pselaphidae.

The purpose of this paper is to describe, illustrate, and comment briefly on the morphology and development of a new genus to accommodate *Autophagomyces microveliae* and ten new species.

MATERIALS AND METHODS

Except for the host of *Autophagomyces microveliae*, *Microvelia albolineolata* Bueno, all other hosts of fungi described in this study were collected in the field by John and/or Dan Polhemus and preserved in 70–80% ethyl alcohol. Some specimens later had been pinned (affixed to paper points), dried, and placed in museum boxes, and any of these insects found to bear fungi were relaxed before removal of the parasites. Labels and insects were carefully separated from the pin. Labels were set aside in vials for eventual reunion with the insects. Infected insects were placed directly into 0.2% saline or a fluid consisting of benzene (5%), ethyl alcohol (45%), water (35%), and ethyl acetate (15%) for a few hours or overnight after which they were removed to 70% ethyl alcohol for storage along with a duplicate set of labels. Unsorted lots of insects still in fluid were carefully examined with a dissecting microscope and those bearing parasites were segregated and placed, along with appropriate labels, in vials containing fresh 70% ethyl alcohol.

Using methods described previously (Benjamin 1971: 101–102 [up to step e]; 1986: 247; 1993: 560), I carefully removed the fungi from hosts and mounted them in glycerine on slides. All observations related to the descriptions and illustrations were made using a Leitz Dialux microscope having differential interference contrast optics. In the citations of specimens taken from insects collected by John and/or Dan Polhemus, CL numbers, i.e., *collection localities* as described in their field notebooks, are given.

Loan of the slides bearing Thaxter's type and isotypes of *Autophagomyces microveliae* was kindly ar-

ranged by Dr. Donald H. Pfister, curator of the Farlow Herbarium.

Terminology and abbreviations used in describing the ascoma (used here for the entire peritheciium-bearing thallus) are defined in the text or in a separate key to labeling preceding the first set of legends for figures, and mostly 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, with few exceptions, descriptions and measurements of thalli were based on study of specimens as seen from one side or the other. When thalli are mounted on slides, the true relationship of the peritheciium 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. An attempt was made to interpret correctly such distortions in preparing the descriptions. With reference to the peritheciium 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 peritheciium, and cells of the appendage, inner (or inward) is in the direction of the longitudinal axis of the ascoma, outer (or outward) 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 peritheciium may be \pm curved, bent, or reflexed, was measured along the median axis. Occasionally, length is the only dimension given for some cells where orientation made meaningful determination of width uncertain, e.g., cell VII, cells *n*, *m*, *n'*, and outer wall cells. The length of cells I and II of the receptacle, which are separated by a strongly diagonal cross wall, was, for cell I, measured upward from the tip of the foot and, for cell II, downward from the base of cell VI to the tips of the region of overlap of each cell with the other. Because 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

Monandromyces R. K. Benj., gen. nov.

Receptaculum cellularum trium superpositarum (I, II, III) constans, peritheciium stipitatum et appendicem simplicem liberam utrinsecus gerens; cellulae basilaris (I) et suprabasilaris (II) fortiter oblique superpositae; cellula II peritheciium subtenens; cellula terminalis (III) appendicem subtenens. Appendix cellularum trium superpositum et antheridii singuli simplicis terminalis constans; cellula

basilaris parva isodiametra vel plerumque latiora quam longa; cellula media elongata, compluribus longiora quam lata; cellula terminalis parva isodiametra vel aliquantum longiora quam lata; antheridium ampulliforme tubo elongato gracili. Perithecium stipe cellularum duorum (VI, VII), cellulis basilaribus tribus persistentibus (*m*, *n*, *n'*), et cellulis parietis externis in quatuor ordinibus longitudinalibus numerosque quinque cellularum. Trichogyna ramulis terminalibus brevibus gracilibus divaricatis, corpore unicellulari sive bicellulari ovoideo apice et basi constricto. Cellula ascogena unica. Ascospores 1-septatae.

Receptacle consisting of three in-line superposed cells (I, II, III) bearing distally on one side a stalked perithecium and on the other side a simple, free appendage; basal (I) and suprabasal (II) cells strongly obliquely superposed; cell II subtending the perithecium; terminal cell (III) subtending the appendage. Appendage consisting of three superposed cells and a single, terminal, simple, flask-shaped antheridium; basal cell small, broader than long to nearly isodiametric; median cell elongate, several times longer than broad; terminal cell small, nearly isodiametric or \pm elongate, always less than length of median cell; antheridium flask shaped with an elongate, slender efferent tube. Perithecium with two stalk cells (VI, VII), three persistent basal cells (*m*, *n*, *n'*), and four vertical rows of outer wall cells of five cells each. Trichogyne forming slender, divaricate branchlets terminally; body consisting of a single slender cell or of two superposed cells separated by a median transverse cross wall, the pair of cells abruptly constricted above and below. Ascogonic cell single. Ascospores 1-septate.

Type species.—*Monandromyces microveliae* (Thaxt.) R. K. Benj.

Etymology.—From the combination of *mon-* (one) + *andro-* (male) + *-myces* (fungus) (all in Gr. compound words) in reference to the appendage with its single antheridium.

KEY A. THE SPECIES OF MONANDROMYCES

- A. Host *Microvelia* B
- Host otherwise H
- B. Small, but well-defined, dome-shaped protuberance arising from a cell of basal tier of outer wall cells G
- Basal cells of vertical rows of outer wall cells lacking outgrowths C
- C. Terminal cell of stalk of primary appendage two or more times longer than broad D
- Terminal cell of stalk of primary appendage nearly isodiametric E
- D. Posterior cell (ex *n* adj. *n'*) of terminal tier of outer wall cells forming a prominent, broad-based \pm conical projection 2. *M. umbonatus*
- Cells of terminal tier of outer wall cells lacking outgrowths 3. *M. falcatus*
- E. Receptacle ca. one half total length of thallus 1. *M. microveliae*
- Receptacle ca. only one third total length of thallus F
- F. Length of cells I and II of the receptacle subequal; thallus ca. 200 μ m long on average 4. *M. australis*

- Cell II ca. one half longer than cell I; thallus ca. 300 μ m long on average 5. *M. polhemorum*
- G. Protuberance (ex *n* adj. *m*) small, inconspicuous; est. ca. 2 μ m high; cell II of receptacle slender, 7–7.5 μ m wide 6. *M. tenuistipitis*
- Protuberance (ex *n* adj. *m*) larger, ca. 8–15 μ m high 7. *M. protuberans*
- H. Host *Neolardus* 8. *M. neolardi*
- Host *Pseudoveliea* I
- I. One suprabasal outer wall cell (ex *n* adj. *n'*) forming a protuberance J
- Outer wall cells lacking outgrowths 9. *M. pseudovelieae*
- J. Protuberance (ex *n* adj. *m*) small, dome shaped, ca. 6 μ m high; thallus >400 μ m long 10. *M. elongatus*
- Protuberance (ex *n* adj. *n'*) large, elongate, attenuate, up to 125 μ m long; thallus usually <300 μ m long 11. *M. longispinae*

KEY B. THE SPECIES OF MONANDROMYCES

- A. One of the basal or suprabasal perithecial outer wall cells bearing a short or long lateral protuberance B
- Basal or suprabasal outer wall cells lacking protuberances E
- B. Protuberance arising from a cell of basal tier of cells C
- Protuberance arising from a cell of suprabasal tier of cells D
- C. Protuberance (ex *n* adj. *m*) small, with narrow base, estimated ca. 2 μ m high; cell II of receptacle slender, 7–7.5 μ m wide (on *Microvelia*) 6. *M. tenuistipitis*
- Protuberance (ex *n* adj. *m*) large with broad base, ca. 8–15 μ m high; cell II of receptacle 13–15 μ m wide (on *Microvelia*) 7. *M. protuberans*
- D. Protuberance (ex *n* adj. *m*) small, narrow based, ca. 6 μ m high, arising near base of wall cell; thallus > 400 μ m tall (on *Pseudoveliea*) 10. *M. elongatus*
- Protuberance (ex *n* adj. *n'*) elongate, attenuate, broad based, up to 125 μ m long, arising near middle of wall cell; thallus usually < 300 μ m tall (on *Pseudoveliea*) 11. *M. longispinae*
- E. Terminal cell of stalk of primary appendage two or more times longer than broad F
- Terminal cell of stalk of primary appendage nearly isodiametric H
- F. Cells of terminal tier of outer wall cells (i.e., lip cells) unmodified except for length (on *Microvelia*) 3. *M. falcatus*
- One cell of terminal tier of outer wall cells highly modified, readily distinguished from the other three cells G
- G. Posterior cell (ex *n* adj. *n'*) forming a prominent, broad-based, umbonate projection (on *Microvelia*) 2. *M. umbonatus*
- Anterior cell (ex *m*) elongate, with a broad, truncate, depressed apex having a small, median umbo (on *Neolardus*) 8. *M. neolardi*
- H. Receptacle (cells I, II, III) ca. one half total length of thallus (on *Microvelia*) 1. *M. microveliae*
- Receptacle (cells I, II, III) ca. only one third total length of thallus I
- I. Length of cells I and II of receptacle subequal; thallus ca. 200 μ m long on average (on *Microvelia*) 4. *M. australis*
- Cell II ca. one half longer than cell I; length of thallus ca. 300 μ m or slightly more on average J
- J. Distal margins of cell II of receptacle strongly convex; median cell of primary appendage 18–25 μ m long (on *Microvelia*) 5. *M. polhemorum*
- Distal margins of cell II of receptacle \pm parallel; median cell of primary appendage 33–38 μ m long (on *Pseudoveliea*) 9. *M. pseudovelieae*

1. *Monandromyces microveliae* (Thaxter.) R. K. Benj., comb nov. Fig. 1–2

=*Autophagomyces microveliae* Thaxter, *Mem. Amer. Acad. Arts* 16: 96, Pl. 18, fig. 5, 1931 (BASIONYM).

Ascoma: Erect, nearly straight, bent backward slightly below cell II of receptacle, hyaline to pale yellow, except basal cell of appendage, which is brownish yellow, and perithecium, which is tinged with pale brownish yellow. Length from tip of foot to tip of perithecium 270–322 μ m. **Receptacle:** Slender, elongate, 135–160 μ m long from tip of foot to base of appendage; basal cell (I) short, tapered slightly to blackened foot, 28–31 \times 9–11 μ m; suprabasal cell (II) long, slender, only slightly narrowed downward toward base, 135–160 μ m long, 16–20 μ m wide distally, the septum separating cells I and II angled upward from rear to front; cell III 14–23 μ m long, 9–12 μ m wide distally, \pm triangular in lateral view, adnate on the inside to base of perithecial stalk cell (VI). **Appendage:** Free, 83–94 μ m long; basal cell isodiametric, ca. 10 \times 10 μ m; median cell 23–29 \times 9–11 μ m, its wall variable in thickness and appearing slightly moniliform in optical section; terminal cell somewhat longer than broad, 11–15 \times 8–10 μ m; antheridium 40–45 μ m long, venter 7–10 μ m wide, efferent tube 20–25 \times 2.5–3 μ m. **Perithecium:** Primary stalk cell (VI) ca. three times longer than broad, 33–44 \times 10–11 μ m; secondary stalk cell (VII) 18–22 μ m long; perithecial basal cells (*m*, *n*, *n'*) comprising ca. 20% of total length of perithecial body above stalk cells; body elongate, straight, uniformly inflated upward from base, broadest near middle, then evenly tapered to the blunt apex, 114–132 μ m long including basal cells, 38–48 μ m wide; cells comprising lower three tiers of outer wall cells strongly individually convex, especially those of tier three; cells of terminal tier subequal in length, ca. 10–12 μ m long, one cell (ex *n* adj. *m*) slightly more rounded externally than other three. Ascospores ca. 45–50 \times 5–5.5 μ m.

Specimens examined.—INDONESIA: SUMATRA; Sumatra Barat Prov.; Fort de Kock, ca. 80–90 km N of

Padang; 1925; E. Jacobson coll.; on the posterior legs of *Microvelia albolineolata* Bueno; Thaxter 3302 (FH Acc. #s 4016 [HOLOTYPE], 4017, and 4018 [ISOTYPES]).

Notes.—Thaxter's three slides include seven mature individuals of *Autophagomyces microveliae* (4016 [3], 4017 [2], and 4018 [2]) on which the above description is based. *Monandromyces microveliae* (Fig. 1) differs from the other species parasitic on *Microvelia* by its erect, nearly straight habit; its relatively long, slender stalk (cells I and II); the pronounced external convexity of the cells comprising the lower three of the five tiers of outer wall cells, especially the median tier; and the \pm distally rounded lip cells, which are nearly equal in length.

