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Arthromyces and Blastosporella, two new genera of conidia-producing lyophylloid agarics (Agaricales, Basidiomycota) from the neotropics

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ABSTRACT

Two new genera encompassing three new species of lyophylloid agarics that produce conidia on the basidiomata are described. *Arthromyces* is a genus comprised of two very different arthrospore-producing mushroom species found in the Greater Antilles and Central America. *Blastosporella* is a monotypic genus with spherical balls of blastospores covering the pileus surface with age and is known from Hispaniola and Colombia. A key to the species of *Arthromyces* is included.

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Introduction

Three new conidial forming agaric species have been found in neotropical montane forests of Puerto Rico, Dominican

Republic, Colombia, and Belize. Two of these species form dark-pigmented and ornamented arthrospores with schizolytic secession (Walther *et al.* 2005), whereas the other taxon produces dark-pigmented and ornamented blastospores.

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These three new species share several morphological characters that might indicate they belong in the same genus, i.e. dark brown, powdery conidia production on the pileus and stipes, thin-fleshed, glabrous pileus, very crowded and narrow lamellae that produce white spore deposits, abundant and well-formed, narrow cheilocystidia, small, hyaline, pip-shaped or ellipsoid, smooth inamyloid basidiospores that have cyanophilic walls, narrow, equal and rather tough stipes, and basidia with siderophilous/cyanophilous bodies (granules). The differences in conidial formation suggest distinct lineages, and an analysis of the nuLSU rDNA region (Hofstetter, unpublished data) show that the arthrosporic forming taxa are clearly distinct from the blastospore-forming taxon. The arthrospore-forming taxa appear to be related to *Termitomyces*, whereas the blastospore-forming species is separate from this group and allied with *Tephrocybe rancida*. These relationships based on an analysis of a broader molecular dataset will be dealt with in a separate paper.

We also compared the ITS sequences of the asexual spores to ITS sequences from tissue extracts of the basidiomata to confirm that the asexual stages were in fact being produced by the basidiomata. Several samples were run for each species and all ITS sequences confirmed that the conidial states were indeed being produced by the basidiomata. Attempts to germinate the conidia of *Arthromyces claviformis* were not successful.

We originally thought these new taxa might be members of the genus *Arthrosporella* because they formed dry powdery conidia directly on the basidiomata. *Arthrosporella* was described as monotypic by Singer (1970) for a single collection he made with Digilio in Anta Muerta, Tucumán, Argentina in April 1949. The type collection was found in the 'subtropical forests of the Myrtaceae (fog-) zone at 1000–1100 m alt.' Singer (1950) originally considered this taxon as a species of *Armillariella*, and 20 y later realized this organism was not morphologically related to the other species in *Armillariella* (syn. *Armillaria*). The collection was unusual for a member of the *Agaricales*, as it consisted of independent teleomorph and anamorph states. The agaricoid form he called *Arthrosporella ditopa* and the clavarioid, but totally anamorphic form, he described as *Nothoclavulina ditopa* (Singer 1970). The unusual feature about this species was that the agaricoid basidiomata produced white, colourless, smooth arthrospores on the pileus and stipe that were identical to the white, colourless, smooth arthrospores produced on the clavarioid counterpart it was found fruiting with. *Arthromyces* and *Blastosporella* produce very different kinds of conidia as compared with *Arthrosporella* and a phylogenetic connection between *Arthrosporella* and these two new genera now seems dubious after studying what remains of the type collection of *Arthrosporella*. The only material left in the type collection of *A. ditopa* is an arthrospore covered clavarioid fruiting structure. The arthrospores on that structure are hyaline, thin-walled, globose, smooth, and often with a 'clamp-like' structure at the juncture between conidia. The specimen is not suitable for DNA extraction and we did not have permission to do so in any case. The agaricoid part of the collection no longer exists, and unfortunately, *Arthrosporella ditopa* is known only from the type collection.

Many agarics produce anamorphic states at least in culture (Watling 1979; Kendrick & Watling 1979; Walther et al. 2005), but significantly fewer produce those anamorphs directly on the teleomorphic basidiomata. *Cystoderma jasonis* (syn *Cystoderma amianthinum* var. *longisporum*), *C. tricholomoides*, *Asterophora parasitica*, *A. lycoperdoides*, *Dendrocollybia racemosa*, *Pleurotus cystidiosus*, *Squamamanita odorata*, *S. paradoxa*, and *S. pearsonii* are the other species, besides *Arthrosporella ditopa*, that produce some form of conidia directly on the already-formed agaricoid basidiomata (Bas 1965; Harmaja 1979; Heinemann & Thoen 1973; Kendrick & Watling 1979; Kühner 1969). The acanthocysts on the surfaces of fruiting bodies of *Mycena* section *Saccharifereae* are able to germinate and grow, thus apparently playing a role in asexual reproduction (Desjardin 1995) and therefore might well qualify to be considered members in this small group of fungi that produce anamorphic states directly on the basidium-forming teleomorph. *Arthromyces* and *Blastosporella* can also now be added to this small group of agarics known to have anamorphs directly associated with the teleomorph.

Arthromyces and *Blastosporella* appear to be solely New World taxa, and more specifically, tropical taxa restricted to montane or even cloud forest environments. At least one species, described from Malesia by Corner (1994), *Tricholoma furcatifolium*, may eventually be shown to have some affinities with *Arthromyces* because of its very similar morphological appearance to *A. claviformis*. However, as described by Corner (1994), *T. furcatifolium* does not produce an anamorphic state, nor does it have siderophilous basidia. Other taxa in the Malesian mycota that might also be compared with *Arthromyces* because of similar macromorphology are *T. umbraticum* and *Collybia umbraticoides*. Corner (1994) indicated these two taxa may have some affinities with each other and to *T. furcatifolium*. The resemblances may only be superficial but the similarities are striking enough to warrant future investigations.

Blastosporella is known only from Colombia and the Dominican Republic. One of the species of *Arthromyces* has been found in Puerto Rico and The Dominican Republic, whereas a completely different species of *Arthromyces* is only known from the highest peak in Belize.

