

## The *Entolomataceae* of the Pakaraima Mountains of Guyana 2: *Inocephalus dragonosporus* comb. nov.

DAVID L. LARGENT<sup>1</sup>, M. CATHERINE AIME\*<sup>2</sup>,  
TERRY W. HENKEL<sup>1</sup> & TIMOTHY J. BARONI<sup>3</sup>

\*maime@agcenter.lsu.edu

<sup>1</sup>Department of Biological Sciences, Humboldt State University  
Arcata, CA 95521, USA

<sup>2</sup>Department of Plant Pathology and Crop Physiology, Louisiana State University  
Agricultural Center, Baton Rouge, LA 70803, USA

<sup>3</sup>Department of Biological Sciences, State University of New York–  
College at Cortland, New York 13045, USA

**Abstract** — *Entoloma dragonosporum*, a saprotrophic agaric, is reported for the first time from the Pakaraima Mountains of Guyana, occurring on soil in tropical rainforests. Based on its stellate spores, clamp connections, mycenoid habit, appressed fibrillose pileus, and pileipellis morphology, this Singerian species is transferred from *Entoloma* to *Inocephalus*. The species is fully described and illustrated and the new combination *Inocephalus dragonosporus* is proposed.

**Keywords**—Agaricomycotina, Basidiomycota, Dicymbe, Guayana Highlands, Neotropics

### Introduction

*Entoloma dragonosporum* was first described (as *Rhodophyllus dragonosporus*) on soil from the Bolivian Amazon (Singer 1965). Subsequently, it has been reported from tropical forests in central Brazil (De Meijer 2001), on rotten wood and on soil in northern Brazil (Horak 1982, Singer & Aguiar 1986), and on rotten wood in northeastern Brazil (Wartchow 2006). Additional collections have been made in Trinidad (Baroni, unpublished), Belize (Baroni, unpublished), and in Puerto Rico (Baroni 2007). Herein, this species is reported for the first time from the Pakaraima Mountains of Guyana. It has yet to be collected or reported from North America.

Species of *Inocephalus* are recognized by their mycenoid to collybioid basidiomata with appressed fibrillose or at least not truly glabrous pilei that are often acutely umbonate. Microscopically *Inocephalus* can be differentiated from other *Entolomataceae* by its basidiospores that are often, but not always,

4-sided or stellate, hyphae of the subpellis that are indistinct from the hyphae of the pileal trama, and abundant formation of clamp connections at least on the hyphae of the pileipellis. In addition the hyphal cells of the pileal and lamellar trama are extremely long. The genus *Nolanea* can easily be confused with *Inocephalus* because of its mycenoid to collybioid stature and acutely umbonate pileus. However, *Nolanea* is differentiated by its glabrous pileus, inflated hyphae of the subpellis that are distinct from the hyphae of the pileal trama, lack of clamp connections, lack of 4-sided spores, and in most species the lack of stellate spores. Basidiomata of taxa classified into *Entoloma* s. str. are fleshier, typically tricholomatoid in stature, possess abundant clamp connections, lack 4-sided or stellate basidiospores, and possess relatively short and broad hyphae in the pileal and lamellar trama. Largent (1994) provided a more detailed discussion of the genus *Inocephalus*.

Because of its mycenoid stature, papillate umbo, large stellate spores, abundant clamp connections, long hyphal cells in the pileal and lamellar trama, and the hyphae of the subpellis that are not differentiated from the hyphae of the pileus trama, *Entoloma dragonosporum* is a good example of an *Inocephalus* species, and the new combination *Inocephalus dragonosporus* is here proposed.

