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LABOULBENIALES ON SEMIAQUATIC HEMIPTERA. II.
AUTOPHAGOMYCES, *DIOICOMYCES*, AND
PROLIXANDROMYCES GEN. NOV.

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INTRODUCTION

In a previous contribution (Benjamin, 1967), I reviewed briefly those Laboulbeniales found on insects of the order Hemiptera and described in detail the species of *Laboulbenia* then known to me that parasitize semiaquatic bugs of the families Macroveliidae and Veliidae. In this paper I shall describe representatives of three other genera of Laboulbeniales that occur on species of Veliidae or Mesoveliidae.

Subsequent to publication of the above mentioned paper, I learned of two earlier studies by the French entomologist Raymond Poisson that also dealt with Laboulbeniales parasitizing semiaquatic bugs. In 1954, Prof. Poisson published a short account of his observations on a species of *Laboulbenia* found on *Velia osborniana* collected in southern Peru. He named the fungus *L. titschackii* but did not provide a validating Latin diagnosis. Poisson's illustrations show clearly that *L. titschackii* is related to other species on Veliidae, but it can not be identified with any of the species illustrated by me. In his discussions of aquatic Hemiptera published in 1957, Poisson reported a species of *Autophagomyces* on *Microvelia pygmaea* (Dufour) and *Autophagomyces mesoveliae* on *Mesovelia furcata* (Mulsant & Rey) and *M. vittigera* Horváth from France. He did not, however, formally describe or illustrate these fungi, and their characteristics are unknown.

In my earlier work (Benjamin, 1967), I followed the classification of insects of Brues, Melander, & Carpenter (1954). In this system, four families of primarily semiaquatic bugs, Hebridae, Hydrometridae, Mesoveliidae, and Saldidae, are placed in the superfamily Aradoidea and the Macroveliidae in the Lygaeoidea¹. The late Dr. Robert L. Usinger, a leading authority on aquatic Hemiptera, informed me (personal communication) that these families all undoubtedly belong to the Gerroidea and thus are more or less related phylogenetically.

¹Please note the following errors in my previous paper (Benjamin, 1967): In all instances the epithets *uhleri* and *usingeri* should replace the orthographically incorrect *uhlerii* and *usingerii*.—On p. 118, l. 9 from bottom: *leechii* not *lechii*.—On p. 134, l. 20: *drakei* not *drakeii*.—On p. 135, l. 7 of last paragraph: Lygaeoidea not Aradoidea.

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I wish to thank Dr. I. Mackenzie Lamb, Director, Farlow Herbarium, Harvard University, for loan of the type specimen of *Autophagomyces microveliae* Thaxter, and Dr. David Lauck, Division of Biological Sciences, Humboldt State College, Arcata, Calif., who collected the hosts from which were taken the other fungi described in this study. I also am indebted to Dr. Jean Balazuc, Eaubonne, France, for calling my attention to the two publications by Poisson noted above.

DESCRIPTIONS

AUTOPHAGOMYCES Thaxter.

Proc. Amer. Acad. Arts & Sci. 48:172. 1912.

When Thaxter established *Autophagomyces* in 1912 he described two species, *A. platensis*, the type, and *A. nigripes*, both found on *Tomoderus forticornis* Pic of the Anthicidae (Coleoptera). In 1931 he added four more species that also parasitize *Tomoderus*. With some reservation, Thaxter first decided that *Autophagomyces* species were dioecious, the male parasitizing the female near its base, and he so characterized the genus. However, by 1931 he had learned that they are, instead, hermaphroditic. The generic type and its related species on *Tomoderus* is a simple one, the mature receptacle consisting of three cells: a very small basal cell (I) that forms the foot and usually becomes darkly pigmented so that its relationship to the other two cells is partly obscured; a subbasal cell (II) that bears the stalked perithecium; and an upper cell (III) that subtends the antheridial appendage or appendages. The latter cell, in the forms known on Anthicidae, usually is relatively small and positioned near the base or along the lower lateral margin of the subbasal cell in close proximity to the basal cell. It was this unusual relationship of the basal and terminal cells of the receptacle to the subbasal cell that caused Thaxter to misinterpret the true relationship of the sexual structures when he originally described the genus. In the forms on *Tomoderus*, the antheridial appendage, of which one to several may be present, consists of 2-3 superposed cells terminated by a simple antheridium; occasionally a pair of antheridia may develop. The perithecium has a well-developed stalk-cell, clearly defined basal cells, and five tiers of wall-cells.

In his final treatment of *Autophagomyces*, Thaxter (1931) also added several species found on representatives of other families of insects: five on Pselaphidae (Coleoptera), of which three were new combinations of forms previously placed in other genera of Laboulbeniales; three on Phalacridae (Coleoptera); one on Orthoperidae (Coleoptera); and one on Veliidae (Hemiptera). *Autophagomyces peyerimhoffii* (Maire) Thaxter (= *Cryptandromyces peyerimhoffii* Maire, 1920), on a species of *Arthrolips* (Orthoperidae) from Algeria, probably is not properly classified in this genus, and the author has unpublished data showing that *A. sarawakensis* Thaxter, on an undetermined species of Phalacridae from Borneo, definitely does not belong in the genus. The receptacle of the species of *Autophagomyces* that occur on Pselaphidae and Phalacridae as well as the one on Veliidae

differs from that of species on Anthicidae in that the cell (III) subtending the antheridial appendage is closely associated with the upper rather than the lower end of the subbasal cell. Cell III usually is more or less united with the base of the stalk-cell of the perithecium as shown in Fig. 1A.

