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NEW GENERA OF LABOULBENIALES<sup>1, 2</sup>

R. K. BENJAMIN

During the course of investigations of the Laboulbeniales several undescribed genera have been encountered and studied. Four of these new taxa are described below. Unless otherwise indicated, slide mounts designated as the holotypes have been deposited in the Mycological Collections, Department of Botany Herbarium, University of Illinois, Urbana, Illinois. The insect hosts from which the fungi were taken are in the collections of the Section of Faunistic Surveys and Insect Identification, State Natural History Survey, Urbana, Illinois.

**Homaromyces** gen. nov.

Receptaculum multicellulare, planatum, essentialiter ordinem medium cellularum superpositarum habente quae super cellulam basalem et sub cellula terminale cellulas inaequaliter polygonias a dextra et sinistra in utroque latere habente; aliquibus cellularum peripheralium perithecia aut appendices antheridiales vel steriles (?) generantibus. Perithecia breve stipitata, cellulis parietis in 4 ordinibus longitudinalibus dispositis utroque 4 cellularum; cellulis basalibus exterioribus in aetate plus aut minus dissolutis et obscuratis. Appendices 2-cellulares; steriles (?) aut cellulam terminalem habentes quae simples antheridium ampullaceum est. Sporae semel-septatae.

Receptacle multicellular, flattened, consisting essentially of a median row of superposed cells which, above the basal and below the terminal, are flanked, right and left, by groups of irregularly polygonal cells; some of the peripheral cells producing perithecia or antheridial or sterile (?) appendages. Perithecia short-stalked; wall-cells disposed in four longitudinal rows of four cells each; the outer basal cells becoming more or less disorganized and indistinct. Appendages two-celled; sterile (?) or with the terminal cell a simple flask-shaped antheridium. Spores once-septate.

**Homaromyces epieri** sp. nov.

Sine colore. Receptaculum seriem mediam plerumque 6 plus minusve elongatarum cellularum superpositarum habente; cellulis, super cellulam pedalem basi nigra et sub comparate parva cellula appendiculata terminali, additicias cellulas parviore ad dextram sinistramque parientibus; toto planatum, multicellulare plus minusve elongato-ovoideum receptaculum 95-125  $\mu$  longitudine X 30-45  $\mu$  latitudine formante; 3-5 cellulis peripheralibus in utroque latere receptaculi perithecia aut appendices antheridiales sterilesve (?) generantibus. Perithecium paene symmetricum, sub-

<sup>1</sup>A portion of this paper is adapted from a dissertation presented to the faculty of the University of Illinois in June, 1951, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Botany where the writer carried out his studies under the guidance of Dr. Leland Shanor.

<sup>2</sup>Figures 1-7, 11, and 13-14, were prepared during the tenure of the writer as a Natural Research Fellow in Botany at Harvard University, 1951-1952, under the sponsorship of Professor Wm. H. Weston, Jr.

ellipticum, breves stirpes habente; cellulis parietis bene circumscriptis; cellulis labii ad extremitatem paulum eminentibus, 4 parvas, comparate inconspicuas diversas papillas formantibus; exterioribus cellulis basalibus dissolutescens. Cellulae appendicium paene aequales, bis longioribus quam latis; cellula terminali sterili (?) aut antheridium ampulliforme formante; basali infra paulum constricta. Perithecia 65-80 X 25-30  $\mu$ . Longitudo tota ad extremitatem perithecii 150-175  $\mu$ . Sporae 55 X 5  $\mu$ .

Colorless. Receptacle consisting of a median series of usually six more or less elongate superposed cells; the cells, above the basally blackened foot-cell and below the relatively small terminal appendiculate cell, giving rise to additional smaller cells to the right and left; the whole forming a flattened, multicellular more or less elongate-ovoid receptacle 95-125  $\mu$  long by 30-45  $\mu$  wide; three to five peripheral cells on each side of the receptacle producing perithecia or antheridial or sterile (?) appendages. Perithecium nearly symmetrical, sub-elliptical, short-stalked; wall-cells well-defined; lip-cells protruding slightly at the apex to form four small, relatively inconspicuous divergent papillae; outer basal cells becoming disorganized. The cells of the appendages nearly equal, twice as long as broad; the terminal one sterile (?) or forming a flask-shaped antheridium; the basal one somewhat constricted below. Perithecia 65-80 X 25-30  $\mu$ . Total length to the tip of the perithecium 150-175  $\mu$ . Spores 55 X 5  $\mu$ .

The material from which the holotype and one of the isotypes (Figs. 4 and 5 respectively: U. I. No. 21,951; R. K. B. No. 593) were selected was found on all parts of *Epiervus pulicarius* Er. (Coleoptera: Histeridae), collected by C. C. Hoff near Ursa, Illinois, 9 Aug., 1945; additional specimens (R. K. B. No. 915) have been examined which were taken from the same host species collected by C. L. Remington near Norco, Louisiana, 3 Nov., 1944. The hosts were kindly determined by Dr. R. L. Wenzel, Chicago Natural History Museum, Chicago, Illinois.

The material upon which this genus is based is ample for description, but it is not sufficient to provide a series of specimens suitable for a detailed ontogenetic study. Thus, as is the case for so many of the Laboulbeniales, a fuller knowledge of the development of this fungus must await the collection and study of additional specimens. The morphology of *Homaromyces* does not suggest a close alliance of the genus to any of the described genera of the Laboulbeniales, and there is little likelihood of confusing it with any other of the known members of the order. Maturation, usually, of a single perithecium subterminally on one or both sides of the receptacle lends to the type species a curious lobster-like appearance, and this suggested the name which has been assigned to the genus. In the material studied, which had been preserved in alcohol, the appendages had become more or less disorganized apically, and the nature of these has been determined only tentatively. The appendage shown in Fig. 6 is one of the few observed which appeared to be intact, and, while spermatia could not be detected, the terminal cell definitely has the flask-shaped structure which is characteristic of the antheridia of members of the Laboulbeniaceae. The nature of all of the appendages on any one individual could not be determined.

As the perithecium matures two of its three basal cells become disorganized. The one which persists grows downward along the stalk-cell and ultimately makes contact with the cell of the receptacle from which the perithecium arose (Figs. 4 and 5). A similar phenomenon was described recently by Shanor for the genus *Filaromyces* (4) in which one of the anterior basal cells of the perithecium grows downward and establishes direct contact with the receptacle proper.

