

A revision of lichenicolous fungi growing on *Cladonia*, mainly from the Northern Hemisphere, with a worldwide key to the known species

MIKHAIL P. ZHURBENKO¹ AND RAQUEL PINO-BODAS²

ABSTRACT. – The paper documents 70 species of fungi found on species of the lichen genus *Cladonia*, 65 of which are obligately lichenicolous. One genus, *Brackelia*, and seven species, *Biciliopsis cladoniae*, *Brackelia lunkei*, *Caeruleoconidia biazrovii*, *Neolamya ahtii*, *Niesslia keissleri*, *Sclerococcum crassitunicatum* and *S. epicladonia*, are here described as new to science. The names *Caeruleoconidia* and *C. ochrolechia* are validated. *Ameroconium cladoniae* is considered as a heterotypic synonym of *Taeniolella beschiana*. *Merismatium cladoniicola* most likely is a heterotypic synonym of *M. decolorans*. Taxonomic notes on critical specimens, including those of *Abrothallus* cf. *pezizicola*, *Arthonia* cf. *lepidophila*, *Cladophialophora* cf. *cladoniae*, *Hainesia* cf. *bryonorae*, *Merismatium* cf. *nigritellum* as well as of unidentified species of *Acremonium*, *Dactylospora*, *Leptosphaeria*, *Lichenopeltella* and *Pronectria* found on *Cladonia* are provided. *Cercidospora cladoniicola*, *Didymocyrtis cladoniicola*, *Hainesia longicladoniae*, *Pezizella ucrainica*, *Plectocarpon cladoniae* and *Polycoccum laursenii* are documented as new to Asia. *Biazrovia stereocaulicola*, *Hainesia longicladoniae* and *Polycoccum microcarpum* are new to North America. The following species are new to various countries: Argentina (*Bachmanniomyces uncialicola* and *Niesslia cladoniicola*), Finland (*Didymocyrtis foliaceiphila* and *Roselliniella cladoniae*), Japan (*Lichenosticta alcorniaria*), Lithuania (*Abrothallus* cf. *pezizicola*), Mongolia (*Arthonia digitatae*, *Didymocyrtis cladoniicola*, *Epicladonia stenospora* s. lat., *Lichenostigma alpinum* s. lat., *Phaeopyxis punctum*, *Sphaerellothecium cladoniicola* and *Taeniolella beschiana*), New Zealand (*Abrothallus cladoniae* s. lat. and *Epicladonia sandstedei*), Norway (*Arthonia digitatae*), Kazakhstan (*Sphaerellothecium cladoniae*), Kyrgyzstan (*Epicladonia sandstedei*), Papua New Guinea (*Opegrapha cladoniicola*), Portugal (*Epicladonia stenospora* s. lat.), Russia (*Abrothallus cladoniae* s. lat., *A.* cf. *pezizicola*, *Arthrorhaphis aeruginosa*, *Didymocyrtis foliaceiphila*, *Hainesia longicladoniae*, *Neoburgoa freyi*, *Pezizella ucrainica* and *Polycoccum laursenii*), Spain (*Lichenococcium aeruginosum*), U.S.A. (*Biazrovia stereocaulicola*, *Hainesia longicladoniae*, *Niesslia cladoniicola* and *Polycoccum microcarpum*), Venezuela (*Roselliniella cladoniae*) and Vietnam (*Pyrenidium actinellum* s. lat.). *Epicladonia sandstedei* and *E. stenospora* s. lat. are new to Macaronesia. *Heterocephalacria bachmannii* is for the first time documented in the polar desert biome. *Biazrovia stereocaulicola*, *Coniochaeta* sp., *Merismatium coccisporum* and *Pyrenidium actinellum* s. lat. are newly reported to occur on *Cladonia*. A key to 138 species of fungi so far known to occur on *Cladonia* is provided.

KEYWORDS. – Cladoniicolous fungi, new taxa, new records, new host lichens, taxonomy.

INTRODUCTION

Cladonia (Cladoniaceae) is a subcosmopolitan genus of macrolichens characterized by a dimorphic thallus, formed by a crustose or squamulose primary thallus that is sometimes evanescent, and fruticose podetia (Ahti & Stenroos 2013). It currently comprises 470 species (T. Ahti, pers. comm., 2016)

¹MIKHAIL P. ZHURBENKO – Lab. of the Systematics and Geography of Fungi, Komarov Botanical Institute Russian Academy of Sciences, Professor Popov 2, St. Petersburg, 197376, Russia. – e-mail: zhurb58@gmail.com

²RAQUEL PINO-BODAS – Real Jardín Botánico de Madrid (CSIC), Plaza Murillo 2, E-28014 Madrid, Spain. – e-mail: rpino@rjb.csic.es

and, along with *Arthonia*, *Lecanora*, *Pertusaria* and *Xanthoparmelia*, belongs to the five largest lichen genera in terms of species numbers (Lücking et al. 2016). The species of *Cladonia* mostly grow on soil, but also occur on tree bases and decaying wood, and play an important role in the ground vegetation of tundra and boreal forest vegetation biomes (Ahti & Oksanen 1990). They also frequently occur in many temperate and even tropical habitats (Ahti 2000).

Zhurbenko and Alstrup (2004) provided a key to 77 species of lichenicolous fungi that occurred on *Cladonia*. Subsequently, 25 further species of fungi have been reported from this host lichen genus, viz. *Ameroconium cladoniae* U. Braun & Zhurb. (Zhurbenko & Braun 2013), *Arthonia coniocraeae* Brackel (Brackel 2010b), *A. coronata* Etayo (Coppins & Aptroot 2009), *A. rangiformicola* Brackel & Etayo (Brackel 2015), *Calongeomyces gibelluloides* (D. Hawksw. & Etayo) D. Hawksw. & Etayo (Hawksworth & Etayo 2010), *Cladophialophora cladoniae* (Diederich) Diederich (Diederich 2010), *Dacampia cladoniicola* Halici & A.O. Türk (Halici et al. 2008), *Didymocyrtis cladoniicola* (Diederich, Kocourk. & Etayo) Ertz & Diederich, *D. foliaceiphila* (Diederich, Kocourk. & Etayo) Ertz & Diederich (both Diederich et al. 2007), *Endophraggiella stordeuriana* U. Braun, Zhurb., Diederich, Tsurykau & Heuchert (Zhurbenko et al. 2015b), *Galloea cladoniicola* Alstrup & Søchting (Alstrup & Søchting 2009), *Hainesia brevicladoniae* Diederich & Van den Boom, *H. longicladoniae* Diederich & Van den Boom (both Diederich & Van den Boom 2013), *Lichenocodium aeruginosum* Diederich, M. Brand, Van den Boom & Lawrey (Lawrey et al. 2011), *Lichenopeltella rangiferinae* Brackel (Brackel 2011), *L. uncialicola* Brackel (Brackel 2010a), *Micarea kemmleri* Brackel (Brackel 2016), *Nectriopsis cariosae* Brackel & D.G. Zimmermann (Brackel & Zimmermann 2012), *Neoburgoa freyi* Diederich, Zimmermann & Lawrey (Lawrey et al. 2016), *Phoma grumantiana* Zhurb. & Diederich (Diederich et al. 2007), *Pronectria minuta* Motiej. & Kukwa (Motiejūnaitė & Kukwa 2008), *Ramichloridium cladoniicola* U. Braun & Heuchert (Braun et al. 2009), *Stigmidium cladoniicola* Zhurb. & Diederich (Zhurbenko & Diederich 2008), *S. subcladoniicola* Van den Boom (Van den Boom 2016) and *Sypastospora cladoniae* Etayo (Etayo 2008).

The aims of the paper are to 1) provide new information on the taxonomy, geographic distribution and host preferences of fungi that occur on *Cladonia*; 2) describe a new genus and seven new species of cladoniicolous fungi; and 3) present an updated worldwide key to the species of lichenicolous fungi that occur on *Cladonia*.

MATERIALS AND METHODS

The study is based on 747 examined specimens of fungi (including some lichenized ones) growing on *Cladonia* housed in the herbaria LE (667 specimens) and H (80 specimens), with two duplicates in herb. Diederich. Of these 727 were collected in the Northern Hemisphere (including 389 specimens collected by M. P. Zhurbenko and 26 by R. Pino-Bodas) and 21 were from the Southern Hemisphere. Within the Northern Hemisphere, 622 specimens were from the arctic and boreal forest (taiga) biomes, and 105 represented more southern biomes. The material was examined and photographed using a Stemi 2000–CS dissecting microscope and Axio Imager A1 compound microscope equipped with Nomarski differential interference contrast optics. Microscopic examination was carried out in water, 10% KOH (K), Lugol's iodine, directly (I) or after 10% KOH pre-treatment (K/I), Brilliant Cresyl blue (BCr), lactic acid, nitric acid (N), Phloxine B or Phloxine B after 10% KOH pre-treatment. Measurements were taken from water mounts, unless otherwise indicated. When ten or more measurements are summarized in the text, they are indicated as (minimum–){X –SD}–{X +SD};(–maximum), where X is the arithmetic mean and SD the corresponding standard deviation, followed by the number of measurements. The length/breadth ratios of ascospores and conidia are indicated as l/b and given in the same way.

The DNA of *Coniochaeta* sp. was extracted using E.Z.N.A.® Forensic DNA Kit (OMEGA) according to the manufacturer's instructions. The ITS rDNA region was amplified with the primers ITS1F (Gardes and Bruns 1993) and ITS4 (White et al. 1990). The PCR was done with Ready-to-Go-PCR Beads (GE Healthcare Life Sciences, Little Chalfont, UK), using 3 µl of DNA extracted. The PCR program was described in Pino-Bodas et al. (2013). The PCR product was purified with Illustra GFX PCR DNA and Gel Band Purification Kit (GE Healthcare) and the sequencing was performed at Macrogen Europe (www.macrogen.com). A BLASTn search (Altschul et al. 1997) was used to compare the ITS rDNA sequence with the sequences in the GenBank.

CATALOGUE OF THE STUDIED TAXA

Some lichenized or not truly lichenicolous fungi occurring on *Cladonia* are also included here even though they are not obligately lichenicolous. The cited specimens are organized geographically, first for the Northern Hemisphere (starting with Europe), then for the Southern Hemisphere. Descriptions and occasional taxonomic observations are provided for the insufficiently known or critical taxa or for the deviating or insufficiently known characters of the well-known species.

***Abrothallus cladoniae* R. Sant. & D. Hawksw. s. lat.**

DESCRIPTION. – *Apothecia* convex and often somewhat applanate above, sessile, constricted at the base, stipe not observed, 125–375 µm in diameter, black, matt, distinct pruina not seen. *Epihymenium* medium to dark greenish to olive, sometimes with yellow orange crystals (in *Stenroos 5782a*) or indistinct (in LE 308478). *Hymenium* 30–40 µm tall (including epihymenium), light to medium greenish olive brown, sometimes with purple stripes (in *Stenroos 5782a*) or medium purplish brown (in LE 308478), K+ intensively green (in LE 308478) or just becoming slightly paler and more olive with K (in *Stenroos 5782a*). *Hypothecium* medium brown, up to 100 µm tall basally and up to 30 µm thick laterally. *Asci* narrowly clavate, (40.4–)42.9–49.6(–56) × (6.6–)7.0–8.4(–9.0) µm (n = 23, in K/I), 8-spored. *Ascospores* first light, then medium brown, subellipsoid to short clavate/soleiform, (0–)1-septate, upper cell slightly wider and of more or less the same length as the lower one, constricted at the septum, quite often splitting into semi-spores even in the asci, (7.0–)7.6–9.0(–9.7) × (2.9–)3.2–3.6(–3.8) µm, l/b = (2.0–)2.3–2.7(–2.9) (n = 34; LE 308478) or (5.5–)6.2–7.4(–8.5) × (2.5–)2.6–3.2(–3.6) µm, l/b = 2.1–2.5(–2.7) (n = 42, in water or K; *Stenroos 5782a*), smooth to distinctly verruculose when old. Pathogenicity not observed.

NOTES. – The examined material was quite variable in the pigmentation of the epihymenium and hymenium, reaction with K and in the size of the ascospores. It is noteworthy, that according to the observations of A. Suija (pers. comm., 2015) the K reaction can vary in this species from positive to negative in different ascomata within the same specimen. In the species protologue (Hawksworth 1990) its apothecia were reported as being initially densely green pruinose and often short stipitate, the color of the hymenium and its reaction with K were not indicated, asci were reported to be shorter (28–35 × 7.5–9 µm), and a wider ranger was reported for the size of the ascospores (7–11 × 3–4.5 µm).

Here we report the second record of this species from Asia after Kocakaya et al. (2016). It is also newly reported for Russia and New Zealand. *Cladonia gracilis* ssp. *vulnerata* and *C. neozelandica* are new host taxa.

Specimens examined. – **RUSSIA. CHUKOTKA AUTONOMOUS AREA:** Vesnovannaya River, 65°20'N, 174°26'E, 8.vi.1950, on *Cladonia gracilis* ssp. *vulnerata* (darkened bases of podetia), *M.N. Avramchik s.n.* (LE 308478). **NEW ZEALAND. SOUTH ISLAND:** Fiordland National Park, 45.442°S, 167.688°E, 7.v.2010, on *C. neozelandica* (upper parts of podetia and apothecia), *S. Stenroos 5782a* (H).

***Abrothallus cf. pezizicola* Diederich & R.C. Harris**

DESCRIPTION. – *Apothecia* convex and often somewhat applanate above, sessile, constricted at the base, rarely substipitate, 100–350 µm in diameter, black, matt, occasionally with yellowish green pruina. *Epihymenium* medium olive brown, green, blue-green and/or purple, with yellowish or reddish orange crystals. *Hymenium* colorless or sometimes with purple patches (in *Högnabba 220911-15b*), ca. 40 µm tall (including epihymenium), K+ intensively green or blue green. *Hypothecium* medium olive brown basally and partly purple, with red orange crystals laterally, becoming more olive in K. *Asci* narrowly clavate to subcylindrical, 29–41 × 6–10 µm (n = 9), 8-spored. *Ascospores* light to medium brown, clavate, 1-septate, upper cell usually much broader and up to 2.5 times longer than the lower one, occasionally splitting into semi-spores, but this was not observed within the asci, occasionally slightly constricted at the septum, (7.9–)8.8–10.4(–11.5) × (2.5–)3.0–3.6(–4.1) µm, l/b = (2.2–)2.6–3.4(–4.6) (n = 89, in water or K), distinctly verrucose.

NOTES. – There are some discrepancies between the examined material and the protologue (Diederich 2003) where the ascomata were reported as being smaller (up to 220 µm in diameter), the epihymenium dark olivaceous green to almost blackish, the hymenium yellowish-brown, 30–35 µm tall (including epihymenium) and K–, the hypothecium reddish to olivaceous brown and K–, the asci much

shorter (17–19 × 5.5–7.5 μm), and ascospores light brown, often indistinctly verruculose and somewhat smaller (6.5–9.0 × 2.0–3.0 μm). The species is here reported new to Lithuania and Russia. *Cladonia fimbriata* and *C. pyxidata* are new host species.

Specimens examined. – **LITHUANIA:** Asveja Regional Park, 55.073°N, 25.419°E, 22.ix.2011, on *Cladonia fimbriata* (apothecia), *F. Högnabba 220911-15b* (H). **RUSSIA. REPUBLIC OF BURYATIA:** Malyi Bugatai River, 51°52'N, 102°21'E, elev. 750 m, 10.vi.2005, on *C. pyxidata* (podetia), *M.P. Zhurbenko 5129* (LE 309154).

***Acronium* sp. 1**

NOTES. – Compared to the *Acronium* species formerly documented on lichens, the examined specimen is most similar to *A. bavaricum* Brackel, reported from *Melanelixia glabrata* (Brackel et al. 2012). However, according to W. von Brackel (pers. comm., 2015) it is not conspecific with that species. The conidiogenous cells are 27–46 μm long, 1.3–1.6 μm wide at the apex, 2.8–3.3 μm wide at the base. The conidia are oblong, sometimes slightly constricted in the middle, rounded at the apices, truncated at the bases, aseptate, and (4.2–)4.6–5.6(–6.6) × 2.0–2.4(–2.8) μm in size [l/b = (1.9–)2.1–2.5(–2.8) (n = 22)].

Specimen examined. – **RUSSIA. CHUKOTKA AUTONOMOUS AREA:** Baranikha, 68°30'N, 168°16'E, 21.vi.1971, on *Cladonia amaurocraea* (somewhat darkened portions of podetia), *I.I. Makarova s.n.* (LE 308481).

***Acronium* sp. 2**

NOTES. – The material examined is reminiscent of *Acronium lichenicola* W. Gams, which differs in having subcylindrical, 0–1-septate, somewhat thinner conidia [5–9.5 × 1.5–2(–2.5) μm, l/b = 3–4.4; Hawksworth 1979]. In our material the conidiogenous cells are 41–49 μm long and approximately 3 μm wide at the base. The conidia are hyaline, oblong to subcylindrical, sometimes slightly wider below or constricted in the middle, rounded at the apices, truncated at the base, aseptate, and (7.0–)7.1–7.9(–8.3) × (2.4–)2.5–2.9 μm in size [l/b = 2.6–3.0(–3.1) (n = 13)], often with 2–3 large guttules.

Specimen examined. – **RUSSIA. KRASNODAR TERRITORY:** Caucasus, Lagonaki Upland, Mt. Fisht, 43°57'46"N, 39°55'36"E, elev. 1600 m, 23.viii.2014, on *Cladonia pocillum* (darkened parts of basal squamules), *M.P. Zhurbenko 14276* (LE 308607).

***Anzina carneonivea* (Anzi) Scheid.**

NOTES. – This is a lichen with a rather inconspicuous thallus occasionally found on macrolichens from the genera *Cladonia*, *Peltigera* and *Stereocaulon* (Hafellner 2000, Zhurbenko 2010a). The specimen cited below was formerly erroneously identified and published as *Lettauia cladoniicola* (Zhurbenko 2009a).

Specimen examined. – **U.S.A. ALASKA:** Denali National Park and Preserve, headwaters of Hinnes Creek, 63°43'N, 149°07'W, elev. 900 m, 30.viii.2000, on *Cladonia stygia* (moribund podetia), *M.P. Zhurbenko 00304b* (LE 309147b)

***Arthonia coronata* Etayo**

DESCRIPTION. – *Ascomata* blackish, matt, rough and aggregated in groups. *Hymenium* covered by medium to dark brown, aseptate, cylindrical to somewhat acuminate hairs with acute and sometimes attenuated apices, 9–37 × 3.3–4.7 μm. *Ascospores* hyaline to occasionally light brown, (9.3–)10.7–13.3(–15.0) × (3.9–)4.1–4.9(–6.3) μm, l/b = (1.7–)2.4–3.0(–3.3) (n = 76, in water, K or K/I).

NOTES. – Found on podetia (mainly on their tips) of *Cladonia cornuta*, *C. cyanipes*, *C. deformis* and an unidentified *Cladonia* species. It sometimes causes light bleaching of the host tissues. Formerly known in the United States from Maine and in Canada from Quebec (Lendemer & Harris 2012), its range in North America is here extended to Alaska. *Cladonia cornuta*, *C. cyanipes* and *C. deformis* are new host species.

Specimens examined. – **U.S.A. ALASKA:** Goldstream Valley, 64°57.188'N, 147°42.775'W, 31.vii.2004, on *Cladonia deformis* (upper parts of podetia), *M.P. Zhurbenko 0458* (LE 309141); on *C. cyanipes* (tips of podetia), *M.P. Zhurbenko 0467a* (LE 309140a); Kenai Peninsula, Chugach National Forest, 60°10'N, 149°30'W, elev. 150 m, 1.ix.2000, on *C. cornuta* (podetia), *M.P. Zhurbenko 00478a* (LE 309142a). **CANADA. BRITISH COLUMBIA:** Columbia River Valley near mouth of Mica Creek, 23.vii.2002, on *Cladonia* sp. (upper parts of podetia), *M.P. Zhurbenko 02407* (LE 308779).

***Arthonia digitatae* Hafellner**

DESCRIPTION. – *Apothecia* black, sometimes with brown cast when moistened, epruinose, glossy, convex to applanate, irregularly rounded or elongated in surface view, 70–330 µm lengthways, dispersed to aggregated, sometimes adjacent to confluent. *Epihymenium* distinct, medium to dark brown or brownish orange, sometimes with scattered granules, 5–10 µm tall, becoming pure brown or acquiring gray or olive tint in K. *Hymenium* hyaline to light brown, brownish gray or olive gray, sometimes with scattered granules, 25–45 µm tall, I+ red, K/I+ blue, becoming slightly discolored in K. *Subhymenium* distinct, light to medium brown or brownish orange, 15–50 µm tall, becoming slightly discolored in K. *Paraphysoids* 1.5–3 µm wide, flexuous, branched; tips usually thickened to capitate, 2–6 µm in diameter, sometimes with a distinct dark brown cap (in LE 207410, LE 260947, LE 308503). *Asci* broadly clavate, (23–)30–40(–47) × (10–)13–17(–18) µm (n = 36, in water, K or I), with K/I+ blue ring in the tholus, 8-spored. *Ascospores* consistently hyaline, narrowly clavate, 1-septate, not or rarely slightly constricted at the septum, upper cell wider and occasionally shorter than the lower one (length ratio up to 2:3), (8.2–)10.2–12.8(–16.7) × (3.5)4.1–4.9(–6.6) µm, l/b = (1.7–)2.3–2.9(–3.7) (n = 367, in water, K or K/I), smooth-walled, sometimes with a halo 0.5–1 µm thick.

NOTES. – There are some discrepancies between our material and the protologue (Hafellner 1999), where ascomata were reported as being 0.1–0.2 mm in diameter, asci 20–25 × 12–15 µm, ascospores 9–11 × 3–4.5 µm, without a distinct halo, and the subhymenium hyaline to light brown. The examined material was quite variable, particularly with respect to the pigmentation of different ascomatal parts, and thus almost includes the concept of *Arthonia rangiformicola*, a species so far known from a few finds on *Cladonia rangiformis* in Italy and Spain (Brackel 2015). However, according to observations of W. von Brackel (pers. comm., 2016), the latter species is macroscopically distinct from *A. digitatae* by its scattered ascomata with slightly constricted bases associated with bleached parts of the host thallus.

We found *Arthonia digitatae* on *Cladonia arbuscula*, *C. borealis*, *C. cariosa*, *C. chlorophaea* s. lat., *C. coccifera*, *C. cyanipes*, *C. deformis*, *C. digitata*, *C. foliacea*, *C. furcata*, *C. gracilis*, *C. macroceras*, *C. pleurota*, *C. pyxidata*, *C. stricta*, *C. subcervicornis*, *C. subulata*, *C. symphylicarpa*, *C. trassii*, *C. verticillata*, *C. umbricola*, *C. uncialis* and unidentified *Cladonia* species. It mainly occurs on healthy-looking or moribund podetia (sometimes being restricted to their tips), but also occasionally on basal squamules. Heavy infections cause bleaching of the host tissues. Formerly the species was known in Asian Russia only from Trans-Baikal Territory (Zhurbenko et al. 2016), but it is widely distributed in the Holarctic including the polar desert biome. Here we report the species as new to Norway (Svalbard) and Mongolia. *Cladonia arbuscula*, *C. cariosa*, *C. chlorophaea* s. lat., *C. cyanipes*, *C. deformis*, *C. furcata*, *C. gracilis*, *C. macroceras*, *C. pyxidata*, *C. stricta*, *C. subcervicornis*, *C. symphylicarpa*, *C. trassii*, *C. verticillata*, *C. umbricola* and *C. uncialis* are new host species. It should be noted that one collection cited below (*Zhurbenko 03451*, LE 260947) was formerly reported as *Arthonia* sp. 1 by Zhurbenko and Brackel (2013). Likewise another (*Lukicheva s.n.*, LE 308513a) was reported as *Arthonia* cf. *epicladonia* by Zhurbenko and Alstrup (2004).

Specimens examined. – **SPAIN. SORIA:** Abejar, 41°46'34"N, 2°46'6"W, elev. 1150 m, 7.vii.2014, on *Cladonia foliacea* (basal squamules), *R. Pino-Bodas s.n.* (H). **NORWAY. SVALBARD:** Aldegondabreen glacier, 78°00'N, 14°12'E, elev. 100 m, 16.vii.2003, on *C. trassii* (moribund podetia), *M.P. Zhurbenko 03451* (LE 260947), on *C. subcervicornis* (moribund bleached podetia), *M.P. Zhurbenko 03212* (LE 308503). **RUSSIA. REPUBLIC OF ADYGEYA:** Caucasus, Mt. Ekspeditsiya, 43°54'48"N, 40°15'43"E, elev. 1950 m, 9.viii.2014, on *C. cf. pyxidata* (basal squamules, occasionally podetia), *M.P. Zhurbenko 14273* (LE 308604). **TYUMEN' REGION:** Yamal Peninsula, Saletayakha River, 69°45'N, 68°40'E, 9.viii.1990, on *C. coccifera* (podetia), *O.V. Rebristaya s.n.* (LE 308819). **KRASNOYARSK TERRITORY:** Severnaya Zemlya Archipelago, Bol'shevik Island, Cape Antsev, 78°13'N, 103°15'E, 16.vii.2000, on *C. coccifera* (basal squamules), *N.V. Matveeva s.n.* (LE 309281); Taimyr Peninsula, Enisey

Bay, Sibiryakova Island, 72°50'N, 79°10'E, 19.vii.1990, on *C. coccifera* (podetia), *V.B. Kuvaev 1537* (LE 308815); Taimyr Peninsula, Tareya, 73°20'N, 90°36'E, 2.vii.1965, on *C. arbuscula* (podetia), *N.V. Matveeva s.n.* (LE 308750); Taimyr Peninsula, Pyasinskii Bay, Ptichii Island, 74°06'52"N, 86°35'04"E, 25.vii.1993, on *C. cyanipes* (podetia), *V.B. Kuvaev 2126* (LE 308514); Taimyr Peninsula, Syratururku Lake, 73°42'N, 97°40'E, 21.viii.1994, on *C. pyxidata* (moribund cups), *E.B. Pospelova* (LE 207410); Taimyr Peninsula, Levinson-Lessinga Lake, 74°31'N, 98°36'E, elev. 200 m, 26.viii.1995, on *C. pyxidata* (podetia), *M.P. Zhurbenko 95600a* (LE 308920a); elev. 300 m, 30.viii.1995, on *C. stricta* (podetia), *M.P. Zhurbenko 95593* (LE 308884); 74°24'N, 98°46'E, elev. 120 m, 28.viii.1995, on *Cladonia* sp. (podetia), *M.P. Zhurbenko 95599a* (LE 308916a), on *C. pyxidata* (podetia), *M.P. Zhurbenko 95594* (LE 308891).

TRANS-BAIKAL TERRITORY: Kodar Range, Sul'ban River, Zolotoi Creek, 56°50'12"N, 117°17'21"E, elev. 1663 m, 14.vi.2015, on *C. borealis* (tips of podetia), *L.A. Konoreva s.n.* (LE 309227).

REPUBLIC OF SAKHA (YAKUTIA): Daldyn River, 68°30'N, 124°00'E, 13.viii.1957, on *C. pyxidata* (podetia), *A.N. Lukicheva s.n.* (LE 308513a); Lena River delta, Samoilovskii Island, 72°22'N, 126°29'E, elev. 10 m, 26.vii.1998, on *C. furcata* (podetia), *M.P. Zhurbenko 98414* (LE 308900); Bytantai River basin, lower Kel'-Sene River, 20.ix.1965, on *C. verticillata* (podetia), *V.I. Perfil'eva s.n.* (LE 308765); Siibikte River, 15.viii.1957, on *C. subulata* (podetia), *A.N. Lukicheva s.n.* (LE 308805).

CHUKOTKA AUTONOMOUS AREA: Wrangel' Island, Upper Mamontovaya River, 70°14'N, 179°35'E, 16.vii.1996, on *C. macroceras* (podetia), *S.S. Kholod s.n.* (LE 308825); Iskaten' pass, 66°35'N, 179°10'E, 3.vii.1971, on *C. coccifera* (podetia), *I.I. Makarova s.n.* (LE 308558); conjunction of Enmyvaam and Shummaya Rivers, 68°15'N, 166°03'E, 3.vii.1980, on *C. coccifera* (podetia), *I.I. Makarova s.n.* (LE 308817); Pepenveem River, 65°55'N, 175°50'W, 3.viii.1970, on *C. coccifera* (podetia), *A.V. Galanin s.n.* (LE 308814); Palyavaam, 68°44'N, 173°50'E, 16.viii.1989, on *C. coccifera* (podetia), *B.A. Yurtsev s.n.* (LE 308784); Bezymyannoe Lake, 66°39'N, 176°40'E, on 5.vii.1979, *C. coccifera* (podetia), *I.I. Makarova s.n.* (LE 308783a); Televeem River, 65°50'N, 175°05'E, 22.vii.1979, on *C. cariosa* (basal squamules), *I.I. Makarova s.n.* (LE 308771).

MONGOLIA. UBSUNUR AIMAK: Mt. Tsagan-Khairkhan-Ula, 49°23'N, 94°20'E, elev. 2100 m, 6.vii.1976, on *C. pleurota* (podetia), *L.G. Biazrov 3148* (LE 308842).

ARA-KHANGAI AIMAK: 5 km SE of Tevshrulekh, elev. 1800 m, 27.viii.1980, on *C. digitata* (podetia), *L.G. Biazrov 4100* (LE 308845).

DZABKHAN AIMAK: headwaters of Ubur-Teliin-Gol River, 48°30'N, 98°20'E, elev. 2120 m, 19.vi.1973, on *Cladonia* sp. (basal squamules, podetia), *L.G. Biazrov 2638* (LE 308848); 10 km W of Toson-Tsengel, elev. 2050 m, 3.vii.1976, on *C. chlorophaea* s. lat. (moribund podetia), *L.G. Biazrov 6354b* (LE 308871b).

CANADA. BRITISH COLUMBIA: Columbia Mts., Beaver River, 51°15'N, 117°22'W, elev. 1150 m, 17.vii.2002, on *C. umbricola* (moribund bleached podetium), *M.P. Zhurbenko 02100f* (LE 308752); Wells Gray Provincial Park, Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *C. symphyrcarpa* (podetia), *M. P. Zhurbenko 02278* (LE 308728).

NUNAVUT: Ellef Ringnes Island, Isachsen Bay, 78°47'N, 103°33'W, elev. 40 m, 25.vii.2005, on *C. coccifera* (tips of moribund scyphi), *N.V. Matveeva s.n.* (LE 260706).

U.S.A. ALASKA: Howe Island, 70°18'55"N, 147°59'35"W, elev. 17 m, 5.viii.2003, on *C. coccifera* (podetia), *D.A. Walker s.n.* (LE 308504b); Toolik Lake, 68°37.446'N, 149°36.457'W, elev. 770 m, 28.vii.2001, on *Cladonia* sp. (moribund podetia), *M.P. Zhurbenko 01448* (LE 309067); Brooks Range, Atigun Canyon, 68°26'42"N, 149°20'40"W, elev. 800 m, 31.vii.2001, on *C. coccifera* (moribund basal squamules and podetia), *M.P. Zhurbenko 01273* (LE 309066); Kotzebue, 66°53'N, 162°31'W, elev. 35 m, 19.viii.2000, on *C. arbuscula* (podetia), *M.P. Zhurbenko 00160a* (LE 309070a); 19.viii.2000, on *C. gracilis* s. lat. (podetia), *M.P. Zhurbenko 00176* (LE 309065); 19.viii.2000, on *C. deformis* (podetia), *M.P. Zhurbenko 00475* (LE 309064); Denali Highway, 64°04'N, 147°27'W, elev. 850 m, 3.ix.2000, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 00265b* (LE 309063); Denali National Park and Preserve, Rock Creek, 63°43.35'N, 148°57.53'W, elev. 650 m, 17.viii.2004, on *C. chlorophaea* s. lat. (podetia), *M.P. Zhurbenko 04222* (LE 309071); 20.viii.2004, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 04163* (LE 309069); 20.viii.2004, on *C. pyxidata* (podetia), *M.P. Zhurbenko 04177* (LE 309068), *M.P. Zhurbenko 04188b* (LE 309045b); Seward Peninsula, Mauze Creek, 65.4129°N, 164.6337°W, elev. 250 m, 22.vii.2000, on *C. coccifera* (podetia), *D.A. Walker* (LE 308557); Aleutian Islands, Amlia Island, 52.11332°N, 173.83478°W, 2.viii.2013, on *C. uncialis* (podetia), *S. Talbot & S. Talbot AML295* (H).

***Arthonia* cf. *lepidophila* (Anzi) Clauzade, Diederich & Cl. Roux comb. inval.**

DESCRIPTION. – *Apothecia* irregularly convex, sometimes applanate, brownish black, glossy, 50–300 µm lengthways, dispersed to aggregated and sometimes confluent. *Epiphymenium* medium to dark olive brown or brown, K+ more olive. *Hymenium* light brownish gray, sometimes almost colorless below,

ca. 30 µm tall, I+ red, K/I+ blue. *Paraphysoids* flexuous, branched, apical cells 2.5–5.5 µm wide. *Subhymenium* light to medium olive brown or brown. *Asci* broadly clavate, 22–33 × 11–17 µm, 8-spored. *Ascospores* hyaline, soleiform/clavate (with enlarged upper cell), (9.5–)10.7–13.1(–16.0) × (3.5–)4.0–5.0(–6.5) µm, l/b = (2.1–)2.4–3.0(–3.7) (n = 107, in water or I), (0–)2-septate, smooth-walled, occasionally with halo 0.5–1 µm thick.

NOTES. – *Arthonia lepidophila* is an obscure species so far known from old reports from the Italian Alps growing on *Cladonia parasitica* and *C. pyxidata* (Anzi 1868, Clauzade et al. 1989, Keissler 1930). It differs from the examined material in having greenish pruinose ascomata, longer asci (ca. 60 × 10–12 µm) and fusiform, 1–3-septate ascospores. *Arthonia coniocraeae*, the only other *Arthonia* species with more than 1-septate ascospores known on *Cladonia*, differs in having a taller (60–80 µm), K+ dirty violet then gray hymenium, and brown, finely verrucose, 1(–2)-septate ascospores (Brackel 2010b). The examined material is conspecific with *Arthonia* sp. from Siberia described and illustrated in Zhurbenko and Zhdanov (2013). Possibly it just represents deviating forms of *Arthonia digitatae* with (0–)2-septate instead of typically 1-septate ascospores. But further study is needed. The species has been found on apothecia, podetia and/or basal squamules of *Cladonia capitellata*, *C. crispata*, *C. didyma*, *C. squamosa* and *Cladonia* spp.

Specimens examined. – **RUSSIA. NENETS AUTONOMOUS AREA:** Bol'shezemel'skaya tundra, Khar'yaga oilfield, 67°11'N, 56°30'E, elev. 60 m, 24.vii.2007, on *Cladonia* sp. (moribund podetia), *M.P. Zhurbenko 0776* (LE 308585). **TRANS-BAIKAL TERRITORY:** Kodar Range, Syul'ban River, 56°50'38"N, 117°18'05"E, elev. 1380 m, 13.vi.2015, on *Cladonia* sp. (basal squamules) growing on lignum, *S.V. Chesnokov s.n.* (LE 309349a). **SAKHALIN REGION:** Sakhalin Island, Palevo, 50°37'N, 142°43'E, 20.ix.2008, on *Cladonia* sp. (basal squamules), *N. A. Tsarenko s.n.* (LE 308647). **U.S.A. ALASKA:** Prince of Wales Island, Salt Chuck mine, 55°37'28"N, 132°33'04"W, elev. 5 m, 7.viii.2001, on *C. squamosa* (podetial squamules), *M.P. Zhurbenko 0115* (LE 309143). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *C. crispata* (apothecia, podetia), *M.P. Zhurbenko 02164* (LE 308705). **VENEZUELA. MÉRIDA:** elev. 2300 m, 30.xii.1978, on *C. didyma* (podetia and podetial squamules), *M. López Figueiras 17497a* (H). **ECUADOR. AZUAY PROVINCE:** Parque Nacional El Cajas, elev. 3890 m, 26.iii.2014, on *Cladonia* sp. (decaying podetia and basal squamules), *X.Y. González Rentería s.n.* (H); 10.ix.2014, on *Cladonia* sp. (basal squamules), *X.Y. González Rentería s.n.* (H). **NEW ZEALAND. SOUTH ISLAND:** Denniston, 41.746°S, 171.799°E, elev. 660 m, 15.v.2010, on *C. capitellata* (podetia), *F. Högnabba 1728a* (H).