Materials and methods

Colour notations in the macroscopic descriptions are from Kornerup & Wanscher (1978). Methods used in preparation of microscopic structures were those of Baroni (1981). Testing for cyanophilic reactions of spore walls and other structures was carried out as follows: un-revived lamella fragments were gently heated over a flame in a drop of Cotton blue/lactic acid (Singer 1986) on a clean glass slide; when the mountant began to release vapour (not boiled), the fragment was removed and placed in a clear drop of lactic acid at room temperature, and washed to remove excess dye. This fragment was finally transferred to a fresh drop of clear lactic acid at room temperature on a clean slide to make a squash mount. It has previously been shown that siderophilous inclusions in basidia can be determined by using the Cotton blue/lactic acid test described above (Baroni 1981), as siderophilous inclusions stain in a similar fashion in Cotton blue. Using this Cotton blue/lactic acid

test, cyanophilous inclusions were present in the basidia of all specimens examined. Measurements of anatomical features were made in mounts of 3 % potassium hydroxide under an oil-immersion lens. The designations used for basidiospore measurements are those of Baroni & Horak (1994) where n/x = number of spores measured for x number of collections, Q = range of length/width of individual spores and Q^m = mean of those Q values. All measurements were made with an Olympus BHS light microscope under Hoffman interference optics using an ocular micrometer or by using a semi-automated image analysis system (a GTCO digitizer pad and Metrics5 software written by David Malloch). Descriptive statistical analysis of the measurements was obtained using EXCEL 5.0 and Sigma-Stat 1.0. Illustrations of microscopic features were made with the aid of a drawing tube. All longitude/latitude readings listed were made by hand-held GPS (GARMIN Etrex Vista) set on the WGS84 Datum standard or the UTM standard.

Taxonomy

Arthromyces T. J. Baroni & Lodge, **gen. nov.**

Mycobank no.: MB510711

Habitus mycenoideus vel collybioideus, lamellis affixis percongestis angustissimis, superficie pilei stipitisque catenulis ex arthroconidiis obscure fusco-brunneis vel obscure olivaceo-brunneis compositas formante, basidia corpora siderophilica vel cyanophilica habentia, parietibus basidiosporicis cyanophilicis.

Species with a mycenoid or collybioid habit with extremely crowded and very narrow, attached lamellae, surface of pileus and stipe producing chains of dark fuscous brown or dark olivaceous brown, ornamented arthroconidia, basidia with siderophilous/cyanophilous bodies and basidiospore walls cyanophilic.

Key to the species of *Arthromyces* in the New World

- 1 Pileus convex or campanulate with incurved then plane margin, greyish yellow or dark blonde or clay colour with age, disc white floccose at first, soon dark greyish brown from powdery conidia developing on the disc and spreading toward margin with age, translucent-striate over margin, pileus 9–55 mm broad; arthroconidia dark brown and finely punctate roughened, in curling erect chains over the pileus surface (known only from the Maya Mts. in Belize) **matolae**

Pileus convex, plano-convex, or convex with broadly truncate disc and strongly inrolled margin, disc always sunken or shallowly depressed like a bowl and filled with dark olivaceous brown, powdery conidia, pileus 3–15 mm broad; the whole basidiome looking much like a construction nail; arthroconidia dark brown and finely verrucose, produced in straight or branching chains of dense deep layers over the pileus and stipe (known only from the Dominican Republic and Puerto Rico) **claviformis**

Typus: Arthromyces claviformis T. J. Baroni & Lodge 2007.

Arthromyces claviformis T. J. Baroni & Lodge, **sp. nov.**

(Figs 1,2B–C)

Mycobank no.: MB510712

Etym.: claviformis, shape of a nail.

Pileus primo albo vestimento floccoso vel pannoso-tomentoso praeditus, cito per conidia pulveracea obscure olivaceo-fuscus,

3–5 mm latus, planus atque late depressus ad marginem valde involutus. Lamellae sordide albae vel pallide cremeae aciebus auris vel aureo-virescentibus granulatis, emarginatae vel sinuatae compactae angustae fimbriatae. Stipes eodem colore ac pileus, mox conidiis pulveratis olivaceo-fuscis dense obsitus ad apicem 2–5 mm latus, 15–70 mm longus, aequilateralis, ad basem valde angustatus. Basidiosporae 4.5–6.5 × 3–4 μm, ellipsoidales vel ovoideae hyalinae inamyloideae parietibus cyanophilicis. Cheilocystidia anguste clavata vel cylindrica vel aliquot capitata in fasciculos dense contiguos aggregata, super apices exsudatum pallide vel obscure aureum resinolum secernentia. Pileipellis atque stipitipellis simul trichodermium e hyphis laxae intricatis cylindraceis compositum formantes, aliquae harum hypharum arthroconidia fusco-brunnea verrucosa producentes. Arthroconidia ad pileum atque stipitem maximam partem rectangularia, aliquot globosa. Fibulae nullae.

Typus: Dominican Republic: Santiago Prov.: Parque Armando Bermudez, entrance to Anton Sape Bueno, 950 m elev., 19° 12' 07.4" N 70° 59' 58.3" W, 24 Nov. 1999, J. Jilberto Torres & T.J. Baroni 8995 (NYBG – holotypus; JBSD – isotypus).

