

Two new and another interesting lichenicolous hyphomycete

Uwe BRAUN, Bettina HEUCHERT & Paul DIEDERICH

Abstract: BRAUN, U., HEUCHERT, B. & DIEDERICH, P. 2009. Two new and another interesting lichenicolous hyphomycete. – *Herzogia* 22: 165–171.

Two new lichenicolous hyphomycete species are described, viz. *Ramichloridium cladonicola* on *Cladonia portentosa* and *C. stygia* from Denmark and *Verrucocladosporium roccellae* on *Roccella boergesenii* from the Canary Islands. Furthermore, a sterile (mycelial) capnodialean hyphomycete on *Cladonia* sp. in Switzerland and *Parmelina tiliacea* in Turkey is morphologically characterised, illustrated and discussed, but not formally described as new species.

Zusammenfassung: BRAUN, U., HEUCHERT, B. & DIEDERICH, P. 2009. Zwei neue und ein weiterer interessanter lichenicoler Hyphomyzeten. – *Herzogia* 22: 165–171.

Zwei neue lichenicole Hyphomyzeten werden beschrieben: *Ramichloridium cladonicola* auf *Cladonia portentosa* und *C. stygia* aus Dänemark und *Verrucocladosporium roccellae* auf *Roccella boergesenii* von den Kanarischen Inseln. Weiterhin wird ein steriler (myzelialer) capnodialer Hyphomyzeten auf *Cladonia* sp. aus der Schweiz und auf *Parmelina tiliacea* aus der Türkei morphologisch charakterisiert, abgebildet und diskutiert, aber nicht formal als neue Art beschrieben.

Key words: Lichens, anamorphs, *Ramichloridium*, *Verrucocladosporium*, Capnodiales.

Introduction

Lichens are known to be hosts of a wide range of lichenicolous ascomycetes and ascomycetous anamorphs, including hyphomycetes. Detailed treatments and surveys of lichenicolous fungi have been given by HAWKSWORTH (1979), CLAUZADE et al. (1989), and LAWREY & DIEDERICH (2003). During the course of monographic studies of the genus *Taeniolella* S.Hughes, with special emphasis on lichenicolous taxa of this genus, HEUCHERT & BRAUN (2006) found two new species of lichen-inhabiting hyphomycetes belonging to the genera *Cladosporium* Link and *Ellisembia* Subram., and reallocated *Taeniolella laevistipitata* M.S.Cole & D.Hawksw. to *Corynespora* Güssow, and CROUS et al. (2007) described *Verrucocladosporium dirinae* K.Schub et al. Recently, two additional new lichenicolous hyphomycetes have been encountered, including one species belonging in a genus that has not yet been known to harbour any lichenicolous taxa. Furthermore, an interesting sterile (mycelial) hyphomycete, resembling anamorphs of the Capnodiales, has been found on lichens.

Material and Methods

All collections have been examined and described, mounted in distilled water, by means of light microscopy (Olympus BX 50, Hamburg, Germany). The collections examined are deposited in the herbaria BR, C, H, and POLL (abbreviations according to HOLMGREN et al. 1990) and in the private herbarium of P. Diederich.

Taxonomy

Ramichloridium cladoniicola U.Braun & Heuchert **sp. nov.** [MycoBank 513405] (Fig. 1)

Ramichloridium apiculato simile, sed conidiophoris brevioribus, ad 70 µm longis, interdum nodulosis, (0–)1–4-septatis, conidiis brevioribus, 2–5(–7) × 2–3.5(–4) µm, laevibus.

Holotype: On thalli of *Cladonia stygia*, Denmark, Jutland, Thy, Klitmøller, Hanstedreservatet, 2 June 1992, V. Alstrup (C 5485).

Additional material examined: On thalli of *Cladonia portentosa*, Denmark, Jutland, Thy, 12 September 1992, V. Alstrup, Lichenes Danici Exsiccati No. 57 (H), mixed collection with *Taeniolella cladonicola* Alstrup.

