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A NEW SPECIES OF GENUS *LABOULBENIA* (LABOULBENIALES) ON *CRASPEDOPHORUS FORMOSANUS* (COLEOPTERA, CARABIDAE) FROM TAIWAN, WITH A NOTE ON *LABOULBENIA ASIATICA*

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ABSTRACT

Laboulbenia taiwaniana sp. nov. on *Craspedophorus formosanus* is described from Taiwan and illustrated with photographs. It is characterized by a long, asymmetrical perithecium with an oblique apex and a pale-colored lower wall, a slender, evenly tapered receptacle with cylindrical cell *I* and *II* and trapezoidal cell *IV*, well developed appendages with black septa concentrated in the basal portion of the appendage system, and especially by black septa on the distal end of cell *g*. *Laboulbenia asiatica*, which was described from an Asian carabid—"*Casnonia* sp."—in 1899 and was illustrated in 1908 by Thaxter, is reviewed and compared with *L. taiwaniana* morphologically.

Key words: Carabidae, *Laboulbenia*, Laboulbeniales, morphology, new species, Taiwan, taxonomy.

INTRODUCTION

Laboulbenia asiatica (Laboulbeniales Engler) was described by Thaxter from an Asian carabid identified as "*Casnonia* sp." in 1899. *Casnonia* is a genus in tribe Odacanthini [Carabidae], but present knowledge suggests that this genus cannot be applied to any of the species of the Asian odacanthines. Therefore, we know almost nothing about the host of *L. asiatica*, except that it apparently is a carabid belonging to Odacanthini. More recently Sugiyama (1981) reported *L. asiatica* from Taiwan; he found his specimens on *Craspedophorus formosanus* Jedlička belonging to tribe Panagaeini [Carabidae]. Juan and Chien (1995) also reported the same fungus and host species from Taiwan. However the photographs published by these authors showed that the form of the fungus was rather different from *L. asiatica* illustrated by Thaxter (1908: pl. LXV, Fig. 15). We now describe this fungus as a new *Laboulbenia* species on *C. formosanus* and discuss the taxonomic relation between *L. asiatica* and the new species.

MATERIALS AND METHODS

Fungus-bearing host specimens were found in the collection preserved in the National Taiwan University (NTU). After fungi were removed from the insect body, preparations were made following the methods introduced by Benjamin (1971). All specimens, including mature and immature thalli used in this study, have been deposited in NTU and in the first author's laboratory.

In the present paper, thallus length was measured from the foot base to the perithecial tip. The length (height) of the perithecium was measured from the lower septa of the basal cells of the perithecium to the perithecial tip; the stalk and the secondary stalk cells (*VI* and *VII*) were excluded from the height measurement of the perithecium. The width of the perithecium was measured at the middle portion of the perithecium. In terminology and abbreviations, the present paper basically follows Tavares (1985).

For the determination of the color of the thallus, fully mature thalli were examined. However, it should be noted that the color of the thallus varies somewhat depending on thallus maturation, the condition of the specimens preserved, and the light conditions under the microscope.

TAXONOMY

Laboulbenia taiwaniana K.Terada, M.H.Hsu et W.J.Wu, sp. nov.

Laboulbenia asiatica Thaxter sensu Sugiyama (1981: 311); misidentification.

Laboulbenia asiatica Thaxter sensu Juan and Chien (1995: 13); misidentification.

Thallus 400–500 μm longus. Receptaculum exilis, fulvum, in parte superna fusco-maculatum; cellula *I* cylindrica, ca. 4-plo longior quam latior; cellula *II* cylindrica, quam cellula *I* ca. 1.5-plo longior; cellula *III* longior quam latior, basin versus attenuata; cellula *IV* trapeziformis, quam cellula *III* dimidio brevior; cellula *V* cuneiformis, quam cellula *IV* dimidio parvior; cellula insertionis discoidea, nigra, prope basin perithecii locata. Appendices subhyalinae, ca. 300 μm longae, in parte inferna septis nigris, in parte superna septis hyalinis, ex cellulis *f* majore et cellulis *g* parviore constans; cellula *f* subcubica, extra denigrata, septis nigris, 3–6 ramis longis; cellula *g* cubica, septis nigris, ramis brevis; antheridia solitaria vel binata, basi septis nigris. Perithecium luteo-brunneum, prope basin pallidum, asymmetricum, plus minusve longum, 170–195 × 45–50 μm, apice obliquum et nigrum; trichogyne septis nigris; ascosporae hyalinae, ca. 50 × 3 μm. Holotypus: Taiwan, *KT 1608A* (NTU).

