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New pyrenocarpous lichens from NE Argentina

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Abstract: Five new species of corticolous pyrenocarpous lichens are described from tropical and subtropical forests in the Chaco and Misiones provinces in NE Argentina: *Aspidothelium submuriforme* with globose, grey ascomata and ascospores mostly 7-septate with 0–2 oblique longitudinal septa, 25–28 × 8–10 µm; *Pyrenula inspersoleucotrypa*, characterized by a thallus without pseudocyphellae, aggregated ascomata, an inspersed hamathecium, and ascospores of 17–20 × 6·5–8·0 µm with diamond-shaped lumina; *Pyrenula punctoleucotrypa*, which has a thallus with pseudocyphellae, aggregated ascomata in a conical pseudostroma, with fused ostioles, not inspersed hamathecium, and ascospores of 10–12 × 4–5 µm with rounded lumina; *Strigula muriconidiata*, containing immersed pycnidia with hyaline, densely muriform, ellipsoid conidia, 90–103 × 32–35 µm; *Trypethelium globolucidum*, forming sessile pseudostromata with black and whitish parts, an inspersed hamathecium, ascospores 13–19-septate, (65–)83–97 × 11·5–14·5 µm, lumina rounded to lentiform and containing lichexanthone.

Key words: Chaco, Misiones, *Pyrenulaceae*, *Strigulaceae*, taxonomy, *Thelenellaceae*, *Trypetheliaceae*

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Introduction

The forests in NE Argentina are the tropical part of this country, including for example the famous Iguazú waterfalls on the border with Brazil. It comprises evergreen tropical rainforest in the eastern part (Misiones Province) and semi-deciduous subtropical forest to the west of this, as in the Chaco Province (Ferraro 1995). The non-foliicolous microlichens in this area are still incompletely known, unlike the foliicolous and foliose lichens (Ferraro 1978, 1997).

During a 10-day field trip by the authors in February 2013, special attention was paid to the pyrenocarpous lichens. Among the species found, no less than five appear to be undescribed. The purpose of this paper is to describe them so that they might also be recognized elsewhere, such as in adjacent Brazil, from where many other pyrenocarpous lichens have been recently described (Aptroot *et al.* 2013).

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Material and Methods

Identification and descriptive work were carried out using an Olympus SZX7 stereomicroscope and an Olympus BX50 compound microscope with interference contrast, connected to a Nikon Coolpix digital camera. Sections were mounted in tap water, on which all measurements were taken. The chemistry of the type specimens was investigated by thin-layer chromatography (TLC) using solvent A (Orange *et al.* 2001).

The Species

Aspidothelium submuriforme Aptroot, L. I. Ferraro & M. Cáceres sp. nov.

MycoBank No.: MB 805199

Corticolous *Aspidothelium* with globose, grey ascomata and ascospores mostly 7-septate with 0–2 oblique longitudinal septa, 25–28 × 8–10 µm.

Type: Argentina, Chaco Province, Parque Provincial Pampa del Indio, 26°16′20″S, 59°58′40″W, alt. *c.* 110 m, on twig bark in semi-deciduous subtropical forest, 26 February 2013, *L. I. Ferraro, A. Aptroot & M. Cáceres* 10732 (CTES—holotype; ABL—isotype).

(Fig. 1)