Thallus of the host discoloured, brownish; colonies loosely caespitose, scattered, brown. Mycelium internal, occasionally with a few external hyphae. Hyphae sparingly branched, 1–2 µm wide, septate, subhyaline to pale brown, thin-walled, smooth. Stromata lacking, only with a few swollen hyphal cells. Conidiophores solitary, in pairs or loose aggregations, but not fasciculate, arising from swollen hyphal cells, erect, straight to slightly curved, subcylindrical to somewhat attenuated towards the apex, unbranched, moderately sinuous-subgeniculate, occasionally with nodulose swellings, 10–70 × 2–5 µm, (0–)1–4-septate, pale to medium brown, somewhat paler towards the apex, tips occasionally subhyaline, wall somewhat thickened in the lower half, 0.5–1 µm, thinner at the apex, smooth; conidiogenous cells integrated, terminal, 10–25 µm long, slightly raduliform, with numerous conspicuous subdenticulate conidiogenous loci, flat to slightly protuberant, 0.5–1 µm diam., slightly darkened-refractive. Conidia formed singly, broadly obovoid, occasionally subglobose, 2–5(–7) × 2–3.5(–4) µm, aseptate, subhyaline to pale olivaceous or brown, smooth, thin-walled, ≤ 0.5 µm, apex broadly rounded, base rounded to somewhat attenuated, basal hilum rather inconspicuous to subconspicuous by being somewhat darkened-refractive, about 0.5 µm diam.

Notes: The *Ramichloridium* Stahel ex de Hoog complex has recently been revised by ARZANLOU et al. (2007). Several new genera have been introduced, e.g. *Myrmecridium* Arzanlou et al. and *Radulidium* Arzanlou et al., which comprise some former *Ramichloridium* species. Other *Ramichloridium* species have been reallocated to *Rhinocladiella* Nannf. The new generic concept within this complex, based on a reassessment of morphology and results of molecular sequence analyses, has been summarised in a key to *Ramichloridium*-like genera. Using this new concept, the lichenicolous hyphomycete on two *Cladonia* species in Denmark can be easily identified as a member of the genus *Ramichloridium* emend. *R. cladoniicola* is the first lichenicolous species of *Ramichloridium* (ARZANLOU et al. 2007). Due to smooth hyphae and pigmented conidia, the new *Ramichloridium* on *Cladonia* is morphologically close to the saprobic *R. apiculatum* (J.H.Mill., Giddens & A.A.Foster) de Hoog, the type species of the genus *Ramichloridium*, which differs, however, in having longer, non-nodulose conidiophores, up to 100 µm, only with 0–2(–3) septa (De HOOG 1977, ARZANLOU et al. 2007) and somewhat longer, verruculose conidia, (3–)5–6.3(–7.5) × 2–4 µm. *Ramichloridium cerophilum* (Tubaki) de Hoog has longer, colourless conidia, (4–)6–7(–11) × 2–3 µm (De HOOG 1977, ARZANLOU et al. 2007), and *R. brasilianum* Arzanlou & Crous (ARZANLOU et al. 2007), isolated from soil in Brazil, differs in having up to 10-septate conidiophores and longer, smooth to verruculose conidia, (4–)5–6(–8.5) × 2–2.5(–3) µm. Numerous other mostly saprobic *Ramichloridium* species have been described and carefully compared with the new lichenicolous species (De HOOG 1977, De HOOG et al. 1983, MORGAN-JONES 1983, MATSUSHIMA 1993, 1996, CHI 1994, PARTRIDGE et al. 2000, ARZANLOU et al. 2007). Some of these species have recently been excluded from *Ramichloridium* and reallocated to other genera (ARZANLOU et al. 2007), and the other taxa are morphologically easily distinguishable from *R. cladoniicola* by having hyaline, verruculose, much larger or subglobose conidia.

