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# Type study of *Calvatia lachnoderma* from Brazil

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*Calvatia lachnoderma* was described by Patouillard in 1907 based on material collected by P.F. Noack, in the State of São Paulo, southeast Brazil. The species was not considered in accounts of gasteroid fungi from Brazil, nor in recent monographs on the genus. We examined type material from Farlow Herbarium and concluded that it is a good species in the genus, based mostly on peridium texture, basidiospore size/shape and ornamentation under scanning electron microscopy (SEM). The holotype is the only available material. A description of the microscopic features is provided, as well as SEM analysis of the basidiospores and brief taxonomic discussion.

**Key words** – *Agaricomycetidae* – gasteromycetes – puffball – taxonomy

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## Introduction

In 1907, the French mycologist N.T. Patouillard described, among other fungal species, a puffball that he named *Calvatia lachnoderma*. The specimens were sent to him by P.F. Noack, who collected the type in the municipality of Araraquara, State of São Paulo, southeast region of Brazil. Since then, *C. lachnoderma* has, except for a recent checklist of the Brazilian gasteromycetes (Trierveiler-Pereira & Baseia 2009) never received any mention in the Brazilian mycological literature, even in specific studies on the genus (Silveira 1943, Baseia 2003, Cortez et al. 2012). Even Kreisel (1989, 1992, 1994), in his world accounts of *Calvatia* s.l. did not mention this species, which remains unknown since its original description by Patouillard (1907).

In the course of a survey of the gasteroid fungi from the western region of Paraná State, in southern Brazil (Alves &

Cortez 2013), we considered it relevant to study some of the species reported from the subtropical zone of Brazil, including the type material of *C. lachnoderma*. Thus, the holotype was requested in order to check its morphology, provide a modern description of microscopic data, including scanning electron microscopy (SEM) of the basidiospores, and verify the taxonomic status of the species in the light of current generic concepts.

## Methods

Specimens were borrowed from the Farlow Herbarium (FH) at Harvard University. A microscopic examination was performed with a Motic BA310 optical microscope and measurements taken from MotiCam camera and processed by software Motic Image Plus software. Scanning electron microscopy (SEM) was performed at the Center of Electron Microscopy (CME) of the Universidade

Federal do Paraná (UFPR) following methods described by Alves & Cortez (2013).

### Taxonomy

*Calvatia lachnoderma* Pat., Ann. Mycol. 5, 366, 1907. Figs 1–6

Original diagnosis (after Patouillard, 1907): “*Peridio subglobozo vel ovoideo, 3–6 cm diam., superne rotundato inferne conico, rigido, firmo, crasso, laevi, minute velutino, rufulo, frustulatim dehiscenti; basi sterili peridii tertium inferum occupante, compacta, dura, celluloso-fibrosa, albo-olivascenti; gleba pulverulenta, ochracea dein obscure rufo-ochracea; capillitio parum evoluto, ex hyphis brevibus, vix ramosis, rufo-ochraceis, 5  $\mu$  crassis formato; sporis globosis rufidulis, laevibus vel vix rugulosis, ecaudatis, 6  $\mu$  diam. Hab. ad terram.*”

Type study: Macroscopically, the material presented the following features: basidiomata subglobose with a rooting base, peridium dark brown, with a slightly velutinous texture, but without conspicuous spines, irregular dehiscence, gleba pulverulent and dark brown, subgleba fibrous to cellular and not compact, reaching about 1/3 to 1/2 of basidioma height. Basidiospores 5–6  $\mu$ m diam. (excluding ornamentation), globose to broadly ovoid in profile, in a few cases broadly ellipsoid, with strong and dense echinate ornamentation, the spines are sharp and measure up to 1.0  $\mu$ m in length; under SEM, the basidiospores present a conical spiny to verrucose ornamentation more or less connected by a gross reticulation, also a short pedicel (<1  $\mu$ m long) can be seen in some basidiospores, although it is mostly obscured among the spines. Basidia not seen. Eucapillitium 3–6  $\mu$ m diam., yellowish, filamentous, with dichotomous branches and tapering tips, pores numerous and circular, <1  $\mu$ m diam. Peridium composed by three distinct layers: 1) external layer, composed by sparse groups of elliptical to subglobose hyphae, 15–27  $\times$  12–15(–23)  $\mu$ m, pale yellowish brown, walls thickened (2–5  $\mu$ m thick); 2) middle layer, 110–150  $\mu$ m thick, formed by radially arranged hyphae, 4–7(–9)  $\mu$ m diam., yellow to yellowish brown, with slightly thickened walls; 3) internal layer, pseudoparenchymatic,