**Columnomyces** gen. nov.

Receptaculum elongatum, multicellulare, transverse circulare, cellulam basalem habente super quam deinceps ordines cellularum planatarum faciuntur; cellulis ordinis terminalis aut ordinum terminalium multos ramos tenues simplices aut compositos gerentibus, sterilibus aut libra antheridia ampulliformia ferentibus; cellula singula ordinis medialis perithecium stipitatum gerente. Perithecium 4 ordines cellularum parietis habens, utroque 4 cellularum; cellulis basalibus et stirpis persistentibus.

Receptacle elongate, multicellular, circular in cross section, consisting of a single basal cell above which are formed successive tiers of flattened cells; the cells of the terminal tier or tiers giving rise to numerous slender, simple, or ramiform branches, sterile or bearing free, flask-shaped antheridia; a single cell of one of the median tiers giving rise to a stalked perithecium. Perithecium with four rows of wall-cells of four cells each, stalk- and basal-cells persistent.

**Columnomyces ptomaphagi** sp. nov.

Receptaculum ad 18 ordines superpositos cellularum laterum planatarum habente; ordine utroque super 2-3 basales 2-3 cellulas in aspecto laterale tote aut partem visibiles habente; receptaculo sucineo-fusco, rosa tincto, cellula basale supra hyalina infra nigra; cellulis ordinis terminalis multos appendices tenues septatos ramulosos gerentibus, sterilibus aut antheridia simplicia ferentibus; 2-3 ordinibus subterminalibus appendices additios postea gerentibus. Perithecium unum stipitatum ex cellula ordinis submedialis latere nascente; perithecio inflato subsymetrico, griseo-viride, apice constricto obscuro; cellula stirpis hyalina, super basem angustam et subnigram supra curvata. Perithecium totum 95 X 65  $\mu$ ; cellula stirpis 112 X 30  $\mu$ . Receptaculum 120 X 35-40  $\mu$ . Appendices longissimi 50 X 1.5-3  $\mu$ . Longitudo tota ad extremitatem perithecii 230  $\mu$ . Trichogynum bene explicatum, multicellulare, saepius dichotomum; cellulis terminalibus breves prominentias diversas gerentibus.

Receptacle consisting of up to eighteen superposed tiers of broad, flattened cells; each tier above the two or three basal ones with two or three cells wholly or partly visible in lateral view; amber brown, darker below, tinged here and there with pink, except the basal cell which is hyaline above the blackened foot; the cells of the terminal tier giving rise to many slender, septate, ramulose appendages, sterile or bearing simple antheridia; two or three subterminal tiers subsequently producing additional appendages by proliferation. The single stalked perithecium arising laterally from one cell of a tier located slightly below the middle of the receptacle; perithecium inflated, subsymmetric, two-thirds as broad as long, grayish-green, the tapered apex darker; stalk-cell hyaline, about four times as long as broad, curved upward sharply above its narrow blackened base. Perithecium, including basal cells 95 X 65  $\mu$ ; stalk cell 112 X 30  $\mu$ . Receptacle 120 X 35-40  $\mu$ . Appendages, longest, 50 X 1.5-3  $\mu$ . Total length to the tip of the perithecium 230  $\mu$ . Trichogyne well-developed, multicellular, several times dichotomous, the terminal cells bearing short divergent prominences.

The unique holotype (Fig. 8: U. I. No. 21,949; R. K. B. No. 821) and many broken specimens were taken from the elytra of an undetermined species of *Ptomaphagus* (Coleoptera: Catopidae), collected by G. and A. Ulrick, Giant City State Park, Union Co., Illinois, 9 Apr., 1950; the immature paratype (Fig. 7: R. K. B. No. 1170), on *Ptomaphagus* sp., was collected at the type locality by M. W. Sander-son, 27 July, 1951, and it is in the author's collection.

Here too the character of the male organelles must be confirmed. In the material

examined, structures which have the appearance of antheridia of the simple laboulbeniaceus type, borne terminally and laterally, may be discerned on many of the appendages; spermata, however, are not in evidence. Knowledge of the exact nature of the antheridium is not essential, however, to the ready separation of this very distinct genus from all other known genera of the order. The production of an elaborate trichogyne (Fig. 7, *tr*) would seem to suggest that functional male organs are formed, at least during the early stages of development.

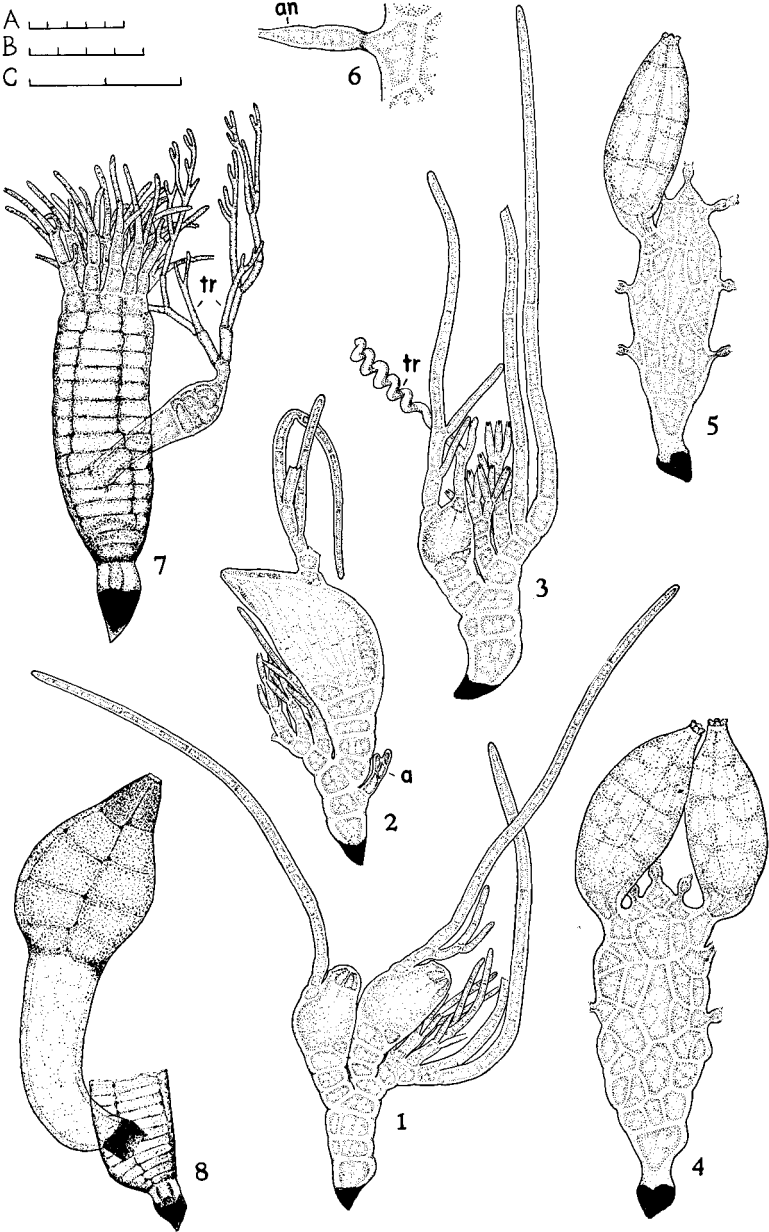
### *Colonomyces* gen. nov.

