

FULL PAPER

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Three species of the genus *Laboulbenia* (Laboulbeniales) parasitic on *Chydaeus bedeli* (Coleoptera, Carabidae) from Asia

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Abstract Three species of the genus *Laboulbenia* were recorded on *Chydaeus bedeli* (Coleoptera, Carabidae, Harpalini) from high-altitude localities in Asia. *Laboulbenia obtusa* was obtained from tarsi of the midlegs of the male hosts; *Laboulbenia acrogeniodontis* was on the margins of the elytra of the male and female hosts; and *Laboulbenia polyphaga* was on the elytra (near the apex) and the pronotum (at the base) of the male and female hosts. Each of the three species is distinct in the shape of the perithecia and the structure of the appendages.

Key words Asia · Carabidae · *Chydaeus* · *Laboulbenia* · Taxonomy

Introduction

Species of the Laboulbeniales, particularly of the genus *Laboulbenia*, frequently occur on ground beetles (Coleoptera, Carabidae). *Chydaeus bedeli* Tschitschérine, a harpaline carabid, is distributed widely in Asia, inhabiting high mountains, where it is sometimes found under stones or moist leaf litter (Ito 2003). Thaxter (1899, 1908) described two species of *Laboulbenia* from this carabid species (as *Aerogenidion bedeli* Tsch., an error for *Acrogeniodon*), probably from China. In addition, he reported *L. polyphaga* Thaxter from this host. Since then, few records of the Laboulbeniales on *Chydaeus* have been published (Balazuc 1972, 1975, 1979).

Through the courtesy of Mr. Noboru Ito, I examined 35 specimens of *Chydaeus bedeli* in Ito's collection in search of Laboulbeniales, and obtained fungus material from five males and four females of the hosts. These fungi correspond to the species of *Laboulbenia* on *C. bedeli* reported by

Thaxter (1899, 1908), i.e., *L. acrogeniodontis* Thaxter, *L. obtusa* Thaxter, and *L. polyphaga* Thaxter.

Materials and methods

The fungus-bearing hosts (numbered 1636 to 1642) with the following data were obtained from 35 specimens of *Chydaeus bedeli* in Ito's collection: 5♂♂ (1637, 1638, 1639, 1641, and 1642) Yunnan, Hengduan, 3700 m alt., July 10–13, 1996, O. Semela leg.; 1♀ (1635) Sichuan, Muli (Bowa), 3100 m alt., June 30, 1998, J. Turna leg.; 2♀♀ (1640, 1642) West Sikkim, Bakkhim near Yuksam, 2670 m alt., Sept. 13, 1983, M. Sakai leg.; 1♀ (1636) West Bengal, Tiger Hill, Darjeeling District, 2550 m alt., Oct. 10, 1983, M. Sakai leg.

Fungal thalli were removed with a fine needle, put on a glass slide with a small drop of glycerol, and covered with a coverslip (for detailed instructions, see Benjamin 1971; Tavares 1985). Each of the slides was observed under a microscope at a magnification of 100–400×. Fungal specimens studied for the present article are preserved in TNS (Department of Botany, National Science Museum, Tokyo).

