A GASTEROID FUNGUS, *PALAEOGASTER MICROMORPHA* GEN. & SP. NOV. (BOLETALES) IN CRETACEOUS MYANMAR AMBER

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ABSTRACT

A new genus and species of gasteroid fungus, **Palaeogaster micromorpha** gen. & sp. nov. is described from Early-Mid Cretaceous amber from the Republic of Myanmar. The species is represented by some 25 complete or partial fruiting bodies in various developmental stages. Diagnostic characters for the new taxon are its small size, the globose to pyriform shape of the fruiting bodies, mycelial hyphae with clamp connections and small globose to subglobose spores. It is assigned to the Order Boletales (Sclerodermatineae) and possesses many features of the family Sclerodermataceae, which includes the earthballs and hard skinned puffballs. *Palaeogaster micromorpha* represents the first fossil member of the Sclerodermatineae and the oldest known gasteroid fungus.

RESUMEN

Se describen un género y especie nuevos de hongo gasteroide, **Palaeogaster micromorpha** gen. & sp. nov. del ámbar del cretácico temprano-medio de la República de Myanmar. La especie está representada por unos 25 cuerpos fructíferos completos o parciales en varios estados de desarrollo. Los caracteres diagnósticos del nuevo taxon son su pequeña talla, cuerpos fructíferos de forma globosa a piriforme, hifas del micelio fibuladas y esporas globosos a subglobosas pequeñas. Se asigna al Orden Boletales (Sclerodermatineae) y tiene muchas características de la familia Sclerodermataceae, que incluye los bejines. *Palaeogaster micromorpha* representa el primer miembro fósil de las Sclerodermatineae y el hogo gasteroide fósil más antiguo conocido.

INTRODUCTION

Aside from containing a variety of animal and plant fossils, amber from Myanmar includes some interesting fungal remains, such as the Hymenomycete, *Palaeoclavaria burmitis* Poinar & Brown (2003) and one of the earliest known mushrooms, *Palaeoagaracites antiquus* Poinar and Buckley (2007). The present study describes a gasteroid fungus preserved in Myanmar (Burmese) amber. Fossil gasteroids, which include puffballs, earthballs, earthstars and stinkhorn fungi, are exceedingly rare with previous records limited to *Lycoperdites tertiarius* Poinar (2001), from Tertiary Mexican amber, a Late Cenozoic earthstar (Geasteraceae) from Pueblo, Mexico (Magallon-Pueble & Cervallos-Ferriz 1993) and a subfossil from Holocene deposits in Alaska (Chaney & Mason 1936).

MATERIALS AND METHODS

The amber piece contains some 25 complete or partial fruiting bodies in various developmental stages. Some of the opened fruiting bodies near the edge of the piece were sectioned with a diamond saw and mounted in immersion oil to observe hyphae, and spores. The amber originated from a mine excavated in 2001, in the Hukawng Valley, southwest of Maingkhwan in Kachin State (26°20'N, 96°36'E) in Myanmar. This location, known as the Noije Bum 2001 Summit Site, was assigned to the Early-Mid Cretaceous, Upper Albian, on the basis of paleontological evidence (Cruickshank & Ko 2003) placing the age at 97 to 110 mya. Nuclear mag-

Fig. 1. Group of *Palaeogaster micromorpha* in Myanmar amber. Holotype is the specimen with the large opening in the center of the photo. Scale bar = 3 mm.

netic resonance (NMR) spectra and the presence of araucaroid wood fibers in amber samples from the Noije Bum 2001 Summit Site indicate an araucarian (possibly *Agathis*) tree source for the amber (Poinar et al. 2007). Descriptive terminology and taxonomy is based on Guzmán (1970), Guzmán and Ovrebo (2000), Gurgel, et al. (2008), Alfredo et al. (2012) and Nouhra et al. (2012).