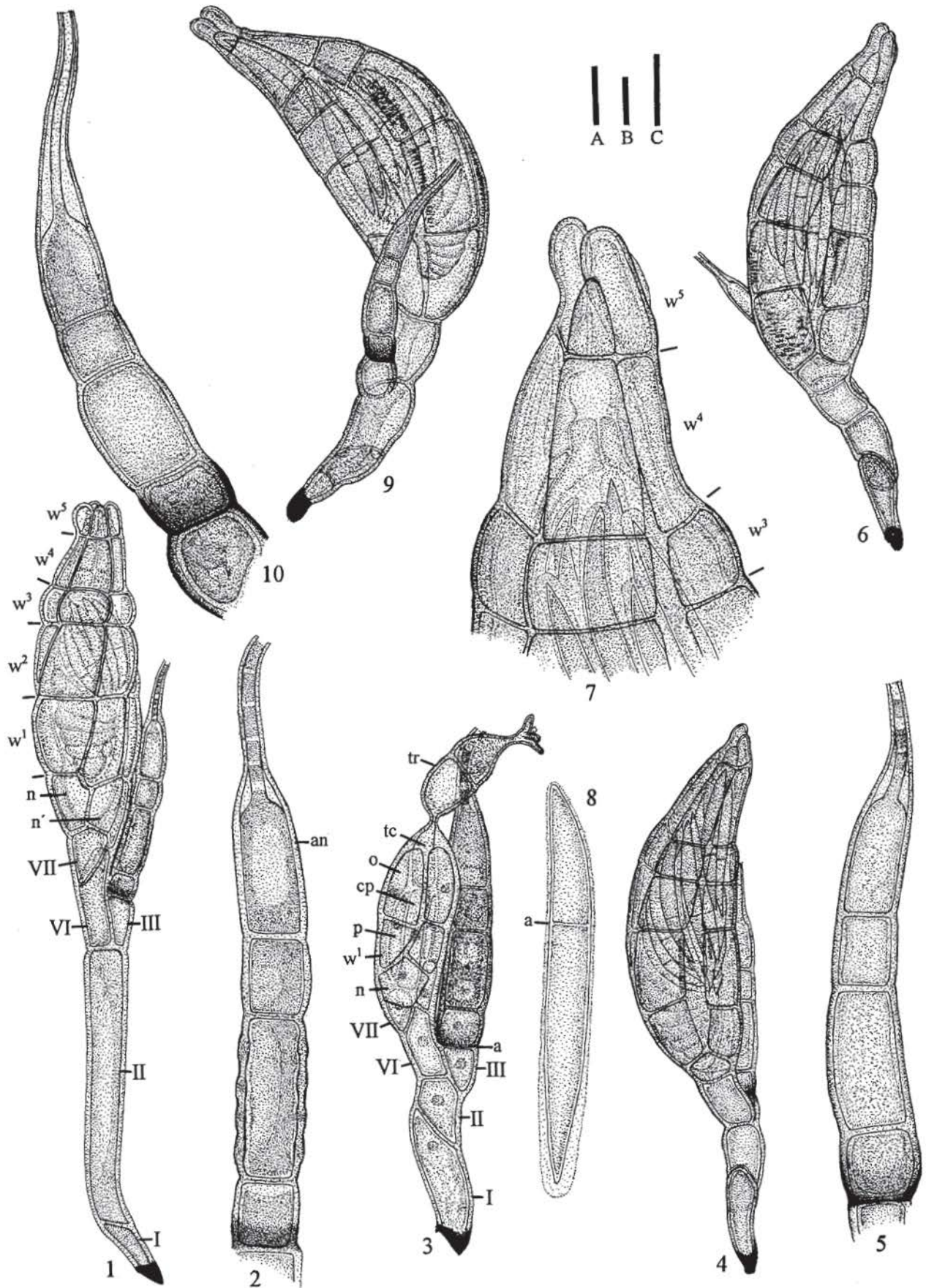
2. *Monandromyces umbonatus* R. K. Benj., sp. nov. Fig. 11–14

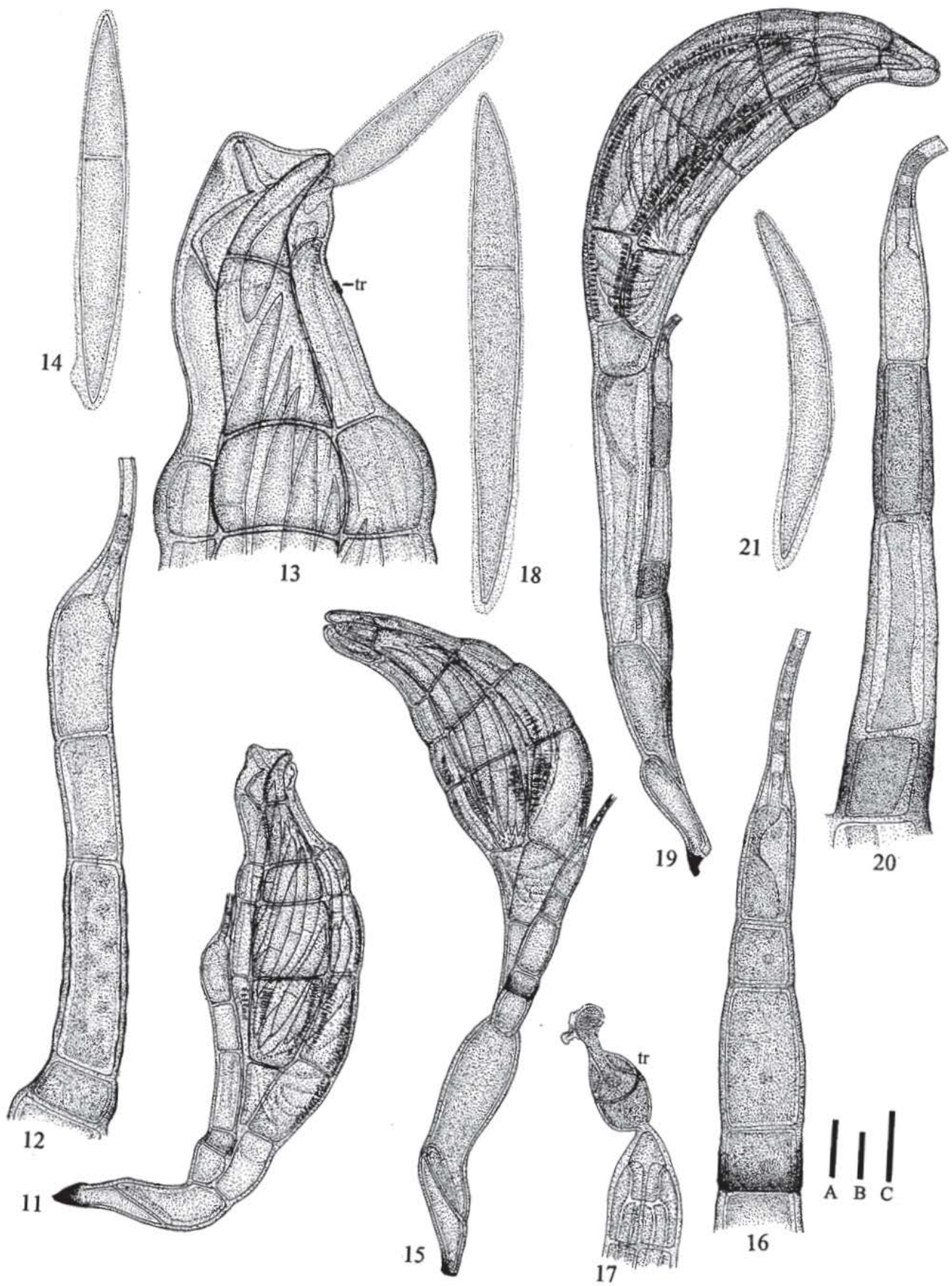
Ascoma: Fortiter basi obstipa infra cellularum III et VI, cetera prope recta; pallide luteobrunnea, perithecio aliquantum fuscato. Thallus totus 206–262 μ m longus ad apicem perithecii. **Receptaculum:** Longitudo totum 58–70 μ m usque ad basim appendicis; longitudo cellularum basilarium (I) et suprabasilarium (II) subaequalis; cellula I decrescens ad pedem denigratum, 38–45 \times 10–13 μ m; cellula II 38–50 μ m longa, latitudo distalis 13–20 μ m; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) 13–20 μ m longa, 11–15 μ m lata, externe convexa, interne basi cellulae VI adnata. **Appendix:** Libera, leniter sigmoidea, 85–100 μ m longa; cellula basilaris 6–9 \times 19 μ m; cellula media 25–35 \times 8–10 μ m, paries aliquantum moniliformis in latere aspectu; cellula terminalis (14–)18–20 \times 8–10 μ m; antheridium 30–40 μ m longum, venter 10 μ m latus, aliquantum asymmetricus, tubus 13–22 \times 2.5–3 μ m. **Perithecium:** Cellula VI 20–30 \times 12–15 μ m; cellula VII 16–23 \times 12–16 μ m; cellulae basiliares perithecii (*m*, *n*, *n'*) prope $\frac{1}{5}$ corporis perithecii in tota longitudine supra cellulas VI et VII; corpus perithecii elongatum, plus minusve uniformiter inflatum ad medianum, decrescens ad apicem, 126–168 μ m longum cum cellulis basilaribus, 39–54 μ m in maxime latitudinem; cellulae strati medii fortiter externe convexae; cellulae basiliares, apprime *m* et *n'*, perithecii et quoque cellulae stratorum basilarium et suprabasilarium cellularum ex *m* et *n'* seriebus angustis verticalibus striarum confertarum brevissimarum prope margines cellularum; apex paulo obstipus, cellula postica umbonem prominentem ca. 7–10 μ m altum formans. Ascosporeae 50–60 \times 5–6 μ m. Typus RKB 3777A (RSA).

Ascoma: Strongly bent or reflexed backward below cells III and VI, otherwise nearly straight; pale yellow-

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; *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 basal cell derived from cell VII, gives rise to one vertical row of wall cells; *o*, a primordial outer wall cell; *pa*, primary appendage; *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. 1–10.—1–2. *Monandromyces microveliae* (Thaxter 3302 [INDONESIA; Sumatra]).—1. Mature individual (holotype).—2. Appendage showing slightly moniliform aspect of lateral wall of median cell of stalk as viewed in optical section.—3–10. *M. australis* (3–8, RKB 3629 [AUSTRALIA; Western Australia]; 9–10, RKB 3779 [INDONESIA; Flores Island]).—3. Juvenile individual at two-outer-wall-cell stage of development with well-developed trichogyne having an ovoid, transversely septate basal part.—4. Mature individual.—5. Appendage of same.—6. Mature individual.—7. Distal part of perithecium of same showing variable lengths of lip cells (i.e., cells of terminal tier of outer wall cells).—8. Ascospore.—9. Mature individual.—10. Appendage of same. (Bars. A = 20 μ m, Fig. 1, 4, 6, 9; B = 10 μ m, Fig. 3; C = 10 μ m, Fig. 2, 5, 7, 8, 10.)





brown, with peritheciium somewhat darker. Length from tip of foot to tip of peritheciium 206–262 μm . *Receptacle*: Length 58–70 μm from tip of foot to base of appendage; basal and suprabasal cells (I, II) subequal in length; cell I tapered downward to the blackened foot, 38–45 \times 10–13 μm ; cell II 38–50 μm long, 13–20 μm wide distally; cross wall separating cells I and II angled upward from rear to front; terminal cell (III) slightly longer than broad, 13–20 μm long, 11–15 μm wide and externally convex distally, adnate on the inside to base of perithecial stalk cell (VI). *Appendage*: Free, slightly sigmoid, 85–100 μm long; basal cell shorter than wide, 6–9 \times 10–12 μm ; median cell 25–35 \times 8–10 μm , wall variable in thickness, appearing somewhat moniliform in optical section, the thicker areas \pm evenly separated from one another and, in surface view, appearing slightly darker than intervening thinner areas; terminal cell twice as long as wide, (14–)18–20 \times 8–10 μm ; antheridium 30–40 μm long, venter 10 μm wide, somewhat asymmetrical, outer margin slightly convex, inner margin slightly concave, efferent tube 13–22 \times 2.5–3 μm . *Peritheciium*: Primary stalk cell (VI) about twice as long as broad, 20–30 \times 12–15 μm ; secondary stalk cell (VII) slightly shorter, 16–23 \times 12–16 μm ; perithecial basal cells (*m*, *n*, *n'*) comprising ca. 20% of total length of perithecial body above stalk cells; body elongate, \pm uniformly inflated upward from base, then tapered towards apex, broadest near middle, 39–54 μm wide, 126–168 μm long including basal cells; cells comprising median tier of outer wall cells individually more strongly convex than those of the two subtending tiers of cells; perithecial basal cells, especially *m* and *n'*, and cells (ex *m* and *n'*) of basal and suprabasal tiers of outer wall cells with narrow vertical rows of very short, closely spaced, transverse striae bordering the lateral margins of the cells; apex slightly tipped forward, posterior cell (ex *n* adj. *n'*) slightly longer than other three and forming a prominent umbo ca. 7–10 μm high. Ascospores 50–60 \times 5–6 μm .

Etymology.—From *umbonatus* (L.), in reference to the umbonate terminal outer wall cell.

Holotype.—INDONESIA: TIMOR; Nusa Tenggara Timur Prov.; spring and stream at Oe Noah near Polen, 23 km NE of Soë, 840 m; 12 Sept 1991; D. A. & J. T. Polhemus (CL 2594); on the left, mid, lateral sur-

face of the abdomen of a ♀ of *Microvelia* sp.; RKB 3777A (designated slide; RSA).

Isotypes.—Data as for the holotype; RKB 3777A (designated slides; RSA).

Notes.—Fifteen mature individuals of *Monandromyces umbonatus* were recovered from a single female host. Features that most readily distinguish this species from others in the genus are: 1) the prominent umbo arising from the posterior cell of the terminal tier of outer wall cells (Fig. 11, 13); 2) the slightly sigmoid appendage with its asymmetrical antheridial venter (Fig. 12); and 3) the \pm strongly convex cells of the lower three tiers, especially the median tier, of outer wall cells (Fig. 13).

3. *Monandromyces falcatus* R. K. Benj., sp. nov.

Fig. 19–21

Ascoma: Erectum, receptaculum et stipes peritheci (cellula VI) stipitem elongatum prope $\frac{1}{2}$ thalli in tota longitudine formantes; cellula basilaris (I) receptaculi leniter postice angulata; peritheciium fortiter postice recurvatum super appendicem; pagina distalis postica receptaculi, cellulae basiliares et terminales stipitis appendicis, et peritheciium atroluteobrunnea, aliter pallide luteobrunnea. Thallus totus 340–378 μm longus ad apicem peritheci. *Receptaculum*: Gradiatim angustatum ad pedem, 100–102 μm longum; cellula basilaris (I) extra fortiter convexa in parte distalibus, 44–47 \times 10–12 μm ; cellula suprabasilaris (II) gradiatim angustata ad basim, 58–60 μm longa, 21–25 μm lata in parte distalibus; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) 30–35 \times 14–16 μm , interne basi cellulae VI adnata. *Appendix*: Liber, gracilis, prope recta, leniter decrescens ad apicem, 94–97 μm longa; cellula basilaris isodiametra, 10–13 \times 13–14 μm ; cellula media 31 \times 10–12 μm ; cellula terminalis 20–22 \times 8–9 μm ; antheridium 32–33 μm longum, venter 6–8 μm latus, tubus 12–15 \times 2.5–3 μm . *Peritheciium*: Cellula VI elongata, 95–100 μm longa, 24–28 μm lata in parte distalibus; cellula VII paulo brevis ca. 23 μm in altitudine; cellulae basiliares peritheci (*m*, *n*, *n'*) prope $\frac{1}{4}$ corporis peritheci in tota longitudine supra cellulas VI et VII; corpus peritheci elongatum, fortiter curvatum, inflatum ad medianum, decrescens ad apicem, margo antica concava, margo postica convexa, 146–184 μm longum cum cellulis basilaribus peritheci, 40–50 μm in maxime latitudinem; cellulae basiliares peritheci et omnes cellulae stratorum basilarium, suprabasilarium, et mediorum seriebus angustis verticalibus striarum confertarum brevissimarum prope margines cellularum; apex rotundatus; cellulae strati terminalis ex cellulis *m* et *n* contiguo *n'* breviores quam cellulae ex cellulis *n'* et *n* contiguo *m*. Ascospores 50–53 \times 15 μm . Typus RKB 3778A (RSA).