Taxonomy

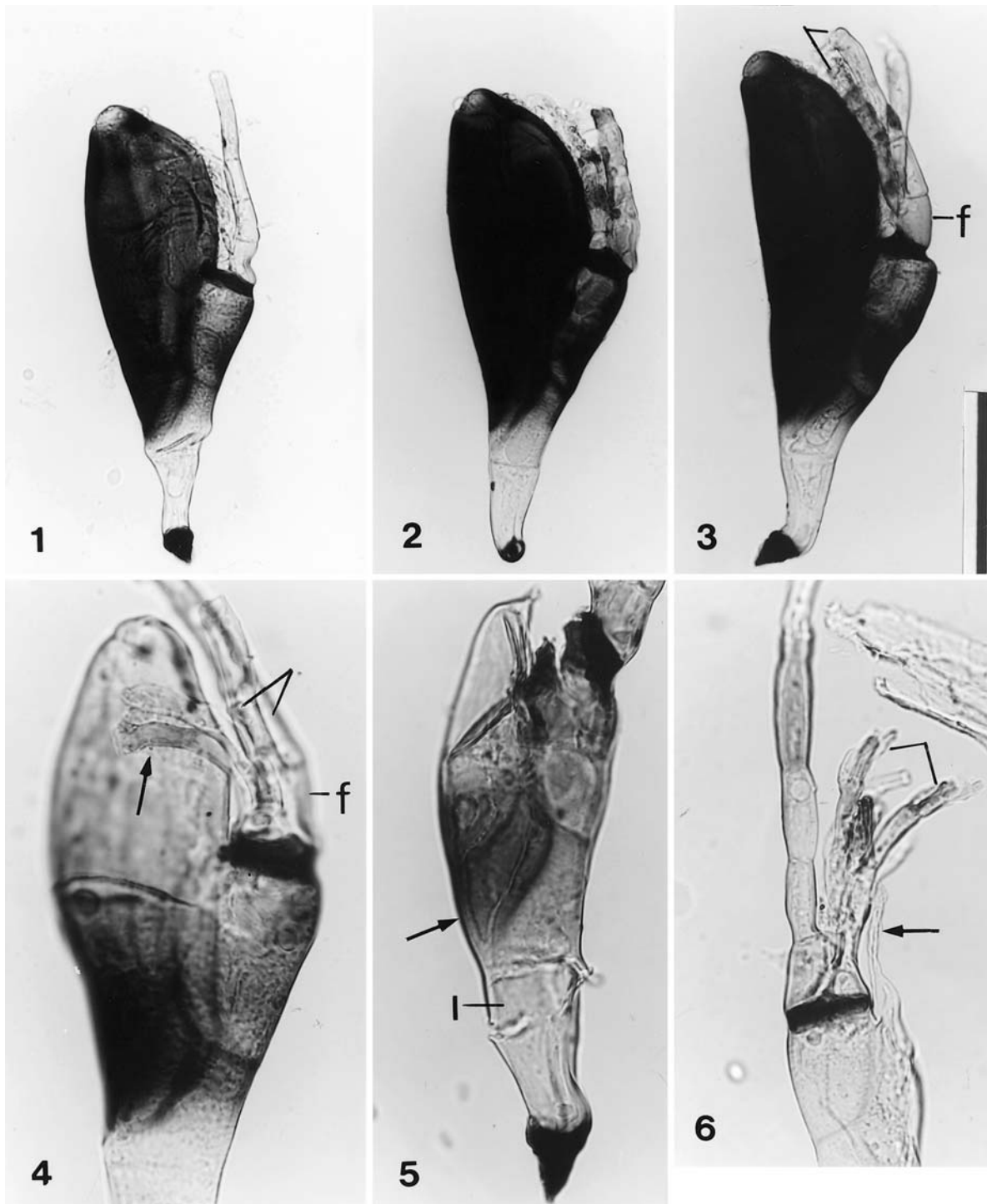
Laboulbenia obtusa Thaxter, Proc. Amer. Acad. Arts Sci. 35: 189, 1899. Type: No. 198, Paris Museum, on left inferior margin of prothorax of *Chydaeus bedeli* Tschitschérine [Carabidae, Harpalini], Mon-Pin, China (?) (host-label misread by Thaxter as *Aerogenidion*).

Figs. 1–6

Specimens examined. K. Terada 1637, 1638, 1639, 1641, and 1642.

Measurements. Total length to tip of perithecium 250–270 μm; perithecia 140–155 × 65 μm; appendages 120–190 μm long (upper portion of branches almost always broken).

