

## Study on the Laboulbeniales (Ascomycetes) of Taiwan (II)

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### ABSTRACT

Seven species of Laboulbeniales (Ascomycetes) and one species of its ally, namely: *Amphoromorpha entomophila* Thaxter, *Dixomyces stomonaxi* (Thaxter) Tavares, *Laboulbenia balazucii* var. *exilis* Terada, *L. fasciculata* Peyritsch, *L. nebriae* Peyritsch, *L. olivaceae* Thaxter, *L. torta* Sugiyama, *Rhacomyces tenuis* Thaxter are identified and illustrated. Among these except *R. tenuis*, *A. entomophila*, *D. stomonaxi*, *L. balazucii* var. *exilis*, *L. fasciculata*, *L. nebriae*, *L. olivaceae* and *L. torta*, are described as new record from Taiwan.

**Key words:** *Amphoromorpha*, *Dixomyces*, *Laboulbenia*, Laboulbeniales, *Rhacomyces*, Taiwan.

### Introduction

The Laboulbeniales (Ascomycetes) are known as the perithecial obligate exoparasites of Arthropoda, with the exception of a small number of species found on mites (class Arachnida) and millipedes (class Diplopoda). Most of the species infesting Insecta are found on Coleoptera and Diptera that occupied more than 90% of the total species. Totally fourteen orders have been recognized (Benjamin, 1973; Lee, 1986).

All members of Laboulbeniales lack proper mycelium and their compact ascoma are organized with a receptacle which bearing one or more perithecia, antheridia and appendages. It is obvious that the base of ascoma with an important foot which can anchor the integument of the host. However, this is often reduced in size or lacking in taxa having conspicuous haustoria. Ascospores are unequally bicelled with gelatinous envelope (Tavares, 1985). Members of the Laboulbeniales are widely distributed in world and include about 2,000 known species under 133 genera (Lee, 1986). This paper is reported to continue our current works of Juan and Chien (1994 & 1995).

### Materials and Methods

Collecting insect's methods refer to Stevens (1974) and Yanz (1993). Insect specimens were observed under

a binocular dissecting microscope (WILD, M 7A) and examined the parasitization through all parts of the insect and voucher slides were made and seal with finger nail. The fungi were observed as minute, mostly less than one millimeter long, and look like hairs or bristles of the insects own. The fungi on the surface of insects were removed by a watchmaker's needle and mounted by a glycerol lactophenol plus cotton blue for preparation. All specimens and permanent slides are preserved and deposited in the Mycological Collections, Department of Biology, National Taiwan Normal University, Taipei, Taiwan, R.O.C.

