

***Lecanora panticapaensis* sp. nova and *Buelliella poetshii*, two noteworthy species from Ukraine**

Alexander Ye. KHODOSOVITSEV¹, Ganna O. NAUMOVICH¹, John A. ELIX²
& Sergij Ya. KONDRATYUK³

¹ Kherson State University, Chair of Botany, 27, 40 let Oktyabrya str., 73033 Kherson,
Ukraine; e-mail: khodosovtsev@ksu.ks.ua

² Research School of Chemistry, Building 33, Australian National University, Canberra,
A.C.T. 0200, Australia; e-mail: John.Elix@anu.edu.au

³ M.H. Kholodny Institute of Botany, Tereshchenkivska str. 2, 01601 Kiev, Ukraine; e-mail:
ksya_net@ukr.net

Abstract: *Lecanora panticapaensis* Khodosovtsev, Naumovich, Elix & S. Y. Kondr., the first sorediate representative of the *L. frustulosa* group, is newly described. Notes on the noteworthy *Buelliella poetshii* Hafellner, a lichenicolous fungus on *Endocarpon* species, are provided. Both species are found on siliceous black schist outcrops in the Kryvyi Rih ironstone pool, Dnipropetrovs'ka oblast, Ukraine.

Introduction

A new, sorediate species belonging to the otherwise non-sorediate *Lecanora frustulosa* group, was found together with specimens of *Endocarpon psorodeum* (Nyl.) Blomb. & Forssell and *E. pusillum* Hedw. supporting small, black apothecia-like ascomata of the recently described lichenicolous fungus *Buelliella poetshii* Haf. during a study of saxicolous lichens of the Kryvyi Rih ironstone pool, Dnipropetrovs'ka oblast, Ukraine, in October 2007.

Materials and Methods

The study presented here is based mainly on herbarium material kept in KHER, LD and KW. Squamules with lichenicolous fungi, areoles, apothecia and pycnidia of lichen specimens were sectioned by free-hand and mounted in water. Anatomical structure and hymenial characters were studied with a Zeiss Axioscope and a MICMED light microscope.

The species

Lecanora panticaensis Khodosovtsev, Naumovich, Elix & S. Y. Kondr., sp. nova (Fig. 1)

Lecanora argopholi similis, sed thallo sooredioso, pycnidibus et conidiis minoribus et acido rhizocarpico continente, acido norstictico, acido stictico et gangaleoidino deficiente ab ea differt.

TYPE: **Ukraine:** Dnipropetrovs'ka oblast, Kryvyi Rih town, right bank of Ingulets River, "Skeli MODRu" landscape reserve, on vertical surfaces of black schist outcrops, 18.x.2007, A. Khodosovtsev & G. Naumovich (KHER 3885 – holotype, KHER 3886, KW, LD – isotypes).

Thallus up to 10 cm wide, crustose, continuous, areolate to lobulate at the periphery, grey, greyish-yellow or yellow-green, soeradiate. *Areoles* strongly convex, semiglobose to bullate, (0.3-)1.6-1.2(-1.8) diam., 0.5-1.5 mm thick, compressed and stipitate at the centre, rare forming small lobules up to 2 mm long. *Prothallus* usually indistinct, whitish when present, cottony, forming a zone up to 0.5 mm wide. *Soralia* punctiform to hemispherical, convex, dispersed, bright yellowish-green in contrast with the thallus (0.5-)1.2-2.5(-3.5) mm wide (Fig. 3), soeradia (30-)50-60(-70) μm diam., aggregated into consoreadia 80-150 μm diam., incrusting small hyaline crystals not dissolved in K. *Cortex* 20-40 μm high, paraplectenchymatous, cells 3.5-6.0 μm diam., embedded with small hyaline crystals and dispersed, dark brownish granules. *Algal layer* 120-175 μm thick, algae *Trebouxia*, cells (6-)9-12(-13) μm diam. *Medulla* white, up to 1.5 mm high, containing crystals, hyphae 2-3 μm thick.