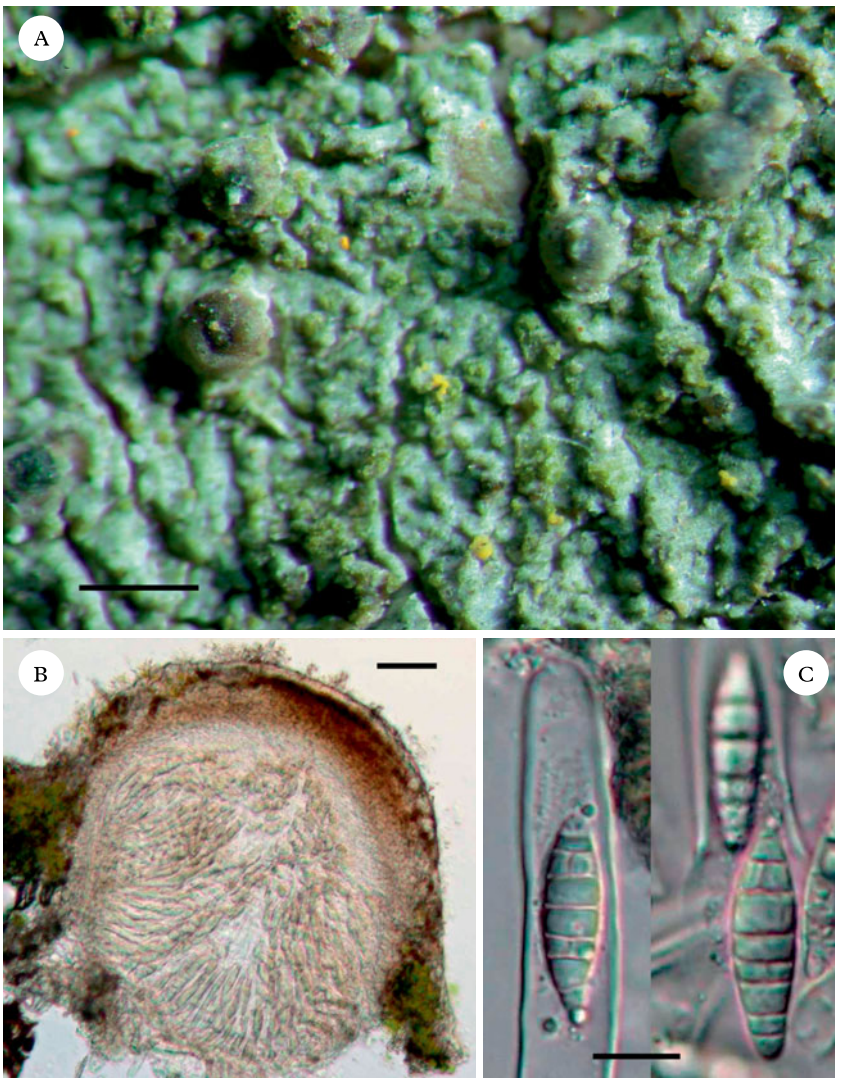

FIG. 1. *Aspidothelium submuriforme* (isotype). A, habit; B, section through ascoma; C, ascospores. Scales: A = 0·5 mm; B = 50 μm; C = 10 μm. In colour online.

Thallus corticate, covering areas of up to 3 cm diam., smooth, continuous but consisting of isolated rounded patches towards the margin, thin, greyish, without prothallus. *Algae* chlorococcoid.

Ascomata perithecioid, sessile on the thallus, nearly globose, 0·3–0·4 mm diam. and height, sides greyish brown, top dark grey, without ornamentation. *Wall* carbonized only near the ostiole. *Ostioles* apical, dark grey. *Hamathecium* hyaline, not inspersed. *Asci* cylindrico-clavate, with 8 ascospores. *Ascospores* hyaline, submuriform, mostly 7-septate, rarely up to 11-septate, with 0–2 oblique longitudinal septa, asymmetrically clavate-fusiform, without constrictions, 25–28 × 8–10 μm, ends obtuse.

Pycnidia not observed.

Chemistry. Thallus UV−, C−, K−, KC−, P−. No substances detected by TLC.

Etymology. The epithet refers to the submuriform ascospores.

Ecology and distribution. On smooth bark of trees in semi-deciduous subtropical forest. Known only from Argentina.

Discussion. The genus *Aspidothelium* Vain. is a small genus with 12, mostly foliicolous, species (Lücking 2008). The new species has the smallest muriform ascospores known in the genus. All corticolous species known are keyed out in Aptroot *et al.* (2008). The new species is closest to *Aspidothelium glabrum* Lücking *et al.* (Aptroot *et al.* 2008), which differs by the larger, densely muriform ascospores, and 4-spored asci. These differences, as well as the constant morphology of the richly fertile thalli of the new species, suggest that it is not merely young material of the latter.

Pyrenula inspersoleucotrypa Aptroot, L. I. Ferraro & M. Cáceres sp. nov.

MycoBank No.: MB 805200

Corticolous *Pyrenula* having thallus without pseudocyphellae, aggregated ascomata, inspersed hamathecium, and ascospores of 17–20 × 6·5–8·0 µm with diamond-shaped lumina.