Pileus white or pale ashy grey at first from floccose, felty tomentose/fibrillose or matted hyphal mat overall, soon dark olivaceous fuscous (5F4-5 sepia-soot brown) from powdery conidia progressively developing from centre to margin, 3–15 mm broad, convex or plano-convex and broadly depressed or on some very sharply and deeply depressed, with strongly inrolled margin. Flesh fuscous-watery or dark greyish, ca 1 mm thick. *Lamellae* sordid white or pale cream, with pale golden, greenish golden or chartruese granulate edge (use lens), dark golden or golden-brown granulate as dried, adnate, emarginate or somewhat sinuate, crowded, very narrow when young, moderately broad with age (ca 0.5–1 mm), edge serrate or mostly eroded, finely fimbriate. Stipe concolour with pileus, white mycelioid over base, densely white floccose-fibrillose then soon in development densely olivaceous-fuscous pow-

dery over the fibrils, 2–5 mm broad at apex, 15–50(–70) mm long, mostly equal but often with a strongly tapered, rooting base; vestiture on stipe perpendicular erect and white with olive-fuscous tips, ca 1 mm thick covering apex to near base, but not over base, dark greyish stuffed, becoming narrowly to moderately hollow. *Odor* musty or not distinctive. *Taste* not noted.

Basidiospores white in deposit, 4.5–6.5 × 3–4 μm ($n/4 = 53$, mean = $5.5 \pm 0.41 \times 3.5 \pm 0.21$, $Q = 1.29$ – 1.90 , $Q^m = 1.59 \pm 0.14$), ellipsoid or ovoid or somewhat pip-shaped, round in polar

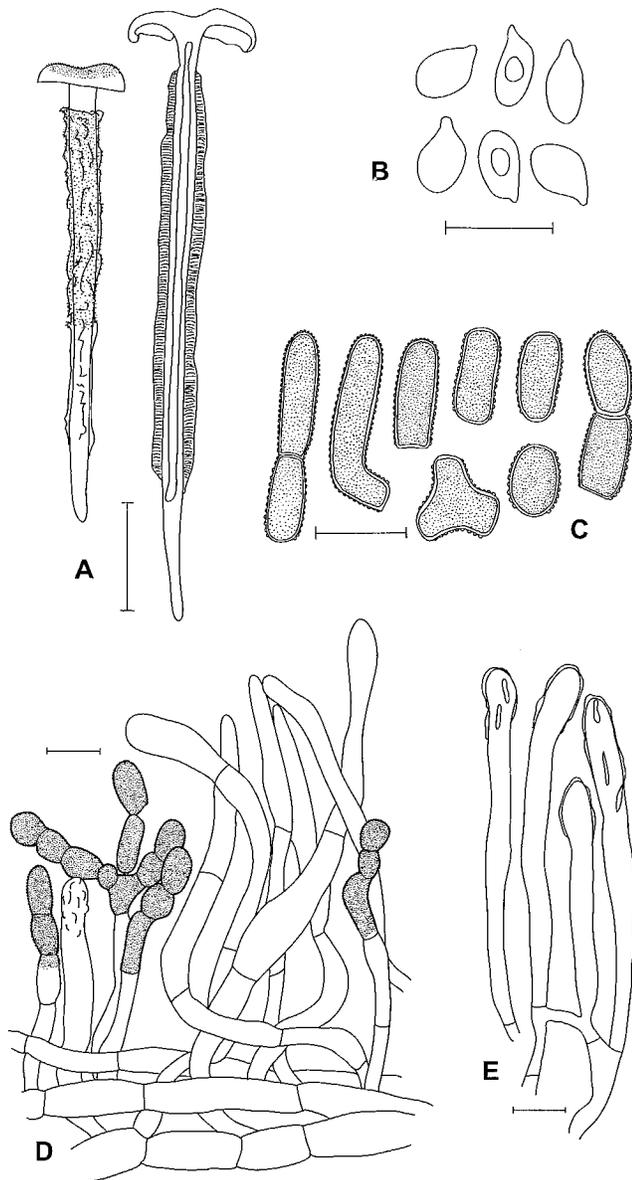


Fig 1 – *Arthromyces claviformis* (all from T. J. Baroni 8995, holotype). (A) Basidiomata, scale bar = 10 mm. (B) Basidiospores. (C) Arthroconidia. (D) Pileipellis. (E) Cheilocystidia. Bars (B–E) = 10 μ m.

view, hyaline, inamyloid, not dextrinoid, walls cyanophilic, smooth. Basidia 4-sterigmate, narrowly clavate, 13.5–18 \times 4.5–5.5 μ m, with cyanophilic (siderophilic) bodies. Cheilocystidia narrowly clavate or cylindrical, some subcapitate, 33–63 \times 4–5 μ m, in densely packed clusters forming a sterile edge, pale golden or dark golden in 3% potassium hydroxide, individual cells hyaline with thin, resinous, golden coating or exudate in an even or disrupted coating over apices. Pleurocystidia absent. Lamella trama hyaline, of parallel, inflated hyphae, 6–14 μ m diam. Pileus context radially arranged, hyaline near the surface, pale brownish deeper in context from yellowish brown encrusted and intraparietal pigments of the thickened walls, of mostly inflated hyphae, 4–21 μ m diam. Pileipellis a loosely entangled or erect layer (\pm trichodermial

or in places collapsed, of hyaline cylindrical, non-encrusted hyphae, 2.5–4 μ m diam, producing from the erect hyphal tips with age, dark brown pigmented chains of arthroconidia that easily disarticulate into individual cells. Arthroconidia mostly rectangular or many ellipsoid with rounded corners, some \pm globose, occasionally branched, some curved, occasionally also remaining in pairs (with septa between two cells), 5.5–11.5 \times 3–5 μ m, thick-walled, brown from intraparietal pigment and finely brown verrucose roughened. Stipitipellis similar in construction to pileipellis, with a hyaline \pm trichodermial layer producing dense masses of dark brown ornamented arthroconidia (see above). Clamp connections none.

Habit, habitat, fruiting period: single or gregarious in small numbers, on clay soil, under *Pinus occidentalis* or near *Eucalyptus* sp. or under mixed lower montane wet forests. November and June.