Receptaculum axem cellularum superpositarum habente; aliquot cellulis, super basalem, cellulas parviores in uno latere (antere) formatione septorum longitudinalium separantibus quae fortasse axes secundarias cellularum superpositarum generant; cellula proximale unae aut plurum axium secundariorum solum perithecium pariente. Axis receptaculi in appendicem aliquot cellularum exeunt duobus aut pluribus ramis elongatis simplicibus terminatam; utraque cellula sub ramis terminalibus et super axem perithecialem superiorem, appendicem antheridiale brevem, aliquot cellulas superpositas habentem, in latere anteriore pariente; his cellulis superpositis antheridia ampulliformia simplicia directe aut parvos ramos steriles vel fertiles antheridia gerentes generantibus. Perithecium in stirpe trium aut plurum cellularum superpositarum, vera cellula stirpis adnumerata, situm, et in superficie anteriore superiorem appendicem simplicem aut ramosam elongatam gerente quae extremitas axis secundariae est; cellulis parietis in 4 ordinibus longitudinalibus 4 cellularum singularum, cellulis basalibus exterioribus in aetate dissolutis. Sporae semel-septatae.

Receptacle consisting of an axis of superposed cells; several cells, above the basal, separating, by the formation of longitudinal septa, smaller cells on one side (the anterior) which may produce secondary axes of superposed cells; a proximal cell of one or more of the secondary axes giving rise to a single perithecium. The axis of the receptacle ending in a several celled appendage terminated by two or more simple elongate branches; each cell, below the terminal branches and above the upper perithecial axis, producing, anteriorly, a short antheridial appendage consisting of several superposed cells which give rise to simple flask-shaped antheridia directly or to sterile or fertile branchlets, the latter bearing antheridia. Perithecium borne on a stalk consisting of three or more superposed cells including the true stalk-cell, and bearing on its upper anterior surface an elongate simple or branched appendage which is the extremity of the secondary axis; wall-cells disposed in four longitudinal rows of four cells each, the outer basal cells becoming disorganized. Spores once-septate.

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Figs. 1-8. 1-3. *Colonomyces appendiculatus*. 1. Young individual (paratype) with two immature perithecia. 2. The mature holotype; note the young perithecial axis (*a*) arising from the single cell which has been cut off laterally from the subbasal cell of the primary axis. 3. Young individual (paratype) with immature perithecium bearing unbroken appendage and intact trichogyne (*tr*). 4-6. *Homaromyces eperi*. 4. The mature holotype with two perithecia. 5. Mature isotype with a single perithecium. 6. Intact appendage with terminal antheridium (?[an]). 7-8. *Columnomyces ptomaphagi*. 7. Young individual (paratype) showing the multicellular receptacle giving rise terminally to sterile and antheridial appendages and laterally to a single perithecium bearing a well-developed trichogyne (*tr*). 8. The mature holotype; the terminal portion of the receptacle has become disorganized. The base of the perithecial stalk cell has been somewhat displaced by the pressure of the coverglass. All figures drawn with the aid of a camera lucida. Scale A for Fig. 8, X 250; scale B for Figs. 1-5 and 7, X 325; scale C for Fig. 6, X 1000. Each unit of the scales equals 10 $\mu$ .



See bottom of page 186.

### *Colonomyces appendiculatus* sp. nov.

Flavus. Axis principalis 6-7 cellularum superpositarum super pedem subnigrum et in fere 2 ramos elongatos simplicesque terminatus qui cellulas comparate elongatas et angustas habent. Cellula basalis leviter longioris quam lata, infra constricta; 2-4 cellulis succedentibus subplanatis et formatione septorum longitudinalium solas cellulas parviores in uno latere separantibus, utraque parva cellula axem perithecialem pariente; 2-3 cellulis infra ramis terminalibus et super axem superiorem perithecialem aliquid parvioribus, subaequalibus, utraque in latere ad axem perithecialem ramum antheridiale 2-4 aut plurium cellularum parvarum subquadratarum aut rectangularium superpositarum ferente; his cellulis multa antheridia simplicia ampulliformia lateralia aut terminalia aut ramulos steriles vel fertiles gerentibus; antheridiis fere in fasciculis 2-plurium. Axis perithecialis supra divergens; 2-3 plus aut minus planatis cellulis perithecium subtendentibus; axe in appendicem simplicem aut ramosum terminante, qui situm submediale in margine superiore et anteriore perithecii habet; cellulis appendicis longis et angustis (2 inferioribus parvis, subaequalibus). Perithecium latum, acutum; margine posteriore prope recto; margine anteriore bene convexo; cellulis anterioribus basalibus in aetate dissolutis. Longitudo tota ad extremitatem perithecii 90-120  $\mu$ . Perithecium (cum cellula stirpis) 45-65 X 20-30  $\mu$ ; stirpe 12-25 X 10-15  $\mu$ ; appendice 90-195  $\mu$  longo. Appendices antheriorum 30-55  $\mu$  longi. Rami libri axis principalis 120-180  $\mu$  longi. Sporae 30 X 3  $\mu$ .