Type: Argentina, Misiones Province, Puerto Iguazú, near Hotel Selvático Don Horacio, 25°36′20″S, 54°33′33″W, alt. *c.* 230 m, on tree bark in evergreen tropical rainforest, 22 February 2013, *L. I. Ferraro, A. Aptroot & M. Cáceres* 10533 (CTES—holotype; ABL—isotype).

(Fig. 2A)

Thallus corticate, smooth, continuous, rather thin, olivaceous brown, without pseudocyphellae, surrounded by a black prothallus line. *Algae* trentepohlioid.

Ascomata perithecioid, erumpent, 0·4–1·2 mm diam., black, conical with flattened tips, mostly aggregated in groups or lines of 2–8, with partly fused walls but separate ostioles. *Wall* carbonized all around, up to *c.* 100 µm thick. *Ostioles* pale brown, apical, flat. *Hamathecium* hyaline, inspersed with hyaline oil droplets. *Asci* cylindrico-clavate, with 8 ascospores. *Ascospores* brown, 3-septate, fusiform, without constrictions, 17–20 × 6·5–8·0 µm, ends obtuse but rather pointed, middle lumina broadly diamond-shaped, end lumina triangular, separated from the wall by thick endospore layer.

Pycnidia not observed.

Chemistry. Thallus UV−, C−, K−, KC−, P−. No substances detected by TLC.

Etymology. The name refers to the inspersed hamathecium and the superficial similarity to *Pyrenula leucotrypa* (Nyl.) Upreti.

Ecology and distribution. On smooth bark of trees in rainforest. Known only from Argentina.

Discussion. This species does not key out in the world key to the species of *Pyrenula* Ach. (Aptroot 2012). The new species is close to *Pyrenula infraleucotrypa* Aptroot & M. Cáceres (Aptroot *et al.* 2013), which was found and described after the publication of the world key. It differs from the latter mainly by the inspersed hamathecium.

Pyrenula punctoleucotrypa Aptroot, L. I. Ferraro & M. Cáceres sp. nov.

MycoBank No.: MB 805201

Corticolous *Pyrenula* having thallus with pseudocyphellae, aggregated ascomata in a conical pseudostroma, with fused ostioles, not inspersed hamathecium, and ascospores 10–12 × 4–5 µm with rounded lumina.

Type: Argentina, Misiones Province, Puerto Iguazú, near Hotel Selvático Don Horacio, 25°36′20″S, 54°33′33″W, alt. *c.* 230 m, on tree bark in evergreen tropical rainforest, 22 February 2013, *L. I. Ferraro, A. Aptroot & M. Cáceres* 10530 (CTES—holotype; ABL—isotype).

(Fig. 2B)

Thallus corticate, smooth, continuous, rather thin, olivaceous green, with numerous pale pseudocyphellae, surrounded by a black prothallus line. *Algae* trentepohlioid.

Ascomata perithecioid, pyriform, *c.* 0·2–0·4 mm diam., immersed in erumpent, 0·4–1·2 mm diam., black, conical pseudostromata with flattened tips, which are formed by the fused walls of 2–6 ascomata with mostly fused ostioles. *Wall* carbonized mostly above and fusing to form an up to *c.* 100 µm thick pseudostroma. *Ostioles* pale brown,