In connection with the present report, the one species of *Autophagomyces* that has been described from semiaquatic Hemiptera (Veliidae) is *A. microveliae* found on *Microvelia albolineata* Bueno from Fort de Kock, Sumatra. Thaxter characterized and illustrated this species in Part V of his monograph (Thaxter, 1931, p. 96, Pl. XVIII, Fig. 5). My own drawings of the type specimen, kindly provided by Dr. Lamb, from the Thaxter Collection at Harvard are shown in Fig. 1 A-B.

As noted in the introduction, Poisson (1957) reported the existence of an "*Autophagomyces mesoveliae*" on two species of *Mesovelia* (Mesoveliidae) from France. Prof. Poisson did not, however, properly describe and validate this species, and according to Jean Balazuc, M.D. (personal communication), he did not preserve specimens. Dr. Balazuc has collected and examined numerous specimens of *Mesovelia* in France but has not encountered the fungus. A single collection of *Mesovelia mulsanti* White from the vicinity of Georgetown, Texas, has been found parasitized by a species of *Autophagomyces*. Whether or not this is the same species as the one observed by Poisson in France remains to be determined.

Autophagomyces poissonii sp. nov.

(Fig. 1 C-D)

Receptaculum: Porphyreum; $50\ \mu \times 30\ \mu$; cellula basilaris (I) parva et parte opaca; cellula subbasilaris (II) et cellula superna (III) subaequae elongatae fere parallelae.

Appendix: Tota longitudo 85-90 μ ; ex quatuor cellulis subaequis superpositis et duobus antheridiis terminalibus simplicibus $25-30\ \mu \times 8-10\ \mu$ constans; antheridium extimum cellula parva subtentum.

Perithecium: Pallide porphyreum; stipes 80-100 $\mu \times 25\ \mu$; corpus uniformiter inflatum 110-140 $\mu \times 50\ \mu$; apex gradatim deminutus obtusatus margine interiore fusca.

Totus fungus 225-290 μ longus.

Receptacle: Suffused with reddish-brown, darker than the yellowish to pale reddish-brown perithecium and its stalk; basal cell (I) small, partly obscured by the blackish suffusion of the foot; subbasal cell (II) about two times longer than broad, subtending a single, stalked perithecium; upper cell (III) two times longer than broad, shorter than the subbasal cell, bearing a single antheridial appendage distally, laterally adnate to the subbasal cell, extending nearly to the base of the latter. Receptacle, $50\ \mu \times 30\ \mu$.

Appendage: Consisting of four superposed cells, the two upper cells slightly longer than broad; the upper cell darker in color than the other three, subtending two simple, flask-shaped antheridia; the upper antheridium itself subtended by a smallish cell that is adnate to the venter of the

lower antheridium. Total length of the appendage including the antheridia, 85–90 μ . Antheridia, 25–30 $\mu \times 8$ –10 μ .

Perithecium: Stalk-cell slightly longer than broad, 30 $\mu \times 23 \mu$, together with the elongate secondary stalk-cell and basal cells forming a stalk 80–100 $\mu \times 25 \mu$; perithecium to base of the ascigerous region, 110–140 $\mu \times 50 \mu$, more or less uniformly inflated, its outline somewhat angular at the juncture of the successive tiers of wall-cells, tapered to the bluntly rounded apex that is more darkly pigmented on the inner side.

Total length from base of foot to tip of perithecium, 225–290 μ .

Etym.—Named for Prof. Raymond Poisson, French zoologist.

Holotype.—TEXAS. Williamson County: Georgetown, 15 June, 1957, D. Lauck coll. On abdomen and legs of *Mesovelia mulsanti* White (Hemiptera: Mesoveliidae); RKB 2075 B, C; slides in RSA.

The material upon which this species is based is scanty and consists of but two immature and two mature individuals. Undoubtedly the collection of additional specimens may require emendation of the above description, but the illustration of the mature type (Fig. 1 C) should serve for ready identification of the fungus. The four appendages studied all bore two antheridia as shown in Fig. 1 C–D. The small cell subtending the terminal antheridium probably should be regarded as the upper cell of a 5-celled appendage. The second antheridium, adherent along one side to this small cell, appears definitely to arise from what then is the subterminal cell. Thus interpreted, the appendage is like that of the type species of *Acallomyces*, *A. homalotae* Thaxter (1902; 1908, p. 300, Pl. XLII, Fig. 1–4). *Acallomyces*, however, has a perithecium with but four tiers of wall-cells, the upper, or lip-cells, form upwardly-directed outgrowths, and there are four ascogenous cells. The perithecium of *Autophagomyces*, on the contrary, has a wall composed of five tiers of wall-cells, the lip-cells lack conspicuous outgrowths, and there is but one ascogenous cell. There is some variation in the number of cells composing the appendage of the various forms included in *Autophagomyces* by Thaxter, and in several species the appendage may be terminated by two rather than one antheridium. For the present, it seems best to classify the species found on *Mesovelia mulsanti* in *Autophagomyces*.

DIOICOMYCES Thaxter.

Proc. Amer. Acad. Arts & Sci. 37: 33. 1901.