DESCRIPTION

Boletales (Sclerodermatineae)

Palaeogaster Poinar, Alfredo, & Baseia, gen. nov. (**Figs. 1–8**), MycoBank no.: **MB 801127.** Type Species: *Palaeogaster micromorpha* Poinar, Alfredo, & Baseia.

Fruiting bodies small, subglobose to pyriform, spore case filling fruiting body; sterile base absent; peridium brown, hard, thick, splitting irregularly at terminus or subterminally to form large, roundish aperture; gleba firm, then becoming powdery yellow-orange at maturity; spores small, clear at maturity, globose to subglobose, smooth to slightly irregular surface; capillitium, hymenium and peridioles absent.

Palaeogaster micromorpha Poinar, Alfredo, & Baseia, sp. nov. (**Figs. 1–8**), MycoBank no.: **MB 801127.** Type: MYANMAR (BURMA): Amber mine in the Hukawng Valley, SW of Maingkhwan in Kachin State (26°20'N, 96°36'E), 1999, *unknown amber miner s.n.* (holotype: the open, centered specimen in Fig. 1; catalogue number B-F-1 deposited in the Poinar amber collection maintained at Oregon State University, Corvallis, Oregon 97331, U.S.A.).

Fruiting bodies from 5–7 mm in length, 3–4 mm in width; peridium persistent, peridium wall 6–12 µm wide; surface with areas of fine concentric, often intersecting lines; peridium splitting irregularly at terminus or subterminus to form large, roundish apertures ranging from 2–3 mm in diameter; apertures rimmed with fragments of original peridium; mature gleba powdery, yellow-orange; spores clear, globose to subglobose, lacking

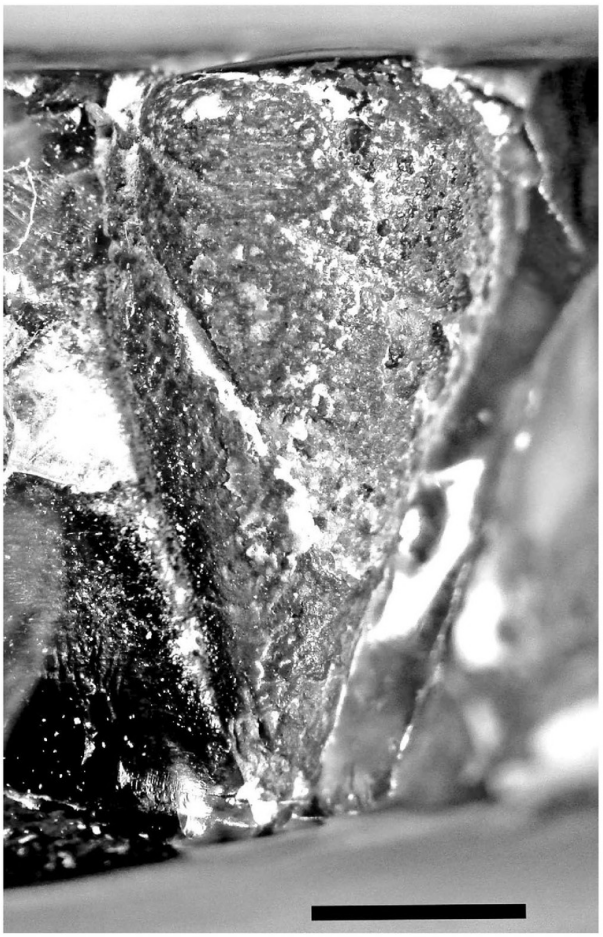

Fig. 2. Lateral view of pyriform fruiting body of *Palaeogaster micromorpha* in Myanmar amber. Scale bar = 2 mm.