Pale yellow. Primary axis consisting of six or seven cells superposed above a blackened foot and ending in usually two elongate simple branches the cells of which are relatively long and narrow. Basal cell slightly longer than broad, tapered below; the succeeding two to four cells somewhat flattened, and separating, by the formation of longitudinal septa, single smaller cells on one side, each of which, beginning with the uppermost, may give rise to a perithecial axis; the two or three cells immediately below the terminal branches and above the upper perithecial axis somewhat smaller, subequal, and each producing, on the side adjacent to the perithecial axes, an antheridial branch consisting of two to four or more small, squarish to rectangular superposed cells which bear, from their upper angles, numerous simple flask-shaped antheridia or sterile or fertile branchlets, the latter producing antheridia laterally or terminally; antheridia borne usually in groups of two to four or more. Perithecial axis diverging upward with two to three more or less flattened cells subtending the true stalk-cell of the perithecium, and ending above in a simple or branched appendage which assumes a nearly median position on the upper anterior margin of the perithecium; the cells of this appendage relatively long and narrow, except the two lowest which are rather small and subequal. Perithecium broad, tapering to the slightly distinguished, acute apex; the posterior margin nearly straight; the anterior margin strongly convex; the anterior basal cells becoming disorganized. Total length to the tip of the perithecium 90-120  $\mu$ . Perithecium, including the true stalk-cell, 45-65 X 20-30  $\mu$ ; the stalk 12-25 X 10-15  $\mu$ ; the appendage 90-195  $\mu$  long. Antheridial appendages 30-55  $\mu$  long. The free branches of the primary axis 120-180  $\mu$  long. Spores 30 X 3  $\mu$ .

The material which included the holotype (Fig. 2: U. I. No. 31,238; R. K. B. No. 1167) was removed from the elytra of *Colom* sp. (Coleoptera: Colonidae), collected by M. W. Sanderson near Fayetteville, Washington Co., Arkansas, 26 Oct., 1941; additional material has been examined which was taken from *Colom excisum* (?) Hatch collected by Dr. Sanderson at the type locality on 19 May, 1942 (paratypes, Figs. 1 and 3: U. I. No. 31, 239; R. K. B. No. 500) and 26 May, 1942 (R. K. B. No. 501).

*Colonomyces* apparently is more closely allied to *Asaphomyces* Thaxter (16)<sup>3</sup> than to any other of the described genera of the Laboulbeniales, and indeed their known representatives occur on beetles belonging to very closely related families, the Colonidae and Catopidae respectively. The receptacles of *Asaphomyces* and *Colonomyces* are very similar, consisting essentially of a series of cells superposed above a blackened foot in which one or more of the proximal cells give rise ultimately to perithecia while the more distal cells produce sterile or antheridial branchlets which in turn subtend one or more simple elongate branches.

In both *Asaphomyces* and *Colonomyces* one or more cells of the receptacle immediately above the basal cell separate, by the formation of longitudinal septa, smaller cells on one or both (in *Asaphomyces* [unpublished observation]) sides. In the former genus these small lateral cells may give rise directly to perithecia the stalk-cells of which they subtend, whereas in the latter genus these cells may each produce a secondary axis of several superposed cells a proximal cell of which gives rise to a perithecium. Thus, in contrast to the terminal perithecium of *Asaphomyces*, the perithecium of *Colonomyces* is intercalary, ultimately is subtended by a stalk of two or more cells, and bears as an appendage, on its upper anterior surface, the distal portion of the axis from which it arose.

The perithecial appendage of *Colonomyces* has no counterpart, with respect to its origin, in any other of the known genera of the Laboulbeniales. The perithecium of most species included in *Autoicomycetes* Thaxter (13, pp. 434-435; 16, pp. 355-363), *Ceratomyces* Thaxter (6, pp. 34-36; 10, pp. 372-380; 13, pp. 435-441; 16, pp. 344-354), and *Synaptomyces* Thaxter (14, pp. 217-218; 16, pp. 341-342) characteristically is armed with a multicellular appendage (three in *Synaptomyces*) of varying structure which bears a resemblance, more or less, to that found in the present genus; these appendages, however, arise as direct outgrowths from the wall-cells of the perithecium. Similarly the perithecium of representatives of many other genera in the order often possess characteristic adornments (i.e. protuberances, trigger organs, etc.) of like origin.

### *Neohaplomyces* gen. nov.

Receptaculum trium cellularum superpositarum super pedem subnigrum; cellula subbasale perithecium stipitatum in uno latere et distante ferente; cellula terminale antheridium compositum subtendente. Perithecium elongatum, cellulis stirpis et basis persistentibus; cellulis parietis in 4 ordinibus longitudinalibus utroque 4 cellularum. Antheridium elongato-ovoideum aut forma tholi, cum (a) paucis aut multis parvis cellulis antheridialibus quae sunt superpositae in ordinibus parallelibus plus minusve intra directis et in ambis lateribus cavernae centralis, ordinibus inferioribus cellula basale subtensis et ordine posteriore marginale 1-2-aliquot cellularum superpositarum in speciem sterilibus et (b) solo ordine anteriore marginale cellularum antheridialium inter ordines infimos laterales supra extenso; cellulis antheridialibus spermatia in cavernam communem emittentibus ex qua haec effugit per foramen solum plus minusve terminale; apice indurato sporae per-

<sup>3</sup>*Barbariella* Middelhoek, based on *B. tubantica* Middelhoek and Bolens (3; p. 260, Figs. 9-10), is here considered to be synonymous with *Asaphomyces* Thaxter (16; p. 310). The writer has not had an opportunity to examine the type of *B. tubantica*, but on the basis of the description and illustrations given for this species there seems to be no good reason for separating it from the type of *Asaphomyces*, *A. cholevae* Thaxter (16; p. 311, Pl. XXXIX, Figs. 12-14), which the author has seen. The writer also has collected and studied *A. cholevae* from several localities in the United States. The material on which the original descriptions of *Barbariella tubantica* and *Asaphomyces cholevae* are based was taken from very similar host species, *Catops nigricans* Spence and *C. terminans* Lec. respectively.



sistente et brevem prominentiam spinosam et subterminalem in margine posteriore formante. Sporae semel-septate.