Dioicomycetes anthici, the type, *D. onchophorus*, and *D. spiniger* were described by Thaxter in 1901 when he established this dioecious genus of Laboulbeniales. All three species were taken from specimens of *Anthicus floralis* L (Anthicidae) collected in the vicinity of Cambridge, Mass. Subsequently, 21 additional species and two varieties of *Dioicomycetes* that parasitize various members of this family of Coleoptera have been described from both the new and the old world (Thaxter: 1908, 1912, 1931; Spegazzini: 1917; Maire: 1920). Although most of the described species of *Dioicomycetes* have been found on anthicid beetles a few are known on

other insect groups. Two species, first named *Amorphomyces floridanus* Thaxter (1893) and *A. obliqueseptatus* Thaxter (1900), parasitic on species of Staphylinidae were referred to *Dioicomyces* by Thaxter in 1901.

Fig. 1. A-D.—A-B. *Autophagomyces microveliae* Thaxter.—A. The mature type specimen (Thaxter 3302) showing the distinctive, slightly spiral arrangement of the vertical rows of wall-cells. $\times 400$.—B. Appendage consisting of three superposed cells terminated by a single flask-shaped antheridium. $\times 895$.—C-D. *Autophagomyces poissonii* Benjamin.—C. The mature type specimen. $\times 485$.—D. Receptacle and appendage. Note the small, partly obscured basal cell (I) and the elongate subbasal cell (II) and terminal cell (III). The latter subtends the four-celled appendage that is terminated by two flask-shaped antheridia the outermost of which is subtended by a single smallish cell. In the specimen depicted here, the primary perithecium had aborted and only the base of the stalk-cell is shown. The subbasal cell (II) of the receptacle is beginning to grow upward as the first stage of development of a second perithecium. $\times 855$.

An anomalous species, *D. endogaeus*, taken from one of the Carabidae, *Anillus coecus* Jacq., was described and illustrated by Picard in 1912.

The male individual of *Dioicomycetes* species consists of four superposed cells, the upper of which is a simple antheridium. The basal cell usually constitutes nearly half the total length and represents the lower cell of the original spore; the antheridium and the two smallish cells immediately below are products of division of the upper spore segment (Fig. 2 E, G; 3 B-C). In most species on Anthicidae the discharge tube of the antheridium diverges slightly below the apex of the upper cell (Fig. 3 C). However, in several species on Asiatic hosts, such as *D. formicomi* Thaxter (1931) and *D. indentatus* Thaxter (1931) from the Philippines, the discharge tube is strictly terminal (Fig. 3 B). In several species the spore giving rise to the male is decidedly smaller than that from which the female is derived (Fig. 3 D). Spore germination often begins while the spores still are inside the perithecium, and the foot-cell of the young receptacle of both sexes often has taken on its characteristic dark color prior to spore discharge (Fig. 3 D). In *Dioicomycetes*, the male typically forms a single antheridium, but if for some reason this aborts or is damaged a second antheridium develops alongside the first. It is not unusual to find males having two antheridia, only one of which is functional. Thaxter separated into separate genera a small number of species having females more or less identical in basic structure to *Dioicomycetes* but with males that normally bear multiple antheridia. Whether or not any or all of these genera, *Dicrandromycetes* Thaxter (1931), *Triandromycetes* Thaxter (1931), and *Tetrandromycetes* Thaxter (1912, 1931), should be retained as distinct from *Dioicomycetes* remains to be determined from study of additional species.

The receptacle of the female individual of *Dioicomycetes* is, like many other genera of Laboulbeniales, extremely simple, and when it is mature consists of but three cells: a basal cell (I) the lower part of which is partially obscured by the darkening of the foot; a usually somewhat smaller subbasal cell (II) that subtends a single, divergent, stalked perithecium;

Fig. 2. A-I. *Dioicomycetes mesoveliae* Benjamin.—A. Post-germination stage of a female spore prior to differentiation of cells in the receptacle and appendage. The haustorium (h) developed by the basal foot had penetrated the host integument and was broken and then withdrawn in part when the specimen was detached. $\times 1080$.—B. Immature female individual showing the small basal cell of the receptacle partly obscured by the blackened surface of the foot and the parallel subbasal and terminal cells of the receptacle. The subbasal cell (left) subtends the young perithecium (per) terminated by the immature trichogyne (tr). The upper cell of the receptacle subtends the two-celled appendage derived from the upper spore segment. $\times 610$.—C. Later stage of development of a female individual showing the mature two-celled trichogyne (tr) on the upper right side of the immature perithecium. $\times 610$.—D. Still later stage of development of female showing the elongating stalk. The female sexual organ inside the perithecium has reached maturity. $\times 610$.—E. Mature male individual. The receptacle, derived from the basal spore segment, consists of the elongate basal cell; the terminal antheridium and the two small cells below are derived from the upper spore segment. $\times 895$.—F. Mature female individual showing the long-stalked perithecium within the body of which the basal ascogenous cell is forming a succession of asci that mature as they progress upward towards the ostiole. $\times 400$.—G. Mature male individual. $\times 400$.—H. Another mature female individual. $\times 400$.—I. Six mature ascospores. $\times 600$.

and a small, often inconspicuous upper cell (III) that subtends a sterile appendage. The appendage typically is unicellular, somewhat flattened in several species, and pigmented or not; it represents the undeveloped upper segment of the female spore. The stalk-cell of the perithecium is well-developed and variable in length depending on the species, the basal cells are clearly defined, and the outer wall of the body proper is composed of five tiers of cells.