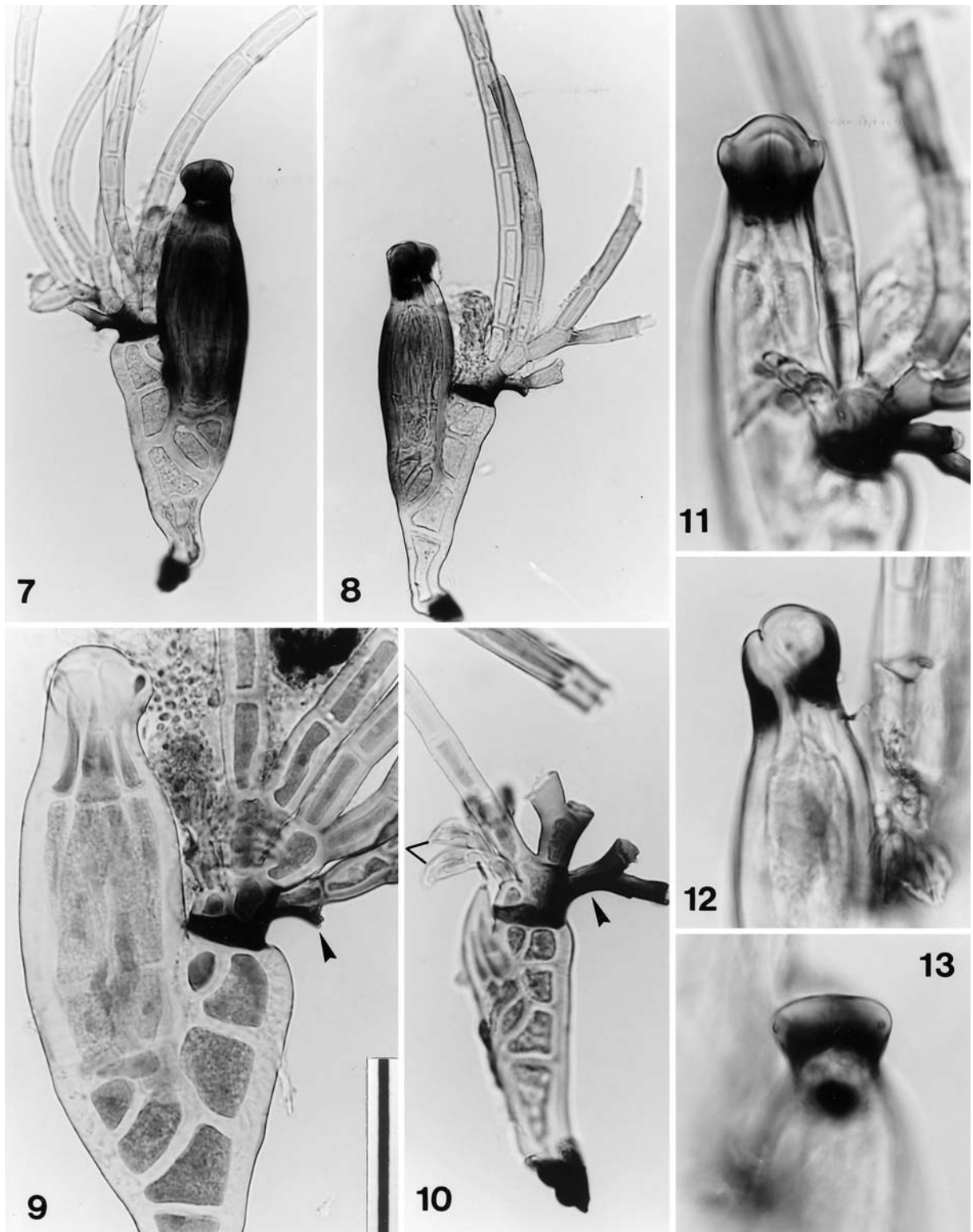
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Figs. 1–6. *Laboulbenia obtusa*, K. Terada 1637, 1638, and 1639. **1–3** Mature thalli. Two branches from cell *f* are indicated by *V*-line in **3**. **4–6** Young thalli with immature perithecia. **4** Arrow indicates inner appendage bending toward perithecium. Two branches from cell *f* are indicated by *V*-line. **5** Arrow indicates narrow oblique cell *VI* whose lower end approaches upper end of cell *I*. **6** Arrow indicates trichogyne with no black septa. Antheridial clusters are indicated by *V*-line. Bars **1–3** 100 μ m; **4–6** 50 μ m