### Materials and methods

Collections were made during the mid-May to mid-June rainy seasons of 2000–04 from the Upper Potaro River Basin, within a 5 km radius of a permanent base camp at 5° 18' 04.8'' N; 59° 54' 40.4'' W; elevation 710m. Collections were made in both mixed tropical forest, and in forests dominated by the leguminous, ectomycorrhizal (EM) tree *Dicymbe corymbosa* Spruce ex Benth. Macroscopic features were described fresh in the field. Colors were described subjectively and coded according to Kornerup & Wanscher (1978), with color plates noted in parentheses. Abbreviations used in specific descriptions indicate page number, the column, and the row; for example 8D-F5-6 indicates page 8, columns D to F, and from rows 5 to 6. Herbarium designations are according to Holmgren et al. (1990).

Micromorphological features of dried specimens were examined with a trinocular research-grade Nikon Labophot compound microscope fitted with light contrast optics. General techniques used follow Largent (1994); techniques used for measuring spores of *Entolomataceae* followed Baroni (1998). Digitized photomicrographs were made using a Nikon Coolpix 990 focused through the trinocular head of the compound microscope.

All microscopic measurements were obtained using a GTCO Corporation Graphic Digitizer, Model DP5A-111A connected to an IBM compatible Chem Book Laptop computer. The software utilized was Measure Me 101 v 1.0 which is modified for use on a contemporary laptop computer from a BASIC program called Metrics5 developed and provided by David Malloch, University of Toronto. The mathematical results from this program are summarized in Largent (1994). Factors determined include:  $\bar{x}$ , the arithmetic means of spore length and spores width  $\pm$  standard deviation; E, the quotient of spore length by spore width indicated as a range variation in n objects measured; Q,

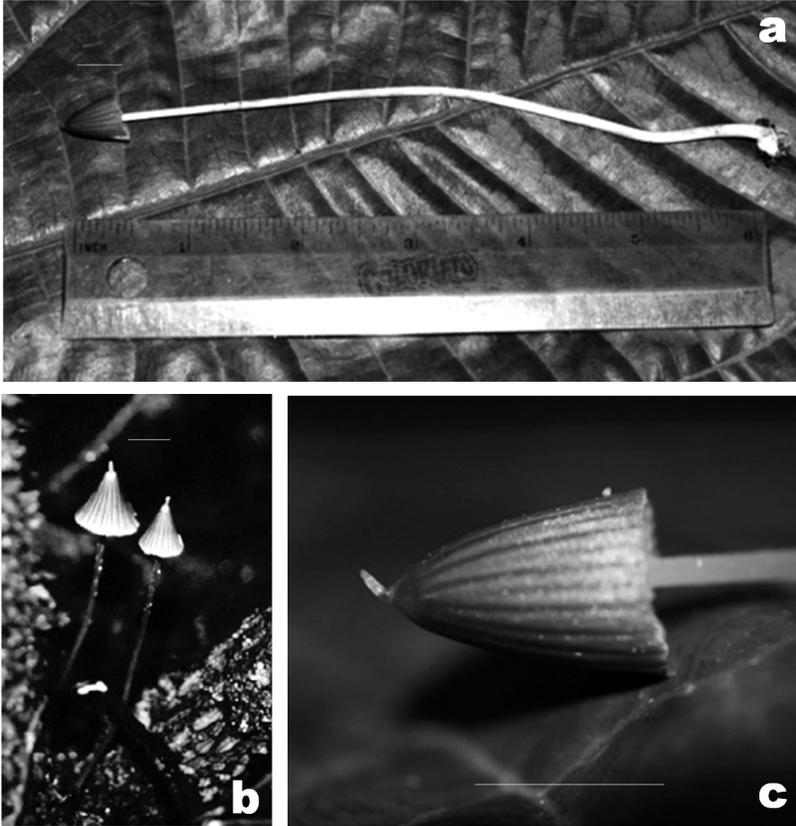


Figure 1: *Inocephalus dragonosporus* basidiomata.  
a. MCA 1563; b. field aspect (MCA 968); c. papilla (MCA 1563).

the mean of E-values  $\pm$  standard deviations, and for spores only, L-D the length-diameter of spores, and AL-D the average L-D  $\pm$  standard deviation for n spores measured; n/4 indicates the number of objects measured/in the number of collections studied.