Additional material examined: **Dominican Republic:** *La Vega Province*, Ebano Verde Reserve, trail from Arroyazo to Loma de La Sal, N19 2 43 W 70 32 43, 30 Aug. 2003, M. Quirico, O. Perdomo, M. Marmolejo & R. Concepción [MQ-204 M. Quirico (=DR-2983); JBSD)]. – **Puerto Rico:** *Municipio Villalba*, Toro Negro Reserve Campground area, ca 1000 m elev., N18 10 30.6 W66 29 31.4, 9 Nov. 1996, S. A. Cantrell & T. J. Baroni [(8258 T. J. Baroni CORT)] and same loc., trail to campground, A. Nieves-Rivera (PR-647; BPI 843768); *Municipio de Loiza*, off of Rt. 186, Caribbean National Forest, Pico El Toro Trail, ca 828 m elev., N18 16 51.4 W65 51 31.3, 5 Jun. 1998, T. J. Baroni [8777 T. J. Baroni (UPRRP and NYBC)]; same general location, 11 Jun. 1998, [8840 T. J. Baroni (NYBC)].

Discussion: *Arthromyces claviformis* is characterized by its construction nail-like appearance, the dark brown powdery surface of the pileus and stipe, the very strongly inrolled pileus margin and broadly depressed disc filled with powdery conidia, the very crowded, very narrow and adnate lamellae with serrate or eroded edges that are often yellowish green. The narrowly clavate, cylindrical, or subcapitate cheilocystidia with resinous covering and the dark brown, finely verrucose arthroconidia in straight or branched chains are also diagnostic for this species.

Even though *A. claviformis* and *A. matolae* do not look similar macroscopically, they do share several unique microscopic characters, e.g. the chains of dark-pigmented and ornamented arthroconidia, the presence of resin-encrusted cheilocystidia, siderophilous basidia, basidiospores with cyanophilous smooth walls, and the lack of clamp connections. For a more complete discussion of the phenetic similarities of these two species, see the discussion under *A. matolae*. Besides the extreme differences in the macromorphological characters, these two species can also be separated by the way the arthroconidia are produced, straight chains for *A. claviformis* and curling chains for *A. matolae*. The type of cheilocystidia are also different, i.e. narrowly clavate or cylindrical with some subcapitate forms in *A. claviformis*, whereas those of *A. matolae* are mostly cylindrical or narrowly fusoid.

Blastosporella zonata looks superficially like *Arthromyces claviformis* when the basidiomata of *B. zonata* are completely mature and the pileus surface is covered with dark brown conidia. However, these two taxa can be distinguished by the zonate pileus of *B. zonata* in early stages of development and

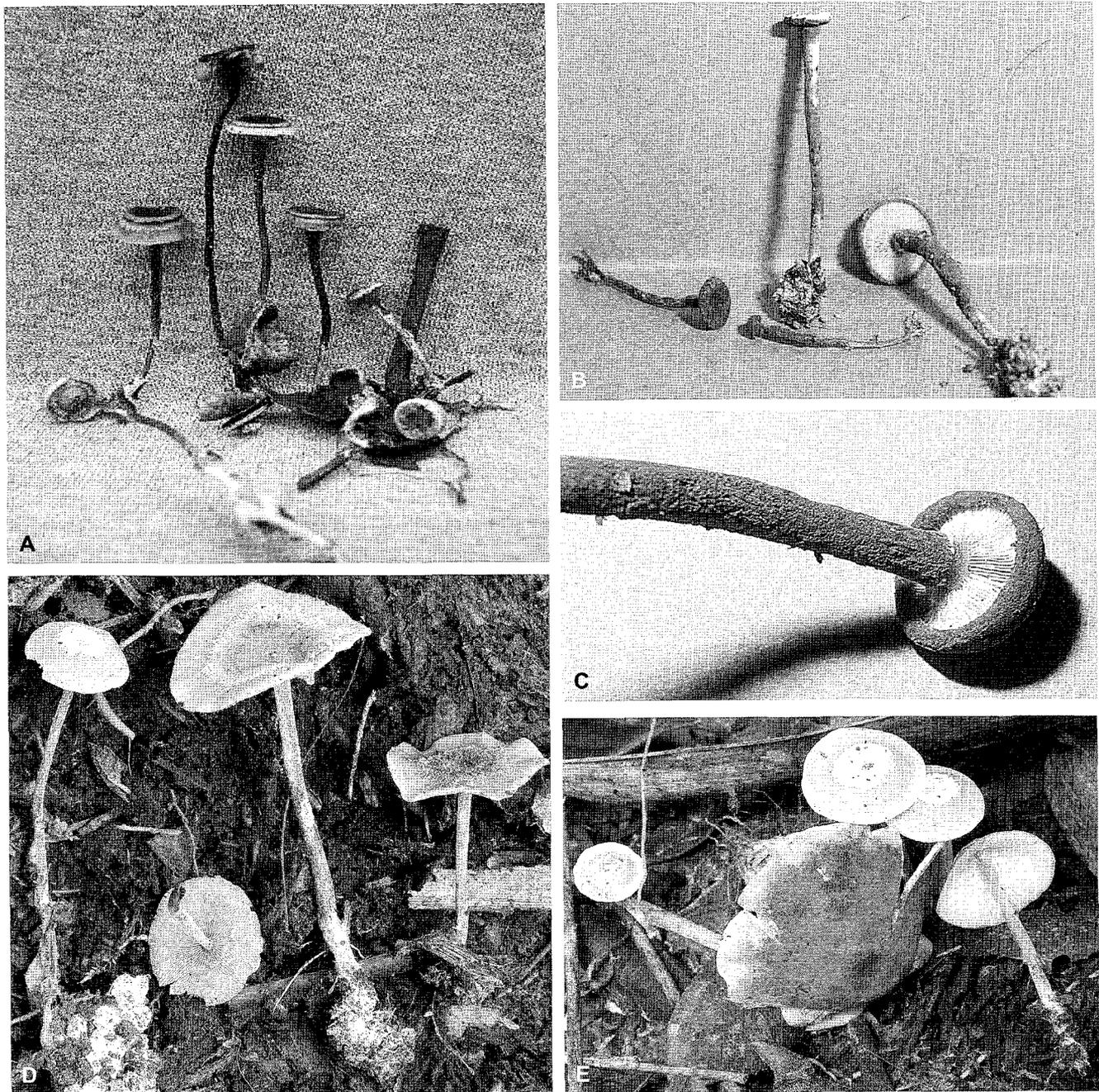


Fig 2 – Basidiomata. (A) *Blastosporella zonata* (A. Corrales #211, holotype). (B) *Arthromyces claviformis* (T. J. Baroni 8995, holotype). (C) *Arthromyces claviformis* (T. J. Baroni 8840). (D) *Arthromyces matolae* (T. J. Baroni 9835). (E) *Arthromyces matolae* (T. J. Baroni 9820, holotype).

by the spherical clusters of coarsely dark brown tuberculate ornamented globose blastospores found on the disc of the pileus, the larger basidiospores and the fusoid, non-encrusted cheilocystidia.