Arthrorhaphis aeruginosa R. Sant. & Tønsberg

NOTES. – The first author has collected in the Arctic and boreal regions of Russia dozens of *Cladonia* specimens with sterile dark green spots, resembling the typical infection symptoms of this species. However, all of the aforementioned specimens were sterile and only a single fertile specimen of *Arthrorhaphis aeruginosa* is documented for Russia below. The species is newly reported for Russia, it was formerly known in Asia only from Iran (Sohrabi & Alstrup 2007) and Japan (Zhurbenko et al. 2015a).

Specimens examined. – **RUSSIA. TRANS-BAIKAL TERRITORY:** Kodar Range, Anarga River, 56°55'10"N, 118°00'04"E, elev. 1592 m, 10.vii.2013, on *Cladonia* sp. (basal squamules) on lignum, *L.A. Konoreva s.n.* (LE 309230). **U.S.A. ALASKA:** Revillagigedo Island, Carrol Inlet, 55°32'N, 131°17'W, elev. 250 m, 26.vi.2001, on *Cladonia* sp. (basal squamules), *K. Dillman 2001-258* (LE 309152).

Bachmanniomyces uncialicola (Zopf) D. Hawksw.

NOTES. – The conidia in our material are simple, hyaline, usually more or less ellipsoid and acute at both apices (lens-shaped), occasionally obpyriform or limoniform, have truncate bases, sometimes narrowly so, and are (5.9–)7.5–9.9(–14.5) × (3.4–)4.1–4.9(–6.2) µm in size [l/b = (1.2–)1.7–2.2(–3.5) (n = 179)]. Hawksworth (1981) reported the conidia to be slightly wider than in our material [(7–)8–10(–10.5) × 4–5.5(–6) µm]. Typically the species induces distinct galls, but in LE 308802 gall formation was not observed despite the presence of abundant conidiomata scattered over podetia of *Cladonia amaurocraea*. It is noteworthy that Diederich (2003: 49) also reported a specimen of *Bachmanniomyces uncialicola* (on *Cladonia portentosa*) without conspicuous galls.

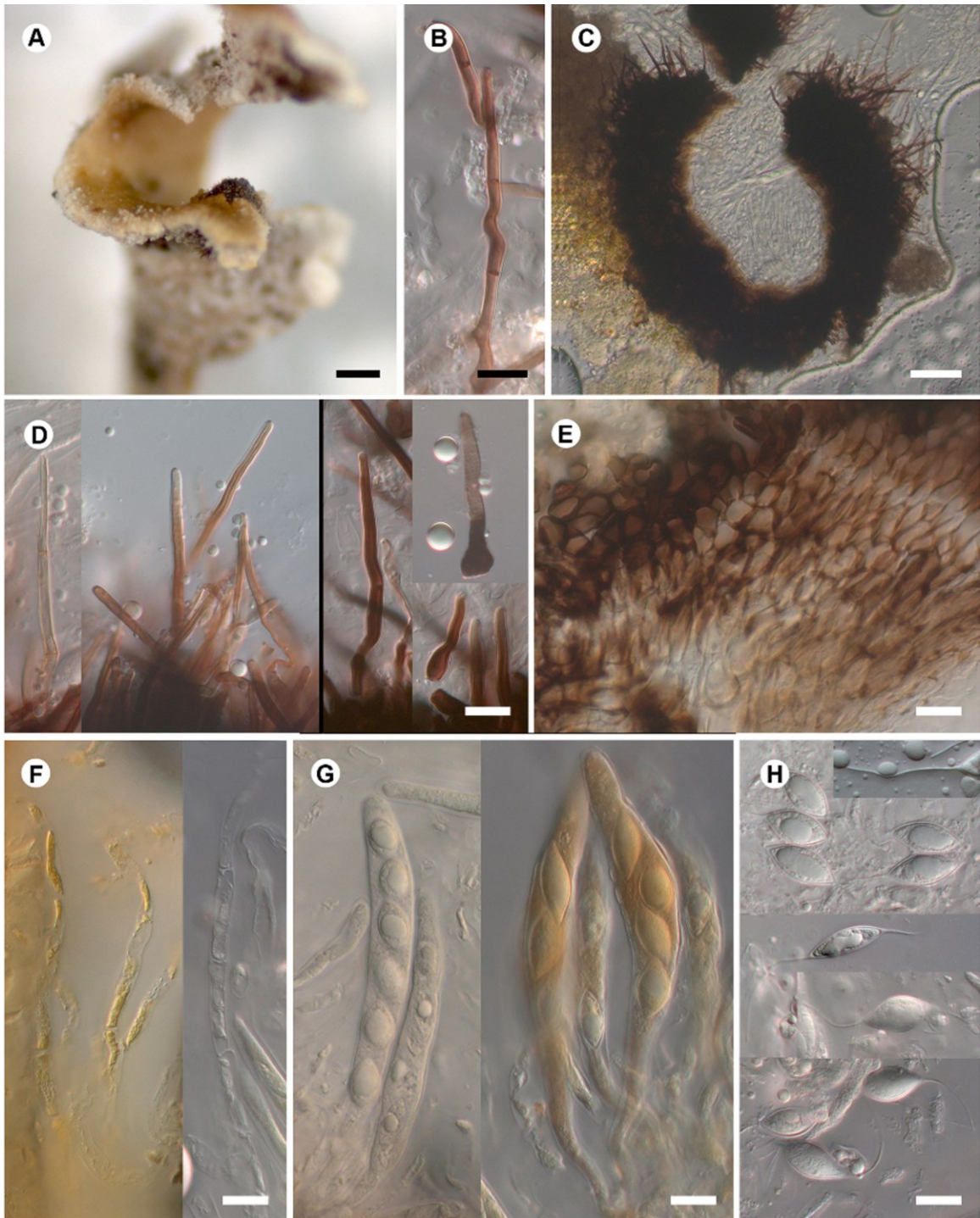


Figure 1. *Biciliopsis cladoniae* (all from the holotype). **A**, ascoma. **B**, vegetative hyphae in K. **C**, ascoma in cross section in water. **D**, setae in water (left) and in K (right). **E**, ascomatal wall in cross section in water. **F**, possible interascal hyphae in I. **G**, asci in water (left) and I (right). **H**, ascospores in water. Scale bars: A = 200 μm , B & D–H = 10 μm , C = 50 μm .

This species has been found on the podetia or rarely the basal squamules of *Cladonia amaurocraea*, *C. arbuscula*, *C. pyxidata*, *C. rangiferina*, *C. stygia*, *C. subfurcata*, *C. subsubulata* and *C. uncialis*. It is here reported new to Argentina and *C. rangiferina*, *C. subfurcata* and *C. subsubulata* are new host species.

Specimens examined. – **FINLAND. KANTA-HÄME:** Torronsuo National Park, 60°44'N, 23°43'E, 31.x.2014, on *Cladonia stygia* (podetia), *R. Pino-Bodas s.n.* (H). **FINLAND PROPER:** Salo, 60°25'12"N, 23°09'12"E, elev. 20 m, 24.v.2015, on *C. uncialis* (podetia), *R. Pino-Bodas s.n.* (H). **RUSSIA. REPUBLIC OF ADYGEYA:** Caucasus, Mt. Tybga, 43°52'48"N, 40°15'59" E, elev. 2480 m, 6.viii.2014, on *C. arbuscula* (podetia), *M.P. Zhurbenko 14426* (LE 309442). **YAMAL-NENETS AUTONOMOUS AREA:** watershed of Pur and Taz Rivers, 21.viii.1990, on *C. amaurocraea* (podetia), *G.E. Vil'chek s.n.* (LE 308839). **KRASNOYARSK TERRITORY:** Taimyr Peninsula, Enisey Bay, Sibiryakova Island, 72°50'N, 79°10'E, 31.vii.1989, on *C. subfurcata* (podetia), *V.B. Kuvaev 1331* (LE 308785); Taimyr Peninsula, Ladanakh Lake, 70°00'N, 87°30'E, elev. 50 m, 24.vii.1983, on *C. pyxidata* (basal squamules), *M.P. Zhurbenko 8353* (LE 308903). **CHUKOTKA AUTONOMOUS AREA:** headwaters of Enmil'veergin River, 12.viii.1951, on *C. stygia* (podetia), *Ababkov s.n.* (LE 308754); Iskaten' Pass, 66°35'N, 179°10'E, 7.1967, on *C. amaurocraea* (podetia), *Voronova s.n.* (LE 308802); Bering Strait, Ratmanova Island, 65°47'N, 169°03'W, 4.viii.1958, on *C. subfurcata* (podetia), *B.A. Tikhomirov s.n.* (LE 308822a). **U.S.A. ALASKA:** Kotzebue, 1961, on *C. stygia* (podetia), *B. Neiland s.n.* (LE 309095); Great Kobuk Sand Dunes, 67°08'N, 159°03'W, elev. 65 m, 15.viii.2000, on *C. rangiferina* (podetia), *M.P. Zhurbenko 00114b* (LE 308490b); 66°59'N, 158°47'W, elev. 300 m, 31.vii.2000, on *C. uncialis* (podetia), *M.P. Zhurbenko 00134* (LE 309094); Seward Peninsula, Guy Rowe Creek, 64.7507°N, 163.8938°W, elev. 174 m, 17.vii.2000, on *C. uncialis* (podetia), *D.A. Walker s.n.* (LE 309092); Ophir Creek, 64.9276°N, 163.7418°W, elev. 76 m, 2000, on *C. amaurocraea* (podetia), *D.A. Walker s.n.* (LE 309093); Aleutian Islands, Adak Island, Mt. Reed, 51°49'55"N, 176°40'29"W, elev. 130 m, 28.viii.2013, on *C. uncialis* (podetia), *S. Talbot & S. Talbot ADA726a* (H). **ARGENTINA. LOS ESTADOS ISLAND:** Bahía Flinders, elev. 75 m, 7.xi.1971, on *C. subsubulata* (podetia), *H. Imshaug 53524a & K. Ohlsson* (H).

***Biazrovia stereocaulicola* Zhurb. & Etayo**

NOTES. – Previously this species was known from two localities in Siberia where it was found growing on terricolous *Stereocaulon* species (Zhurbenko & Etayo 2013). The examined material perfectly fits the protologue, except for having somewhat smaller asomata (70–120 µm vs. 100–250 µm in diameter), and ascospore walls that are not consistently smooth, but also occasionally granulate. The species is here reported new to North America and *Cladonia* is reported as a new host genus.

Specimen examined. – **U.S.A. ALASKA:** Denali National Park and Preserve, 63°43.35'N, 148°57.53'W, elev. 650 m, 20.viii.2004, on *Cladonia pyxidata* (partly moribund basal squamules), *M.P. Zhurbenko 04381* (LE 309169).

***Biciliopsis cladoniae* Zhurb., Pino-Bodas & Diederich, sp. nov.**

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FIGURE 1

DIAGNOSIS. – Lichenicolous fungus. Morphologically similar to *Biciliopsis leptogiicola*, but distinguished mainly by the absence of a stroma, erumpent vs. superficial ascomata, the presence of setae and interascal hyphae, 4(–6)-spored vs. 2-spored asci, and a different host, *Cladonia* vs. *Leptogium*.

TYPE: **FRANCE (OVERSEAS DEPARTMENT). RÉUNION:** Takamaka, feuchte waldige Felshänge neben der Elektrostation, 21.09105°S, 55.61998°E, elev. 800 m, 10.ix.2009, on *Cladonia ceratophylla* (squamules), *F. Schumm & J.-P. Frahm 15283* (H!, holotype).

DESCRIPTION. – *Vegetative hyphae* light to medium brown, septate, 2–5 µm in diameter. *Ascomata* perithecioid, brownish black, matt, subglobose to broadly ovate, up to 350 µm in diameter, up to 380 µm tall, non-papillate, ostiolate, setose, initially immersed, finally to about 1/3 exposed (sometimes on both sides of the host squamules), dispersed to occasionally adjacent. *Setae* light to mainly medium or dark brown, sometimes paler above, 0(–2)-septate, straight, (20–)35–69(–75) µm long (n = 12), expanded at the

base, 3–4 µm in diameter below, gradually tapering to 2–2.5 µm in diameter above, with rounded tip, not branched. Exciple medium to dark brown, 20–30 µm thick, composed of pseudoparenchymatous or tangentially elongated thin-walled cells. Interior of ascomata without lipid drops, I and K/I–. *Interascal hyphae* hyaline, septate, occasionally branched, up to 120 µm long, 1.5–6.5 µm in diameter, gradually tapering to the tip. *Periphyses* hyaline, septate, occasionally branched. *Asci* non-fissitunicate, subcylindrical or mainly slightly swollen in the upper half (claviform) or in the middle, rounded at the apex, wall thin, apically somewhat thickened and without visible structures, (95–)102–123(–130) × (9–)10–12 (n = 14, in water or I), I and K/I–, 4(–6)-spored. *Ascospores* hyaline, bicaudate with tail-like filiform appendages ca. 0.5 µm in diameter, (13–)19–27(–30) µm long (n = 23) at each end, bodies narrowly to broadly ellipsoid, (12.0–)14.1–17.5(–19.7) × (5.3–)6.8–8.2(–9.2) µm, l/b = (1.5–)1.8–2.4(–3.2) (n = 69), aseptate, with a smooth wall ca. 0.5 µm thick, overlappingly uniseriate in the ascus. *Anamorph* not found.

ETYMOLOGY. – The epithet refers to the host lichen genus *Cladonia*.

DISTRIBUTION AND HOST. – The new species is known only from the type specimen collected in a mountain forest in the Paleotropics (Réunion Island), growing on squamules of *Cladonia ceratophylla*. Pathogenicity not observed.

DISCUSSION. – By its bicaudate ascospores this fungus morphologically stands out among lichenicolous fungi, where distinct caudae are known only from *Biciliopsis leptogiicola* Diederich, *Capronia paranectrioides* Etayo, Flakus & Kukwa and *Paranectria* species (Aptroot et al. 1997, Etayo et al. 2013, Hawksworth 1982, Rossman et al. 1999, Zhurbenko 2009c). The species is placed in the so far monotypic genus *Biciliopsis* Diederich with some hesitation due to the following differences with the protologue (Aptroot et al. 1997): 1) ascomata erumpent, dispersed, stroma absent vs. ascomata superficial, aggregated on black stroma; 2) ascomata with true setae vs. ascomata without setae, but with external hyphae arising from its outer wall; 3) presence vs. absence of interascal hyphae; 4) 4(–6)-spored vs. 2-spored asci. By the setose ascomata and characteristics of interascal hyphae, exciple and asci, the examined material is also reminiscent of species of *Roselliniella*, including *R. cladoniae* (Anzi) Matzer & Hafellner growing on *Cladonia*. However, the latter species readily differs in the absence of true setae and in its medium brown mature ascospores that are up to 4-septate, sometimes with a small apical beak, but without distinct caudae (Matzer & Hafellner 1990, and herein).

***Brackelia* Zhurb., gen. nov.**

Mycobank #MB 819555

DIAGNOSIS. – Apothecia dark brown to almost black, glossy, epruinose, superficial, roundish, disc plane, margin sometimes raised. Exciple composed of cells with rounded or tangentially elongated lumina, not radiating, without hairs, laterally brownish orange, basally subhyaline. Epihymenium indistinct. Hymenium hyaline to medium brown or brownish orange, not interspersed, I and K/I–. Subhymenium hyaline to brownish. Paraphyses hyaline, light to medium brown or brownish orange, filiform, sometimes slightly gradually clavate above, occasionally branched below, remotely septate, not constricted at the septa, easily separating in K. Asci non-fissitunicate, narrowly clavate, apex rounded, apical wall thickened, apical structures not observed, I and K/I–, 8-spored. Ascospores hyaline, ellipsoid to very narrowly obovate, 0(–1)-septate, guttulate, wall smooth, without gelatinous sheath, diagonally uniseriate to irregularly biseriate in the ascus.

GENERIC TYPE: *Brackelia lunkei* Zhurb.

ETYMOLOGY. – Named in honor of Wolfgang von Brackel for his outstanding contribution to the knowledge of lichenicolous fungi.

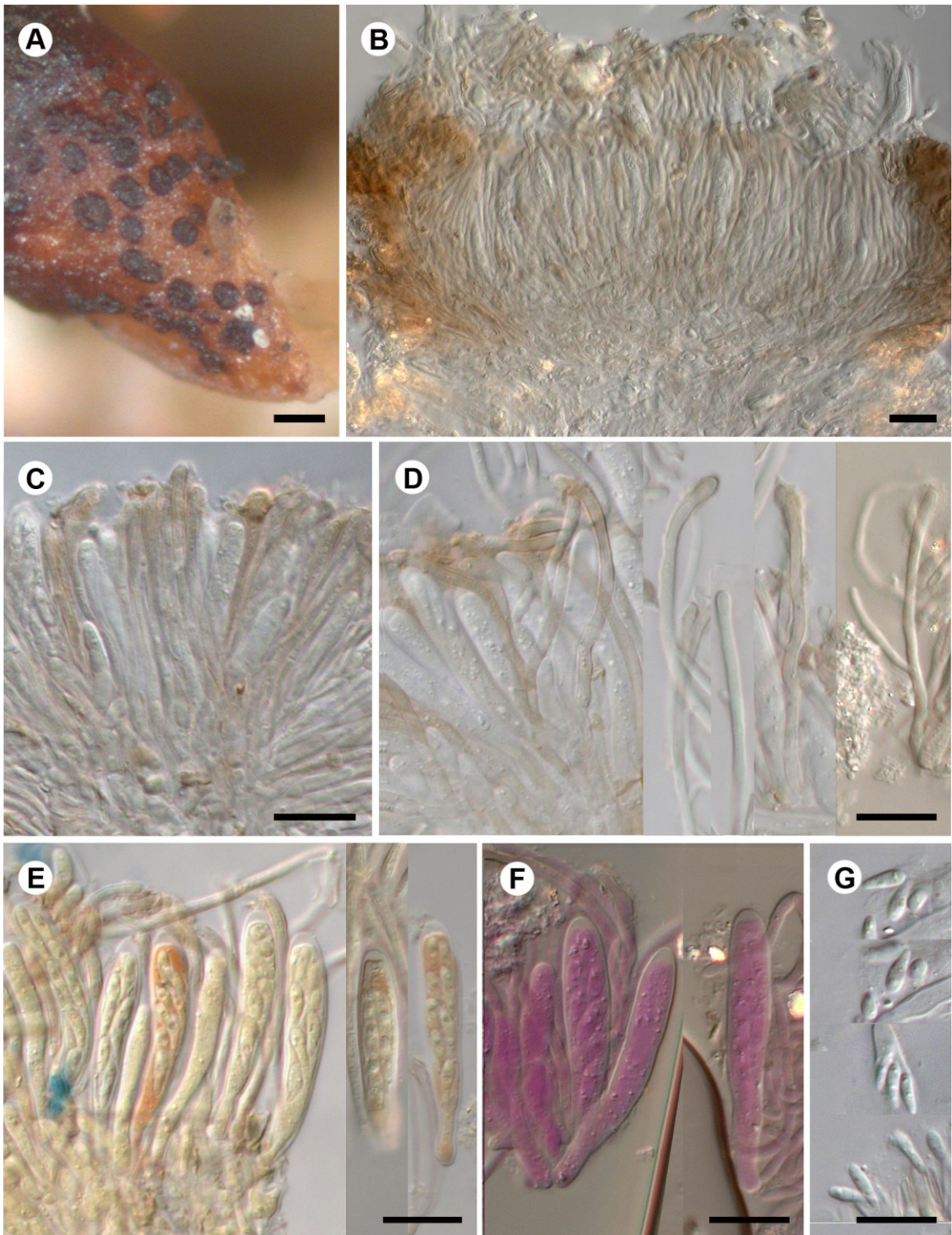


Figure 2. *Brackelia lunkei* (all from the holotype). **A**, apothecia. **B**, squashed cross section of apothecium in water. **C**, asci and paraphyses in water. **D**, asci and paraphyses in K. **E**, asci in K/I. **F**, asci in Phloxine B after 10% KOH pre-treatment. **G**, ascospores in K. Scale bars: A = 100 μ m, B–G = 10 μ m.

***Brackelia lunkei* Zhurb., sp. nov.**

MycoBank #MB 819556

FIGURE 2

DIAGNOSIS. – Lichenicolous fungus. Morphologically similar to *Llimoniella phaeophysciae*, but distinguished by the presence of an indistinct epihymenium, poorly developed, subhyaline basal exciple, often pigmented paraphyses, asci with rounded apex and distinct tholus, ellipsoid to very narrowly obovate, 0(–1)-septate ascospores, and a different host, *Cladonia* vs. *Phaeophyscia*.

TYPE: **RUSSIA. ALTAI TERRITORY:** Solonesh Region, Bashchelak Range, middle reaches of Shinok River, 51°22'N, 84°37'E, elev. 1000 m, extensive treeless area with big stones and *Cladonia* carpets among *Larix* taiga forest, 22.vii.1996, on *Cladonia amaurocraea* (hymenium), *T. Lunke 451b* (LE 308941!, holotype; herb. Diederich!, isotype).

DESCRIPTION. – *Ascomata* apothecia, dark brown to almost black, glossy, epruinose, superficial with somewhat immersed base, more or less roundish in surface view, (30–)55–90(–120) μm in diameter ($n = 54$), 15–30 μm tall; disc more or less plane, concolorous or slightly paler than margin; margin 15–25 μm thick, raised or at the disc level, sometimes lacerate; dispersed to occasionally adjacent. *Exciple* composed of cells with rounded or tangentially elongated lumina, 3–6 \times 2–4 μm , with walls 0.5–1.5 μm thick; laterally medium brownish orange, 10–20 μm thick, not radiating, without enlarged end cells or hairs; basally rather indistinct, subhyaline, 10–15(–30) μm thick. *Epihymenium* indistinct. *Hymenium* hyaline to light or medium brown or brownish orange, pigmentation is more saturated above and in the aged apothecia, not interspersed, 30–45 μm tall, I and K/I–. *Subhymenium* hyaline to brownish, ca. 5 μm tall. *Paraphyses* hyaline, light to medium brown or brownish orange, pigmentation usually gradually fading from the apex to the base and becoming more saturated under maturation, filiform, 1.2–2.5(–3.5) μm in diameter, apices sometimes slightly clavate, occasionally branched below, remotely septate, not constricted at the septa, easily separating in K under slight pressure on cover glass. Pigmentation of the exciple and hymenium becomes yellowish-brown in K and slightly more orange in N. *Asci* non-fissitunicate, narrowly clavate, apex rounded, tholus up to 2.5 μm tall, apical structures not observed, (31–)32–41(–45) \times 5–6(–7) μm ($n = 32$, in water, K/I or Phloxine B), I and K/I–, 8-spored. *Ascospores* hyaline, ellipsoid to very narrowly obovate, (5.3–)6.1–9.1(–10.9) \times (1.5–)1.7–2.0(–3.2) μm , l/b = (2.8–)3.2–4.4(–5.5) ($n = 60$, in water, I, K, K/I or Phloxine B), 0(–1)-septate, not constricted at the septum, guttulate, wall thin, smooth, without gelatinous sheath, diagonally uniseriate to irregularly biseriate in the ascus. *Anamorph* not found.

ETYMOLOGY. – Named in honor of Thomas Lunke, who collected the holotype.

DISTRIBUTION AND HOSTS. – The new species is known from two collections made in the boreal forest (taiga) biome of Asia and North America, where it grew on the hymenia of apothecia of *Cladonia amaurocraea* and *C. coccifera*. Infections were partly associated with bleached or blackened parts of the hymenium.

DISCUSSION. – Compared to other lichenicolous Helotiales, *Brackelia lunkei* seems to be most similar to species of *Llimoniella* Hafellner & Nav.-Ros., particularly to the *L. phaeophysciae* group (Diederich & Etayo 2000, Diederich et al. 2010, Hafellner & Navarro-Rosinés 1993). However, species of *Llimoniella* differ in several important characters, such as the exciple, typically consisting of radiating hyphae composed of more or less isodiametric cells, with enlarged end (outer) cells. In addition to the anatomy of the exciple, the generic type *L. scabridula* (Müll. Arg.) Nav.-Ros. & Hafellner is distinguished from the new species by a purplish, K+ violet, N+ orange or red hymenium and exciple. *Llimoniella phaeophysciae* Diederich, Ertz & Etayo has a similarly colored, K–, N+ brighter orange exciple and hymenium, but differs in having a distinct epihymenium, a dark basal exciple that is sometimes elongated into a stipe, colorless paraphyses, asci that are more or less applanate at the apex, with a slightly thinner apical wall, and subglobose to short ellipsoid, aseptate, uniseriate ascospores.

By its tiny ascomata confined to the hymenia of the host apothecia the new taxon is reminiscent of *Hymenobia insidiosa* Nyl., a species that mainly occurs in the hymenium of *Lecidea* species [Triebel 1989; as *Hymenobiella aporea* (Nyl.) Triebel]. However, that species is distinguished by its perithecium-like ascomata, an I+ red and K/I+ blue hymenium, and gall induction.

Among the other cladoniicolous fungi (see the key herein), *Brackelia lunkei* is most similar to *Phaeopyxis punctum*, from which it differs in smaller and consistently superficial ascomata, an indistinct epihymenium, K/I- asci, and smaller, aseptate ascospores.

Additional specimen examined. – U.S.A. ALASKA: Great Kobuk Sand Dunes, 67°04'N, 158°54'W, elev. 50 m, sparse *Picea glauca* forest, 1.viii.2000, on *Cladonia coccifera* (hymenium), M.P. Zhurbenko 0090 (LE 309167).

***Caeruleoconidia* Zhurb. & Diederich, gen. nov.**

MycoBank #MB 819620

≡ *Caeruleoconidia* Zhurb. & Diederich *nom. inval.* (Art. 40.1) in Zhurbenko, Frisch, Ohmura & Thor, Herzogia 28: 764. 2015.

MycoBank #MB 814592

DIAGNOSIS. – *Conidiomata* pycnidoid or sporodochoid to pulvinate, but sometimes with a lateral ring-like rudimentary wall, blackish, stromatic, erumpent. *Conidiophores* hyaline to bluish green, composed of cells resembling conidia or vertically elongated cells, densely aggregated into a compact basal stroma. *Conidiogenous cells* hardly distinguishable from the underlying stromatic cells. *Conidia* holoblastic, bluish green, K⁺ becoming greener, mainly subglobose, solitary to indistinctly catenate, dry, 0(–1)-septate, smooth-walled.

GENERIC TYPE: *Caeruleoconidia ochrolechia* Zhurb. & Diederich.

ETYMOLOGY. – The generic name refers to the peculiar bluish green conidia of the type species.

NOTES. – The name *Caeruleoconidia* was originally introduced in Zhurbenko et al. (2015a) to accommodate *C. ochrolechia* Zhurb. & Diederich. Unfortunately an identifier issued by a recognized repository was not cited in the protologue of *C. ochrolechia* and thus its description does not meet the requirements of Art. 42.1 of the *Melbourne Code* (McNeill et al. 2012). These names are validly published herein, along with the description of a second species of the genus. For a comparison of *Caeruleoconidia* with the most similar genera *Coniambigua* Etayo & Diederich and *Epaphroconidia* Calat. & V. Atienza refer to Zhurbenko et al. (2015a).

***Caeruleoconidia ochrolechia* Zhurb. & Diederich, sp. nov.**

MycoBank #MB 819621

≡ *Caeruleoconidia ochrolechia* Zhurb. & Diederich *nom. inval.* (Art. 42.1) in Zhurbenko, Frisch, Ohmura & Thor, Herzogia 28: 764. 2015.

MycoBank #MB 817479

DIAGNOSIS. – Lichenicolous fungus. *Conidiomata* sporodochial to pulvinate, but sometimes with a lateral ring-like rudimentary wall, convex to applanate, black, stromatic, erumpent. *Conidiophores* hyaline to light bluish green, densely aggregated in a compact basal stroma. *Conidiogenous cells* hardly distinguishable from the underlying stromatic cells. *Conidia* holoblastic, light to moderate bluish green, K⁺ becoming greener, mainly subglobose to irregularly ellipsoid or rectangular, mainly 5.2–7.2 × 4.1–5.5 μm, abundant, solitary to indistinctly catenate, dry, 0(–1)-septate, with smooth wall.

TYPE: MEXICO. CHIHUAHUA: ridge crest area along a secondary dirt road to Casas Grandes from Bavispé, Sonora, 30°24'20"N, 108°24'20"W, elev. 2180 m, open pine-juniper-manzanita area, 18.vii.1994, on *Ochrolechia pseudopallescens* (discs and margins of apothecia, thallus), T.H. Nash III 36366a (ASU!, holotype; herb. Diederich!, isotype).

ETYMOLOGY. – The epithet refers to the host lichen genus *Ochrolechia*.

NOTES. – For detailed information on the morphology, taxonomic position, distribution and hosts of this species refer to Zhurbenko et al. (2015a).

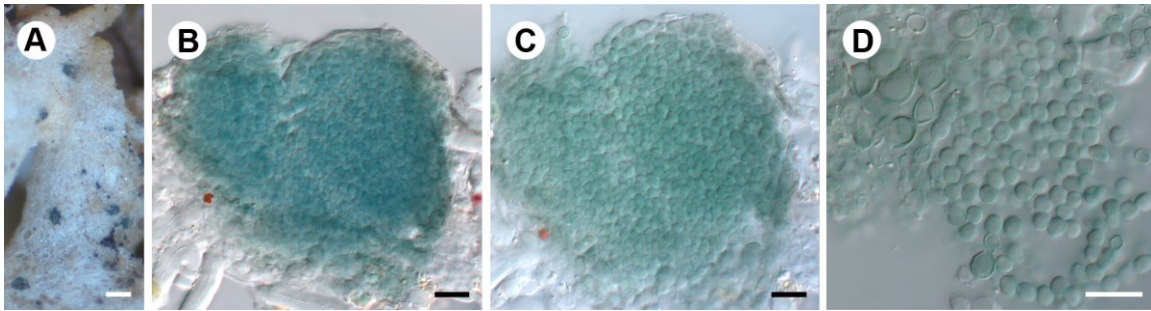


Figure 3. *Caeruleoconidia biazrovii* (A from LE 308876, B-D from the holotype). **A**, conidiomata. **B**, conidioma in cross section in water. **C**, conidioma in cross section in K. **D**, conidia and details of conidiogenesis in K. Scale bars: A = 100 μm , B–D = 10 μm .

***Caeruleoconidia biazrovii* Zhurb., sp. nov.**

Mycobank #MB 819622

FIGURE 3

DIAGNOSIS. – Lichenicolous fungus. Morphologically similar to *Caeruleoconidia ochrolechia*, but distinguished primarily by the smaller conidiomata, 30–80 μm vs. 50–190 μm in diameter, the smaller conidia, mainly 3.5–5 \times 3–4.5 μm vs. 5–7 \times 4–5.5 μm , and a different host, *Cladonia* vs. *Ochrolechia*.

TYPE: MONGOLIA. ARA-KHANGAI AIMAK: E shore of Terkhiin-Tsagan-Nur Lake, 48°10'N, 99°43'E, elev. 2100 m, lava field among sparse *Larix* forest, 21.viii.1972, on *Cladonia stellaris* (upper parts of podetia), *L.G. Biazrov 1839* (LE 308849!, holotype).

DESCRIPTION. – *Conidiomata* pycnidoid or sporodochoid, blackish, rounded to angular in surface view, convex to appanate, 30–80 μm in diameter, stromatic, initially immersed in the host thallus, later erumpent, dispersed; completely or only laterally covered by a poorly developed subhyaline, grayish, olivaceous or blue-green wall ca. 3–5 μm thick, composed of tangentially elongated cells. *Conidiophores* hyaline below to medium bluish green (sometimes with an olive tinge) above, densely aggregated into a compact basal stroma, composed of cells that are vertically strongly elongate or similar in shape and size to the conidial cells. *Conidiogenous cells* arising from the basal stroma, indistinguishable from the underlying stromatic cells. *Conidia* holoblastic, very light to medium bluish green, K+ light green, angular subglobose, occasionally oblong or ovoid, solitary to indistinctly catenate, (2.8–)3.3–4.9(–6.3) \times (2.5–)3.1–4.3(–5.3) μm , l/b = (0.8–)1.0–1.2(–1.8) (n = 76, in water or K), dry, aseptate, with smooth wall ca. 0.5 μm thick.

ETYMOLOGY. – The new species is named in honor of the distinguished Russian lichenologist Lev G. Biazrov, who collected the type material.

DISTRIBUTION AND HOST. – The new species is known from two specimens collected in sparse mountain *Larix* forests of Eastern Asia (Mongolia), where it was found on healthy-looking podetia of *Cladonia stellaris*. Pathogenicity was not observed.

DISCUSSION. – *Caeruleoconidia biazrovii* clearly differs from the other known species of the genus, *C. ochrolechia*, which has larger conidiomata (50–190 μm in diameter) and 0(–1)-septate, larger conidia (mainly 5–7 \times 4–5.5 μm).

Additional specimen examined. – **MONGOLIA. DZABKHAN AIMAK:** 12 km W of Toson-Tsengel, elev. 2100 m, sparse *Larix* forest, 2.vii.1976, on *Cladonia stellaris* (upper parts of podetia), *L.G. Biazrov 6560* (LE 308876).

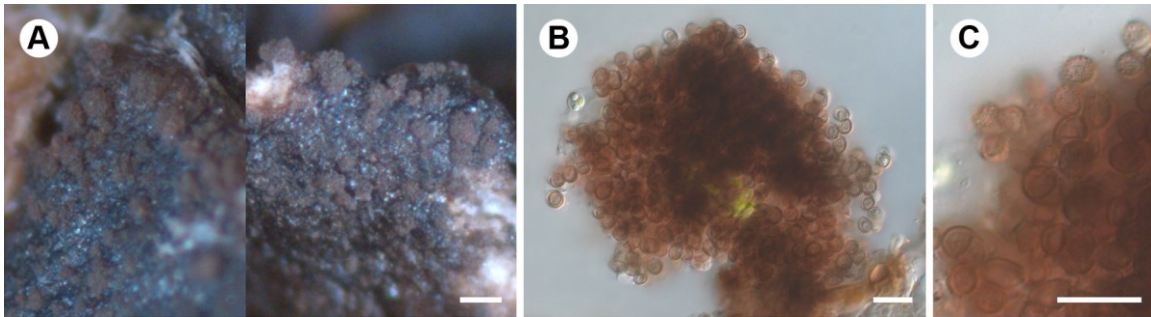


Figure 4. *Cladophialophora* aff. *cladoniae* (all from LE 308669). **A**, sporodochia. **B**, squashed cross section of sporodochium in water. **C**, conidia in water. Scale bars: A = 100 μ m, B & C = 10 μ m.

Cercidospora cladoniicola Alstrup

DESCRIPTION. – *Ascomata* black, subglobose, 80–100(–200) μ m in diameter, more or less protruding above. *Exciple* mainly olive to brown, sometimes partly reddish purple brown, grayish olive or blue-green, paler to subhyaline at the base, not distinctly changing color in K. *Asci* (4–)8-spored. *Ascospores* hyaline to sometimes light brown, mostly clavate (wider above) or sometimes fusiform (mostly fusiform in LE 261631), (11.0–)13.3–17.5(–21.9) \times (2.7–)4.0–5.2(–6.0) μ m, l/b = (2.0–)2.8–4.0(–5.1) (n = 166, in water or K), (0–)1–3-septate (usually 3-septate, but in some specimens mostly 1-septate), sometimes constricted at the septa, smooth, halo not seen.

NOTES. The protologue of this species characterized the exciple as brown and the ascospores as 3-septate, with narrower lower cells (16–20 \times 5–6 μ m) (Alstrup 1997). The material we examined shows significant variation in color and shape of the exciple, size and septation of ascospores, and thus is possibly heterogenous. The specimens we examined were found on basal squamules and/or podetia of *Cladonia coccifera*, *C. mitis* and *C. sulphurina*. The species is newly reported for Asia, as it was formerly known in Russia only from Northern Ural (Zhurbenko 2004). *Cladonia coccifera* and *C. sulphurina* are new host species.

Specimens examined. – **RUSSIA. REPUBLIC OF BURYATIA:** SE coast of Baikal Lake, 5 km SW of Turka, 52°50'50"N, 108°00'50"E, elev. 460 m, 25.viii.2002, on *Cladonia mitis* (podetia), *M.P. Zhurbenko* 02408 (LE 309153). **REPUBLIC OF SAKHA (YAKUTIA):** Bytantai River basin, lower Kel'-Sene River, 18.ix.1965, on *C. sulphurina* (podetia), *V.I. Perfil'eva s.n.* (LE 308763). **MAGADAN REGION:** Magadan, Snezhnaya Dolina, 59°44'N, 150°50'E, elev. 200 m, 26.vi.1972, on *C. coccifera* (basal squamules, occasionally podetia), *L. Blagodatskikh s.n.* (LE 308751).

Chaenothecopsis parasitaster (Bagl. & Carestia) D. Hawksw.