composed of hyaline, subglobose, thin-walled hyphae, 16–32(–43)  $\mu$ m diam.

Distribution – known only from type locality.

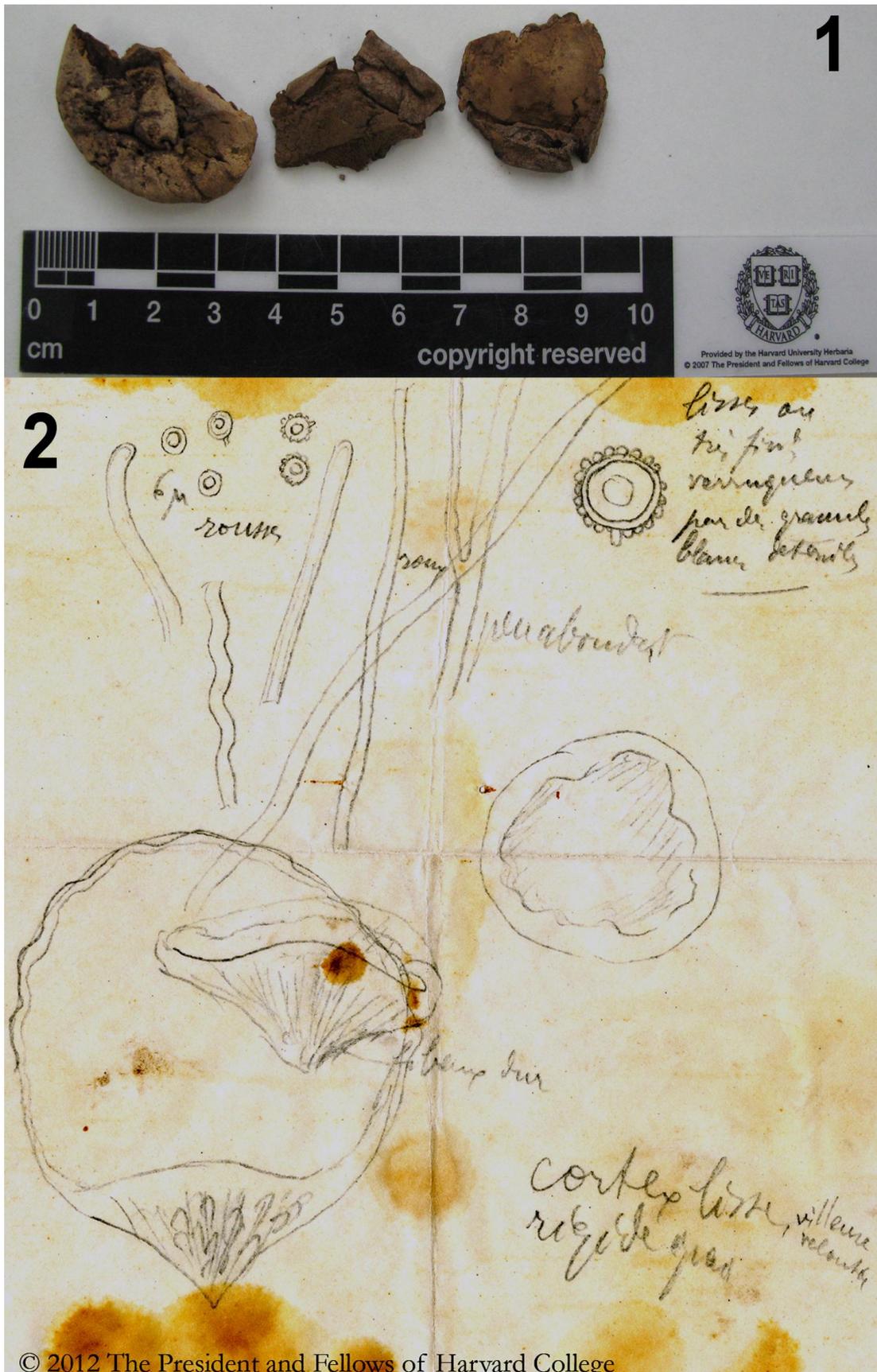
Material examined – Brazil, São Paulo State, municipality of Araraquara, “*ad terram*”, Nov 1896, leg. F. Noack 836 (HUH 00301413).