A colour image of *A. claviformis* can be found in Cantrell et al. (2001) in Fig 3B as *Arthrosporella* sp.

***Arthromyces matolae* T. J. Baroni, Lodge & Linder, sp. nov.**

(Figs 2D–E,4)

Mycobank no.: MB510719

Etym.: “matolae”, in honor of Sharon Matola, avid supporter of Belizean natural history, and mainly responsible for arranging the expedition to Doyle’s Delight, one of the highest peaks in Belize, where this species was discovered.

Pileus per conidia pulveracea pallide ravidoflavus, in disco conidia pulveracea fusco-brunnea efficiens, trama tenui tenaciflexibili. Lamellae albae vel pallide cremeae adnatae vel emarginatae, dense compactae angustissimae fimbriatae. Stipes pallide cinerascens areis parvis floccosis albis sparsis ornatus, aequilateralis, teres, ad basem strigosus, tenaciflexibilis.

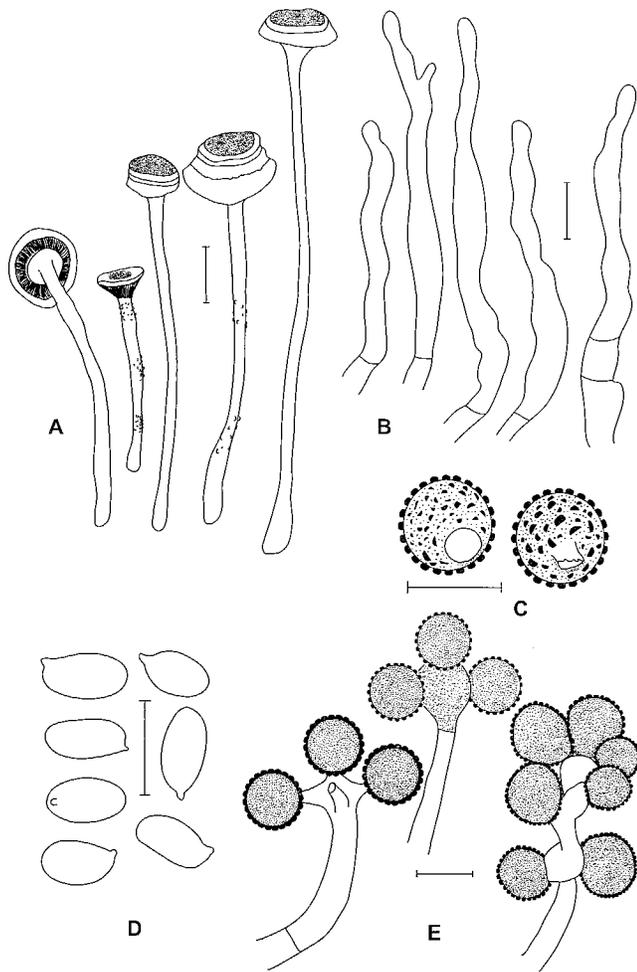


Fig 3 – *Blastosporella zonata* (all from A. Corrales #211, holotype). (A) Basidiomata, bar = 10 mm. (B) Cheilocystidia. (C) Blastospores. (D) Basidiospores. (E) Conidial heads from pileipellis. Bars (B–E) = 10 μm.

Basidiosporae 5.5–7.5 × 3.5–4.5 μm ellipsoideae laeves inamyloideae. Cheilocystidia cylindrica vel anguste fusioidea exsudatum nitens aureum vel aureum-brunneum secermentia. Arthroconidia in pileo stipiteque in catenas moniliformes disposita ad earum apices curvas, e cellulis brunneis verrucato-punctatis composita. Fibulae nullae.

Typus: Belize: Toldedo District, Maya Mountains, Doyles Delight, south trail from camp, 1134 m elev., 16° 29' 37.4" N 89° 02' 44.6" W (UTM N816 W244), 11 Aug. 2004, T. J. Baroni 9820 (NYBG – holotypus; BRH, CORT – isotypi).

Pileus pale greyish yellow at first (4B3 corn/golden wheat to 4C4 blonde), darker brown with age (5C-D3 brownish orange-nougat; 5D4-5 dark blonde-clay; 6D3 café-au-lait) mostly over margin and up to disc, slightly hygrophanous and becoming paler, disc developing white floccose hyphae early in development, soon pale ashy white with brownish grey at centre (4-5D2 cement-dust), disc rapidly developing greyish brown colours from outwardly developing conidia (5E3 drab or mouse grey) but maintaining white floccose margin of expanding ring, eventually most of the disc becomes a very