Apothecia numerous, lecanorine, dispersed, sessile to constricted at the base, (0.6-)0.8-1.2(-1.5) mm diam.; disc brown, flat, surrounded by an entire to flexuose thalline margin, concolorous with the thallus. *Epihymenium* brownish, up to 15 μm thick, containing dark brownish granules insoluble in K and small, hyaline crystals. *Amphythecium* up to 200 μm thick, algae numerous, cortex paraplectenchymatous, 20-30 μm thick. *Subhymenium* hyaline, 15-25 μm high. *Hymenium* up to 175 μm high, hyaline, with oil droplets. *Asci* 8-spored, ascospores hyaline, simple, ellipsoid, (9-)10.5-[11.7]-13.5(-14.5) \times (4.5-)5.2-[6.4]-6.8(-7.2) μm . *Pycnidia* immersed in the centre of areoles, with brownish pigmentation around the ostioles, ellipsoid, 150-160 \times 110-130 μm , walls colourless, subparaplectenchymatous, thin; conidiophores simple, 1-celled, conidio-genous cells arising terminally, subterminally and laterally from conidiophores, slightly swollen in the central part, hyaline, 18-22 \times 1.3-2.2 μm , conidia filiform, (12-)15-[17.5]-18(-21) \times 0.5 μm .

Chemistry: thallus K+ yellow, C-, Pd+ yellow, medulla, K-, C-, Pd- or Pd+ pale yellowish, soeradia K-, Pd+ yellow. Constituents: atranorin (major), zeorin (major), roccellic acid (major), muronic acid (minor), isomuronic acid (minor), epanorin (major), rhizocarpic acid (trace).

Ecology and distribution. This species grows on vertically exposed surfaces of siliceous schist outcrops near a river. Associated species included *Immersaria cupreoatra*, *Candelariella vitellina* and *Aspicilia cinerea*. At present this species is only known from the type locality (Fig. 4).

Etymology. The species epithet *panticapaensis* refers to the old Greek name 'Panticapa' of the Ingulets River in Ukraine.

Notes. *Lecanora panticapaensis* belongs to the *L. frustulosa* group that includes *L. argopholis* (Ach.) Ach., *L. frustulosa* (Dickson) Ach. and *L. sphaerospora* Müll. Arg.. The conidiogenous cells are similar to those of *L. argopholis* (VĀNSKĀ, 1984), but the pycnidia are similar in size to those of *L. frustulosa* s.str. *L. panticapaensis* differs from both *L. argopholis* and *L. frustulosa* in having a sorediate thallus, shorter pycnoconidia, and ascospores of medium width (BRUSSE 1987; VĀNSKĀ 1984) (Table 1).

Although *L. panticapaensis* is similar to *L. argopholis* in containing high concentrations of atranorin, epanorin and zeorin, it differs in containing rhizocarpic acids as well as in lacking gangaleoidin, norstictic, stictic and usnic acids (Table 1). It differs from *L. frustulosa* in containing atranorin, epanorin and rhizocarpic acids as well as in lacking cryptostictic, norstictic, stictic and usnic

Table 1. The key characters of *Lecanora panticapaensis* and similar species of the *L. frustulosa* group.

Species	<i>Lecanora panticapaensis</i> Khodosovtsev, Naumovich, Elix & S.Y. Kondr.	<i>Lecanora argopholis</i> (Ach.) Ach.	<i>Lecanora frustulosa</i> (Dicks.) Ach.	<i>Lecanora sphaerospora</i> Müll. Arg.
Vegetative diaspores, Ascospore shape and size	Soredia Ellipsoid (8.75-)11.7(-14.5) × (4.5-)6.4(-7.25) µm	Absent Wide ellipsoid (9.5-)12.7(-16.6) × (5.7-)7.3(-9.5) µm	Absent Narrow ellipsoid (9.0-)12.6(-16.6) × (-3.8)5.3(-6.7) µm	Absent Subglobose 7.5-10.0 × 6.5-8.5 µm
Pycnidia, width	Present, 110-130 µm	Very rare, 150-220 µm	Present, 110-135 µm	Present, ca. 150 µm
Conidiogenous cells, size	18-22 × 1.3-2.2 µm	10-19(-22) × 2-2.5 µm	6.5-9.5 × 2.0-2.5 µm	?
Conidia, size	(12-)17.5(-21) × 0.5 µm	(21-) 23.8(-28.5) × 0.5 µm	(21-) 28(-39) × 0.5 µm	12-22 × 1.0 µm
Spot tests, cortex	K+ yellow, C-, PD+ yellow	K+ yellow to pale yellow, C-, KC+ yellow to pale yellow, PD+ pale yellow to yellow	K+ pale yellow, C-, KC+ pale yellow, PD- or PD+ orange yellow	?
Spot tests, medulla	K-, C-, PD- or PD+ pale yellow	K- or, rarely, K+ pale yellow, C- KC-, PD- or rarely PD+ pale yellow	K-, C-, KC-, PD- or PD+ pale orange yellow	?
Chemistry	Atranorin, epanorin, zeorin, roccellic acid, moronic acid, isomuronic acid, rhizocarpic acid	Atranorin, usnic acid, epanorin, zeorin, fatty acids, gangaleoidin, norstictic acid, stictic acid	Usnic acid, zeorin, fatty acids, stictic acid, cryptostictic acid, norstictic acid	Atranorin and/or chloroatranorin, zeorin
Substrate	Siliceous schist	Siliceous and carbonaceous rocks	Siliceous and carbonaceous rocks	Limestone rocks
References	The present paper	VĀNSKĀ (1984)	VĀNSKĀ (1984)	BRUSSE (1987)