Thallus 400–500 μm long. Receptacle slender, yellow brown, dark-spotted in upper part; cell *I* cylindrical, about 4 times longer than broad; cell *II* cylindrical, about 1.5 times longer than cell *I*, subequal with cell *I* in width; cell *III* longer than broad, abruptly narrowed to the base; cell *IV* trapezoidal in optical section, about half of cell *III* in height; septum between cell *III* and *IV* oblique; cell *V* wedge-shaped, about half of cell *IV* in size, but subequal with cell *IV* in height, located close to the upper corner of cell *III*; cell *VI* subequal with cell *III* in size, but located at a somewhat lower level; the lower end of cell *VI* broader than that of cell *III*. Insertion cell discoid, blackened, located near the bottom of the perithecial cavity.

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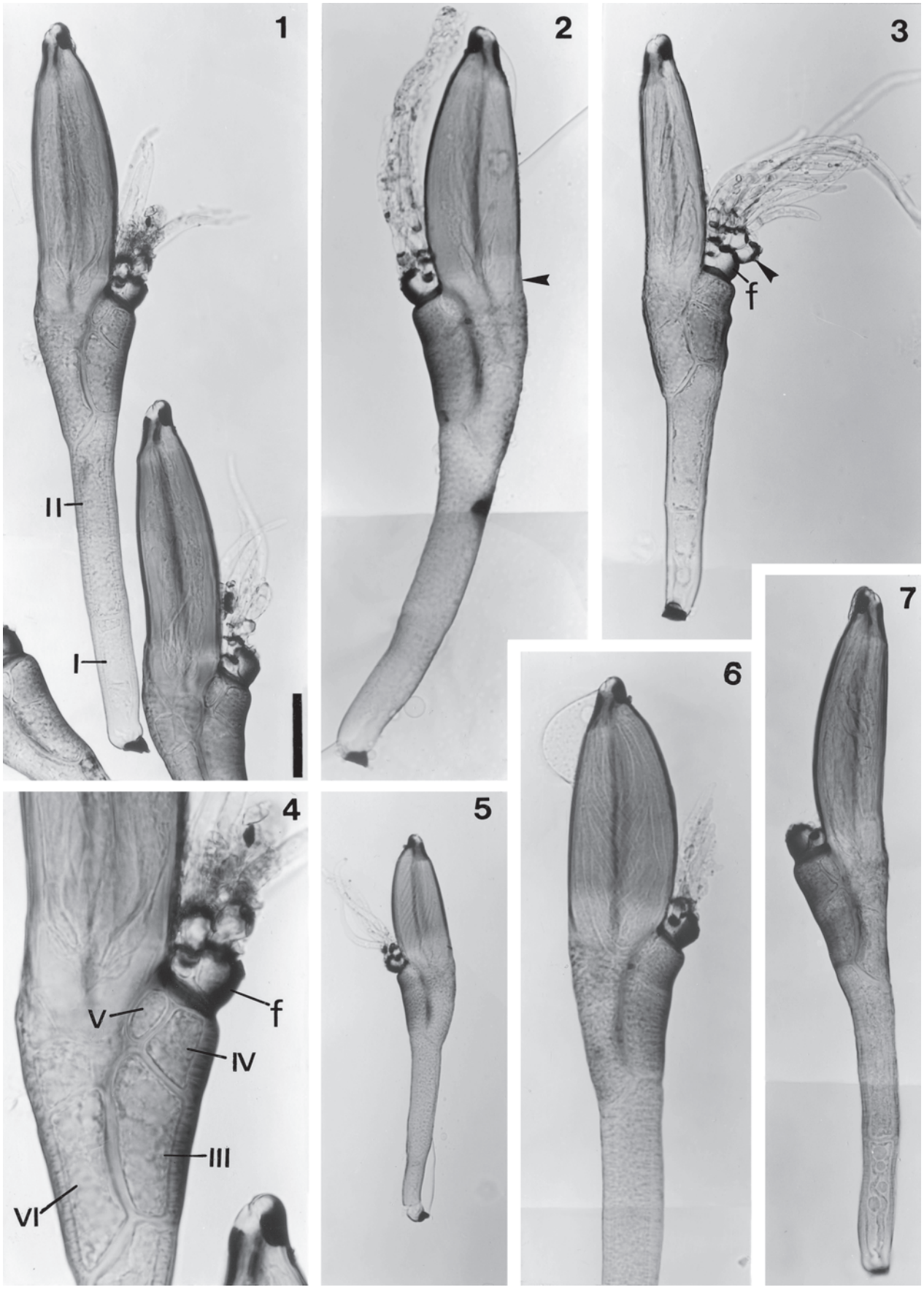
1
II
I
2
3
f
4
V
f
IV
III
VI
5
6
7

