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**New Species or Interesting Records of Foliicolous
Lichens. III.
Arthonia crystallifera spec. nova (Lichenized
Ascomycetes: *Arthoniaceae*), with a World-Wide Key
to the Foliicolous *Arthoniaceae***

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With 2 Figures

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Summary

FERRARO L. I. & LÜCKING R. 1997. New species or interesting records of foliicolous lichens. III. *Arthonia crystallifera* spec. nova (Lichenized Ascomycetes: *Arthoniaceae*), with a world-wide key to the foliicolous *Arthoniaceae*. *Phyton* (Horn, Austria) 37 (1): 61–70, 2 figures. – English with Spanish and German summary.

A new foliicolous species of *Arthonia* from northern Argentina and Brazil is described: *A. crystallifera* L. I. FERRARO & R. LÜCKING is distinguished from other foliicolous species of the genus by the presence of large, conspicuous, shiny crystals on the ascocarp surface. It is further characterized by the brownish colour of its ascocarps, the macrocephalic, 2-septate, colourless ascospores, and the radiate phyco-biont cells, indicating a close relationship to *A. accolens* STIRT. In order to facilitate the delimitation of foliicolous *Arthoniaceae*, a key to all hitherto known species (28) is presented. The new combination *Eremothecella cingulata* (R. SANT.) L. I. FERRARO & R. LÜCKING comb. nova is proposed (Bas.: *Arthothelium cingulatum* R. SANT.).

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Resumen

FERRARO L. I. & LÜCKING R. 1997. Nuevas especies o comunicaciones interesantes de líquenes foliícolas. III. *Arthonia crystallifera* spec. nova (Ascomycetes Liquenzadas: *Arthoniaceae*), con una clave mundial para las especies foliícolas de *Arthoniaceae*. *Phyton* (Horn, Austria) 37 (1): 61–70, 2 figuras. – Inglés con resumen Español y Alemán.

Se describe una nueva especie foliícola del género *Arthonia* del norte de Argentina y de Brazil: *A. crystallifera* L. I. FERRARO & R. LÜCKING se distingue de otras especies foliícolas del género por la presencia de cristales brillantes grandes en la superficie de los ascocarpos. Además, está caracterizada por el color marrón de sus ascocarpos, por las esporas macrocefálicas, 2-septadas y incoloradas, y por las células radiantes del ficobionte, lo que indica una relación con *A. accolens* STIRT. Para facilitar la delimitación de las *Arthoniaceae* foliícolas, se presenta una clave para todas las especies conocidas (28) hasta la fecha. Además, se propone la nueva combinación *Eremothecella cingulata* (R. SANT.) L. I. FERRARO & R. LÜCKING comb. nova (Bas.: *Arthothelium cingulatum* R. SANT.).

Zusammenfassung

FERRARO L. I. & LÜCKING R. 1997. Neue Arten oder interessante Nachweise foliicolier Flechten. III. *Arthonia crystallifera* spec. nova (lichenisierte Ascomyceten: *Arthoniaceae*), mit einem weltweiten Schlüssel für foliicole *Arthoniaceae*. – *Phyton* (Horn, Austria) 37(1): 61–70, 2 Abbildungen. – Englisch mit spanischer und deutscher Zusammenfassung.

Eine neue foliicole *Arthonia*-Art aus N Argentinien und Brasilien wird beschrieben: *A. crystallifera* L. I. FERRARO & R. LÜCKING ist von anderen foliicolen Arten der Gattung durch den Besitz großer, deutlicher, glänzender Kristalle auf der Ascocarp-Oberfläche verschieden. Weiters sind bräunliche Ascocarp-Farbe, macrocephalische, 2-septierte, farblose Ascosporen und strahlige Phycobionten-Zellen charakteristisch, was auf nahe Verwandtschaft mit *A. accolens* STIRT deutet. Um die Abgrenzung foliicolier *Arthoniaceae* zu erleichtern, wird ein Schlüssel aller bisher bekannten Arten (28) vorgelegt. Die Neukombination *Eremothecella cingulata* (R. SANT.) L. I. FERRARO & R. LÜCKING (Bas.: *Arthothelium cingulatum* R. SANT.) wird vorgeschlagen.