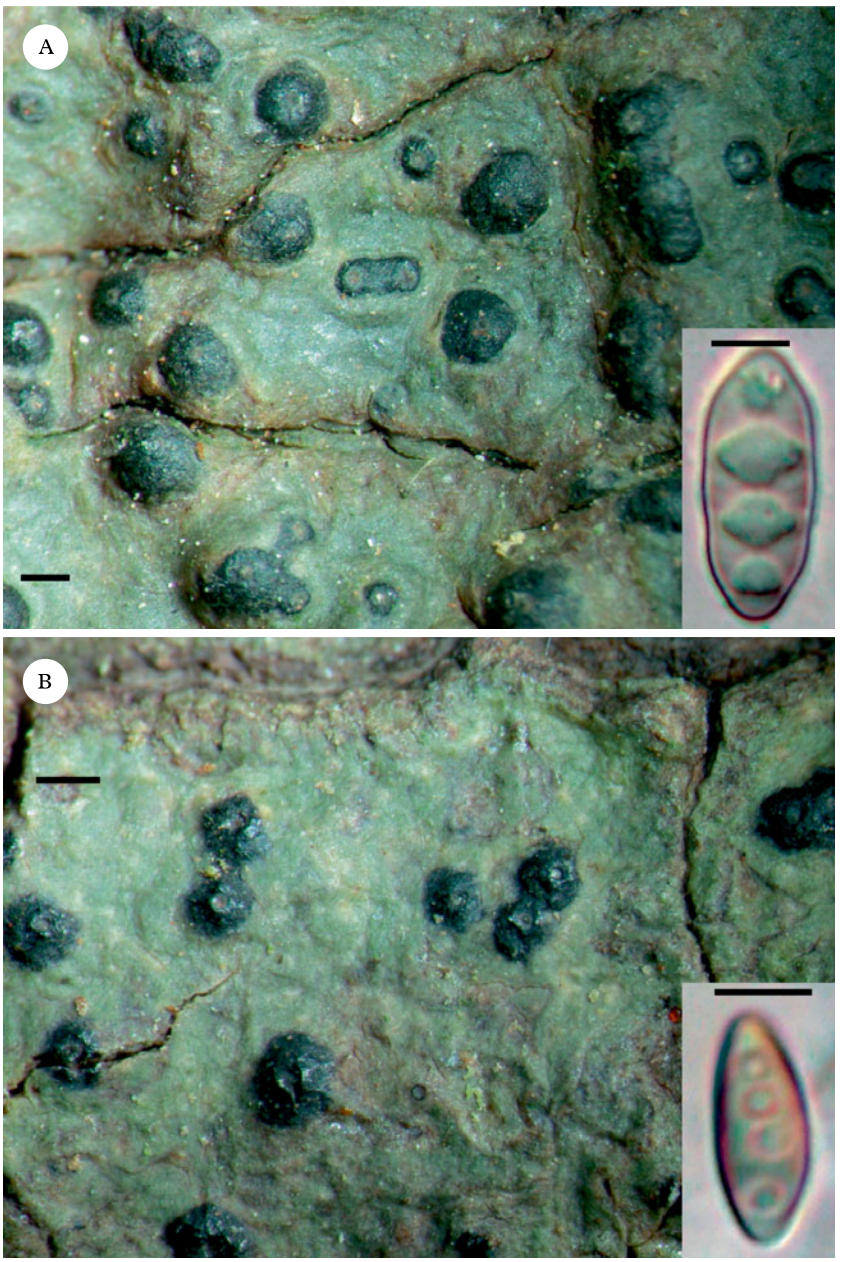

FIG. 2. *Pyrenula inspersoleucotrypa* (isotype), habit; inset, ascospore. B, *Pyrenula punctoleucotrypa* (isotype), habit, inset, ascospore. Scales: A & B = 0·5 mm; insets = 5 μm. In colour online.

lateral, but central in the conical pseudostroma, often concave and angular. *Hamathecium* hyaline, not inspersed. *Asci* cylindrico-clavate, with 8 ascospores. *Ascospores* brown, 3-septate, fusiform, without constrictions, 10–12 × 4–5 μm, ends obtuse, lumina rounded, separated from the wall by thick endospore layer.

Pycnidia not observed.

Chemistry. Thallus UV−, C−, K−, KC−, P−. No substances detected by TLC.

Etymology. The epithet refers to the pseudocyphellae and the superficial similarity to *Pyrenula leucotrypa*.

Ecology and distribution. On smooth bark of trees in rainforest. Known only from Argentina.

Discussion. This species would key out close to *Pyrenula septicollaris* (Eschw.) R. C. Harris in the world key to the species of *Pyrenula* (Aptroot 2012). In the latter species however, the ascomata are generally fused together only with the ostioles, not the walls as in the new species, and the ascospores are always longer. The new species is in aspect closer to *Pyrenula paraminarum* Aptroot & M. Cáceres (Aptroot *et al.* 2013), which was found and described after the publication of the world key. It differs from the latter mainly by the smaller ascospores, the fused lateral ostioles and the presence of pseudocyphellae. The presence or absence of pseudocyphellae seems to be a rather fundamental character within the genus *Pyrenul*a, as it is the only morphological character that is well correlated with the basal split within the genus following a preliminary phylogenetic reconstruction (Weerakoon *et al.* 2012). The ascospores in the new species are among the smallest known in the genus, with only *Pyrenula minutissima* Aptroot *et al.* (Aptroot *et al.* 2012) having smaller ascospores (7–10 μm long).

Strigula muriconidiata Aptroot, L. I. Ferraro & M. Cáceres sp. nov.

