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Notes on two boletes with tiny basidioma in tropical China

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Abstract — Two species of boletes with minute basidioma, *Boletus coccineinanus* and *B. patouillardii*, were described and illustrated based on materials made in tropical Yunnan, southwestern China. Both of them are new to China. Comparisons to other similar species were made. *Boletus minimus*, originally described from southeastern China, is regarded as a synonym of *B. patouillardii*.

Key words — taxonomy, morphology, *Boletales*, *Basidiomycota*

Introduction

During a study of boletes from Yunnan Province, China, we came across two boletes with minute basidioma. They could easily be overlooked in the field due to their small sizes. Descriptions and illustrations for the each species are provided herein, and they are compared with similar species described from China and Japan.

Materials and methods

Revived tissues were mounted in 5% KOH for microscopic examination. The abbreviation [n/m/p] shall mean n basidiospores measured from m basidiocarps of p collections. Dimensions of basidiospores excluding the apiculus are given using notation of the form (a) b–c (d). The range b–c contains a minimum of 90% of the measured values. Extreme values a and d are given in parentheses. Q refers to the length/width ratio of basidiospores; **Q** refers to the average Q of all basidiospores ± sample standard deviation. Herbarium abbreviations follow Holmgren et al. (1990) but with one exception that is not included in Index Herbariorum: HKAS—the Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Sciences.

Taxonomy

Boletus coccineinanus Corner,
Boletus in Malaysia (Singapore): 152, Fig. 47, Pl. 11/2 (1972). Figs. 1–4

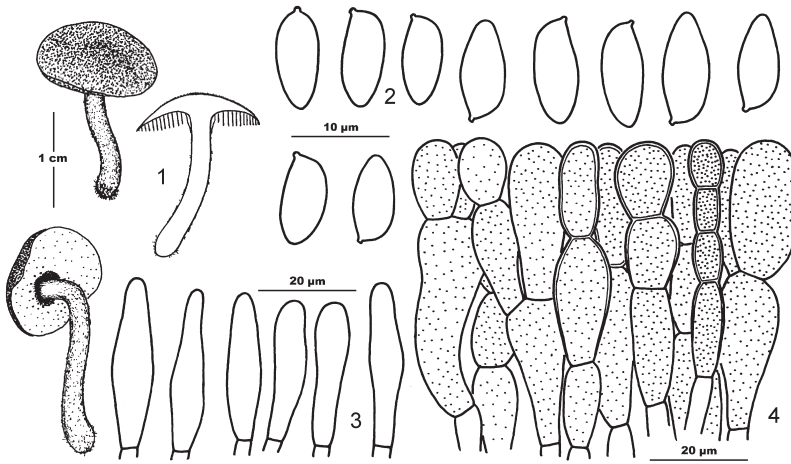
Basidiomata (Fig. 1) very small. Pileus 10–12 mm in diam., convex to plano-convex; surface dry, red to vinaceous red, often cracked into minute squamules; context white to whitish, unchanging. Hymenophore poroid, carneous, unchanging when bruised, slightly depressed around apex of stipe; pores 2–3/mm, but becoming somewhat larger towards apex of stipe; color of tubes unknown. Stipe 12–20 × 2–3 mm, subequal, often curved near apex or base, smooth, without nets, sometimes with longitudinal striations, nearly glabrous or with very small fibrillose squamules, dry, mostly concolorous with pileus, whitish at apex, with ochre to yellow mycelium at base; context yellowish but ochreous yellow at base, unchanging. Annulus absent.

Tube Trama boletoid with deep-colored mediostratum and light-colored lateral strata. Basidia 25–30 × 8–10 μm, clavate, hyaline, 4-spored, no clamps observed on basal septa. Basidiospores (Fig. 2) [35/2/1] (8) 8.5–10.5 (11) × 4–5 μm, Q = (1.55) 1.88–2.33 (2.44) (**Q** = 2.0 ± 0.17), yellowish in KOH, slightly thick-walled (< 0.5 μm), smooth, boletoid to subamygdaliform in side view and usually without a suprahilar depression, nearly ellipsoid in ventral view. Cheilocystidia (Fig. 3) 30–40 × 6–8 μm, subfusiform to narrowly clavate, thin-walled, nearly colorless and hyaline. Pleurocystidia similar to cheilocystidia in form and size, but rare. Pileipellis (Fig. 4) an epithelioid trichoderm composed of more or less vertically arranged, moniliform hyphae with ovoid, subglobose to ellipsoid, often thick-walled (up to 1.5 μm thick), reddish brown vacuolar pigmented cells (10–30 × 8–15 μm) 2–4 in chains. Clamps absent in all tissues.

Habit, habitat, distribution and season — Single or in groups, on soil in tropical forest; Tropical China, Indonesia (Corner 1974), Malaysia (Corner 1972), and Thailand (Watling 2001); August–November.