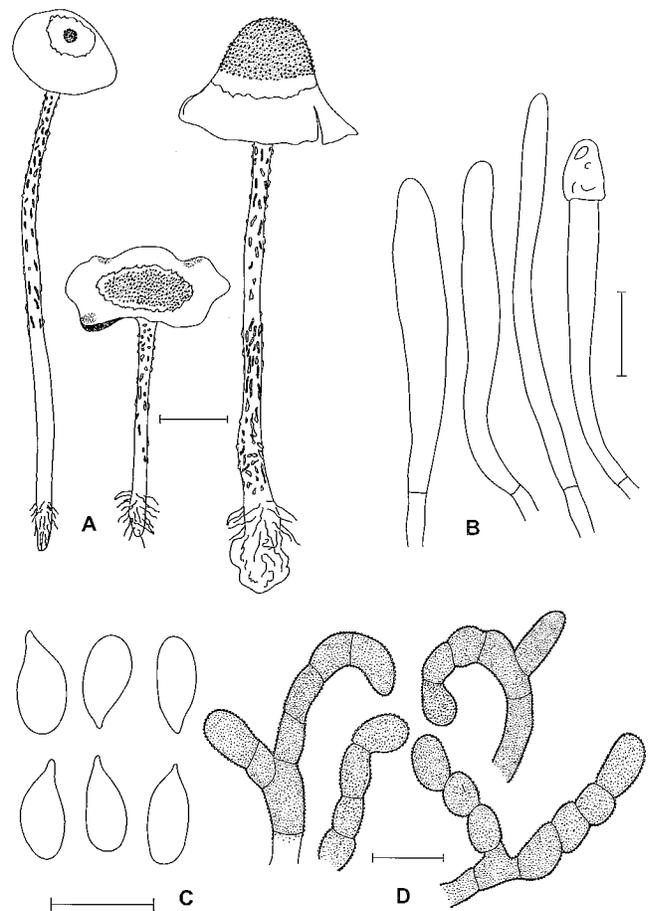


Fig 4 – *Arthromyces matolae* (all from T. J. Baroni 9820, holotype). (A) Basidiomata, bar = 20 mm. (B) Cheilocystidia. (C) Basidiospores. (D) Arthroconidia. Bars (B–D) = 10 μm.

powdery dark grey brown (5F4 sepia or 6E-F2-3 brownish grey-brownish beige-negro; 7F3 greyish brown) from conidia, 9–55 mm broad, convex becoming plano-convex with slight depressed disc, soon campanulate, edge often undulate, becoming plane, surface smooth or irregularly rugose where conidia have not developed, mostly over margin, faintly translucent-striate at very margin (ca 2 mm from very edge) at first, otherwise smooth, opaque, glabrous, margin incurved at first, soon decurved becoming plane, becoming strongly undulate and more or less completely covered with powdery brown conidia with age. *Context* grey with a white core, ca 1 mm thick, tough-pliant. *Lamellae* off white, pale ashy white, pale greyish buff or pale sordid cream (nearest 4A2 yellowish white), adnate, adnexed or emarginate or slightly decurrent on some or arcuate decurrent with emarginate attachment, very crowded, moderately narrow (ca 1 mm broad), edges finely fimbriate or densely granulate-fimbriate, becoming obscurely golden yellow after dried (use lens). *Stipe* pale greyish (5C2 birch grey to 5D3 nougat) or becoming darker grey brown (6E2 saruk; 6F3 negro) with silvery white or white appressed fibrils overall, also with white floccose mounds (not truly pruina nor furfuraceous scales – irregularly distributed and irregular in sizes) over upper third and with age spreading to

the base, these mounds becoming brownish from conidial production with age, dry, equal, terete, 1–5 mm broad at apex, 23–80(–90) mm long, tough-pliant, firm, white/pale silvery greyish strigose mycelioid over base, hollow and concolor with grey surface. *Odor* fruity and \pm farinaceous when cut open or farinaceous-spermatoc or not distinctive. *Taste* not distinctive or slightly sweet.

Basidiospores white in deposit, $5.5\text{--}7.5 \times 3.5\text{--}4.5 \mu\text{m}$ ($n = 31$, mean = $6.1 \pm 0.44 \times 3.9 \pm 0.33$, $Q = 1.37\text{--}2$, $Q^m = 1.6 \pm 0.14$), ellipsoid or somewhat pip-shaped, round in polar view, hyaline, inamyloid, smooth, walls cyanophilic. *Basidia* 4 sterigmate (very difficult to find, very small), narrowly clavate, $13\text{--}16 \times 4\text{--}5.5 \mu\text{m}$, with cyanophilic bodies. *Cheilocystidia* mostly cylindrical or narrowly fusoid, some narrowly clavate, $26\text{--}48.5 \times 3\text{--}5 \mu\text{m}$, clustered in pyramidal agglutinated groups along lamella edge, these groups mostly covered with deep golden brown shiny exudate in 3% potassium hydroxide or this exudate a bright golden yellow in Melzer's reagent, individual cells with resinous looking exudate on their tips, and this exudate spreads down over the cystidia obscuring individual cells, when squashed the resinous material fractures like glass (it is not oil-like in consistency). *Pleurocystidia* absent. *Lamella trama* hyaline, of parallel, cylindrical hyphae, 4–14 μm diam. *Pileus context* hyaline near the surface pale brown deeper in context and nearer hymenium form pale yellow brown intraparietal pigments, radially arranged, cylindrical near surface but strongly inflated hyphae deeper in context with inflated cells more common near the hymenium, 4–20(–28) μm diam. *Pileipellis* a repent hyaline layer of cylindrical hyphae, 2.5–5 μm diam, but producing brown pigmented moniliform like arthroconidial chains over the disc early in development, this layer up to 200 μm or more deep, the arthroconidial chains straight or more often curled at the apex from curved cells. *Arthroconidia* sphaerical, ellipsoid or broadly allantoid, $4\text{--}9 \times 3\text{--}5 \mu\text{m}$, \pm thick-walled, brown from intraparietal pigment, finely punctate roughened, in chains of 3–10 or more cells, some branched, disarticulating into individual cells, but some remaining as pairs (i.e. a two-celled spore with a cross wall), produced from hyaline, cylindrical hyphae that often possess hyaline nodules or hyaline verrucose encrustations. *Stipitipellis* a repent layer of hyaline, parallel, cylindrical hyphae, 2.5–4 μm diam, producing irregular patches of brown arthroconidia identical to those of the pileus. *Clamp* connections none.