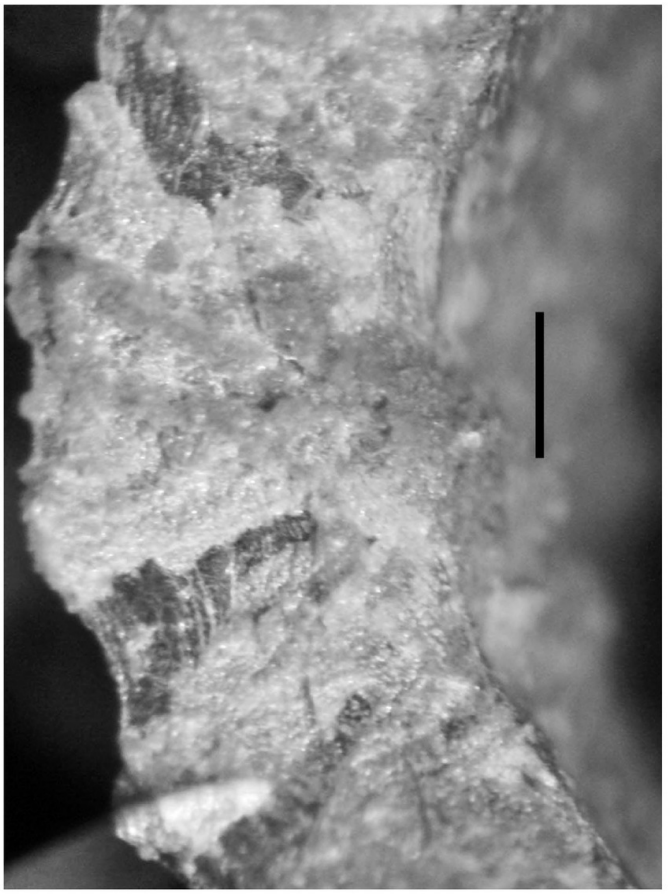

Fig. 3. Cross-section of the peridium of a fruiting body of *Palaeogaster micromorpha* in Myanmar amber. Scale bar = 35 µm.

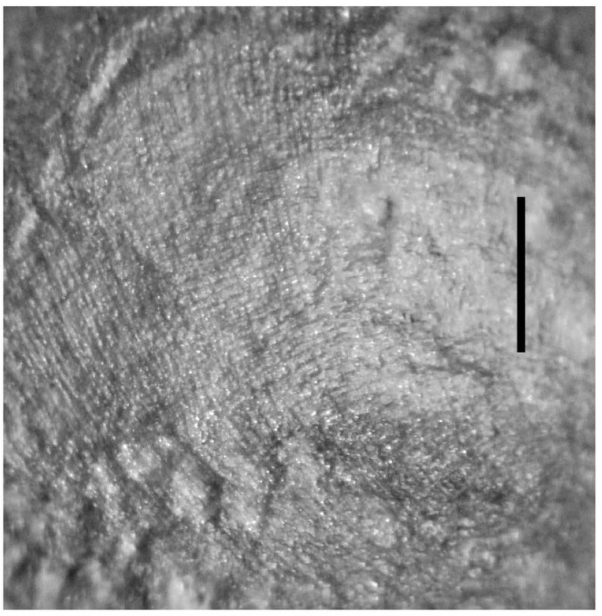

Fig. 4. Intersecting lines on the peridial surface of a fruiting body of *Palaeogaster micromorpha* in Myanmar amber. Scale bar = 27 µm.