1. Introduction

Although the *Arthoniaceae* play a major role in cryptogam communities of tropical forest ecosystems, their diversity on leaves is moderate as compared to other groups, such as the *Trichotheliaceae*, *Gomphillaceae*, or *Pilocarpaceae* (SANTESSON 1952; FARKAS & SIPMAN 1993). Nevertheless, particularly in lowland rain forests, members of *Arthoniaceae* are an important and conspicuous element of the foliicolous lichen flora (LÜCKING 1992a, b, 1995, 1997a). The present paper deals with the new species *Arthonia crystallifera*, which was found on leaves in a rather restricted area in northern Argentina and southern Brazil. The species, which is most closely related to *A. accolens* STIRT, is particularly characterized by the

large, conspicuous crystals which are deposited on the ascocarp surface and easily visible under lens magnification.

In addition to the 19 foliicolous *Arthoniaceae* treated by SANTESSON 1952, together with *A. crystallifera* ten new species and one variety have been described in recent years (XAVIER FILHO 1964; UPADHYAY 1964; BATISTA & MAIA 1967; KANTVILAS & VĚZDA 1988; APTROOT & SIPMAN 1991; LÜCKING 1991, 1995; BECKER & LÜCKING 1995; LÜCKING & LÜCKING 1995; LÜCKING & al. 1997). Three species, viz. *A. lividofusca* MÜLL. ARG., *A. anisolocularis* L. XAVIER & TALTASSE, and *A. opegraphina* R. LÜCKING, have later been synonymized with *A. aciniformis* STIRT., *A. cyanea* MÜLL. ARG., and *A. orbygniae* (H. B. P. UPADHYAY) MATZER, respectively (LÜCKING 1995; MATZER 1996; LÜCKING & al. 1997). Furthermore, considerable generic rearrangements have been made with the reinstatement of *Eremothecella* and the introduction of *Amazonomyces* as new generic name (BATISTA & PERES 1964; SÉRUSIAUX 1992; LÜCKING & al. 1997; THOR & al. 1997). Thus, while SANTESSON 1952 listed two species of *Stirtonia*, one species of *Cryptothecia*, 15 species of *Arthonia*, and one species of *Arthothelium*, in the present paper, one species of *Cryptothecia*, two species of *Amazonomyces*, 20 species and one variety of *Arthonia*, and five species of *Eremothecella* are accepted, leaving the genera *Stirtonia* and *Arthothelium* without foliicolous representants. In order to facilitate access to all taxonomic and systematic alterations, an key is presented to all world-wide known foliicolous, lichenized species of *Arthoniaceae*.

2. *Arthonia crystallifera* L. I. FERRARO & R. LÜCKING spec. nova.

Thallus epiphyllus, tenuis, continuus vel dispersus, 5–15 mm diam., 10–15 µm crassus, flavovirens, opacus; prothallo nullo. Apothecia rotundata, 0.3–0.5 mm lata, 35–45 µm alta, leviter prominentia, fusca, marginibus crystallis nitidis instructa, K+ rubrofusca. Stratum hypotheciodeum rubrofuscum. Stratum ascigerum incoloratum vel leviter fuscum. Asci ovati, 20–30 × 15–20 µm. Ascopora 8-nae, 2-septatae, oblongae, macrocephalae, incoloratae, 9–14 × 2.5–3 µm. Pycnidia rotundata, 0.1 mm lata., appanata vel leviter conica, fusca; conidia simplices, ellipsoides, 2.5–3 × 0.7 µm (microconidia?) vel bacillares, 4–6 × 1–1.5 µm (macroconidia?). Alga ad genus *Phycopeltis* pertinens, cellulis rectangularibus, 12–15 × 3–5 µm.