acids (Table 1). *L. panticapaensis* differs from the similar South Australian-South African species, *L. sphaerospora* Müll. Arg. (BRUSSE 1987, LUMBSCH & FEIGE 1992, 1993) by containing high concentrations of epanorin, the presence of rhizocarpic acids, and in lacking chloratranorin. In addition, the latter species does not form soredia and is characterized by subglobose ascospores (Table 1).

***Buelliella poetshii* Hafellner**

(Figs 2-3)

Ascomata lichenicolous on squamules of *Endocarpon* species (Figs 2A and 3), apothecia-like pseudothecia, black, epruinose, originating as closed perithecia-like primordia (Fig. 2A), surrounded by 1-2 layers of thin walled brown pigmented cells, K-, N-, becoming rounded to angular and opening to form an urceolate to flat disc, (100-)150-180(-200) µm diam., usually dispersed, sometimes aggregated in groups of 2-3 ascomata. *Exciple* dark brown, pale brownish below the subhymenium, laterally 18-23 µm wide, cells 6.5-7.5 µm thick, basally indistinct, K-, N-. *Subhymenium* pale brownish. *Hymenium* hyaline to brownish (68-)75-85(-90) µm high, hymenial gelatins I/KI-, I-. *Epihymenium* brown, K-, N-. *Paraphysoids* 2-2.5 µm thick, simple to sparsely branched, apical cells up to 6-8 µm thick, with brownish pigment, K-, N-. *Asci* clavate, bitunicate, tholus thick, up to 8 µm high, without a distinct ocular chamber, 8-spored, (42-)45-55(-57) × (17-)23-25(-27) µm, all parts I/KI-, I- (Fig. 2B). *Ascospores* ellipsoid, 1-septate, colourless at first but generally brownish at maturity, smooth, constricted at the septa, upper cell usually wider than the lower one, (11.2-)15.5-17.5(-19.5) × (5.2-)7-8 (-8.8) µm (Fig. 2C). *Pycnidia* not seen.

Ecology. *Buelliella poetshii* is a lichenicolous fungus growing on *Endocarpon adsurgens*, *E. psorodeum* and *E. pusillum*, colonizers of vertical surfaces of exposed black schist outcrops or growing on mosses over conglomerate and diorite rocks. *Buelliella poetshii* is probably commensalic and only slight damage to the host thalli has been observed. In Ukraine, species associated with *B. poetshii* include *Caloplaca xerica* Poelt & Vězda, *C. demissa* (Körb.) Arup & Grube, *Lecanora dispersa* (Pers.) Sommerf., *Lichinella stipatula* Nyl., *Aspicilia caesiocinerea* (Nyl ex Malbr.) Arnold, *Staurothele areolata* (Ach.) Lettau and *Verrucaria umbrinula* Nyl.

Distribution. The species is known from alpine regions of Austria and Switzerland, and USA (Montana) (HAFELLNER et al. 2008) and the steppe zone and Crimean mountains in southern Ukraine (Fig. 4).