NOTES. – Formerly known in Russia from the Krasnoyarsk Territory, Republic of Buryatia and Kamchatka Territory (Kharpukskaeva 2013, Stepanchikova & Himelbrant 2011, Zhurbenko 2009b). We report two additional records from Russia here.

Specimens examined. – **RUSSIA. REPUBLIC OF BURYATIA:** Dzherginskii Reserve, Kovyli River, 55°07'18"N, 111°28'00"E, elev. 900 m, 14.vii.2002, on *Cladonia digitata* (basal squamules, podetia), *T.M. Kharpukskaeva s.n.* (LE 308566). **CHUKOTKA AUTONOMOUS AREA:** Mt. Gil'mymlinei, 65°53'N, 173°44'W, 2.vii.1977, on *C. sulphurina* (podetia), *I.I. Makarova s.n.* (LE 308808).

Cladophialophora aff. *cladoniae* (Diederich) Diederich

FIGURE 4

DESCRIPTION. – *Conidiomata* sporodochial, grayish brown, superficial, more or less convex, (37–)49–79(–97) μ m in diameter (n = 37), up to 65 μ m tall, dispersed to occasionally adjacent or confluent. *Conidia* light reddish brown, more or less orbicular to occasionally broadly ellipsoid, 0(–)1-septate, possibly very rarely narrowly ellipsoid and 2-septate, aseptate conidia (3.1–)4.0–5.0(–5.7) \times (2.8–)3.5–

4.3(–5.1) μm , l/b = 1.0–1.2(–1.7) (n = 90), 1-septate conidia 5.7–6.9 \times 3.7–4.9 (n = 9), not adhering in chains, wall 0.6–0.8 μm thick, evenly colored, indistinctly verruculose.

NOTES. – The examined material exhibits several discrepancies with the species protologue, where the sporodochia were reported to be much smaller [7–20(–30) μm in diameter], and conidia reported to be much smaller (2.2–3 μm in diameter), uniformly aseptate, smooth-walled and adhering in short chains (Diederich 2010). It is possible that these differences reflect the limited material available for the description, since *Cladophialophora cladoniae* was previously known only from the type locality in Luxembourg where it grew on *Cladonia pocillum* and *C. subulata* (Diederich 2010).

Specimen examined. – **RUSSIA. KRASNOYARSK TERRITORY:** Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 54°00'N, 95°29'E, elev. 1400 m, 20.vii.2009, on *Cladonia pocillum* (darkened basal squamules), *M.P. Zhurbenko 0968* (LE 308669).

Coniochaeta sp.

FIGURE 5

DESCRIPTION. – *Ascomata* subglobose to pyriform, ca. 150 μm in diameter, superficial, densely covered by aseptate setae 20–40 μm long. *Ascospores* medium to dark brown, discoid, subglobose to ellipsoid, (7.9–)8.4–10.6(–12.9) \times (4.6–)6.3–9.1(–11.5) μm , l/b = (1.0–)1.1–1.5(–2.1) (n = 27), aseptate, smooth-walled, uniseriate in the asci.

NOTES. – This species resembles *Roselliniella cladoniae*, which readily differs in having larger ascomata without true setae, and 0(–2)-septate, larger ascospores (see notes on that species below). A BLAST search of an ITS sequence (KY775602) recovered 99% similarity (558 bp identical of 562 bp aligned) with *Coniochaeta ligniaria* (Grev.) Cooke (KP941078), however, according to Munk (1957) that species differs in having larger ascomata (200–350 μm in diameter), and discoidal, larger ascospores [(9–)12–14(–20) \times 8–12(–15) \times 4–6 μm]. Species of *Coniochaeta* (Sacc.) Cooke usually grow on decaying wood and bark, but have also exceptionally been documented on lichens, viz. *C. ligniaria* on *Diploschistes diacapsis* (Etayo 2008).

Specimen examined. – **FINLAND. UUSIMAA PROVINCE:** Espoo, Takkula, 400 m SE of Vaakkoi Lake, 60°20'N, 24°33'E, elev. 90 m, 19.viii.2014, on *Cladonia coccifera* (podetia), *R. Pino-Bodas s.n.* & *T. Ahti s.n.* (H).

Dactylospora deminuta (Th. Fr.) Triebel

NOTES. – In our material the ascospores are initially light olive turning medium brown, narrowly ellipsoid/fusiform to occasionally oblong, (3–)5–7(–8)-transseptate, rarely with an additional oblique septum, and (14.2–)16.9–21.7(–28.0) \times (4.0–)4.7–5.9(–7.0) μm in size [l/b = (2.7–)3.2–4.0(–5.7) (n = 79)]. This species has been found on various distantly related lichens, including species of *Cladonia* (Zhurbenko & Alstrup 2004). *Cladonia rangiferina* is here reported as a new host species.

Specimens examined. – **RUSSIA. KRASNOYARSK TERRITORY:** Severnaya Zemlya Archipelago, Bol'shevik Island, Cape Baranova, 79°16'N, 101°40'E, elev. 20 m, 13.vii.1996, on *Cladonia rangiferina* (podetia) and adjacent terricolous lichens, *M.P. Zhurbenko 961032* (LE 308918); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°28'E, elev. 1450 m, 14.vii.2009, on *C. pyxidata* (moribund basal squamules) and adjacent terricolous lichens, *M.P. Zhurbenko 0971* (LE 308672).

Dactylospora sp.

DESCRIPTION. – *Ephymenium* light to medium reddish brown. *Hymenium* hyaline to partly slightly reddish brown. *Exciple* medium to dark reddish brown, without violet, K+ aeruginose patches; reddish tinge of the apothecial section disappears in K. *Ascospores* ellipsoid to narrowly ellipsoid or occasionally slightly wider above, medium brown when mature, (9.3–)12.7–17.3(–19.7) \times (4.0–)5.0–6.2(–7.3) μm , l/b = (1.3–)2.2–3.2(–3.7) (n = 84, in water or K), (0–)3-septate, sometimes constricted at the septa, smooth, non-halonate.

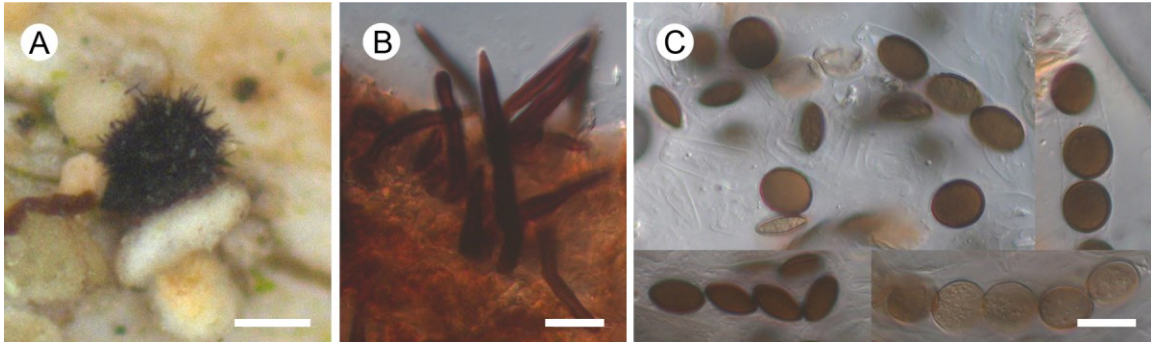


Figure 5. *Coniochaeta* sp. (all from *Pino-Bodas & Ahti s.n.*). **A**, ascoma. **B**, setae in water. **C**, ascospores in water. Scale bars: A = 100 μ m, B & C = 10 μ m.

NOTES. – Among the *Dactylospora* species with up to 3-septate ascospores, our material is most reminiscent of *D. rhyparizae* Arnold, so far reported only from the terricolous lichen *Bryodina rhypariza* (Lawrey & Diederich 2016). *Dactylospora rhyparizae* has ascospores of a very similar size [(9.5–)12.9–16.9(–18.0) \times (5.0–)5.3–6.7(–7.5) μ m, l/b = (1.6–)2.1–2.9(–3.6) (n = 63, in water or K)], but differs in having a brown epihymenium and exciple without red tinge that sometimes has violet, K+ aeruginose patches.

Specimens examined. – **RUSSIA. MAGADAN REGION:** M. Gor’kii mine, 62°36’11”N, 150°18’05”E, 12.ix.1949, on *Cladonia stygia* (bases of podetia), *A.M. Fisher s.n.* (LE 308767). **MONGOLIA. ARA-KHANGAI AIMAK:** watershed of Khukh-Sumein-Gol and Tsetserleg-Gol Rivers, Mt. Khairkhan, 47°15’N, 101°50’E, elev. 2400 m, 20.viii.1977, on *C. rangiferina* (moribund podetia), *L.G. Biazrov 6551a* (LE 308851a).

Specimens of Dactylospora rhyparizae examined for comparison. – **CANADA. NORTHWEST TERRITORIES:** Canadian Arctic Archipelago, Ellef Ringnes Island, Isachsen Bay, 78°47’N, 103°32’W, elev. 30 m, 23.vii.2005, on *Bryodina rhypariza* (thallus), *N.V. Matveeva s.n.* (LE 260409). **RUSSIA. KRASNOYARSK TERRITORY:** Putorana Plateau, Kapchuk Lake, taiga mountain belt, 11.viii.1982, on *B. rhypariza* (discs and margins of apothecia), *A.N. Titov s.n.* (LE 207216).

***Didymocyrtis cladoniicola* (Diederich, Kocourk. & Etayo) Ertz & Diederich**

NOTES. – This species is here reported for the first time from Asia, and *Cladonia subturgida* is reported as a new host species.

Specimens examined. – **SPAIN. CANARY ISLANDS:** La Gomera Island, Los Barranquillos, 28°9.125’N, 17°18.299’W, elev. 1015 m, 13.ii.2002, on *Cladonia cervicornis* (squamules), *F. Schumm s.n.* (H). **TOLEDO:** between Sevilleja de la Jara and Puerto Rey, 39°28’42”N, 5°00’12”W, elev. 900 m, 20.xii.2014, on *C. rangiformis* (podetia), *R. Pino-Bodas s.n.* (H); Minas de Santa Quiteria, 39°28’18”N, 4°59’27”W, elev. 1000 m, 20.xii.2014, on *C. subturgida* (basal squamules), *R. Pino-Bodas s.n.* (H); Cáceres, Losar de la Vera, 40°5’40.40”N, 5°33’13.8”W, 14.xii.2014, on *C. subturgida* (upper side of basal squamules), *R. Pino-Bodas s.n.* (H). **MONGOLIA. KHENTII AIMAK:** Gorchin-Ana, ca. 60 km NE of Ulan-Bator, ca. 48°05’N, 107°20’E, 20.vii.1978, on *C. pyxidata*, (basal squamules), *S. Huneck MVR-228a* (H).

***Didymocyrtis foliaceiphila* (Diederich, Kocourk. & Etayo) Ertz & Diederich**

NOTES. – In the material cited below the conidia measured (4.1–)5.3–6.5(–7.4) \times (1.9–)2.1–2.5(–2.6) μ m [l/b = (1.8–)2.3–2.9(–3.4) (n = 107)], which corresponds to the range of variation of conidial size given by Diederich et al. (2007). The species was previously known from Asia based on an uncertain report from Turkey (as ‘aff. *foliaceiphila*’; Kocakaya et al. 2016). Here we report it as new to Finland and Russia. *Cladonia arbuscula*, *C. uncialis* and *C. uliginosa* are also new host species.

Specimens examined. – **FINLAND. UUSIMAA:** Vantaa, Koivukylä, 60°19'45"N, 25°02'19"E, elev. 32 m, 1.vi.2014, on *Cladonia arbuscula* (podetia), *R. Pino-Bodas s.n.* (H). **RUSSIA. KRASNODAR TERRITORY:** Caucasus, Mt. Armovka, 43°52'28"N, 40°39'20"E, elev. 2250 m, 31.viii.2014, on *C. uncialis* (podetia), *M.P. Zhurbenko 14282* (LE 308614). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Dal'negorsk, 44°35'48"N, 135°33'12"E, elev. 240 m, 18.viii.2013, on *C. uliginosa* (podetia including podetial squamules), *M.P. Zhurbenko 13173* (LE 308689).

***Endophraggiella stordeuriana* U. Braun, Zhurb., Diederich, Tsurykau & Heuchert**

NOTES. – This is the second report of this species from Asia and Russia, it was found close to the type locality (Zhurbenko et al. 2015b). *Cladonia gracilis* is a new host species.

Specimen examined. – **RUSSIA. PRIMORYE TERRITORY:** Iman River, 3 km W of Glubinnoe (Sibichi), 46°04'N, 135°23'E, 31.viii.1946, on *Cladonia gracilis* (podetia), *M.V. & A.A. Korchaginy s.n.* (LE 308768b).

***Epiclادonia sandstedei* (Zopf) D. Hawksw.**

DESCRIPTION. – *Conidiomata* 50–150(–220) µm in diameter, immersed to almost sessile, sometimes gaping, with pore up to 80 µm in diameter, often extruding a white opaque droplet; wall reddish/orange-brown. *Conidiogenous cells* (9.0–)10.2–15.4(–18.0) × (2.0–)2.4–3.6(–4.3) µm (n = 37). *Conidia* oblong and usually slightly attenuated below, slightly clavate or subcylindrical, apex rounded, base broadly truncate, often slightly convex, sometimes with tiny marginal indentations of wall remnants, (6.9–)9.0–11.6(–16.7) × (2.5–)3.0–3.6(–5.1) µm, l/b = (1.8–)2.7–3.7(–5.4) (n = 712), (0–)1-septate (in some specimens up to 50% aseptate), not or rarely slightly constricted at the septum, guttulate, hyaline and smooth-walled or very rarely light brown and verruculose (evidently when overmature).

NOTES. – Hawksworth (1981) reported conidiomata of this species to be 50–80(–120) µm in diameter, and conidia to be (7.5–)9–12(–14) × (2.5–)3–4 µm in size, consistently hyaline and smooth-walled. Our material differs from the prior published description in having conidiomata that may be larger in diameter, and conidia that are usually smooth-walled and hyaline, but occasionally are also light-brown and verruculose when overmature. We found this species on the basal squamules and/or podetia of *Cladonia alaskana*, *C. cf. cenotea*, *C. chlorophaea*, *C. coniocraea*, *C. cornuta*, *C. crispata*, *C. fimbriata*, *C. gracilis* s. lat., *C. gracilis* ssp. *elongata*, *C. gracilis* ssp. *vulnerata*, *C. humilis* s. lat., *C. macilenta*, *C. nana*, *C. ochrochlora*, *C. pocillum*, *C. pyxidata*, *C. rei*, *C. stricta*, *C. subfurcata*, *C. subrangiformis*, *C. subulata*, *C. trassii*, *C. verticillata* and unidentified *Cladonia* species. Usually it induces galls on the host, but occasionally these are indistinct (e.g., in LE 309075, LE 308734). The taxon is widely distributed in the Holarctic including the tundra biome, but not known from the polar desert biome. Here we report the species for the first time from Kyrgyzstan, New Zealand and Macaronesia. *Cladonia alaskana*, *C. crispata*, *C. macilenta*, *C. nana*, *C. stricta*, *C. subfurcata*, *C. trassii* and *C. verticillata* are new host species.

Specimens examined. – **PORTUGAL. MADEIRA:** NW of Pico d Fonde do Bispo, 32°47.84'N, 17°10.88'W, elev. 1110 m, 2.v.2012, on *Cladonia nana*, *P.P.G. Van den Boom 47938a* (H). **SPAIN. TOLEDO:** between Sevilleja de la Jara and Puerto Rey, 39°28'42"N, 5°00'12"W, elev. 900 m, 20.vii.2014, on *C. humilis* s. lat. (basal squamules and podetia), *R. Pino-Bodas s.n.* (H). **BOSNIA AND HERZEGOVINA.** Ruište, 43°24'23"N, 18°00'35"E, elev. 110 m, 30.iii.2010, on *C. subrangiformis* (podetia), *A.R. Burgaz s.n.* (H). **LITHUANIA.** Asveja Regional Park, 55.073°N, 25.419°E, 22.ix.2011, on *C. rei* (podetia), *F. Högnabba 220911-15a* (H). **FINLAND. PÄIJÄNNE TAVASTIA:** Heinola, Keiö, 6.v.2010, on *C. coniocraea*, *V. Haikonen 27543a* (H). **RUSSIA. REPUBLIC OF ADYGEYA:** Caucasus, Mt. Tybga, 43°52'48"N, 40°15'59"E, elev. 2480 m, 7.viii.2014, on *Cladonia* sp. (podetia), *M.P. Zhurbenko 141* (LE 308482). **NENETS AUTONOMOUS AREA:** Bol'shezemel'skaya tundra, Khar'yaga oilfield, 67°11'N, 56°30'E, elev. 60 m, 24.vii.2007, on *C. gracilis* (podetia), *M.P. Zhurbenko 0739b* (LE 308553). **KRASNOYARSK TERRITORY:** Taimyr Peninsula, Uboinaya River, 73°39'N, 82°22'E, elev. 20 m, 3.viii.1990, on *C. trassii* (podetial squamules), *M.P. Zhurbenko 90385* (LE 308572); Taimyr Peninsula, Ragozinka River, 72°48'N, 80°53'E, elev. 5 m, 24.vii.1990, on *C. pocillum* (podetia and basal squamules), *M.P. Zhurbenko 90475* (LE 308561); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°30'E, elev. 1450 m, 6.vii.2009, on *C. pocillum* (basal squamules, podetia), *M.P. Zhurbenko 0962* (LE 308663); 7.vii.2009, on *C. pocillum* (basal squamules, podetia), *M.P. Zhurbenko 0960* (LE 308661);

8.vii.2009, *M.P. Zhurbenko* 0952 (LE 308655); 14.vii.2009, *M.P. Zhurbenko* 0955 (LE 308657), 20.vii.2009, *M.P. Zhurbenko* 0976 (LE 308676); 22.vii.2009, *M.P. Zhurbenko* 0975 (LE 308675). **REPUBLIC OF BURYATIA:** SE coast of Baikal Lake, 5 km SW of Turka, 52°50'50"N, 108°00'50"E, elev. 460 m, 25.viii.2002, on *C. macilenta* (basal squamules, podetia), *M.P. Zhurbenko* 02404 (LE 309084); Khamar-Daban Range, Chernoe Lake, 7.viii.1996, on *C. cornuta* (podetia), *I.N. Urbanavichene s.n.* (LE 308836); Khamar-Daban Range, Klyuchevaya River, 3.viii.1996, on *C. coniocraea* (basal squamules), *I.N. Urbanavichene s.n.* (LE 308770); Khamar-Daban Range, Mt. Osinovka, 51°30'N, 105°23'E, elev. 1300 m, 24.vi.1993, on *Cladonia* sp. (basal squamules), *I.N. Urbanavichene s.n.* (LE 308782). **KHABAROVSK TERRITORY:** Mt. Tabo, 51°37'55"N, 140°54'05"E, elev. 105 m, 6.viii.2011, on *C. cf. cenotea* (podetia), *L.S. Yakovchenko s.n.* (LE 308691b). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Kabanii Creek, 45°06'35"N, 135°52'01"E, elev. 490 m, 5.ix.2013, on *C. coniocraea* (podetia), *M.P. Zhurbenko* 13165 (LE 308643); Sikhote-Alin' Range, Valinku River, 46.13474°N, 136.6867°E, elev. 1460 m, 27.viii.2013, on *Cladonia* sp. (basal squamules), *Yu.V. Gerasimova s.n.* (LE 308698). **CHUKOTKA AUTONOMOUS AREA:** Wrangel' Island, Klark River, 71°08'N, 178°16'W, 24.viii.1998, on *C. stricta* (podetia), *S.S. Kholod s.n.* (LE 308581); Provideniya, 64°27'N, 173°11'W, elev. 200 m, 23.viii.2001, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko* 0189 (LE 308559). **KYRGYZSTAN.** Alai Range, 19.viii.1979, on *C. pyxidata* (basal squamules, podetia), *L.I. Bredkina* 3406 (LE 308857). **MONGOLIA. ARA-KHANGAI AIMAK:** watershed of Khukh-Sumein-Gol and Tsetserleg-Gol rivers, Mt. Khaikhan, 47°15'N, 101°50'E, elev. 2300 m, 28.viii.1979, on *C. pyxidata*, *L.G. Biazrov s.n.* (H), 13.vii.1973, on *C. cornuta* (podetia), *L.G. Biazrov* 2076 (LE 308872), 1.viii.1979, on *C. ochrochlora* (basal squamules, podetia), *L.G. Biazrov* 6143 (LE 308870), 19.vi.1971, on *C. subfurcata* (podetia), *L.G. Biazrov* 1741 (LE 308841); 14 km SE of Tevshrulekh, 22.vi.1976, on *Cladonia* sp. (podetia), *L.G. Biazrov* 8572 (LE 308855). **BULGAN AIMAK:** Burgut Range, 48°30'N, 102°30'E, elev. 2000 m, 24.vii.1977, on *C. pyxidata* (basal squamules, podetia), *L.G. Biazrov s.n.* (LE 308873). **DZABKHAN AIMAK:** Tarbagatai Range, 48°15'N, 98°54'E, elev. 2450 m, 1.vii.1976, on *Cladonia* sp. (podetia), *L.G. Biazrov* 2354 (LE 308863). **JAPAN, HOKKAIDO:** Mt. Dairoku, 1300 m, 1.ix.1972, on *C. gracilis* ssp. *elongata*, *T. Ahti* 28955 (H). **U.S.A. ALASKA:** Seward Peninsula, 7 km NE of Nome, Newton Peak, 64°33'21"N, 165°21'23"W, elev. 220 m, 4.ix.2001, on *C. pyxidata* (basal squamules, podetia), *M.P. Zhurbenko* 01644a (LE 308594a); Blueberry Hill, 64.8919°N, 163.6470°W, elev. 113 m, 19.vii.2000, on *C. gracilis* (podetia), *D.A. Walker s.n.* (LE 309074); Kotzebue, 1961, on *C. pocillum* (basal squamules, podetia), *B. Neiland s.n.* (LE 309075); 66°53'N, 162°31'W, elev. 30 m, 19.viii.2000, on *Cladonia* sp. (podetia), *M.P. Zhurbenko* 00172 (LE 309082); Selawik Wildlife Refuge, 28.vi.2008, on *C. gracilis* ssp. *vulnerata* (podetia), *G. Frost s.n.* (LE 308567); Tanana River, Bonanza Creek, 64°42.207'N, 148°18.937'W, elev. 140 m, 25.viii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko* 04275b (LE 309125b); Goldstream Valley, 64°57.188'N, 147°42.775'W, 31.vii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko* 0470 (LE 309090); Skyline Ridge, 64°55.270'N, 147°43.001'W, elev. 470 m, 31.vii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko* 0443 (LE 309086); Fairbanks, 64°52.741'N, 147°40.085'W, 4.viii.2004, on *C. furcata* (podetia), *M.P. Zhurbenko* 0485 (LE 309088); 64°49.583'N, 147°45.513'W, 4.viii.2004, on *C. crispata* (podetia), *M.P. Zhurbenko* 0487 (LE 309085); Denali National Park and Preserve, Rock Creek, 63°43.35'N, 148°57.53'W, elev. 650–700 m, 17.viii.2004, on *Cladonia* sp. (podetia), *M.P. Zhurbenko* 04209b (LE 309112b); on *C. subulata* (podetia), *M.P. Zhurbenko* 04214b (LE 309040b); on *C. alaskana* (podetia), *M.P. Zhurbenko* 04215 (LE 309087); 20.viii.2004, on *C. pyxidata* (basal squamules, podetia), *M.P. Zhurbenko* 04380 (LE 309089); on *C. gracilis* (podetia), *M.P. Zhurbenko* 04164 (LE 309091); on *C. pyxidata* (basal squamules, podetia), *M.P. Zhurbenko* 04189 (LE 309072); Anchorage, Ft. Richardson Army base, 61°15'N, 149°42'W, elev. 59 m, 17.vii.2000, on *Cladonia* sp. (podetia), *T. Jorgenson s.n.* (LE 308542); Prince of Wales Island, Salt Chuck mine, 55°37'28"N, 132°33'04"W, elev. 5 m, 7.viii.2001, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko* 01207 (LE 309081). **ARIZONA:** APACHE CO.: Mount Baldy Wilderness, 33°57'00"N, 109°31'30"W, 4.vii.1994, on *C. verticillata* (podetia), *T.H. Nash III* 34946 (H, LE 260933). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Spahats Creek, 51°44'23"N, 120°00'23"W, elev. 770 m, 10.vii.2002, on *C. fimbriata* (podetia), *M.P. Zhurbenko* 02244 (LE 308729); Mt. Raft, 51°44'N, 119°50'W, elev. 1800 m, 13.vii.2002, on *Cladonia* sp. (basal squamules, podetia), *M.P. Zhurbenko* 02143 (LE 308735), on *Cladonia* sp. (podetia), *M.P. Zhurbenko* 02189 (LE 308726); Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko* 02403 (LE 308734); Columbia Mts., Beaver River, 51°18'N, 117°24'W, elev. 1100 m, 17.vii.2002, on *C. fimbriata* (podetia), *M.P. Zhurbenko* 0278 (LE 308736); Columbia River Valley near mouth of Downie Creek, elev. 650 m, 20.vii.2002, on *C. cf. ochrochlora* (basal squamules, podetia), *M.P. Zhurbenko* 0225a (LE

308778a). **NEW ZEALAND. SOUTH ISLAND:** Fiordland National Park, Mt. Burns, 45.746°S, 167.380°E, elev. 1000 m, 8.v.2010, on *C. chlorophaea* (podetia), *S. Stenroos 5861b* (H).

***Epicladonia simplex* D. Hawksw.**

DESCRIPTION. – *Conidiomata* mainly semi-immersed, (30–)50–100(–150) µm in diameter, often gaping, with pore up to 50 µm in diameter extruding a white opaque droplet, dispersed to aggregated; wall blue green in the proximity of conidiogenous cells, otherwise olive to brown. *Conidiogenous cells* occasionally with up to 4 annellations. *Conidia* hyaline, fusiform to occasionally almost oblong, apex rounded, base truncate (sometimes indistinctly), (6.4–)7.3–8.5(–9.5) × (2.0–)2.4–2.8(–3.5) µm, l/b = (2.3–)2.7–3.3(–4.0) (n = 103), aseptate, smooth-walled, occasionally passively attached in short “false chains”.

NOTES. – There are some discrepancies between our material and the protologue (Hawksworth 1981) where the conidia were reported as being slightly longer, (8.5–11(–12) × 2.5–3(–3.5) µm), and the excipular pigments only brown. It is noteworthy that Ihlen and Wedin (2006) also observed both brown and olivaceous green pigmentation of the pycnidial wall. According to the protologue, the species usually induces galls, but in the examined material they were observed only in LE 308685. The species has been found on the apothecia, podetia and/or basal squamules of *Cladonia botrytes* and *C. coccifera*. Most specimens were collected on epiphytic *Cladonia botrytes*, which corresponds to the observations of Ihlen and Wedin (2006).

Specimens examined. – **FINLAND. SATAKUNTA:** Teikangas, 61°47'14"N, 22°59'02"E, elev. 120 m, 15.vi.2013, on *Cladonia botrytes* (apothecia), *T. Ahti 72075a* (H). **RUSSIA. TYUMEN' REGION:** Polar Ural, Mt. Rai-Iz, 66°50'N, 65°05'E, elev. 580 m, 10.ix.2001, on *C. coccifera* (basal and podetial squamules), *S.S. Kholod s.n.* (LE 308573). **KRASNOYARSK TERRITORY:** Western Sayan Mts., Ergaki Nature Park, Bol'shaya Baklanikha River, 52°46'N, 93°19'E, elev. 1150 m, 24.vii.2010, on *C. botrytes* (hymenium, occasionally podetia), *M.P. Zhurbenko 1050* (LE 308685); Turukhansk Region, Zotino, 61°N, 89°50'E, elev. 100 m, 21.viii.1979, on *C. botrytes* (basal squamules), *V.B. Kuvaev s.n.* (LE 308924b). **REPUBLIC OF BURYATIA:** Khamar-Daban Range, Vydrinaya River, 31.vii.1996, on *C. botrytes* (basal squamules), *I.N. Urbanavichene s.n.* (LE 308792). **SAKHALIN REGION:** Sakhalin Island, Palevo, 50°37'N, 142°43'E, 20.ix.2008, on *C. botrytes* (apothecia), *N.A. Tsarenko s.n.* (LE 309076).

***Epicladonia stenospora* (Harm.) D. Hawksw. s. lat.**

DESCRIPTION. – *Conidiomata* 40–130 µm in diameter, first immersed and later partly erumpent, dispersed; wall with brown pigments. Annellations of *conidiogenous cells* not observed. *Conidia* hyaline, narrowly ellipsoid, oblong or slightly narrowly ovoid, occasionally rather irregular in shape, for instance constricted in the middle, sometimes slightly attenuated below, apex rounded to occasionally slightly acute, base narrowly truncate, (5.3–)6.9–9.1(–14.4) × (2.3–)3.1–3.9(–4.6) µm, l/b = (1.4–)2.0–2.6(–3.5) µm (n = 323), only aseptate conidia observed.

NOTES. – According to Sérusiaux et al. (2003) this species may be heterogenous; for instance, the shape of the conidia in neotype differ from those depicted by Hawksworth (1981: Fig. 9), the former being always narrower in the middle, while the latter are broader in the middle. The conidia of the neotype are 9–10 × 3.5–4 µm in size, and 0(–1)-septate (Sérusiaux et al. 2003). We found the species on the basal squamules and/or podetia of *Cladonia amaurocraea*, *C. angustiloba*, *C. cenotea*, *C. chlorophaea*, *C. pyxidata*, *C. squamosa* and *Cladonia* spp. Distinct gall formation was not observed, although infected host thalli were rarely somewhat swollen and/or slightly discolored. Here we report the species as new to Portugal, Mongolia and Macaronesia. *Cladonia angustiloba*, *C. cenotea* and *C. squamosa* are also reported as new host species.

Specimens examined. – **PORTUGAL. AZORES ISLANDS:** Pico Island, Porto do São Caetano, 38°25'33"N, 28°25'39"W, elev. 30 m, 27.ii.2015, on *Cladonia angustiloba* (basal squamules), *R. Pino-Bodas s.n.* (H). **RUSSIA. MURMANSK REGION:** Dal'ne-Zelenetskaya Bay, 69°07'N, 36°05'E, elev. 20 m, 22.viii.1997, on *Cladonia* sp. (basal and podetial squamules), *M.P. Zhurbenko 97414* (LE 308911). **LENINGRAD REGION:** Vuoksa Lake, 3.5 km NW of Priozersk, 61°04'55"N, 29°59'38"E, 17.vii.2012, on *Cladonia* sp. (podetia), *M.P. Zhurbenko 02200* (LE 308756). **NENETS AUTONOMOUS AREA:**

Bol'shezemel'skaya tundra, Ortin River, 67°49'25"N, 54°00'07"E, 30.vi.1999, on *C. squamosa* (podetia), *O.V. Lavrinenko s.n.* (LE 308929). **KHABAROVSK TERRITORY:** Mt. Tabo, 51°37'55"N, 140°54'05"E, elev. 105 m, 6.viii.2011, on *Cladonia* sp. (podetia), *L.S. Yakovchenko s.n.* (LE 308690). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Zabolochennaya River, 45°13'42.8"N, 136°31'04.5"E, elev. 150 m, 26.viii.2013, on *C. cenotea* (podetia), *M.P. Zhurbenko 13139* (LE 308483). **CHUKOTKA AUTONOMOUS AREA:** Lavrentiya Bay, 65°31'N, 170°59'W, 22.viii.1975, on *C. amaurocraea* (podetia), *I.I. Makarova s.n.* (LE 308827). **MONGOLIA. ARA-KHANGAI AIMAK:** Khukh-Sum-Gol River, 47°15'N, 101°50'E, elev. 2000 m, 20.vii.1975, on *Cladonia* sp. (basal squamules), *L.G. Biazrov 1051* (LE 308877). **U.S.A. ALASKA:** Kotzebue, 1961, on *Cladonia* sp. (podetia), *B. Neiland s.n.* (LE 309077); Denali National Park and Preserve, 63°43.35'N, 148°57.53'W, elev. 650 m, 20.viii.2004, on *C. pyxidata* (basal squamules), *M.P. Zhurbenko 04188c* (LE 309045c); Aleutian Islands, Adak Island, Clam Lagoon, 51°57'04"N, 176°34'05"W, elev. 12 m, 26.viii.2013, on *C. chlorophaea* (basal squamules), *S. Talbot & S. Talbot ADA702a* (H).

***Epigloea soleiformis* Döbbeler**

NOTES. – The species has been reported from algal films over moribund bryophytes, detritus, humus, rotten wood, tree bark, rock and decaying terricolous lichen species of the genera *Cladonia*, *Peltigera*, *Placynthiella* and *Stereocaulon* (Berger 2000, Chambers & David 2009, Döbbeler 1984, Suija et al. 2010, Zhurbenko 2010b). It is not lichenized in the classic sense, nor is it truly lichenicolous. Nonetheless we include it here for completeness. The species was previously known in Russia also from Southern Siberia (Zhurbenko 2010b); we provide two additional records here.

Specimens examined. – **RUSSIA. KRASNOYARSK TERRITORY:** Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°32'E, elev. 1500 m, 22.vii.2009, on algal films over moss remnants and *Cladonia coccifera* (moribund basal squamules and podetia), *M.P. Zhurbenko 0969* (LE 308670). **TRANS-BAIKAL TERRITORY:** Kodar Range, Surpriznoe Lake, 56°54'21"N, 117°38'20"E, elev. 2011 m, 5.vii.2013, on *Cladonia* sp. (moribund thallus), *L.A. Konoreva s.n.* (LE 309280).

***Hainesia brevicladoniae* Diederich & Van den Boom**

DESCRIPTION. – *Conidiomata* olive brown to dark brown or almost black, glossy, superficial, 40–220 µm in diameter, initially pyriform or subglobose, sometimes with papillae, almost closed, later hemispherical to cupulate, with a wide opening. *Conidia* hyaline, bacilliform, (10.4–)12.4–16.0(–20.7) × (1.0–)1.2–1.6(–1.7) µm, l/b = (6.3–)8.2–12.0(–15.8) (n = 89), (0–)1(–3)-septate.

NOTES. – In the protologue the conidia were reported as being aseptate and somewhat thinner than in the specimens we examined [(13.5–)15.3–17.5(–18.0) × (1.0–)1.0–1.1(–1.2) µm, l/b = (11.5–)14.0–16.9(–17.5)] (Diederich & Van den Boom 2013). P. Diederich (pers. comm., 2015) has revised the holotype and confirmed that the conidia are septate. This species was formerly known in Russia only from the Caucasus (Zhurbenko & Kobzeva 2014) and we here report it from two new locations. *Cladonia coniocraea* is also a new host species.

Specimens examined. – **RUSSIA. PRIMORYE TERRITORY:** Sikhote-Alin' Range, Kabanii Creek, 45°06'35"N, 135°52'01"E, elev. 490 m, 5.ix.2013, on *Cladonia coniocraea* (podetia), *M.P. Zhurbenko 13167b* (LE 309176). **SAKHALIN REGION:** Sakhalin Island, Mt. Bol'shevik near Yuzhno-Sakhalinsk, 46°57'N, 142°47'E, elev. 800 m, 13.x.1996, on *C. gracilis* (podetia), *A.A. Dobrysh s.n.* (LE 308826).

***Hainesia cf. bryonora* Zhurb.**

NOTES. – In the specimens that we examined the conidiomata measured (60–)100–150(–190) µm in diameter (n = 50). The conidia were hyaline, bacilliform to filiform, (14.4–)17.4–22.4(–28.5) × (1.0)1.1–1.3(–1.7) µm in size [l/b = (12.8–)14.3–19.7(–22.2) (n = 104)], and primarily (0–)1-septate, rarely up to 3-septate. The examined material agrees well with the protologue (Zhurbenko & Brackel 2013), including the size of conidia [(12.0–)18.1–24.5 (–29.1) × (1.1–)1.3–1.5 (–1.6) µm]. However, the conidiomata are larger than was originally reported (30–100 µm in diameter), and the species was described from a different host (*Bryonora*, Lecanoraceae, in the same order Lecanorales). Nonetheless, some lichenicolous species of *Hainesia* are known to demonstrate low host specificity. For instance *H.*

xanthoriae Brackel was reported on lichens from the orders Lecanorales and Peltigerales (Brackel 2014). Compared to the *Hainesia* species described from *Cladonia*, the examined material is most similar to *H. brevicladoniae*, which mainly differs in having shorter conidia (see notes on this species above). *Hainesia bryonora* was described from the tundra and polar desert biomes of Svalbard and the Canadian Arctic archipelago, growing on the hymenium of apothecia of terricolous *Bryonora castanea* (Zhurbenko & Brackel 2013).