Typus: Argentina. Prov. Misiones: Depto. Iguazú, Isla Grande frente al Puerto Canoas, sobre hojas de *Pilocarpus pennatifolius* (*Rutaceae*), III. 1995, L. FERRARÓ, V. MARUŃAK & R. VANNI 5137 (CTES, holotypus; ULM, isotypus).

Thallus (Fig. 1) rounded or irregular in outline, continuous or marginally dispersed, 5–15 mm diam., 10–15 µm thick, yellowish-green. No visible prothallus, but sometimes a thin brownish zone when bordered by

other lichens. Ascocarps (Fig. 1) rounded, 0.3–0.5 mm diam., 35–45 μm high, chestnut-brown, K+ slightly reddish brown (better observed in microscopic sections), their surface especially in lateral parts encrusted with large, conspicuous, very nitidous, \pm tetraedric crystals. Hypothecoid layer 5 μm high, reddish brown. Ascigerous layer 25–35 μm high, colourless to pale brown. Asci (Fig. 2) ovate, 20–30 \times 15–20 μm . Ascospores 8 per ascus, 2-septate, colourless, macrocephalic, 9–14 \times 2.5–3 μm . Pycnidia rounded, 0.1 mm diam., applanate to slightly conical, brown. Conidia (Fig. 2) simple, either ellipsoid and 2.5–3 \times 0.7 μm (microconidia?) or bacillar, 4–6 \times 1–1.5 μm . Phycobiont a species of *Phycopeltis*, with rectangular, 12–15 \times 3–5 μm large cells, forming continuous, radiate plates, encrusted with scattered crystallites.



Fig. 1. *Arthonia crystallifera* (isotypes). General habit; note the large crystals on the ascocarp surface. Scale = 1 mm.

A. crystallifera is easily recognized by its large, brilliant crystals distributed on the lateral surface of the ascocarps. Although the production of crystals, especially calcium-oxalate, is rather frequent in foliicolous lichens, no species is hitherto known with a type of crystals similar to that of *A. crystallifera*. Particular, needle-shaped crystals on the lateral apothecial surface are known from *Echinoplaca furcata* and *E. verrucifera* (SÉRUSIAUX 1989; LÜCKING 1997b), but their structure and chemistry is certainly very different from that of the crystals found in *A. crystallifera*.

The brownish ascocarps, the 2-septate, macrocephalic ascospores, the pycnidia, and the phycobiont suggest a close relationship of the new species to *A. accolens* STIRT. However, the very slight reddish K-reaction of the ascocarps, which is best observed under the microscope, points also towards *A. mira* R. SANT. The latter has slightly larger ascospores, and the ascocarps are laterally orange brown and react K+ deep purple.



Fig. 2. *Arthonia crystallifera* (holotype). (A) Hymenium with asci and large crystals deposited in the epithecioid layer; (B) Ascospores. (C) Conidia. (D) Cells of the phycobiont. (E) Crystals from the ascocarp surface. Scale = 10 µm.

The new species seems to be restricted to northern Argentina and adjacent areas and was found in humid spots with rather high foliicolous lichen diversity. Interestingly, in both Corrientes and Misiones, one of the identified phorophytes belonged to the same species, viz. the *Rutaceae* *Pilocarpus pennatifolius*.

Additional specimens examined: Argentina. Prov. Misiones: Depto. Iguazú, Parque Nacional Iguazú, Isla Grande frente al Puerto Canoas, foliícola sobre hojas de *Pilocarpus pennatifolius* (*Rutaceae*), III. 1995, L. FERRARO, V. MARUŃAK & R. VANNI 5140 (CTES, ULM); *ibid.*, L. FERRARO & al. 5143 (CTES); *ibid.*, Paseos Inferiores, sobre *Sorocea bonplandii* (*Moraceae*), II. 1996, R. VANNI, D. KURTZ, O. POPOFF & J. HERRERA 3640 (CTES). – Prov. Corrientes: Depto. Ituzaingó, camino a San Carlos, sobre *Pilocarpus pennatifolius* (*Rutaceae*), 1980, M. M. Arbo & al. 2394 (CTES, LG). – Brazil: Santa Catarina, Ytayubá, Restinga Municipio Barra Velha, sobre hojas de *Rudgea villiflora* (*Rubiaceae*), 1988, A. KRAPOVICKAS & al. 43558b (CTES).