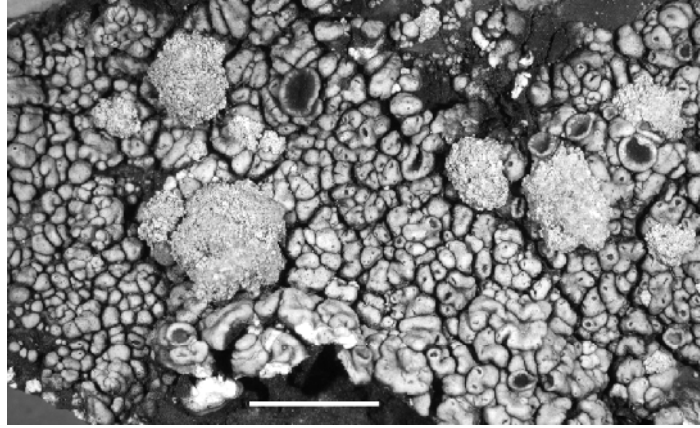


Fig. 1. *Lecanora panticapaensis* (isotype – LD): thallus with apothecia and soralia. Bar = 5 mm.

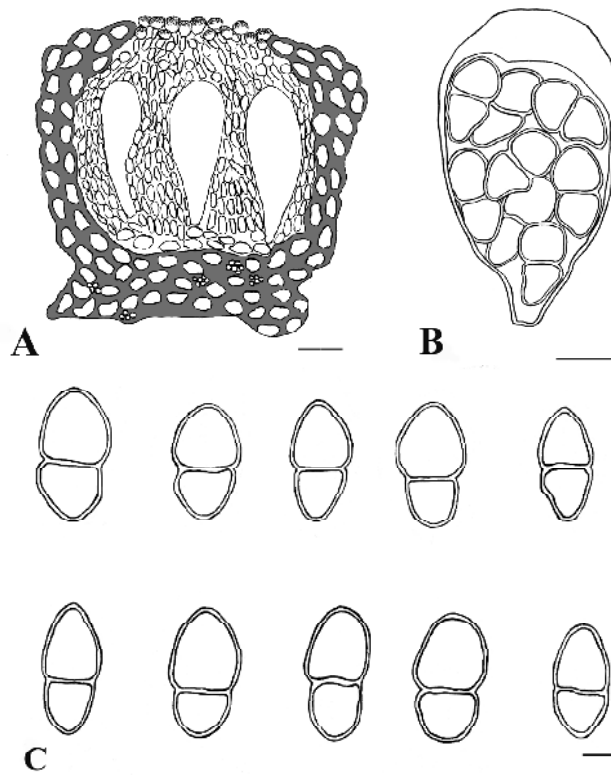


Fig. 2. *Buelliella poetshii* (KW). A, young apothecia-like pseudothecium; B, ascus; C, ascospores. Bar: A = 20 μ m, B = 10 μ m, C = 5 μ m.