Receptacle consisting of three cells superposed above a blackened foot; the sub-basal cell giving rise distally, on one side, to a stalked perithecium; the terminal cell subtending a compound antheridium. Perithecium elongate, stalk- and basal cells persistent; wall-cells in four longitudinal rows of four cells each. Antheridium elongate-ovoid or dome shaped, consisting of (*a*) few to many small antheridial cells which are superposed in upwardly and more or less inwardly directed parallel rows on both sides of a central cavity with the lower rows subtended by a basal cell and a posterior<sup>4</sup> marginal row of one to several superposed apparently sterile cells and (*b*) a single anterior marginal row of antheridial cells extending upward between the lowermost lateral rows; the antheridial cells discharging spermatia into a common cavity from which these escape through a single more or less terminal pore; the indurated spore apex persisting as a short spine-like process which is borne subterminally on the posterior margin. Spores once-septate.

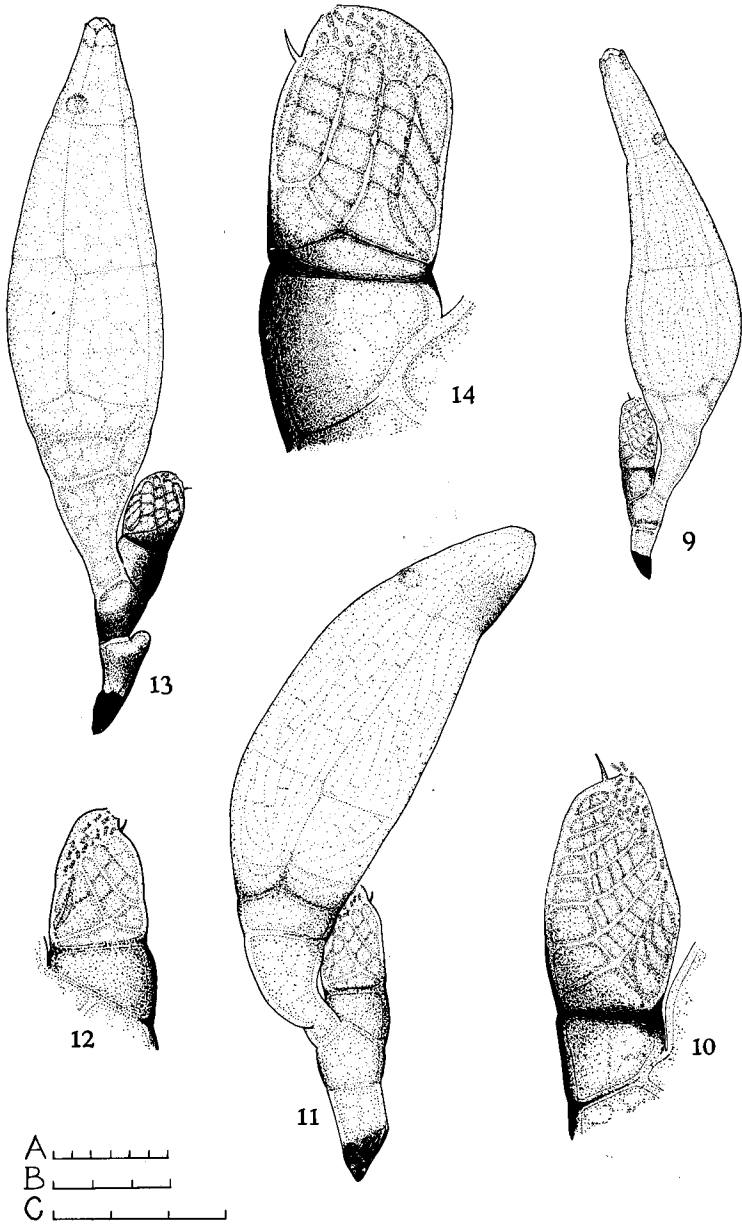
Type species: *Neohaplomyces medonalis*.

### *Neohaplomyces medonalis* sp. nov.

Cellula basalis receptaculi angusta, leviter longioris quam cellula subbasalis latior subaequalis subferruginea; cellula terminalae aequae longa et lata, obscuro-ferruginea. Antheridium latitudine duplo longiore, cum 6-8 ordinibus diagonalibus cellularum antheridialium in uno latere antheridii, utroque ordine 5-6 cellularum, ordinibus distalibus cellularum pauciorum; ordinibus proximalibus cellula basale et succedentibus 3-4 cellulis posterioribus marginalibus que subtensis; cellulis totis 2-3 ordinum terminalium specie antheridialibus; solo ordine anteriore ca. 4 cellularum antheridialium inter ordines infimos laterales supra extendentibus; spina 4.5  $\mu$  longa. Perithecium grande, ferrugineum, in regione cellularum basaliu conspicuarum obscuriore; perithecio subsymmetrico, infra inflato, quarta parte distale subito angustata; apice super cellulas labii diversas rotundato; cellula stirpis distante dimidio lata quam longa. Perithecium (cellulis basalibus inclusis) 210-240 X 65-85  $\mu$ ; cellula stirpis (supra) 45-50 X 24-27  $\mu$ . Antheridium 40-50 X 24-37  $\mu$ . Receptaculum 50-60 X 25-30  $\mu$ . Sporae 34 X 3.7  $\mu$ . Longitudo tota ad extremitatem perithecii 265-335  $\mu$ .

The basal cell of the receptacle narrow, slightly longer than the broader, nearly equal, pale orange-brown subbasal cell; the terminal cell as long as broad, dark orange-brown, as is the lower portion of the elongate-ovoid antheridium. Antheridium about two times as long as broad, with six to eight diagonal rows of antheridial cells on each side of the antheridium, each row with 5-6 cells; the distal rows with fewer cells; the proximal rows subtended by the basal cell and the succeeding three to four posterior marginal cells; all cells of the terminal two or three rows apparently antheridial; a single anterior row of about four antheridial cells extending upward between the lowermost lateral rows; the spine 4.5  $\mu$  long. Perithecium large, pale orange-yellow; darker in the region of the conspicuous basal cells; nearly symmetrical; inflated below; anterior margin slightly more convex than the posterior; tapering to the abruptly narrowed distal one-fourth; apex rounded above the tips of the slightly divergent lip-cells; stalk-cell about two times as long as it is broad distally. Perithecium, including the basal cells, 210-240 X 65-85  $\mu$ ; stalk-cell 45-50 X 24-27  $\mu$  (above). Antheridium 40-50 X 24-27  $\mu$ . Receptacle 50-60 X 25-30  $\mu$ . Spores 34 X 3.7  $\mu$ . Total length to the tip of the perithecium 265-335  $\mu$ .