3. Key to the foliicolous, lichenized *Arthoniaceae*

The following key includes all presently known species of foliicolous, lichenized *Arthoniaceae* (28 species). The various lichenicolous taxa are not included; the worker is here referred to the keys provided by MATZER 1996. For practical reasons, the key is artificially structured; a natural key

to the genera being presented by LÜCKING & al. 1997. Data on the distribution of the species are based on SANTESSON 1952, FARKAS & SIPMAN 1993 and own, partly unpublished observations. Synonyms are listed if differing from FARKAS & SIPMAN 1993.

Foliicolous *Arthoniaceae* may be distinguished from externally similar taxa (*Byssolecania*, *Echinoplaca*) by their emarginate ascocarps (exciple completely absent), rather thick, irregularly branched and anastomosing, interascal hyphae, mainly ovoid to subglobose, apically thick-walled asci, with the walls being I (K/I+ bluish), mostly macrocephalic ascospores, and *Trentepohliaceae* as phycobiont.

- | | | |
|----|---|---------------------------------------|
| 1 | Ascospores transversely septate (very rarely with a few longitudinal septa) | 2 |
| 1* | Ascospores (sub)muriform | 30 |
| 2 | Ascospores (6-)9-25 × (2-)3-8 µm, with 1-5 transverse septa; pycnidia, if present, radiately symmetrical, with short (2-25 mm), ellipsoid to acicular conidia (rarely with campylidia-like anamorphs) . | 3 |
| 2* | Ascospores 30-90 × 7-12 µm in size, with 5-11 transverse septa; pycnidia, if present, bisymmetrical, with long (50-150 mm), filiform conidia | 26 |
| 3 | Ascocarps elongate-lirellate and branched or at least distinctly lobate | 4 |
| 3* | Ascocarps rounded to irregular-angular in outline, but not lirellate or lobate | 5 |
| 4 | Ascocarps thinly elongate-lirellate and branched; Neotropics, tropical Africa <i>Arthonia orbygniae</i> (H. B. P. UPADHYAY) MATZER 1996 [Syn.: <i>Arthonia opegraphina</i> R. LÜCKING] | |
| 4* | Ascocarps lobate; tropical Africa (Ivory Coast)
. <i>Arthonia lobulocarpa</i> BECKER & R. LÜCKING 1995 | 1995 |
| 5 | Ascospores predominantly 1-septate | 6 |
| 5* | Ascospores predominantly 2-3(-5)-septate | 8 |
| 6 | Ascocarps pale yellowish brown, marginally byssoid; ascospores bacillar | see <i>Vezeadaea foliicola</i> SÉRUS. |
| 6* | Ascocarps dark brown to black, emarginate; ascospores macrocephalic | 8 |
| 7 | Ascospores 6-10 × 2-3 µm, thin-walled; ascocarps dark brown, very slightly prominent and often with a velvet-like glance; often provided with rounded or radially elongate pycnidia; conidia simple, 2-3.5 × 0.7-1 µm; Neotropics, tropical Africa
. <i>Arthonia leptosperma</i> (MÜLL. ARG.) R. SANT. | |
| 7* | Ascospores 9-12 × 3-5 µm, thick-walled; ascocarps blackish brown, not prominent and without a velvet-like glance; very rarely with | |