Ascoma: Erect, receptacle and perithecial stalk cell (VI) forming an elongate stipe comprising ca. one half total length of thallus; cell I of receptacle angled slightly backward below cell II; peritheciium strongly

Fig. 11–21.—11–14. *Monandromyces umbonatus* (RKB 3777A [INDONESIA; Timor]).—11. Mature individual (holotype).—12. Appendage of same showing median cell with its pattern of contrasting light and dark areas resulting from irregular thickening of its lateral wall.—13. Distal part of a peritheciium showing umbonate lip cell (ex *n* adj. *n'*) and an ascospore exiting through ostiole.—14. Ascospore.—15–18. *M. polhemorum* (RKB 3777B [INDONESIA; Timor]).—15. Mature individual (holotype).—16. Appendage of same.—17. Tip of immature peritheciium showing a trichogyne in early stage of degeneration with an ovoid, transversely septate basal part.—18. Ascospore.—19–21. *M. falcatus* (RKB 3778A [INDONESIA; New Guinea]).—19. Mature individual (holotype) showing distinctive pattern of distribution of perithecial striae.—20. Appendage of same.—21. Ascospore. (Bars. A = 20 μm , Fig. 11, 15, 19; B = 10 μm , Fig. 17; C = 10 μm , Fig. 12–14, 16, 18, 20, 21.)

recurved backwards over appendage; distal posterior surface of receptacle, basal and terminal cells of stalk of appendage, and perithecium dark yellow-brown, otherwise pale yellow-brown. Length from tip of foot to tip of perithecium 340–378 μm . *Receptacle*: Tapered gradually below cells III and VI, 100–102 μm long from tip of foot to base of appendage; basal cell (I) outwardly strongly convex distally, $44\text{--}47 \times 10\text{--}12 \mu\text{m}$; suprabasal cell (II) tapered downward, 58–60 μm long, 21–25 μm wide distally; cross wall separating cells I and II angled upward from rear to front; terminal cell (III) about twice as long as broad, $30\text{--}35 \times 14\text{--}16 \mu\text{m}$, adnate on the inside to base of perithecial stalk cell (VI). *Appendage*: Free, slender, nearly straight, tapered upward slightly from base, 94–97 μm long; basal cell isodiametric, $10\text{--}13 \times 13\text{--}14 \mu\text{m}$; median cell $31 \times 10\text{--}12 \mu\text{m}$; terminal cell slightly more than two times longer than broad, $20\text{--}22 \times 8\text{--}9 \mu\text{m}$; antheridium 32–33 μm long, venter 6–8 μm wide, efferent tube $12\text{--}15 \times 2.5\text{--}3 \mu\text{m}$. *Perithecium*: Primary stalk cell (VI) elongate, only slightly wider above than below, 95–100 μm long, 24–28 μm wide distally; secondary stalk cell (VII) relatively short, ca. 23 μm high, perithecial basal cells (*m*, *n*, *n'*) comprising ca. 25% of total length of perithecial body above stalk cells; body curved, tapered upward from base, broadest near middle, then tapered towards apex, 146–184 μm long including basal cells, 40–50 μm wide, posterior margin concave, anterior margin strongly convex; perithecial basal cells and cells of basal, suprabasal, and median tiers of outer wall cells with short, narrow, closely spaced, transverse striae vertically arranged adjacent to lateral margins of cells; apex rounded; two cells (*ex m* and *n* adj. *n'*) of terminal tier of outer wall cells slightly shorter than other two cells. Ascospores $50\text{--}53 \times 5 \mu\text{m}$.

Etymology.—From *falcatus* (L.), in reference to the falcate habit of the thallus.

Holotype.—INDONESIA: NEW GUINEA; Irian Jaya Prov.; Batuputih River near Krooy, 3 km NW of Kaimana, 30 m; 12 Oct 1991; D. A. & J. T. Polhemus (CL 2639); on the left lateral surface of the pronotum just above the middle leg of *Microvelia* sp.; RKB 3778A (designated slide; RSA).

Isotype.—Data as for the holotype; RKB 3778A (designated slide; RSA).

Notes.—I found only three individuals of *Monandromyces falcatus*; however, the thalli were fully mature and the species should not be confused with any other in the genus. Distinguishing characteristics of the species include the elongate, strongly falcate habit of the thallus (Fig. 19) and the stalk of the appendage, which has a relatively long terminal cell that, like the much shorter basal cell, is more darkly pigmented than the

even longer median cell (Fig. 20). The narrow, vertical zones of short, transverse striations bordering adjacent margins of the perithecial basal cells and the cells of the lower three tiers of outer wall cells (Fig. 19) are a feature also of *M. elongatus* (Fig. 41), which is otherwise very different in overall habit.

4. *Monandromyces australis* R. K. Benj., sp. nov.

Fig. 3–10

Ascoma: Erectum, prope rectum vel plus minusve fortiter postice recurvum pede usque ad apicem; luteobrunneum praeter perithecium atroluteobrunneum et $\frac{1}{2}\text{--}\frac{1}{2}$ partem infernam cellulae basilaris appendicis atroluteobrunneum. Thallus totus 185–210 μm longus ad apicem perithecii. *Receptaculum*: Relative breve circa $\frac{1}{2}$ longitudinis thalli in tota longitudine, 58–66 μm longum ad basim appendicis; cellula basilaris (I) deorsum decrescens ad pedem denigratum, fortiter convexa in parte distalibus, $34\text{--}45 \times 11\text{--}15 \mu\text{m}$; cellula suprabasilaris (II) $21\text{--}40 \times 15\text{--}25 \mu\text{m}$; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) $12\text{--}18 \times 10\text{--}15 \mu\text{m}$, interne basi cellulae VI adnata. *Appendix*: Libera, recta vel plus minusve arcuata, 59–83 μm longa; cellula basilaris prope isodiametra, $8\text{--}10 \times 10\text{--}12 \mu\text{m}$; cellula media $15\text{--}25 \times 9\text{--}11 \mu\text{m}$; cellula terminalis isodiametra, $8\text{--}10 \times 9\text{--}11 \mu\text{m}$; antheridium 30–40 μm longum, venter 8–11 μm latus, tubus $15\text{--}25 \times 3\text{--}3.5 \mu\text{m}$. *Perithecium*: Cellula VI $20\text{--}23 \times 10\text{--}18 \mu\text{m}$; cellula VII $11\text{--}14 \mu\text{m}$ in altitude; cellulae basiliares perithecii (*m*, *n*, *n'*) prope $\frac{1}{2}$ corporis perithecii in tota longitudine supra cellulas VI et VII; corpus perithecii plus minusve rectum, inflatum ad medianum, decrescens ad apicem, margo antica fortiter convexa, margo postica prope recta vel parce concava, 137–160 μm longum cum cellulis basiliaribus perithecii, $43\text{--}50 \mu\text{m}$ in maxime latitudine; cellula basilaris *n* perithecii striis transversis dispersis; cellulae omnes stratorum basilarium et suprabasilarium seribus angustis verticalibus striarum confertarum brevissimarum prope margines cellularum; apex decrescens; cellula breviores strati terminalis ex cellula *n* cellulae *n'* contiguo $11\text{--}13 \mu\text{m}$ longa, cellula longiores strati terminalis ex cellulae *n* contiguo *m* $20\text{--}25 \mu\text{m}$ longa. Ascospores $54\text{--}59 \times 5.5\text{--}6 \mu\text{m}$. Typus RKB 3629 (RSA).

Ascoma: Erect, nearly straight to \pm strongly curved backward from base to apex; pale yellow-brown except perithecium and lower one third to one half of basal cell of appendage, which are dark yellow-brown. Length from tip of foot to tip of perithecium 185–210 μm . *Receptacle*: Relatively short, ca. one third total length of thallus, 58–66 μm long from tip of foot to base of appendage; basal cell (I) tapered downward to blackened foot, outwardly convex distally, $34\text{--}45 \times 11\text{--}15 \mu\text{m}$; suprabasal cell (II) slightly shorter and wider than cell I, $21\text{--}40 \times 15\text{--}25 \mu\text{m}$; cross wall separating cells I and II angled upward from rear to front; terminal cell (III) slightly longer than broad, $12\text{--}18 \times 10\text{--}15 \mu\text{m}$, adnate on inside to base of perithecial stalk cell (VI). *Appendage*: Free, straight to \pm curved, 59–83 μm long; basal cell nearly isodiametric, $8\text{--}10 \times 10\text{--}12 \mu\text{m}$; median cell $15\text{--}25 \times 9\text{--}11 \mu\text{m}$; terminal cell isodiametric, $8\text{--}10 \times 9\text{--}11 \mu\text{m}$; antheridium 30–40 μm long, venter 8–11 μm wide, efferent tube $15\text{--}25 \times 3\text{--}3.5 \mu\text{m}$. *Perithecium*: Primary stalk cell (VI) slightly longer than broad, $20\text{--}23 \times 10\text{--}18 \mu\text{m}$; secondary stalk cell (VII) shorter, 11–14 μm high, peri-

thecial basal cells (m , n , n') comprising ca. 20% of total length of perithecial body above stalk cells; body \pm straight, tapered upward from base, broadest near middle, then tapered towards apex, 137–160 μm long including basal cells, 43–50 μm wide, anterior margin strongly convex, posterior margin nearly straight to base of subterminal tier of outer wall cells, which may be tipped slightly backward; perithecial basal cell n with scattered, transverse striae; cells of basal and suprabasal tiers of outer wall cells with a few \pm elongate, but usually very short, narrow, closely spaced, transverse striae mostly vertically arranged adjacent to lateral margins of cells; apex tapered; cells of terminal tier of outer wall cells differing slightly in length, the shortest (ex n adj. n') 11–13 μm long, the longest (ex n adj. m) 20–25 μm . Ascospores 54–59 \times 5.5–6 μm .

Etymology.—From *australis* (L.), southern, in reference to the known range of the taxon in Indonesia and Australia.

Holotype.—AUSTRALIA: WESTERN AUSTRALIA; Serpentine River, 2 km E of South Western Highway and falls, clear stream; 4 Dec 1977; J. T. Polhemus (CL 880); on the anterior surface of the pronotum near the margins of *Microvelia peramoena* Hale; RKB 3629 (designated slide; RSA).

Isotype.—Data as for the holotype; RKB 3629 (designated slide; RSA).

Paratypes.—INDONESIA: FLORES ISLAND; Nusa Tenggara Timur Prov.; Wae Garit River, 6 km W of Ruteng, 1100 m; 24 Oct 1985; J. T. & D. A. Polhemus (CL 2179); on the 1st abdominal sternite, just below the left margin of a ♀ of *Microvelia* n. sp. nr. *M. magnifica* Lundblad [fide J. T. Polhemus]; RKB 3779 (designated slides; RSA)

Notes.—The collection of *M. australis* from Western Australia included three mature (cf. Fig. 4, 6), two nearly mature, and two immature individuals, one of the latter bearing a trichogyne (Fig. 3). The material from Flores Is., which differed from that from Australia only in having a \pm curved thallus (cf. Fig. 9) (probably influenced by its position on the host), numbered seven mature and two immature individuals. Among the species of *Monandromyces* on *Microvelia*, the primary distinguishing characteristics of *M. australis* are the relatively short receptacle and the nearly straight, \pm asymmetric, dark yellowish brown perithecium.

5. *Monandromyces polhemorum* R. K. Benj., sp. nov. Fig. 15–18

Ascoma: Leniter sigmoideum, pallide luteobrunneum praeter perithecium atroluteobrunneum et $\frac{1}{2}$ pars infera cellulae basilaris appendicis atroluteobrunnea. Thallus totus 265–305 μm longus ad apicem perithecii. **Receptaculum:** Circa $\frac{1}{3}$ longitudinem thalli in tota longitudine, 100–124 μm longum ad basim appendicis; cellula basilaris (I) deorsum decrescens ad pedem denigratum, 43–61 \times 10–16 μm ;

cellula suprabasilaris (II) extra convexior in parte distalibus, 63–83 μm longa, 20–29 μm in maxime latitudine; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) 12–17 \times 12–15 μm , interne basi cellulae VI adnata. **Appendix:** Libera, plus minusve attenuata ad apicem, 63–85 μm longa; cellula basilaris latitudine magiore quam altitude, 6–9 \times 10–12 μm ; cellula media 18–25 \times 10–12 μm ; cellula terminalis prope isodiametra, 6–10 \times 8–10 μm ; antheridium 33–42 μm longum, venter 8–10 μm latus, tubus 16–21 \times 3 μm . **Perithecium:** Cellula VI 30–40 \times 13–20 μm ; cellula VII 12–16 \times 13–16 μm ; cellulae basiliares perithecii (m , n , n') prope $\frac{1}{3}$ corporis perithecii in tota longitudine supra cellulas VI et VII; corpus perithecii antice curvatum, inflatum ad aliquanto infra medianum, decrescens ad apicem, margines plus minusve fortiter convexae, 138–153 μm longum cum cellulis basilaribus perithecii, 45–58(–63) μm in maxime latitudine; cellula basilaris n' perithecii et cellulae omnes stratorum basilarium et interdum suprabasilarium seriebus verticalibus striarum confertarum brevissimarum prope margines cellularum; apex rotundatus, cellula ex n contiguo n' brevior quam cellulae ceterae. Ascospores 61–71 \times 6–7 μm . Typus RKB 3777B (RSA).

Ascoma: Slightly sigmoid; pale yellowish brown except perithecium and lower one half of basal cell of appendage, which are more deeply suffused with yellow brown. Length from tip of foot to tip of perithecium 265–305 μm . **Receptacle:** Comprising ca. one third of length of thallus, 100–124 μm long to base of appendage, bent backward slightly near base of cell II; basal cell (I) tapered towards blackened foot, 43–61 \times 10–16 μm ; suprabasal cell (II) broadly rounded distally, narrowed at contact with cells III and VI, 63–82 μm long, greatest width 20–29 μm ; cross wall separating cells I and II angled upward from rear to front; terminal cell (III) 12–17 \times 12–15 μm , adnate on inside to base of perithecial stalk cell (VI). **Appendage:** Free, \pm attenuate, 63–85 μm long; basal cell slightly shorter than wide, 6–9 \times 10–12 μm ; median cell 18–25 \times 10–12 μm ; terminal cell nearly isodiametric, 6–10 \times 8–10 μm ; antheridium 33–42 μm long, venter 8–10 μm wide, efferent tube 16–21 \times 3 μm . **Perithecium:** Primary stalk cell (VI) about two times longer than broad, 30–40 \times 13–20 μm ; secondary stalk cell (VII) about as long as broad, 12–16 \times 13–16 μm , perithecial basal cells (m , n , n') comprising ca. 20% of total length of body above stalk cells; body curved outward away from appendage, tapered upward, broadest slightly below the middle, then tapered towards apex, 45–58(–63) μm wide, 138–153 μm long including basal cells, margins \pm strongly convex; perithecial basal cell n' and cells of basal tier and sometimes suprabasal tier of outer wall cells with vertical rows of relatively short, narrow, closely spaced, transverse striae near lateral margins of cells; apex rounded; one cell (ex n adj. n') of terminal tier of outer wall cells slightly shorter than other three. Ascospores 61–71 \times 6–7 μm .