<sup>4</sup>The side of the receptacle from which the perithecium arises is considered anterior.



Figs. 9-14. 9-10. *Neobaplomyces medonalis*. 9. The mature holotype. 10. Antheridial appendage; lateral view of the compound antheridium. 11-12. *N. cubensis*. 11. The mature holotype. 12. Lateral view of the antheridial appendage. 13-14. *N. neomedonalis*. 13. The mature holotype. 14. Lateral aspect of the antheridial appendage. Scale A for Figs. 9 and 13, X 250; scale B for Fig. 11, X 520; scale C for Figs. 10, 12, and 14, X 750. Each unit of the scales equals 10  $\mu$ .

Holotype on the superior surface of the abdomen of *Medon* sp. (Coleoptera: Staphylinidae) collected near Mineral, Tehama Co., California, 8 June, 1954 (R. K. B. No. 1740A), in the Mycological Collections, Rancho Santa Ana Botanic Garden; additional material, on apparently the same host species, has been examined from the following localities: Graham Mts., Graham Co., Arizona, collected by Owen Bryant, 6 Aug., 1949 (U. I. No. 21,944; R. K. B. No. 533); Evey Canyon, 4.5 mi. NNE of Claremont, Los Angeles Co., California, 25 Apr., 1953 (R. K. B. No. 1644); near Del Loma, Trinity Co., California, 12 May, 1953 (R. K. B. No. 1658) and Pigmy Forest, Mendocino Co., California, collected by J. Helfer, 28 Nov., 1953 (R. K. B. No. 1802).

*Neohaplomyces medonalis* is distinguished readily from the slightly larger *N. neomedonalis* by the structure of its antheridium and the unmodified basal cell of the receptacle. Both of these species are considerably larger than *N. cubensis*.

### *Neohaplomyces neomedonalis* sp. nov.

Cellula basalis receptaculi leviter longior quam cellula subbasalis, margine posteriore subnigro, extra et supra enascente et prominentiam conspicuam formante; cellula subbasale leviter longiore quam lata, infra nigro-fusca et opaca, suffusione supra extendente. Antheridium tholo-formatum, leviter longiore quam latum, habente: (a) 3 ordines subverticales 4-5 cellularum antheridialium in lateribus utrisque cavernae centralis cellulis basalibus et 2 posterioribus marginalibus subtensis (b) ordinem anteriorem marginalem ca. 4 cellularum antheridialium et superiorem posteriorem marginalem ca. 2 cellularum antheridialium; spina 6-7  $\mu$  longa. Perithecium grande, flavum, subsymmetricum; margine anteriore leviter convexiore quam posteriore, ad apicem rotundatum contractum; apicibus cellularum labii leviter diversis; cellula stirpis  $1\frac{1}{2}$  longiora quam lata distante; cellulis basalibus prominentibus. Perithecium (cellulis basalibus inclusis) 175-240 X 70-90  $\mu$ ; cellula stirpis 40-60 X 30-45  $\mu$ . Antheridium 45 X 30  $\mu$ . Receptaculum 65-75 X 20-30  $\mu$ . Sporae 35 X 4.5  $\mu$ . Longitudo tota ad apicem peritheci 280-360  $\mu$ .

The basal cell of the receptacle slightly longer than the subbasal, moderately suffused, posterior margin nearly black and growing outward and upward distally to form a conspicuous prominence; subbasal cell slightly longer than broad, brownish-black and opaque below, the suffusion extending upward and involving the posterior surface of the terminal cell and the base of the antheridium. Antheridium dome shaped, slightly longer than broad, consisting of (a) three nearly vertical rows of four or five antheridial cells on both sides of the central cavity which are subtended by the basal and two posterior marginal cells and (b) an anterior marginal and upper posterior marginal row of about four and two antheridial cells respectively; the spine 6-7  $\mu$  long. Perithecium large, yellow, nearly symmetrical; anterior margin slightly more convex than the posterior; tapered to the rounded apex; the tips of the lip-cells slightly divergent; stalk-cell one-half again as long as it is broad distally; basal cells prominent. Perithecium, including the basal cells, 175-240 X 70-90  $\mu$ ; stalk-cell 40-65 X 30-45  $\mu$  (above). Antheridium 45 X 30  $\mu$ . Receptacle 65-75 X 20-30  $\mu$ . Spores 35 X 4.5  $\mu$ . Total length to the tip of the perithecium 280-360  $\mu$ .

Holotype on all parts of *Neomedon arizonense* Csy. (Coleoptera: Staphylinidae) collected by Owen Bryant, Santa Catalina Mts., NE of Tucson, Pima Co., Arizona, 15 July, 1938 (U. I. No. 21,947; R. K. B. No. 874); additional material has been examined from the same host species also collected by Mr. Bryant: vicinity of the type locality on 12 Apr., 1936 (U. I. No. 21,945; R. K. B. No. 572) and 25 May,

1937 (U. I. No. 21,946; R. K. B. No. 848); Graham Mts., Graham Co., Arizona, 15 Aug., 1933 (U. I. No. 21,948; R. K. B. No. 876).

The tendency of the basal cell of the receptacle to grow upward and outward distally on the posterior side to form a conspicuous protuberance (Fig. 13) apparently is characteristic of this species, and the phenomenon has been observed in all of the specimens of the fungus which have been examined.

### *Neohaplomyces cubensis* sp. nov.

Pallido-ferrugineus; valide posteriore curvatus. Cellula basalis receptaculi leviter longiora et angustiora quam subbasalis; cellula terminalis aequale longa et lata, cellulis infimis concolore, sed superficie posteriore brunneo-tincta. Antheridium  $1\frac{1}{2}$  longiore quam latum, habente: (a) 3 ordines 2-3 cellularum antheridialium in latere utroque cavernae centralis supra et intra cellula basale et 2 cellulis posterioribus marginalibus diagonale extendentibus, (b) 2 cellulas anteriores marginales et 1-2 cellulas superiores marginales antheridiales; regione spinifera subiter concava; spina ca.  $2.5\ \mu$  longa. Perithecium infra apice pallido rotundato posteriore brunneo-suffusum et aliquid in regione cellularum basalium; margine anteriore convexo, posteriore subrecto; cellula stirpis  $1\frac{1}{2}$  longiora quam distante lata. Perithecium (cellulis basalibus inclusis) 115-125 X 42-48  $\mu$ ; cellula stirpis 30-32 X 20  $\mu$  (supra). Receptaculum 34-38 X 14-17  $\mu$ . Antheridium 23-24 X 15-17  $\mu$ . Sporae 34 X 3.1  $\mu$ . Longitudo tota ad extremitatem perithecii 165-180  $\mu$ .