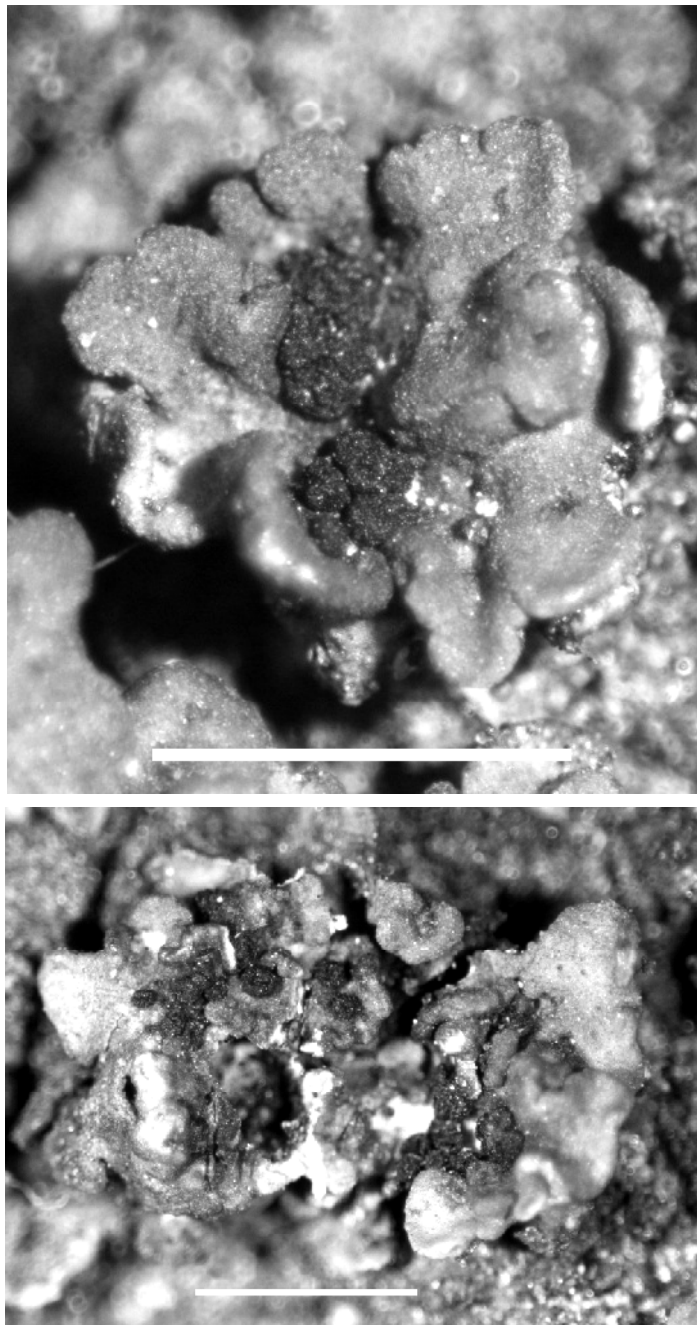


Fig. 3. *Buelliella poetsii* (KW). Ascomata on thallus squamules of *Endocarpus psorodeum*. Bar = 1 mm.

Notes. The species was recently described by HAFELLNER et al. (2008). The ascus type, together with the brownish ascospores, indicate the generic position of *Buelliella poetschii*, but it is nevertheless, similar to species included in *Melaspilea* Nyl. The Dothidealean genus *Buelliella*, so far represented by 12 species (HAFELLNER 1979; HAFELLNER 1985; KALB 1990; SANTESSON 1994, APTRoot et al. 1997; ETAYO 2002; HAFELLNER et al. 2002, 2008; LAWREY & DIEDERICH 2003; SUIJA & ALSTRUP 2004), produces apothecioid ascomata which are initially closed and then gradually open, 2-celled, brown ascospores, and a negative iodine reaction over the entire bitunicate ascus (SUIJA & ALSTRUP 2004).

The position of the family *Melaspileaceae* in the *Arthoniomycetidae* remains uncertain (KIRK et al. 2001), but it is a family characterized by a cylindrical, persistent ascus with a poorly developed, usually I– tholus and ocular chamber.

Table 2. List of lichenicolous *Buelliella* spp. with dark epihymenia and *Melaspilea* with brownish ascospores.