Habit, habitat and fruiting period: Gregarious or scattered on soil or humus in lower montane subtropical wet forest (Holdridge et al. 1971) composed of mixed tropical angiosperm trees with some cloud forest elements rich with epiphytes (some of the trees were *Euterpe precatoria*, *Colpothrinax cookii*, *Cyrilla racemiflora*, *Sloanea floribunda*, *Magnolia* sp., *Clusia* sp., *Neea* sp., *Calatola* sp., *Quercus* spp., etc.).

Additional material Examined: Belize: Toledo District: Maya Mountains, Doyle's Delight, south trail from camp to headwaters of Rio Grande, ca 1050 m elev., 14 Aug. 2004, T. J. Baroni (9858 T. J. Baroni, NYBG, BRH); *ibid.*, 1115 m elev, 11 Aug. 2004, D. J. Lodge (BZ-3810 D. J. Lodge 10, BRH, CFMR); *ibid.* 14 Aug. 2004, D. J. Lodge

(BZ-3853 D. J. Lodge 51, BRH, CFMR); Bladen Nature Reserve, east trail from camp, part way down to creek bed, UTM N818 W246, 12 Aug. 2004, T. J. Baroni (9835 T. J. Baroni, NYBG, COURT, BRH) and 15 Aug. 2004, T. J. Baroni (9873, T. J. Baroni, COURT, BRH); west ridge trail, UTM N810 W241, 1030 m elev., 16 Aug. 2004, T. J. Baroni (9887 T. J. Baroni, FH, COURT, BRH); same general area on west ridge trail, 18 Aug. 2004, T. J. Baroni (9912 D. J. Lodge, BRH, NYBG); base camp, south of peak at Doyle's Delight, N16° 29' 39" W89° 2' 43.2", 1124 m elev., 19 Aug. 2004, T. J. Baroni (BZ-3935 D. J. Lodge 129). Cayo District: Maya Mountains, Doyle's Delight, Chiquibul National Park, north from peak on west ridge, 1090 m elev., 15 Aug. 2004, D. J. Lodge (BZ-3879 D. J. Lodge 77, F, BRH); north trail, 1080 m elev., 17 Aug. 2004, D. J. Linder (04170 D. J. Linder, CFMR, BRH).

Discussion: *Arthromyces matolae* is a rather large conspicuous agaric in the cloud forests of the Maya Mountains in southern Belize. The pileus reaches 55 mm and the stipe can be quite long, up to 90 mm. The powdery brown disc with a white floccose ring around it, contrasting with the greyish yellow or clay coloured pileus margin is distinctive in the field. Specimens, as they age, show a progressive spread of dark brown powdery conidial development, centrifugally outward from the pileus disc, with the white floccose edge of the developing conidia leading the way (for a colour image of *A. matolae* see p. 15 in [http://www.msafungi.org/55\(6\).pdf](http://www.msafungi.org/55(6).pdf), the online version of Lodge 2004). The dark brown ornamented arthroconidia, together with the very crowded narrow lamellae with resin encrusted cheilocystidia, the tough-pliant nature of the basidiomata, the small, smooth, ellipsoid, inamyloid cyanophilic basidiospores, and the siderophilous/cyanophilous basidia are diagnostic features for this new genus, *Arthromyces*.

A. matolae and *A. claviformis* are phenetically related because of the type and the formation of their arthroconidia are similar and unique in the Agaricales, the basidiospore size/shape overlaps and the golden brown or golden yellow exudates of the cheilocystidia are characteristic of these two species. These taxa clearly differ in their macromorphology with *A. matolae* producing large obviously lamellate basidiomata with a convex or campanulate pileus, whereas the much smaller *A. claviformis* actually appears much like a small fleshy-tough powdery 'nail' with a plane or depressed pileus with a strongly enrolled margin. The lamellae of *A. claviformis* are obscure, crowded, narrow and partially hidden by the strongly inrolled pileus margin, whereas the lamellae of *A. matolae* are obvious and typical for an agaric with densely crowded lamellae, like *Gymnopus confluens*. Another distinctive difference that separates these two taxa is that the stipe of *A. claviformis* produces prodigious amounts of dark olivaceous brown powdery conidia whereas *A. matolae* produces scant amounts of conidia in small scattered patches. The edges of the lamellae on *A. claviformis* are often golden or greenish golden when young. The lamella edges of *A. matolae* are never coloured differently than the sides of the lamellae when fresh, whether young or old. These two species can also be differentiated by the curling chains of arthroconidia for *A. matolae* versus the consistently straight chains of arthroconidia found in *A. claviformis*. The individual arthroconidia of *A. claviformis* are rectangular, sometimes branched but not commonly spherical or ellipsoidal as the arthroconidia are in *A. matolae*. *Arthromyces claviformis* has not been found in Central America as yet.

Blastosporella zonata T. J. Baroni & Franco-Molano, *gen. et sp. nov.*
(Figs 2A,3)

Mycobank no.: MB510720

Etym.: "zonata" from the obvious zonation of the pileus.

Pileus per vittas ravidobubalinas et fusco-brunneas alternantes zonatus, supra marginem laevem disco uniformiter atro-fusco pulverulaceo atque plano vel late depresso, 8–12 mm latus. Lamellae albae compactae angustae. Stipes brunneo-canus, aequilateralis, in apice valde expansus, laevis sed ad apicem squamulis albis ornatus. Basidiosporae 6.5–8.5 × 3.5–5 μm, ellipsoideae hyalinae inamyloideae parietibus cyanophilicis laeves. Basidia corpora siderophila vel cyanophila habentia. Cheilocystidia fusioidea cylindracea undulata. Pileipellis in disco bistratosa strato exteriore e massis atro-fusco-brunneis sphaericis conidiorum globosorum blastosporicorum valde tuberculatum composito, strato interiore e hyphis cylindricis repentibus composito. Fibulae praesentes.

Typus: **Colombia**: Dpto. de Tolima: Municipio of Murillo, in mixed forest with *Quercus humboldtii* near the sewage treatment plant, 2950 m elev., 4° 52' 47.1" N 75° 10' 0.8" W, 22 Apr. 2004, A. Corrales #211 (HUA – holotypus; CORT – isotypus).