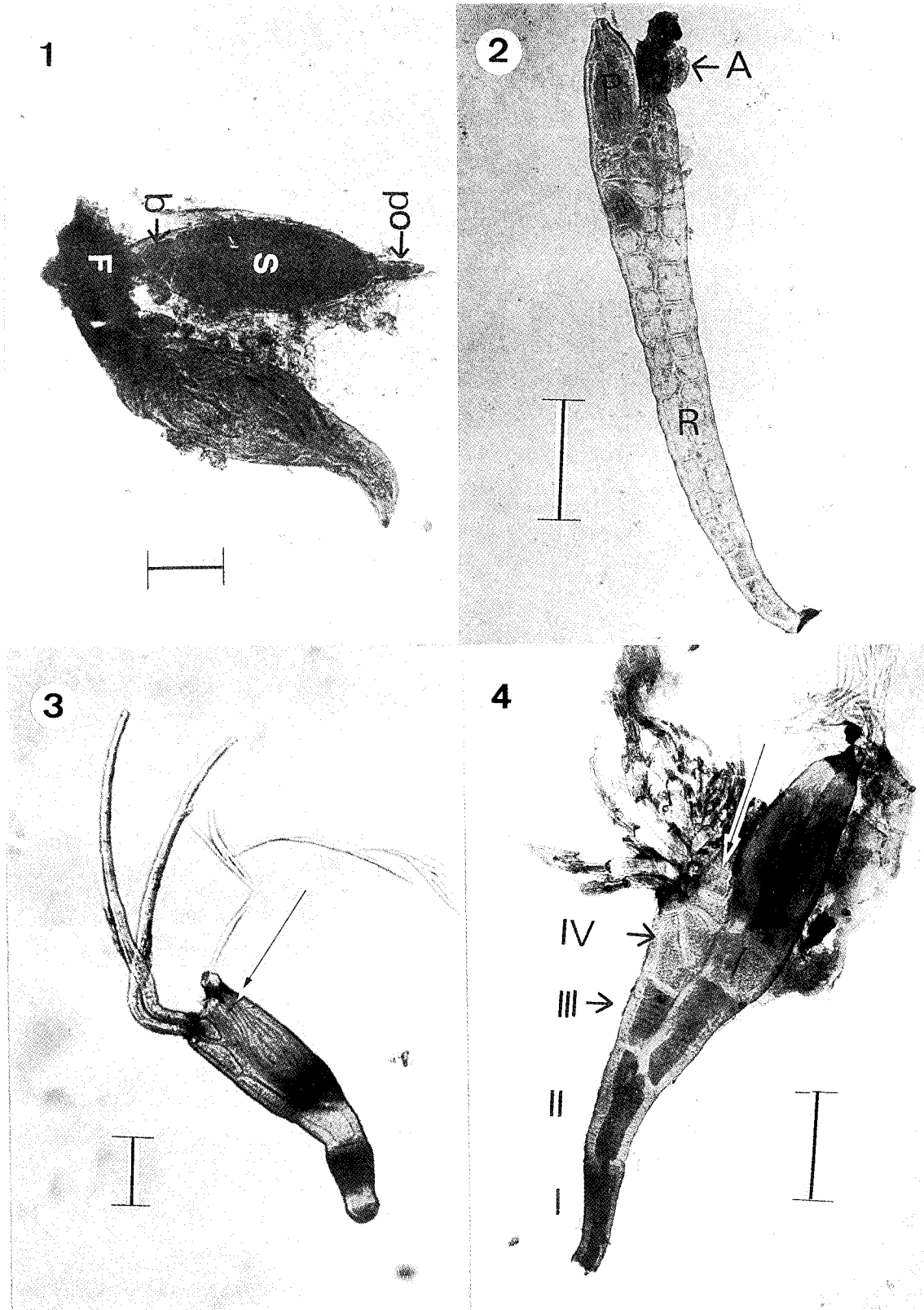
### Results and Discussion

*Amphoromorpha entomophila* Thaxter (Fig. 1)

Thaxter, Bot. Gaz. 58:251, 1914.

The fungus consisting of black foot, the body and a more slender necklike portion. The body distal region is filled with closely packed spores which discharge from the terminal necklike pore. After the discharge has taken place, the basal bell enlarges to fill the cavity. The body is long elliptical and tapering to the narrow base, the terminal neck is subcylindrical, the apex of which is slightly compressed and truncate; the foot is relatively large, somewhat spreading, black. Total length 150 $\mu$ m, the body 105 $\times$ 21-39 $\mu$ m, the neck 18 $\times$ 6 $\mu$ m, foot 30 $\mu$ m long.

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**Figure 1.** *Amphoromorpha entomophila* Thaxter. b:basal cell; F:foot; PO:terminal necklike pore; s:spaced spores. Bar=30  $\mu$ m

**Figure 2.** *Dixomyces stomonaxi* (Thaxter) Favares. A:appendages; P:perithecium; R:receptacle. Bar=100  $\mu$ m

**Figure 3.** *Laboulbenia balazucii* var. *exilis* Terada. perithecium with two small black spots (arrow). Bar=50  $\mu$ m

**Figure 4.** *L. fasciculata* Peyritsch. I:the first layer; II:the second layer; III:the third layer; IV:the fourth layer; the fourth and fifth layers of the receptacle are composed of many cells arranged in transverse series (arrow). Bar=100  $\mu$ m

**Host:** *Periplaneta americana* L. (Blattaria; Blattidae); on the bristle of antenna; parasite on the *Herpomyces periplanetae*.