Appendages subhyaline, later becoming brownish, reaching ca. 300 μm long, with black septa only in the lower part which separate short cells, and colorless septa in the upper part which separate elongate cells, consisting of a larger outer basal cell (*f*) with 3–6 long branches in anterio-posterior arrangement, and a much smaller inner basal cell (*g*) with shorter branches. Cell *f* nearly cubical, blackened externally, having 3–6 black septa, each of which separates cell *f* from a branch of the outer appendage. The outermost branch branches dichotomously from its basal cell; this basal cell and the superposed cells are cubical or somewhat roundish. Cell *g* also cubical, having black septa, each of which separates cell *g* from a branch of the inner appendage. Usually there is only one black septum within each appendage branch, but there may be more, separating the short lower cells, especially in the inner appendage. Antheridia solitary or paired, each with a black septum at the base. Perithecium rich yellow brown, somewhat pale on the lower wall, blackened around the hyaline ostiole, asymmetrical (side view), more or less elongate (height/width = ca. 3.6), oblique at the apex, 170–195 × 45–50 μm; trichogyne with black septa; ascospores hyaline, ca. 50 × 3 μm.

Etymology.—Named for the country Taiwan.

Specimens examined.—On *Craspedophorus formosanus* Jedlička [Carabidae, Panagaeini]: Fushan, Ilan County, Taiwan, 23 Jun 1998, leg. Y. T. Lin, *KT 1608* (including holotype); same locality, 17 Jun 1996, leg. R. L. Yang, *KT 1611*, *1616*. The fungal specimens were found on the elytra and pronotum of the host body.

DISCUSSION

Laboulbenia asiatica Thaxter is a poorly known species in spite of its several distinct features. The type collection is preserved in FH, and one drawing of the thallus and an incomplete description have been published. The host identity is unknown. Thaxter (1899) provided little information about the perithecium and receptacle in his description of *L. asiatica*, although he described appendages in detail. However, the following description, which is based on Thaxter's line drawing (Thaxter 1908: pl. LXV, Fig. 15), adds to our understanding of the characteristics of *L. asiatica*.

The perithecium (height/width = ca. 2.9) is proportionately shorter than in *L. taiwaniana*, subsymmetrical, bottle-shaped (slightly inflated on both sides), and the outer wall cells at the apex are of equal breadth and extend the same distance (in *L. taiwaniana*, one side extends farther, so the apex is oblique). The color of the perithecium was described as "somewhat smoky brown" in the middle portion, and "dirty brownish yellow" in the lower portion (Thaxter 1899, 1908); the size of the perithecium was measured as 140 × 45 μm. Of the receptacle cells, cell *I* is abruptly narrowed to the base; cell *II* is about 2.5 times longer than cell *I*; cell *III* is about 2 times longer than broad; cell *IV* is also longer than broad and a little shorter than cell *III* (in *L. taiwaniana*, this cell is markedly shorter than cell *III*); cell *V* is wedge-shaped, slightly shorter than cell *IV*, and almost reaching cell *III*; cell *VI* is subequal with cell *III* in size; the insertion cell is discoid and blackened.

With respect to the appendages, the following point should be mentioned. Thaxter (1899, 1908) described the outer and inner basal cells of the appendages as a "very large subtriangular basal cell" and "much smaller basal cell", respectively. However, the difference in size of these two cells is not shown in his illustration; what appears to be the inner basal cell is approximately the same size as the outer basal cell. This suggests that a septum may exist in the center of the cell. The presence of this septum has been confirmed by examination of the type collection by I. Tavares (pers. comm.). A somewhat thick black line on the outer basal cell in Thaxter's illustration suggests the presence of crowded black septa (also confirmed by Tavares). The shape of the outer basal cell was described as "subtriangular" (Thaxter 1908: 362), but its shape in the illustration suggests that it is very broad and somewhat rounded. In Thaxter's drawing the specimen lacks the outermost branch of the outer appendage. The longest appendage was measured as 400 μm and the total length of the thallus was measured as 400–500 μm (Thaxter 1899, 1908).