Specimens examined. – **NORWAY. SVALBARD:** Aldegondabreen Glacier, 78°00'N, 14°12'E, elev. 100 m, 16.vii.2003, on *Cladonia* sp. (moribund bleached podetia), *M.P. Zhurbenko 03453* (LE 308501). **RUSSIA. KRASNOYARSK TERRITORY:** Taimyr Peninsula, Ragozinka River, 72°48'N, 80°53'E, elev. 5 m, 4.vii.1990, on *C. macroceras* (podetial squamules), *M.P. Zhurbenko 90100* (LE 308576).

***Hainesia longicladoniae* Diederich & Van den Boom**

NOTES. – In the specimens examined the conidiomata measured 60–100 µm in diameter. The conidia were hyaline, filiform, mainly 3–6-septate, and $35\text{--}50 \times 1.5\text{--}2$ µm in LE 308594b or $(52.5\text{--})58.0\text{--}71.0(-74.5) \times (1.5\text{--})1.6\text{--}1.8(-2.0)$ µm, $l/b = (29.2\text{--})33.0\text{--}42.4(-46.5)$ ($n = 18$) in LE 308828. Originally the conidia of the species were reported as being aseptate, but later P. Diederich (pers. comm., 2015) revised the holotype and confirmed that they are septate. In the protologue the conidia were stated to measure $(28.0\text{--})40.1\text{--}63.5(-69.0) \times (1.0\text{--})1.1\text{--}1.4(-1.6)$ µm, $l/b = (23.7\text{--})33.6\text{--}49.8(-61.8)$ which agrees well with our material (Diederich & Van den Boom 2013). Here we report *Hainesia longicladoniae* for the first time from Asia and North America, as well as Russia. *Cladonia coccifera* and *C. pyxidata* are new host species.

Specimens examined. – **RUSSIA. KRASNOYARSK TERRITORY:** Taimyr Peninsula, Enisey Bay, Sibiryakova Island, 72°50'N, 79°10'E, 22.vii.1989, on *Cladonia coccifera* (blackened hymenium of apothecia), *V.B. Kuvaev 1307* (LE 308828). **U.S.A. ALASKA:** Seward Peninsula, 7 km NE of Nome, Newton Peak, 64°33'21"N, 165°21'23"W, elev. 220 m, 4.ix.2001, on *C. pyxidata* (basal squamules, podetia), *M.P. Zhurbenko 01644b* (LE 308594b).

***Heterocephalacria bachmannii* (Diederich & M.S. Christ.) Millanes & Wedin**

NOTES. – In the specimens we examined the basidiospores measured $(6.0\text{--})7.2\text{--}9.2(-11.0) \times (3.9\text{--})4.6\text{--}5.8(-6.8)$ µm, $l/b = (1.3\text{--})1.4\text{--}1.8(-2.0)$ ($n = 92$, in water or K). Asteroconidia (found in LE 308608, LE 308758 and LE 309190a) are reported here for the first time for this species (Diederich 1996), lunate conidia (found in LE 308547, LE 308541, LE 308548, LE 309186, LE 309188, LE 308740a and LE 309202) are quite common. The species was found on podetia (mainly on their tips) and sometimes on basal squamules of *Cladonia acuminata*, *C. amaurocraea*, *C. cervicornis*, *C. chlorophaea* s. lat., *C. coniocraea*, *C. cornuta*, *C. ecmocyna*, *C. foliacea*, *C. furcata*, *C. glauca*, *C. gracilis* s. lat., *C. gracilis* ssp. *turbinata*, *C. gracilis* ssp. *vulnerata*, *C. macroceras*, *C. macrophylla*, *C. cf. pleurota*, *C. pocillum*, *C. pyxidata*, *C. rangiferina*, *C. stereoclada*, *C. stygia*, *C. subulata*, *C. sulphurina*, *C. uliginosa*, *C. umbricola*, *C. verticillata* and unidentified *Cladonia* species. Infected parts of the host are usually contorted or otherwise deformed. This taxon is widely distributed in the Holarctic including the tundra biome, but here we report it new to the polar desert biome. *Cladonia acuminata*, *C. amaurocraea*, *C. cervicornis*, *C. foliacea*, *C. glauca*, *C. pocillum*, *C. stereoclada*, *C. stygia*, *C. sulphurina* and *C. uliginosa* are new host species.

Specimens examined. – **PORTUGAL. AZORES ISLANDS:** Flores Island, Ponta Delgada, 39°29'17"N, 31°11'00"W, elev. 580 m, 4.iii.2015, on *Cladonia stereoclada* (podetia), *R. Pino-Bodas s.n.* (H); Pico Island, Cabeço Gordo, 38°29'15"N, 28°27'19"W, elev. 680 m, 28.ii.2015, on *C. stereoclada* (podetia), *R. Pino-Bodas s.n.* (H). **SPAIN. TOLEDO:** Navaltoril, 39°33'45"N, 4°47'56"W, 1.viii.2015, on *C. glauca* (podetia), *R. Pino-Bodas s.n.* (H); Zaragoza, Vera de Moncayo, 41°48'51"N, 1°43'24"W, elev. 650 m, 7.vii.2014, on *C. foliacea* (squamules), *R. Pino-Bodas s.n.* (H). **FINLAND. KANTA-HÄME:** Tammela, Torrnsuo National Park, 60°44'N, 23°43'E, 31.xi.2014, on *C. stygia* (podetia), *R. Pino-Bodas s.n.* (H). **RUSSIA. REPUBLIC OF ADYGEYA:** Caucasus, Guzeripl', 43°59'25"N, 40°08'56"E, elev. 770 m, 13.viii.2014, on *C. coniocraea* (basal squamules, podetia), *M.P. Zhurbenko 14277a* (LE 308608). **KRASnodar TERRITORY:** Caucasus, Lagonaki Upland, Mt. Fisht, 43°57'46"N, 39°55'36"E, elev.

1600 m, 23.viii.2014, on *C. pyxidata* (basal squamules, podetia), *M.P. Zhurbenko 14298a* (LE 309190a); Mt. Armovka, 43°53'27"N, 40°39'47"E, elev. 1830 m, 30.viii.2014, on *C. coniocraea* (basal squamules, podetia), *A.A. Kobzeva 1481b* (LE 309189). **NENETS AUTONOMOUS AREA:** Bol'shezemel'skaya tundra, Khar'yaga oilfield, 67°14'22"N, 56°38'55"E, elev. 70 m, 20.vii.2007, on *C. furcata* (podetia), *M.P. Zhurbenko 0734* (LE 309312); Cape Bolvanskii Nos, 68°18'N, 54°30'E, 20.vii.1999, on *C. macroceras* (podetia), *O.V. Lavrinenko s.n.* (LE 309193). **KOMI REPUBLIC:** Northern Ural, Yanyupuner Range, 62°04'N, 59°08'E, elev. 500 m, 4.vii.1997, on *C. macrophylla* (podetia), *M.P. Zhurbenko 97404* (LE 308555). **KRASNOYARSK TERRITORY:** Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°26'E, elev. 1400 m, 19.vii.2009, on *C. furcata* (podetia), *M.P. Zhurbenko 0950* (LE 309204). **ALTAI TERRITORY:** Malyi Tigirek River, 51°09'N, 83°04'E, 12.vi.1996, on *C. pyxidata* (podetia), *E.A. Davydov s.n.* (LE 308547). **REPUBLIC OF BURYATIA:** Khamar-Daban Range, Mishikha River, elev. 460 m, viii.1995, on *C. verticillata* (podetia), *I.N. Urbanavichene s.n.* (LE 309198); Dzherginskii Reserve, Balan-Tamur Lake, 55°13'42"N, 111°41'57"E, 19.vii.2000, on *C. sulphurina* (podetia) over mossy boulder, *T.M. Kharpuksaeva s.n.* (LE 309185); Levye Kovyli River, 55°07'59"N, 111°28'04"E, 15.vii.2002, on *C. uliginosa* (podetia), *T.M. Kharpuksaeva s.n.* (LE 309180). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, 2 km N of Yasnaya cabin, 45°15'13"N, 136°30'10"E, elev. 180 m, 27.viii.2013, on *C. cervicornis* (podetia, mainly their tips), *M.P. Zhurbenko 13136* (LE 309182); Zabolochennaya River, 45°13'43"N, 136°31'05"E, elev. 150 m, 26.viii.2013, on *C. amaurocraea* (podetia, mainly their tips), *M.P. Zhurbenko 13168* (LE 309178); on *Cladonia* sp. (podetia, mainly their tips), *M.P. Zhurbenko 13169* (LE 309177); Golubichnaya River mouth, 44°54'20"N, 136°31'58"E, elev. 5 m, 3.ix.2013, on *C. cervicornis* (podetia), *M.P. Zhurbenko 13142* (LE 309192). **KAMCHATKA TERRITORY:** Kamchatka Peninsula, Kronotsky Nature Reserve, Levaya Schapina River, 55°08'29"N, 159°58'17"E, elev. 340 m, 12.viii.2009, on *C. gracilis* ssp. *turbinata* (podetia, mainly on their tips), *D.E. Himelbrant & I.S. Stepanchikova s.n.* (LE 308541). **CHUKOTKA AUTONOMOUS AREA:** Sireniki, 64°25'N, 173°57'W, 18.vii.1984, on *C. furcata* (podetia), *A.E. Katenin s.n.* (LE 309201), 23.vii.1986, *A.E. Katenin s.n.* (LE 309200); Lorino, 65°29'N, 171°43'W, 9.vii.1972, on *C. furcata* (podetia), *I.I. Makarova s.n.* (LE 309199); Puoten, 65°50'N, 170°32'W, 19.vii.1972, on *C. furcata* (podetia, mainly their tips), *I.I. Makarova s.n.* (LE 309203). **U.S.A. ALASKA:** Seward Peninsula, 7 km NE of Nome, Newton Peak, 64°33'N, 165°22'W, elev. 250 m, 5.ix.2001, on *C. furcata* (podetia), *M.P. Zhurbenko 0192* (LE 308548); 4.ix.2001, on *C. gracilis* ssp. *vulnerata* (podetia, mainly their tips), *M.P. Zhurbenko 0197b* (LE 308593b); Kotzebue, 66°53'N, 162°31'W, elev. 30 m, 19.viii.2000, on *C. gracilis* ssp. *vulnerata* (podetia), *M.P. Zhurbenko 00233a* (LE 309183); Great Kobuk Sand Dunes, 67°02'N, 158°50'W, elev. 50 m, 1.viii.2000, on *C. pocillum* (podetia), *M.P. Zhurbenko 00456* (LE 308556); 67°08'N, 159°03'W, elev. 65 m, 15.viii.2000, on *C. gracilis* (podetia), *M.P. Zhurbenko 00132* (LE 309205); Tanana River, Bonanza Creek, 64°51.32'N, 147°49.18'W, elev. 150 m, 25.viii.2004, on *C. pyxidata* (podetia, occasionally basal squamules), *M.P. Zhurbenko 04287* (LE 309184); 21.vii.2004, on *C. rangiferina* (podetia, mainly their tips), *M.P. Zhurbenko 04262* (LE 309181); Denali National Park and Preserve, Rock Creek, 63°43.35'N, 148°57.53'W, elev. 650 m, 16.viii.2004, on *C. acuminata* (podetia), *M.P. Zhurbenko 04195* (LE 309186); Tongass National Forest, Laughton cabin, 59.5450°N, 135.0907°W, 6.vi.2009, on *C. cornuta* (podetia), *K. Dillman 2009-150* (LE 308549); Kenai Peninsula, Chugach National Forest, 60°10'N, 149°30'W, elev. 150 m, 1.ix.2000, on *Cladonia* sp. (podetia), *M.P. Zhurbenko 00481* (LE 309188). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Philip Creek, 52°52'N, 120°00'W, 30.vii.2002, on *C. chlorophaea* s. lat. (podetia), *M.P. Zhurbenko 02154a* (LE 308740a); Mt. Raft, 51°44'N, 119°50'W, elev. 1800 m, 13.vii.2002, on *C. ecmocyna* (podetia, mainly their tips), *M.P. Zhurbenko 02142* (LE 308757); Spahats Creek, 51°44'23"N, 120°00'23"W, elev. 770 m, 10.vii.2002, on *C. cornuta* (basal squamules, podetia), *M.P. Zhurbenko 02280a* (LE 308806a); Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *C. subulata* (podetia), *M.P. Zhurbenko 02161* (LE 308758); Edgewood, 51°52'N, 120°01'W, elev. 700 m, 1.viii.2002, on *C. cf. pleurota* (basal squamules, podetia), *M.P. Zhurbenko 02204* (LE 309179); Columbia Mts., Beaver River, 51°15'N, 117°22'W, elev. 1150 m, 17.vii.2002, on *C. umbricola* (podetia, occasionally basal squamules), *M.P. Zhurbenko 02100d* (LE 309202); Mount Revelstoke National Park, elev. 700 m, 18.vii.2002, on *C. pocillum* (basal squamules, podetia), *M.P. Zhurbenko 0243a* (LE 308737a).

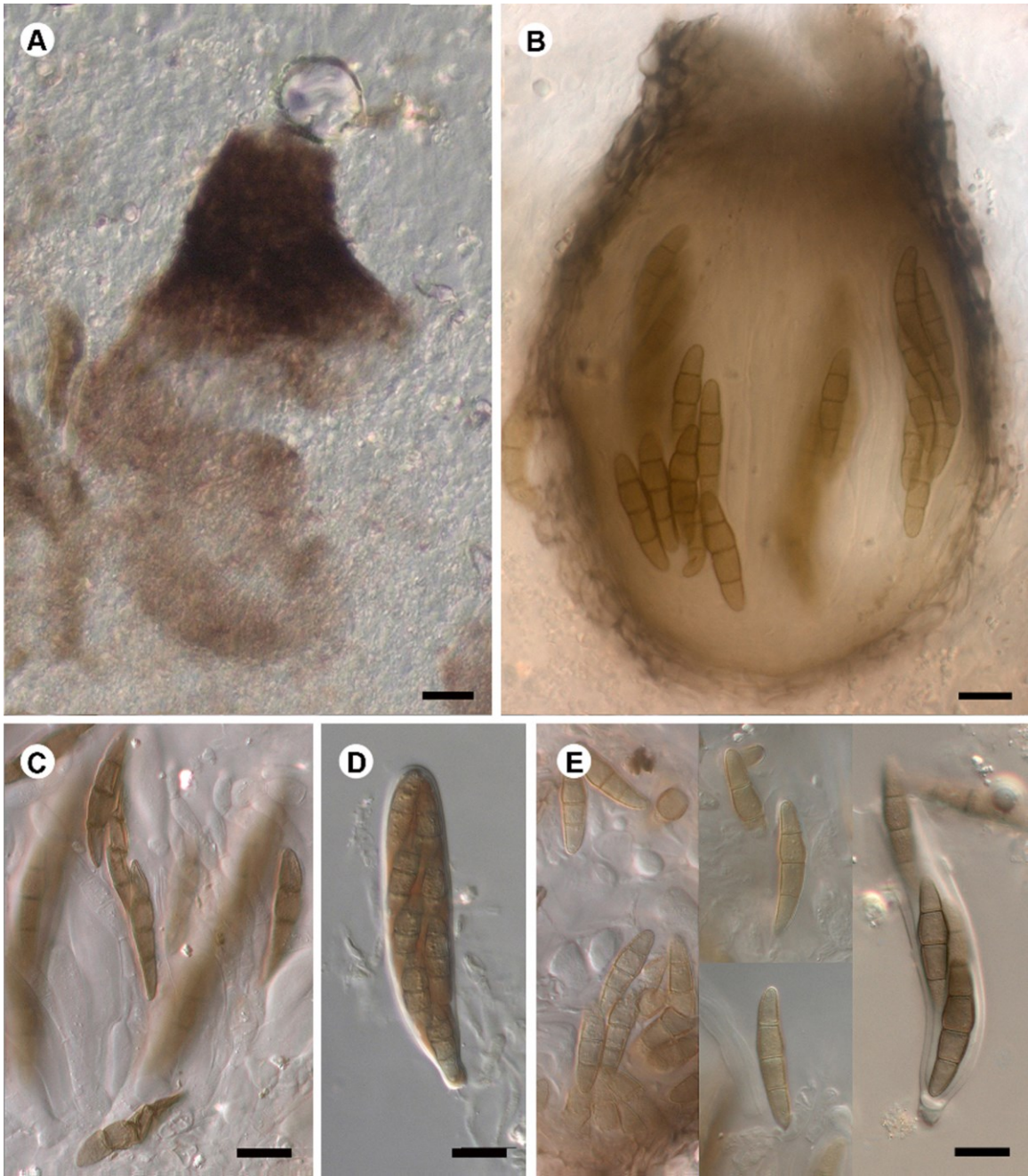


Figure 6. *Leptosphaeria* sp. growing on *Cladonia pocillum* (all from LE 210334). **A**, squashed section of ascoma in water, showing dark neck. **B**, ascoma in cross section in K. **C**, interascal hyphae in K. **D**, ascus with spores in I. **E**, ascospores in water (left) and K (right). Scale bars: A = 50 μ m, B–E = 10 μ m.

Leptosphaeria sp.

FIGURE 6

DESCRIPTION. – *Ascomata* perithecia, pyriform with a neck 40–70 μ m tall, 100–130 μ m in diameter, 200–250 μ m tall including the neck, completely immersed and visible as black dots ca. 50 μ m in diameter or with upper part of the neck protruding above the host thallus; scattered. *Exciple* dark brown above, light brown below, K+ olive; in surface view of *textura angularis*, in vertical section ca. 7–8 μ m thick, composed of 3–4 layers of tangentially strongly compressed cells. *Hymenial gel* I and K/I–.

Interascal hyphae difficult to observe, septate, often markedly constricted at the septa, 1.5–6 µm in diameter. *Asci* subcylindrical, (55–)60–80(–85) × 11–14(–15) µm (n = 13, in K, I or K/I), with short foot, tholus 1.5–4.5 µm tall, with ocular chamber up to 2 µm tall, 8-spored, I and K/I–. *Ascospores* medium yellow or light yellowish-brown, broadly fusiform or somewhat clavate, the penultimate cell broadest, (16.3–)16.4–24.2(–28.0) × (4.3–)4.6–5.4(–6.2) µm, l/b = (3.3–)3.4–4.6(–5.4) (n = 40, in water or I), transversally (1–)3-septate, usually distinctly constricted at the median septum, wall ca. 0.5 µm thick, finely verruculose, without gelatinous sheath, overlappingly biseriolate in the ascus.

NOTES. – The examined material matches relatively well the protologue of *Leptosphaeria clarkii* D. Hawksw., a species so far known from two finds in England and Austria, growing on decaying thalli of *Peltigera praetextata* and *P. cf. rufescens*. However that species has smooth-walled and somewhat shorter ascospores [19–21(–22) × 4.5–6(–6.5) µm; Hawksworth 1980, Kaufmann & Hofmann 1998]. The material also resembles *Didymocyrtis ramalinae* (Desm.) Ertz, Diederich & Hafellner, and more generally fits the description of *Didymocyrtis* Vain. given in Ertz et al. (2015). It is also similar to *Leptosphaeria protousneae* Etayo. Nonetheless both of those species differ in having larger ascomata, longer asci and shorter ascospores up to 20 µm long (Ertz et al. 2015, Etayo & Sancho 2008).

Specimen examined. – **NORWAY. SVALBARD:** Spitsbergen, Bünsow Land, NE extremity of Billefjorden near Kapp Napier, Norddammen Lake near Brucebyen cabin, 78°38'N, 16°44'E, tundra, 5.vii.2003, on *Cladonia pocillum* (moribund/bleached basal squamules), *M.P. Zhurbenko 03234* (LE 210334).

***Lichenoconium aeruginosum* Diederich, M.Brand, Van den Boom & Lawrey**

NOTES. – Previously this species has only been reported from Western Europe (Lawrey et al. 2011) and Turkey (Kocakaya et al. 2016). Here we report it as new to Spain. *Cladonia chlorophaea* is also a new host species.

Specimen examined. – **SPAIN. Zaragoza:** Vera de Moncayo, 41°48'51"N, 1°43'23"W, 650 m, 7.vii.2014, on *Cladonia chlorophaea* (podetia and basal squamules), *R. Pino-Bodas s.n.* (H).

***Lichenoconium erodens* M.S. Christ. & D. Hawksw.**

NOTES. – This is a widely distributed and common parasite reported from various lichen genera (Brackel 2014). *Cladonia coccifera* is a new host species.

Specimens examined. – **SPAIN. TOLEDO:** Aldeanueva de Barbarroja, Uso River, 39°42'04"N, 5°05'09"W, 28.xii.2014, on *Cladonia coccifera* (podetia), *R. Pino-Bodas s.n.* (H). **RUSSIA. PRIMORYE TERRITORY:** Sikhote-Alin' Range, Dal'negorsk, 44°31'39"N, 135°33'23"E, elev. 230 m, 17.viii.2013, on *C. gracilis* (podetia), *M.P. Zhurbenko 13154* (LE 308631).

***Lichenoconium pyxidatae* (Oudem.) Petr. & Syd.**

NOTES. – In the specimens examined the conidiogenous cells measured (5.0–)6.4–9.0(–11.4) × (1.7–)2.2–2.8(–3.4) µm (n = 75, in water or K), and were occasionally brown around the apices. The conidia were light to sometimes medium yellowish-brown (pale when aggregated in masses), occasionally subhyaline, quite often obovoid, attenuated and truncated at the base, and measured (2.2–)2.7–3.7(–6.9) × (1.8–)2.2–2.6(–3.5) µm, l/b = (1.0–)1.1–1.5(–2.8) (n = 279), with indistinctly verruculose walls. Morphologically, the species concepts of *Lichenoconium pyxidatae* and *L. usneae* are quite close, which made it impossible to identify some specimens with certainty. Our assignment to *L. pyxidatae* was thus based on the host in such cases. The species was found on podetia (often on the margins of scyphi) and/or sometimes basal squamules of *Cladonia chlorophaea* s. lat., *C. coniocraea*, *C. deformis*, *C. macrophylla*, *C. pocillum*, *C. pyxidata* and unidentified *Cladonia* species. Occasionally, it was associated with bleached parts of host thalli. *Cladonia deformis* and *C. macrophylla* are new host species.

Specimens examined. – **RUSSIA. REPUBLIC OF ADYGEYA:** Caucasus, Mt. Ekspeditsiya, 43°54'48"N, 40°15'43"E, elev. 1950 m, 9.viii.2014, on *Cladonia pyxidata* (upper margins of scyphi), *M.P. Zhurbenko 14278* (LE 308609). **KRASnodar TERRITORY:** Caucasus, Mt. Armovka, 43°53'27"N, 40°39'47"E, elev. 1830 m, 29.viii.2014, on *C. coniocraea* (moribund podetium), *M.P. Zhurbenko 14280*

(LE 308611); Lagonaki Upland, Mt. Fisht, 43°57'08"N, 39°55'42"E, elev. 1640 m, 18.viii.2014, on *C. pocillum* (basal squamules, podetia), *M.P. Zhurbenko 14281* (LE 308612). **KOMI REPUBLIC:** Northern Ural, Yanyupuner Range, 62°04'N, 59°07'E, elev. 550 m, 4.vii.1997, on *C. pyxidata* (upper margins of scyphi), *M.P. Zhurbenko 97407* (LE 308898), 5.vii.1997, on *C. pocillum* (moribund podetia), *M.P. Zhurbenko 97401* (LE 308518). **KRASNOYARSK TERRITORY:** Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°31'E, elev. 1450 m, 24.vii.2009, on *C. macrophylla* (basal squamules, podetia), *M.P. Zhurbenko 0944* (LE 308651). **CHUKOTKA AUTONOMOUS AREA:** Lavrentiya Bay, 65°31'N, 170°59'W, 22.viii.1975, on *C. pyxidata* (scyphi), *I.I. Makarova s.n.* (LE 308824); Kurupka River, 64°45'N, 174°05'W, 21.viii.1987, on *C. pyxidata* (podetia), *A.E. Katenin s.n.* (LE 308812). **U.S.A. ALASKA:** Fairbanks, 64°49.583'N, 147°45.513'W, 9.viii.2004, on *C. chlorophaea* s. lat. (podetia), *M.P. Zhurbenko 04122* (LE 309097); Kenai Peninsula, Chugach National Forest, 60°10'N, 149°30'W, elev. 150 m, 1.ix.2000, on *Cladonia* sp. (podetia), *M.P. Zhurbenko 00269* (LE 309098). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Clearwater River, 51°43'16"N, 120°01'25"W, elev. 550 m, 14.vii.2002, on *C. deformis* (podetia), *J. Miadlikowska s.n.* (LE 308759a).

***Lichenocodium usneae* (Anzi) D. Hawksw.**

NOTES. – In our material the conidiogenous cells measured (7.2–)8.0–10.0(–11.7) × (2.0–)2.5–3.5(–4.0) μm (n = 27), and were sometimes brown around the apices. The conidia were light to mainly medium brown (never dark in mass), usually distinctly verruculose by light microscopy, mainly subglobose, sometimes obovoid, occasionally attenuated and truncated at the base, and measured (3.0–)3.3–4.1(–6.0) × (2.3–)2.7–3.3(–3.8) μm, l/b = 1.0–1.4(–2.0) (n = 126). It was found on the podetia, and/or occasionally apothecia and basal squamules of *Cladonia cervicornis* ssp. *mawsonii*, *C. chlorophaea* s. lat., *C. coniocraea*, *C. fimbriata*, *C. foliacea*, *C. intermediella*, *C. mitis*, *C. pocillum*, *C. pyxidata*, *C. rangiferina* and *C. sulphurina*. Infected parts of the host were only occasionally slightly bleached. The species was previously known in Africa only from the Canary Islands (Hawksworth 1981). *Cladonia cervicornis* ssp. *mawsonii*, *C. coniocraea*, *C. fimbriata*, *C. foliacea*, *C. intermediella*, *C. pocillum*, *C. rangiferina* and *C. sulphurina* are new hosts.

Specimens examined. – **SPAIN. CÁCERES:** Gamonoso, 39°23'52"N, 4°52'18"W, 20.xii.2014, on *Cladonia foliacea* (apothecia), *R. Pino-Bodas s.n.* (H). **LITHUANIA.** Asveja Regional Park, 55.073°N, 25.419°E, 22.ix.2011, on *C. fimbriata* (apothecia), *F. Högnabba 220911-15b* (H). **RUSSIA. KRASNODAR TERRITORY:** Caucasus, Mt. Armovka, 43°54'18"N, 40°39'43"E, elev. 1700 m, 1.ix.2014, on *C. chlorophaea* s. lat. (tips of podetia), *M.P. Zhurbenko 14481b* (LE 309449b); Mt. Yatyrgvarta, 43°54'33"N, 40°39'54"E, elev. 1650 m, 30.viii.2014, on *C. coniocraea* (podetia and galls induced by *Heterocephalacria bachmannii*), *A.A. Kobzeva 1481a* (LE 308613). **KRASNOYARSK TERRITORY:** Taimyr Peninsula, Levinson-Lessinga Lake, 74°24'N, 98°49'E, elev. 100 m, 29.vii.1995, on *C. rangiferina* (podetia), *M.P. Zhurbenko 95603* (LE 309174). **PRIMORYE TERRITORY:** Sikhotealin' Range, Mt. Lysaya, 45°00'14"N, 136°30'00"E, elev. 850 m, 2.ix.2013, on *C. mitis* (podetia), *M.P. Zhurbenko 13151c* (LE 308497c). **MONGOLIA. DZABKHAN AIMAK:** 10 km W of Toson-Tsengel, elev. 2050 m, 3.vii.1976, on *C. chlorophaea* s. lat. (moribund podetia), *L.G. Biazrov 6354a* (LE 308871a). **U.S.A. ALASKA:** Kotzebue, 66°53'N, 162°31'W, elev. 30 m, 19.viii.2000, on *C. sulphurina* (podetia), *M.P. Zhurbenko 00230* (LE 309096). **CANADA. BRITISH COLUMBIA:** Mount Revelstoke National Park, elev. 700 m, 18.vii.2002, on *C. pocillum* (basal squamules, podetia), *M.P. Zhurbenko 0243c* (LE 308737c). **FRANCE (OVERSEAS DEPARTMENT). RÉUNION:** NE of Bourg-Murat, Col de Bellevue, 21.17797°S, 55.58010°E, elev. 1617 m, 9.ix.2009, on *C. intermediella* (apothecia), *F. Schumm & J.-P. Frahm 15179* (H). **NEW ZEALAND. SOUTH ISLAND:** Pisa Conservation Area, 1 km SW of Cardrona, 44.992°S, 168.953°E, elev. 1040 m, 10.vi.2010, on *C. cervicornis* ssp. *mawsonii* (podetia), *F. Högnabba 1524* (H).

***Lichenopeltella cladoniarum* E.S. Hansen & Alstrup**

NOTES. – The specimens we examined differ from the protologue in having 4-spored versus 8-spored asci (Hansen & Alstrup 1995). In our material the ascocata were 50–90 μm in diameter, the asci were (31–)34–42(–50) × (11.5–)12–13(–15) μm (n = 30), and the ascospores were (12.3–)15.5–18.9(–22.8) × (4.4–)4.8–5.8(–6.5) μm, l/b = (2.4–)2.8–3.6(–4.3) (n = 92, in water or K). Our material was found on podetia of *Cladonia arbuscula*, *C. portentosa* ssp. *pacifica*, *C. rangiferina* and *C. stellaris*. Pathogenicity was not observed. *Cladonia portentosa* ssp. *pacifica* is a new host.

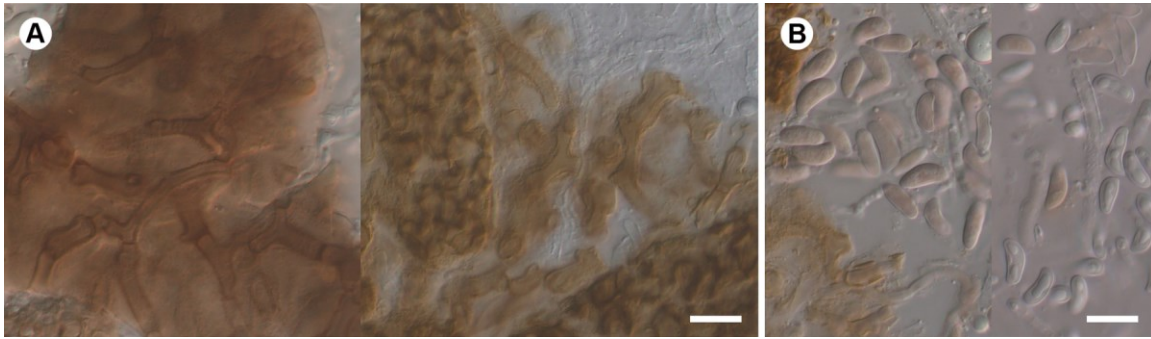


Figure 7. *Lichenosticta alcicorniaria*. **A**, outer excipular hyphae in water (left; LE 309439) and K (right; LE 308760). **B**, occasionally pigmented conidia in K (LE 308760). Scale bars = 10 µm.

Specimens examined. – **RUSSIA. MURMANSK REGION:** 4 km SSE of Dal’nie Zelentsy, 69°05’N, 36°07’E, elev. 100 m, 21.viii.1997, on *Cladonia rangiferina* (podetia), *M.P. Zhurbenko 97420* (LE 308926); Khibiny Mts., Mt. Kukisvumchorr, 67°42’N, 33°36’E, elev. 450 m, 9.viii.1997, on *C. arbuscula* (podetia), *M.P. Zhurbenko 9717b* (LE 308940b); Kaskasnyunjok Creek, 67°46’N, 33°49’W, 18.viii.2007, on *C. stellaris* (podetia), *M.P. Zhurbenko 0766b* (LE 210308b). **NENETS AUTONOMOUS AREA:** Bol’shezemel’skaya tundra, Cape Bolvanskii Nos, 68°14’N, 54°28’E, 25.vii.1999, on *C. arbuscula* (base of podetia), *O.V. Lavrinenko s.n.* (LE 264347). **CHUKOTKA AUTONOMOUS AREA:** Vel’ma River, 15.vi.1939, on *Cladonia* sp. (podetia), *A.A. Trushkovskii s.n.* (LE 308786). **U.S.A. ALASKA:** Aleutian Islands, Amlia Island, 52.05933°N, 173.40353°W, elev. 41 m, 17.viii.2010, on *C. portentosa* ssp. *pacifica* (podetia), *S. Talbot AML003-29a* (H); Carlisle Island, 52°54’N, 170°03’W, 28.vii.2013, on *C. arbuscula* (bleached parts of podetia), *S. Talbot & S. Talbot CAR001-23a* (H).

Lichenopeltella uncialicola Brackel

NOTES. – The examined specimens differ from the protologue (Brackel 2010a) in having 8-spored rather than 4-spored asci. However, asci with four to eight ascospores have been reported for the species (Brackel 2013). In our material the ascomata were approximately 50 µm in diameter, with divergent setae around the ostiole, the asci were 25–26 × 12–14 µm (n = 3), and the ascospores were 1-septate, (11.8–)12.5–13.9(–14.2) × (3.5–)3.6–3.8(–4.0) µm, l/b = (3.2–)3.4–3.8(–3.9) (n = 11). Setulae were not observed on the ascospores. *Lichenopeltella uncialicola* was previously known only from Iceland where it was found on *Cladonia uncialis*, and from Italy where it was found on *C. rangiferina* (Brackel 2010a, 2013).

Specimen examined. – **DENMARK. GREENLAND:** Frederikshåbs Isblink, 62°37’N, 50°08’W, dwarf shrub heath, 7.vii.2009, on *Cladonia rangiferina* (podetia), *E.S. Hansen s.n.* = *Lichenes Groenlandici Exsiccati #1092* (H).

Lichenopeltella sp.

NOTES. – The material cited below possibly represents an unusual specimen of *Lichenopeltella cladoniarum* with comparatively large ascomata and small ascospores (see notes on this species above). Additional material is needed to verify the characteristics, particularly the presence of ascospore setulae, which are absent in *Lichenopeltella cladoniarum*. Our material is characterized by having ascomata 87–107 µm in diameter, without ostiolar setae, 4(–8)-spored asci 33–42 × 11.5–14 µm (n = 5) in size, and ascospores (11.9–)13.5–16.7(–18.0) × (3.6–)3.8–4.2(–4.5) µm in size [l/b = (3.1–)3.4–4.2(–4.6); n = 26, in K], 1-septate, often pseudotetrablastic (seen in K), possibly rarely with 3 pairs of setulae, although the latter were not distinctly observed.

Specimen examined. – **RUSSIA. PRIMORYE TERRITORY:** Sikhote-Alin’ Range, Mt. Glukhomanka, 45°10’N, 135°48’E, elev. 1500 m, 21.viii.2003, on *Cladonia* sp. (moribund bases of podetia), *K.S. Podlubnaya s.n.* (LE 308694a).

NOTES. – As was already noted by Hawksworth (1981) the exciple in this species is composed of multiple layers, inwardly paraplectenchymatous, outwardly composed of somewhat darker, branched, septate, intertwined hyphae (Figure 7A). The conidia in our material were hyaline or exceptionally brownish (Figure 7B), more or less reniform or sometimes ellipsoid or oblong, sometimes slightly wider below, the apex rounded, the base somewhat attenuated and acute (usually giving a lacrimiform appearance) or occasionally rounded, and $(5.1\text{--}7.0\text{--}9.2\text{--}12.2) \times (2.2\text{--}3.2\text{--}4.0\text{--}5.0)$ μm in size [$l/b = (1.6\text{--}1.9\text{--}2.7\text{--}3.9)$; $n = 276$]. The species was found on *Cladonia arbuscula*, *C. cervicornis*, *C. chlorophaea* s. lat., *C. coniocraea*, *C. cornuta*, *C. cyathomorpha*, *C. deformis*, *C. fimbriata*, *C. furcata*, *C. gracilis* s. lat., *C. gracilis* ssp. *turbinata*, *C. macroceras*, *C. mitis*, *C. multiformis*, *C. ochrochlora*, *C. pleurota*, *C. pocillum*, *C. pyxidata*, *C. rangiferina*, *C. stricta* s. lat., *C. sulphurina*, *C. symphyocarpa*, *C. tessellata* and unidentified *Cladonia* species. It occurs mainly on the undersides of basal and podetial squamules or occasionally directly on podetia. Pathogenicity not observed. Widely distributed in the Holarctic including the tundra biome, the species is particularly common in forested habitats. Here we report it new to Japan. *Cladonia cervicornis*, *C. cyathomorpha*, *C. deformis*, *C. multiformis*, *C. pleurota*, *C. rangiferina*, *C. stricta* s. lat., *C. sulphurina* and *C. tessellata* are new host species.