- upright campylidia; conidia septate, filiform, 30–40 × 1 µm; Neotropics and tropical Australasia *Arthonia aciniformis* STIRT.
[Syn.: *Arthonia lividofusca* MÜLL. ARG. (LÜCKING 1995)]
- 8 Ascospores microcephalic or isolocular, often with one of the median cells slightly enlarged (*Opegrapha*-type), 3-septate; ascocarps (except for *Arthonia obesa*) black, very small (0.1–0.2 mm diam.) 9
- 8* Ascospores macrocephalic, with the distal cell distinctly enlarged (*Arthonia*-type), 2–3(-5)-septate; ascocarps variously coloured, medium-sized to large (0.3–1.0 mm diam.) 12
- 9 Ascocarps dark brown with a purplish tinge, often with a thin, pruinose marginal cover, rather large (0.5–1.5 mm diam.); phycobiont cells in irregularly net-like plates; Neotropics and tropical Africa *Arthonia obesa* (MÜLL. ARG.) R. SANT.
- 9* Ascocarps black, non-pruinose, very small (0.1–0.2 mm diam.); phycobiont cells in radiate plates 10
- 10 Ascospores very narrowly fusiform, 18–24' 2–3.5 µm, 6–9 times as long as broad; Neotropics *Arthonia epidendri* (Rehm) R. SANT.
- 10* Ascospores fusiform-ellipsoid, 8–16 × 3–5 µm, 2.5–4 times as long as broad 11
- 11 Ascospores 8–12 × 3–4 µm; pantropical
. *Arthonia nigratula* (MÜLL. ARG.) R. SANT.
- 11* Ascospores 14–16 × 4–5 µm; Vietnam
. *Arthonia microcephala* VĚZDA
- 12 Ascospores predominantly 2-septate. 13
- 12* Ascospores predominantly 3(-5)-septate. 22
- 13 Mature ascospores greyish brown 14
- 13* Mature ascospores colourless. 17
- 14 Ascocarps brownish but marginally with an orange tinge, K+ purple *Arthonia mira* R. SANT.
- 14* Ascocarps dark brown to black, K or K+ greenish 5
- 15 Thallus with scattered, yellowish to pale reddish verrucae; tropical Africa *Arthonia flavoverrucosa* BECKER & R. LÜCKING 1995
- 15* Thallus smooth 16
- 16 Ascocarps blackish brown to black, non-pruinose (very rarely with a slight marginal pruina); ascospores 11–19(-24) × (3-)4.5–6.5 (-9) µm, 2.5–4 times as long as broad; pantropical
. *Arthonia trilocularis* MÜLL. ARG.
- 16* Ascocarps dark brown with a purplish tinge, and with a thin marginal pruina; ascospores 13–19 × 2.5–4.5 µm, 3–5 times as long as broad; Paleotropics
. *Arthonia fuscocyanea* BECKER & R. LÜCKING 1995
- 17 Ascocarps brown with an orange margin or orange red, K+ purple 18

- 17* Ascocarps light to dark brown or with a bluish tinge, K- 19
- 18 Ascocarps orange-red to dark red; tropical Australasia
 *Arthonia ramosii* (RÄS.) R. SANT.
- 18* Ascocarps brown but with the marginal parts having an orange
 tinge; Neotropics *Arthonia mira* R. SANT.
- 19 Ascocarps with numerous large crystals on their lateral surface,
 easily visible under lens magnification; northern Argentina and
 Brazil
 *Arthonia crystallifera* L. I. FERRARO & R. LÜCKING (this paper)
- 19* Ascocarp surface without such crystals 20
- 20 Ascocarps greenish brown to bluish grey, with a white pruina gi-
 ving them a bluish appearance
 *Arthonia cyanea* MÜLL. ARG. var. *cyanea* p.p.
- 20* Ascocarps light to dark brown, non-pruinose 21
- 21 Ascocarps light to dark brown, up to 1.3 mm diam., sharply deli-
 mited; pantropical *Arthonia accolens* STIRT.
- 21* Ascocarps light brown, up to 0.5 mm diam., margins diffuse; tropi-
 cal Australasia *Arthonia lividula* VAIN.
- 22 Ascocarps greenish brown to bluish grey, with a white pruina
 giving them a bluish appearance. 23
- 22* Ascocarps blackish brown to black, non-pruinose. 24
- 23 Ascospores regularly (2-)3-septate, colourless (very rarely slightly
 greyish brown); pantropical
 *Arthonia cyanea* MÜLL. ARG. var. *cyanea* p.p.
 [Syn.: *Arthonia anisolocularis* L. XAVIER & TALTASSE (LÜCKING & al. 1997)]
- 23* Ascospores irregularly (2-)3-4-septate, colourless to greyish brown
 in the same hymenium; Cocos Island (Costa Rica)
Arthonia cyanea var. *cocosensis* R. LÜCKING (LÜCKING & LÜCKING 1995)
- 24 Ascocarps 0.3-1.0 mm diam.; ascospores 3-5-septate, 16-25 × 4-
 8 µm; pantropical *Arthonia palmulacea* (MÜLL. ARG.) R. SANT.
- 24* Ascocarps 0.2-0.5 mm diam.; ascospores (2-)3-septate, 10-16 × 3-
 6 µm 25
- 25 Thallus reduced, phycobiont *Trentepohlia*; epithecium K+ pur-
 plish; Australia (Tasmania)
 *Arthonia apteropteridis* KANTVILAS & VĚZDA
- 25* Thallus normally developed, phycobiont *Phycopeltis*, in irregu-
 larly net-like plates; epithecium K; Neotropics (Brazil).
Arthonia lecythidicola (BAT. & H. MAIA) R. LÜCKING & SÉRUS.
 (LÜCKING & al. 1997)
 [Bas.: *Ameropeltomyces lecythidicola* BAT. & H. MAIA 1967]
- 26 Ascocarps whitish pruinose to pale yellowish or bluish white 27
- 26* Ascocarps dark brown to almost black. 28