Etymology.—Named for John T. and Dan A. Polhemus, father and son respectively, students of Heteroptera, who collected the host.

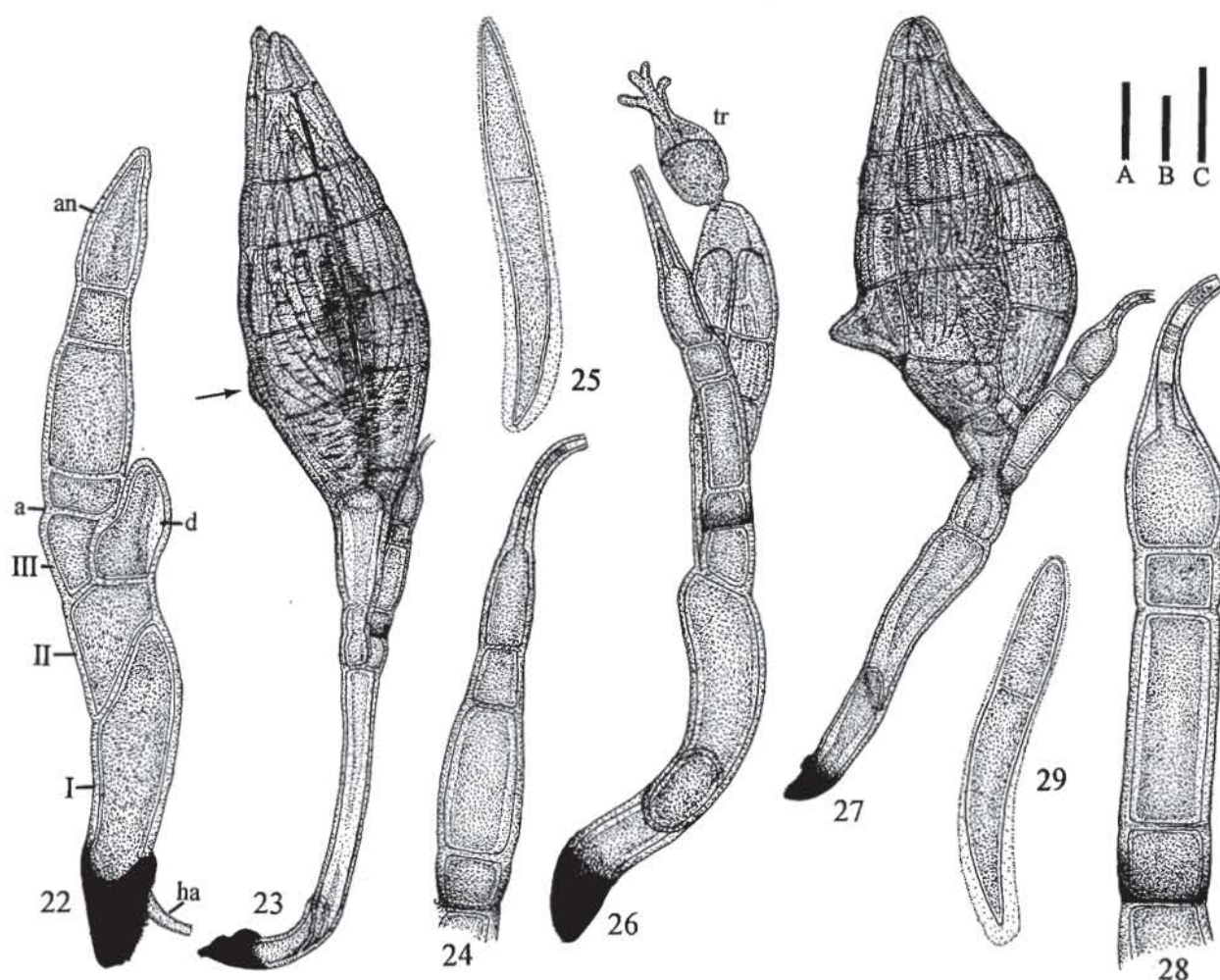


Fig. 22–29.—22–25. *Monandromyces tenuistipitis* (RKB 3778B [INDONESIA; New Guinea]).—22. Very immature individual showing perithecial initial (*p*) arising from cell II and an immature appendage, subtended by cell III, before differentiation of the terminal antheridium. Note also remnant of haustorium (*ha*) projecting downward and to the right of the blackened foot.—23. Mature individual (holotype); note barely visible protuberance (arrow).—24. Appendage of same.—25. Ascospore.—26–29. *M. protuberans* (RKB 3631 [AUSTRALIA; Western Australia]).—26. Juvenile individual at two-outer-wall-cell stage of development bearing a trichogyne with an ovoid, transversely septate basal part.—27. Mature individual (holotype) showing distinctive perithecial protuberance (ex *n* adj. *m*).—28. Appendage of same.—29. Ascospore. (Bars. A = 20 μ m, Fig. 23, 27; B = 10 μ m, Fig. 26; C = 10 μ m, 22, 24, 25, 28, 29.)

Holotype.—INDONESIA: TIMOR; Nusa Tenggara Timur Prov. spring and stream at Oe Noah near Polen, 23 km NE of Soë, 840 m; 12 Sept 1991; D. A. & J. T. Polhemus (CL 2594); on the mid right surface of the prosternum of a ♀ of *Microvelia* sp.; RKB 3777B (designated slide; RSA).

Isotype.—Data as for the holotype; RKB 3777B (designated slides; RSA).

Notes.—*Monandromyces polhemorum* was found on the same host as *M. umbonatus*, which grew on the mid, left, lateral surface of the abdomen. Twelve mature, three nearly mature, and six immature individuals (two with trichogynes [Fig. 17]) of *M. polhemorum* were recovered. As the thallus matures, it appears to undergo a slight natural twist of ca. 90°, and in slide mounts of mature specimens the relationship of the appendage to the base of the perithecium could only

be observed in far or near view, as depicted in Fig. 15; the distortion appears not to be an artifact of preparation. Except for a slight external convexity of the median cell of its stalk, the appendage is slightly but uniformly tapered upward from the base (Fig. 16). Another distinguishing feature of *M. polhemorum* is the \pm pronounced distal inflation of cell II of the receptacle (Fig. 15).

6. *Monandromyces tenuistipitis* R. K. Benj., sp. nov. Fig. 22–25

Ascoma: Erectum, prope rectum praeter cellulam basilem receptaculi plus minusve fortiter curvatum; receptaculum pallide luteobrunneum; appendix pallide luteobrunnea; perithecium atroaurantiobrunneum; cellula basilaris appendicis atroaurantiobrunnea. Thallus totus 245–260 μ m longus ad apicem perithecii. **Receptaculum:** Elongatum, gracile, circa $\frac{1}{3}$ longitudinis thalli, 96–98 μ m longum ad basim appendicis; cellula basilaris (I) 30–33 \times 8–9 μ m,

prope uniformis in latitudinem supra pedem denigratum, paululum extra convexa in parte distalibus; cellula suprabasilaris (II) elongata, gracilis, prope uniformis in latitudinem, $65-75 \times 7-8 \mu\text{m}$; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) $10-11 \times 8 \mu\text{m}$, interne basi cellulae VI adnata. *Appendix*: Libera, $52-56 \mu\text{m}$ longa; cellula basilaris latitudine aliquanto magis quam altitude, $5 \times 8 \mu\text{m}$; cellula media plus minusve extra convexa, $16-17 \times 8 \mu\text{m}$; cellula terminalis altitude aliquanto magis quam latitudine, $6-7 \times 5-6 \mu\text{m}$; antheridium relative angustum, $24-25 \mu\text{m}$ longum, venter circa $5 \mu\text{m}$ latus, tubus $14-15 \times 2 \mu\text{m}$. *Perithecium*: Cellula VI relative longa, apice dilatata, leniter constricta prope basin, $45 \times 14-15 \mu\text{m}$; cellula VII circa $8-10 \mu\text{m}$ in altitude; cellulae basillares peritheci (m, n, n') prope $\frac{1}{4}$ corporis peritheci in tota longitudine supra cellulis VI et VII; corpus peritheci rectum uniformiter inflatum ad medianum, decrescens ad apicem, margines convexae, circa $121 \mu\text{m}$ longum cum cellulis basillaribus, circa $45 \mu\text{m}$ in maxime latitudine; cellula ex n contiguo m strati basilaris processum brevissimum tholiforme circa $2 \mu\text{m}$ altum gignens; cellulae basillares peritheci et cellulae omnes stratorum basilarium et suprabasilarium striis transversis dispersis vel seribus angustis verticalibus striarum confertarum plus minusve brevibus prope margines cellularum; cellula ex n contiguo m strati terminalis aliquanto longior quam ceterum. Ascospores $40-46 \times 5 \mu\text{m}$. Typus *RKB 3778B* (RSA).

Ascoma: Erect, nearly straight, except basal cell of receptacle \pm strongly curved; receptacle and appendage pale yellowish brown; perithecium and basal cell of appendage dark orange-brown. Length from tip of foot to tip of perithecium $245-260 \mu\text{m}$. *Receptacle*: Elongate, slender, comprising ca. $\frac{1}{3}$ of length of thallus, $96-98 \mu\text{m}$ long from tip of foot to base of appendage; basal cell (I) nearly uniform in width above blackened foot, except slightly externally rounded distally, $30-33 \times 8-9 \mu\text{m}$; suprabasal cell (II) elongate, slender, nearly uniform in width above juncture with cell I, $65-75 \times 7-8 \mu\text{m}$; cross wall separating cells I and II angled upward from rear to front; terminal cell small, slightly longer than wide, $10-11 \times 8 \mu\text{m}$, adnate on inside to base of perithecial stalk cell (VI). *Appendage*: Free, $52-56 \mu\text{m}$ long; basal cell slightly wider than high, $5 \times 8 \mu\text{m}$; median cell as wide as basal cell, externally \pm convex, $16-17 \times 8 \mu\text{m}$; terminal cell slightly higher than wide, $6-7 \times 5-6 \mu\text{m}$, narrower than basal and median cells; antheridium relatively narrow, $24-25 \mu\text{m}$ long, venter ca. $5 \mu\text{m}$ wide, efferent tube $14-15 \times 2 \mu\text{m}$. *Perithecium*: Primary stalk cell (VI) relatively long, broadest above, slightly constricted near base, $45 \mu\text{m}$ long, $14-15 \mu\text{m}$ wide distally; secondary stalk cell (VII) ca. $8-10 \mu\text{m}$ high, perithecial basal cells (m, n, n') comprising ca. 25% of total length of body above stalk cells; body straight, uniformly inflated upward from base, broadest near middle, then evenly tapered to apex, ca. $121 \mu\text{m}$ long above stalk cells, ca. $45 \mu\text{m}$ wide, basal outer wall cell (ex n adj. m) bearing near its base a very short, broad-based, dome-shaped protuberance, estimated at ca. $2 \mu\text{m}$ high; perithecial basal cells and cells of basal and suprabasal tiers of outer wall cells with narrow transverse striae of varying lengths arranged randomly or

in closely spaced vertical rows adjacent to lateral margins of cells; one cell of terminal tier of outer wall cells (ex n adj. m) slightly longer than others. Ascospores $40-46 \times 5 \mu\text{m}$.

Etymology.—From the combination of *tenui-* (in *L. comp.*), slender, + *stipes* (*L.*), stipe, in reference to the stalk of the thallus.

Holotype.—INDONESIA: NEW GUINEA; Irian Jaya Prov.; Batuputih River near Krooy, 3 km NW of Kaimana, 30 m; 12 Oct 1991; D. A. & J. T. Polhemus (CL 2639); on the lower surface of the femur of the right anterior leg of *Microvelia* sp.; *RKB 3778B* (designated slide; RSA).

Notes.—Only one very immature and two mature specimens of this distinctive species were found (Fig. 22, 23); they parasitized the same host as *M. falcatus*, which grew on the left lateral surface of the pronotum. The slender stipe (i.e., cells I, II, and VI) subtending the perithecial body is a prime distinguishing feature of *M. tenuistipitis* (Fig. 23). Unfortunately, the orientation of both mature individuals in the slide mount precluded accurate study of the small dome-shaped prominence arising from basal outer wall cell ex n adj. m. Its height of $2 \mu\text{m}$ given in the description is only an estimate; precise dimensions of the prominence must await discovery of additional specimens.

7. *Monandromyces protuberans* R. K. Benj., sp. nov. Fig. 26-29

Ascoma: Plus minusve curvatum vel flexum; pallide luteobrunneum praeter perithecium atroluteobrunneum et cellula basilaris appendicis atroluteobrunnea. Thallus totus $205-230 \mu\text{m}$ longus ad apicem peritheci. *Receptaculum*: Prope rectum, circa $\frac{2}{3}$ longitudinem thalli in tota longitudine, $85-110 \mu\text{m}$ longum ad basim appendicis; cellula basilaris (I) $36-46 \times 8-11 \mu\text{m}$ pede denigratum inclusa; cellula suprabasilaris (II) $59-76 \mu\text{m}$ longa, $13-15 \mu\text{m}$ lata in parte distalibus; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) interne basi cellula VI adnata, prope isodiametra, $9-16 \times 9-12 \mu\text{m}$. *Appendix*: Libera, $65-75 \mu\text{m}$ longa; cellula basilaris prope isodiametra, $7-9 \times 9-11 \mu\text{m}$; cellula media $19-30 \times 9-10 \mu\text{m}$; cellula terminalis isodiametra, $7-9 \times 7-9 \mu\text{m}$; antheridium $30-38 \mu\text{m}$ longum, venter $8-11 \mu\text{m}$ latus, tubus $16-22 \times 2.5-3 \mu\text{m}$. *Perithecium*: Cellula VI constrictione media, $23-30 \mu\text{m}$ longa, basi et apice $10-15 \mu\text{m}$ lata; cellula VII relative parva, circa $10-12 \mu\text{m}$ in altitude; cellulae basillares peritheci (m, n, n') prope $\frac{1}{3}$ corporis peritheci in tota longitudine supra cellulas VI et VII; corpus relative latum uniformiter inflatum ad medianum, decrescens ad apicem, margines fortiter convexae, $100-112 \mu\text{m}$ longum cum cellulis basillaribus peritheci, $48-60 \mu\text{m}$ in maxime latitudine; cellula ex n contiguo m strati basilaris processum tholiforme $8-15 \mu\text{m}$ altum gignens; cellulae basillares peritheci et cellulae omnes stratorum basilarium, suprabasilarium, et mediorum punctis dispersis vel striis minutis transversis dispersis vel seribus verticalibus striarum apprimae prope margines cellularum; apex late rotundatus; cellulae strati terminale subaequales. Ascospores $44-46 \times 6 \mu\text{m}$. Typus *RKB 3631* (RSA).