**Specimens examined:** Chingmei, Taipei metropolitan (台北市景美); JLY-148, Apr. 14, 1994.

**Distribution:** Cosmopolitan.

**Note:** The fungus is known only in mature condition yet life history is not clear. Blackwell and Malloch (1989) concluded that species of *Amphoromorpha* may be the secondary capilliconidia of species of *Basidiobolus*. However, the two species of *Amphoromorpha*, which are not exactly like the capilliconidia of *Basidiobolus rnarum*. Life cycle studies can provide the evidence needed for solving the problem. The fungus parasites on a variety of beetles, a bug, cock-roaches and laboulbenialean fungi. This specimen is parasite on the *Herpomyces periplanetae*, which is a member of laboulbenialean fungi. It is well characterized by amphora-shaped body, terminally necklike pore and relatively large black foot. This specimen is new record from Taiwan.

*Dixomyces stomonaxi* (Thaxter) Tavares (Fig. 2)

Basionym: *Misgomyces stomonaxi* Thaxter

Thaxter, Proc. Amer. Acad. Arts & Sci. 35:443, 1900.

Thaxter, Mem. Amer. Acad. Arts & Sci. 13:431, 1908.

Ascoma monoecious, total length from base of foot to tip of perithecium 405-510 $\mu$ m. Receptacle 330-435  $\times$  18-54 $\mu$ m, consisting of a basal one or two more single superposed cells, the cells above these becoming rather irregularly divided longitudinally to form a double row of variable length, above which a second longitudinal division appears, the receptacle in this region being made up of three-celled tiers as far as the base of the perithecium. Distal part of the receptacle consisting of several superposed pairs of cells, or two rows of cells more irregularly distributed. The insertion of the appendages rather indefinite, the cells composing it producing irregular hyaline or brownish branches distally. Perithecium 75  $\times$  9-33 $\mu$ m, nearly straight, the inner margin convex, the tip straight or curved outward.

**Host:** *Caelostomus* sp. (Coleoptera; Carabidae); on the elytra of the host.

**Specimens examined:** Pingshi, Taipei County(台北縣平溪); JLY-156, Apr. 13, 1995.

**Distribution:** China, Madagascar, Sarawak, Sri Lanka, Taiwan.

**Note:** The fungus is characterized by the tiers of the receptacle and appendages. This specimen is new record from Taiwan.

*Laboulbenia balazucii* W. Rossi var. *exilis* Terada (Fig. 3)

Terada, Mycoscience 36:307, 1995.

Ascoma monoecious, total length 189-210 $\mu$ m. Receptacle consisting of five layers of cells; each layer one-celled except the fourth one is two-celled; the first layer 48-60  $\times$  27-33  $\mu$ m; the second layer 30-39  $\times$  30-45  $\mu$ m; the third layer 33-54  $\times$  15 $\mu$ m; the fourth layer is composed of two cells, arranged antero-posteriorly 39-48  $\times$  15-21 $\mu$ m; the fifth layer blackish and opaque 3  $\times$  12-15 $\mu$ m. Appendage consisting of two simple branches, arranged antero-posteriorly on the fifth layer of receptacle, 210 $\mu$ m long. Perithecium 75-102  $\times$  24-45 $\mu$ m, having two small blackish spots just below the subapical marking. Ascospores hyaline and narrow, 1-septate, 63  $\times$  3 $\mu$ m.

**Host:** *Epomis* sp. (Coleoptera; Carabidae); on the elytra of host.

**Specimens examined:** Shengkang, Taipei county(台北縣深坑); JLY-180, Aug. 5, 1993.

**Distribution:** Japan, Madagascar, Taiwan.

**Note:** The fungus is characterized by the simple inner and outer appendages with no visible antheridium. This specimen is new record from Taiwan.

*Laboulbenia fasciculata* Peyritsch (Fig. 4)

Thaxter, Mem. Amer. Acad. Arts & Sci. 12:350, 1896.

Sugiyama, Ginkgoana 2:51, 1973.