Specimens examined. – **PORTUGAL. MADEIRA:** João do Prado, 32°43.11'N, 16°51.72'W, elev. 1240 m, 27.iv.2012, on *Cladonia cyathomorpha* (underside of basal squamules), *P.P.G. Van den Boom 47591a* (H). **NORWAY. TROMS CO.:** Skibotndalen valley, 69°19.6'N, 20°21.2'E, elev. 50 m, 6.viii.2003, on *Cladonia* sp. (underside of basal squamules), *M.P. Zhurbenko 037* (LE 309101). **FINLAND.** Päijänne Tavastia, Sysmä, Hovila, 10.iv.2010, on *C. mitis*, *V. Haikonen 27511a* (H); Uusimaa, Sipoo, 60.27°N, 25.15°E, 13.ix.2014, on *C. arbuscula* (podetia), *R. Pino-Bodas s.n.* (H). **RUSSIA. REPUBLIC OF ADYGEYA:** Caucasus, Mt. Tybga, 43°52'48" N, 40°15'59" E, elev. 2480 m, 5.viii.2014, on *C. mitis* (podetia), *M.P. Zhurbenko 14442* (LE 309439); Lagonaki Upland, Azishskii pass, 44°04'33"N, 40°00'58"E, 16.viii.2014, elev. 1750 m, on *C. coniocraea* (underside of basal squamules, rarely podetia), *M.P. Zhurbenko 14283* (LE 308615), on *C. pocillum* (basal squamules), *A.A. Kobzeva 1485a* (LE 308620a). **KRASNODAR TERRITORY:** Caucasus, Lagonaki Upland, Mt. Fisht, 43°58'N, 39°56'E, elev. 1600 m, 18.viii.2014, on *C. pocillum* (underside of basal squamules), *M.P. Zhurbenko 14287* (LE 308619), 19.viii.2014, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 14413* (LE 309441), on *Cladonia* sp. (underside of basal squamules), *M.P. Zhurbenko 14417* (LE 309440), 23.viii.2014, on *C. pyxidata* (basal squamules, mainly their undersides), *M.P. Zhurbenko 14298b* (LE 309190b), *M.P. Zhurbenko 14285* (LE 308617); Mt. Armovka, 43°52'28"N, 40°39'20"E, elev. 2250 m, 30.viii.2014, on *C. chlorophaea* s. lat. (podetia and basal squamules, mainly their underside), *M.P. Zhurbenko 14284* (LE 308616), 31.viii.2014, on *C. pyxidata* (basal squamules, mainly their underside), *M.P. Zhurbenko 14286* (LE 308618), *M.P. Zhurbenko 14294* (LE 309172). **NENETS AUTONOMOUS AREA:** Bol'shezemel'skaya tundra, Ortin River, 67°50'04"N, 54°04'35"E, 28.vi.1999, on *C. sulphurina* (basal squamules, podetia), *O.V. Lavrinenko s.n.* (LE 308896); on *C. coccifera* (underside of basal squamules, occasionally podetia), *O.V. Lavrinenko s.n.* (LE 308896); Khar'yaga oilfield, 67°11'N, 56°30'E, elev. 60 m, 24.vii.2007, on *C. sulphurina* (podetia), *M.P. Zhurbenko 0775* (LE 308568). **KRASNOYARSK TERRITORY:** Western Sayan Mts., Ergaki Nature Park, Nizhnyaya Buiba River, 52°46'N, 93°22'E, elev. 1150 m, 26.vii.2010, on *C. pyxidata* (basal squamules, occasionally podetia), *M.P. Zhurbenko 1043* (LE 308680); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 8.vii.2009, on *C. pocillum* (basal squamules, occasionally podetia), *M.P. Zhurbenko 0961a* (LE 308662a). **REPUBLIC OF BURYATIA:** Tunka Mts., Arshan, 51°56'N, 102°25'E, elev. 850 m, 11.vi.2005, on *C. pocillum* (upper side of basal squamules), *M.P. Zhurbenko 0524* (LE 309102); Kitoi Mts., 3 km N of Oka Lake, 51°55'N, 100°40'E, elev. 2000 m, 15.vi.2005, on *C. cornuta* (underside of basal and podetial squamules, occasionally podetia), *M.P. Zhurbenko 05196* (LE 309104), on *C. pyxidata* (lower and sometimes upper sides of basal squamules, occasionally podetia), *M.P. Zhurbenko 05194* (LE 309103); Dzherginskii Reserve, Dzhirga River valley, 54°54'14"N, 111°16'27"E, 19.vii.2002, on neighbouring *C. gracilis* and *C. ochrochlora* (underside of basal squamules, occasionally podetia), *T.M. Kharpukhaeva s.n.* (LE 309105a). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Mt. Glukhomanka, 45°10'N, 135°48'E, elev. 1500 m, 22.viii.2003, on *C. furcata* (podetia), *K.S. Podlubnaya s.n.* (LE 308699). **SAKHALIN REGION:** Sakhalin Island, Tym' River, 50°51'N, 142°40'E, 16.ix.2007, on *C. coniocraea* (underside of basal squamules), *I.F. Skirina s.n.* (LE 308648); Mt. Bol'shevik near Yuzhno-Sakhalinsk,

46°57'N, 142°47'E, elev. 570 m, 13.x.1996, on *C. gracilis* s. lat. (podetial squamules), *A.A. Dobrysh s.n.* (LE 308816); Kunashir Island, 19.ix.1996, on *C. ochrochlora* (underside of basal and podetial squamules), *A.A. Dobrysh s.n.* (LE 308772), 20.ix.1996, *A.A. Dobrysh s.n.* (LE 308837); Iturup Island, Baranovskogo volcano, 43°39'N, 131°55'E, 6.x.1996, on neighbouring *C. cornuta* and *C. stricta* s. lat. (basal squamules, podetia), *A.A. Dobrysh s.n.* (LE 308834). **CHUKOTKA AUTONOMOUS AREA:** conjunction of Enmyvaam and Shumnaya Rivers, 68°15'N, 166°03'E, 1.vii.1980, on *C. coccifera* (basal squamules), *I.I. Makarova s.n.* (LE 308811); Bezymyannoe Lake, 66°39'N, 176°40'E, 5.vii.1979, on *C. coccifera* (basal squamules), *I.I. Makarova s.n.* (LE 308783b). **MONGOLIA. ARA-KHANGAI AIMAK:** Khukh-Sumein-Gol River, 47°15'N, 101°50'E, 22.vii.1970, on *C. chlorophaea* s. lat. (basal squamules), *L.G. Biazrov 1690b* (LE 308840b), 17.viii.1979, on *C. pleurota* (basal squamules), *L.G. Biazrov 5952* (LE 308867), 13.vii.1973, on *C. cornuta* (podetia), *L.G. Biazrov 2031* (LE 308856); Mt. Bayaskhalan-Ula, 48°02'N, 99°25'E, elev. 2700 m, 17.vi.1973, on *C. macroceras* (podetia), *L.G. Biazrov 2084* (LE 308864). **JAPAN. HOKKAIDO:** Mt. Dairoku, elev. 1300 m, 1.ix.1972, on *C. rangiferina* (podetia), *T. Ahti 28164b* (H). **U.S.A. ALASKA:** Kenai Peninsula, Chugach National Forest, 60°10'N, 149°30'W, elev. 150 m, 1.ix.2000, on *C. cornuta* (underside of basal squamules), *M.P. Zhurbenko 00478b* (LE 309142b); Tongass National Forest, Gravina Island, 55°10'N, 131°46'W, elev. 300 m, 17.viii.2000, on *C. chlorophaea* s. lat. (underside of basal squamules), *K. Dillman s.n.* (LE 308510); Aleutian Islands, Adak Island, Mt. Reed, 51.83191°N, 176.67477°W, elev. 130 m, moss meadow, 28.viii.2013, on *C. rangiferina* (throughout the length of podetia to their tips), *S. Talbot & S. Talbot s.n.* (H); Prince of Wales Island, Salt Chuck mine, 55°37'28"N, 132°33'04"W, elev. 5 m, 7.viii.2001, on *C. ochrochlora* (underside of basal squamules) on driftwood, *M.P. Zhurbenko 01206* (LE 309100); between Flicker and Baker Creeks, 56°20'56.3"N, 133°33'56.5"W, elev. 5 m, 11.viii.2001, on *C. ochrochlora* (underside of basal squamules, occasionally podetia), *M.P. Zhurbenko 0113* (LE 309099). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Battle Creek, elev. 750 m, 5.viii.2002, on *C. coniocraea* (basal squamules, occasionally podetia), *M.P. Zhurbenko 02366* (LE 308733); Spahats Creek, 51°44'23"N, 120°00'23"W, elev. 770 m, 10.vii.2002, on *C. cornuta* (basal squamules, podetia), *M.P. Zhurbenko 02280b* (LE 308806b), on *C. fimbriata* (basal squamules, occasionally podetia), *M.P. Zhurbenko 02242b* (LE 308722b); Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *C. chlorophaea* s. lat. (basal squamules, podetia), *M.P. Zhurbenko 02154b* (LE 308740b), on *C. pyxidata* (basal squamules), *M.P. Zhurbenko 02155c* (LE 308704c), on *Cladonia* sp. (basal squamules, podetia), *M.P. Zhurbenko 02276* (LE 308725), on *C. symphycarpa* (basal squamules, occasionally podetia), *M.P. Zhurbenko 02277* (LE 308724), on *C. multiformis* (basal squamules, podetia), *M.P. Zhurbenko 02166* (LE 308720), on *C. cervicornis* (basal squamules, podetia), *M.P. Zhurbenko 02158* (LE 308717); Murtle River, 51°57'51"N, 120°07'24"W, elev. 730 m, 9.vii.2002, on *C. ochrochlora* (basal squamules, rarely podetia), *M.P. Zhurbenko 02250* (LE 308721), 10.vii.2002, on *C. gracilis* ssp. *turbinata* (podetia), *M.P. Zhurbenko 02193* (LE 308719); Clearwater River, 51°43'16"N, 120°01'25"W, elev. 550 m, 14.vii.2002, on *C. deformis* (basal squamules, podetia), *J. Miadlikowska s.n.* (LE 308759b); Mount Revelstoke National Park, elev. 700 m, 18.vii.2002, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 0243b* (LE 308737b), on *C. pyxidata* (basal squamules, occasionally podetia), *M.P. Zhurbenko 02400* (LE 308702), on *C. ochrochlora* (basal and podetial squamules, occasionally podetia), *M.P. Zhurbenko 0246* (LE 308739); Columbia Mts., Beaver River, 51°18'N, 117°24'W, elev. 1100 m, 16.vii.2002, on *C. sulphurina* (basal squamules), *M.P. Zhurbenko 0298b* (LE 308748b), 17.vii.2002, on *C. ochrochlora* (basal squamules, occasionally podetia), *M.P. Zhurbenko 022* (LE 308718); Columbia River Valley near mouth of Downie Creek, elev. 650 m, 20.vii.2002, on *C. cf. ochrochlora* (basal squamules, occasionally podetia), *M.P. Zhurbenko 0225b* (LE 308778b); Columbia River Valley near mouth of Mica Creek, 23.vii.2002, on *C. coniocraea* (basal squamules), *M.P. Zhurbenko 02360* (LE 308747), on *C. ochrochlora* (basal squamules, podetia), *M.P. Zhurbenko 0266* (LE 308780), on *C. fimbriata* (basal squamules), *M.P. Zhurbenko 02405* (LE 308745), on *C. sulphurina* (basal squamules, occasionally podetia), *M.P. Zhurbenko 0285* (LE 308760), on *C. symphycarpa* (basal squamules), *M.P. Zhurbenko 0223* (LE 308761). **NEWFOUNDLAND AND LABRADOR:** Newfoundland, Terra Nova National Park, Newman Sound, 48°33'N, 53°53'W, elev. 5 m, 10.ix.2011, on *C. coniocraea* (squamules) *T. Ahti 71229* (H). **ARGENTINA. SANTA CRUZ PROVINCE:** Huemul Glacier, 49°04'S, 72°54'W, i.2007, on *C. cornuta* (basal squamules), *I. Garibotti 115* (H). **CHILE. REGIÓN DE LOS LAGOS:** Alerce Andino National Park, Guarderia, 41°27'47"W, 72°38'41"W, elev. 130 m, 14.ii.2013, on *C. tessellata* (underside of squamules), *U. Schiefelbein 3940a* (H).

***Lichenostigma alpinum* (R. Sant., Alstrup & D. Hawksw.) Ertz & Diederich s. lat. (anamorph)**

NOTES. – This is probably a cosmopolitan species, which is very common at least in the Arctic. It was described from *Ochrolechia frigida* (Alstrup & Hawksworth 1990) and subsequently reported from various lichen genera including *Cladonia* (Brackel 2014). However, it is possible that the reports from disparate hosts belong to morphologically similar, but different species (Ertz et al. 2014). We found the species on podetia and/or occasionally basal squamules of *Cladonia arbuscula*, *C. nipponica*, *C. pocillum*, *C. rangiferina*, *C. stricta*, *C. subcervicornis* and *C. symphycarpa*. Heavy infections caused bleaching of the host tissues. Here we report the species for the first time from Mongolia. *Cladonia arbuscula*, *C. nipponica*, *C. rangiferina*, *C. stricta*, *C. subcervicornis* and *C. symphycarpa* are new host species.

Specimens examined. – **NORWAY. SVALBARD:** Murchison fjord, Nord Bay, 80°02'11"N, 18°49'04"E, elev. 45 m, 14.viii.2007, on neighbouring *Ochrolechia frigida* and *Cladonia symphycarpa* (basal squamules), *N.V. Matveeva s.n.* (LE 308560). **RUSSIA. ARKHANGELSK REGION:** Franz Josef Land, Scott Keltie Island, 80°20'N, 52°18'E, 25.vii.1930, on *C. stricta* (podetia), *V.P. Savicz s.n.* (LE 308793). **KRASNOYARSK TERRITORY:** Severnaya Zemlya Archipelago, Bol'shevik Island, Cape Antsev, 78°13'N, 103°15'E, 16.vii.2000, on *C. subcervicornis* (podetia), *N.V. Matveeva s.n.* (LE 308546). **REPUBLIC OF BURYATIA:** Eastern Sayan, Tunka Mts., near Arshan, Kyngarga River valley, 51°56' N, 102°25' E, elev. 1080 m, 11.vi. 2005, on *C. pocillum* (basal squamules, podetia), *M.P. Zhurbenko 05303* (LE 309618). **REPUBLIC OF SAKHA (YAKUTIA):** 3 km SW of Tiksi, 71°40'N, 128°40'E, elev. 50 m, 17.vii.1998, on *C. arbuscula* (podetia), *M.P. Zhurbenko 98415* (LE 308919). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Mt. Lysaya, 45°00'14"N, 136°30'00"E, elev. 850 m, 2.ix.2013, on *C. nipponica* (podetia, mainly on their apices), *M.P. Zhurbenko 13141* (LE 308488). **CHUKOTKA AUTONOMOUS AREA:** upper Televeem River, 65°50'N, 175°05'E, 22.vii.1979, on *C. nipponica* (podetia), *I.I. Makarova s.n.* (LE 308821); km 174 of road from Egvekinot to Iul'tin, 67°41'N, 178°35'W, 28.vii.1980, on *C. pocillum* (basal squamules), *B.A. Yurtsev s.n.* (LE 308818). **MONGOLIA. UBSUNUR AIMAK:** Mt. Tsagan-Khairkhan-Ula, 49°23'N, 94°20'E, elev. 2100 m, 6.vii.1976, on *C. rangiferina* (podetia), *L.G. Biazrov 6556* (LE 308846). **U.S.A. ALASKA:** near Fairbanks, Morphy Dome, 64°57'N, 148°21'W, elev. 700 m, 27.viii.2000, on *C. rangiferina* (podetia), *M.P. Zhurbenko 0013* (LE 309164).

***Lichenostigma maureri* Hafellner (anamorph)**

NOTES. – This is probably a cosmopolitan species, common at least in forested environments of the Holarctic. It was described from *Usnea florida* (Hafellner 1982) and subsequently reported from various genera of macrolichens including *Cladonia* (Brackel 2014, Ertz et al. 2014). We found it on basal squamules and/or podetia of *Cladonia subulata* and *C. rangiferina*, both of which are new host species.

Specimens examined. – **RUSSIA. REPUBLIC OF SAKHA (YAKUTIA):** Indigirka River, Moma rapids, 65°25'N, 142°43'E, elev. 400 m, 18.vii.1992, on *C. subulata* (podetia), *M.P. Zhurbenko 92565* (LE 308882); 8 km SW of Ust'-Nera, 64°31'N, 143°08'E, elev. 700 m, 23.vii.1992, on *C. rangiferina* (podetia), *M.P. Zhurbenko 92569* (LE 308938). **MONGOLIA. ARA-KHANGAI AIMAK:** watershed of Khukh-Sumein-Gol and Tsetserleg-Gol Rivers, Mt. Khairkhan, 47°15'N, 101°50'E, elev. 2100 m, 1.viii.1979, on *C. ochrochlora* (basal squamules, podetia), *L.G. Biazrov 3385a* (LE 308869a).

***Merismatium coccisporum* (Norman) Vouaux**

NOTES. – According to Triebel (1989) the ascospores of this species are rather variable in size [(8.5–)11–17(–19) × (5–)6.5–8(–9.5) μm], shape and septation, mainly with obtuse apices. The species mostly occurs on saxicolous lichens; however, it has also been reported on an unidentified lichen on soil (Spribille et al. 2010). In our material the ascomata were 110–180 μm in diameter, semi-immersed to sessile, the ascospores were medium orange brown (walls and septa often much darker than lumen), ellipsoid to occasionally broadly or narrowly ellipsoid, apices acute or occasionally obtuse, with 2–6 transsepta or oblique septa and 0–3 longisepta in central segments, and (10.4–)12.7–16.9(–20.9) × (6.0–)6.9–8.7(–11.9) μm in size [l/b = (1.3–)1.6–2.2(–2.9); n = 54]. *Cladonia* is a new host genus.

Specimen examined. – **RUSSIA. KRASNOYARSK TERRITORY:** Putorana Plateau, Kapchuk Lake, 69°29'N, 91°00'E, elev. 1000 m, 13.viii.1983, on *Cladonia pyxidata* (bleached portions of basal squamules), *M.P. Zhurbenko 83161b* (LE 207221b).

***Merismatium decolorans* (Arnold) Triebel**

DESCRIPTION. – *Ascomata* subglobose, brownish black, glossy, (75–)125–250 µm in diameter, more or less sessile. *Ascospores* ellipsoid, narrowly ellipsoid or clavate (narrower below), rarely of irregular shape, for example triangular, initially subhyaline, then light brown (sometimes with a gray tinge) and finally medium brown, walls and septa usually much darker than lumen, end cells sometimes paler, with (0–)1–3(–4) transsepta and rarely 1(–2) longitudinal or oblique septa in central segments, sometimes slightly constricted at the septa, (9.3–)11.4–14.4(–16.7) × (3.6–)4.1–5.5(–7.0) µm, l/b = (1.4–)2.3–3.1(–3.5) (n = 108), smooth-walled, non-halonate.

NOTES. – The examined material fits well the description in Triebel (1989), except for the ascospores, which were reported to be slightly longer [(10.5–)13.5–16.5(–17.5) × (3.5–)4–5.5(–6) µm]. We found this species on the basal squamules of *Cladonia pocillum*, *C. pyxidata*, *C. ramulosa*, unidentified *Cladonia* species and usually on neighbouring algal films, lichens, bryophytes and detritus on soil. Pathogenicity was not observed in our material. *Cladonia pocillum* and *C. ramulosa* are new host species.

Merismatium cladoniicola Alstrup is an obscure species so far known from the holotype collected in Norway where it was found on a moribund thallus of *Cladonia ciliata* (as *C. ciliaris*; Alstrup 1997), and from a specimen from the Russian Caucasus growing on the basal squamules of *C. pocillum* (reported as *Merismatium cf. cladoniicola*; Zhurbenko & Kobzeva 2014). In the protologue the end cells of the ascospores of *M. cladoniicola* have been described as being often hyaline (Alstrup 1997). This character has not been reported before for *M. decolorans*, but paler ascospore end cells were occasionally observed in the examined material. Given this observation, *M. cladoniicola* fits within the range of variability of *M. decolorans* and most likely is a heterotypic synonym of the latter. However we refrain from a formal synonymy pending further more detailed study.

Specimens examined. – **SPAIN. MALAGA:** Los Reales de Sierra Bermeja, 36°29.458'N, 5°12.158'W, elev. 1154 m, 23.xii.2012, on *Cladonia ramulosa* (basal squamules) and possibly on adjacent thallus of unidentified lichen, *O. Miettinen 15975a* (H). **RUSSIA. KRASNOYARSK TERRITORY:** Putorana Plateau, Lama Lake near Deme River mouth, 69°30'N, 90°42'E, elev. 60 m, 6.viii.1983, on *Cladonia* sp. (basal squamules) and adjacent films of lichens and algae on soil, *M.P. Zhurbenko 83237* (LE 308902); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°28'E, elev. 1450 m, 8.vii.2009, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 0951* (LE 309165), 24.vii.2009, on mosses, algal films and occasionally on basal squamules of *C. pocillum*, *M.P. Zhurbenko 0974b* (LE 308674b). **REPUBLIC OF SAKHA (YAKUTIA):** lower Lena River, Daldyn River, ca. 68°30'N, 124°00'E, 13.viii.1957, on *C. pyxidata* (basal squamules) and adjacent plant remnants, *A.N. Lukicheva s.n.* (LE 308513b).

***Merismatium cf. nigrifellum* (Nyl.) Vouaux**

NOTES. – In the specimens cited below the ascomata were 100–150 µm in diameter, slightly erumpent to semi-immersed, and associated with conspicuous septate brown vegetative hyphae. The ascospores had 3–8 transsepta and 1(–2) longitudinal or oblique septa in most segments, and measured (16.5–)19.9–24.5(–28.5) × (5.7–)7.4–9.4(–10.7) µm in size [l/b = (2.1–)2.4–3.0(–3.3); n = 69]. Goniocysts were only sometimes present. Triebel (1989) reported ascomata of the species to be mainly superficial and larger than those we observed [(150–)200–250(–300) µm in diameter], and the ascospores were also reported to be wider [(14–)15–24.5(–32) × (6.5–)8–12(–15) µm]. The species has previously been reported on *Cladonia* by Brackel (2014). We found the species growing on the bleached basal squamules of *Cladonia pocillum*, *C. pyxidata* and an unidentified *Cladonia* species.

Specimens examined. – **NORWAY. TROMS CO.:** Skibotndalen Valley, 69°19.4'N, 20°21.4'E, elev. 70 m, 6.viii.2003, on *Cladonia pocillum* (bleached basal squamules), *M.P. Zhurbenko 03456* (LE 309168). **RUSSIA. KRASNOYARSK TERRITORY:** Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°28'E, elev. 1500 m, 15.vii.2015, on *Cladonia* sp. (bleached basal squamules), *M.P. Zhurbenko 0965* (LE 308666); on *C. pyxidata* (bleached basal squamules), 14.vii.2009, *M.P. Zhurbenko 0970* (LE 308671). **REPUBLIC OF SAKHA (YAKUTIA):** Tiksi, 71°37'N, 128°54'E, elev. 70 m, 18.vii.1998, on *Cladonia* sp. (moribund basal squamules), *M.P. Zhurbenko 98416a* (LE 308912a).

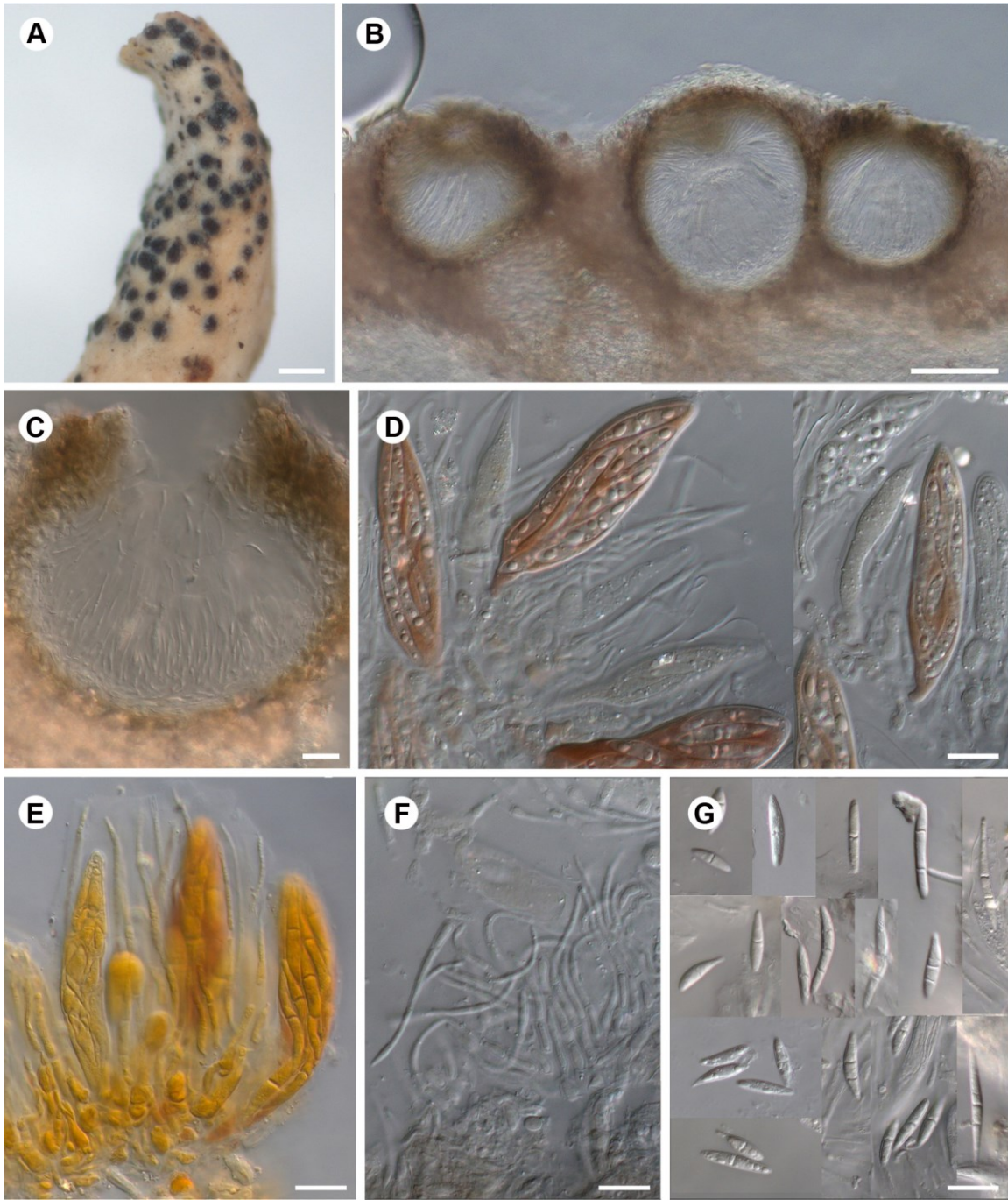


Figure 8. *Neolamya ahtii* (A-D and F from the holotype, E from LE 308800, G from LE 308587). **A**, ascomata. **B & C**, ascomata in cross section in water. **D**, asci in K/I. **E**, asci in I. **F**, paraphyses in K. **G**, ascospores in water. Scale bars: A = 200 μ m, B = 50 μ m, C–G = 10 μ m.

***Neoburgoa freyi* Diederich, Zimmermann & Lawrey**

NOTES. – This recently described species has previously been reported from several alpine localities in the Alps (Switzerland) where it grew on thalli of *Cladonia rangiferina* (Lawrey et al. 2016). Here we report it as new to Russia and report *Cladonia stellaris* as a new host species.

Specimen examined. – **RUSSIA. MURMANSK REGION:** Khibiny Mts., Mt. Kukisvumchorr, 67°42'N, 33°36'E, elev. 450 m, 9.viii.1997, on *Cladonia stellaris* (podetia), M.P. Zhurbenko 9714 (LE 309619).

***Neolamya ahtii* Zhurb., sp. nov.**

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FIGURE 8

DIAGNOSIS. – Lichenicolous fungus. Morphologically similar to *Neolamya peltigerae*, but distinguished primarily by the smaller ascomata, the (8–)16-spored (vs. 16–32-spored) asci, the (0–)1(–3)-septate, 14–22 µm long (vs. 3–6-septate, 65–81 µm long) ascospores, and different host (*Cladonia* vs. *Peltigera*).

TYPE: **RUSSIA. NENETS AUTONOMOUS AREA:** SE of Bol'shezemel'skaya tundra, vicinities of Khar'yaga oilfield, 67°11'N, 56°30'E, elev. 60 m, dwarf shrub-moss-lichen tundra, 24.vii.2007, on *Cladonia gracilis* (podetia) accompanied by *Epicladonia sandstedei* and *Heterocephalacria bachmannii*, M.P. Zhurbenko 0739a (LE 308554!, holotype).

DESCRIPTION. – *Ascomata* perithecia, black (dark brown when wet), matt, subglobose, 60–150 µm in diameter, without clypeus, with a rather irregular pore 15–30 µm lengthways, immersed to slightly protruding in the ostiolar region, without star-like radial splits of the host thallus, aggregated, often adjacent to confluent; wall medium brown and 10–20 µm thick above, hyaline to light brown and 5–10 µm thick below, slightly discoloring in K, innermost layer hyaline, composed of tangentially elongated cells; in surface view of *textura angularis* or *textura epidermoidea*. Ostiolar canal poorly developed. External periphyses (sensu Roux & Triebel 1994), internal periphyses and periphysoids not observed. *Hymenium* hyaline, 50–100 µm tall, hymenial gel I and K/I–. *Subhymenium* indistinct. *Paraphyses* abundant, lining the ascomatal cavity, reaching the ostiole, longer than asci, 20–60 µm long, 2–4 µm in diameter at the base, gradually attenuating towards non-swollen apex 1–1.5 µm in diameter, 1–4-septate, occasionally with small branchlets, sometimes with small guttules, embedded in gel matrix. *Asci* non-fissitunicate, more or less ellipsoid with rather acute and sometimes attenuated apex and short foot, wall thin, thickened at apex only when young, without a discernible ocular chamber, dehiscence not observed, (43–)47–61(–75) × 10–14(–17) µm (n = 23, in water, I or K/I), I and K/I–, (8–)16-spored. *Ascospores* hyaline, greatly varying in shape and size, fusiform to narrowly ellipsoid, occasionally bacilliform or ellipsoid, rarely with slightly wider upper cell, apices rounded to occasionally acute or attenuated, (6.7–)13.5–22.1(–34.0) × (2.3–)2.7–3.9(–6.0) µm, l/b = (1.8–)3.8–7.4(–11.0) (n = 142, in water, I or K/I), (0–)1(–3)-septate, not or rarely slightly constricted at median septum (seen in K), smooth-walled, non-halonate, with large guttules, irregularly 2–6-seriate in the asci. *Anamorph* not found.

ETYMOLOGY. – Named in honor of Teuvo Ahti for his outstanding contribution to lichenology and particularly to the knowledge of the lichen genus *Cladonia*.

DISTRIBUTION AND HOSTS. – The new species is known from three specimens collected in the tundra biome of Europe, Asia and North America, growing on podetia of *Cladonia gracilis* and *C. stellaris*. It causes strong bleaching of the infected host parts.

DISCUSSION. – The placement of the new species in *Neolamya* Theiss. & Syd. is tentative, as the generic type *N. peltigerae* (Mont.) Theiss. & Syd. differs in several essential features, i.e., ascomata covered by thin clypeus, presence of external and internal periphyses and periphysoids, unbranched paraphyses and 16–32-spored asci (Ertz 2004, Kocourková 2009). *Neolamya peltigerae* occurs on species of *Peltigera* and further differs from *N. ahtii* in inducing star-like radial splits of the host thallus, in having

larger ascomata up to ca. 300 µm in diameter, unbranched paraphyses, larger asci [(77.5–)93.5–119.5(–120.0) × (16.0–)18.0–24.0(–27.0) µm] and filiform to long fusiform, 3–6 septate, longer ascospores [(56.0–)65.0–81.0(–90.0) × (2.0–)2.5–3.0(–3.5) µm, l/b = (18.3–)22.5–31.9(–36)] (Kocourková 2009). It is noteworthy that although the species has been characterized as commensalistic (Ertz 2004, Kocourková 2009) heavy infections cause slight bleaching of the host tissues (Zhurbenko 2009b).

Neolamya xanthoparmeliae Kocourk. is the only other member of the genus described to date, and it grows on species of *Xanthoparmelia*. It differs from *N. ahtii* in its larger ascomata (up to ca. 300 µm in diameter), consistently 16-spored and larger asci [(67.5–)98.0–137.5(–140.0) × (13.0–)15.0–20.5(–23.0) µm] and in the filiform to long fusiform, 3–10-septate, longer ascospores [(55.0–)60.0–90.0(–111.5) × (3.0–)3.5–4.75(–5.0) µm, l/b = (12.2–)18.8–21.4(–24.3)] (Kocourková 2009). The report of *N. peltigerae* on species of *Polychidium* (Aptroot et al. 1997) is based on scant material and probably refers to an undescribed species of *Neolamya* (Kocourková 2009; P. Diederich, pers. comm., 2016). Our material is also reminiscent of species of *Sagediopsis* (Sacc.) Vain. subgen. *Sagediopsis*, particularly *S. aquatica* (Stein) Triebel, *S. barbara* (Th. Fr.) R. Sant. & Triebel and *S. vasilyevae* Zhurb. (Hafellner 1993, Zhurbenko & Yakovchenko 2014). However, these species readily differ in having an amyloid or hemiamyloid hymenial gel and 8-spored asci.

Additional specimens examined. – **RUSSIA. CHUKOTKA AUTONOMOUS AREA:** Yuzhno-Anyuiskii Range, headwaters of Ottaipytgin River, stony tundra, 2.viii.1952, on *Cladonia stellaris* (podetia), *D. Baikova s.n.* (LE 308800). **U.S.A. ALASKA:** Seward Peninsula, 7 km ESE of Nome, 64°28'44"N, 165°16'03"W, elev. 5 m, shrub-dwarf shrub-lichen-moss tundra, 1.ix.2001, on *C. gracilis* ssp. *vulnerata* (podetia, often on their tips) accompanied by *Polycoccum microcarpum*, *M.P. Zhurbenko 0199a* (LE 308587).

***Niesslia cladoniicola* D. Hawksw. & W. Gams**

DESCRIPTION. – *Ascomata* perithecioid, black, glossy, subglobose, sometimes with small papilla, often with concave upper part when overmature, (50–)100–130(–150) µm in diameter (n = 73), ostiolate, setose throughout, superficial, dispersed to occasionally adjacent. *Setae* light to mainly medium or dark reddish brown, darker than the ascomatal wall, subulate, straight or sometimes flexuous, with sharp and occasionally attenuated apex, (11–)25–43(–58) µm long (n = 165), ca. 2 µm in diameter in the middle, abruptly expanded up to 10 µm across at the base, not branched or exceptionally with small outgrowths, wall 0.5–1 µm thick, aseptate. *Exciple* medium to dark reddish brown, pigmentation heterogeneous, K+ olive brown, in surface view of *textura epidermoidea*. *Periphyses* hyaline, acuminate, 8–18 × 1–2(–3.5) µm, occasionally septate. *Paraphyses* hyaline, filiform, apically not enlarged, 1–1.2 µm in diameter, branched, often indistinct. *Hymenial gel* I and K/I–. *Asci* subcylindrical, slightly swollen in the middle, with more or less truncate apex, not distinctly stalked, tholus 1–2.5 µm tall, with tiny marginal and central indentations, (35–)39–46(–47) × (4.5–)5–6(–7.5) µm (n = 21), I and K/I–, 8-spored. *Ascospores* hyaline, fusiform to occasionally oblong or clavate (slightly wider above), sometimes slightly curved, apices rounded, (6.5–)8.3–10.3(–13.1) × (1.6–)2.2–2.6(–3.0) µm, l/b = (2.6–)3.5–4.5(–5.5) (n = 141), 1-septate, not or rarely slightly constricted at the septum, smooth, usually with (1–)2(–3) large guttules in each cell, non-halonate, more or less biserial and often diagonally arranged in the asci.