Among the species of *Dioicomycetes* in the author's collection only one has been obtained from a host that is not a member of the Anthicidae. This exception is a very distinctive form that parasitizes *Mesovelvia mulsanti* White of the Mesoveliidae. The species has been found on apparently the same host species from four different localities in the United States, Mexico, and Nicaragua.

Dioicomycetes mesoveliae sp. nov.

(Fig. 2 A-I)

Fungus masculus.—Longitudo tota 60–80 μ ; cellula basilaris paene hyalina, 30–40 $\mu \times 7$ –9 μ ; pes atroporphyreus; cellulae 2–3 pallide porphyreae isodiametricae 6–10 $\mu \times 7$ –10 μ ; antheridium leviter curvatum 15–30 $\mu \times 8$ –10 μ collo terminali.

Fungus femineus.—*Receptaculum*: Porphyreum; cellula basilaris (I) parva inconspicua fere opaca; cellula subbasilaris (II) elongata 25–30 $\mu \times 10$ –12 μ perithecium singulum gerens; cellula superna (III) elongata 30–35 $\mu \times 12$ –15 μ appendicem simplicem sterilem gerens; cellulis II et III prope parallelae.

Appendix: Ex duobus cellulis constans; apex obtuse rotundatus; 28–35 $\mu \times 11$ –13 μ .

Perithecium: Pallidum testaceum rectum aliquantum sigmoideum; stipes elongata 125–185 $\mu \times 20$ –25 μ ; corpus elongatum inflatum 120–190 $\mu \times 40$ –55 μ margine interiore fortiter convexo; apex perithecii attenuatus obtuse rotundatus margine externa atroporphyrea; ascosporae hyalinae 45–55 $\mu \times 6$ –8 μ .

Totus fungus (235–)330–395 μ longus.

Male individual.—Basal cell, 30–40 $\mu \times 7$ –9 μ , about half the total length of 60–80 μ , nearly hyaline except for the dark reddish-brown foot; the middle two cells small, nearly isodiametric, 6–10 $\mu \times 7$ –10 μ , pale reddish-brown; antheridium 15–30 $\mu \times 8$ –10 μ , more rounded on one side, the neck terminal, slightly curved.

Female individual.—*Receptacle*: Reddish-brown; basal cell (I) small, nearly obscured by the opaque surface of the foot; subbasal cell (II) about two times longer than broad, 25–30 $\mu \times 10$ –12 μ , bearing a single, stalked perithecium; cell III elongate, 30–35 $\mu \times 12$ –15 μ , vertically adnate to the subbasal cell, in contact with the basal cell below, bearing the sterile appendage above.

Appendage: Two-celled, 28–35 $\mu \times 11$ –13 μ , apex bluntly rounded; the upper cell about two times longer than the lower cell.

Perithecium: Pale yellowish-brown; more or less erect and slightly sigmoid; the stalk elongate, $125\text{--}185\ \mu \times 20\text{--}25\ \mu$, consisting of the relatively short stalk-cell and the greatly elongate secondary stalk-cell that is united throughout its length with one elongate basal cell; the other two basal cells shorter, about twice as long as wide; outer surface of the stalk immediately above the stalk-cell more darkly tinged with reddish-brown. Body of the perithecium elongate, inflated gradually above the basal-cell region, the outer margin much less strongly convex than the paler inner margin, taper-

Fig. 3. A-D.—A. *Dioicomycetes spiniger* Thaxter. Mature female individual showing the small, 3-celled receptacle bearing, on the upper right the small unicellular appendage and, on the upper left, the large, stalked perithecium. In this species the outer upper wall of the perithecial body bears a long, curved, unicellular process. $\times 350$.—B. *Dioicomycetes* sp. Male individual of an undetermined species from the Philippine Islands in which the discharge tube of the antheridium is terminal. $\times 700$.—C. *Dioicomycetes* sp. Male individual of an undetermined species from California showing the subterminal origin of the antheridial discharge tube that is characteristic of most species of the genus occurring in the Western Hemisphere. $\times 700$.—D. *Dioicomycetes anthici* Thaxter. Upper end of the perithecium showing ascospores that have attained a late stage of germination prior to discharge. The blackened foot has begun to differentiate. The extreme dimorphism of the spores of this species is readily seen in the pair of spores — the female on the left, the male on the right — that are not yet completely free of the ostiole. $\times 500$.

ing gradually to the slightly out-turned apex that is deeply suffused with reddish-brown along the outer margin; total length to base of ascigerous cavity, $120\text{--}190\ \mu \times 40\text{--}55\ \mu$; ascospores $45\text{--}55\ \mu \times 6\text{--}8\ \mu$, not showing marked size differences according to sex.

Total length from base of foot to tip of perithecium, $(235\text{--})330\text{--}385\ \mu$ (mean, $378\ \mu$; based on 15 mature individuals).

Etym.—Named for the host genus, *Mesovelia*.

Holotype.—MEXICO. Oaxaca: 28 June, 1957, D. Lauck coll. On the femur of the right middle leg of *Mesovelia mulsanti* White (Hemiptera: Mesoveliidae, RKB 2080; slides in RSA.

Other specimens examined.—MEXICO. Michoacan: 11 Aug., 1957, D. Lauck coll. On the femur of the right middle leg of *Mesovelia mulsanti*; RKB 2567; slides in RSA.—NICARAGUA. Rivas, 18 July, 1957, D. Lauck coll. On the femur of the right rear leg of *Mesovelia mulsanti*; RKB 2566; slides in RSA.—UNITED STATES. Texas. Williamson County: Georgetown, 15 June, 1957, D. Lauck coll. On the femur of the right middle and rear legs of *Mesovelia mulsanti*; RKB 2075A; slides in RSA.