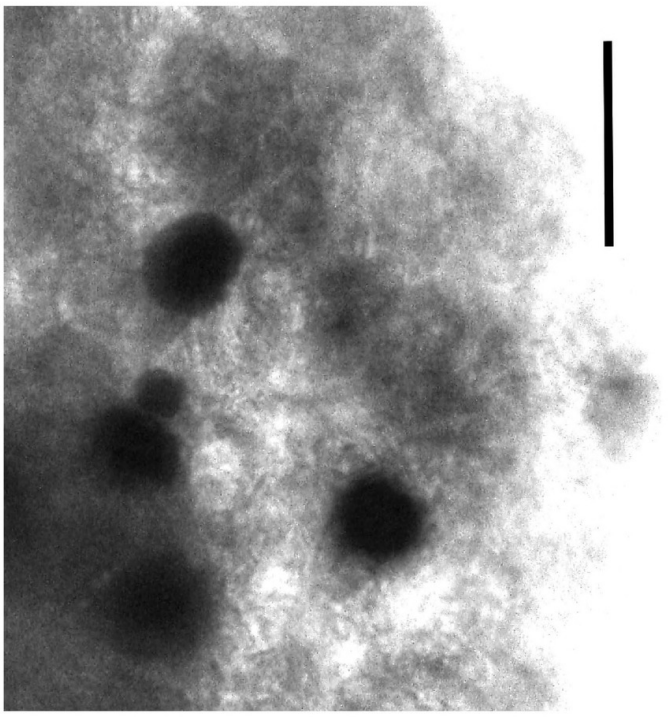

Fig. 5. Group of spores in the gleba of a fruiting body of *Palaeogaster micromorpha* in Myanmar amber. Scale bar = 27 µm.

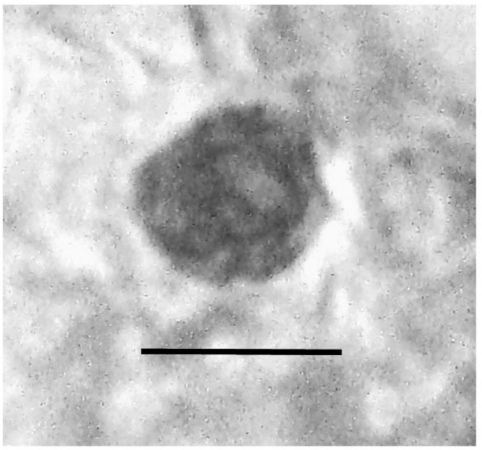

Fig. 6. Detail of a spore in the gleba of a fruiting body of *Palaeogaster micromorpha* in Myanmar amber. Scale bar = 8 µm.

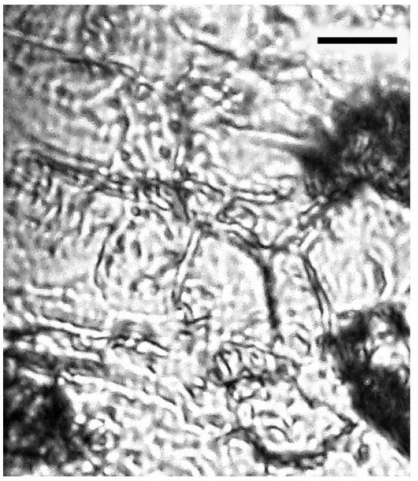

Fig. 7. Mycelial hyphae in a fruiting body of *Palaeogaster micromorpha* in Myanmar amber. Scale bar = 100 µm.