### Taxonomy

*Inocephalus dragonosporus* (Singer) T.J. Baroni & Largent comb. nov. FIGS 1-2  
MYCOBANK MB511283

= *Rhodophyllus dragonosporus* Singer, Atas Inst. Micol. 2: 46. 1965.

= *Entoloma dragonosporum* (Singer) E. Horak, Sydowia 29: 292. 1977.

PILEUS 6–27 mm tall, 7–25 mm broad at base, conic, rounded at apex and terminated by an acute nipple-like papillus which is ephemeral with age, off-white to hyaline at first, glabrous, 1.5–2 mm  $\times$  1 mm; surface moist, brown (6E4–

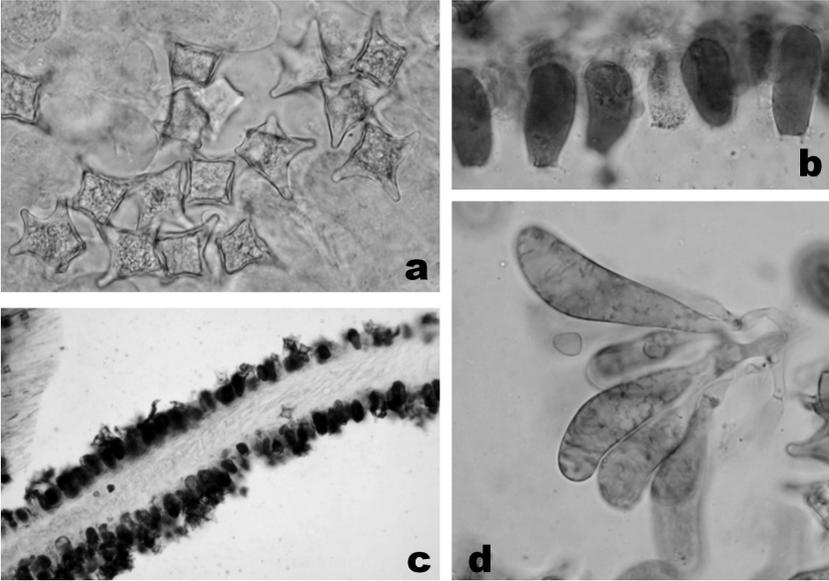


Figure 2: *Inocephalus dragonosporus* micromorphological characters. a. basidiospores (MCA 1563); b. basidia (MCA 1230); c. cyanophilic basidia (TH 8663); d. cheilocystidia (TH 8663).

5) to dark brown (5E6) throughout with darker brown translucent striations, densely radially appressed-fibrillose, fibrils longitudinally striate over entire length; pileus margin crenate to shallowly scalloped. LAMELLAE adnate to subadnexed, oriented long and almost parallel, narrow to moderately broad, 0.5–4.0 mm broad at pileus margin, 1 mm centrally, 0.5–2.0 mm at stipe apex, off-white and pinkish with age (near 5B2), sub-thick, distant; edges roughened, at times with some intervenous connections; lamellulae 0.5 mm long. STIPE 81–200 mm × 1.5–2.0 mm (centrally and at apex), broadening gradually to 2–7 mm at base, off-white, slightly graying upon pressure, fragile, smooth macroscopically but finely longitudinally fibrillose under hand lens; basal mycelium white. ODOR none; TASTE not obtained.