Dioicomyces mesoveliae differs in several respects from all known species of the genus occurring on anthicid beetles. The side-by-side relationship of cells II and III is unique for the genus, and the nearly parallel arrangement of these cells apparently is the result of a longitudinal division of the mother cell rather than a transverse division followed by cellular displacement in the maturing individual (Fig. 2 B). During relatively early stages of development (Fig. 2 C–D) the lower part of the lumen of cell III becomes nearly void of cytoplasm which is concentrated in the upper part of the cell. Because of this, cell III in the mature individual has the appearance of being composed of two superposed cells (Fig. 2 H). Another feature not found in other species is the bicellular appendage of *D. mesoveliae*. The upper spore segment of the female individual divides early in development, but just when this division takes place — sometime between the very early stages shown in Fig. 2 A and Fig. 2 B — was not observed. Finally, in other species of *Dioicomyces* the perithecial stalk consists almost entirely of the more or less elongate true stalk-cell (Fig. 3 A), but in *D. mesoveliae* the stalk is composed of the relatively short true stalk-cell and the greatly elongate secondary stalk-cell combined with one elongate basal cell (Fig. 2 D,F,H). The male of *D. mesoveliae* (Fig. 2 E,G) is similar in all respects to the male of several species of *Dioicomyces* found on Anthicidae (Fig. 3 B).

Prolixandromyces gen. nov.

Receptaculum ex cellulis tribus superpositis constans appendicem liberam et perithecium stipitatum utrinsecus gerens; cellulae basilaris et subbasilaris receptaculi fortiter oblique superpositae; apex cellulae basilaris receptaculi cellula stipiti perithecii basi plus minusve contingens; cellula superna receptaculi appendicem gerens. Appendix ex cellulis tribus superpositis constans ad apicem antheriidia duos simplicia collis magnopere elongatis gerens. Perithecium cum cellulis parietis in quatuor ordinibus

longitudinalibus unusquisque quatuor cellularum; cellula stipiti et cellulae basilares persistentes; cellula ascogena unica; ascosporae 1-septatae.

Receptacle consisting of three superposed cells bearing on one side a free appendage and on the other side a stalked perithecium. The basal and subbasal cells of the receptacle very strongly obliquely superposed; the distal end of the former approaching or contacting the base of the perithecial stalk-cell; the upper cell of the receptacle subtending the appendage. The appendage consisting of three superposed cells, the upper bearing two simple antheridia each having a greatly elongate neck. Perithecium with well-developed and persistent stalk- and basal-cells and four rows of wall-cells of four cells each; ascogenous cell single. Ascospores 1-septate.

Etym.—*Prolixus*, stretched far out + *andro-*, *man* + *myces*, *fungus*.

Type species.—*Prolixandromyces veliae* Benjamin.

Prolixandromyces veliae sp. nov.

(Fig. 4 A-E)

Receptaculum: Atrobrunneoaurantiacum elongatum $60-70\ \mu \times 15-20\ \mu$ prope basin plus minusve curvatum; cellula basilaris (I) et cellula subbasilaris (II) oblique superpositae; cellula basilaris $50-55\ \mu \times 10-15\ \mu$ ad apicem basi stipitis perithecii paene contingens; cellula III parva $17-22\ \mu \times 12-14\ \mu$ ex parte cellula II et ex parte basi stipitis perithecii conjuncta.

Appendix: Atrobrunneoaurantiaca tota longitudo $120-130\ \mu$; corpus $40-55\ \mu \times 15-20\ \mu$ ex tribus cellulis superpositis constans; septum basilare constrictum opacum; cellula basilaris $15-20\ \mu \times 12-16\ \mu$; cellula subbasilaris subaequa; cellula superna a latere visa triangularis $15-20\ \mu$ alta $\times$ basi $14-19\ \mu$ diam.; corpora antheridiorum ad apicem conjuncta; tubi liberi elongati; tubus internus $65-75\ \mu \times 2-3\ \mu$ tubus externus $50-60\ \mu \times 2-3\ \mu$.

Perithecium: Brunneoaurantiacum; cellula stipitis elongata $75-120\ \mu \times 20-28\ \mu$ basi fortiter et abrupte constricta; cellula stipitis secundaria parva a latere visa plus minusve triangularis; cellulae basilares elongatae; corpus perithecii elongatum $215-275\ \mu \times 60-70\ \mu$ fere symmetricum margines uniformiter convexae; apex graditum decrescens; cellula parietina externa superna appendicem leviter sigmoideam recurvatam acuminatam $22-28\ \mu \times 7-9\ \mu$ gerens. Ascosporae hyalinae $40\ \mu \times 5-6\ \mu$.

Totus fungus $300-440\ \mu$ longus.

Ochraceous-orange; the body of the appendage and the receptacle slightly darker than the perithecium.

Receptacle: Elongate, $60-70\ \mu \times 15-22\ \mu$; more or less strongly curved in the basal one-third or one-fourth; basal cell (I) $50-55\ \mu \times 10-15\ \mu$, about two times longer than the subbasal cell (II), the two cells obliquely superposed; the distal end of the basal cell extending nearly to the base of the perithecial stalk-cell; cell III small, $17-22\ \mu \times 12-14\ \mu$, tapered below, the oblique inner face united in part with cell II and in part with the extreme lower, inner surface of the perithecial stalk-cell.