MycoBank No.: MB 805202

Corticolous *Strigula* with immersed pycnidia with hyaline, densely muriform, ellipsoid conidia of 90–103 × 32–35 μm.

Type: Argentina, Chaco Province, Parque Provincial Pampa del Indio, 26°16′20″S, 59°58’40″W, alt. *c.* 110 m, on tree bark in semi-deciduous subtropical forest, 26 February 2013, *L. I. Ferraro, A. Aptroot & M. Cáceres* 10781 (CTES—holotype; ABL—isotype).

(Fig. 3)

Thallus corticate, continuous, covering areas of up to 10 cm diam., thin, smooth and glossy towards the margin, dull and with an intricate pattern of small folds towards the centre, grey, with glossy whitish prothallus zone. *Algae* trentepohlioid.

Ascomata not observed.

Pycnidia immersed in the bark, 0·2–0·4 mm diam., hyaline, visible from above by a whitish ostiolar region. *Conidiogenous cells* hyaline, filamentous, 30–35 × 2–3 μm. *Conidia* hyaline, densely muriform, ellipsoid, 90–103 × 32–35 μm, some with triangular, 10–15 μm wide, 10–20 μm long gelatinous appendage at one end.

Chemistry. Thallus UV−, C−, K−, KC−, P−. TLC: atranorin, zeorin.

Etymology. The specific epithet refers to the muriform conidia.

Ecology and distribution. On smooth bark of trees in semi-deciduous subtropical forest. Known only from Argentina.

Discussion. The genus *Strigula* Fr. was long known to contain mostly tropical foliicolous lichens with tiny, 1-septate ascospores. Various tropical and temperate corticolous species, some with more septa, were gradually added to the genus. Harris (1995) and McCarthy (1995) expanded the scope of the genus by including species with muriform ascospores.

At present, it is not certain that these muriform taxa are really closely related to the core group of the genus, as no muriform taxa have yet been sequenced. This new species is attributed here to the genus *Strigula* as it fits the general profile, even though ascomata were not found, and especially because at least some conidia bear gelatinous appendages. Somewhat similar, large, muriform conidia are known only from this genus in lichenized fungi. *Strigula muriformis* Aptroot & Diederich (Aptroot *et al.* 1997) is closest, but has smaller (57–63 × 16–20 μm) conidia that bear gelatinous appendages at both ends. Moreover, it is saxicolous and occurs in Papua New Guinea.

Even if the new species eventually turns out not to belong to this genus, it is still