Ascoma: More or less curved or bent forward abruptly near base of appendage; pale yellowish

brown, except peritheciium and basal cell of appendage, which are dark yellow brown. Length from tip of foot to tip of peritheciium 205–230 μm . *Receptacle*: Nearly straight, ca. 40% of length of thallus; 85–110 μm long from tip of foot to base of appendage; basal cell (I) including blackened foot 36–46 \times 8–11 μm ; suprabasal cell (II) about one third longer than cell I, 59–76 μm long, 13–15 μm wide distally; cross wall separating cells I and II angled upward from rear to front; terminal cell (III) adnate on inside to base of perithecial stalk cell (VI), nearly isodiametric, 9–16 \times 9–12 μm . *Appendage*: Free, 65–75 μm long; basal cell nearly isodiametric, 7–9 \times 9–11 μm ; median cell 19–30 \times 9–10 μm ; terminal cell isodiametric, 7–9 \times 7–9 μm ; antheridium 30–38 μm long, venter \pm externally convex, 8–11 μm wide, efferent tube 16–22 \times 2.5–3 μm . *Peritheciium*: Primary stalk cell (VI) with a well-defined median constriction, 23–30 μm long, 10–15 μm wide distally and at base; secondary stalk cell (VII) relatively small, ca. 10–12 μm high, perithecial basal cells (*m*, *n*, *n'*) comprising ca. 20% of total length of body above stalk cells; body uniformly inflated upward from base, broadest near middle, then evenly tapered towards rounded apex, 100–112 μm long above stalk cells, median width 48–60 μm , basal outer wall cell (ex *n* adj. *m*) bearing a broad-based tapered to dome-shaped protuberance 8–15 μm high; perithecial basal cells and cells of basal, suprabasal, and median tiers of outer wall cells mottled or minutely punctate, especially near lateral margins of cells; cells of terminal tier of outer wall cells subequal in length. Ascospores 40–44 \times 6 μm .

Etymology.—From *protuberans* (L.), bulging, in reference to the prominence formed by a cell of the basal tier of outer wall cells.

Holotype.—AUSTRALIA: WESTERN AUSTRALIA; Sabina River at Vasse Highway; 5 Dec 1977; J. T. Polhemus (CL 886); on the femur of the left anterior leg of a δ of *Microvelia peramoena* Hale; RKB 3631 (designated slide; RSA).

Isotypes.—Data as for the holotype, except on the femur of the left middle and right anterior legs; RKB 3631 (designated slides; RSA).

Paratypes.—AUSTRALIA: WESTERN AUSTRALIA; Capel; Capel River, slow clear stream; 5 Dec 1977; J. T. Polhemus (CL 884); on the femur and adjacent trochanter of the left anterior leg of 3 δ s of *M. peramoena*; RKB 3630 (designated slides; RSA).

Notes.—Material available for my study of *M. protuberans* included 12 mature, two nearly mature, and 11 immature thalli, one bearing a trichogyne (Fig. 26). The broad-based protuberance arising from basal outer wall cell ex *n* adj. *m* (Fig. 27) readily distinguishes *M. protuberans* from other species of the genus including *M. tenuistipitis*, the only other species parasitizing *Microvelia* that forms a projection, albeit very small, on the same basal outer wall cell.

8. *Monandromyces neolardi* R. K. Benj., n. sp.

Fig. 30–35.

Ascoma: Erectum, prope rectum, uniformiter luteolum. Thallus totus 290–365 μm longus ad apicem peritheci. *Receptaculum*: Elongatum, prope basim retroflexum, 98–130 μm longum ad basin appendicis; cellula basilaris (I) deorsum decrescens ad pedem denigratum, 40–43 \times 10–12 μm ; cellula suprabasilaris (II) gradatim dilatata a basi ad apicem, 57–86 μm longa, 20–28 μm lata in parte distalibus; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) interne basi cellula VI adnata, altitude aliquanto magis quam latitudine, 20–24 \times 13–17 μm . *Appendix*: Libera, 126–137 μm longa; cellula basilaris latitudine aliquanto magis quam altitude, 5 \times 8 μm ; cellula media elongata, 50–60 \times 12–15 μm ; cellula terminalis circa 3plo longiora quam cellula basilaris, 25–33 \times 12–18 μm ; antheridium 30–40 μm longum, venter 12–18 μm latus, tubus 14–25 \times 3–3.5 μm . *Peritheciium*: Cellula VI constrictione media, 40–50 μm longa, basi et apice circa 14–20 μm lata; cellula VII 15–20 μm in altitude; cellulae basiliares peritheci (*m*, *n*, *n'*) prope $\frac{1}{2}$ corporis peritheci in tota longitudine supra cellulas VI et VII; corpus rectum, uniformiter inflatum ad medianum, decrescens ad apicem, 180–210 μm longum cum cellulis basiliaribus peritheci, 40–60 μm in maxime latitudine; cellulae basiliares peritheci et cellulae omnes stratorum basilarium, suprabasilarium, et subterminalium punctis dispersis vel striis transversis longitudinum variarum dispersis vel seriebus verticalibus striarum; cellulae omnes strati terminalis longitudinum dissimilum; cellula ex *n'* brevissima, 12–15 μm longa; cellula ex *m* longissima, 35–38 μm longa, leniter curvata, apice truncato depresso cum umbone in medio. Ascospores 50–56 \times 6–7 μm . Typus RKB 3628 (RSA).

Ascoma: Erect, nearly straight, uniformly pale yellow. Length from tip of foot to tip of peritheciium 290–365 μm . *Receptacle*: Elongate, reflexed slightly backward near the base, 98–130 μm long from tip of foot to base of appendage. Basal cell (I) tapered slightly to blackened foot, 40–43 μm long, 10–12 μm wide distally; suprabasal cell (II) gradually widening upward from base, 57–86 \times 20–28 μm distally; cross wall separating cells I and II angled upward from rear to front; terminal cell (III) adnate on inside to base of perithecial stalk cell (VI), slightly longer than wide, 20–24 \times 13–17 μm . *Appendage*: Free, 126–137 μm long; basal cell shorter than wide, 7–11 \times 13–17 μm ; median cell elongate, 50–60 \times 12–15 μm ; terminal cell relatively long compared to basal cell, 25–33 \times 12–18 μm ; antheridium 30–40 μm long, venter 12–18 μm wide, efferent tube 14–25 μm \times 3–3.5 μm . *Peritheciium*: Primary stalk cell (VI) with median constriction, 40–50 μm long, ca. 14–20 μm wide distally and at base; secondary stalk cell (VII) 15–20 μm high, perithecial basal cells (*m*, *n*, *n'*) comprising ca. 20% of total body length above stalk cells; body straight, uniformly inflated upward from base, broadest near middle, then tapered towards apex, 180–210 μm long above stalk cells, median width 40–60 μm ; perithecial basal cells and cells of basal, suprabasal, and especially subterminal tiers of outer wall cells with inconspicuous, vertically aligned or somewhat scattered, punctae or transverse striations of varying lengths; cells comprising terminal tier of outer wall cells all of

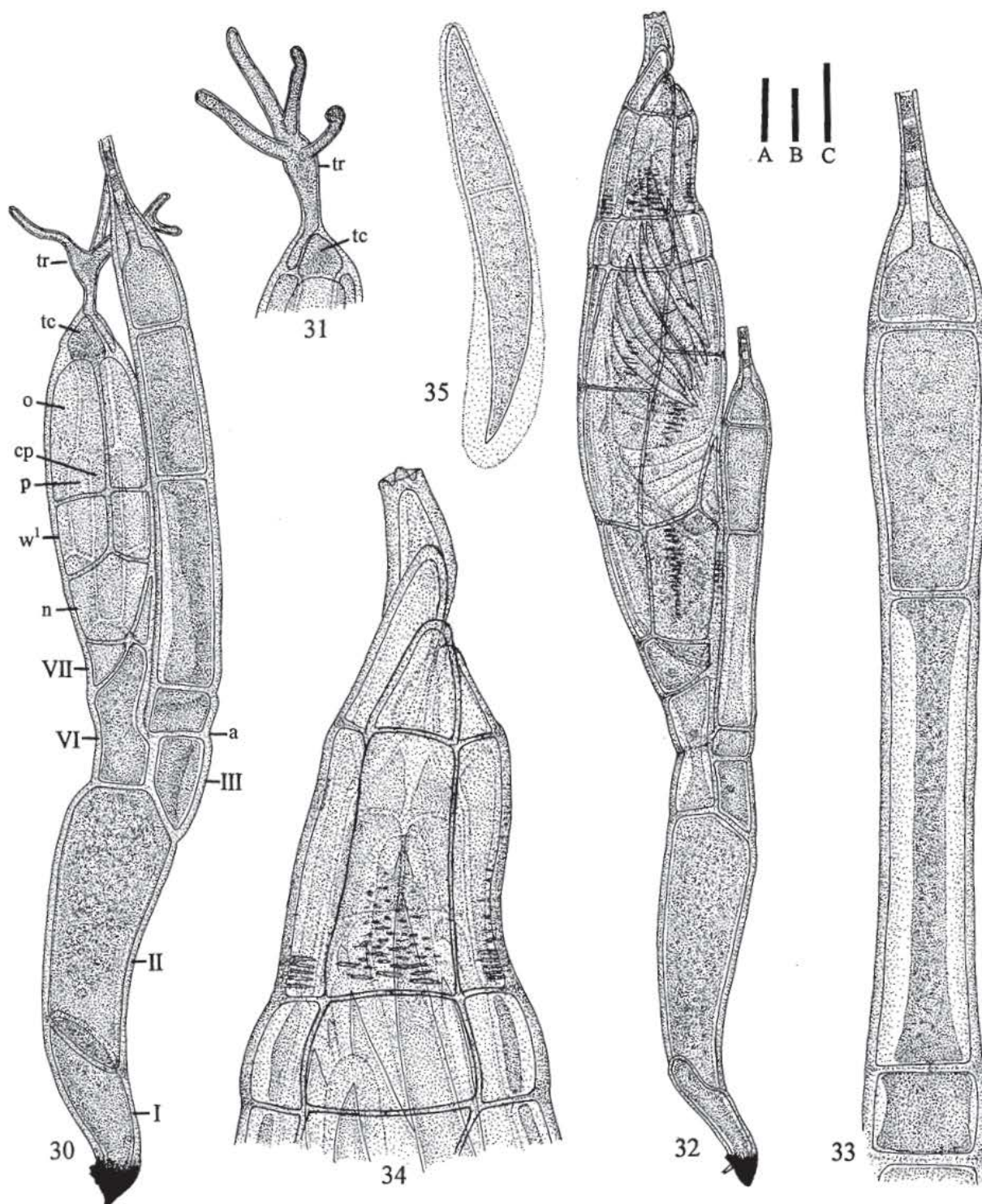


Fig. 30–35. *Monandromyces neolardi* (RKB 3628A [MALAYSIA; Johor]).—30. Juvenile individual at two-outer-wall-cell stage of development with a well-developed trichogyne, which is without an ovoid, transversely septate basal part.—31. Tip of another juvenile perithecium with a similar trichogyne.—32. Mature individual (holotype).—33. Appendage of same.—34. Distal part of perithecium of same showing distinctively modified tip of the longest lip cell (ex *m*), and pattern of transverse striations near base of subterminal tier of outer wall cells.—35. Ascospore. (Bars. A = 20 μm, Fig. 32; B = 10 μm, Fig. 30, 31; C = 10 μm, Fig. 33–35.)

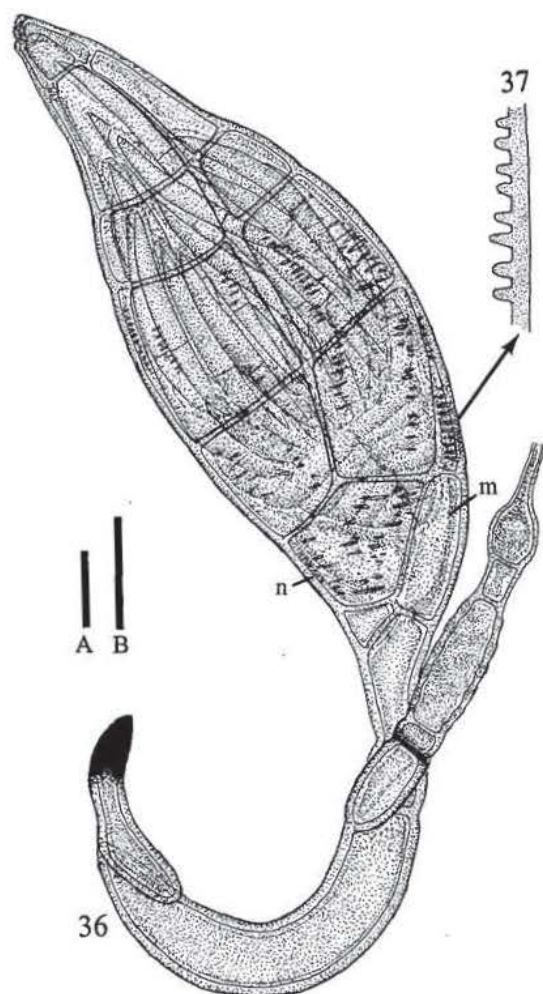


Fig. 36, 37. *Monandromyces pseudoveliae* (RKB 3541B [AFRICA; Madagascar]).—36. Mature individual (holotype).—37. Optical section of small part of cell of an outer wall cell (arrow) showing nature of ingrowths of inner surface of cell wall that result in the punctae or striae seen in surface views of basal cells and outer wall cells of this and other species of *Monandromyces*. (Bars. A = 20 μ m, Fig. 36; B = 10 μ m, Fig. 37.)

different lengths, the shortest, ex. n' , 12–15 μ m long, the longest, ex. m , 35–38 μ m long, slightly curved, with a broad, truncate, depressed apex having a small, median umbo. Ascospores 50–56 \times 6–7 μ m.

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

Holotype.—MALAYSIA: JOHOR; stream 12 km N of Labis; 23 Aug 1985; J. T. & D. A. Polhemus (CL 2087); On the pronotum and adjacent hemelytra of a winged δ of *Neoalardus typicus* (Distant); RKB 3628 (designated slide; RSA).