Pale orange-yellow; rather strongly curved posteriorly. The basal cell of the receptacle slightly longer and narrower than the subbasal; the terminal cell as long as broad, concolorous with the lower cells, except the posterior surface which is more or less suffused with brown. Antheridium about one-half again as long as broad, consisting of (a) three rows of two to three antheridial cells on each side of the central cavity which extend obliquely upward and inward from the basal cell and two posterior marginal cells and (b) two anterior marginal and one or two upper posterior marginal antheridial cells; the spiniferous region rather abruptly concave; the spine about  $2.5\ \mu$  long. Perithecium posteriorly suffused with brown immediately below the pale, rounded apex; somewhat suffused with brown in the region of the basal cells; anterior margin convex, the posterior nearly straight; stalk-cell one-half again as long as it is broad distally. Perithecium, including basal cells, 115-125 X 42-48  $\mu$ ; stalk-cell 30-32 X 20  $\mu$  (above). Receptacle 34-38 X 14-17  $\mu$ . Antheridium 23-24 X 15-17  $\mu$ . Spores 34 X 3.1  $\mu$ . Total length to the tip of the perithecium 165-180  $\mu$ .

Holotype on the right, posterior, superior surface of the abdomen of *Medon schwartzii* Blackwelder (Coleoptera: Staphylinidae), collected by H. B. Mills, near Cienfuegos, Cuba, 1 June, 1950 (U. I. No. 31,240; R. K. B. No. 1579).

Pertinent stages in the development of the individual of *Neohaplomyces medonalis* from the 2-celled spore are essentially as follows:

The basal cell of the spore (Fig. 15, b) becomes separated, by the formation of a nearly median transverse septum and a more distal diagonal septum, into three superposed cells (Fig. 16, c, d, e) which constitute the receptacle. The lowermost cell (c) becomes blackened basally as it forms a typical foot by which the fungus is attached to the host; the distal cell (e) undergoes no further differentiation except for increase in size and serves as the supporting cell of the compound antheridium. The latter is derived from the terminal cell of the spore (Fig. 15, a) as described below; the median cell (d) grows upward and outward on one side (considered anterior), and a small cell (Fig. 17, f) is cut off from its upper angle. The female sex-

ual apparatus and the perithecium together with its stalk- and basal-cells are derived ultimately from cell *f*. While material sufficient for a complete study of all stages in the development of the perithecium of this species has not been available, the initial and final structure of the perithecium (Figs. 23, *per*, and 9) would seem to indicate that its development does not differ fundamentally from that which has been described previously for other members of the order (*Stigmatomyces*: Thaxter, 1896 (10); *Laboulbenia*: Thaxter, 1896 (10); Faull, 1912 (2); Benjamin and Shanor, 1950 (1); *Peyritschella*: Thaxter, 1896 (10); and *Filariomyces*: Shanor, 1952 [4]).

As the receptacle and perithecial primordium develop from the basal cell of the spore, there is a concomitant development of the compound antheridium (Fig. 23, *antb*) from the terminal cell of the spore which proceeds at such a rate that spermatia (Fig. 23, *sp*) are being discharged by the time the female sexual apparatus, or procarp, is mature. The latter, at this stage of development (Fig. 23), consists of a receptive organelle, the trichogyne (*tr*), a trichophoric cell (*tc*), and a carpogenic cell (*cp*). The carpogenic cell eventually produces the ascogonium which in turn gives rise to the ascogonic cells and asci. For detailed accounts of the development of the perithecium in other species see the references cited above.

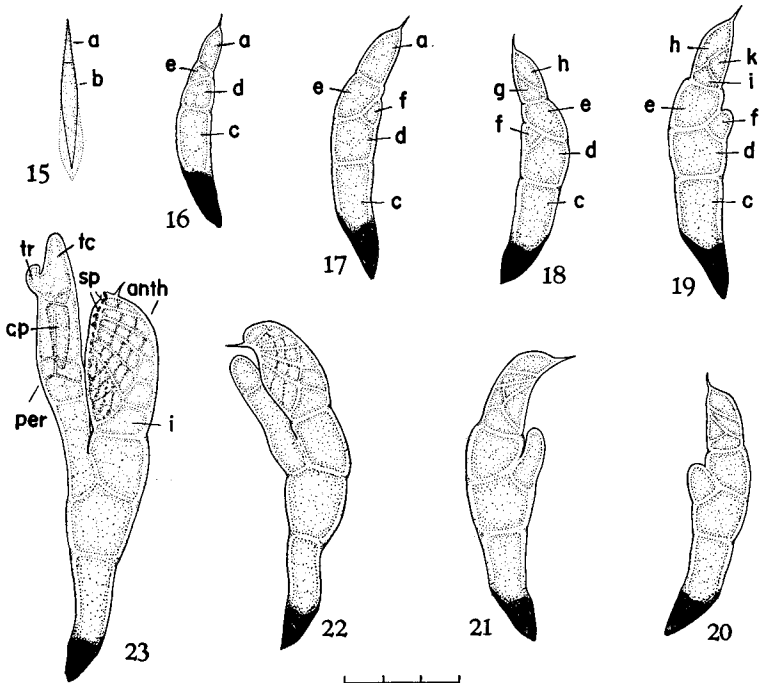
The initial step in the formation of the antheridium usually takes place when development has reached the stage shown in Fig. 17 at which time the terminal cell of the spore undergoes a single division and is separated into two by a diagonal septum as shown (Fig. 18, cells *g* and *b*). Division of cell *g* results next in the formation of cells *i* and *k* (Fig. 19) which are separated by a cross-wall laid down more or less perpendicularly to the septum between cells *g* and *b* (Fig. 18). Cell *i*, the basal cell of the antheridium (Fig. 23), remains unchanged, except for enlargement, throughout further development of the individual. Cell *k* appears to give rise to three rows of antheridial cells, of which one row lies on each side of the central cavity and one row between these and to the front (Figs. 10 and 23). Each row consists of up to four superposed antheridial cells. The remainder of the antheridium is derived from cell *b* (Figs. 18 and 19) following a sequence of divisions (Figs. 20-23) which produces a single distal row of about two antheridial cells and from five to six rows of antheridial cells on each side which extend diagonally upward and around the central cavity into which the spermatia are discharged. A single posterior marginal row of three to four superposed apparently sterile cells subtends the lower three to four rows of antheridial cells. The indurated spore apex remains as a conspicuous spine-like process located posteriorly to the pore which is formed distally in the antheridium and through which the spermatia pass to the outside.