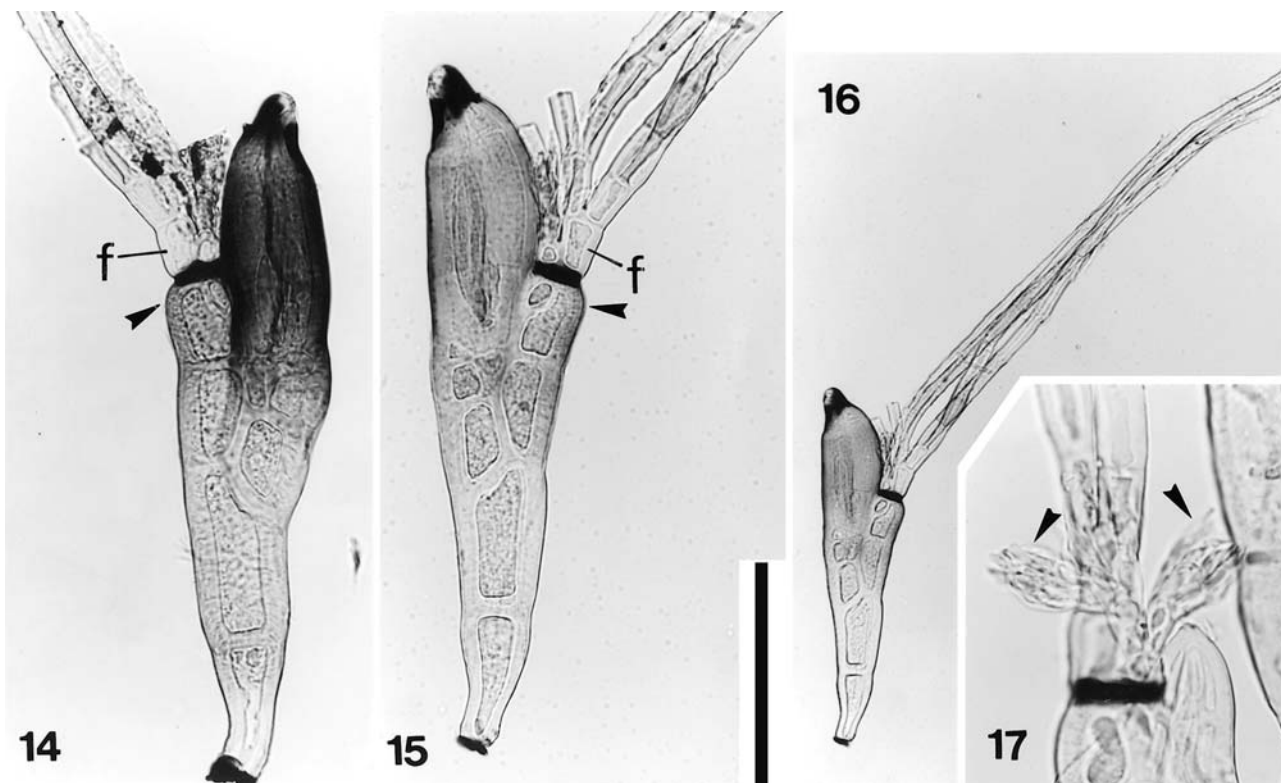
Note. My specimens obtained from *Chydaeus bedeli* agree well with the original description of *L. obtusa* Thaxter and an illustration given by Thaxter (1908, pl. 54, fig. 1), in which the large perithecium with rounded apex and contrasting short and narrow receptacle are characteristic for this fun-

gus (Figs. 1–3), although there is a similar tendency among tarsicolous species of the genus *Laboulbenia* such as *L. curtipes* Thaxter and *L. minima* Thaxter (see Thaxter 1896, pl. 17, fig. 16, and pl. 21, fig. 8). In *L. obtusa*, the perithecium and the upper part of the receptacle including the insertion