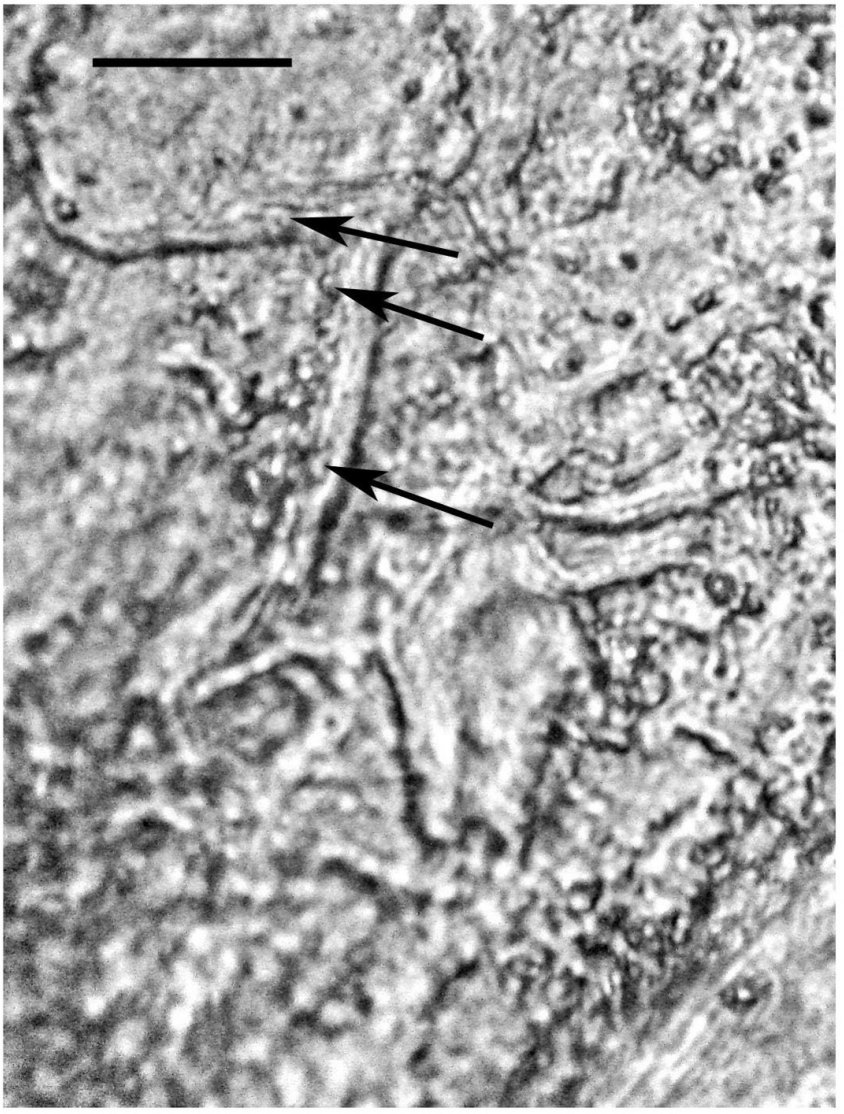

Fig. 8. Mycelial hyphae with clamp connections (arrows) in a fruiting body of *Palaeogaster micromorpha* in Myanmar amber. Scale bar = 80 µm

a hilum or pedicel, ranging from 4 –11 µm in greatest dimension; mycelial hyphae from fruit bodies 7 –10 µm in width, unpigmented, occasionally branched, thin-walled, with clamp connections.

Habitat.—Caespitose, probably growing on decaying wood.

Etymology.—The generic epithet is from the Greek "palaios" = ancient and the Greek "gaster" = stomach. The specific epithet is from the Greek "micros" = small and the Greek "morphe" = form.

DISCUSSION

Palaeogaster is distinguished by its small size, shape of the fruiting bodies, large, roundish terminal to subterminal aperture, yellow- orange gleba, non-sculptured spores and absence of a capillitium, hymenium and peridioles. The subglobose to pyriform fruiting bodies, single layered peridium, large irregular aperture, absence of a sterile base, mycelial hyphae with clamp connections and lack of a capillitium align it with the Sclerodermatineae. *Palaeogaster* shares with the extant genus *Diplocystis* (Sclerodermatineae) the habit of forming aggregates of small fruiting bodies, each forming a leathery, cup-shaped peridium (Louzan et al. 2007). However, the fruiting bodies of *Diplocystis* have a powdery umber gleba and the grayish-brown spores are covered with warty or spiny ornamentation. Small fruiting bodies with a mature yellow-orange gleba and globose to subglobose spores as occur in *Palaeogaster* are not found in extant representatives of the Sclerodermatineae (Arora 1986; Zeller 1949). *Palaeogaster micromorpha* represents the first fossil member of the Sclerodermatineae and the oldest known gasteroid fungus.

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