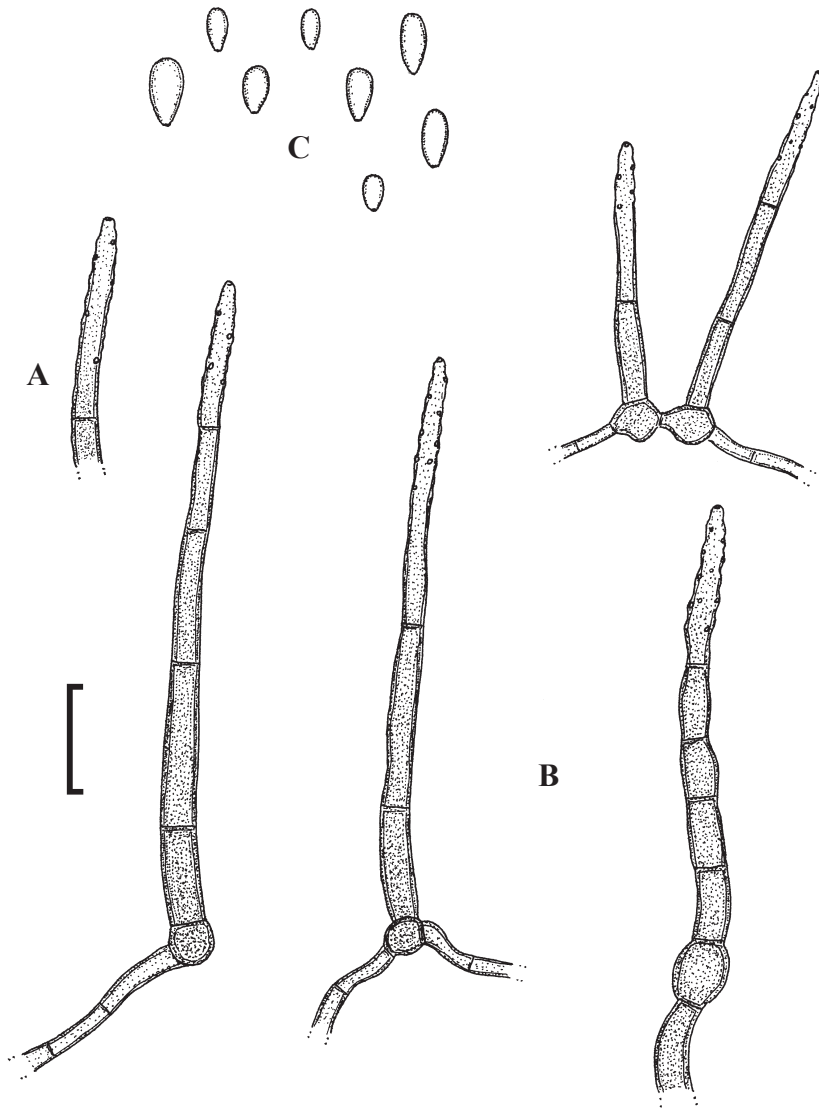


Fig. 1: *Ramichloridium cladoniicola*: **A** – tip of a conidiophore, **B** – conidiophores, **C** – conidia. Scale = 10 μ m. U. Braun del. (based on type material).

Verrucocladosporium roccellae U.Braun, Diederich & Heuchert **sp. nov.** [MycoBank 513406] (Fig. 2)

Verrucocladosporio dirinae simile, sed conidiophoris latioribus, 3–5 μ m, locis conidiogenibus et hilis leniter minoribus, 0.75–1.5 μ m diam., ramoconidiis nullis, conidiis aliquanto brevioribus et latioribus, 5–12 \times 3–5 μ m.

Holotype: On thalli of *Rocella boergesenii*, on lava, Canary Islands, Tenerife, Puerto de la Cruz, Taoro Park, 6 April 2003, P. Diederich 15580 (BR).