Notes – In the protologue Patouillard (1907) compared his new species to *C. hesperia* Morgan, from the USA, from which it differs in the absence of a sterile base, greenish yellow gleba, the smooth to punctuate basidiospores and eucapillitium with slit-like pores (Kreisel 1989, Zeller & Smith 1964). *Calvatia hesperia*, however, was considered in the genus *Gastropila* Homrich & J.E. Wright by Ponce de León (1976) and later in *Handkea* Kreisel by Kreisel (1989); these data obviously suggest that it is a very distinct puffball.

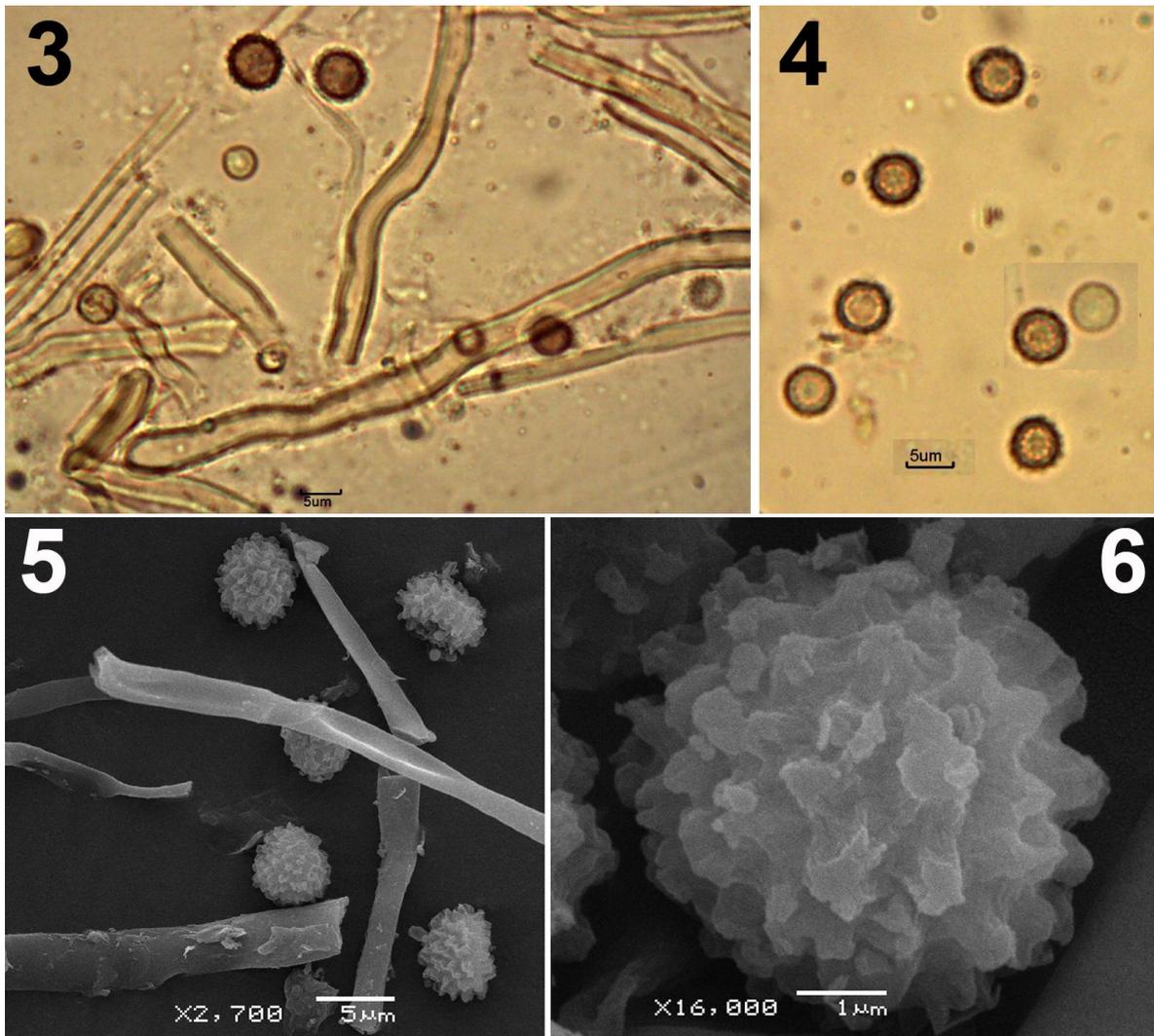
The most interesting features of *C. lachnoderma*, as mentioned in the protologue, as well according to our own observations, are the following: smooth to minutely velutinous and dark brownish exoperidium, the fibrous to cellular subgleba and the size and ornamentation of the basidiospores.