NOTES. – There are some discrepancies between our material and the protologue (Hawksworth 1975b), where the ascomatal setae were reported as being shorter (20–30 µm long), the interascal hyphae evanescent, the asci cylindrical and shorter (25–30 × 3.5–4 µm), and the ascospores smaller (4.5–8 × 1.5–2 µm). Our material was found on the podetia and occasionally basal squamules of *Cladonia amaurocraea*, *C. arbuscula*, *C. cornuta*, *C. gracilis*, *C. pyxidata*, *C. rangiferina*, *C. scabriuscula*, *C. stellaris*, *C. sulphurina* and *C. uncialis*. The species often occurs on moribund host thalli. Here we report *Niesslia cladoniicola* as new to the United States and Argentina. *Cladonia amaurocraea*, *C. cornuta*, *C. gracilis*, *C. scabriuscula*, *C. sulphurina* and *C. uncialis* are new host species.

Specimens examined. – **RUSSIA. KRASNOYARSK TERRITORY:** Severnaya Zemlya Archipelago, Bol'shevik Island, Mt. Bol'shaya, 78°12'N, 103°17'E, elev. 60 m, 10.viii.2000, on *C. uncialis* (bases of podetia), *N.V. Matveeva s.n.* (LE 308477); Western Sayan Mts., Ergaki Nature Park, Olen'ya River, 52°48'N, 93°15'E, elev. 1650 m, 11.vii.2010, on *C. sulphurina* (podetia), *M.P. Zhurbenko 1040* (LE 308678); Tushkanchik River, 52°47'N, 93°21'E, elev. 1150 m, 23.vii.2010, on *C. sulphurina* (podetia),

M.P. Zhurbenko 1046 (LE 308682). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Zabolochennaya River, 45°13'42.8"N, 136°31'04.5"E, elev. 150 m, 26.viii.2013, on *C. pyxidata* (basal squamules, podetia), *M.P. Zhurbenko 13159* (LE 308635). **KAMCHATKA TERRITORY:** Kamchatka Peninsula, Kronotsky Nature Reserve, Levaya Schapina River, 55°08'38"N, 159°59'24"E, elev. 370 m, 13.viii.2009, on *Cladonia* sp. (moribund podetia), *D.E. Himelbrant & I.S. Stepanchikova s.n.* (LE 308520a); **CHUKOTKA AUTONOMOUS AREA:** Innepinkul'veem River, on *C. stellaris* (podetia), 10.viii.1951, *Ababkov* (LE 308801); km 174 of road from Egvekinot to Iul'tin, 67°41'N, 178°35'W, 9.viii.1979, on *C. gracilis* (podetia), *I.I. Makarova s.n.* (LE 308823); Baranikha, 68°30'N, 168°16'E, 21.vi.1971, on *C. amaurocraea* (bases of podetia), *I.I. Makarova s.n.* (LE 308830). **U.S.A. ALASKA:** Kotzebue, 66°53'N, 162°31'W, elev. 30 m, 19.viii.2000, on *C. rangiferina* (podetia), *M.P. Zhurbenko 00121* (LE 309132); Seward Peninsula, Bering Land Bridge National Preserve, 65.3825°N, 163.7145°W, elev. 250 m, 13.vii.2002, on *C. cornuta* (moribund podetia), *T. Jorgenson s.n.* (LE 308575); Seward Peninsula, 7 km NE of Nome, Newton Peak, 64°33'21"N, 165°21'23"W, elev. 220 m, 4.ix.2001, on *C. pyxidata* (moribund podetia), *M.P. Zhurbenko 01643* (LE 308588); 7 km ESE of Nome, 64°28'44"N, 165°16'03"W, elev. 5 m, 1.ix.2001, on *C. rangiferina* (moribund podetia), *M.P. Zhurbenko 0142a* (LE 308589a); Kenai Peninsula, Chugach National Forest, 60°10'N, 149°30'W, elev. 150 m, 1.ix.2000, on *C. scabriuscula* (podetia), *M.P. Zhurbenko 00477* (LE 309133). **ARGENTINA. TIERRA DE FUEGO:** Paso Garibaldi, 54°40'S, 67°55'W, elev. 390 m, 29.ix.1969, on *C. arbuscula* (podetia), *H. Roivainen s.n.* (H).

***Niesslia keissleri* Zhurb., sp. nov.**

MycoBank #MB 819558

FIGURE 9

DIAGNOSIS. – Lichenicolous fungus. Differs from *Niesslia cladoniicola* in producing smaller, more or less immersed ascomata, typically 50–80 µm in diameter (vs. larger, superficial ascomata, 100–130 µm in diameter); setae that are typically isodiametric and usually up to 25 µm long, with a more or less rounded apex (vs. setae subulate that are more than 25 µm long, with an acute apex); narrower asci that are typically clavate with a rounded apex (vs. wider asci that are subcylindrical with a truncate apex); and wider, 0(–1)-septate ascospores that are (6.5–)9–12.5(–15) × (2–)3–4(–5) µm [vs. narrower, 1-septate ascospores that are (6.5–)8.5–10.5(–13) × (1.5–)2–2.5(–3) µm].

TYPE: **RUSSIA. Murmansk Region:** Khibiny Mts., Mt. Kukisvumchorr, 67°42'N, 33°36'E, elev. 450 m, 9.viii.1997, on *Cladonia mitis* (podetia), *M.P. Zhurbenko 9716* (LE 207224!, holotype; herb. Diederich!, isotype).

DESCRIPTION. – *Vegetative hyphae* not observed. *Ascomata* perithecioid, black, subglobose, (35–)53–77(–100) µm in diameter (n = 225), ostiolate, setose, protruding only in the ostiolar area to superficial, dispersed to occasionally adjacent. *Setae* dark reddish brown, markedly darker than the ascomatal wall, more or less isodiametric or occasionally subulate, straight to somewhat bent, slightly swollen at the base, with rounded apex, (5–)10–22(–39) × 3.5–4(–5) µm (n = 193, in water or K), not branched, wall 0.5–1 µm thick, aseptate; often exhibiting on squash mounts a characteristic dark crown around the ostiole; sometimes much reduced and almost inconspicuous under a dissecting microscope, particularly when ascomata grow on host thalli with a well-developed cortex. *Exciple* light to medium reddish brown outside (paler below), subhyaline inside, pigmentation homogeneous, K+ brownish gray, in cross-section 6–10 µm thick, composed of 3–4 layers of tangentially elongated cells, in surface view of *textura angularis*, of cells ca. 3–7 µm lengthways. *Periphyses* hyaline, ca. 5–7 µm long, septate. *Paraphyses* hyaline, filiform, slightly nodulose, apically not enlarged, 10–25 × 1–1.5(–2) µm, occasionally branched, clearly observed only in LE 207224. *Hymenial gel* I and K/I–. *Asci* clavate, obclavate or ellipsoid, rounded at the apex, usually with a short, broad stalk, with distinct tholus, occasionally with ocular chamber, (17–)22–39(–48) × (5–)6–10.5(–14) µm (n = 69, in water, BCr, I or K/I), 8-spored, BCr–, I and K/I–. *Ascospores* hyaline to light brown with age, narrowly ellipsoid or slightly wider in the upper half, (6.6–)9.1–12.3(–15.0) × (2.0–)2.8–4.2(–5.0) µm, l/b = (1.9–)2.7–3.7(–4.5) (n = 126, in water, BCr, K or K/I), 0(–1)-septate, not constricted at the septum, wall smooth or finely granulose with age, guttulate, non-halonate, irregularly 2–3-seriate in the ascus. *Anamorph* not found.

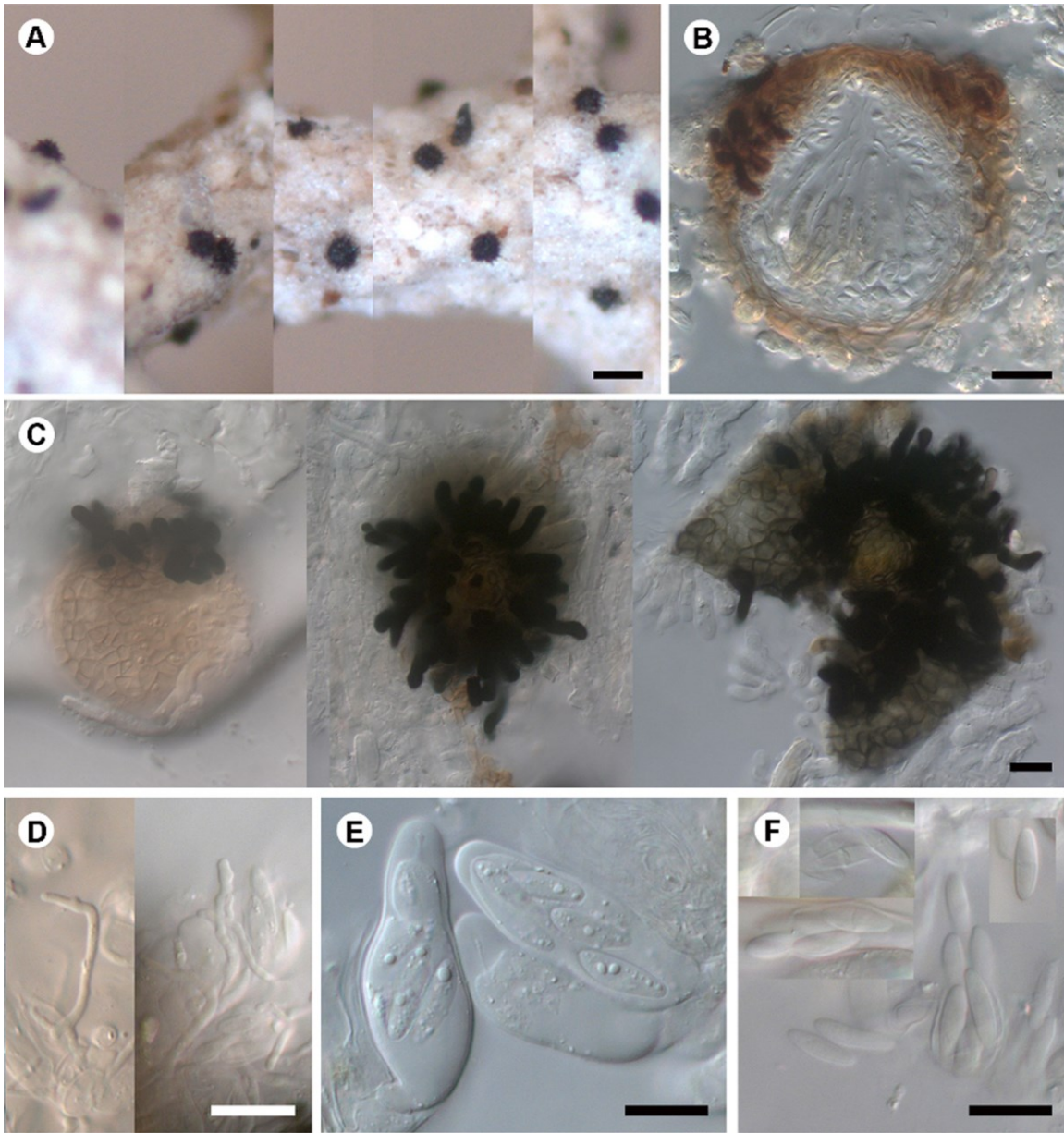


Figure 9. *Niesslia keissleri*. **A**, ascomata (LE 297219). **B**, ascoma in cross section in water (LE 308591). **C**, ascomatal setae at different stages of ascomata maturation in K (LE 308499). **D**, paraphyses in K (holotype). **E**, asci in K (LE 207219). **F**, ascospores in K (LE 308777). Scale bars: A = 100 μ m, B–F = 10 μ m.

ETYMOLOGY. – Named in honor of the eminent Austrian lichenologist and mycologist Karl von Keissler.

DISTRIBUTION AND HOSTS. – The species is widely distributed in the Holarctic and quite common, at least in its arctic and boreal regions (see Figure 15), though not known yet from the polar desert biome. We found this species mainly on podetia, often growing over their entire length up to the tips, occasionally on basal squamules, of *Cladonia amaurocraea*, *C. coccifera*, *C. cornuta*, *C. deformis*, *C. digitata*, *C. ecmocyna*, *C. furcata*, *C. gracilis*, *C. metacorallifera*, *C. mitis*, *C. cf. phyllophora*, *C. rangiferina*, *C. stellaris*, *C. stygia*, *C. sulphurina*, *C. umbricola*, *C. uncialis*, *Cladonia* spp. According to our observations

the fungus often produces rich populations and is occasionally associated with slightly bleached portions of the host thalli.

DISCUSSION. – Compared to the 13 species of *Niesslia* Auersw. so far known to be lichenicolous (Lawrey & Diederich 2016) the new species is somewhat unusual because of its more or less isodiametric setae (vs. typically subulate setae), an exciple of *textura angularis* (vs. *textura epidermoidea*), presence of paraphyses in mature ascomata, and ascospores that become occasionally pigmented and granulose with age. However, the setae of *N. keissleri* are occasionally also subulate, paraphyses have been observed in *N. cladoniicola* (see above) and in *N. tetraedrispora* Etayo (Etayo 2002), and pigmented or granulose overmature ascospores are known in *N. peltigericola* (D. Hawksw.) Etayo (Zhurbenko 2009b) and *N. pseudocypbellariae* Etayo & Diederich (Etayo 2000) respectively. A detailed comparison with *N. cladoniicola*, the second cladoniicolous species of the genus, is given in the diagnosis above and in the key below.

Without a proper morphological description and designation of a type, Keissler (1930: 330) introduced a provisional name '*Echinothecium cladoniae* nov. spec. ad interim' based on several specimens of a setose pyrenomycete from Germany growing on *Cladonia* species. Though Keissler failed to find asci and ascospores in this material, he suggested that it was congeneric with *E. reticulatum* Zopf, differing from the latter in the non-septate, larger and sinuous ascomatal setae and different host genus (*Cladonia*). The new species is probably conspecific with the material examined by Keissler. However, according to the Article 36 [see for instance Ex. 6(b)] of the *Melbourne Code* (McNeill et al. 2012) the name '*Echinothecium cladoniae* nov. spec. ad interim' is not validly published, and therefore a new species is described here. Its placement in the genus *Echinothecium* Zopf would be very doubtful, since the type of that genus, *E. reticulatum*, is quite different from *N. keissleri* and has recently been combined into another genus as *Sphaerellothecium reticulatum* (Zopf) Etayo (Etayo 2008). The latter species has well-developed, branched vegetative hyphae, that form a conspicuous dark superficial net on the host thalli. Furthermore its ascomata do not have true setae, but instead are covered by aerial septate hyphae that grow up and then fall downward, similar to net-forming vegetative hyphae (Navarro-Rosinés & Gómez-Bolea 1989: Fig. 2A, B). It should be noted that one collection cited below (*Yakovchenko s.n.*, LE 261004) was formerly identified and published as *N. cladoniicola* by Zhurbenko and Yakovchenko (2014).

Additional specimens examined. – **RUSSIA. MURMANSK REGION:** Khibiny Mts., Mt. Kukisvumchorr, 67°40'N, 33°40'E, elev. 500 m, 13.viii.1997, on *Cladonia stellaris* (podetia), *M.P. Zhurbenko 97421* (LE 308931); Kaskasnyunjok Creek, 67°46'N, 33°49'E, 18.viii.2007, on *C. stellaris* (podetia), *M.P. Zhurbenko 0766a* (LE 210308a); Ponoï, 67°04'34"N, 41°07'34"E, elev. 50 m, 6.viii.1972, on *C. amaurocraea* (podetia), *A.V. Dombrovskaya s.n.* (LE 308905). **NENETS AUTONOMOUS AREA:** Bol'shezemel'skaya tundra, Khar'yaga oilfield, 67°10'30"N, 56°37'51"E, elev. 70 m, 18.vii.2007, on *C. amaurocraea* (podetia), *M.P. Zhurbenko 0744* (LE 308505); Ortin River, 67°50'04"N, 54°04'35"E, 28.vi.1999, on *C. metacorallifera* (basal squamules, podetia), *O.V. Lavrinenko s.n.* (LE 308928); Khabuikato Lake, 68°32'14"N, 53°50'45"E, 5.vii.1999, on *C. amaurocraea* (podetia), *O.V. Lavrinenko s.n.* (LE 308933). **KOMI REPUBLIC:** Kazhym, 60°19'58"N, 51°32'00"E, 14.x.1988, on *C. digitata* (podetia), *E.N. Melekhina s.n.* (LE 308875a), 12.vii.1989, on *C. rangiferina* (old parts of podetia), *E.N. Melekhina s.n.* (LE 308854); Northern Ural, Yanyupuner Range, 62°05'N, 59°06'E, elev. 800 m, 3.vii.1997, on *C. mitis* (podetia), *M.P. Zhurbenko 97242a* (LE 210227a); 3.vii.1997, on *C. amaurocraea* (podetia), *M.P. Zhurbenko 97241a* (LE 210225a). **TYUMEN' REGION:** Polar Ural, Mt. Rai-Iz, 66°52'N, 65°05'E, elev. 700 m, 4.ix.2001, on *C. furcata* (podetia), *S.S. Kholod s.n.* (LE 308574a); Yamal Peninsula, Kharasavey, 71°10.723'N, 66°58.772'E, 20.viii.2008, on *C. gracilis* (podetia), *D.A. Walker s.n.* (LE 308569); Nadym, 65°18.9'N, 72°51.8'E, 10.viii.2007, on *C. amaurocraea* (podetia), *D.A. Walker s.n.* (LE 308506); Saletayakha River, 69°45'N, 68°40'E, 12.viii.1990, on *C. furcata* (podetia), *O.V. Rebristaya s.n.* (LE 308813). **KRASNOYARSK TERRITORY:** Gydan Peninsula, Leskino, 72°20'N, 79°30'E, 16.viii.1972, on *C. furcata* (podetia), *R.I. Yunak & G.I. Prokop'eva s.n.* (LE 308838); Western Sayan Mts., Ergaki Nature Park, Bol'shaya Baklanikha River, 52°46'N, 93°19'E, elev. 1150 m, 24.vii.2010, on neighbouring *C. coccifera* and *C. sulphurina* (podetia), *M.P. Zhurbenko 1051b* (LE 308686b); Olen'ya River, 52°48'N, 93°15'E, elev. 1500 m, 11.vii.2010, on *C. sulphurina* (basal squamules, podetia), *M.P. Zhurbenko 1045* (LE 308681); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 54°00'N, 95°29'E, elev. 1400 m, 20.vii.2009, on *Cladonia* sp. (basal squamules, occasionally podetia), *M.P. Zhurbenko 0967* (LE 308668); on *C. rangiferina* (podetia), *M.P. Zhurbenko 0945b* (LE 308652b); 53°59'N, 95°25'E, elev. 1550 m,

5.vii.2009, on *C. digitata* (basal squamules, podetia), *M.P. Zhurbenko 0947a* (LE 308654a); elev. 1400 m, 7.vii.2009, on *C. phyllophora* (basal squamules, podetia), *M.P. Zhurbenko 0946a* (LE 308653a). **REPUBLIC OF TUVA:** Todzhinskaya trough, headwaters of Dugdu River, on *C. deformis* (basal squamules, podetia), 24.vii.1999, *N. I. Molokova* (LE 210263a). **REPUBLIC OF ALTAI:** Ukok Plateau, ca. 49°18'N, 87°36'E, elev. 2400 m, 22.vii.1996, on *C. amaurocraea* (podetia), *T. Lunke 451a* (LE 308865). **TRANS-BAIKAL TERRITORY:** Sokhondinskii Reserve, Bukukunskoe Lake, 49°42.474'N, 111°04.749'E, elev. 2295 m, 24.vii.2005, on *C. furcata* (moribund podetia), *L.S. Yakovchenko s.n.* (LE 261004). **REPUBLIC OF SAKHA (YAKUTIA):** without location, 26.vii.1964, on *C. cariosa* (podetia), *V.I. Perfil'eva s.n.* (LE 308766). **KHABAROVSK TERRITORY:** Ayano-Maiskii District, Vatom River, 2.vii.1912, on *C. amaurocraea* (podetia), *F.V. Sokolov s.n.* (LE 308888b). **MAGADAN REGION:** Tal'skii pass, 61°11'N, 152°06'E, elev. 1050 m, 27.vii.1992, on *C. amaurocraea* (podetia), *M.P. Zhurbenko 92567* (LE 308901). **CHUKOTKA AUTONOMOUS AREA:** Mt. Pynei, 3.vi.1951, on *C. amaurocraea* (podetia), *I. Shmorunova s.n.* (LE 308810a); Iskaten' pass, 66°35'N, 179°10'E, tundra, 6.viii.1971, on *C. amaurocraea* (podetia), *I.I. Makarova s.n.* (LE 308807); hot springs at Gil'mymliveem River, 65°48'N, 173°15'W, 26.vii.1977, on *C. ecmocyna* (podetia), *I.I. Makarova s.n.* (LE 308777); Mt. Ioni, 65°55'N, 173°41'W, elev. 650 m, 7.vii.1977, on *C. furcata* (podetia), *I.I. Makarova s.n.* (LE 308831); Zaliv Kresta, 66°21'N, 179°06'W, 22.vii.1951, on *C. amaurocraea* (podetia), *Berezina s.n.* (LE 308794); Baran'e Lake, 66°54'N, 175°15'E, 24.vii.1980, on *C. coccifera* (podetia), *I.I. Makarova s.n.* (LE 308788); headwaters of Utesiki River, 21.viii.1948, on *C. amaurocraea* (podetia), *M.N. Avramchik s.n.* (LE 308773b), on *C. uncialis* (podetia), *M.N. Avramchik s.n.* (LE 308804). **U.S.A. ALASKA:** Great Kobuk Sand Dunes, 67°07'N, 159°03'W, elev. 40 m, 9.viii.2000, on *C. rangiferina* (podetia), *M.P. Zhurbenko 00474* (LE 309061); Fairbanks, 64°51.956'N, 147°52.494'W, elev. 170 m, 14.viii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko 04154b* (LE 309127b); 64°49.236'N, 147°45.498'W, 3.viii.2004, on *C. rangiferina* (podetia), *M.P. Zhurbenko 0476b* (LE 309053b); 64°52'N, 147°52'W, elev. 154 m, 2003, on *C. gracilis* (podetia), *T. Hollingsworth s.n.* (LE 308499); Goldstream Valley, 64°57.188'N, 147°42.775'W, 31.vii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko 0468a* (LE 309060a), 12.viii.2004, on *C. stellaris* (podetia), *M.P. Zhurbenko 04140* (LE 309056); Skyline Ridge, 64°55.270'N, 147°43.001'W, elev. 470 m, 31.vii.2004, on *C. gracilis* (podetia), *M.P. Zhurbenko 04378* (LE 309055a); on *C. cornuta* (podetia), *M.P. Zhurbenko 0449* (LE 309059); Tanana River, Bonanza Creek, 64°51.320'N, 147°49.189'W, elev. 130 m, 21.viii.2004, on *C. gracilis* (podetia), *M.P. Zhurbenko 04379* (LE 309058); on *C. cornuta* (podetia including podetial squamules), *M.P. Zhurbenko 04265a* (LE 309057a); Denali National Park and Preserve, Hinnes Creek, 63°43'N, 149°07'W, elev. 900 m, 30.viii.2000, on *C. stygia* (moribund podetia), *M.P. Zhurbenko 00304c* (LE 309147c); 30.viii.2000, on *C. sulphurina* (podetia), *M.P. Zhurbenko 00311* (LE 308591). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Spahats Creek, 51°44'23"N, 120°00'23"W, elev. 770 m, 10.vii.2002, on *Cladonia* sp. (podetia), *M.P. Zhurbenko 02281a* (LE 308727a); Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *C. cf. phyllophora* (podetia), *M.P. Zhurbenko 02155b* (LE 308704b); Columbia Mts., Beaver River, 51°15'N, 117°22'W, elev. 1150 m, 17.vii.2002, on *C. umbricola* (basal squamules, podetia), *M.P. Zhurbenko 02100b* (LE 308743); 51°18'N, 117°24'W, elev. 1100 m, 17.vii.2002, on *C. sulphurina* (podetia), *M.P. Zhurbenko 0215a* (LE 308706a).

Specimen of Echinothecium reticulatum examined for comparison: **RUSSIA. CHUKOTKA AUTONOMOUS AREA:** Lavrentiya Bay, 65°35'N, 171°00'W, boulder field in tundra, 21.vii.1973, on *Parmelia saxatilis* (thallus), *I.I. Makarova s.n.* (LE 233319).

***Opegrapha cladoniicola* Ertz & Diederich**

NOTES. – The examined material fits the protologue (Ertz & Diederich 2003) except for the ascospores, which are 3–7-transseptate (vs. 3-septate) and larger ($16.5\text{--}27.6 \times 4.1\text{--}4.9 \mu\text{m}$ vs. $14\text{--}17 \times 5\text{--}6 \mu\text{m}$ in the protologue). The species was previously known only from the type specimen collected in Hawaii on *Cladonia ochrochlora* (Ertz & Diederich 2003). Here we report it for the first time from Papua New Guinea and *Cladonia fruticulosa* is a new host.

Specimen examined. – **PAPUA NEW GUINEA. MOROBE PROVINCE:** Heads Hump, 6 km SE of Bulolo, 7°13'S, 146°42'E, elev. 1000 m, 7.iii.1982, on *Cladonia fruticulosa* (podetia), *H. Streimann 17353* (H, LE 309450).

***Pezizella ucrainica* S.Y. Kondr.**

NOTES. – The specimens examined for this study differ from the protologue as follows: the ascomata are medium orange yellow (vs. pale straw yellow) and up to 150 µm in diameter (vs. up to 270 µm in diameter), the asci are subcylindrical and slightly longer [$35\text{--}43 \times 4\text{--}6$ µm ($n = 8$, in K/I) vs. $21\text{--}27 \times 3.5\text{--}5.5$ µm], and the ascospores are slightly shorter [$5.0\text{--}6.3 \times 1.6\text{--}2.3$ µm ($n = 9$, in K/I) vs. $5\text{--}8 \times 1\text{--}2.5$ µm] (Kondratyuk & Galloway 1995). Additionally, we observed that in our material the hymenium is K/I– and the asci have a K/I+ blue apical ring, which has not been mentioned before. Kondratyuk (2010) proposed the combination *Calycina ucrainica* (S.Y. Kondr.) S.Y. Kondr., however provided no justification for this decision and thus we retain the species provisionally in *Pezizella*. Here we report the species for the first time from Asia and Russia.

Specimen examined. – **RUSSIA. PRIMORYE TERRITORY:** Sikhote-Alin' Range, Kabanii Creek, $45^{\circ}06'35''\text{N}$, $135^{\circ}52'01''\text{E}$, elev. 490 m, mixed forest, 5.ix.2013, on *Cladonia* sp. (moribund basal squamules) growing on decaying wood, *M.P. Zhurbenko 13149* (LE 264267).

***Phaeopyxis punctum* (A. Massal.) Rambold, Triebel & Coppins**

DESCRIPTION. – *Apothecia* black or sometimes medium or dark brown, shiny, initially completely immersed with concave or plane disc not protruding above the level of the host thallus, finally superficial, constricted at the base, usually more or less rounded in surface view, with plane disc and more or less distinct margin, 50–250 µm in diameter, often abundant, dispersed, sometimes contiguous; when destroyed leaving deep holes in the host thallus. *Epihymenium* medium to dark grayish red (intensifying in K), reddish brown, dark vinaceous, purplish brown or occasionally almost black, pigmentation very dense, 3–8 µm tall. *Hymenium* colorless or sometimes with scattered violet tinge, becoming light or medium reddish brown when old, 30–50 µm tall; hymenial gel I and K/I–. *Paraphyses* septate, 2–2.5 µm in diameter, sometimes up to 3 µm in diameter at the apex, occasionally branched, embedded in a transparent gelatinous substance. *Subhymenium* colorless or light reddish brown, of *textura globulosa*, up to 30 µm tall. *Exciple* cupulate, medium to dark reddish or orangish brown, blackish gray, bluish olive or olive brown, pigmentation patchy, 10–20 µm thick laterally, 15–30 µm thick basally. Grayish or purplish red tinge of the ascomatal section becomes more pronounced in K. *Asci* non-fissitunicate, clavate to occasionally subcylindrical, $(35\text{--})42\text{--}52.5\text{--}(55) \times (8\text{--})8.5\text{--}10.5\text{--}(11.5)$ µm ($n = 19$), wall evenly I+ very pale blue, K/I+ pale blue, 1–2 µm thick laterally, apically up to 3 µm thick and often slightly inwardly concave, 8-spored; the ascoplasm sometimes light reddish brown. *Ascospores* hyaline or sometimes becoming light reddish brown even within the asci, narrowly ellipsoid, $(7.2\text{--})8.6\text{--}10.2\text{--}(11.0) \times (2.7\text{--})3.1\text{--}3.5\text{--}(3.8)$ µm, l/b = $(2.2\text{--})2.6\text{--}3.2\text{--}(3.5)$ ($n = 56$, in water or I), aseptate, smooth-walled, non-halonate, diagonally biseriolate in the ascus. Subglobose, more or less immersed pycnidia 40–110 µm in diameter, with hyaline, oblong conidia rounded at the apex and truncated at the base, $(2.9\text{--})3.4\text{--}4.6\text{--}(6.4) \times (1.3\text{--})1.4\text{--}1.6\text{--}(1.8)$ µm, l/b = $(1.9\text{--})2.3\text{--}3.1\text{--}(4.1)$ ($n = 130$), were associated with the species ascomata in LE 308691a and 308874a.

NOTES. – This species was found on the podetia and/or basal squamules of *Cladonia albonigra*, *C. amaurocraea*, *C. botrytes*, *C. carneola*, *C. cenotea*, *C. chlorophaea* s. lat., *C. coniocraea*, *C. deformis*, *C. didyma*, *C. digitata*, *C. gracilis*, *C. macilenta*, *C. mitis*, *C. cf. ochrochlora*, *C. pocillum*, *C. rangiferina*, *C. stellaris*, *C. subulata*, *C. sulphurina*, *C. umbricola*, *C. ustulata* and unidentified *Cladonia* species, often growing on rotten wood. It was occasionally associated with bleached or darkened host parts, and once (in LE 308820) was found on gall-like swellings of the host thallus. This conspicuous, common and frequently reported species seems to avoid the Arctic, where it is so far known just from two finds in the tundra biome (Zhurbenko 2008, and herein). Here we report this species for the first time from Mongolia. *Cladonia albonigra*, *C. arbuscula*, *C. carneola*, *C. deformis*, *C. didyma*, *C. rangiferina*, *C. stellaris*, *C. subulata*, *C. sulphurina* and *C. ustulata* are new host species.

Specimens examined. – **FINLAND. UUSIMAA:** Vantaa, Koivukylä, 8.vi.2014, on *Cladonia mitis* (podetia), *R. Pino-Bodas s.n.* (H); **TAVASTIA PROPER:** Hämeenlinna, Lammi, $61^{\circ}05'\text{N}$, $24^{\circ}58'\text{E}$, 13.viii.2013, on *C. coniocraea* (squamules), *V. Haikonen 29409a* (H). **RUSSIA. KOMI REPUBLIC:** Kazhym, $60^{\circ}19'58''\text{N}$, $51^{\circ}32'00''\text{E}$, 14.x.1988, on *C. digitata* (podetia), *E.N. Melekhina s.n.* (LE 308875b); Northern Ural, Yanyupuner Range, $62^{\circ}05'\text{N}$, $59^{\circ}06'\text{E}$, elev. 800 m, 3.vii.1997, on *C. amaurocraea* (podetia), *M.P. Zhurbenko 97241b* (LE 210225b). **TYUMEN' REGION:** Polar Ural, Mt. Chernaya, $66^{\circ}48'\text{N}$, $65^{\circ}30'$, elev. 250 m, 28.vii.2004, on *C. amaurocraea* (podetia), *S.S. Kholod s.n.* (LE 308579).

KRASNOYARSK TERRITORY: Gydan Peninsula, Leskino, 72°20'N, 79°30'E, 1972, on *C. rangiferina* (on gall-like swellings on podetia), *R.I. Yunak & G.I. Prokop'eva s.n.* (LE 308820); Western Sayan Mts., headwaters of Sinyaya River, elev. 2350 m, 22.viii.1991, on *Cladonia* sp. (basal squamules), *V.B. Kuvaev 2104* (LE 308862); Ergaki Nature Park, Tushkanchik River, 52°47'N, 93°21'E, elev. 1150 m, 23.vii.2010, on *C. sulphurina* (basal and podetial squamules), *M.P. Zhurbenko 1049* (LE 309311); Turukhansk Region, Zotino, 61°N, 89°50'E, elev. 100 m, 21.viii.1979, on *C. botrytes* (basal squamules), *V.B. Kuvaev s.n.* (LE 308924a). **IRKUTSK REGION:** 2 km SE of Anchuk, Bol'shaya Bystraya River, 51°44'N, 103°29'E, elev. 700 m, 9.vi.2005, on *C. coniocraea* (podetial squamules), *M.P. Zhurbenko 0563a* (LE 309109); Khamar-Daban Range, Snezhnaya River, 51°23'N, 104°39'E, elev. 550 m, 17.vi.2005, on *C. digitata* (basal and podetial squamules), *M.P. Zhurbenko 05114* (LE 309108). **REPUBLIC OF BURYATIA:** SE coast of Baikal Lake, 5 km SW of Turka, 52°50'50"N, 108°00'50"E, elev. 460 m, 25.viii.2002, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 02406* (LE 309107). **TRANS-BAIKAL TERRITORY:** Sokhondinskii Reserve, Verkhniy Bukukun, 49°37'34"N, 111°02'12"E, elev. 1775 m, 23.viii.2005, on *C. stellaris* (podetia), *L.S. Yakovchenko s.n.* (LE 308544). **KHABAROVSK TERRITORY:** Ayano-Maiskii District, Vatom River, 2.vii.1912, on *C. amaurocraea* (podetia), *F.V. Sokolov s.n.* (LE 308888a). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Kabanii Creek, 45°06'35"N, 135°52'01"E, elev. 490 m, 5.ix.2013, on *C. coniocraea* (basal and occasionally podetial squamules), *M.P. Zhurbenko 13167c* (LE 308649c), *M.P. Zhurbenko 13146* (LE 308640); Sikhote-Alin' Range, Zabolochennaya River, 45°14'07"N, 136°30'34"E, elev. 160 m, 22.viii.2013, on *C. coniocraea* (basal and podetial squamules), *M.P. Zhurbenko 13163* (LE 308641); Sikhote-Alin' Range, Yasnaya River, 45°14'22"N, 136°29'22"E, elev. 160 m, 24.viii.2013, on *C. macilenta* (basal squamules), *M.P. Zhurbenko 13162* (LE 308638); Sikhote-Alin' Range, Valinku River, 46.1315°N, 136.6985°E, elev. 1450 m, 25.viii.2013, on *C. digitata* (basal and podetial squamules), *Yu.V. Gerasimova s.n.* (LE 308646); 46.2173°N, 136.6922°E, elev. 1040 m, 28.viii.2013, on *C. coniocraea* (basal and podetial squamules), *Yu.V. Gerasimova s.n.* (LE 308645). **MAGADAN REGION:** Kamennyi Range, 59°45'25"N, 149°39'18"E, elev. 9 m, viii.2013, on *C. pocillum* (basal squamules), *I.A. Galanina s.n.* (LE 308692). **KAMCHATKA TERRITORY:** Kamchatka Peninsula, Kronotsky Nature Reserve, Levaya Schapina River, 55°08'29"N, 159°58'17"E, elev. 340 m, 12.viii.2009, on *C. gracilis* (podetia), *D.E. Himelbrant & I.S. Stepanchikova s.n.* (LE 309166). **MONGOLIA. ARA-KHANGAI AIMAK:** watershed of Khukh-Sumein-Gol and Tsetserleg-Gol Rivers, Mt. Khairkhan, 47°15'N, 101°50'E, elev. 2400 m, 28.vii.1979, on *C. subulata* (basal squamules), *L.G. Biazrov 3487b* (LE 308866b); headwaters of Khukh-Sumein-Gol River, 16.vii.1971, on *C. chlorophaea* s. lat. (basal squamules), *L.G. Biazrov 1627a* (LE 308874a), 22.vii.1970, *L.G. Biazrov 1690a* (LE 308840a). **BULGAN AIMAK:** 11 km N of Bugat, 49°10'N, 103°45'E, elev. 1270 m, 27.vii.1977, on *C. coniocraea* (basal and podetial squamules), *L.G. Biazrov 6773* (LE 308847). **U.S.A. ALASKA:** Great Kobuk Sand Dunes, 67°05'N, 158°55'W, elev. 50 m, 2.viii.2000, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 0029* (LE 309310); Goldstream Valley, 64°57.188'N, 147°42.775'W, 31.vii.2004, on *C. cenotea* (podetia), *M.P. Zhurbenko 0463* (LE 309113); Fairbanks, 14.viii.2004, on *C. cenotea* (podetia), *M.P. Zhurbenko 04149* (LE 309111); Denali National Park and Preserve, Rock Creek, 63°43.35'N, 148°57.53'W, elev. 670 m, 17.viii.2004, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 04209a* (LE 309112a), 20.viii.2004, *M.P. Zhurbenko 04182* (LE 309114); Kenai Peninsula, Chugach National Forest, 60°10'N, 149°30'W, elev. 150 m, 1.ix.2000, on *Cladonia* sp. (podetial and basal squamules), *M.P. Zhurbenko 00476* (LE 309115). **CANADA. YUKON TERRITORY:** Pine Lake Campground, 60°48'13"N, 137°26'03"W, elev. 670 m, 7.vi.2011, on *C. carneola* (basal squamules), *J.C. Lendemer 29127a* (H). **BRITISH COLUMBIA:** Wells Gray Provincial Park, Mt. Trophy, 7.vii.2002, on *C. sulphurina* (basal and occasionally podetial squamules), *J. Miadlikowska s.n.* (LE 308738); Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 02165* (LE 308711); Battle Creek, elev. 750 m, 5.viii.2002, on *Cladonia* sp. (basal and podetial squamules), *M.P. Zhurbenko 02369* (LE 308708), *M.P. Zhurbenko 02370* (LE 308713); on *C. cf. ochrochlora* (basal and podetial squamules), *M.P. Zhurbenko 02368* (LE 308716), *M.P. Zhurbenko 02371* (LE 308714); Clearwater River, 51°43'16"N, 120°01'25"W, elev. 550 m, 14.vii.2002, on *C. deformis* (basal squamules), *J. Miadlikowska s.n.* (LE 308759c); Columbia Mts., Beaver River, 51°18'N, 117°24'W, elev. 1100 m, 16.vii.2002, on *C. sulphurina* (podetial squamules), *M.P. Zhurbenko 0298a* (LE 308748a); 17.vii.2002, *M.P. Zhurbenko 0215b* (LE 308706b); 51°15'N, 117°22'W, elev. 1150 m, 17.vii.2002, on *C. umbricola* (basal squamules), *M.P. Zhurbenko 02100e* (LE 308742); Mount Revelstoke National Park, Mt. Revelstoke, elev. 700 m, 19.vii.2002, on *C. albonigra* (basal and podetial squamules), *M.P. Zhurbenko 0211* (LE 308744). **SASKATCHEWAN:** Creighton, 54°49'34"N, 102°02'23"W, elev. 350 m, 24.v.2004, on *C. botrytes* (basal squamules), *T. Ahti 62967* (H). **VENEZUELA. TRUJILLO:** Páramo de Guaramacal,

elev. 2750 m, 9.viii.1975/1977, on *C. didyma* (podetial squamules), *M. López Figueiras 10227a* (H); *M. López Figueiras 10382a* (H). **NEW ZEALAND. SOUTH ISLAND:** Kahurangi National Park, Mt. Arthur, 41.19°S, 172.75°E, 16.v.2011, on *C. ustulata* (primary thallus), *S. Stenroos 6040a* (H).