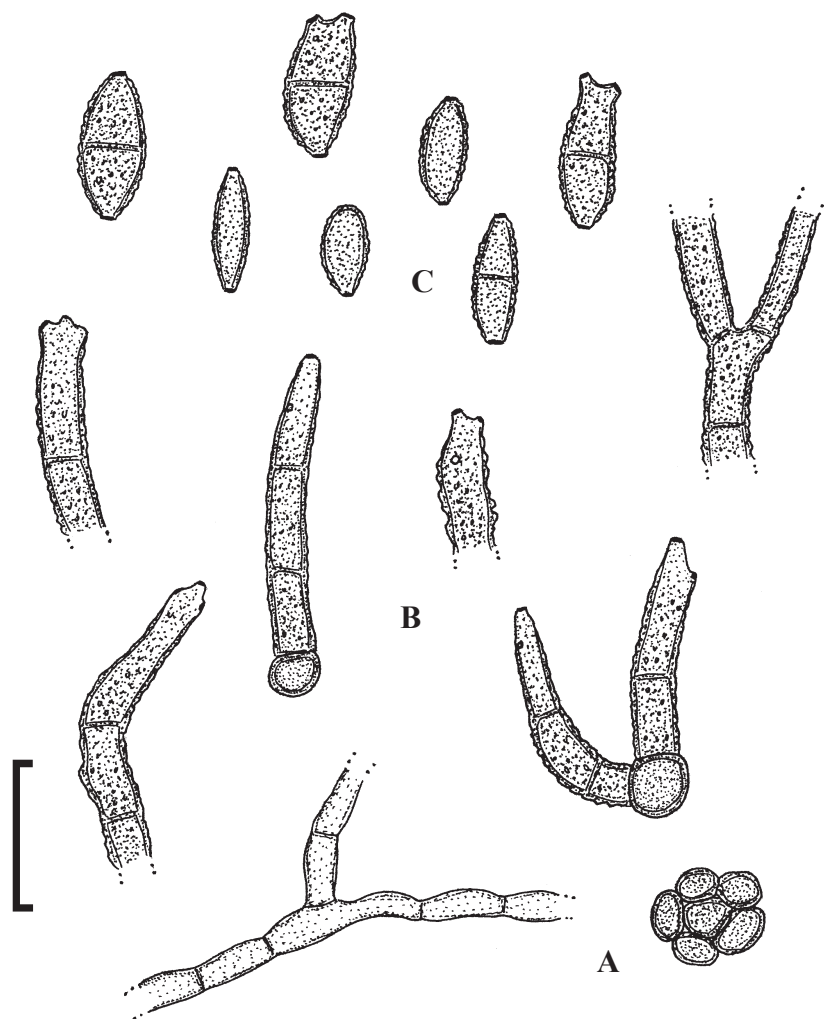


Fig. 2: *Verrucocladosporium roccellae*: **A** – hyphae and stromatic cells, **B** – conidiophores and tips of conidiophores, **C** – conidia. Scale = 10 µm. U. Braun del. (based on type material).

Thallus of the host somewhat discoloured, grey; colonies loose, effuse, not very conspicuous, blackish. Mycelium immersed; hyphae straight to sinuous-torulose, sparingly branched, 1–2.5(–3.5) µm wide, septate, subhyaline or pale to medium brown, thin-walled, smooth to faintly rough-walled; hyphal cells swollen, 2–7 µm diam., brown, wall 0.5–1.5 µm thick, forming small to moderately large stromatic aggregations. Conidiophores solitary, occasionally in pairs or loosely aggregated, but not fasciculate, arising from swollen hyphal cells, erect, straight to curved, usually unbranched, occasionally branched in the upper half, subcylindrical, slightly narrower towards the tip, outline slightly irregular-sinuuous, 15–50 × 3–5 µm, 1–3-septate, pale to medium brown, olivaceous-brown or yellowish brown, tips somewhat paler, wall up to 1 µm thick, ornamentation irregularly rugose-verrucose; conidiogenous cells integrated, terminal, 5–15 µm long, straight, cylindrical-conical to slightly geniculate-sinuuous,