The irregular dehiscence of the peridium, the medium-sized (about 1/3 of basidioma height) and fibrous to cellular subgleba, the presence of eucapillitium with circular pores and the echinate basidiospores are features that support the placement in *Calvatia* s. str. (Calonge & Martín 1990). In his notes, Patouillard (1907) mentioned “*Scleroderma*” on the herbarium sheet (Fig. 2); but it is not clear, what his intention was. On the basis of the above mentioned features, it cannot be considered a *Scleroderma*. Although the leathery peridium is suggestive of *Gastropila*, the echinate basidiospores and presence of a subgleba justify the placement in *Calvatia*.

Contrary to Patouillard’s (1907) description of the basidiospores, reported as smooth to rugulose, his own notes and drawings (Fig. 2) show strongly ornamented basidiospores, as confirmed also in our own examination, both under light microscopy and SEM. Indeed, the distinct spiny ornamentation pattern could be observed under SEM, composed of densely grouped conical



**Figs 1–2** – *Calvatia lachnoderma*. 1 Type specimen. 2 Original notes accompanying the type. All images from Farlow Herbarium, Harvard University Herbaria, Harvard University, Cambridge, Massachusetts, USA.



**Figs 3–6** – *Calvatia lachnoderma*. **3** Basidiospores and eucapillitium. **4** Basidiospores. **5** Basidiospores and eucapillitium under SEM **6** Basidiospore under SEM. All images from holotype.

verrucae. The short pedicel is best seen under SEM, although it is usually obscured by the dense ornamentation, justifying Patouillard’s description of basidiospores as “*ecaudatis*” (tailless, without pedicel).

Unfortunately, Patouillard (1907) did not furnish additional information on the habitat where the fungus was collected, except that it was growing on soil. It would be important to know at least if it was a forest or open area species, because it is known that these habitats harbour distinct taxa in the genus (Kreisel 1994, Coetzee & van Wyk 2009, Cortez et al. 2012). It is hoped that the present contribution will encourage mycologists working in the subtropical zone of southeast and southern Brazil to be on the look-out for this poorly known species, thus improving knowledge on the Brazilian *Calvatia*.

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