In a majority of the species of genus *Laboulbenia*, two cells stand side by side on the insertion cell (*e*). These cells are the outer basal cell (*f*) and the inner basal cell (*g*), which form the base of the appendages. Cell *f* is usually larger and cell *g* is usually smaller. Cell *g* usually produces a single branch or two obliquely ascending branches. A septum is always formed between cell *g* and the base of each branch. This septum is usually colorless, but it is distinctly black in *L. taiwaniana* (Fig. 9, 11). The blackening in this septum occurs very early in the thallus development of *L. taiwaniana* (Fig. 8). Three black septa arranged in a horizontal line on cell *g* are shown in Fig. 14. This indicates that three branches may arise from cell *g* in *L. taiwaniana*, an unusual characteristic. A similar condition can be seen in Thaxter's illustration of *L. asiatica*, but the black septa are on the upper side of what appears to be one large cell (but actually, two flat superposed cells separated by a colorless septum). Cell *f* of *L. taiwaniana* is blackened externally (Fig. 4), whereas no such blackening can be seen in Thaxter's illustration of *L. asiatica*. In *L. taiwaniana*, the basal cells of the branches of the outer appendage arranged on cell *f*

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Fig. 1–7. ***Laboulbenia taiwaniana***.—1. Mature thalli showing similar width of cell *I* and cell *II*. *KT 1608*.—2. Mature thallus with a pale-colored lower perithecial wall (arrowhead). The black spot on cell *II* was formed by accident and is not a species character. *KT 1616*.—3. Submature thallus. The basal cell of the outermost branch indicated by an arrowhead is almost as large as cell *f*. The undulation visible along the upper posterior margin of the receptacle is not a constant feature.—4. Middle part of thallus (enlargement of Fig. 1) showing cell relations from cell *III* to *VI*. Cell *f* is blackened externally. *KT 1608*.—5. Mature thallus. *KT 1616*.—6. Mature thallus bearing a somewhat inflated asymmetrical perithecium with a slightly convex posterior margin and a relatively straight anterior margin. The lower portion of the perithecium is somewhat paler in color. Many dark spots spread over the surface of the receptacle. *KT 1616*.—7. Mature thallus bearing a narrow asymmetrical perithecium. All parts of the appendages except the basal cells have broken off. *KT 1608*. (Bar = 25 μm, Fig. 4; bar = 50 μm, Fig. 1–3, 6, 7; bar = 100 μm, Fig. 5).