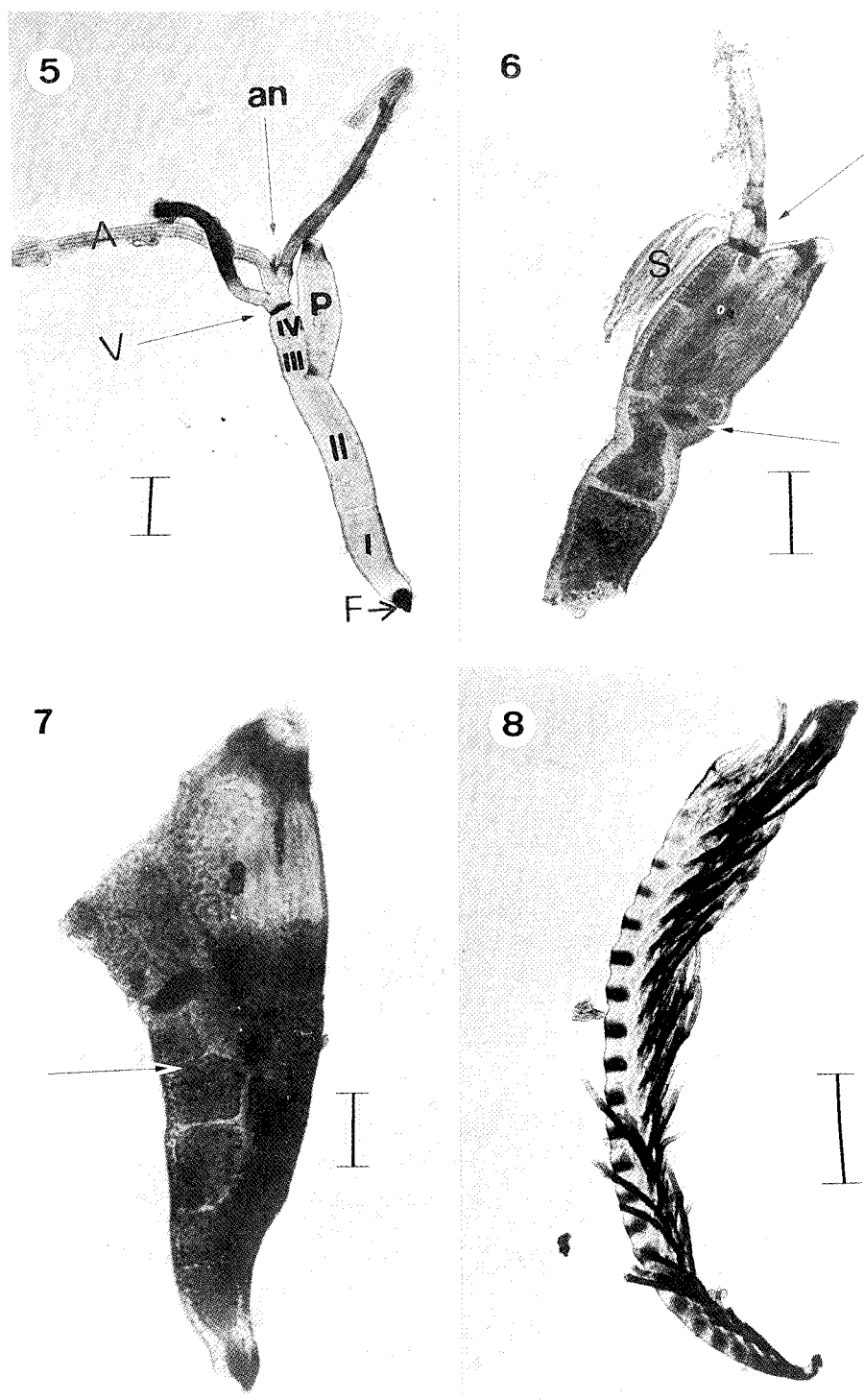
Ascoma monoecious, total length 570 $\mu$ m. Receptacle consisting of three basal one-celled layers and two distal many-celled layers; the first layer 96-135  $\times$  30 $\mu$ m; the second layer 111-126  $\times$  48 $\mu$ m; the third layer 72-90  $\times$  39 $\mu$ m; the fourth layer composed of 5-8 cells arranged in a transverse series; the fifth layer hyaline, composed of 5-8 small cells arranged in a transverse series. Perithecium elliptical, unites to the third to fifth layers of receptacle at the base, free from receptacle at about distal half portion 180-210  $\times$  78 $\mu$ m. Appendage consists of hyaline and filamentous 5-10 branches, each branches are composed of a stout basal cell and a few simple branchlets 210 $\mu$ m long, basal cell constricted at both basal and distal ends, with blackish septa.