Figs. 7–13. *Laboulbenia acrogeniodontis*, K. Terada 1640. **7, 8** Mature thalli. **9, 10** Young thalli with immature perithecia. **9** Arrowhead indicates black edge of the outer appendage. **10** Antheridial clusters are indicated by V-line. The outer appendage is widely blackened (arrow-

head). **11** Almost mature perithecium showing characteristic apex (anteroposterior view). **12** Same specimen as in **11** showing perithecium in lateral view. **13** Apical portion of perithecium showing the spreading posterior lip cells. Bars **7, 8** 100 μ m; **9–13** 50 μ m



Figs. 14–17. *Laboulbenia polyphaga*, K. Terada 1635, 1636, and 1640. **14, 15** Mature thalli. Outer appendage in each thallus bears a tall basal cell *f*. Cell IV in each thallus is not protruded externally (arrowhead).

16 Mature thallus with long appendages (same specimen as in **15**). **17** Young thallus showing antheridial clusters (arrowheads). Bars **16** 200µm; **14, 15** 100µm; **17** 50µm

cell are very dark and opaque (the appendages and the lower part of the receptacle are contrastively pale in color); the outer appendage looks like single (unbranched) in Figs. 1, 2 and 6, but it really divides on cell *f* (besides the outer main branch, one inner branch is formed from cell *f* sublaterally; see Figs. 3, 4, V-line); the branches of the inner appendage is formed on either side of cell *g* and these branches are much shorter than those of the outer appendage, bearing the clusters of the antheridia (Fig. 6, V-line); the appendages are curved toward the perithecium; the septa of the branches and the trichogyne are not blackened; and each of the cells in the branches is rather elongated (Figs. 4–6). In my specimens of *L. obtusa*, cell VI is very flat and oblique, adnate laterally to the side of cell II, with its lower end approaching the base of cell II (Fig. 5, arrow), although blackish opacity makes it difficult to distinguish clearly each cell shape. In Thaxter's specimen (Thaxter 1908, pl. 54, fig. 1), cell VI is more remote from the base of cell II. I found this species on the underside of the midtarsi of the male host legs, but Thaxter (1899) reported it from "left inferior margin of prothorax." I could not find any thalli of this species on the prothorax.

There are two published records of *L. obtusa* on *Dicranoncus* and *Colpodes* from Taiwan (Lee and Sugiyama 1984; Juan and Chien 1995); both hosts are carabid beetles belonging to the tribe Platynini. Probably these records are erroneous because the photographs given by the

authors show appendages and receptacles unlike those of *L. obtusa* on *Chydaeus*.

Laboulbenia acrogeniodontis Thaxter (as *L. aerogenidii*), Proc. Amer. Acad. Arts Sci. 35: 155. 1899. Orthographic correction by Benjamin, 1971, p. 130.

Type: No. 179, Paris Museum, along the margins of elytra of *Chydaeus bedeli* Tschitschérine [Carabidae, Harpalini], Mon-Pin, China (?).

Figs. 7–13

Specimens examined. K. Terada 1636, 1639, and 1640.

Measurements. Total length to tip of perithecium 210–250µm; perithecia 135–145 × 50–55µm; appendages up to 700µm.

Note. My specimens obtained from *Chydaeus bedeli* agree well with the original description of *L. acrogeniodontis* Thaxter and illustrations given by Thaxter (1908, pl. 54, figs. 4, 5). The remarkable conformation of the spreading tip of the perithecium (Figs. 7, 8, 11, 13); the clusters of antheridia (Fig. 10, V-line), and the blackish edge at the base of the outer appendage (Figs. 9, 10, arrowhead) are characteristic for *L. acrogeniodontis*. The perithecial apex sometimes looks normal in shape as shown in Fig. 12, owing to the directions to be seen. This fungus occurs on the lateral margins of elytra of both male and female hosts.

As has been pointed out by Thaxter (1908, p. 340), this species is closely related to *Laboulbenia intermedia* Thaxter

on *Anisodactylus* from Asia by reason of the similar conformation of the appendages and receptacle cells (see Thaxter, 1908, pl. 54, figs. 2, 3). *Chydaeus* and *Anisodactylus* are related genera, and both belong to the subtribe Anisodactylina.