***Phoma grumantiana* Zhurb. & Diederich**

NOTES. – Formerly known in the United States only from Alabama (Diederich et al. 2007), we report this species for the first time from Alaska.

Specimen examined. – **U.S.A. ALASKA:** Denali National Park and Preserve, 63°43.35'N, 148°57.53'W, elev. 650 m, mixed *Picea glauca* forest, 20.viii.2004, on *Cladonia pocillum* (basal squamules), *M.P. Zhurbenko 04169* (LE 309150).

***Plectocarpon cladoniae* R. Sant.**

NOTES. – This species has previously been reported in Russia only from the Murmansk Region and Karelia Republic (Zhurbenko & Alstrup 2004, Zhurbenko & Himelbrant 2002). Here we report it from two additional locations and report it for the first time from Asia.

Specimens examined. – **RUSSIA. REPUBLIC OF KARELIA:** coast of Kandalaksha Bay of the White Sea, 15 km of Poyakonda, 66°34'N, 33°08'E, elev. 5 m, 15.viii.1964, on *Cladonia* sp. (basal squamules), *T. Piin s.n.* (LE 308925). **TRANS-BAIKAL TERRITORY:** Kodar Range, Olenii Rog Creek, 56°47'57"N, 117°21'59"E, elev. 1674 m, 18.vi.2015, on *Cladonia* sp. (basal squamules), *L.A. Konoreva s.n.* (LE 309332a).

***Polycoccum laursenii* Zhurb.**

NOTES. – In the specimen cited below the ascospores were light to medium brown, clavate to narrowly obovate (with wider upper cell) or occasionally almost homopolar, (0–)1(–3)-septate, and (6.7–)8.4–10.6(–14.0) × (2.8–)3.7–4.7(–5.6) µm in size [l/b = (1.7–)2.0–2.6(–3.4); n = 70]. In the protologue the ascospores were reported as always being heteropolar and only 1-septate (Zhurbenko & Alstrup 2004). Previously, the species was known only from the type locality in subarctic Alaska. Here we report it for the first time from Asia and Russia.

Specimen examined. – **RUSSIA. KHABAROVSK TERRITORY:** Bol'shekhekhtsirskii Reserve, Sosnenskii Creek, 48°14'46"N, 134°46'45"E, elev. 340 m, 2.viii.2013, open boulder field in mixed forest, on *Cladonia* sp. (basal squamules, podetia), *M.P. Zhurbenko 13161* (LE 308637).

***Polycoccum microcarpum* Diederich & Etayo**

NOTES. – There are several essential discrepancies between our material and the protologue (Etayo & Diederich 1998), where this species was described as having smaller ascomata (mainly 30–60 µm in diameter), tightly aggregated in groups of 20–80 on galls induced on *Cladonia* squamules, shorter asci (30–35 × 15 µm), and ascospores without distinct ornamentation. In our material the ascomata are mainly 50–70 µm in diameter, immersed to slightly protruding and aggregated in groups, the asci are 40–50 × 12–14 µm (n = 7, in I), and the ascospores are initially hyaline, then medium brown, narrowly obovoid with a wider and sometimes longer upper cell (ratio up to 3:2), 1-septate or very exceptionally with an additional septum in the upper cell, usually constricted at the septa, verruculose, without halos, and measure (11.8–)12.9–14.9(–17.0) × (4.5–)5.0–6.2(–7.4) µm in size [l/b = (2.1–)2.3–2.7(–3.2); n = 65].

Flakus et al. (2008) also reported that some of the ascospores of this species can be verruculose and up to 17 µm long, the asci are up to 55 × 15 µm and the ascomata are up to 120 µm in diameter. *Polycoccum cladoniae* Diederich & D. Hawksw., which also occurs on *Cladonia*, has similarly sized ascospores [13.5–16.5(–22) × 6.5–8(–9) µm], which are also 1-septate and verruculose, but readily differs in having more or less superficial and much larger ascomata (100–250 µm in diameter) (Hawksworth & Diederich 1988).

We found this species on the podetia of *Cladonia gracilis* (mainly ssp. *vulnerata*) where it caused light to strong bleaching. Swellings of the host thallus and gall-formation were not observed. This is the first report of the taxon from North America.

Specimens examined. – **U.S.A. ALASKA:** Kotzebue, 66°53'N, 162°31'W, elev. 30 m, 19.viii.2000, on *Cladonia gracilis* ssp. *vulnerata* (podetia), *M.P. Zhurbenko 00233b* (LE 309149), *M.P. Zhurbenko 00243a* (LE 308592a); Great Kobuk Sand Dunes, 67°07'N, 159°03'W, elev. 50 m, 9.viii.2000, on *C. gracilis* (podetia), *M.P. Zhurbenko 00473* (LE 308512), *M.P. Zhurbenko 00180c* (LE 308507c); Seward Peninsula, near Nome, 64°28'44"N, 165°16'03"W, elev. 5 m, 1.ix.2001, on *C. gracilis* ssp. *vulnerata* (podetia), *M.P. Zhurbenko 0199b* (LE 308586); 7 km NE of Nome, Newton Peak, 64°33'21"N, 165°21'23"W, elev. 220 m, 4.ix.2001, on *C. gracilis* ssp. *vulnerata* (podetia), *M.P. Zhurbenko 0197a* (LE 308593a).

***Pronectria tibellii* Zhurb.**

NOTES. – This species is known only from a few occurrences in the United States and Russia (Alstrup et al. 2005, Zhurbenko 2009b, Zhurbenko & Alstrup 2004).

Specimen examined. – **RUSSIA. KRASNOYARSK TERRITORY:** Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 54°00'N, 95°29'E, elev. 1400 m, 20.vii.2009, on *Cladonia pocillum* (basal squamules, podetia), *M.P. Zhurbenko 0973* (LE 308673).

***Pronectria* sp.**

NOTES. – The specimen cited below is characterized by having ascomata 75–100 µm in diameter, with exposed upper parts that are light to medium reddish brown in color, walls that are orange-brown and do not change color in lactic acid. The asci are 8-spored, and the ascospores are hyaline, subfusiform, sometimes with slightly wider upper cell, smooth-walled, guttulate, and (11.0–)12.7–17.5(–19.2) × (2.7–)3.0–3.4(–3.6) µm in size [$l/b = (3.4–)3.8–5.6(–6.8)$; $n = 22$, in water or lactic acid]. It is possible that the material represents a deviating specimen of *Pronectria tibellii* with smooth and comparatively long and narrow ascospores (see notes on this species above). Further study is needed.

Specimen examined. – **RUSSIA. PRIMORYE TERRITORY:** Sikhote-Alin' Range, Mt. Lysaya, 45°00'14"N, 136°30'00"E, elev. 850 m, 2.ix.2013, on *Cladonia mitis* (podetia), *M.P. Zhurbenko 13151b* (LE 308497b).

***Protothelenella leucothelia* (Nyl.) H. Mayrhofer & Poelt**

NOTES. – This is a lichen that mainly grows on bryophytes, but also occurs on moribund thalli of other lichens, especially species of *Cladonia*. We found it on moribund podetia of *Cladonia arbuscula*, *C. mitis* and *C. stygia*.

Specimens examined. – **U.S.A. ALASKA:** Kobuk Valley Wilderness, Waring Mts., 66°59'N, 158°47'W, elev. 300 m, 31.vii.2000, on *Cladonia arbuscula* (moribund podetia), *M.P. Zhurbenko 00479* (LE 309146); Denali National Park and Preserve, Hinnes Creek, 63°43'N, 149°07'W, elev. 900 m, 30.viii.2000, on *C. stygia* (moribund podetia), *M.P. Zhurbenko 00129* (LE 308570), *M.P. Zhurbenko 00304a* (LE 309147a). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Mt. Raft, 51°44'N, 119°50'W, elev. 2100 m, 3.viii.2002, on *C. mitis* (podetia), *M.P. Zhurbenko 02349* (LE 308746).

***Protothelenella santessonii* H. Mayrhofer**

NOTES. – In the specimens examined the ascospores were usually ellipsoid to narrowly ellipsoid, with mostly acute apices, sometimes attenuated and/or with apiculi, with (0–)3–5(–7) transversal or oblique septa and usually one longiseptum in central segments, and measured (14.4–)19.4–26.0(–31.6) × (6.0–)8.3–11.3(–16.2) µm, $l/b = (1.5–)1.9–2.7(–3.4)$ ($n = 120$, measured with apiculi). This species is known from many reports on *Cladonia* species, but was also once reported on *Solorina crocea* (Alstrup & Cole 1998). Our material was found on the basal squamules and/or podetia of *Cladonia coccifera*, *C. pocillum*, *C. pyxidata*, *C. stricta*, *C. stygia* and unidentified *Cladonia* species. *Cladonia stricta* and *C. stygia* are new host species. We observed that occasionally the fungus caused distinct bleaching of the host tissues.

Specimens examined. – **NORWAY. SVALBARD:** Aldegondabreen glacier, 78°00'N, 14°12'E, elev. 50 m, 16.vii.2003, on *Cladonia* cf. *stricta* (moribund podetia), *M.P. Zhurbenko 03454* (LE 308502), 15.vii.2003; on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 03179* (LE 308578). **RUSSIA. KRASNOYARSK TERRITORY:** Severnaya Zemlya Archipelago, Bol'shevik Island, Cape Antsev,

78°13'N, 103°15'E, 7.viii.1997, on *C. coccifera* (podetia), *N.V. Matveeva s.n.* (LE 308881); Taimyr Peninsula, Uboynaya River, 73°39'N, 82°22'E, elev. 15 m, 15.viii.1990, on *C. stricta* (basal squamules, podetia), *M.P. Zhurbenko 901085a* (LE 308571a); Taimyr Peninsula, Levinson-Lessinga Lake, 74°31'N, 98°27'E, elev. 450 m, 10.viii.1995, on *C. stygia* (podetia), *M.P. Zhurbenko 95597* (LE 308908); 74°31'N, 98°36'E, elev. 200 m, 26.viii.1995, on *C. pyxidata* (basal squamules, podetia), *M.P. Zhurbenko 95600b* (LE 308920b); Western Sayan Mts., headwaters of Sinyaya River, elev. 2350 m, 22.viii.1991, on *Cladonia* sp. (basal squamules), *V.B. Kuvaev s.n.* (LE 308861); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°30'E, elev. 1500 m, on *C. pocillum* (basal squamules, podetia), 14.vii.2009, *M.P. Zhurbenko 0954* (LE 308656); 22.vii.2009, *M.P. Zhurbenko 0964* (LE 308665); 24.vii.2009, *M.P. Zhurbenko 0974a* (LE 308674a). **REPUBLIC OF BURYATIA:** Khamar-Daban Range, headwaters of Klyuchevaya River, 2.viii.1996, on *C. coccifera* (basal squamules), *I.N. Urbanavichene s.n.* (LE 308832). **TRANS-BAIKAL TERRITORY:** Kodar Range, Leprindinskoe Plateau, 56°40'00"N, 117°24'52"E, elev. 2042 m, 15.viii.2012, on *Cladonia* sp. (basal squamules), *L.A. Konoreva s.n.* (LE 309236). **U.S.A. ALASKA:** Prudhoe Bay, 1989, on *C. pocillum* (basal squamules), *C. Parker s.n.* (LE 309148).

***Pyrenidium actinellum* Nyl. s. lat.**

DESCRIPTION. – *Ascomata* 160–230 µm in diameter, subimmersed to almost sessile, sometimes aggregated on stromatic gall-like swellings up to 2 mm diameter; wall brown, K+ olive; blue-green/green pigmentation usually present near the ostiole. *Asci* 4(–5) spored. *Ascospores* ellipsoid, light to dark brown, end cells sometimes paler, (19.0–)21.3–25.7(–28.0) × (8.5–)9.2–10.8(–11.5) µm, l/b = (1.8–)2.1–2.7(–3.2) (n = 34, in water or K), (1–)3-septate, constricted at the septa.

NOTES. – This taxon was found on the podetia of *Cladonia arbuscula* s. lat., *C. squamosa* and an unidentified *Cladonia* species. It was often associated with moribund parts of the host thallus, and sometimes induced gall-like swellings. This is the first report of *Pyrenidium actinellum*, albeit in a broad sense, from Vietnam. The species has been reported on various lichen host genera that are not closely related and these are the first reports from *Cladonia*.

Specimens examined. – **PORTUGAL. AZORES ISLANDS:** Faial Island, Caldeira, 38°34'28"N, 28°41'48"W, elev. 730 m, 25.ii.2015, on *Cladonia squamosa* (blackened areas of podetia), *R. Pino-Bodas s.n.* (H). **VIETNAM. DAK LAK PROVINCE:** Chu Yang Sin National Park, 8 km W of Mt. Chu Yang Sin, 12°22'16"N, 108°21'13"E, elev. 1900 m, montane tropical forest, 23.iii.2013, on *Cladonia* sp. (podetia) growing on rock, *A.V. Alexandrova s.n.* (LE 261147). **U.S.A. ALASKA:** Tanana River, Bonanza Creek, 64°51'N, 147°49'W, elev. 130 m, 22.viii.2004, on *C. arbuscula* (over the entire length of podetia, mainly on their moribund bases), *M.P. Zhurbenko 04258* (LE 308511); Goldstream Valley, 64°57.155'N, 147°42.832'W, 12.viii.2004, on *C. arbuscula* (moribund parts of podetia), *M.P. Zhurbenko 04135a* (LE 309144a).

***Roselliniella cladoniae* (Anzi) Matzer & Hafellner**

DESCRIPTION. – *Ascomata* pyriform, 250–500 µm in diameter, superficial, basally or sometimes laterally attached to the host, covered by medium brown, remotely septate, long hyphae, protruding or descending to the host thallus surface. *Ascospores* initially hyaline, then medium brown, mainly ellipsoid, occasionally narrowly ellipsoid, oblong, ovoid, citriform or subglobose, apices rather acute to occasionally rounded, sometimes attenuated or with a small beak/apiculus, aseptate or occasionally with 1 (non-median) to exceptionally up to 4 thin septa, not constricted at the septa, (11.8–)18.2–29.0(–38.0) × (7.3–)9.8–13.2(–16.5) µm, l/b = (1.3–)1.7–2.5(–4.0) (n = 182), significantly varying in size in different specimens, usually with few large and numerous small guttules, wall smooth and thin, sometimes cracking and disintegrating into large pieces in squash mounts, occasionally with halo when immature, 4–8 per ascus, mostly diagonally uniseriate or partly biseriate in the asci.

NOTES. – A characteristic hyphomycete (Figure 10) possibly representing the anamorph of this species is sometimes associated with the ascomata. According to Matzer & Hafellner (1990), the ascospores of this taxon are mostly verruculose, (1–)2–8 per ascus, and longer (15–52 × 6–17 µm) than those reported here. We found the species on the podetia and/or basal squamules of *Cladonia arbuscula*, *C. ceratophyllina*, *C. coccifera*, *C. coniocraea*, *C. corniculata*, *C. cornuta*, *C. crispata*, *C. didyma*, *C. fimbriata*, *C. gracilis* s. lat., *C. gracilis* ssp. *turbinata*, *C. gracilis* ssp. *vulnerata*, *C. mitis*, *C. pocillum*, *C. pyxidata*, *C. rangiferina*, *C. subfurcata*, *C. sulphurina*, *C. symphyarpa*, *C. trassii* and unidentified *Cladon-*

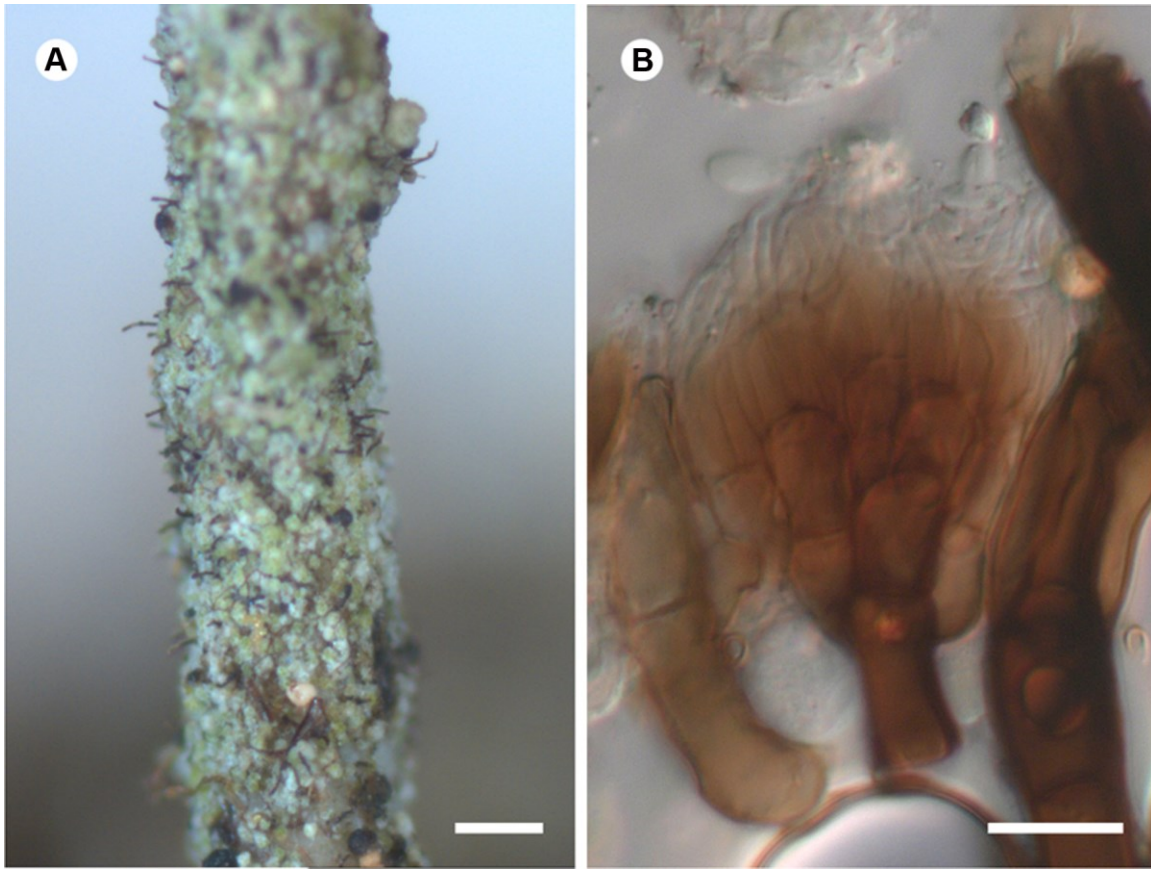


Figure 10. A hyphomycete associated with *Roselliniella cladoniae*. **A**, colonies (LE 308649a). **B**, conidiogenous head at the top of conidiophore in K (LE 308853). Scale bars: A = 200 μ m, B = 10 μ m.

-ia species. Pathogenicity was not observed. The species is widely distributed in the Holarctic including the tundra biome, but is not known from the polar desert biome. Here we report it for the first time from Finland and Venezuela. Previously it was known in Africa only from Macaronesia (Berger & Aptroot 2002, Hafellner 1996). *Cladonia ceratophyllina*, *C. corniculata*, *C. didyma*, *C. fimbriata*, *C. subfurcata*, *C. symphyocarpa* and *C. trassii* are new host species.

Specimens examined. – **CZECH REPUBLIC. SOUTH BOHEMIA:** 2 km W of Dráčov, 49°13'40"N, 14°40'04"E, elev. 440 m, 31.viii.2014, on *Cladonia rangiferina* (thallus), *J. Kocourková s.n.* (H). **FINLAND. SOUTH HÄME:** Kaivolampi, 61°06'01"N, 24°12'06"E, elev. 130 m, 18.iv.2008, on *C. gracilis* ssp. *turbinata* (podetia), *H. Väre 1863a* (H). **PÄIJÄNNE TAVASTIA:** Paistjärvi, Kärmevuori, 61°16'N, 26°21'E, 8.x.2009, on *C. mitis* (podetia), *V. Haikonen 27415a* (H). **UUSIMAA:** Sipoo, S of Sipoonkorven National Park, 60°16'12"N, 25°09'00"E, 13.xi.2014, on *C. arbuscula* (podetia), *R. Pino-Bodas s.n.* (H, with presumed anamorph); Espoo, Luukkaa Recreation Area, 60°19'N, 24°39'E, elev. 90 m, 19.ix.2014, on *C. arbuscula* (podetia), *R. Pino-Bodas s.n.* (H); Uusimaa, Helsinki, Kontula, 60°24'35"N, 25°04'07"E, 10.viii.2014, on *C. mitis* (podetia), *R. Pino-Bodas s.n.* (H). **RUSSIA. MURMANSK REGION:** Khibiny Mts., Mt. Kukisvumchorr, 67°40'N, 33°41'E, elev. 500 m, 15.viii.1997, on *C. trassii* (underside of basal squamules), *M.P. Zhurbenko 97419* (LE 308923, with presumed anamorph). **KRASNOYARSK TERRITORY:** Taimyr Peninsula, Enisey Bay, Sibiryakova Island, 72°50'N, 79°10'E, 8.vii.1989, on *C. subfurcata* (podetia), *A. Kozhevnikova s.n.* (LE 309175, with presumed anamorph); Western Sayan Mts., Ergaki Nature Park, Tushkanchik River, 52°47'N, 93°21'E, elev. 1150 m, 23.vii.2010, on *C. sulphurina* (podetia), *M.P. Zhurbenko 1039* (LE 308677). **REPUBLIC OF BURYATIA:** Khamar-Daban Range, Bol'shoi Mamai River, 29.vi.1965, on *C. gracilis* (podetia), *L.G. Burova s.n.* (LE 308853, with presumed anamorph); Dzherginskii Reserve, Dzhirga River, 54°54'14"N, 111°16'27"E, 19.vii.2002, on *Cladonia* sp. (podetia), *T.M. Kharpukskaeva s.n.* (LE 309105b). **KHABAROVSK TERRITORY:**

Bol'shekhkhtsirskii Reserve, Sosnenskii Creek, 48°14'50"N, 134°46'46"E, elev. 340 m, 2.viii.2013, on *C. coniocraea* (podetia, basal squamules), *M.P. Zhurbenko 13157* (LE 308633), 4.viii.2013, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 13156* (LE 308632). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Dal'negorsk, 44°35'48"N, 135°33'12"E, elev. 240 m, 18.viii.2013, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 13158* (LE 308634); Sikhote-Alin' Range, 2 km N of confluence of Yasnaya and Zabolochennaya Rivers, 45°15'13"N, 136°30'10"E, elev. 180 m, 27.viii.2013, on *C. pyxidata* (podetia), *M.P. Zhurbenko 13166* (LE 308644); Sikhote-Alin' Range, Kabanii Creek, 45°06'35"N, 135°52'01"E, elev. 490 m, 5.ix.2013, on *C. coniocraea* (basal squamules, podetia), *M.P. Zhurbenko 13167a* (LE 308649a, with presumed anamorph), *M.P. Zhurbenko 13148* (LE 308639); Sikhote-Alin' Range, Iman River, 3 km W of Glubinnoe, 46°04'N, 135°23'E, 31.viii.1946, on *C. gracilis* (podetia), *M.V. Korchaginy & A.A. Korchaginy s.n.* (LE 308768a). **KAMCHATKA TERRITORY:** Kamchatka Peninsula, Kronotsky Nature Reserve, Levaya Schapina River, 55°08'38"N, 159°59'24"E, elev. 370 m, 13.viii.2009, on *Cladonia* sp. (moribund podetia), *D.E. Himelbrant & I.S. Stepanchikova s.n.* (LE 308520b). **MONGOLIA. ARA-KHANGAI AIMAK:** watershed of Khukh-Sumein-Gol and Tsetserleg-Gol Rivers, Mt. Khairkhan, 47°15'N, 101°50'E, elev. 2200 m, 28.viii.1979, on *C. cornuta* (darkened bases of podetia), *L.G. Biazrov 3328* (LE 308563). **U.S.A. ALASKA:** Seward Peninsula, Quartz Creek, 65.4279°N, 164.614°W, 24.vii.2012, on *C. coccifera* (podetia, basal squamules), *A. Breen 2012129* (LE 308508); Gates of the Arctic National Park and Preserve, 67.3213°N, 53.4694°W, elev. 1 m, 7.viii.2008, on *C. pocillum* (bleached basal squamules), *T. Loomis s.n.* (LE 308565a); Kotzebue, 1961, on *C. coccifera* (basal squamules), *B. Neiland* (LE 309116); 66°53'N, 162°31'W, elev. 30 m, 19.viii.2000, on *C. gracilis* ssp. *vulnerata* (podetia), *M.P. Zhurbenko 00213* (LE 308562), *M.P. Zhurbenko 00233c* (LE 309122, with presumed anamorph), *M.P. Zhurbenko 00243b* (LE 308592b); Great Kobuk Sand Dunes, 67°06'N, 159°02'W, elev. 40 m, 4.viii.2000, on *C. symphyocarpa* (underside of basal squamules), *M.P. Zhurbenko 00119b* (LE 309041b); 8.viii.2000, *M.P. Zhurbenko 00472* (LE 308480); 9.viii.2000, on *C. gracilis* (podetia), *M.P. Zhurbenko 00104* (LE 309123), *M.P. Zhurbenko 00180a* (LE 308507a, with presumed anamorph); on *C. rangiferina* (podetia), *M.P. Zhurbenko 00249* (LE 309119, with presumed anamorph); Goldstream Valley, 64°57'N, 147°43'W, 31.vii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko 0464* (LE 309120, with presumed anamorph), *M.P. Zhurbenko 0469* (LE 309128); on *C. crispata* (podetia), *M.P. Zhurbenko 0462* (LE 309130, with presumed anamorph); Fairbanks, 64°52'N, 147°52'W, elev. 170 m, 14.viii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko 04154a* (LE 309127a); on *C. arbuscula* (podetia), *M.P. Zhurbenko 04145* (LE 309124, with presumed anamorph); 64°54'N, 147°49'W, 15.viii.2004, on *C. gracilis* (podetia), *M.P. Zhurbenko 04160* (LE 309121); Tanana River, Bonanza Creek, 64°51'N, 147°49'W, elev. 150 m, 21.viii.2004, on *C. fimbriata* (podetia), *M.P. Zhurbenko 04260* (LE 309129, with presumed anamorph); on *C. gracilis* (podetia), *M.P. Zhurbenko 04267* (LE 309126), 25.viii.2004; on *C. cornuta* (podetia), *M.P. Zhurbenko 04275a* (LE 309125a); on *C. pocillum* (basal squamules), *M.P. Zhurbenko 04279* (LE 309131). **FRANCE (OVERSEAS DEPARTMENT). RÉUNION:** NE of Bourg-Murat, Col de Bellevue, 21.1780°S, 55.5801°E, elev. 1617 m, 9.ix.2009, on *C. ceratophyllina* (podetia), *F. Schumm & J.-P. Frahm 15184 s.n.* (H). **VENEZUELA. MÉRIDA:** Páramo de Guaraque vía Tovar-Guaraque, 8°10'N, 71°46'W, elev. 2400 m, 31.iii.1980, on *C. didyma* (podetia), *M. López Figueiras 22747a* (H). **NEW ZEALAND. SOUTH ISLAND:** Wilderness Scientific Reserve, 45.532°S, 167.856°E, 6.v.2010, on *C. corniculata* (podetia), *S. Stenroos 5769a* (H).

***Sclerococcum crassitunicatum* Zhurb., Diederich & U. Braun, sp. nov.**

Mycobank #MB 819559

FIGURE 11

DIAGNOSIS. – Lichenicolous fungus. Morphologically similar to *Sclerococcum aptrootii*, but distinguished by having persistently aseptate and larger conidia, 7.5–9.5 × 6.5–8 µm (vs. 5–6.5 × 4–5 µm in *S. aptrootii*), with a much thicker wall up to 2 µm wide, never forming distinct chains, and a different host, *Cladonia* vs. *Fissurina*.

TYPE: **U.S.A. ALASKA:** Skyline Ridge, 10 km N of Fairbanks, 64°55.270' N, 147°43.001' W, elev. 470 m, *Picea mariana* forest, 31.vii.2004, on thalli and apothecia of *Cladonia gracilis*, *M.P. Zhurbenko 0450a* (LE 309173!, holotype; herb. Diederich!, isotype).

DESCRIPTION. – *Vegetative hyphae* pale brown, immersed in the host thallus. *Conidiomata*

sporodochioid, dark brown to blackish, usually more or less pulvinate or occasionally flattened to host thallus level, (40–)60–120(–180) μm in diameter ($n = 59$) and up to 90 μm tall, usually originating from cupuliform depressions of the host thallus 40–130 μm in diameter, 20–80 μm deep; distinct conidiomatal wall not developed, but surrounding host tissues forming a pale to medium brown layer 10–20(–40) μm thick; dispersed to occasionally gregarious. *Conidiophores* little differentiated, micronematous, arising from supporting hypha of tightly adhering compact ‘parenchymatous’ sporodochioid hyphal aggregations, few-celled or reduced to conidiogenous cells measuring (4.6–)5.4–7.6(–9.5) \times (3.3–)4.0–6.0(–7.8) μm ($n = 20$), differentiation between hyphae and conidiophores difficult to distinguish. *Conidia* formed from hyaline, thick-walled conidiogenous cells integrated in a ‘parenchymatous’ cell mass presumably by budding; under maturation becoming light to medium olive gray (olive brown in K), mostly subglobose, sometimes broadly ellipsoid, ovoid, oblong with truncate ends, triangular, quadrangular, pentangular in surface view or irregularly shaped, rarely with an apiculus-like projection, (6.0–)7.4–9.6(–12.8) \times (4.3–)6.5–8.1(–9.6) μm , $l/b = (1.0\text{--})1.1\text{--}1.3(1.7)$ ($n = 153$), aseptate, formed singly, neither in distinct chains nor in groups, with smooth or at least sometimes minutely verruculose ($\times 1000$, DIC), 1.2–2.0 μm thick wall (thus reminiscent of chlamydosporous conidia), usually composed of two distinct layers visible in light microscopy, sometimes with large guttules clearly seen in K, glued together in cirrhous-like aggregations on the host surface.

ETYMOLOGY. – The epithet refers to the remarkably thick-walled conidia of the fungus.

DISTRIBUTION AND HOSTS. – The new species is known only from the type collection that was made in the boreal forest (taiga) biome of North America (Alaska), growing on thalli and apothecia of *Cladonia gracilis* and *C. cornuta*. Pathogenicity was not observed.

DISCUSSION. – The conidiogenesis of *Sclerococcum* Fr. species is considered to be mono- to polyblastic or possibly “meristem thallic” (Seifert et al. 2011). Without cultures, it is difficult to discern details of the conidiogenesis of the new cladoniicolous species. However, the conidiogenous cells presumably give rise to conidia by budding, which is supported by the observation of presumed conidiogenous cells with small neck-like projections suggesting conidial formation by cell budding. Hence, the conidiogenesis of the new species on *Cladonia* coincides with the principle processes of conidial formation of species assigned to *Sclerococcum* and can be assigned to this genus in its current circumscription, irrespective of whether the genus is monophyletic or polyphyletic.

Due to the aseptate, smooth-walled conidia, the new species is similar to *Sclerococcum simplex* D. Hawksw. (confined to corticolous *Pertusaria* species) and *S. aptrootii* Diederich (growing on *Fissurina* species). However, these two species are readily distinguished by their indistinctly catenate, medium to dark brown, smaller conidia [(3.5–)4–7(–8) μm in diameter and (4.5–)5.0–6.3(–7.2) \times (4.0–)4.1–5.0(–5.7) μm , respectively] with thinner walls, occasionally provided with a single septum, and in occurring on different hosts (Diederich 2015, Hawksworth 1979). Additionally, *S. simplex* differs in having larger, often confluent sporodochia [(50–)100–300 μm in diameter]. *Sclerococcum epicladonia*, also described from *Cladonia* in this contribution, is quite distinct because of its brown, multi-celled, comparatively thin-walled conidia. *Cladophialophora cladoniae* (syn. *Sclerococcum cladoniae* Diederich) develops similar, minuscule conidiomata on the thallus of *Cladonia* species, but is distinguished by its much smaller, thin-walled, indistinctly catenate conidia that are 2.2–3 μm in diameter (Diederich 2010, Diederich et al. 2013).