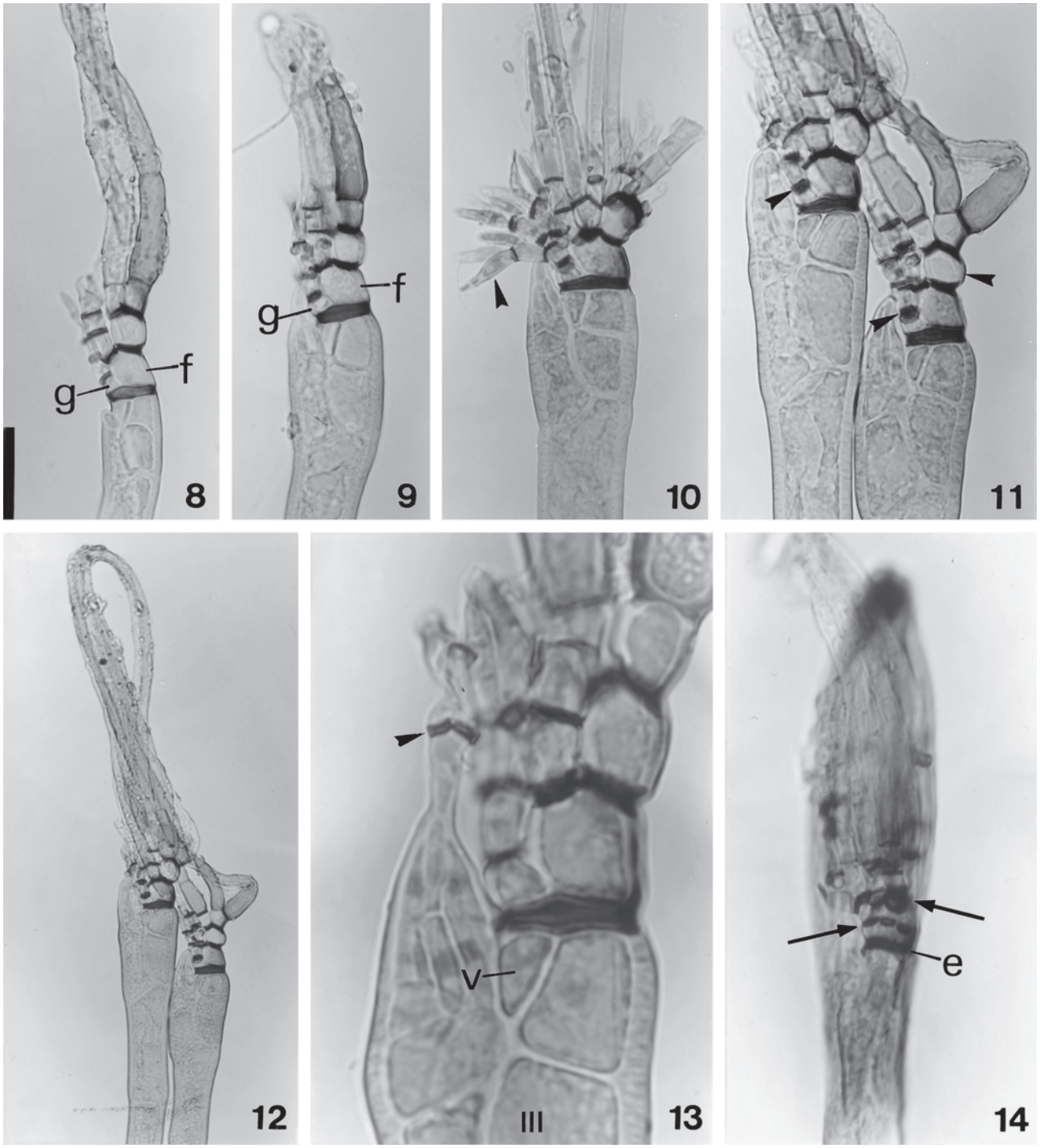

Fig. 8–14. ***Laboulbenia taiwaniana***.—8. Very immature thallus showing a short inner appendage arising from cell *g* and an outer appendage arising from cell *f*. The outer appendage consists of short cells with black septa in the lower part and elongate cells with colorless septa in the upper part. *KT 1611*.—9. Immature thallus at a slightly more advanced stage of thallus development. Cell *g* has an upper black septum that underlies the branch above. Height of cell *g* is about half that of cell *f*. *KT 1611*.—10. Immature thallus with well developed appendages. On the left side, an antheridium with a basal black septum is visible (arrowhead). *KT 1608*.—11. Two immature thalli showing the distribution of black septa. The black septum on cell *g* looks very thick because more than two septa are superimposed on one another (arrowheads at middle and on left). The basal cell of the outermost branch is large, stout, and somewhat rounded (arrowhead on right). *KT 1611*.—12. Two immature thalli (reduction of Fig. 11), showing the very long outer appendage. The black septa are only in the lower part of the appendage, separating short cells, whereas in the upper part of the appendages the cells are elongate and with colorless septa. *KT 1611*.—13. Immature thallus showing basal portion of trichogyne with black septa (arrowhead). Protoplast of wedge-shaped cell *V* is remote from cell *III*, but its outer wall almost reaches *III*. *KT 1611*.—14. Mature thallus oriented in anterio-posterior direction, showing two horizontal black lines above black insertion cell *e*; the lower line consists of three black septa on basal cell *g* (arrow on left); the upper line is formed by several black septa on cell *f* (arrow on right). *KT 1616*. (Bar = 10 μm, Fig. 13; bar = 25 μm, Fig. 8–11, 14; bar = 50 μm, Fig. 12).

are proportionately larger than those of *L. asiatica* with respect to the size of cell *f* (Fig. 3, 11).

The long, asymmetrical perithecium with an oblique apex, the slender, evenly tapered receptacle with cylindrical cell *I* and *II* (lacking the swelling at the base of cell *II* shown in Thaxter's illustration of *L. asiatica*), trapezoidal cell *IV*, and wedge-shaped cell *V* reaching cell *III* or separated for a short distance from cell *III* are also characteristic for *L. taiwaniana* (Fig. 1, 4, 5, 7, 13). However, the most distinctive character is the black upper septum (or septa) of cell *g*.

Laboulbenia taiwaniana and *L. asiatica* resemble each other in having a perithecium with a pale lower wall and well developed appendages with black septa concentrated in the basal portion of the appendage system (Fig. 2, 6, 10, 12). Presumably because of this, *L. taiwaniana* was previously misidentified as *L. asiatica* in spite of the disagreement of the host group. Thaxter's description and illustration did not make it clear that two superposed cells not separated by a black septum formed the base of the inner appendage system. If the identity of the host of *L. asiatica* were known, this added information would aid us in the elucidation of the true affinity of this fungus.

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