Appendage: Separated from cell III of the receptacle by a constricted, externally blackened cross-wall; composed of three superposed cells, the basal cell $15\text{--}20\ \mu \times 12\text{--}16\ \mu$, slightly longer than the nearly isodiametric median cell; the upper cell triangular in cross-section, $15\text{--}20\ \mu$ high $\times 14\text{--}19\ \mu$ at the base, subtending two antheridia the venters of which are united above; antheridial discharge tubes free, elongate, the inner $65\text{--}75\ \mu \times 2\text{--}3\ \mu$, the outer $50\text{--}60\ \mu \times 2\text{--}3\ \mu$. Body of the appendage to tip of upper cell $40\text{--}55\ \mu \times 15\text{--}20\ \mu$; total length to tip of longest antheridium $120\text{--}130\ \mu$.

Perithecium: Stalk-cell elongate, $75\text{--}120\ \mu \times 20\text{--}28\ \mu$, strongly and abruptly constricted at the base; the secondary stalk-cell small, more or less triangular in lateral view; basal cells elongate, forming the lower portion of the body of the perithecium; the latter elongate, $215\text{--}275\ \mu \times 60\text{--}70\ \mu$ including the basal cells, nearly symmetrical, broadest near the middle, the wall-cells individually slightly convex, tapered gradually to the bluntly-rounded apex; the outer, upper wall-cell giving rise to a very slightly sigmoid, recurved, pointed appendage $22\text{--}28\ \mu \times 7\text{--}9\ \mu$. Ascospores hyaline, $40\ \mu \times 5\text{--}6\ \mu$.

Total length from base of foot to tip of perithecial appendage, $300\text{--}440\ \mu$ (mean, $400\ \mu$; based on 19 mature individuals).

Etym.—Named for the host genus, *Velia*.

Holotype.—MEXICO. Michoacan: Jacona, 11 Aug., 1957, D. Lauck coll. On the femur of the right rear leg of *Velia* sp. (Hemiptera: Veliidae); RKB 2073A; slides in RSA.

***Prolixandromyces corniculatus* sp. nov.**

(Fig. 4 F–J)

Receptaculum: Fuscum ochraceaurantiacum; cellula III extrinsecus fuscoris e rubro; relative parvum fortiter curvatum $35\text{--}40\ \mu \times 13\text{--}17\ \mu$; cellula basilaris (I) et cellula subbasilaris (II) oblique superpositae; cellula

Fig. 4. A–J.—A–E. *Prolixandromyces veliae* Benjamin.—A. The mature type. $\times 300$.—B. Detail of the receptacle showing the oblique relationship of the basal cell (I) and subbasal cell (II). Note remnant of haustorium (h) that was withdrawn from the host integument when the fungus was detached for mounting. The constricted base of the perithecial stalk-cell is at the upper left; the base of the appendage separated by a blackened septum from the upper cell (III) of the receptacle is at the upper right. $\times 660$.—C. Detail of perithecial apex showing the terminal appendage projecting upward and to the left behind the two lateral lip-cells. The blackened remnant of the base of the trichogyne (tr) is seen at the upper end of the inner lip-cell. $\times 895$.—D. Detail of appendage showing relationship of the two terminal antheridia and their extremely long discharge tubes. $\times 660$.—E. Ascospore. $\times 1080$.—F–J. *Prolixandromyces corniculatus* Benjamin.—F. The mature type. $\times 300$.—G. Detail of perithecial apex showing horn-like terminal projection of outer lip-cell. The apex of the inner lip-cell curves inward sharply between the lateral lip-cells and contacts the base of the outer appendage. Note remnant of the trichogyne (tr) attached to the upper end of the inner lip-cell. $\times 895$.—H. Detail of receptacle. The laterally superposed basal (I) and subbasal (II) cells are in contact with the base of the perithecial stalk-cell at the upper right. Note constriction of base of stalk-cell. $\times 660$.—I. Detail of appendage showing relationship of the three sterile cells composing the body and the two terminal antheridia bearing elongate discharge tubes. $\times 660$.—J. Ascospore. $\times 1080$.

basilaris 25–30 μ $\times$ 8–10 μ ad apicem basi stipitis peritheci conjuncta; cellula III parva 10–15 μ $\times$ 10–12 μ ex parte cellula II et ex parte basi stipitis peritheci conjuncta.

Appendix: Fusca ochraceoaurantiaca e rubro; tota longitudo 105–125 μ ; corpus 35–40 μ $\times$ 12–16 μ ex tribus cellulis superpositis constans; cellula basilaris 13–17 μ $\times$ 12–16 μ ; cellula subbasilaris subaequa; cellula superna a latere visa triangularis 10–15 μ alta $\times$ basi 12–15 μ diam.; corpora antheridiorum ad apicem conjuncta; tubi liberi elongati; tubus internus 65–80 μ $\times$ 2–3 μ tubus externus 50–70 μ $\times$ 2–3 μ .

Perithecium: Ochraceoaurantiacum; cellula stipitis elongata 25–80 μ $\times$ 12–24 μ basi fortiter et abrupte constricta; cellula stipitis secundaria parva a latere visa plus minusve triangularis; cellulae basillares elongatae; corpus peritheci elongatum 210–250 μ $\times$ 45–58 μ symmetricum margines uniformiter convexae; apex graditum decrescens; cellula parietina externa superna appendicem elongatam erectam leviter curvatam acuminatam 26–30 μ longam $\times$ basi 7–10 μ diam. gerens. Ascosporae hyalinae 32–38 μ $\times$ 4–5 μ .