**Host:** *Pheropsophus javanus* Dejean and *Chlaenius* sp. (Coleoptera; Carabidae); on the elytra of host.

**Specimens examined:** Shengkang, Taipei county(台北縣深坑); JLY-116, Aug. 5, 1993; Hsintien, Taipei county(台北縣新店); JLY-179, Oct. 7, 1995.

**Distribution:** Cosmopolitan.

**Note:** The fungus is characterized by the fourth and fifth layers of receptacle which are composed of many cells



**Figure 5.** *L. nebriae* Peyritsch. V:the fifth layer; an:antheridium. Bar=100  $\mu$ m

**Figure 6.** *L. torta* Sugiyama. posterior branch bent and perithecial stalk obliquely attached to the perithecium proper (arrow). Bar=30  $\mu$ m

**Figure 7.** *L. olivaceae* Thaxter. secondary division of posterior cell of the fourth layer by a horizontal septum (arrow). Bar=20  $\mu$ m

**Figure 8.** *Rhacomyses tenuis* Thaxter. Bar=100  $\mu$ m

arranged in transverse series. This specimen is new record from Taiwan.

*Laboulbenia nebriae* Peyritsch (Fig. 5)

Thaxter, Proc. Amer. Acad. Arts & Sci. 27:45, 1892.

Sugiyama, Ginkgoana 2:55, 1973.

Ascoma monoecious, total length 510-720 $\mu$ m. Receptacle consisting of five layers of cells; all layers are one-celled except the fourth one is two-celled; the first layer 150 $\times$ 54-63 $\mu$ m; the second layer 189-270 $\times$ 54-63 $\mu$ m; the third layer 48-84 $\times$ 36-39 $\mu$ m; the fourth layer is composed of two cells arranged antero-posteriorly 42-51 $\times$ 39-42 $\mu$ m, the anterior cell smaller; the fifth layer flat and blackish 6 $\times$ 30 $\mu$ m. Perithecium cylindrical, unites to the third to fifth layers of receptacle 141-210 $\times$ 54-69 $\mu$ m. Appendage consists of two branches arranged antero-posteriorly 420 $\times$ 21 $\mu$ m; the posterior branch simple or branched; the anterior branch usually branched subdichotomously, bearing one or two antheridia 30 $\times$ 6 $\mu$ m.

**Host:** *Nebria* sp. (Coleoptera; Carabidae). on the elytra of host.

**Specimens examined:** Wulai; Taipei county(台北縣烏來); JLY-151, May, 25, 1995.

**Distribution:** Europe, Japan, Korea, Taiwan, U.S.A.

**Note:** The fungus is characterized by the opacity of its perithecium and its single rigid outer appendage. This specimen is new record from Taiwan.

*Laboulbenia olivaceae* Thaxter (Fig. 7)

Thaxter, Proc. Amer. Acad. Arts & Sci. 41:315, 1905.

Thaxter, Mem. Amer. Acad. Arts & Sci. 13:360, 1908.

Ascoma monoecious, total length 120-186 $\mu$ m. Receptacle 90-120 $\mu$ m, consisting of five layers of cells; all layers composed one-celled except the fourth one is three-celled; the first layer 30-36 $\times$ 15-18 $\mu$ m; the second layer 15-21 $\times$ 15-27 $\mu$ m; the third layer 15-21 $\times$ 15 $\mu$ m; posterior(outer) cell of the fourth layer produce secondary division by a horizontal septum 21 $\times$ 18 $\mu$ m; the fifth layer is flat and blackish 6 $\times$ 15 $\mu$ m. Appendage 45 $\mu$ m long, reach about to the tip of the perithecium. or may be longer. Perithecium 75 $\times$ 54 $\mu$ m, nearly free from the receptacle, broader distally and olivaceous brown.