- 27 Ascocarps whitish pruinose, not covered by thallus tissue; phycobiont *Phycopeltis*; ascospores macrocephalic, with one large cell at the distal end, vermiform and tapering towards the proximal end; pycnidia black; tropical Australasia
Eremothecella macrocephala (R. SANT.) THOR, SÉRUS., R. LÜCKING
 & MATSUMOTO (THOR & al. 1997)
- 27* Ascocarps pale bluish white, laterally covered by algiferous thallus tissue; phycobiont *Trentepohlia*; ascospores microcephalic, with one large cell near the middle, fusiform; pycnidia pale bluish to greyish white, with a darker zone in the centre; Neotropics (Amazon basin)
Amazonomyces sprucei (R. SANT.) R. LÜCKING & SÉRUS. (LÜCKING & al. 1997)
- [Bas.: *Stirtonia sprucei* R. SANT.]
- 28 Ascospores 7–11-septate, 50–90 × 8–12 µm; tropical Asia
Eremothecella macrosperma (ZAHLEBR.) SÉRUS.
- 28* Ascospores 5–7-septate, 28–45 × 7–10 µm 29
- 29 Ascocarps K+ purple; tropical Asia (New Guinea)
Eremothecella variatae (SIPMAN & APTROOT) SÉRUS.
- 29* Ascocarps K–; pantropical *Eremothecella calamicola* SYD.
- 30 Ascocarps dark brown to almost black; pycnidia ± rounded, 0.15 mm diam.; Neotropics
Eremothecella cingulata (R. SANT.) L. I. FERRARO & R. LÜCKING comb. nova.
- [Bas.: *Arthothelium cingulatum* R. SANT., Symb. Bot. Ups. 12: 93 (1952).
 – Type: Chile, Valdivia, 1905, THAXTER s.n. (MICH, holotype)]
- 30* Ascocarps white to pale yellowish 31
- 31 Ascocarps unorganized, cotton-like, pure white, without covering thallus layer; asco-spores regularly muriform; pycnidia unknown
Cryptothecia candida (Kremp.) R. SANT.
- 31* Ascospores organized, smooth, pale yellowish to greenish white, laterally covered by an algiferous thallus layer; ascospores with a large, undivided cell near the middle; pycnidia oval, with a pale margin and dark centre, producing long, filiform conidia
Amazonomyces farkasiae (R. LÜCKING) R. LÜCKING & SÉRUS. (LÜCKING & al. 1997)
- [Bas.: *Cryptothecia farkasiae* R. LÜCKING]

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