The specific epithet “*aerogenidii*” given by Thaxter (1899) is derived from what he believed to be the host genus *Aerogenidion*. However, this generic name is incorrect; the correct name is *Acrogeniodon* Tschitschérine. Therefore, Benjamin (1971) corrected the specific name to “*acrogeniodontis*.”

Laboulbenia polyphaga Thaxter, Proc. Amer. Acad. Arts Sci. 28: 165. 1893. Type: not designated in publication, but Farlow Herbarium slide 8460 on *Olistopus parmatus* (Say) [Carabidae, Platynini], USA, was labeled as type (Tavares, personal communication).

Figs. 14–17

Specimens examined. K. Terada 1635, 1636, 1639, and 1640. *Measurements.* Total length to tip of perithecium 310–380 µm; perithecia 120–140 × 45–60 µm; appendages up to 800 µm.

Note. Thalli that I found on the elytra and the pronotum of *Chydaeus bedeli* quite resemble those of *Laboulbenia stenolophi* Spegazzini in color and form (see Terada 2001, figs. 1, 2). The appendages are very long (Fig. 16). At first, only antheridial clusters are present on the inner appendage (Fig. 17, arrowheads), but before long, branches grow out from the base of each cluster. However, I referred the specimens to *L. polyphaga* because cell IV is normal in shape (not protruded laterally below the insertion cell) and basal cell f of the outer appendage is tall (about two times longer than broad) (Figs. 14, 15).

Thaxter (1908, p. 342) listed carabid species in several genera as hosts of *L. polyphaga*, including *C. bedeli* (no. 197, Mon-Pin, China?), although he was not sure about his

identification. A thorough study of *L. polyphaga* on the various reported hosts is needed.

Balazuc (1979) described *Laboulbenia himalayensis* Balazuc from two Asian species of *Chydaeus* including *C. bedeli* from Nepal. However, this fungus seems to be identical with *L. polyphaga* on *C. bedeli* (see Balazuc 1979, fig. 3).

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References

- Balazuc J (1972) Laboulbéniales nouvelles, parasites d’Insectes. Bull Soc Entomol Fr 76(1971):226–235
- Balazuc J (1975) Diagnoses nonnullorum Laboulbenialium nuper francogallice descriptorum. Acta Mycol 11:49–57
- Balazuc J (1979) Recherches sur les Laboulbéniomycètes. IV. Descriptions de cinq espèces de Laboulbéniales. Rev Mycol 43:393–404
- Benjamin RK (1971) Introduction and supplement to Roland Thaxter’s Contribution towards a monograph of the Laboulbeniaceae. Bibl Mycol 30:1–155
- Ito N (2003) Notes on species of the harpaline subtribe Anisodactylina (Coleoptera, Carabidae) from China. Spec Bull Jpn Soc Coleopterol 6:79–86
- Juan LY, Chien CY (1995) Studies on the Laboulbeniales (Ascomycetes) of Taiwan. Biol Bull NTNU 30:11–22
- Lee YB, Sugiyama K (1984) Laboulbeniomycetes of Formosa IV. Trans Mycol Soc Jpn 25:243–248
- Tavares II (1985) Laboulbeniales (Fungi, Ascomycetes). Mycologia memoir, no. 9. Cramer, Braunschweig
- Terada K (2001) Notes on *Laboulbenia stenolophi* and *Laboulbenia anoplogenii* (Ascomycetes, Laboulbeniales). Mycoscience 42:1–9
- Thaxter R (1896) Contribution towards a monograph of the Laboulbeniaceae. Part I. Mem Am Acad Arts Sci 12:187–429
- Thaxter R (1899) Preliminary diagnoses of new species of Laboulbeniaceae I. Proc Am Acad Arts Sci 35:153–209
- Thaxter R (1908) Contribution toward a monograph of the Laboulbeniaceae. Part II. Mem Am Acad Arts Sci 13:217–469