SPORE PRINT dull salmon pink on stipe apex. SPORES distinctly 4–5-sided, stellate in all views with extremely elongated corners and concave sides, large,  $22.6\text{--}36.7 \times 19.4\text{--}34.5 \mu\text{m}$ , ( $\bar{x} = \text{AL } 28.52 \pm 2.84 \times 27.16 \pm 3.0 \mu\text{m}$ ,  $E = 0.9\text{--}1.34$ ,  $Q = 1.05 \pm 0.08$ ,  $L\text{-}D (-) 2.64\text{--}6.56 \mu\text{m}$ ,  $\text{AL}\text{-}D 1.36 \pm 1.92 \mu\text{m}$ ;  $n/4 = 82$ ). BASIDIA; broadly cylindrical with parallel sides and a rounded base,  $38.5\text{--}66.0 \times 16.5\text{--}22.9 \mu\text{m}$ , ( $\bar{x} = 49.07 \pm 4.95 \times 19.81 \pm 1.31 \mu\text{m}$ ,  $E = 1.91\text{--}3.34$ ,  $Q = 2.48 \pm 0.31$ ;  $n/4 = 71$ ); distinctly cyanophilic in Amman's; 2–4 sterigmate; sterigmata small and indistinct. LAMELLAR TRAMA HYPHAE subparallel, some with distinct globules as seen in Amman's and KOH/Phloxine, broad with long hyphal cells,

214.5–891.1 × 9.8–32.6 µm. CHEILOCYSTIDIA abundant, forming a sterile gill edge, broadly clavate to napiform and with distinct granular contents, colorless but staining reddish in KOH/Phloxine, 39.6–104.5 × 9.1–35.7 µm. PLEUROCYSTIDIA absent. PILEPELLIS an entangled layer of hyphae on the umbo area; subpellis not differentiated from the suprapellis and intergrades imperceptibly with the pileus trama; terminal cells cylindrical to cylindro-clavate, moderately broad and long, too few to measure. PILEUS TRAMA HYPHAE with abundant globules or granules as seen in Amman's and in KOH/Phloxine; broad with long hyphal cells, 192.9–427.5 × 7.9–25.9 µm. STIPITPELLIS with rare to scattered clusters of hymenial elements, otherwise a cutis; stipe trama very broad. PIGMENTATION suggestively cytoplasmic, occasionally with minute patches of material adhering to the inner hyphal walls of the pileipellis near the subpellis region. CLAMP CONNECTIONS present but inconspicuous at the base of the basidioles, basidia, and cheilocystidia, and on the pileipellis hyphae.

MATERIAL STUDIED: GUYANA. REGION 8 POTARO-SIPARUNI: Pakaraima Mountains, Upper Potaro River, 20 km east of Mt. Ayanganna, near confluence of Potaro River and Alukyadongbaru Creek, Ayanganna airstrip, growing in shelter of standing snag, 17 May 2000, *Aime* 968 (BRG, LSU), near Potaro base camp, 14 June 2000 *Aime* 1230 (BRG, LSU), *Dicymbe* Plot 3, on soil, 18 May 2001 *Aime* 1466 (BRG, LSU), *Dicymbe* Plot 2, sheltered in hollow of standing snag, 22 May 2001, *Aime* 1563 (BRG, LSU), Mixed Forest Plot 1, 15 June 2001 *Henkel* 8147 (BRG, HSU), Mixed Forest Plot 3, 8 June 2004, *Henkel* 8663 (BRG, HSU).

HABIT, HABITAT AND RANGE: Solitary to scattered on leaf humus or soil, at times sheltered at base of standing snags or under logs in mixed tropical rainforest or in forest dominated by *Dicymbe corymbosa*. Known from central and northeastern South America (Brazil, Guyana), Caribbean Central America (Belize) and the Greater and Lesser Antilles (Puerto Rico, Trinidad).

REMARKS—*Inocephalus dragonosporus* can be recognized by its narrowly conic pileus with a hyaline to white nipple that disappears with age (Fig. 1c), extremely long and narrow stipe measuring 81–200 mm × 1.5–2 mm (Fig. 1a), unique, very large, stellate spores with 4–5 distinctly protruding angles like the corners of a pagoda (Fig. 2a), large, broadly cylindrical basidia with nearly parallel sides and rounded basal ends (Figs. 2b–c), clavate colorless cheilocystidia (Fig. 2d), and small clamp connections. Heretofore, all published illustrations of these distinctive features have been line drawings. Cheilocystidia were not mentioned or diagrammed by Horak (1977, 1982) or by Singer (1965).