Totus fungus 255–355 μ longus.

Ochraceus-orange; cell III of the receptacle and the appendage darker, tinged with red.

Receptacle: Relatively small, strongly curved, 35–40 μ $\times$ 13–17 μ ; basal cell (I), 25–30 μ $\times$ 8–10 μ , broader than the subbasal cell (II), the two cells approximately equal in length, obliquely superposed, the distal ends of both cells in contact with the lower end of the perithecial stalk-cell; cell III small, 10–15 μ $\times$ 10–12 μ , nearly triangular in lateral view, the outer margin darker, the oblique inner face united in part with cell II and in part with the extreme lower, inner surface of the perithecial stalk-cell.

Appendage: Separated from cell III of the receptacle by a constricted, externally blackened cross-wall; composed of three superposed cells, the basal cell 13–17 μ $\times$ 12–16 μ , slightly longer than the nearly isodiametric subbasal cell; the upper cell small, pointed above, 10–15 μ high $\times$ 12–15 μ wide at the base, subtending two antheridia; venters of antheridia united above; antheridial discharge tubes free, elongate, the inner 65–80 μ $\times$ 2–3 μ , the outer 50–70 μ $\times$ 2–3 μ . Body of the appendage to tip of upper cell 35–40 μ $\times$ 12–16 μ ; total length to tip of longest antheridium 105–125 μ .

Perithecium: Stalk-cell elongate, 25–80 μ $\times$ 12–24 μ , strongly and abruptly constricted at the base; secondary stalk-cell small, triangular in lateral view; basal cells elongate, forming the lower part of the body of the perithecium, the latter elongate, 210–250 μ $\times$ 45–58 μ including the basal cells, nearly symmetrical, broadest near the middle, the wall-cells individually very slightly convex, tapering gradually to the bluntly rounded apex; the outer, upper wall-cell giving rise to an elongate, erect, slightly curved, pointed appendage 26–30 μ $\times$ 7–10 μ at the base. Ascospores hyaline, 32–38 μ $\times$ 4–5 μ .

Total length from base of foot to tip of perithecial appendage, 255–335 μ (mean, 310 μ ; based on 21 mature individuals).

Etym.—corniculatus, horned.

Holotype.—MEXICO. Michoacan: Jacona, 11 Aug., 1957, D. Lauck coll. On the lower surface of the mesothorax of a male of *Velia* sp. (Hemiptera: Veliidae); *RKB 2073B*; slides in RSA.

Other specimens examined.—MEXICO. Michoacan: Jacona, 11 Aug., 1957, D. Lauck coll. On the posterior median margin of the pronotum of a female of *Velia* sp.; *RKB 2074*; slide in RSA.—EL SALVADOR. La Union, 24 July, 1957, D. Lauck coll. On the right margin of the pronotum of a female of *Velia* sp.; *RKB 2072*; slide in RSA.

The relationship of *Prolixandromyces* clearly is with a complex of genera constituting what Thaxter (1908) termed the Stigmatomyceteae of the Laboulbeniaceae. This assemblage includes at least ten other genera: *Acallomyces* Thaxter (1931), *Acompsomyces* Thaxter (1901, 1931), *Arthrorhynchus* Kolenati (1857; Thaxter, 1908), *Autophagomyces* Thaxter (1912, 1931), *Gloeandromyces* Thaxter (1931), *Hesperomyces* Thaxter (1891, 1931), *Ilyomyces* Picard (1916), *Stemmatomyces* Thaxter (1931), *Stigmatomyces* Karsten (1869; Thaxter, 1896, 1908, 1931), and *Synandromyces* Thaxter (1912, 1931). All species belonging to these genera are characterized by a simple receptacle composed of three superposed cells: the upper cell (III) subtends an appendage; the subbasal cell (II) gives rise to a stalked perithecium; and the basal cell (I) forms the foot by which the fungus is attached to the host. The appendage bears one or more simple antheridia either terminally or laterally and lacks sterile branchlets; the apex of the spore, however, often persists in the form of a small spine terminating the appendage or one of its distal cells or projecting from one of the distal antheridia. Generic distinctions are based primarily on the structure of the appendage and to a lesser extent on the relationship of the cells composing the receptacle and modifications of the perithecial apex. For purposes of comparison with *Prolixandromyces*, salient features of the above genera are given here.

Species of *Autophagomyces*, discussed earlier in this paper, are characterized by a simple appendage of 2–4 superposed cells terminated by usually one, rarely two, antheridia; the perithecium contains only one ascogenous cell and the apex is more or less unmodified; the basal and subbasal cells of the receptacle are transversely or in some instances somewhat obliquely superposed. *Ilyomyces*, with two described species that occur on species of *Stenus* and are the only Laboulbeniales known on representatives of the subfamily Steninae of the Staphylinidae, has a perithecium that also contains a single ascogenous cell but the terminal wall-cells bear specialized ligulate or mammillate upgrowths. The appendage consists of 1–2 superposed cells, the upper cell subtending two small cells placed side-by-side each of which bears one or two free antheridia. The basal and subbasal cells of the receptacle of *Ilyomyces* spp. are positioned obliquely so that they are more or less vertically parallel with the upper end of the basal cell contacting cell III, the supporting cell of the appendage.