Specimen examined — **CHINA. Yunnan Province: Longchuan County**, along a roadside near Nongxianhe, alt. 1200 m, 25.VIII.2003, H. Luo *62* (HKAS 43601).

Comments—*Boletus coccineinanus* is well characterized by its very small basidioma with a red pileus, a red stipe with an ochre basal mycelium, a pink to pinkish hymenophore, relatively subamygdaliform basidiospores and an epithelioid trichoderm of the pileipellis with thick-walled cells. Corner (1972) put this species in the alliance around *B. nanus* of *Boletus* subgen. *Tylopilus*. Because molecular phylogenetic studies of many species of boletes including *B. coccineinanus* are still unavailable, we prefer to keep it in the genus *Boletus* temporarily. The characters observed from the Chinese material agrees relatively well with the protologue of *B. coccineinanus*. In the protologue the



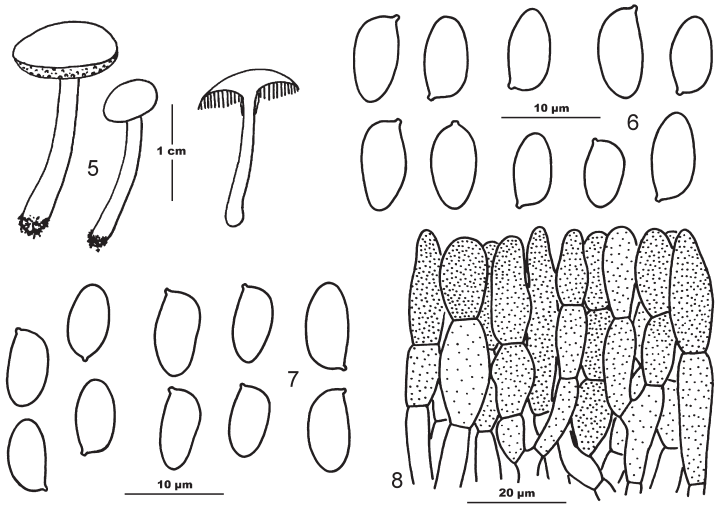
Figs. 1–4: *Boletus coccineianus* (HKAS 43601).
1. Basidiomata; 2. Basidiospores; 3. Cheilocystidia; 4. Pileipellis.

cheilocystidia were described as clavate with pink walls. The pink wall probably can only be observed in water with fresh material. In the Chinese material the pink color of the cell wall couldn't be discernible. This species has not been reported from China before (see Bi et al. 1994, 1997; Zang 2006).

Boletus patouillardii Singer, Am. Middl. Nat. 37: 55 (1947). Figs. 5–9
≡ *Porolaschia bicolor* Pat., Bull. Soc. Mycol. France 39: 54 (1923).
= *Boletus minimus* M. Zang & N.L. Huang, Acta Bot. Yunnanica 24: 723, fig. 1/1–6 (2002).

Basidiomata (Fig. 5) very small. Pileus 8–17 mm in diam., convex to plano-convex; surface dry, dark red to orange red when fresh, becoming dark brown when dried, nearly glabrous to finely tomentose; context yellowish, unchanging. Hymenophore poroid, yellowish to yellow at first, but becoming pale yellow-brown when mature, slightly depressed around apex of stipe; pores 2(3)/mm, but becoming larger towards apex of stipe and 1/mm, and often forming lamella-like "teeth" adnate to apex of stipe and, thus, hymenophore somewhat appearing decurrent. Stipe 10–20 × 1–3 mm, subcylindrical, smooth, without nets or striations, nearly glabrous or with fine fibrillose squamules, dry, vinaceous, with yellow to yellowish mycelium at base. Annulus absent.

Tube Trama boletoid with deep-colored mediostratum and light-colored lateral strata. Basidia 25–30 × 7–10 µm, clavate, hyaline, 4-spored, no clamps observed on basal septa. Basidiospores (Figs. 6–7) [63/3/2] (6.5) 7–8.5 (9) × 4–5 µm, Q = (1.56) 1.63–1.90 (2.0) (**Q** = 1.78 ± 0.11), ochreous to yellowish, slightly thick-walled (< 0.5 µm), smooth, ellipsoid to subamygdaliform in side



Figs. 5–8: *Boletus patouillardii*.
5. Basidiomata (holotype); 6. Basidiospores (holotype);
7. Basidiospores (HKAS 43602); 8. Pileipellis (HKAS 43602).

view and usually without a suprahilar depression, ellipsoid in ventral view. Cheilocystidia 30–50 × 5–8 μm, subfusiform to fusiform, nearly colorless and hyaline, thin-walled. Pleurocystidia similar to cheilocystidia in size and form, but rare. Pileipellis (Figs. 8–9) an epithelioid trichoderm composed of more or less vertically arranged, moniliform hyphal elements 2–4 in chains, 10–40 × 7–16 μm, ellipsoid, ovoid, subglobose, thin-walled with yellowish, yellow-brown to brownish vacuolar pigment; terminal ones broadly ellipsoid to subfusiform or subcylindrical, with round to obtuse apices. Clamps absent in all tissues.