with 1–4 conspicuous conidiogenous loci, 0.75–1.5 µm diam., slightly thickened and darkened-refractive, somewhat bulging, truncate to convex, but not coronate, without distinctly raised periclinal rim. Conidia in simple or branched acropetal chains, ellipsoid-ovoid, fusiform to somewhat irregular, subhyaline, pale to medium brown or olivaceous-brown, wall thin, about 0.5 µm, verruculose-verrucose, ramoconidia lacking, secondary ramoconidia and intercalary conidia 8–12 × 3–5 µm, 0–1-septate, both ends mostly somewhat attenuated, with 1–2 hila, terminal conidia obovoid (-subglobose), 5–8 × 3–4 µm, aseptate, apex rounded, base somewhat attenuated, with a basal hilum, hila truncate to somewhat convex, about 1 µm diam., unthickened or slightly thickened and somewhat darkened-refractive.

Notes: CROUS et al. (2007) introduced the new genus *Verrucocladosporium* K.Schub. et al., isolated from *Dirina massiliensis* (Roccellaceae, Arthoniales) found in UK. Molecular sequence analyses showed that this cladosporioid genus belongs in the Capnodiales, but clustering apart of *Davidiella* Crous & U.Braun (Davidiellaceae) and its *Cladosporium* anamorphs. The new cladosporioid hyphomycete on *Rocella boergesenii* (also belonging in the Roccellaceae) agrees well with the concept of the genus *Verrucocladosporium* by having rugose-verrucose conidiophores and conidia, and conidiogenous loci with a similar structure. This species is morphologically close to the type species of *Verrucocladosporium*, but sufficiently different to introduce a new species. *V. dirinae* has narrower conidiophores, 2–3 µm wide, somewhat larger conidiogenous loci, 1–2 µm diam., and often very irregularly shaped, longer and narrower conidia, 4–18(–23) × (2–)2.5–3.5 µm.

A sterile (mycelial), capnodialean hyphomycete on lichens

Material examined: On *Cladonia* sp., Switzerland, Valais, Les Haudères, 11 August 1983, P. Diederich (herb. Diederich). On *Parmelina tiliacea*, Turkey, Anatolia, Prov. Muğla, Besparmak Dağı, near Kosan, between Narhisar and Çukurköy, 850 m, 25 March 1983, V. John 5.959 (POLL).

Description of the collection on *Cladonia* sp. (Fig. 3): Colonies on thalli, densely caespitose, effuse, blackish, sterile. Mycelium composed of two types of hyphae; primary hyphae narrow, immersed to erumpent, sparingly branched, straight to flexuous, subtorulose, 1.5–4 µm wide, subhyaline to pale brown, thin-walled (wall < 1 µm wide), smooth, septate, often constricted at the septa; secondary hyphae forming loose to dense colonies, superficial, decumbent to partly erect, up to 500 µm long or occasionally even longer, 4–14 µm wide, simple or branched, often with short lateral branches, usually branched at right angles, sometimes parallel threads with anastomoses, terminal parts of threads becoming narrower towards the tip and constrictions at the septa less evident, densely pluriseptate, monilioid, i.e. distinctly constricted at the septa, with sequences of swollen hyphal cells, medium to dark brown or olivaceous-brown, wall 1–2.5 µm thick, sometimes distinctly two-layered, almost smooth to verruculose-rugose.

Notes: The characters of the rather broad, monilioid, pigmented sterile hyphal structures remind one of capnodialean fungi (sooty moulds) belonging to the Euantennariaceae and above all Metacapnodiaceae (HUGHES 1976, SIVANESAN 1984). A final determination of these lichen-inhabiting mycelia is, however, not yet possible since an associated anamorph has not yet been observed. In the collection from Switzerland four small, bud-like, holoblastic, one-celled, subglobose to broadly ovoid outgrowths have been observed at the end of a terminal cell of a lateral branchlet. These structures were similar to the *Capnobotrys* S.Hughes anamorph of *Metacapnodium* Speg. (HUGHES 1976, SIVANESAN 1984). However, a single observation is not sufficient for a final conclusion. The collection from Turkey is close to the specimen from