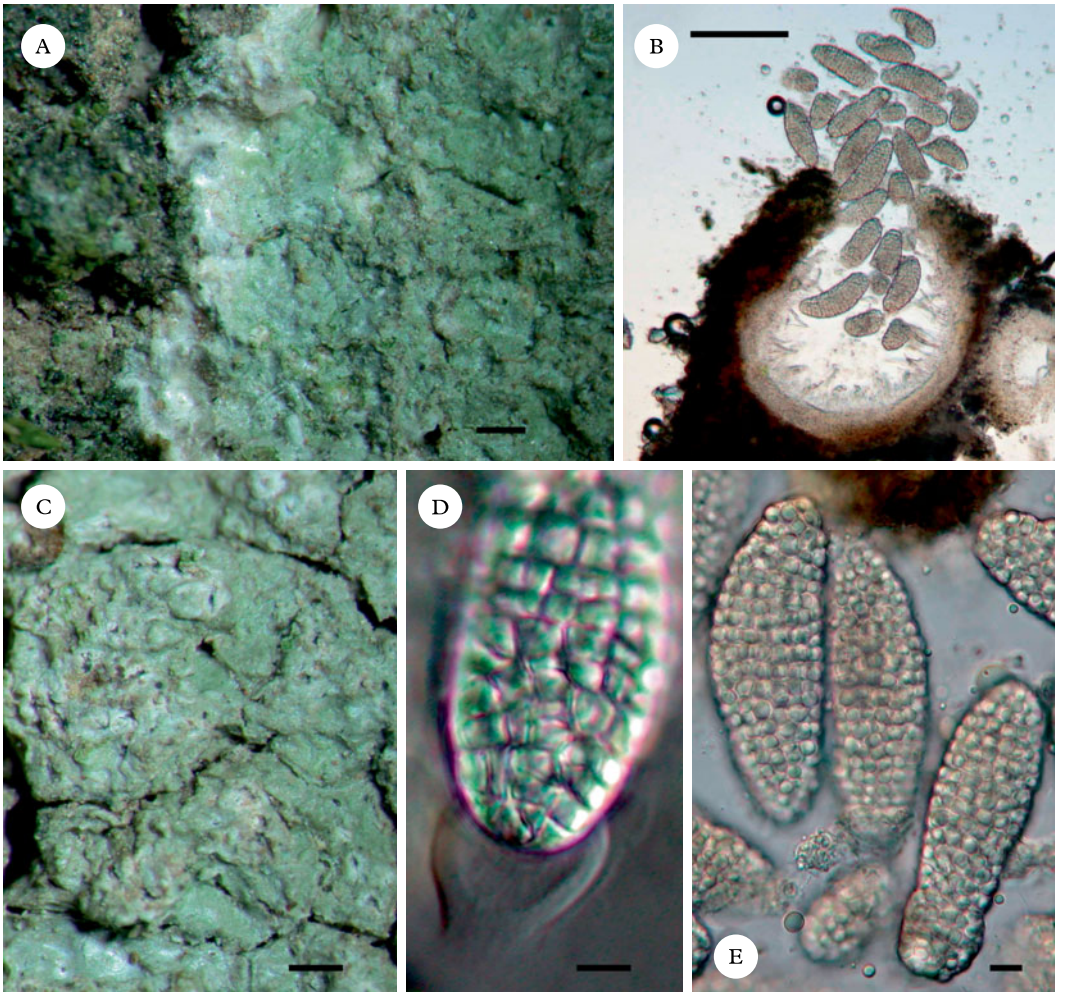

FIG. 3. *Strigula muriconidiata* (isotype). A, prothallus; B, section through pycnidium; C, habit; D & E, conidia. Scales: A & C = 0·5 mm; B = 50 μm; D = 10 μm. In colour online.

undoubtedly an undescribed species, as no lichen with such conidia has ever been reported.

This new species is common and abundant in two of the forests visited during the field trip. It differs from all known lichens by the large muriform conidia.

Additional specimens seen. **Argentina:** *Chaco*: same as the type, *L. I. Ferraro, A. Aptroot & M. Cáceres* 10780; 15 km W of Presidencia Roca, alt. 100 m, 26°06′28″S, 59°47′20″W, on tree bark in semi-deciduous subtropical forest, 2013, *L. I. Ferraro, A. Aptroot & M. Cáceres* 10884 & 10887 (all CTES, ABL).

Trypethelium globolucidum Aptroot, L. I. Ferraro & M. Cáceres sp. nov.

MycoBank No.: MB 805203

Corticolous *Trypethelium* forming sessile pseudostromata with black and whitish parts, inspersed hamathecium, ascospores 13–19-septate, (65–)83–97 × 11·5–14·5 μm, lumina rounded to lentiform and containing lichexanthone.

Type: Argentina, Misiones Province, Iguazú National Park, along railroad, 25°41′50″S, 54°26′50″W, alt. *c.* 200 m, on twig bark along path near evergreen tropical rainforest, 24 February 2013, *L. I. Ferraro, A. Aptroot & M. Cáceres* 10630 (CTES—holotype; ABL—isotype).

(Fig. 4)