*Rhodophyllus pinus* Romagn. from Madagascar is the only other species remotely similar to *I. dragonosporus* and it can be recognized by its larger pileus (30–40 × 35–40 mm), smaller basidia (32–48 × 11.5–15 µm), lack of hymenial cystidia, and much smaller spores ((12) 14–16.5 × 10–15 µm).

Of the more than 50 species of *Entolomataceae* thus far recorded from the Pakaraima Mountains (Largent et al. 2007, and unpublished), *Entoloma*

*viscaurantium* E. Horak & Singer is the only species whose spore shape remotely resembles that of *I. dragonosporus*. However, *E. viscaurantium* can easily be differentiated by its viscid, orange brown pileus, lamellae that are pale pinkish yellow at first, then yellowish-orange (4A7–8), a much shorter stipe, and smaller spores (7.8–13.6 × 7.2–12.8 μm).

### Acknowledgments

Field work in Guyana was made possible by grants from the National Geographic Society's Committee for Research and Exploration (TWH), the Smithsonian Institution's Biological Diversity of the Guianas Program (TWH), the Explorer's Club, Washington Group Exploration and Field Research Program (MCA) and a field research gift from W.K. Smith to MCA. We are grateful to Mimi Chin, Christopher Andrew, Francino Edmund, and Luciano Edmund for expert field assistance in Guyana. TJB acknowledges support from the National Science Foundation for grants DEB 0103621 and DEB 9525902, and the USDA Forest Service, Center for Forest Mycology Research, Forest Products Laboratory which provided logistical support, for making possible field work in Belize and the Caribbean to obtain additional comparative information on entolomatoid species. Finally, we thank Jean Lodge and Andy Methven for their reviews of this manuscript. This paper is No. 138 in the Smithsonian Institution's Biological Diversity of the Guiana Shield Program publication series.

### Literature cited

- Baroni TJ, Lodge DJ. 1998. *Alboleptonia* from the Greater Antilles. *Mycologia* 90(4): 680–696.
- Baroni TJ. 2007. Basidiomycetes of the Greater Antilles. [www.cortland.edu/nsf/ga.html](http://www.cortland.edu/nsf/ga.html) (uploaded on 27 April 2007).
- De Meijer AAR. 2001. Mycological work in the Brazilian state of Paraná. *Nova Hedwigia* 72 (1–2): 105–159.
- Holmgren PK, Holmgren NH, Barnett LC, eds. 1990. Index herbariorum part 1. The Herbaria of the World. 8<sup>th</sup> ed. New York: New York Botanical Gardens. 693 pp.
- Horak E. 1977. Addition to "On cuboid spored species of *Entoloma*". *Sydowia* 29: 289–299.
- Horak E. 1982. *Entoloma* in South America II. *Sydowia* 35: 75–99.
- Kornerup A, Wanscher JH. 1978. *Methuen handbook of colour*. 3<sup>rd</sup> edition. Chichester, Sussex: Richard Clay Ltd. 252 p.
- Largent DL. 1994. Entolomatoid Fungi of the Western United States and Alaska. Mad River Press Inc., Eureka, California. 495 pp.
- Largent DL, Henkel TW, Aime MC, Baroni TJ. 2007. The *Entolomataceae* of the Pakaraima Mountains of Guyana I. New species of *Entoloma* s. str. *Mycologia* (in press)
- Singer R. 1965. Interesting and new agarics from Brazil. *Atas do Instituto de Micologia da Universidade do Recife*. 2: 15–47.
- Singer R, Aguiar IA. 1986. Litter decomposing and ectomycorrhizal basidiomycetes in an Igapó Forest. *Plant Systematics and Evolution*. 153 (1–2): 107–117.
- Wartchow F. 2006. The Neotropical *Entoloma dragonosporum* (*Agaricales*, *Basidiomycota*): New Record from Northeast Brazil. *Biociências*, Porto Alegre, 14 (1): 93–94.