Species	Key characters	Host and distribution	References
<i>Buelliella poetschii</i> Haf.	Ascomata rounded to angular, 150-180 µm diam., ascospores brownish 15.5-17.5 × 7.0-8.0 µm, hymenium 75-85 µm high, epihymenium N–	On <i>Endocarpon adsurgens</i> , <i>E. psorodeum</i> , <i>E. pusillum</i> ; Austria, Switzerland, Ukraine, USA	HAFELLNER et al. (2008) the present paper
<i>Buelliella inops</i> (Triebel & Rambold) Hafellner	Ascomata rounded, 150-200 µm diam., ascospores 16-17 × 6-8 µm, hymenium 45-55 µm high, epihymenium N–	On <i>Caloplaca</i> spp.; Australia, Mexico and USA	SUIJA & ALSTRUP (2004)
<i>Buelliella lecanorae</i> Suija & Alstrup	Ascomata rounded, 200 µm diam., ascospores 17-19 × 7.5-9.5 µm, hymenium 60-65 µm high, epihymenium reddish brown, N+ slightly red	On <i>Lecanora</i> spp.; Estonia	SUIJA & ALSTRUP (2004)
<i>Buelliella trypethelii</i> (Tuck.) Fink	Ascomata rounded, 300-450 µm diam., ascospores 16-19 × 8-11.5 µm, hymenium 55-65 µm high, epihymenium N+ red	On <i>Trypethelium</i> spp.; USA, Guyana	SUIJA & ALSTRUP (2004)
<i>Melaspilea canariensis</i> D. Hawksw.	Ascomata lirellate, 300-400 × 100-200 µm, ascospores brownish, 17-20 × 6-8 µm, hymenium I–	On unknown saxicolous lichens; Canary islands	HAWKSWORTH (1982)
<i>Melaspilea epigena</i> Müll. Arg.	Ascomata lirellate, 200 µm wide, ascospores brownish, 10-12 × 5 µm	On <i>Leptotrema heterosporum</i> ; Paraguay	CLAUZADE et al. (1989)
<i>Melaspilea leciographoides</i> Vouaux	Ascomata lirellate, 150-500 × 100-200 µm, ascospores brownish, 18-22 × 9-12 µm, hymenium I+ blue	On <i>Verrucaria</i> spp.; N. England, France	PURVIS et al. (1992)
<i>Melaspilea lentiginosa</i> (Lyell ex Leight.) Müll. Arg.	Ascomata lirellate, 500-1000 × 100-200 µm, ascospores brownish, 10-13.5 × 5-7.5 µm, hymenium I+ blue	On <i>Phaeographis</i> spp.; S. England	PURVIS et al. (1992)
<i>Melaspilea rhododendri</i> (Arnold & Rehm) Almq.	Ascomata lirellate 200-300 × 200 µm, ascospores brownish, 12-20 × 6-7 µm, 3-septate	On <i>Lecidella elaeochroma</i> ; Austria (Alps), Germany: Bavaria, Italy: Sardinia	CLAUZADE et al. (1989)

The type species of the genus *Melaspilea*, *M. urceolata* (Fr.) Almb., is characterized by a fine exciple with radiate, thin hyphae, not exceeding 1 µm across, anastomosing, thin paraphysoids up to 1 µm wide, with brownish apical cells to 2-3 µm wide. The appearance of the ascomata, the structure of the exciple and the non-anastomosing, thick paraphysoids of the new species are more consistent with *Buelliella*, although only four *Buelliella* species have a dark coloured epihymenium like that of *B. poetshii* (SUIJA & ALSTRUP 2004; HAFELLNER et al. 2008), i.e. *B. lecanorae* (SUIJA & ALSTRUP 2004), *B. trypethelii* (HAFELLNER 1979) and *B. inops* (SANTESSON 1994). The latter three species have lower hymenia but are associated with different hosts (Table 2). *Melaspilea* is a large genus that includes eight lichenicolous species (LAWREY & DIEDERICH 2003), five of which have brownish ascospores when mature [as observed in *Buelliella poetshii* (Table 2)]. *Melaspilea canariensis* has an I- hymenium, rather large ascospores and also differs from *Buelliella poetshii* in having lirellate ascomata and an alternative host. Some species of *Verrucaria* which are similar to *Endocarpon* have been recorded as hosts for the lichenicolous *Melaspilea leciographoides*, but the latter species has an I+ blue hymenium, gelatin, and lirellate ascomata.



Fig. 4. Distribution of *Lecanora panticaeensis* and *Buelliella poetshii* Haf. in Ukraine.

Specimens examined: **Ukraine:** Crimea AR, Alushta region, Mt Ayu-Dag, on *Endocarpon pusillum* over saxicolous mosses, 15.9.1999, A. Khodosovtsev (KHER); Mt South Demerdji, on *Endocarpon pusillum* over saxicolous mosses, 08.5.2000, A. Khodosovtsev (KHER); Dnipropetrovs'ka oblast, Kryvyi Rih town, right bank of Ingulets River, on *Endocarpon psorodeum* thalli, 11.10.2008, A. Khodosovtsev & G. Naumovich (KHER); right bank of Ingulets River, "Skeli MODRu" landscape reserve, vertical surfaces of black schist outcrops, on *Endocarpon psorodeum*, 18.10.2007, A. Khodosovtsev & G. Naumovich (KW, KHER 3881, 3882, 3883, 3884, LD).