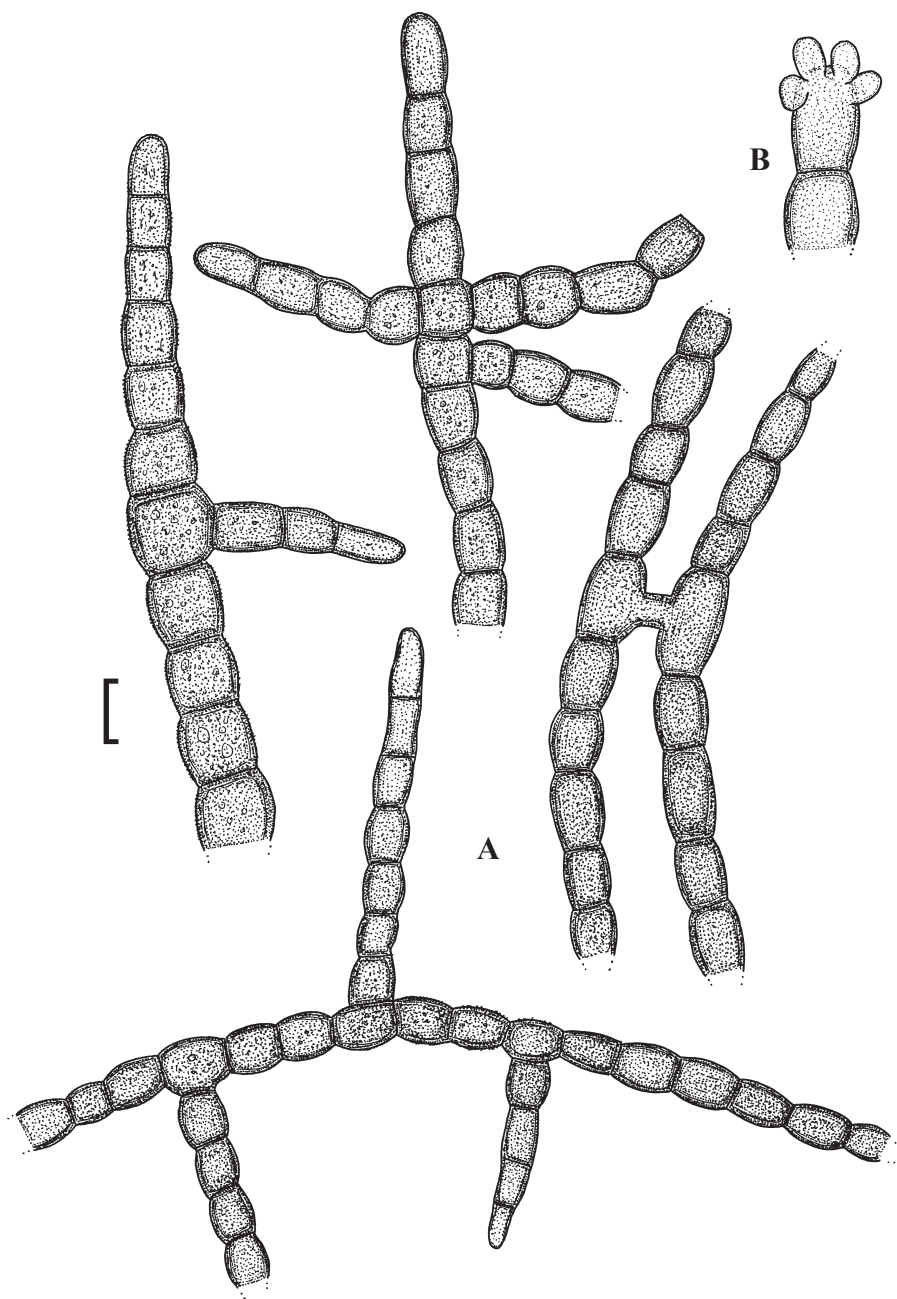


Fig. 3: Sterile (mycelial), capnodialean hyphomycete on lichens, **A** – branched, monilioid hyphae, **B** – terminal cell with bud-like structures. Scale = 10 μm . U. Braun del. (based on the material on *Cladonia* sp.).