**Host:** *Colpodes* sp. (Coleoptera; Carabidae); on the leg of the host.

**Specimens examined:** Wulai, Taipei county(台北縣烏來); JLY-152, May, 25, 1995.

**Distribution:** Indonesia, Taiwan.

**Note:** The fungus is characterized by the regular secondary division of posterior cell of the fourth layer by a horizontal septum. Receptacle relatively small, cell of the first layer is hyaline except distally. Both of the

second layer and the third layer are dark suffusion and coarsely punctate. This specimen is new record from Taiwan.

*Laboulbenia torta* Sugiyama (Fig. 6)

Sugiyama, Trans. Mycol. Soc. Japan 20:145, 1979.

Ascoma monoecious, total length 138-159 $\mu$ m. Receptacle consisting of five layers of cells; each layer one-celled except the fourth one is two-celled; the first layer 48-51 $\times$ 21-27 $\mu$ m; the second layer 15-21 $\times$ 18-24 $\mu$ m; the third layer 30 $\times$ 15 $\mu$ m; the fourth layer composed of two cells arranged antero-posteriorly 18-27 $\times$ 15 $\mu$ m; the anterior cell smaller, subtriangular in the lateral view; the fifth layer blackish, opaque 3 $\times$ 9 $\mu$ m. Perithecium 60-75 $\times$ 24 $\mu$ m, unites to the third, fourth and fifth layers of receptacle. Appendage consists of two simple branches, arranged antero-posteriorly on the fifth layer of receptacle; the anterior branch shorter and thinner than the posterior, bent on its basal cell in an angle; the posterior branch long and stout, 87-105 $\mu$ m.

**Host:** *Haplochlaenius* sp. (Coleoptera; Carabidae); on the elytra of host.

**Specimens examined:** Wulai, Taipei county(台北縣烏來); JLY-161, May, 25, 1995.

**Distribution:** Japan, Taiwan.

**Note:** The fungus is characterized by the stout receptacle, simple appendage and free posterior side of the perithecium from the receptacle. This fungus is closely ally to *L. exigua* Thaxter, but can be distinguished from the latter by the following respect: 1. in the former, the anterior branch of receptacle is distinctly shorter than the posterior, and strongly and posteriorly bent; while in the latter, the two branches are straight and almost equal length; 2. in the former, the perithecial stalk is obliquely attached to the perithecium proper, while in the latter, it is placed beneath the perithecium proper(Sugiyama, 1979). This specimen is new record from Taiwan.

*Rhacomycetes tenuis* Thaxter (Fig. 8)

Thaxter, Proc. Amer. Acad. Arts & Sci., 35:437, 1900.

Thaxter, Mem. Amer. Acad. Arts & Sci. 13:426, 1908.

Ascoma not maturity. Receptacle 630 $\mu$ m, very long and slender, the cells of the main axis twenty-three in number, dark reddish brown or nearly opaque, the cells increasing slightly in size from the base upward. Appendage 168 $\mu$ m, straight and appressed, not very numerous; some of the lower appendages also longer and curved conspicuously outward as the antheridia.

**Host:** *Agonum* sp. (Coleoptera, Carabidae); on the elytra of host.

**Specimens examined:** Ilan county, Taipingshan(宜蘭縣

太平山), JLY-109, Jun. 29, 1994.

**Distribution:** Java, Taiwan.

**Note:** This fungus is characterized by the long and slender receptacle with straight and subulate appendage. The locality of this specimen collected is newly recorded from Taiwan.

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# 台灣產蟲囊真菌研究 (II)

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## 摘 要

本文報導 *Dixomyces stomonaxi* (Thaxter) Tavares, *Laboulbenia balazucii* var. *exilis* Terada, *L. fasciculata* Peyritsch, *L. nebriae* Peyritsch, *L. olivaceae* Thaxter, *L. torta* Sugiyama, *Rhacomycetes tenuis* Thaxter 等七種蟲囊菌及一新記錄類似種 *Amphoromorpha entomophila* Thaxter 的鑑定並做形態及分類學上的記述。其中除了 *R. tenuis* 之外 *D. stomonaxi*, *L. balazucii* var. *exilis*, *L. fasciculata*, *L. nebriae*, *L. olivaceae* 和 *L. torta* 等六種為新記錄種類。

關鍵詞： *Amphoromorpha*, *Dixomyces*, *Laboulbenia*, Laboulbeniales, *Rachomyces*, 台灣