Acknowledgements

The first two authors are grateful to Dr I. Moysienko (Kherson State University, Ukraine) and O. Shvets (Kherson, Ukraine) for considerable assistance during their fieldwork, as well as to Dr A. Mazur, Dr V. Kucherevskiy and Dr A. Smetana (Kryvyi Rih Botanical Garden, Ukraine) for assistance and hospitality. We sincerely thank Torbjörn Tyler (LD) for assistance with the Latin descriptions and Prof. V. Wirth for very valuable remarks.

References

- APTROOT, A. DIEDERICH, P. SERUSIAUX, E. & SIPMAN, H. J. M. (1997): Lichens and lichenicolous fungi from New Guinea. – *Bibliotheca Lichenologica* **64**: 1-220.
- BRUSSE, F. A. (1987): *Schistoplaca* (Lichenes, Biatioraceae), a new lichen genus. – *Mycotaxon*: **29**: 245-249.
- CLAUZADE, G., DIEDERICH, P. & ROUX, C. (1989): Nelikenigintaj fungoj likenlogaj. Ilustrita determinlibro. – *Bulletin de la Societe Linneenne de Provence*, Numero Special **1**: 1-142.
- ETAYO, J. (2002): Aportación al Conocimiento de los Hongos Liquenicolas de Colombia. – *Bibliotheca Lichenologica* **84**: 1-154.
- HAFELLNER, J. (1979): *Karschia*. Revision einer Sammelgattung an der Grenze von lichenisierten und nichtlichenisierten Ascomyceten. – *Beiheft zur Nova Hedwigia* **62**: 1-248.
- HAFELLNER, J. (1985): Studien über lichenicole Pilze und Flechten IV. Die auf *Brigantinea*-Arten beobachteten Ascomyceten. – *Herzogia* **7**: 163-180.
- HAFELLNER, J., TRIEBEL, D., RYAN, B. D. & NASH III, T. H. (2002): On lichenicolous fungi from North America II. – *Mycotaxon* **84**: 293-329.
- HAFELLNER, J., HERZOG, G. & MAYRHOFER, H. (2008): Zur Diversität von lichenisierten und lichenicolous Pilzen in den Ennstaler Alpen (Österreich: Steiermark, Oberösterreich). – *Mitt. Naturwiss. ver. Steiermark* **137**: 131-204.
- HAWKSWORTH, D. (1982): *Melaspilea canariensis* sp. nova and other lichenicolous fungi from Tenerife. – *Lichenologist* **14**: 83-86.
- KALB, K. (1990): Lichenes Neotropici. Fasc. XI (No. 451-475). Neumarkt in der Oberpfalz, 12 pp.
- KIRK, P. M., CANNON, P. F., DAVID, J. C. & STALPERS, J. A. (eds) (2001): *Ainsworth & Bisby's Dictionary of the Fungi*. 9th edition. CABI Publishing, Wallingford, 665 pp.
- LAWREY, D. & DIEDERICH, P. (2003): Lichenicolous fungi: interaction, evolution, and biodiversity. – *Bryologist* **106**: 80-120.
- LUMBSCH, H.T. & FEIGE, G.B. (1992): Comments on the exsiccata 'Lecanoroid Lichens' I. – *Mycotaxon* **45**: 473-488.
- LUMBSCH, H.T. & FEIGE, G.B. (1993): Comments on the exsiccata 'Lecanoroid Lichens' I. – *Mycotaxon* **52**: 429-442.
- MATZER, M. (1996): Lichenicolous ascomycetes with fissitunicate asci on foliicolous lichens. – *Mycological Papers* **171**: i-x + 1-202.
- SANTESSON, R. (1994): Fungi Lichenicoli Exsiccati. Fasc. 7 & 8 (Nos 151-200). – *Thunbergia* **21**: 1-18.
- SUIJA, A. & ALSTRUP, V. (2004): *Buelliella lecanorae*, a new lichenicolous fungus. – *Lichenologist* **36**: 203-206.
- VÄNSKÄ, H. (1984): The identity of the lichens *Lecanora frustulosa* and *L. argopholis*. – *Annales Botanici Fennici* **21**: 391-402.