Isotype.—Data as for the holotype, except on the lower mid surface of the abdomen of the host; RKB 3624 (designated slide; RSA).

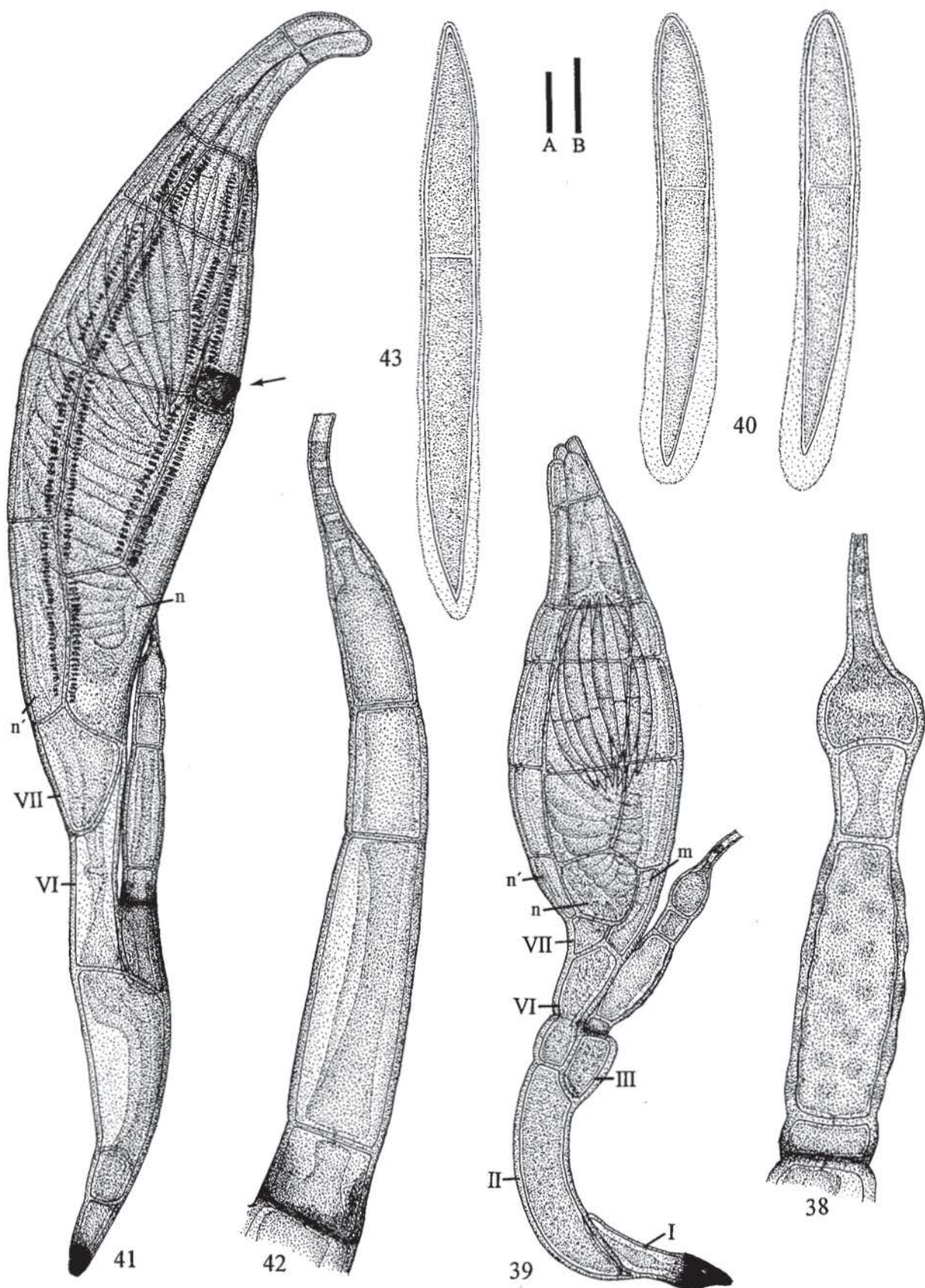
Notes.—Material representing *Monandromyces neoalardi*, the only species of Laboulbeniales known on *Neoalardus*, consists of five mature and two immature individuals, both of the latter bearing trichogynes (Fig. 30, 31). Like *Monandromyces falcatus* (Fig. 20), the terminal cell of the stalk of the appendage of *M. neoalardi* is considerably longer than the basal cell; however, it is significantly shorter than the median cell (Fig. 33). The singular modification of the tip of the longest cell (ex. m) of the terminal tier of perithecial outer wall cells (Fig. 34) is one of the most notable characteristics of the species. The perithecial punctae and transverse striations (Fig. 32, 34) are relatively inconspicuous and are best viewed with interference contrast optics.

9. *Monandromyces pseudoveliae* R. K. Benj., n. sp. Fig. 36–40

Ascoma: Leniter sigmoideum, uniformiter pallide luteobrunneum. **Thallus totus** 320–370 μ m longus ad apicem peritheci. **Receptaculum:** Elongatum, plerumque plus minusve curvatum, 108–140 μ m longum ad basim appendicis; cellula basilaris (I) deorsum decrescens ad pedem denigratum, 48–50 \times 10–12 μ m; cellula suprabasilaris (II) relative elongata, prope uniformiter in diametro, 79–95 \times 15–20 μ m, angulus septi inter cellulas I et II sursum ad dorsum; cellula terminalis (III) circa 2plo longiora quam lata, 25–30 \times 13–17 μ m, interne basi cellula VI adnata, margo externa fortiter convexa, cellula basilaris appendicis abrupte distinguibili. **Appendix:** Libera, 83–92 μ m longa; cellula basilaris latitudine magniore quam altitudine, 6 \times 10–13 μ m; cellula media 33–38 \times 12–14 μ m, margins plus minusve convex, crassities parietis variabilis, paries aliquantum moniliformis in latere aspectu; cellula terminalis prope isodiametra, 10–13 \times 9–11 μ m; antheridium 32–43 μ m longum, venter plus minusve externe convexus, 12–14 μ m latus in medio, tubus 17–29 \times 3–4 μ m. **Perithecium:** Cellula VI constrictione submedia, 44–50 \times 16–20 μ m; cellula VII 12–18 μ m in altitudine; cellulae basillares peritheci (m , n , n') prope $\frac{1}{2}$ corporis peritheci in tota longitudine supra cellulas VI et VII; corpus uniformiter inflatum ad partem submedianam, decrescens ad leniter obstipum apicem, 170–190 μ m longum cum cellulis basillaribus peritheci, 60–76 μ m in maxime latitudine; cellulae basillares peritheci, praesertim n et n' , et cellulae omnes stratorum basilarium et suprabasilarium striis angustis transversis dispersis vel seriebus verticalibus striarum; cellulae strati terminales leniter inaequales, cellula ex n' brevissima, 15–18 μ m longa, cellula ex m longissima, circa 23 μ m longa, cellulae ceterae, ex n contiguo m et n' , 18–20 μ m longa. Ascospores 60–65 \times 71 μ m. Typus RKB 3541B (RSA).

Ascoma: Slightly sigmoid; uniformly pale yellow tinged with brown. Length from tip of foot to tip of perithecium 320–370 μ m. **Receptacle:** Elongate, often \pm curved, 108–140 μ m long from tip of foot to base of appendage; basal cell (I) slightly tapered downward to blackened foot, 48–50 \times 10–12 μ m; suprabasal cell (II) relatively long, 79–95 \times 15–20 μ m, margins above juncture with cell I nearly parallel; cross wall

Fig. 38–43.—38–40. *Monandromyces pseudoveliae* (RKB 3541B [AFRICA; Madagascar]).—38. Appendage of holotype (see Fig. 37) showing median cell with its pattern of contrasting light and dark areas resulting from irregular thickening of its lateral wall.—39. Nearly mature individual (isotype) showing relationship of cells of receptacle, appendage, and perithecium.—40. Two ascospores.—41–43. *M.*



elongatus (RKB 3780 [INDONESIA; Sumatra]).—41. Mature individual (holotype) showing distinctive distributional pattern of perithecial striae and location of protuberance (arrow).—42. Appendage of same.—43. Ascospore. (Bars. A = 20 μ m, Fig. 39, 41; B = 10 μ m, Fig. 38, 40, 42, 43.)

separating cells I and II angled upward from front to rear; terminal cell (III) about two times longer than broad, $25\text{--}30 \times 13\text{--}17 \mu\text{m}$, adnate on the inside to base of perithecial stalk cell (VI), outer margin strongly convex, abruptly distinguished from base of appendage. *Appendage*: Free, $83\text{--}92 \mu\text{m}$ long; basal cell shorter than wide, $6 \times 10\text{--}13 \mu\text{m}$; median cell $33\text{--}38 \times 12\text{--}14 \mu\text{m}$, margins \pm convex, wall variable in thickness, appearing moniliform in optical section, the thicker areas \pm evenly separated from one another and, in surface view, appearing slightly darker than intervening thinner areas; terminal cell nearly isodiametric, $10\text{--}13 \times 9\text{--}11 \mu\text{m}$; antheridium $32\text{--}43 \mu\text{m}$ long, venter \pm externally convex, median width $12\text{--}14 \mu\text{m}$; efferent tube $17\text{--}29 \times 3\text{--}4 \mu\text{m}$. *Perithecium*: Primary stalk cell (VI) with submedian constriction, $44\text{--}50 \times 16\text{--}20 \mu\text{m}$; secondary stalk cell (VII) $12\text{--}18 \mu\text{m}$ high, perithecial basal cells (*m*, *n*, *n'*) comprising ca. 20% of total body length above stalk cells; body uniformly inflated upward from base, broadest slightly below the middle, then tapered towards the blunt apex, which is bent slightly forward, $170\text{--}190 \mu\text{m}$ long above stalk cells, greatest width $60\text{--}76 \mu\text{m}$; perithecial basal cells, especially *n* and *n'*, and basal and suprabasal outer wall cells with narrow transverse striae of varying length, scattered or vertically aligned and closely spaced; cells comprising terminal tier of outer wall cells of slightly unequal lengths: the shortest, ex *n'*, $15\text{--}18 \mu\text{m}$; the longest, ex *m*, ca. $23 \mu\text{m}$; the other two, ex *n* adj. *m* and *n'*, $18\text{--}20 \mu\text{m}$. Ascospores $60\text{--}65 \times 7 \mu\text{m}$.

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

Holotype.—AFRICA: MADAGASCAR; Diego Suarez Prov.; Montagne d'Ambre Forest Reserve; stream at Petite Cascade; 991 m; 15 Nov 1986; J. T. & D. A. Polhemus (CL 2280); on the upper surface of the trochanter of the left rear leg of a ♂ of *Pseudovelia* sp.; *RKB 3541B* (designated slide; RSA).

Isotypes.—Data as for the holotype; *RKB 3541B* (designated slides; RSA).

Notes.—The collection of *Monandromyces pseudoveliae* included three mature and two nearly mature individuals. The marked curvature of the receptacle of the three fully mature thalli (cf. Fig. 36) probably was influenced by the position of growth of the fungus on the host integument. Unlike the other currently known species of the genus except for *M. elongatus*, also on *Pseudovelia*, the cross wall separating cells I and II of the receptacle of *M. pseudoveliae* angles upward from front to rear (Fig. 39) rather than upward from rear to front (cf. Fig. 1, 6, 11, 19, 32, 44). The pattern of \pm evenly spaced thick and thin areas characterizing the wall of the median cell of the appendage of *M. pseudoveliae* (Fig. 38) is a feature also of *M. microveliae*

(Fig. 2), *M. umbonatus* (Fig. 12), and *M. longispinae* (Fig. 48).

10. *Monandromyces elongatus* R. K. Benj., sp. nov. Fig. 41–43

Ascoma: Elongatum, erectum, leniter sigmoideum, pallide luteo-brunneum praeter corpus perithecii atroluteobrunneum et cellula III receptaculi et cellulae basales et terminales atroluteobrunnae. *Thallus* totus $420\text{--}465 \mu\text{m}$ longus ad apicem perithecii. *Receptaculum*: Elongatum, versus basim attenuatum sub cellulis III et VI, $115\text{--}125 \mu\text{m}$ longum ad basin appendicis; cellula basilaris (I) $40\text{--}46 \mu\text{m}$ longa, $11\text{--}15 \mu\text{m}$ lata in parte distalibus; cellula suprabasilaris (II) $70\text{--}80 \mu\text{m}$ longa, $28\text{--}35 \mu\text{m}$ lata in parte distalibus, angulus septi inter cellulas I et II sursum ad dorsum; cellula terminalis (III) circa 2plo longiora quam lata, $28\text{--}38 \times 13\text{--}19 \mu\text{m}$, interne basi cellula VI adnata, margine externo recto vel leniter concavo. *Appendix*: Libera, $100\text{--}120 \mu\text{m}$ longa; cellula basilaris prope isodiametra, $10\text{--}12 \times 11\text{--}13 \mu\text{m}$; cellula media $33\text{--}43 \times 12\text{--}15 \mu\text{m}$, marginibus leniter convexis; cellula terminalis (III) prope 2plo longiora quam lata, $15\text{--}19 \times 9\text{--}11 \mu\text{m}$; antheridium $40\text{--}45 \mu\text{m}$ longum, venter $9\text{--}10 \mu\text{m}$ latus, tubus $20\text{--}22 \times 3 \mu\text{m}$. *Perithecium*: Cellula VI marginibus prope parallelae, $69\text{--}75 \times 19\text{--}25 \mu\text{m}$; cellula VII $31\text{--}40 \mu\text{m}$ in altitudine; cellulae basales perithecii (*m*, *n*, *n'*) prope $\frac{1}{4}$ corporis perithecii in tota longitudine supra cellulas VI et VII; corpus uniformiter inflatum ad parte medianum, decrescens ad apicem; $225\text{--}290 \mu\text{m}$ longum cum cellulis basilaribus perithecii, $60\text{--}70 \mu\text{m}$ in maxime latitudine, cellula ex *n* contiguo *m* strati suprabasilaris processum brevissimum tholiforme circa $6 \mu\text{m}$ altum basi $15 \mu\text{m}$ latum gignens; cellulae basales perithecii et cellulae et omnes stratorum basilarium, suprabasilarium, et mediorum seriebus angustus verticalibus striarum confertarum brevissimarum prope margines cellularum; apex rotundatus leniter retrocurvatus; cellulae strati terminalis longitudinibus subaequalibus. Ascospores $70\text{--}82 \times 7 \mu\text{m}$. Typus *RKB 3780* (RSA).