Habit, habitat, distribution and season — Single or in groups, on soil in forest; Cambodia, and tropical and subtropical China; July–August.

Specimens examined — **CAMBODIA**. **Kompong Chhnang:** Forest Reserve, 1921, M. Petelot *222* (**holotype** of *Porolaschia bicolor* and *Boletus patouillardii*, FH-Pat. Herb.3644). **CHINA**. **Yunnan Province: Longchuan County**, along a roadside near Nongxianhe, alt. 1200 m, 25.VIII.2003, H. Luo *63* (HKAS 43602); **Fujian Province: Yongchun County**, Niumulin Nature Reserve, 3.VII.2001, N.L. Huang *703* (HKAS 39514, holotype of *Boletus minimus*).

Comments—*Boletus patouillardii* is well characterized by its very small basidioma with a red pileus, and a red stipe with a yellow basal mycelium, a yellowish to yellow hymenophore unchanging in color when injured, relatively short ellipsoid to subamygdaliform basidiospores and an epithelioid trichoderm of the pileipellis.

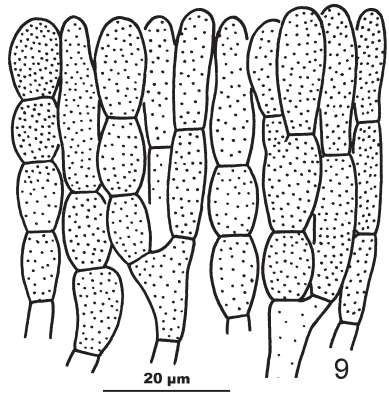


Fig. 9: *Boletus patouillardii.*
Pileipellis (holotype of *B. minimus*).

The holotype specimen did not rehydrate well, thus microscopic studies were limited. Cystidia and pileipellis were not recovered, and basidiospores were [42/2/1] (6.5) 7–9 × 4–5 µm, Q = (1.56) 1.63–1.89 (2.0) (**Q** = 1.75 ± 0.11). The name *Porolaschia bicolor* was published by Patouillard (1923), based on the same type specimen. Singer was aware that Patouillard had examined the specimen and named it as a species of *Porolaschia*, but mistakenly thought that this was merely a herbarium name (Singer 1945, 1947). *Porolaschia bicolor* cannot be recombined in *Boletus*, because the epithet is already occupied by *Boletus bicolor* Peck; thus Singer's epithet is the earliest available in *Boletus* for this taxon. Although published as a "sp. nov.", *Boletus patouillardii* should be regarded as a nom. nov. for its homotypic synonym, *Porolaschia bicolor.* This species was known only from its type collection.

Boletus minimus is apparently conspecific with *B. patouillardii* due to its minute basidioma with a red pileus, a red stipe and a yellow hymenophore. Although the base of the stipe was described as "whitish", reexamination of the holotype of *B. minimus* showed that the mycelium at the base of the stipe is yellowish. The only basidioma available for our study is unfortunately not mature. In the protologue, the basidiospores of *B. minimus* were described as "10.4–14 × 4–5.2 µm", longer than those of *B. patouillardii*. However, the line-drawings (Zang & Huang 2002, Fig. 1/4; Zang 2006, Fig. 36/4) showed that the size and the form of the spores are just within the ranges of those of *B. patouillardii*. Furthermore, the pileipellis of the holotype of *B. minimus* (Fig. 9) is very similar to that of *B. patouillardii*. Thus, *B. minimus* should be regarded as a synonym of *B. patouillardii*.

Another species with small basidiomata, *Xerocomus tengii* M. Zang et al., was described from southern subtropical China (Zang et al. 2002). Restudy

of the type of *X. tengii* (HKAS 39594) revealed that the surface of the pileus is rugulose and in some areas even distinctly reticulate, the basidiospores are 10–14 × 4–5 μm, and the pileipellis is an ixotrichoderm consisting of more or less vertically arranged, frequently septate filamentous hyphae, very similar to that of *Aureoboletus thibetanus* (Pat.) Hongo & Nagas. (Yang et al. 2003). However, cystidia with refractive substance on its surface, very characteristic for *A. thibetanus*, were not observed from the holotype.

Boletus aokii Hongo, originally described from Japan, looks like *B. patouillardii*, but differs from the latter by its basidioma becoming blue on injury, longer basidiospores, and subventricose, apically tapering terminal cells in the pileipellis (Hongo 1984).

Acknowledgments

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