Pileus dark grey or fuscous over disc (6F1-3) from powdery conidia, when young strongly zonate from edge of disc to margin with pallid greyish buff zone alternating with a dark brown zone (6F5 - Teak), then back to pallid greyish buff zone and finally a moderate brownish grey zone (6E2 - Saruk) at very margin, with age evenly grey brown (6E3) or darker fuliginous to soot brown, 8–12(–16) mm in diameter, truncate-convex, truncate-campanulate or plano-convex with age, but always with broadly depressed disc producing a rim-like edge or cup around the disc, inrolled margin at first, margin eventually elongates producing truncate-convex shapes with shallowly and broadly depressed discs (shallow concave disc filled with dark brown powdery conidia), margin becoming decurved, dry, heavily pulverulent over disc, radially fibrillose in zonate areas outward to margin, margin translucent-striate, weakly hygrophanous and becoming opaque, entire. Context bicoloured, white spongy on top of a brownish grey (7F2) solid zone, eventually evenly fuscous, 1–2 mm thick. Lamellae white (paler than 1B1) or pale grey, with edges becoming dark greyish or black with age, adnate, emarginate, sinuate or slightly decurrent, close or crowded ($L = 30$, $l = 0-1$), even at first becoming eroded or denticulate, narrow or moderately broad (to 3 mm). Stipe brownish grey (6F2-4) at the apex, paler towards base (5E4) or coloured as pileus overall with age, white squamulose-floccose over apex, appressed fibrillose elsewhere or densely covered overall with scattered, loosely attached, white squamules or patches of coarse fibrils with age, base with conspicuous white strigose hairs, 2–3 mm broad near the apex (much broader at the strongly expanded area at lamella attachment zone), 75–115 mm long, equal, terete, but often strongly expanded at very apex and tapered/rooting at base, dry, stiff, narrowly hollow, cortex concolourous with surface, medulla white fibrillose stuffed. Odor and taste strongly farinaceous or rancid farinaceous. *Chemical reactions*: 5 % potassium hydroxide negative.

Basidiospores white in deposit, 6.5–8.5 × 3.5–5 μm, μm ($n = 34$ /holotype, mean = $7.3 \pm 0.46 \times 4.2 \pm 0.24$, $Q = 1.49-1.97$, $Q^m = 1.72 \pm 0.13$), ellipsoid or somewhat pip-shaped, round

in polar view, hyaline, inamyloid, smooth, walls cyanophilic. Basidia 4-sterigmate, clavate, 21–25 × 7–8 μm, with cyanophilic bodies. Cheilocystidia fusoid, cylindrical but not always with tapered apex, some narrowly clavate, mostly undulate, hyaline, thin-walled, producing sterile edge, 34–60 × 3–6.5 μm. Pleurocystidia absent. Pileus context pale brown, inflated or cylindrical cells, 5–30 μm diam. Pileipellis two-layered over the disc, a dense thick layer of dark fuscous brown conidia in sphaerical aggregations overlying a repent layer of cylindrical hyphae on the disc and surrounding areas, only repent hyphae in zonate area near mid to margin, repent hyphae, 2.5–6.5 μm diam, some with shiny brown encrusting pigments. Conidia mostly globose, 8–12 μm diam (some slightly ellipsoid, then 8.5–10.5 × 7–8 μm), ornamented with dark brown truncate tuberculae projecting 0.5–1.5(–2.5) μm, these chlamydospores or holoblastospores in clusters of typically 10–20 conidia per conidiophore, conidiophores either swollen or not swollen, typically with dark brown intraparietal pigments. Stipitipellis at apex a pale brown layer of repent cylindrical hyphae, 4–18 μm in diam, mostly strongly shiny brown pigment encrusted. Clamp connections present on hyphae of pileipellis and stipitipellis.

Habit, habitat, and fruiting period: On decaying leaves, small sticks or soil among mosses January, April and November.

Additional material examined: **Colombia**: Vereda Sabana Larga, Sabana Verde Protected Area, in mixed forest with *Quercus humboldtii*, 4° 56' 6" N 75° 10' 57" W, 3180 m elev., 20 Apr. 2004, D. Gallo (D. Gallo #51, paratype: HUA). — **Dominican Republic**: La Vega Province, Valle Nuevo, La Nevera, east of El Monumento, on soil among mosses and fern trees in cloud forest dominated by *Pinus occidentalis*, 2180–2200 m elev., 24 Nov. 1997, E. Horak (ZT 6333; JBSD), La Vega Province, Ebano Verde Reserve, El Col Trail, on leaf litter and decaying spiny frond of *Cyathea* sp., 5 Jan. 1997, T. J. Baroni and Omar Paino-Perdomo, (8371 T. J. Baroni; NY, CORT, JBSD).

Discussion: Even though *Blastosporella zonata* has a strongly zonate pileus in early stages of development, making it immediately distinctive in the field, on mature specimens the entire surface can be obscured with dark brown powdery conidia. These conidia are diagnostic when trying to distinguish *B. zonata* from the species of *Arthromyces*. *B. zonata* produces dark brown, heavily tuberculate ornamented, globose chlamydospores or holoblastospores that stay together in ball-like clusters and remain tenaciously attached to the hyphae that produced them, i.e. the individual conidia do not readily disarticulate. The species of *Arthromyces* produce disarticulating chains of brownish punctate or verrucose arthrospores.

Some additional microscopic features that are useful in separating these species are cheilocystidia and presence or absence of clamp connections. *A. claviformis* and *A. matolae* produce narrowly clavate-capitate or fusoid cheilocystidia with golden resinous encrustations. The cheilocystidia of *A. zonata* are uniformly fusoid or cylindrical, frequently undulate, but lack any resinous encrusting materials. The species of *Arthromyces* lack clamp connections, whereas *B. zonata* has abundant and obvious clamp connections on the hyphae of the pileus and stipe surfaces.

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