Ascoma: Elongate, erect, slightly sigmoid; pale yellow-brown; perithecial body, cell III of receptacle, and basal and terminal cells of appendage darker. Length from tip of foot to tip of perithecium $420\text{--}465 \mu\text{m}$. *Receptacle*: Elongate, tapered downward below cell III and cell VI, $115\text{--}125 \mu\text{m}$ long from tip of foot to base of appendage; basal cell (I) $40\text{--}46 \times 11\text{--}15 \mu\text{m}$ distally; suprabasal cell (II) broadest above, $70\text{--}80 \mu\text{m}$ long, $28\text{--}35 \mu\text{m}$ wide distally; cross wall separating cells I and II angled upward from front to rear; terminal cell (III) more than two times longer than broad, $28\text{--}38 \times 13\text{--}19 \mu\text{m}$ adnate on the inside to base of perithecial stalk cell (VI), outer margin straight to very slightly concave above. *Appendage*: Free, $100\text{--}120 \mu\text{m}$ long; basal cell nearly isodiametric, $10\text{--}12 \times 11\text{--}13 \mu\text{m}$; median cell $33\text{--}43 \times 12\text{--}15 \mu\text{m}$, margins slightly convex; terminal cell nearly two times longer than broad, $15\text{--}19 \times 9\text{--}11 \mu\text{m}$; antheridium $40\text{--}45 \mu\text{m}$ long, body $9\text{--}10 \mu\text{m}$ wide, efferent tube $20\text{--}22 \times 3 \mu\text{m}$. *Perithecium*: Primary stalk cell (VI) with \pm parallel margins, $69\text{--}75 \times 19\text{--}25 \mu\text{m}$; secondary stalk cell (VII) $31\text{--}40 \mu\text{m}$ high, perithecial basal cells (*m*, *n*, *n'*) comprising ca. 25% of total body length above stalk cells; body uniformly inflated upward from base, broadest near middle, then tapered towards the rounded apex, which is slightly curved backward, $255\text{--}290$

μm long above stalk cells, median width 60–70 μm , suprabasal outer wall cell (ex *n* adj. *m*) bearing at its base a short, dome-shaped protuberance ca. 6 μm high and 15 μm wide at base; perithecial basal cells and cells of basal, suprabasal, and median tiers of outer wall cells with short, narrow, closely spaced, transverse striae vertically arranged adjacent to lateral margins of cells; cells comprising terminal tier of outer wall cells subequal in length. Ascospores 70–82 \times 6–7 μm .

Etymology.—From *elongatus* (L.), in reference to the elongate habit of the thallus.

Holotype.—INDONESIA: SUMATRA; Bengkulu Prov.; Ketalang River; 39 km SE of Muaraaman, 720 m; 8 Sept 1991; D. A. & J. T. Polhemus (CL 2585); on the right lateral surface of the thorax of a δ of *Pseudovelia hypodonta* (Lundblad); RKB 3780 (designated slide; RSA).

Isotype.—Data as for the holotype; RKB 3780 (designated slide; RSA).

Notes.—Like several species described in this work, specimens of *M. elongatus* available for study were limited, only four mature individuals being found; however, the species should be readily distinguished from all others in the genus. It differs in several ways from the other two taxa on *Pseudovelia* in its greater size; its small, median, domelike perithecial outgrowth (Fig. 41); and the precise arrangement of its perithecial sculpturing (Fig. 41). However, like *M. pseudoveliae* the septum between cells I and II of the receptacle of *M. elongatus* angles upward from front to rear (Fig. 41). Also, in *M. elongatus* the wall of the elongate median cell of the stalk of the appendage is \pm uniform in thickness (Fig. 42), lacking the alternating thick and thin areas characterizing the appendages of *M. pseudoveliae* (Fig. 39) and *M. longispinae* (Fig. 48).

11. *Monandromyces longispinae* R. K. Benj., sp. nov. Fig. 44–49

Ascoma: Erectum, leniter sigmoideum, receptaculo saepe plus minusve fortiter curvato; pallide aurantiacobrunneum, perithecio interdum atroaurantiacobrunneo et spina perthecii interdum atroaurantiacobrunnea. Thallus totus 245–345 μm longus ad apicem perithecia. **Receptaculum:** Elongatum, 75–97 μm longum ad apicem appendicis; cellula basilaris (I) 38–59 \times 10–13 μm , fortiter extra convexa in parte distalibus; cellula suprabasilaris (II) 48–70 μm longa, 16–25 μm lata in parte distalibus; angulus septi inter cellulas I et II sursum ad frontem; cellula terminalis (III) aliquanto longiora quam lata, 16–23 \times 11–16 μm , interne basi cellula VI adnata. **Appendix:** Libera, 81–94 μm longa; cellula basilaris latitudine maiore quam altitudine, 5–7 \times 10–15 μm ; cellula media 30–40 \times 10–15 μm , marginibus prope parallelis, crassities parietis variabilis, paries aliquantum moniliformis in latere aspectu; cellula terminalis leniter longiora quam lata, 10–14 \times 9–11 μm ; antheridium 30–38 μm longum, venter 9–11 μm latus, tubus 15–22 \times 2.5–3 μm . **Perithecium:** Cellula VII constrictione media forti, 20–38 μm longa, basi et apice 15–25 μm lata; cellula VII 12–20 μm in altitudine; cellulae basiliares

perithecia (*m*, *n*, *n'*) prope $\frac{1}{2}$ corporis perithecia in tota longitudine supra cellulas VI et VII; corpus uniformiter inflatum ad parte infra spinam perithecia, decrescens ad leniter obstipum apicem, 139–204 μm longum cum cellulis basilaribus perithecia, 53–78 μm in maxime latitudine; cellula ex *n* contiguo *n'* strati suprabasilaris processum spiniforme medium, elongatum, attenuatum, plus minusve sigmoideum, 63–125 μm longum, basi 12–18 μm latum, gignens; cellulae basiliares perithecia et cellulae omnes basiliares suprabasiliares punctis dispersum vel striis breves vel elongatis transversis; apex rotundatus; cellulae strati terminale subaequales. Ascospores 63–81 \times 6–7 μm . Typus RKB 3541C (RSA).

Ascoma: Erect, slightly sigmoid, receptacle often \pm strongly curved; pale orange-brown, the perithecium and its spinelike outgrowth often darker. Length from tip of foot to tip of perithecium 245–345 μm . **Receptacle:** Elongate, 75–97 μm long from tip of foot to base of appendage; basal cell (I) 38–59 \times 10–13 μm , externally strongly convex distally; suprabasal cell (II) slightly broader above than below, 48–78 μm long, 16–25 μm wide distally; cross wall separating cells I and II angled upward from rear to front; terminal cell (III) slightly longer than broad, 16–23 \times 11–16 μm , adnate on the inside to base of perithecial stalk cell (VI). **Appendage:** Free, 81–94 μm long; basal cell half as long as wide, 5–7 \times 10–15 μm ; median cell 30–40 \times 10–15 μm , margins nearly parallel, wall variable in thickness, appearing moniliform in optical section, thickened areas \pm evenly spaced, in surface view appearing slightly darker than intervening thinner areas; terminal cell slightly longer than wide, 10–14 \times 9–11 μm ; antheridium 30–38 μm long, venter 9–11 μm wide; efferent tube 15–22 \times 2.5–3 μm . **Perithecium:** Primary stalk cell (VI) with a strong median constriction, \pm equally wide above and below, 20–38 μm long, 15–25 μm wide distally; secondary stalk cell (VII) 12–20 μm high, 16–25 μm wide in face view, perithecial basal cells (*m*, *n*, *n'*) comprising ca. 20% of total body length above stalk cells; body uniformly inflated upward from base, broadest near middle below perithecial outgrowth, then tapered upward towards rounded apex, which is curved slightly forward, 139–204 μm long above stalk cells, median width 53–78 μm , suprabasal outer wall cell (ex *n* adj. *n'*) bearing a median, elongate, slightly sigmoid, attenuate, spinelike projection 63–125 \times 12–18 (at base) μm ; perithecial basal cells and cells of basal and suprabasal tiers of outer wall cells with punctae or short to elongate, narrow, transverse striae arranged across \pm the entire breadth of the cells; cells comprising terminal tier of outer wall cells subequal in length. Ascospores 63–81 \times 6–7 μm .

Etymology.—From the combination of *longi-* (in L. comp.), long, + *spina* (L.), spine, in reference to the long spine formed by the suprabasal wall cell of the thallus.

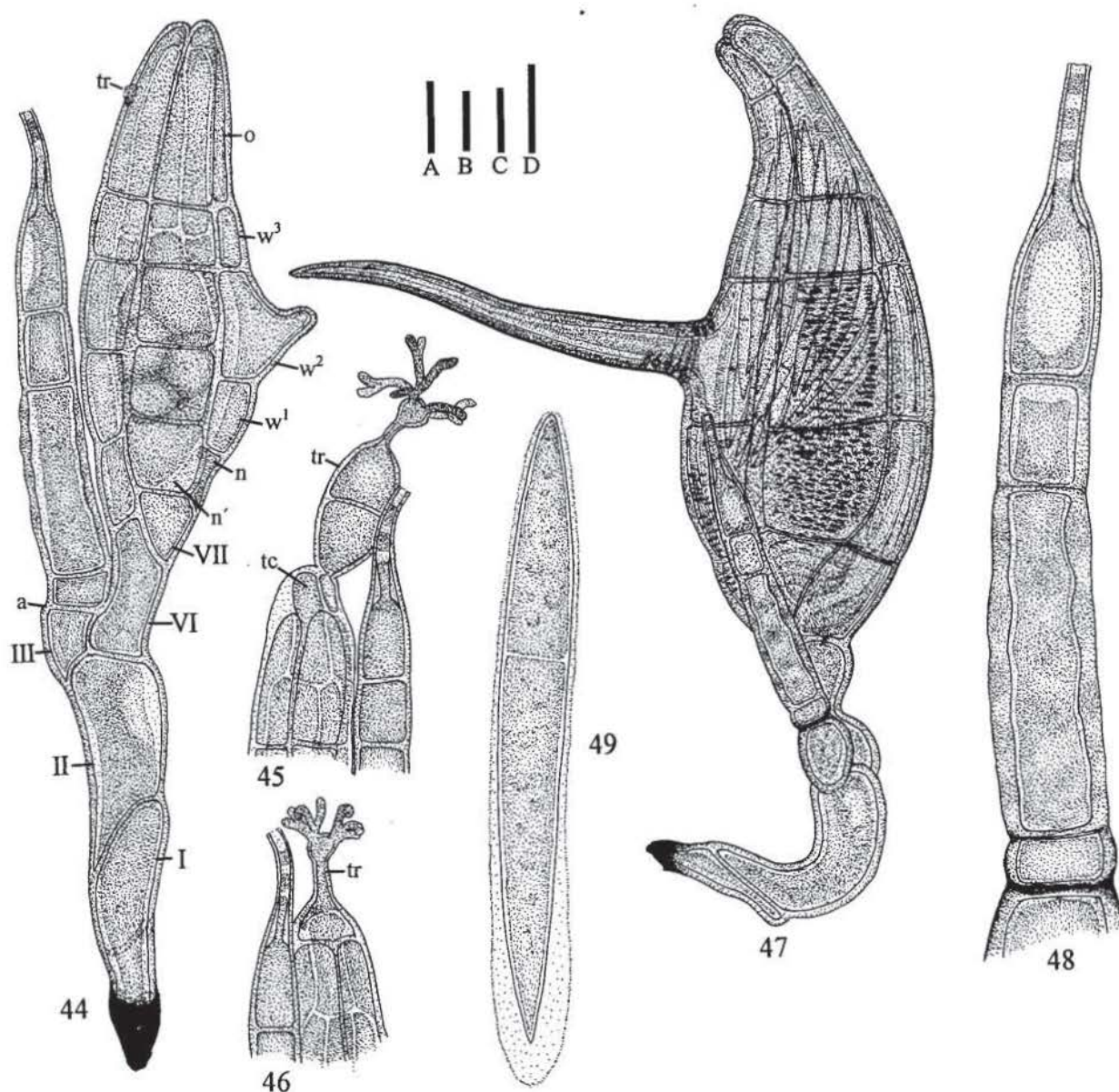


Fig. 44–49. *Monandromyces longispinae* (45, 47–49, RKB 3541C [AFRICA; Madagascar]; 44, RKB 3542B [AFRICA; Madagascar]; 46, RKB 3645 [AFRICA; Tanzania]).—44. Juvenile individual at four-outer-wall-cell stage of development showing early stage of development of perithecial outgrowth from a cell (n adj. n') of suprabasal tier of outer wall cells.—45. Tip of perithecium of juvenile individual from Madagascar with trichogyne having an ovoid, transversely septate basal part (see also: *M. australis*, Fig. 3; *M. polhemorum*, Fig. 17; and *M. protuberans*, Fig. 26).—46. Tip of perithecium of juvenile individual from Tanzania with trichogyne without an ovoid, transversely septate basal part (see also *M. neoalardi*, Fig. 30, 31).—47. Mature individual (holotype) showing elongate, attenuate perithecial outgrowth and pattern of perithecial striations.—48. Appendage of same showing median cell with its pattern of contrasting light and dark areas resulting from irregular thickening of its lateral wall.—49. Ascospore. (Bars. A = 20 μ m, Fig. 47; B = 10 μ m, Fig. 44; C = 10 μ m, Fig. 45, 46; D = 10 μ m, Fig. 48, 49.)

Holotype.—AFRICA: MADAGASCAR; Diego Suarez Prov.; Montagne d'Ambre Forest Reserve; stream at Petite Cascade; 991 m; 15 Nov 1986; J. T. & D. A. Polhemus (CL 2280); on the upper left surface of the abdomen of a δ of *Pseudovelicia* sp.; RKB 3541C (designated slide; RSA).

Isotypes.—Data as for the holotype (4 δ s); RKB 3541C designated slides; RSA).

Paratypes.—Data as for the holotype (5 δ s); RKB 3542B (designated slides; RSA).—AFRICA: MALAWI; Zomba Plat.; Mandala Falls; 1 Mar 1979; J. T. Polhemus (CL 986); on the upper anterior surface of the abdomen near the pronotum of a δ of *Pseudovelicia* n. sp. [fide J. T. Polhemus]; RKB 3644 (designated slide; RSA).—TANZANIA; Amani; Dodwe Stream; 2 March 1979; J. T. Polhemus (CL 992); on the left anterior surface of the abdomen near the pronotum of a δ of *Pseudovelicia* sp.; RKB 3645 (designated slide).

Notes.—Specimens of *Monandromyces longispinae* from Madagascar included 25 mature and seven im-

mature individuals. Those from Africa were fewer in number, including but one mature and three immature individuals from Malawi and two mature and three immature individuals from Tanzania.