Stigmatomyces, a genus of many diverse species occurring on a variety of hosts, especially species of free-living Diptera, has an appendage consisting of a variable number — depending on the species — of superposed cells most of which bear usually one or sometimes 2–3 antheridia. The perithecium contains 2 or 4 ascogenous cells and the apex usually lacks any special modifications. The cross-wall separating the basal and sub-basal cells of the receptacle typically is more or less transverse. Allied to *Stigmatomyces* are *Arthrorhynchus* and *Gloeandromyces*, all known species of which occur on flies parasitic on bats. Both genera may have evolved directly from *Stigmatomyces*-like ancestors, but they have undergone modifications that readily distinguish them generically. In *Arthrorhynchus*, parasitic on species of Nycteribiidae, the fertile cells of the appendage bear antheridia arranged in whorls; the perithecium contains a single ascogenous cell; and the basal cell of the receptacle penetrates the host by means of an extensive rhizoidal system. The latter feature, however, probably is not significant as a generic characteristic, for it occurs sporadically in other unrelated genera of Laboulbeniales. *Gloeandromyces*, found only on species of Streblidae, is very much *Stigmatomyces*-like in appearance and the perithecium contains 2 or 4 ascogenous cells. The antheridial appendage, however, is unique in that its cells proliferate laterally and form a small number of superposed rows of cells. Each cell of the upper row bears an antheridium; in age, the antheridia gelatinize and may disappear entirely. Some species of *Gloeandromyces* form a typical blackened foot of limited penetration, whereas other species develop an extensive penetrating rhizoid much like that of *Arthrorhynchus* species. *Acallomyces* and *Hesperomyces* also are *Stigmatomyces*-like in many respects, but the perithecium of all known species of these genera is distinguished by unicellular upgrowths arising from the upper wall-cells. The perithecium of *Acallomyces* contains four ascogenous cells, whereas that of *Hesperomyces* only one. The two described species of *Acallomyces* occur on species of Staphylinidae; six species of *Hesperomyces* have been described, five on species of Coccinellidae and Mycetophagidae (Coleoptera) and one on a species of Anthocoridae (Hemiptera).

Acompsomyces includes four species on cucujoid beetles, two on members of the family Cryptophagidae and two on Lathridiidae. The genus is readily distinguished from other Stigmatomyceteae by the structure of the appendage which consists of four superposed cells the lower of which separates 2–3 antheridia, the median two cells remain sterile, and the terminal cell forms a single spinose antheridium with or without a small associated cell. The perithecium contains a single ascogenous cell. The last two genera to be considered here are *Synandromyces* with eight species known on members of four families of cucujiform beetles, Cucujidae, Cryptophagidae, Lathridiidae, and Nitidulidae, and *Stemmatomyces* with two species on beetles belonging to the Elateridae. The receptacle of members of both genera is unlike that of all other related genera in having the basal cell (I) almost completely surrounded by cells II and III which extend downward externally so that when viewed in optical section the

three cells appear to lie more or less parallel to one another. The perithecium of members of both genera contains a single ascogenous cell, and that of *Stemmatomyces* is crowned by four conspicuous upgrowths that surround the ostiole.

Although resembling *Autophagomyces* superficially, *Prolixandromyces* has been segregated generically from this and the other genera of Stigmatomyceteae on the basis of its receptacle and especially the antheridia. The type of extreme oblique superposition of the basal and subbasal cells of the receptacle as seen in *Prolixandromyces* is found rarely in other genera of Laboulbeniales having 3-celled receptacles and can be regarded as a generic characteristic in only two of them. In both *Eucantharomyces* Thaxter (1895, 1908) and *Acrogynomyces* Thaxter (1931) the basal and subbasal cells of the receptacle are more or less parallel to one another and, as in *Prolixandromyces*, the distal end of the basal cell lies in contact with the lower surface of the perithecial stalk-cell. Neither of these genera, however, is closely related to *Prolixandromyces* or other Stigmatomyceteae. *Eucantharomyces* has a very distinctive type of compound antheridium, and the characteristics of the *Acrogynomyces* appendage suggest a relationship of this genus with *Corethromyces* Thaxter (1892, 1931) and its allies. The receptacle of one species of *Hesperomyces*, *H. lasiochili* Thaxter (1931), is like that of *Prolixandromyces*, but species of these genera are readily separated by the characteristics of their appendages and perithecia. The greatly elongate discharge tube of the antheridium of *Prolixandromyces* species is unique and is regarded as a primary generic characteristic. Whether or not the horn-like terminal appendage and the basal constriction of the perithecial stalk-cell found in both species of *Prolixandromyces* are of generic importance must await discovery of additional species. Such features are known to occur in some, but not all, species of various other genera of Laboulbeniales.

SUMMARY

Five species representing three genera of Laboulbeniales parasitic on semiaquatic Hemiptera are illustrated; four of these species are described as new. The type specimen of *Autophagomyces microveliae* Thaxter is illustrated for comparison with *A. poissonii* parasitic on *Mesovelvia mulsanti* White (Mesoveliidae). *Dioicomyses mesoveliae*, also parasitic on *Mesovelia mulsanti*, is contrasted with other representatives of this dioecious genus which are known only on species of Coleoptera. The new genus *Prolixandromyces* with two species, *P. veliae* and *P. corniculatus*, is described and its possible relationship with the Stigmatomyceteae of the Laboulbeniaceae is discussed. Both species of *Prolixandromyces* were found on an undetermined species of *Velia* (Veliidae).

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