Switzerland, except for somewhat broader hyphae, up to 20 μm , and somewhat thicker walls, up to 3 μm .

Acknowledgements

We are indebted to V. John (Germany) for the possibility to examine one of his collections.

References

- ARZANLOU, M., GROENEWALD, J. Z., GAMS, W., BRAUN, U., SHIN, H.-D. & CROUS, P. W. 2007. Phylogenetic and morphotaxonomic revision of *Ramichloridium* and allied genera. – *Stud. Mycol.* **58**: 57–93.
- CHI, P. K. 1994. Fungal diseases of cultivated medical plants in Guangdong Province. – Guangdong: Guangdong Academic Press (in Chinese).
- CLAUZADE, G., DIEDERICH, P. & ROUX, C. 1989. Nelikenigintaj fungoj likenologaj. Ilustrita determinlibro. – *Bull. Soc. Linn. Provence, Numéro spécial* **1**: 1–142.
- CROUS, P. W., BRAUN, U., SCHUBERT, K. & GROENEWALD, J. Z. 2007. Delimiting *Cladosporium* from morphologically similar genera. – *Stud. Mycol.* **58**: 33–56.
- DE HOOG, G. S. 1977. *Rhinochlorella* and allied genera. – *Stud. Mycol.* **15**: 1–140.
- DE HOOG, G. S., RAHMAN, M. A. & BOEKHOUT, T. 1983. *Ramichloridium*, *Veronaea* and *Stenella*: generic delimitation, new combinations and two new species. – *Trans. Brit. Mycol. Soc.* **81**: 485–490.
- HAWKSWORTH, D. L. 1979. The lichenicolous hyphomycetes. – *Bull. Brit. Mus. Nat. Hist., Bot. Ser.* **9**: 1–98.
- HEUCHERT, B. & BRAUN, U. 2006. On some dematiaceous lichenicolous hyphomycetes. – *Herzogia* **19**: 11–21.
- HOLMGREN, P. K., HOLMGREN, N. H. & BARNETT, L. C. 1990. Index herbariorum, Part. 1: The Herbaria of the World. 8th edn. *Regnum vegetabile* **120**: 1–163.
- HUGHES, S. J. 1976. Sooty moulds. – *Mycologia* **68**: 693–820.
- LAWREY, J. D. & DIEDERICH, P. 2003. Lichenicolous fungi: interactions, evolution, and biodiversity. – *Bryologist* **106**: 81–120.
- MATSUSHIMA, T. 1993. Matsushima Mycological Memoirs, No. **7** – Kobe: published by the author.
- MATSUSHIMA, T. 1996. Matsushima Mycological Memoirs, No. **9**. – Kobe: published by the author.
- MORGAN-JONES, G. 1983. Notes on hyphomycetes. XXVIII. *Veronaea bambusae*. – *Mycotaxon* **8**: 149–151.
- PARTRIDGE, E. C., BAKER, W. A. & MORGAN-JONES, G. 2000. Notes on hyphomycetes. LXXVII. A new species of *Ramichloridium*, *R. bacillisporum*, occurring on leaf glands of *Crataegus flava* in Alabama. – *Mycotaxon* **75**: 147–152.
- SIVANESAN, A. 1984. The bitunicate ascomycetes and their anamorphs. – *Vaduz: J. Cramer*.

Manuscript accepted: 18 June 2009.

Addresses of the authors

Uwe Braun & Bettina Heuchert, Martin-Luther-Universität, Institut für Biologie, Bereich Geobotanik und Botanischer Garten, Neuwerk 21, D-06099 Halle (Saale), Germany.

E-Mail: uwe.braun@botanik.uni-halle.de, bettina-heuchert@botanik.uni-halle.de

Paul Diederich, Musée national d'histoire naturelle, 25 rue Munster, L-2160 Luxembourg, Luxembourg. E-Mail: paul.diederich@education.lu