The structure and origin of its compound antheridium suggests a rather close alliance of *Neobaploomyces* to the following group of apparently related genera of monocious Peyritschellaceae which is parasitic on Coleoptera: *Camptomyces* Thaxter (on Staphylinidae); *Cantharomyces* Thaxter (on Staphylinidae, Dryopidae, Hydrophilidae, and Byrrhidae); *Eucantharomyces* Thaxter (on Carabidae); *Haploomyces* Thaxter (on Staphylinidae); *Eubaploomyces* Thaxter (on Staphylinidae); *Porophoromyces* Thaxter (on Pselaphidae); and possibly *Polyascomyces* Thaxter (on Staphylinidae). All of these genera have in common a three-celled receptacle in which the subbasal cell gives rise to a stalked perithecium and the terminal cell subtends a more or less simple appendage which produces a compound antheridium variously formed by the repeated subdivision of a single cell. The nature of the antheridium of *Polyascomyces* (11, pp. 414-415; 13, pp. 299-300, Pl. 37, Figs 1-2)

is not fully known, and the genus was placed by Thaxter (16, p. 31) in this generic complex only provisionally.

*Cantharomyces* (5, pp. 9-10; 7, pp. 161-162; 10, pp. 271-273, Pl. 7, Figs. 11-24; 13, pp. 281-282, Pl. 37, Figs. 5-6; 16, pp. 20-31, Pl. 1, Figs. 1-15 and Pl. 2, Figs. 9-18) is somewhat more generalized than the other members of the above group in that the antheridium subtends two to several more or less elongate cellular branches of indeterminate length. In this genus the basal cell (and the next one or two cells above it in certain species parasitic on Dryopidae) of the appendage divides into two parts longitudinally or obliquely, one of which forms the compound antheridium by further subdivisions into numerous small antheridial cells which discharge spermata into a common cavity from which these are released through a single lateral pore.

In *Haplomyces* (7, pp. 159-161; 10, pp. 269-271, Pl. 7, Figs. 1-10; 16, p. 31) the antheridial appendage, which, as in the other genera being considered here, is derived from the terminal spore segment, consists only of a small spinose cell subtended by a relatively large compound antheridium composed of numerous small irregularly arranged antheridial cells surrounding a central cavity which opens distally by a single pore. This arrangement of antheridial cells is seen also in *Porophoromyces* (15, p. 550, Pl. 24, Figs. 417-418) which differs, however, in that the spermata escape through a well-developed efferent tube and the indurated spine-like spore apex subtends the antheridium directly.



Figs. 15-23. *Neobaplomyces medonalis*. Representative stages in the development of the individual. An explanation of these figures is provided in the text. All X 500. Each unit of the scale equals 10  $\mu$ .

In *Camptomyces* (8, pp. 100-101; 10, pp. 274-276, Pl. 6, Figs. 1-6; 15, pp. 547-550, Pl. 24, Figs. 403-416) and *Euhaplomyces* (12, pp. 25-26; 13, p. 281, Pl. 37, Figs. 19-21) the spore apex apparently is converted directly into the discharge pore of the antheridium, a spine being absent. The latter genus differs from the others in the greatly reduced number of antheridial cells produced. The arrangement of the antheridial cells also serves to distinguish these genera.

In *Eucantharomyces* (9, p. 480; 10, pp. 273-274, Pl. 7, Figs. 25-27; 13, pp. 275-280, Pl. 38, Figs. 1-38; 15, pp. 545-547, Pl. 23, Figs. 397-402) as in *Neobaplomyces* the antheridial cells are arranged in parallel rows which are more or less obliquely disposed on both sides of a central cavity. In *Neobaplomyces* these rows are directed diagonally upward from the posterior margin of the antheridium, whereas in *Eucantharomyces* the rows are arranged in a similar manner from the anterior margin of the antheridium. Also in *Eucantharomyces* the central cavity is bordered posteriorly by a single elongate cell which extends from the basal cell of the antheridium to the base of a well-developed terminal efferent tube through which the spermata pass to the outside. The antheridium of *Neobaplomyces* lacks such a discharge tube.

#### SUMMARY

Four new genera of Laboulbeniales, three of them monotypic, parasitic on Coleoptera are described: *Columnomyces ptomaphagi* on *Ptomaphagus* sp. (Cato-pidae); *Colonomyces appendiculatus* on *Colon excisum* (?) Hatch and *Colon* sp. (Colonidae); *Homaromyces epieri* on *Epierus pulcarius* Er. (Histeridae); and *Neobaplomyces* including *N. medonalis* (type species) on *Medon* sp., *N. neomedonalis* on *Neomedon arizonense* Csy., and *N. cubensis* on *Medon schwartzii* Blackwelder (all Staphylinidae).

The production of simple flask-shaped antheridia by the type species of *Colonomyces* places the genus in the Laboulbeniaceae as the family is defined at present. While the exact nature of the antheridia of the type species of *Colonomyces* and *Homaromyces* must be confirmed, the presence in both of structures resembling simple antheridia permits the tentative assignment of these genera to the same family. *Neobaplomyces* is included in the Peyritschiellaceae on the basis of its compound antheridium.

*Columnomyces* and *Homaromyces* do not show obvious affinities to any other of the known genera of the Laboulbeniales. *Colonomyces* appears to be closely allied to *Asaphomyces* Thaxter, although it differs fundamentally from the latter, and *Neobaplomyces* is believed to belong to a complex of apparently allied genera which includes *Camptomyces* Thaxter, *Cantharomyces* Thaxter, *Eucantharomyces* Thaxter, *Euhaplomyces* Thaxter, *Haplomyces* Thaxter, *Porophoromyces* Thaxter, and possibly *Polyascomyces* Thaxter.

*Barbariella* Middelhoek is considered to be synonymous with *Asaphomyces*.

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