The elongate, acuminate perithecial projection (Fig. 47) is the primary characteristic distinguishing *M. longispinae* from all species in the genus.

The three mature individuals of *M. longispinae* from Malawi and Tanzania—neighboring countries in mainland SE Africa located slightly NW of Madagascar across the Mozambique Channel—are identical morphologically to one another but deviate in several ways from those collected in Madagascar. They have relatively short perithecial projections compared to those from Madagascar, 63–73 μm vs. 80–125 μm long. The stalk of the appendage is gradually tapered rather than being \pm cylindrical, and its median cell has a thicker wall. Also, the perithecial basal cells and outer wall cells are much less conspicuously striate. Finally, the trichogyne of a juvenile from Tanzania (Fig. 46, but see *M. neoalardi* [Fig. 30, 31]) lacks the basal, septate enlargement of a juvenile from Madagascar (Fig. 45). Because such differences may reflect only minor changes that have occurred following isolation of the precursor of the populations now found in Madagascar and mainland Africa, I have chosen not to separate the latter from the former taxonomically.

GENERAL OBSERVATIONS

Ascospores

Ascospores of *Monandromyces* spp. were hyaline, \pm aciculate, and consisted of two somewhat unequal cells (Fig. 8, 14, 18, 21, 25, 29, 35, 40, 43, 49). The shorter cell, depending on the species, comprised from about two fifths to one third of the length of the body of the spore and was oriented downward in the perithecium prior to spore discharge (e.g., Fig. 9, 11, 32, 39, 41). The sheath enveloping each spore, as it appeared in nonliving, mounted specimens, was in \pm close contact with the shorter cell of the body until gradually expanding towards the apex of the longer cell where it extended slightly beyond the tip. (e.g., Fig. 7, 13, 34). Following spore discharge, the distal part of the longer cell differentiated the foot, which served to affix the developing thallus to the host integument (Fig. 22).

Ascoma

Immature individuals with a range of growth stages sufficient for studying thalloid development of one or more species of *Monandromyces* were unavailable. The juvenile of *M. tenuistipitis* shown in Fig. 22 was the youngest of any found in the taxa studied. The suprabasal cell (II) had given rise to the perithecial

initial (*d*) and the terminal cell (III) subtended the four-celled appendage in which the cell terminating the three-celled stalk had not yet been transformed into an antheridium (*an*). However, juveniles of several species at the one- to two-outer-wall-cell stage of perithecial development and with well-developed trichogynes were recovered (Fig. 3, 17, 26, 30, 45, 46). Also, a few young thalli at still later stages of growth aided in interpreting the relationship to one another of perithecial basal and outer wall cells as well as other features of perithecial development (Fig. 44).

Receptacle.—The three cells (I, II, III) comprising the receptacle in *Monandromyces* were superposed in line (e.g., Fig. 1, 19, 32, 41). However, early in development the terminal cell (III) became offset laterally and was united below with cell II by a \pm diagonal cross wall and on the inside to the base of the perithecial primary stalk cell (VI), which was subtended by cell II (Fig. 3, 22, 30, 44). From the beginning, apparently, the cross wall separating cells I and II was strongly diagonal and was oriented upward from rear to front in all but two of the species, i.e., *M. pseudoveliae* and *M. elongatus*, where the reverse was true (Fig. 39, 41).

Appendage.—In all species of *Monandromyces*, the median cell of the three-celled stalk was relatively very long compared to the length of the other two cells, especially the basal, which was isodiametric or even somewhat wider than long (Fig. 2, 5, 10, 12, 16, 20, 24, 28, 33, 38, 42, 48). Exceptions involved the terminal cell, which often was slightly longer than wide, and in the case of four species, i.e., *M. umbonatus* (Fig. 12), *M. falcatus* (Fig. 20), *M. neoalardi* (Fig. 33) and *M. elongatus* (Fig. 42), was two or more times longer than broad, but never as long as the median cell. The vertical wall of the median cell of the stalk in several species, i.e., *M. microveliae* (Fig. 2), *M. umbonatus*, (Fig. 12), *M. pseudoveliae* (Fig. 38), and *M. longispinae* (Fig. 48), appeared \pm moniliform in optical view, a result of the formation of \pm evenly spaced lenticular thickenings.

There was no evidence of a spine, i.e., the indurated remnant of the tip of the original ascospore, on either the terminal antheridium or another cell of the appendage.

Perithecium.—Although only a few immature individuals were available among the several species of *Monandromyces*, those that were found provided information on several stages of early perithecial development. The perithecial primordium (*d*) arose distally from cell II of the receptacle (Fig. 22). Products of division of this cell led to formation of the two perithecial stalk cells (VI and VII) and the three perithecial basal cells (*m*, *n*, and *n'*). The latter gave rise to the four vertical rows of outer (*w*) and inner (*p*) wall cells,

and the female organ—three superposed organelles consisting of a basal carpogenic cell (*cp*), a median trichophoric cell (*tc*), and a terminal trichogyne (*tr*) (Fig. 3). Figures 3, 26, and 30 depict immature individuals at nearly the same stage of development showing the first permanent tier of outer wall cells (*w*¹), a tier of outer-wall-cell primordia (*o*), the first tier of inner wall cells (*p*), and the female organ, the lower part of which was surrounded by the upwardly growing wall cells.

Trichogynes were present on juveniles of five of the 11 species of *Monandromyces* studied. In all instances these were terminated by a small cluster of short, \pm digitate, coenocytic branchlets, which sometimes emanated directly from a small, \pm ovoid or globoid enlargement (Fig. 31, 45). In three species, *M. australis* (Fig. 3), *M. polhemorum* (Fig. 17), and *M. protrudens* (Fig. 26), the complex of branchlets was subtended by a relatively large, medianly septate, ovoid body that was abruptly constricted basally and distally. In one species, *M. neoalardi*, only a short, slender nonseptate stalk separated the group of trichogynic branchlets from the tip of the perithecium (Fig. 30, 31). However, both types of trichogynes were found in *M. longispinae* (Fig. 45 [from Madagascar], 46 [from Malawi and Tanzania]). In a juvenile of *M. longispinae* where the perithecium had reached the four-outer-wall stage and the centrum had begun to develop, the trichogyne had degenerated and only a small remnant persisted about midway from tip to base on the surface of primordial outer wall cell *o* derived from basal cell *m* (Fig. 44). Such remnants, always small and inconspicuous and often difficult to detect, were seen on mature perithecia of several species. These were located distally on the surface of the tier-four outer wall cell of the vertical row derived from basal cell *m* near the juncture of this cell with the adjacent tier-four outer wall cell of the row derived from basal cell *n* (Fig. 13).

On average, depending on the species, heights of the basal (*w*¹), suprabaasal (*w*²), and subterminal (*w*⁴) tiers of outer wall cells were \pm equal, always, however, exceeding the height of the median tier (*w*³), which typically was nearly the same height as the terminal tier (*w*⁵) (Fig. 1, 4, 6, 9, 11, 15, 19, 23, 27, 32, 36, 39, 41, 47). However, in some taxa, modification of tier-five cells terminating the four vertical rows of outer wall cells resulted in consistent variation in shape or length of some cells (e.g., Fig. 7, 13, 15, 19, 23, 34, 36). Also, perithecial asymmetry or curvature affected the length of some cells relative to other cells in a given tier (e.g., Fig. 4, 15, 19). The distinctive punctae or short or \pm elongate transverse striae seen in surface view of the basal cells and outer wall cells of several species of *Monandromyces*, (Fig. 4, 6, 9, 11, 15, 19, 23, 27, 32, 34, 36, 41, 47) were found to result from the formation of narrow, rounded or trans-

verse ingrowths arising on the inner surface of the cells (Fig. 37).

DISCUSSION

Information on the three slides of *Autophagomyces microveliae* (FH 4016–4018) is written in ink or pencil on a pair of labels affixed left and right on each slide and is inscribed in Thaxter's own hand. At the top of each left-hand label Thaxter wrote, in ink, "No. 3302," i.e., his accession number. Near the top of each right-hand label he wrote, in ink, "*Monandromyces*." Immediately above and to the right he added "*n. g.*" At the midpoint of each he wrote "*on post. leg riparian bug.*" At the bottom of each he wrote, in two lines, "*Fort de Kock Sumatra/Jacobson. Jan. 1925.*" Thus, in addition to giving data regarding where on the host the fungus grew and where, when, and by whom the host had been collected, Thaxter indicated that his first impulse was to place the fungus in a new genus. However, he subsequently drew a line through "*Monandromyces*" and immediately below wrote on one slide, in pencil, "*Bordea hemipteralis*"; on the other two slides he wrote, also in pencil, only "*Bordea*." Thus, he later considered assigning the fungus to the genus proposed earlier by Maire (1916). Finally, he overwrote the penciled notations, in ink, with "*Autophagomyces hemipteralis*." However, when he described the species in the last part of his monograph (Thaxter 1931: 96), he did not retain the epithet *hemipteralis*, using instead *microveliae* after the host genus, which by then had been identified. Because of Thaxter's practice not to prepare new slide labels after formally describing the Laboulbeniales he studied, his original, hand-written labels often reflect his changing views regarding their taxonomic disposition (see Benjamin 1995: 53).

Because it is available and suitable, I chose *Monandromyces*—tentatively coined by Thaxter when he first studied his *A. microveliae*—as the name for the genus described in this study.

My reasons for earlier removing several taxa from *Autophagomyces*, i.e., *A. sarawakensis*, *A. peyerimhoffii*, and *A. sericoderi* (to *Corylophomyces*), and *A. poissonii* (to *Triceromyces*) have been presented elsewhere (Benjamin 1986, 1995) and will not be paraphrased here.

Discovery of ten additional species—from localities ranging from eastern Africa to southwestern Australia—all having the same basic characteristics and parasitizing hosts belonging to the same family of true bugs as those of Thaxter's *Autophagomyces microveliae* firmed up my long-held opinion that the latter should be distinguished generically, an idea that, as mentioned above, crossed Thaxter's mind when he first studied the species.

Two thaloid characteristics common to all species of *Monandromyces* distinguish the genus from other possibly closely related genera of Stigmatomycetinae (sensu Tavares 1985) that have simple appendages lacking sterile branchlets: 1) the strongly diagonally superposed basal and suprabasal cells of the receptacle and 2) the considerably greater length of the median cell of the three-celled stalk of the appendage relative to the length of the basal and terminal cell. Also, it may be significant in that all species of *Monandromyces* known at present parasitize only riparian bugs of the family Veliidae (Heteroptera).

In a paper now in preparation, I will present a detailed study, based on known taxa and several to be described, that will restrict the generic limits of *Autophagomyces* to those taxa currently known on Anthicidae, Phalacridae, and perhaps Cryptophagidae (Coleoptera: Cucujiformia) and reinstate the genus *Bordea* to include taxa parasitizing Pselaphidae (Coleoptera: Staphyliniformia). Structural characteristics of the receptacle, appendage, and especially the trichogyne serve readily to separate these genera from one another and from *Monandromyces*.

ACKNOWLEDGMENTS

I am deeply indebted to Dr. John T. Polhemus, Englewood, Colorado, and his son Dr. Dan A. Polhemus, Department of Entomology, Smithsonian Institution, Washington, DC, for providing, from their extensive collections of semiaquatic Heteroptera, the hosts from which all of the new taxa described in this study were taken as well as host identifications. Also, I thank Dr. Donald H. Pfister, Farlow Herbarium, Harvard University, for arranging the loan of Thaxter's specimens, which included the type of *Autophagomyces microveliae*, and Drs. John Polhemus, Isabelle Tavares, and Alex Weir for critically reviewing the manuscript.

LITERATURE CITED

- ARNETT, R. H. 1985. American insects. A handbook of the insects of America north of Mexico. Van Nostrand Reinhold Company, New York, New York. 850 p.
- BENJAMIN, R. K. 1970. Laboulbeniales on semiaquatic Hemiptera. II. *Autophagomyces*, *Dioicomyces*, and *Prolixandromyces* gen. nov. *Aliso* 7: 165-182.
- . 1971. Introduction and supplement to Roland Thaxter's contribution towards a monograph of the Laboulbeniaceae. *Bibliotheca Mycol.*, Vol 30. J. Cramer, Lehre, Germany. 155 p.
- . 1986. Laboulbeniales on semiaquatic Hemiptera. V. *Triceromyces*: with a description of monoecious-dioecious dimorphism in the genus. *Aliso* 11: 245-278.
- . 1993. Laboulbeniales on semiaquatic Heteroptera. VI. The genus *Tavaresiella*. *Aliso* 13: 559-576.
- . 1995. *Corylophomyces*, a new dioecious genus of Laboulbeniales on Corylophidae (Coleoptera). *Aliso* 14: 41-57.
- . 1998. Laboulbeniales on semiaquatic Heteroptera. VII. Addenda to species of *Triceromyces* on Hydrometridae and further observations on dioecism in the order. *Aliso* 17: 1-21.
- HENRY, T. J., AND R. C. FROESCHNER (editors) 1988. Catalog of the Heteroptera, or true bugs, of Canada and the continental United States. E. J. Brill, Leiden-New York-Copenhagen-Cologne. 958 p.
- MAIRE, R. 1916. Deuxième contribution à l'étude des Laboulbeniales de l'Afrique du Nord. *Bull. Soc. Hist. Nat. Afrique N.* 7: 6-39, Pls. 1, 2.
- MAJEWSKI, T. 1973. Rare and new Laboulbeniales from Poland. IV. *Acta Mycol.* 9: 229-238.
- ROSSI, W. 1982. Laboulbeniali della Sierra Leone (Ascomycetes). *Accad. Naz. Lincei*, Quaderno No. 255, pp. 9-22, Tav. I-IV.
- . 1990. New or interesting Laboulbeniales (Ascomycetes) from Sierra Leone. *Accad. Naz. Lincei*, Quaderno No. 265, pp. 5-13, Pls. I, II.
- SANTAMARIA, S. 1993. New and interesting Laboulbeniales (Fungi, Ascomycotina) from Spain, II. *Nova Hedwigia* 56: 409-422.
- TAVARES, I. I. 1985. Laboulbeniales (Fungi, Ascomycetes). *Mycol. Mem.*, No. 9. The Mycological Society of America. J. Cramer, Braunschweig, Germany. 627 p.
- THAXTER, R. 1912. New or critical Laboulbeniales from the Argentine. *Proc. Amer. Acad. Arts* 48: 153-223.
- . 1931. Contribution towards a monograph of the Laboulbeniaceae. Part V. *Mem. Amer. Acad. Arts* 16: 1-435, Pls. 1-60, 1 fig.