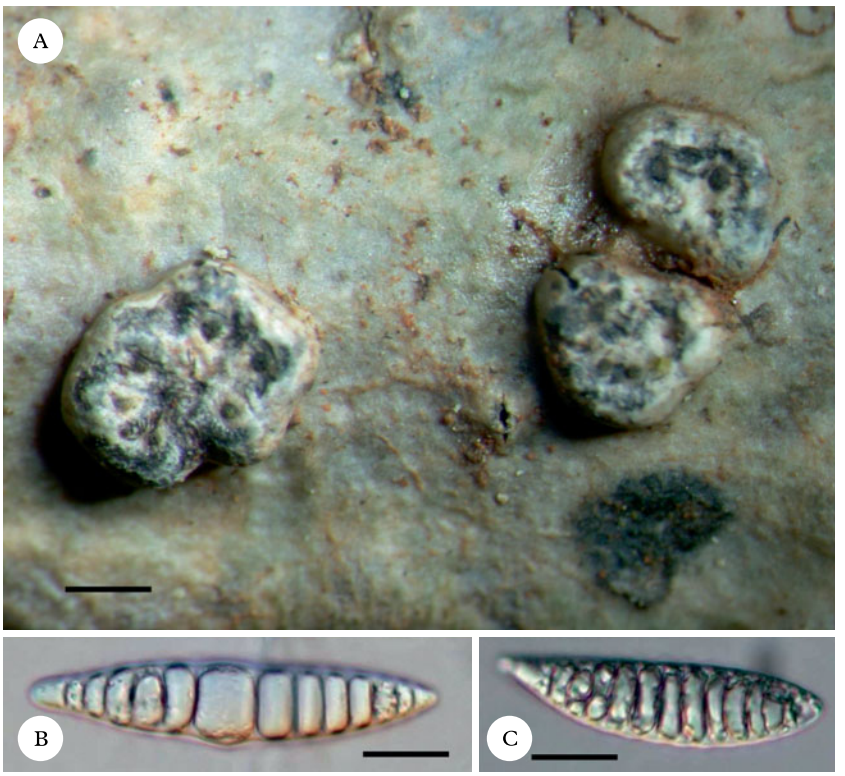

FIG. 4. *Trypethelium globolucidum* (isotype). A, habit; B, mature ascospore; C, young ascospore. Scales: A = 0·5 mm; B & C = 10 µm. In colour online.

Thallus corticate, smooth, somewhat shiny, continuous, covering areas up to 10 cm long and encircling twigs, thin, olivaceous green to olivaceous brown, without pseudocyphellae, surrounded by a black prothallus line. *Algae* trentepohlioid.

Ascomata perithecioid, sessile, 0·4–0·8 mm diam., black, mostly aggregated with 2–12(–25) in pseudostromata. *Wall* carbonized all around, up to *c.* 100 µm thick. *Ostioles* apical, flat to usually papillate, red-brown to black. *Pseudostromata* lobate in outline, up to *c.* 3 mm diam. and 1·5 mm high, sessile with nearly vertical sides, partly or completely covered with whitish to cream tissue. *Hamathecium* hyaline, inspersed with hyaline oil globules. *Asci* cylindrico-clavate, with 8 ascospores. *Ascospores* hyaline, 13–19-septate, fusiform, with a slight constriction at the median septum, (65–)83–97 × 11·5–14·5 µm, ends rather pointed, lumina rounded to lentiform, surrounded by a gelatinous layer of up to 7 µm thick.

Pycnidia not observed.

Chemistry. Thallus UV−, C−, K−, KC−, P−; whitish parts of pseudostromata UV+ yellow. TLC: lichexanthone.

Etymology. The epithet refers to the sessile, nearly globose ascomata and the UV+ yellow (lucid) reaction.

Ecology and distribution. On smooth twig bark of trees along path near rainforest. Known only from Argentina.

Discussion. The genus *Trypethelium* Spreng. is a mostly tropical genus. So far, over 100 species have been described within it, but a significant proportion of those are synonyms

or accepted in other genera. Phylogenetic studies of the family *Trypetheliaceae* (M. P. Nelsen, R. Lücking, A. Aptroot, C. J. Andrew, M. E. S. Cáceres, E. Rivas Plata, C. Gueidan, L. Da Silva Canez, A. Knight, L. R. Ludwig, *et al*. unpublished data) have shown that the type species of the genus, *Trypethelium eluteriae* Spreng., does not cluster with the majority of the species in the genus, and particularly not with the most common species. It forms a monophyletic group that is characterized by hyaline, multiseptate, transversely septate ascospores with rounded lumina. The lumen shape in *Trypethelium* is unique within the family, characterized mostly by diamond-shaped lumina due to thick endospore formation, and also species without endospore formation resulting in quadrangular lumina. In this restricted sense, the genus *Trypethelium* probably encompasses less than 10 species. The new species differs from all species in the family by the combination of 65–97 µm long ascospores with many (at least 13) septa and the presence of lichexanthone on the whitish pseudostromata, but absent in the thallus.

Additional specimens seen. **Argentina:** *Misiones*: Iguazú National Park, Paseos Superiores, 2003, *L. I. Ferraro & O. Popoff* 6792; Iguazú National Park, Senderos Macuco, 2003, *L. I. Ferraro & O. Popoff* 6601 (all CTES & ABL).

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