The new species also recalls the lichenicolous genera *Caeruleoconidia*, *Coniambigua*, *Epaphroconidia*, *Katherinomyces* Khodos. and *Nigropuncta* D. Hawksw. Comparison with their type species reveals the following differences. *Caeruleoconidia ochrolechia* occurs on *Ochrolechia* species and differs in having conidiomata with a lateral ring-like rudimentary wall and greenish blue, 0(–1)-septate, smooth-walled conidia (Zhurbenko et al. 2015a). *Coniambigua phaeographidis* Etayo & Diederich is confined to *Phaeographis* species and strongly resembles *S. crassitunicatum*. While its conidiogenesis is difficult to interpret, the distinct conidiophores observed in the new species are not present in that taxon (Etayo & Diederich 1995). *Epaphroconidia hawksworthii* Calatayud & V. Atienza occurs on species of *Pertusaria* and is distinguished from the new species by its pycnidial conidiomata with bluish green walls, enteroblastic conidiogenesis, and much larger, hyaline conidia (Calatayud & Atienza 1995). *Katherinomyces cetrariae* Khodos., recently described from *Cetraria aculeata*, is distinct by its pycnidium-like conidiomata, poorly developed conidiophores, consisting of 1–2 cells, and brown conidia, sometimes forming short chains (Khodosovtsev et al. 2016). *Nigropuncta rugulosa* D. Hawksw. confined to species of

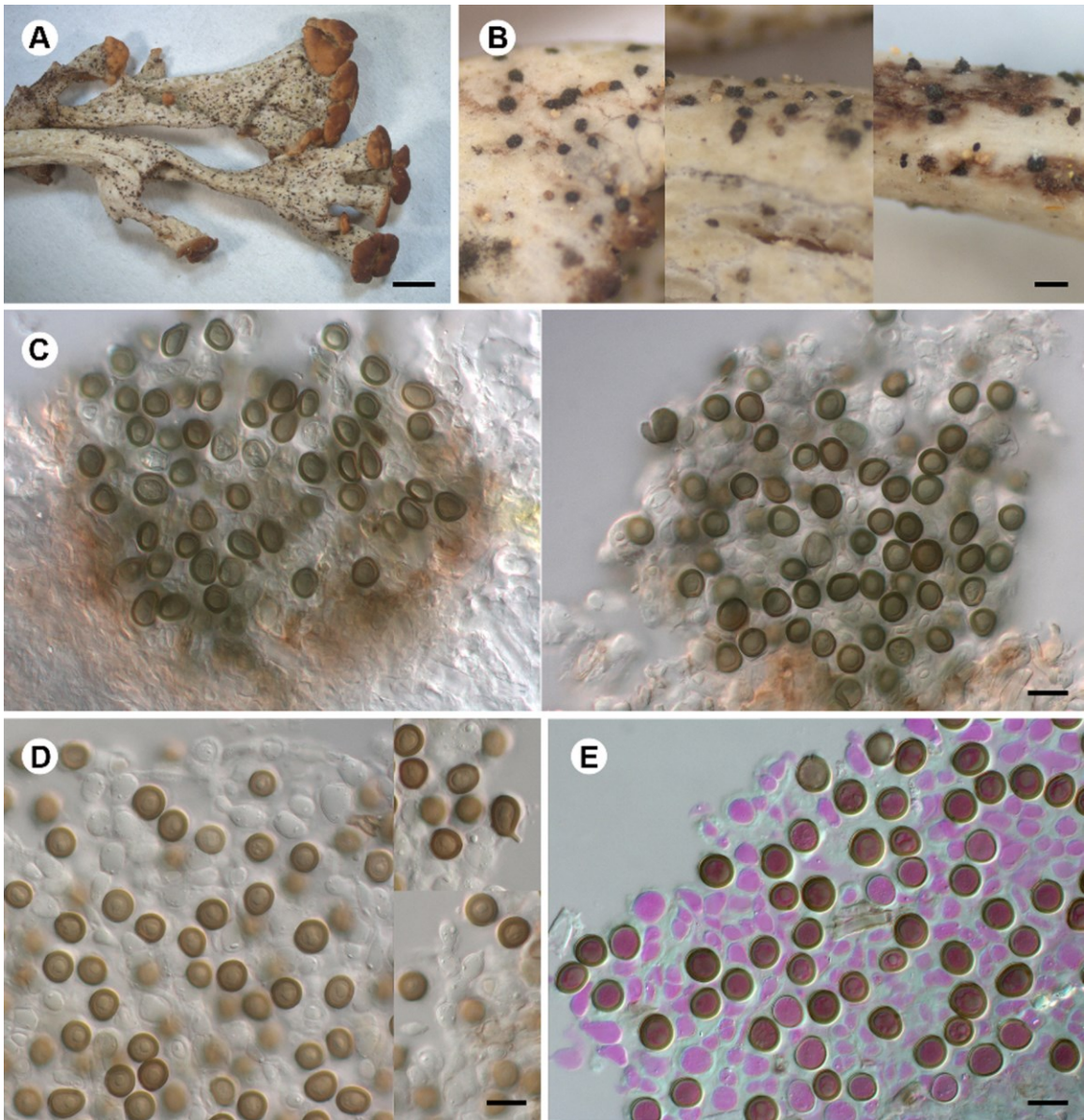


Figure 11. *Sclerococcum crassitunicatum* (all from the holotype). **A & B**, infections on the host surface. **C**, conidiomata in cross section in water. **D**, conidiomata in cross section in K; note presumable budding of the conidia and a conidium with an apiculus-like projection. **E**, conidiomata in cross section in Phloxine B after 10% KOH pre-treatment. Scale bars: A = 2 mm, B = 200 μ m, C–E = 10 μ m.

Bellemeria resembles the new species in such characters as having a blackish cirrus, an indistinct conidiomatal wall and thick-walled conidia of a similar color, but clearly differs in having pycnidial conidiomata, a distinctly thallic conidiogenesis and conidia that are mainly 1–2-celled or sometimes multi-celled, with a granular-lacerate wall, arising in short chains (Hawksworth 1981).

Additional specimen examined. – Same locality as type, on *Cladonia cornuta* (podetia), M.P. Zhurbenko 0450b (LE 309453, paratype).

Sclerococcum epicladonia Zhurb., sp. nov.

MycoBank #MB 819560

FIGURE 12

DIAGNOSIS. – Lichenicolous fungus. Morphologically similar to *Sclerococcum sphaerale*, but distinguished mainly by the loose versus compact sporodochia, the approximately 2–50-celled rather than 2–9-celled conidia that are longer (up to 30 µm long), and occurrence on *Cladonia* rather than *Pertusaria*.

TYPE: **RUSSIA. KRASNODAR TERRITORY:** Caucasus, Mt. Armovka, 43°54'18"N, 40°39'43"E, elev. 1700 m, mixed forest, 1.ix.2014, on *Cladonia chlorophaea* (podetia), *M.P. Zhurbenko 14481a* (LE 309449a!, holotype).

DESCRIPTION. – *Vegetative hyphae* hyaline to light brown, ca. 1.5–2.5 µm wide, septate, occasionally branched, immersed in the host thallus. *Colonies* dark brown to mostly almost black, aggregated in dispersed to contiguous, loose, superficial sporodochia (20–)43–145(–260) µm in diameter (n = 42). *Conidiophores* hyaline to light brown, semi-macronematous, formed by a chain of single or occasionally double, subglobose or elongated cells, constricted at the septa, 2.2–4(–6.5) µm in diameter, not or occasionally branched. *Conidiogenous cells* subhyaline to light brown, monoblastic or occasionally polyblastic, integrated, terminal, determinate, more or less doliiform, often somewhat tapering downwards, (2.7–)3.3–4.9(–5.8) × (2.6–)2.8–4.0(–4.4) µm (n = 14, in K), not very distinct. *Conidia* light to mainly medium brown, K+ olive, dry, acrogenous, irregularly subglobose to irregularly elongated, sometimes indistinctly lobed, composed of two to ca. 50 cells (single cells also rarely observed in squash mounts), with individual cells (3.4–)3.6–4.8(–5.7) × (2.1–)2.7–3.9(–4.4) µm (n = 32), in total (5.4–)7.2–18.4(–30.0) × (3.4–)5.7–13.7(–23.5) µm, l/b = 1.0–1.6(–2.3) (n = 159, in water or K), sizes depending on the number of cells, as presented in Table 1, the largest conidia disintegrating in squash preparations in K into fragments, occasionally in short chains when few-celled, with evenly thickened and evenly colored smooth wall ca. 0.5–0.8 µm thick, not splitting at maturation.

ETYMOLOGY. – The epithet refers to the host lichen genus *Cladonia*.

DISTRIBUTION AND HOSTS. – The new species is known from two specimens collected in mountain forests of Asia (the Caucasus and Sayan Mountains), where it grew on the podetia and basal squamules of *Cladonia chlorophaea* and *C. coniocraea*. Distinct pathogenicity was not observed.

DISCUSSION. – At present the genus *Sclerococcum* includes 13 species of lichenicolous fungi confined to particular host genera, none of which is known to grow on *Cladonia* (Lawrey & Diederich 2016). Among those species only *S. epiphytorum* Diederich (which occurs on *Varicellaria hemisphaerica*), *S. serusiauxii* Boqueras & Diederich (which occurs on *Parmelina* spp.) and *S. sphaerale* (Ach.) Fr. (the generic type, which occurs on *Pertusaria* spp.) are also characterized by smooth-walled multi-celled conidia like those of the new species (Diederich 2015). *Sclerococcum epiphytorum* is distinguished from *S. epicladonia* by its smaller (9–15 × 6–10 µm), 2–7-celled, sometimes finely verruculose conidia (Diederich 1990). *Sclerococcum serusiauxii* differs in having conidia with unevenly thickened walls and well-delimited darker regions (Boqueras & Diederich 1993). Finally *S. sphaerale* differs in having 2–6(–9)-celled, smaller conidia [(8–)10–15(–17) µm in length], with larger individual cells [mainly (4–)6–10 µm in diameter] (Hawksworth 1975a). Additionally, the aforementioned species can be distinguished from *S. epicladonia* by their compact sporodochia and different host selection. *Sclerococcum crassitunicatum*, the other species of the genus growing on *Cladonia* that is also described here, is readily distinguishable from *S. epicladonia* by its olive gray, aseptate, thick-walled conidia. *Sclerococcum epicladonia* is also reminiscent of lichenicolous species of *Cladophialophora* Borelli, including *C. cladoniae* that occurs on *Cladonia*. Members of the genus have quite loose sporodochia as well, but clearly differ from the new species in having aseptate or 1-septate, sometimes ornamented conidia (Diederich et al. 2013).

Additional specimen examined. – **RUSSIA. REPUBLIC OF BURYATIA:** Eastern Sayan, Tunka Mts., near Arshan, Kyngarga River valley, 51°56'N, 102°25'E, elev. 900 m, taiga forest, 11.vi.2005, on *Cladonia coniocraea* (basal squamules, mainly underside), *M.P. Zhurbenko 0525* (LE 309451).

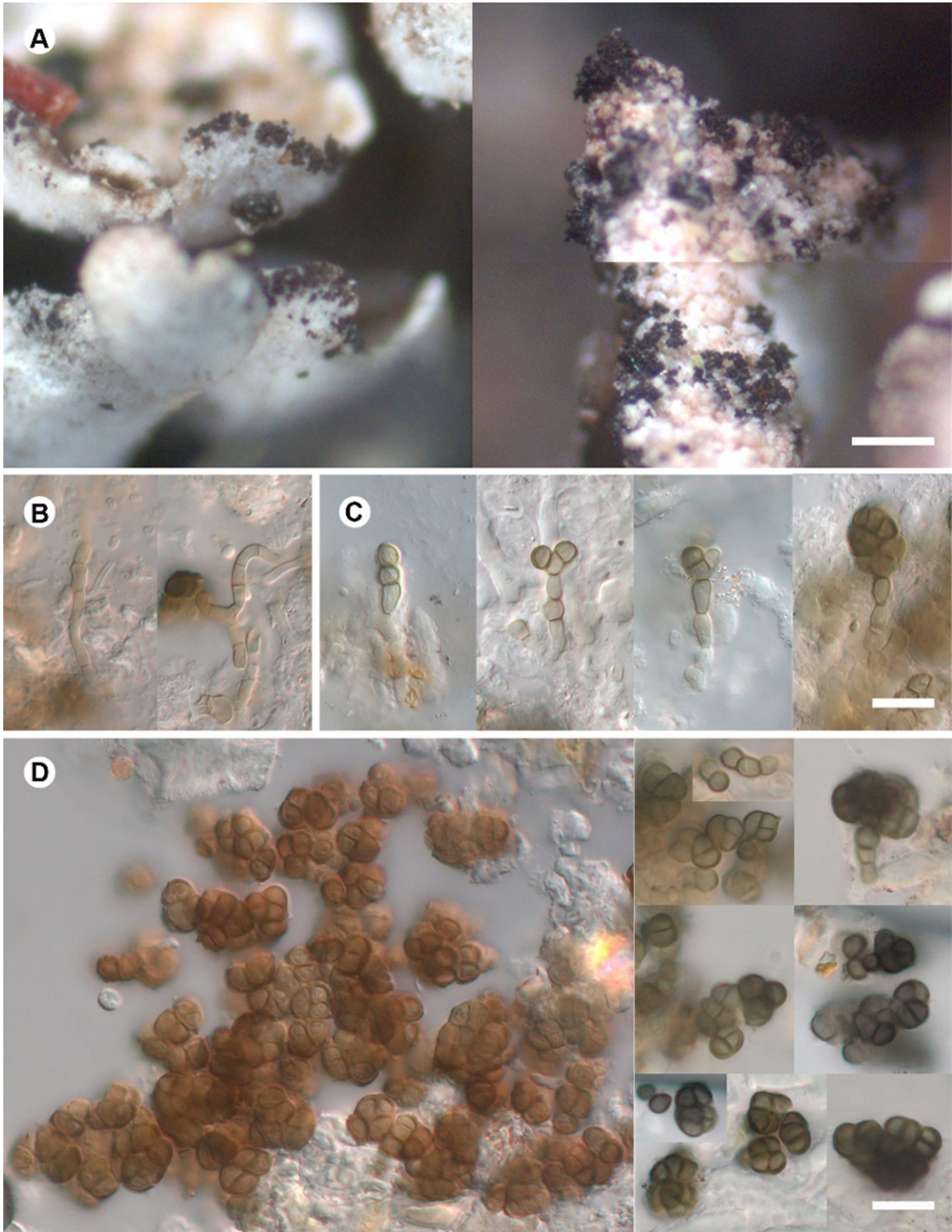


Figure 12. *Sclerococcum epicladonia*. **A**, colonies (left, LE 309451; right, holotype). **B**, vegetative hyphae in K (LE 309451). **C**, conidiophores and conidiogenous cells with conidia in K (LE 309451). **D**, conidia in water (left, LE 309451) and in K (right, holotype). Scale bars: A = 200 μm, B–D = 10 μm.

Cells per conidium	Length (µm)	Breadth (µm)	Length/ breadth ratio	Measurements (in water or K)
2	(5.4–)5.9–7.3(–8.1)	(3.4–)3.7–5.3(–6.5)	(1.2–)1.3–1.7(–2.0)	14
3–5	(5.6–)6.3–8.7(–11.0)	(4.4–)5.2–7.0(–8.1)	1.0–1.4(–1.6)	31
6–10	(8.0–)9.3–13.1(–15.0)	(6.0–)7.3–10.7(–12.2)	1.0–1.6(–2.1)	32
11–15	(12.1–)12.4–16.2(–18.2)	(9.2–)10.0–12.8(–14.0)	1.1–1.5(–1.6)	17
16–50	(16.0–)17.7–24.9(–30.0)	(10.7–)13.1–19.1(–23.5)	(1.0–)1.1–1.5(–1.9)	25

Table 1. Sizes of conidia of *Sclerococcum epicladonia* depending on the number of cells per conidium.

***Sphaerellothecium cladoniae* (Alstrup & Zhurb.) Hafellner**

NOTES. – This species was found on the basal squamules, and rarely podetia, of *Cladonia* cf. *cariosa*, *C. coccifera*, *C. ochrochlora*, *C. pocillum* (most occurrences), *C. pyxidata* and unidentified *Cladonia* species. The infected parts of the host were sometimes bleached. It is widely distributed in the Holarctic including the polar desert biome (Zhurbenko & Alstrup 2004). This is the first report from Kazakhstan and *C. ochrochlora* is a new host species.

Specimens examined. – **NORWAY. TROMS COUNTY:** Skibotndalen Valley, 69°19.6'N, 20°21.2'E, elev. 50 m, 6.viii.2003, on *Cladonia pocillum* (basal squamules), *M.P. Zhurbenko 036* (LE 309158). **RUSSIA. MURMANSK REGION:** Barents Sea coast, Olenka River mouth, 69°02'N, 36°24'E, elev. 50 m, 5.ix.1997, on *C. coccifera* (basal squamules), *M.P. Zhurbenko 97418* (LE 308921). **REPUBLIC OF ADYGEYA:** Caucasus, Mt. Tybga, 43°52'48" N, 40°15'59" E, elev. 2480 m, 5.viii.2014, on *C. coccifera* (basal squamules), *M.P. Zhurbenko 14435* (LE 309443); Mt. Ekspeditsiya, 43°55'N, 40°16'E, elev. 2000 m, 9.viii.2014, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 14291* (LE 308625), 6.viii.2014, on *C. pocillum* (basal squamules), *A.A. Kobzeva 1486* (LE 308628). **KRASNODAR TERRITORY:** Caucasus, Mt. Armovka, 43°52'28"N, 40°39'20"E, elev. 2250 m, 31.viii.2014, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 14293* (LE 308627); 30.viii.2014, on *C. pyxidata* (basal squamules), *M.P. Zhurbenko 14292* (LE 308626); Lagonaki Upland, Mt. Fisht, 43°57'08"N, 39°55'42"E, elev. 1640 m, 19.viii.2014, on *Cladonia* sp. (basal squamules), *A.A. Kobzeva 1482* (LE 308629); on *C. pocillum* (basal squamules), *A.A. Kobzeva 1479* (LE 308630); between Mt. Fisht and Mt. Pshekho-Su, 43°58'36"N, 39°53'38"E, elev. 2050 m, 21.viii.2014, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 14403* (LE 309444); on *C. pocillum* (basal squamules, occasionally podetia), *M.P. Zhurbenko 14402* (LE 309445). **KRASNOYARSK TERRITORY:** Taimyr Peninsula, Aya-Turku Lake, 73°50'N, 92°10'E, on *C. pocillum* (basal squamules), 14.viii.1975, *M.V. Sokolova s.n.* (LE 308696); Putorana Plateau, Kapchuk Lake, 69°29'N, 91°00'E, elev. 1000 m, 13.viii.1983, on *C. pyxidata* (basal squamules), *M.P. Zhurbenko 83161c* (LE 207221c); on *C. cf. cariosa* (basal squamules), *M.P. Zhurbenko 83162* (LE 207220); Western Sayan Mts., Ergaki Nature Park, Bol'shaya Baklanikha River, 52°46'N, 93°19'E, elev. 1150 m, 24.vii.2010, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 1048* (LE 308683); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°31'E, elev. 1500 m, 4.vii.2009, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 0943* (LE 308650); 14.vii.2009, *M.P. Zhurbenko 0957* (LE 308659); 20.vii.2009, *M.P. Zhurbenko 0963* (LE 308664); 22.vii.2009, *M.P. Zhurbenko 0966a* (LE 308667a); 24.vii.2009, *M.P. Zhurbenko 0974c* (LE 308674c). **REPUBLIC OF ALTAI:** Ukok Tableland, ca. 49°18'N, 87°36'E, elev. 2400 m, 6.viii.1996, on *C. coccifera* (basal squamules), *T. Lunke 532* (LE 308889). **REPUBLIC OF BURYATIA:** Tunka Mts., Arshan, 51°56'N, 102°25'E, elev. 1080 m, 11.vi.2005, on *C. pocillum* (basal squamules, partly bleached), *M.P. Zhurbenko 0518* (LE 309156). **TRANS-BAIKAL TERRITORY:** Kodar Range, Sul'ban River, 56°50'12"N, 117°17'21"E, elev. 1655 m, 14.vi.2015, on *C. cf. pyxidata* (basal squamules), *S.V. Chesnokov s.n.* (LE 309231). **REPUBLIC OF SAKHA (YAKUTIA):** Tiksi, 71°37'N, 128°54'E, elev. 70 m, 18.vii.1998, on *Cladonia* sp. (moribund basal squamules), *M.P. Zhurbenko 98416b* (LE 308912b); confluence of Indigirka and In'yali Rivers, 65°10'N, 143°10'E, 16.vi.1976, on *C. pyxidata* (basal squamules), *I.I. Makarova s.n.* (LE 308887). **KAZAKHSTAN.** Central Tyan'-Shan' Mts., Turgen'-Aksu River, 25.vii.1979, on *C. pocillum* (basal squamules), *L.I. Bredkina 2831* (LE 308858); Central Tyan'-Shan' Mts., Kuilyu River, 27.vii.1979, on *C. pocillum* (basal squamules), *L.I. Bredkina 2926* (LE 308852). **MONGOLIA. ARA-KHANGAI AIMAK:** watershed of Khukh-Sumein-Gol and Tsetserleg-Gol Rivers, Mt. Khairkhan, 47°15'N, 101°50'E, elev. 2000 m, 1.viii.1979, on *C. ochrochlora* (basal squamules), *L.G. Biazrov 3555* (LE 308859). **U.S.A. ALASKA:** Gates of the Arctic National Park and Preserve, 67.3213°N, 53.4694°W, 7.viii.2008, on *C. pocillum* (basal squamules), *T. Loomis s.n.* (LE 308565b); Denali

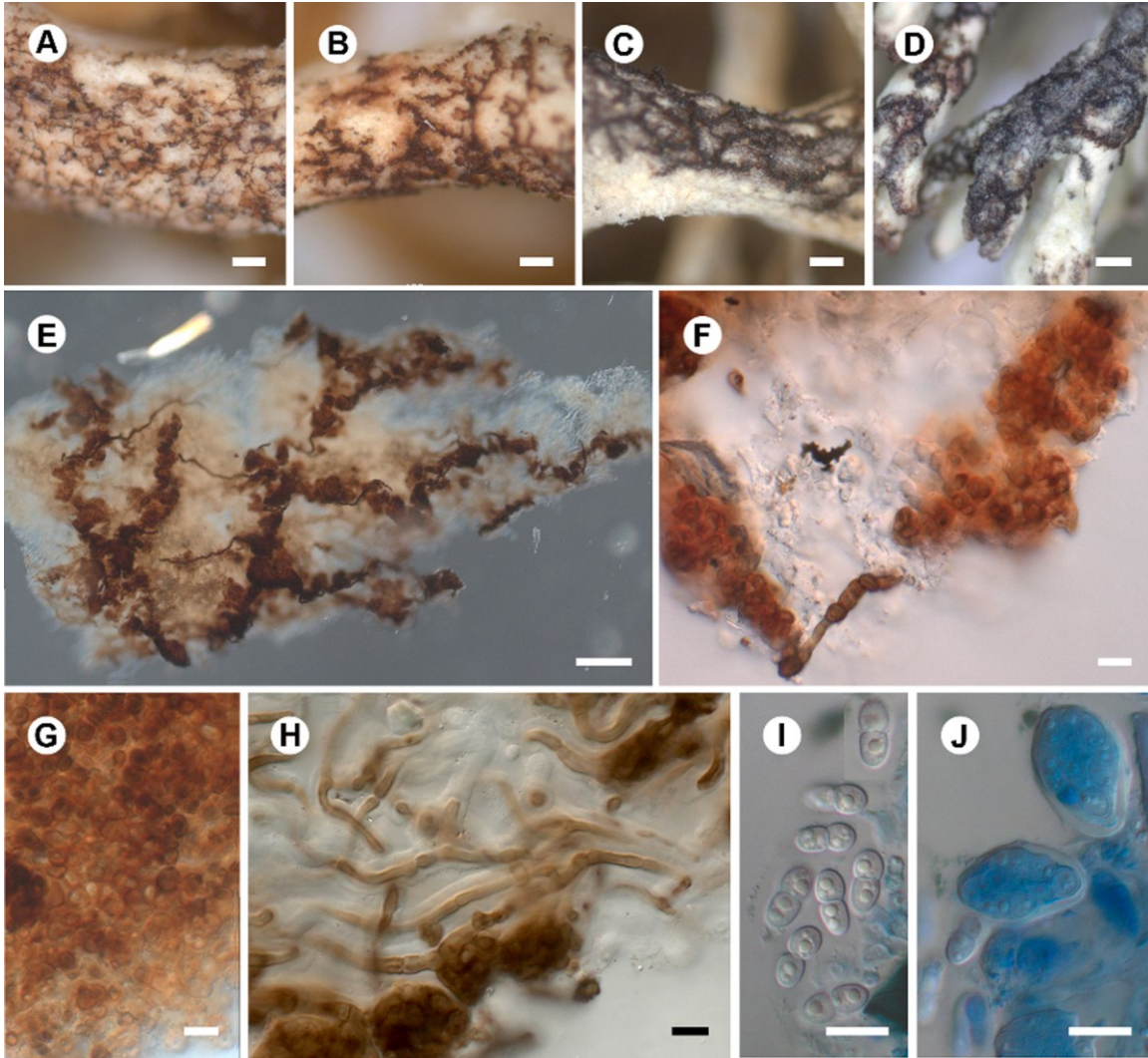


Figure 13. *Sphaerellothecium cladoniicola* (A and B from LE 308584; C, D, F and G from LE 308493; E from LE 308564; H–J from LE 308491). **A–D**, infections with different degrees of development of dark stripes on the host surface. **E–G**, squashed sections of the host podetia in water, showing dark stripes and vegetative hyphae. **H**, vegetative hyphae occasionally growing inside hyphae of the host thallus in K. **I**, ascospores in BCr. **J**, asci in BCr. Scale bars: A–D = 200 μ m, E = 50 μ m, F–J = 10 μ m.

Highway, 64°04'N, 147°27'W, elev. 850 m, 3.ix.2000, on basal squamules of neighbouring *C. coccifera* and *C. pocillum*, M.P. Zhurbenko 00265a (LE 309157). **CANADA. BRITISH COLUMBIA:** Kamloops, 50°40'N, 120°09'W, elev. 400 m, 25.vii.2002, on *C. pyxidata* (basal squamules, podetia), M.P. Zhurbenko 02124 (LE 308732).

***Sphaerellothecium cladoniicola* E.S. Hansen & Alstrup**

FIGURE 13

DESCRIPTION. – *Vegetative hyphae* mostly superficial, sometimes distinctly elevated above the host surface, appearing dark brown by reflected light, branched, medium brown to olive brown in transmitted light, often associated with conspicuous medium to dark brown or almost black, branched, flexuose stripes 40–80 μ m wide (stripes composed of aggregations of medium to dark reddish brown subglobose cells of unclear origin, usually more or less protruding over the host thallus surface, sometimes becoming crest-like, and occasionally fuseed in irregular patches), strongly flexuose, mainly one cell thick, single cells (5.0–)5.7–10.3(–16.1) \times (3.2–)4.4–6.8(–7.7) μ m (n = 32), occasionally including segments with more than

one row of cells, but parallel, agglutinated hyphae not observed, with rough surface, septate, usually distinctly constricted at the septa, some vegetative hyphae composed of smooth-walled, longer and thinner cells 2–4 µm in diameter grow inside the hyaline hyphae of the host thallus (being wrapped by the latter). *Ascomata* perithecia, 25–35(–50) µm in diameter, superficial. *Asci* mostly ovoid, 21–26 × 13.5–15 µm, wall BCr– [(reaction with BCr was not mentioned in the protologue (Hansen & Alstrup 1995)]. *Ascospores* hyaline, soleiform/narrowly ovoid with wider upper cell, (9.5–)9.9–11.5 × 4.2–4.8(–5.0) µm, l/b = (2.1–)2.2–2.6(–2.7) (n = 12, in water or BCr), 1-septate, constricted at the septum, usually with 1–3 large guttules in each cell, distinct halo not observed, wall BCr–.

NOTES. – In the protologue Hansen and Alstrup (1995) did not mention the dark stripes associated with vegetative hyphae, but instead described a superficial reticulate mycelium composed of parallel, agglutinated hyphae which we have not observed in the examined material. It is possible that they interpreted the stripes as belonging to vegetative hyphae. However, based on our observations, the stripes originate from the host thallus and are induced by the parasite infection. The vegetative hyphae growing inside the host hyphae have also not been noted before and are reminiscent of *Taeniolella cladinicola* Alstrup (Alstrup 1993b).

This species was found on both healthy-looking and decaying podetia of *Cladonia arbuscula* (most occurrences), *C. mitis*, *C. rangiferina*, *C. stellaris* and *C. stygia*. Host thalli become discolored or darkened by especially heavy infections. The species is widely distributed in the Holarctic, including the polar desert biome. It has been previously documented in Russia and Asia only from Chukotka and Magadan Regions of Russia (Hansen & Alstrup 1995, Zhurbenko & Zheludeva 2015). A report from Turkey (Kocakaya et al. 2016) was based on a misidentification of *Sphaerellothecium cladoniae* (revised by R. Pino-Bodas, 2016). We here report the species for the first time from Mongolia.

Specimens examined. – **NORWAY. SVALBARD:** Aldegondabreen glacier, 78°00'N, 14°12'E, elev. 15 m, 15.vii.2003, on *Cladonia mitis* (podetia), *M.P. Zhurbenko 03178* (LE 308582). **RUSSIA. KRASNOYARSK TERRITORY:** Severnaya Zemlya Archipelago, Bol'shevik Island, Akhmatov Bay, 79°03'N, 102°41'E, elev. 450 m, 16.vii.1996, on *C. arbuscula* (podetia), *M.P. Zhurbenko 961031* (LE 308917); 17.vii.1996, *M.P. Zhurbenko 96408* (LE 308551); Cape Antsev, 78°13'N, 103°15'E, 1.viii.1997, on *C. rangiferina* (podetia), *N.V. Matveeva s.n.* (LE 308904); Taimyr Peninsula, Osipovka River, 72°42'N, 80°51'E, elev. 50 m, 18.vii.1990, on *C. arbuscula* (podetia), *M.P. Zhurbenko 901104* (LE 308564); Taimyr Peninsula, Dikson Island, 73°30'N, 80°20'E, elev. 30 m, 7.vii.1990, on *C. arbuscula* (podetia), *M.P. Zhurbenko 901108* (LE 308577); Taimyr Peninsula, Uboinaya River, 73°25'N, 82°51'E, elev. 150 m, 5.viii.1990, on *C. arbuscula* (podetia), *M.P. Zhurbenko 901109* (LE 308580); Taimyr Peninsula, Levinson-Lessinga Lake, 74°31'N, 98°27'E, elev. 450 m, 10.viii.1995, on *C. arbuscula* (podetia), *M.P. Zhurbenko 95596* (LE 308894). **REPUBLIC OF BURYATIA:** Kitoi Mts., 3 km N of Oka Lake, 51°55'N, 100°40'E, elev. 2000 m, 15.vi.2005, on *C. arbuscula* (podetia), *M.P. Zhurbenko 05172* (LE 309163); Dzherginskii Reserve, Balan-Tamur Lake, 55°14'10"N, 111°42'15"E, elev. 1200 m, 23.vii.2000, on *C. stygia* (podetia), *T.M. Kharpukhaeva s.n.* (LE 309161). **REPUBLIC OF SAKHA (YAKUTIA):** 3 km SW of Tiksi, 71°40'N, 128°40'E, elev. 50 m, 17.vii.1998, on *C. arbuscula* (podetia), *M.P. Zhurbenko 98413* (LE 308890). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Mt. Lysaya, 45°00'14"N, 136°30'00"E, elev. 850 m, 2.ix.2013, on *C. arbuscula* (podetia), *M.P. Zhurbenko 13140* (H, LE 308491), on *C. mitis* (podetia), *M.P. Zhurbenko 13151a* (H, LE 308493), on *C. stellaris* (podetia), *M.P. Zhurbenko 13150* (LE 308492). **MAGADAN REGION:** Magadan, Mt. Nagaevskaya, 59°34'N, 150°45'E, elev. 400 m, 2.vii.2001, on *C. arbuscula* (podetia), *D.S. Lysenko s.n.* (LE 308550). **CHUKOTKA AUTONOMOUS AREA:** Wrangel' Island, Kulikovyi Creek, 70°58'N, 179°00'E, elev. 140 m, 23.viii.1992, on *C. rangiferina* (podetia), *S.S. Kholod s.n.* (LE 308879); Somnitel'naya River, 71°59'N, 179°38'W, elev. 170 m, 9.viii.1984, on *C. arbuscula* (podetia), *S.S. Kholod s.n.* (LE 308583); Anyui Upland, Elvinei-Veem River, 21.vi.1967, on *C. arbuscula* (podetia), *B.A. Yurtsev s.n.* (LE 308764); Inchoun, 66°17'N, 170°17'W, 2.viii.1975, on *C. stygia* (podetia), *I.I. Makarova s.n.* (LE 308790); Enurmino, 66°56'N, 171°49'W, 1.viii.1972, on *C. arbuscula* (podetia), *I.I. Makarova s.n.* (LE 308799); Baran'e Lake, 66°54'N, 175°15'E, 24.vii.1980, on *C. rangiferina* (podetia), *I.I. Makarova s.n.* (LE 308769); km 174 of road from Egvekinot to Iul'tin, 67°41'N, 178°35'W, 10.viii.1979, on *C. rangiferina* (podetia), *I.I. Makarova s.n.* (LE 308803). **MONGOLIA. AR-KHANGAI AIMAK:** Terkhiin-Tsagan-Nur Lake, 48°10'N, 99°43'E, elev. 2100 m, 21.viii.1972, on *C. stellaris* (podetia), *L.G. Biazrov 1828* (LE 308850). **U.S.A. ALASKA:** Seward Peninsula, Guy Rowe Creek, 64.7577°N, 163.8872°W, elev. 321 m, 2000, on *C. arbuscula* (podetia), *D.A. Walker s.n.* (LE

309162); Great Kobuk Sand Dunes, 67°04'N, 158°54'W, elev. 50 m, 1.viii.2000, on *C. mitis* (podetia), *M.P. Zhurbenko 00480* (LE 309159); Wrangell Saint Elias Park and Preserve, Chititu Ridge, 61.2523°N, 142.5560°W, elev. 1364 m, 16.vii.2004, on *C. arbuscula* (podetia), *J. Roth s.n.* (LE 308584). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Mt. Raft, 51°44'N, 119°50'W, elev. 2100 m, 3.viii.2002, on *C. mitis* (podetia), *M.P. Zhurbenko 02350* (LE 308731).

***Stigmidium cladoniicola* Zhurb. & Diederich**

NOTES. – In the specimens examined the ascospores measured (9.0–)11.5–14.3(–16.5) × (3.0–)3.4–4.2(–5.0) μm, l/b = (2.2–)3.0–3.8(–5.0) (n = 141, in water or BCr). It was found on the podetia and occasionally basal squamules of *Cladonia coccifera* (most occurrences), *C. metacorallifera*, *C. squamosa* and an unidentified *Cladonia* species. Infected parts of the host were often moribund and bleached. The species was previously known in Asia only from Korea (Kondratyuk et al. 2016) and in Russia only from Northern Ural (Zhurbenko & Diederich 2008). Here we report it for the first time from Asian Russia. *Cladonia coccifera*, *C. metacorallifera* and *C. squamosa* are new host species.

Specimens examined. – **RUSSIA. MURMANSK REGION:** Barents Sea coast, Dal'ne-Zelenetskaya Bay, 69°07'N, 36°05'E, elev. 20 m, 22.viii.1997, on *Cladonia coccifera* (podetia), *M.P. Zhurbenko 97417* (LE 308915); Olenka River mouth, 69°02'N, 36°24'E, elev. 50 m, 5.ix.1997, on *C. squamosa* (bleached podetia), *M.P. Zhurbenko 97406b* (LE 308893); on *C. coccifera* (moribund podetia), *M.P. Zhurbenko 97410a* (LE 308906). **NENETS AUTONOMOUS AREA:** Malozemel'skaya tundra, Peschanka Lake, 68°46'24"N, 53°14'36"E, 21.viii.1998, on *C. metacorallifera* (podetia), *O.V. Lavrinenko s.n.* (LE 308934a). **KOMI REPUBLIC:** Northern Ural, Yanyupuner Range, 62°04'N, 59°08'E, elev. 500 m, 4.vii.1997, on *Cladonia* sp. (moribund podetia and basal squamules), *M.P. Zhurbenko 97403* (LE 308552, topotype). **KRASNOYARSK TERRITORY:** Taimyr Peninsula: Levinson-Lessinga Lake, 74°24'N, 98°46'E, elev. 120 m, 28.viii.1995, on *C. coccifera* (moribund podetia), *M.P. Zhurbenko 95602* (LE 308936). **TRANS-BAIKAL TERRITORY:** Kodar Range, Olenii Rog Creek, 56°47'57"N, 117°21'59"E, elev. 1674 m, 18.vi.2015, on *Cladonia* sp. (bleached podetia), *L.A. Konoreva s.n.* (LE 309332b).

***Taeniolella beschiana* Diederich**, Bull. Soc. Nat. Luxemb. 93: 156. 1992. TYPE: Luxembourg, Mersch, Fischbach, 15.xi.1980, on *Cladonia chlorophaea*, *P. Diederich 3480* (LG, holotype).

Syn. nov. *Ameroconium cladoniae* U. Braun & Zhurb. in Zhurbenko & Braun, Lichenologist 45: 584. 2013. TYPE: Russia, Irkutsk Region, near Erbogachen, 60°59'15"N 108°28'55"E, 10.ix.2008, on *Cladonia rangiferina*, *K.E. Vershinin s.n.* (LE 260838!, holotype).

NOTES. – When describing this lichenicolous hyphomycete that occurs on *Cladonia* species, Diederich (1992) mentioned that it differs from *Taeniolella* S. Hughes s. str. Later a new hyphomycetous genus, *Ameroconium* U. Braun & Zhurb., was introduced to accommodate *A. cladoniae* also growing on species of *Cladonia* (Zhurbenko & Braun 2013) and clearly differing from *Taeniolella*, as described in Seifert et al. (2011), by its percurrently proliferating conidiogenous cells with distinct flaring annellations. Morphological examination of extensive additional material convinced us that *T. beschiana* and *A. cladoniae* belong to the same widespread, common and morphologically variable species and thus are synonymized here. The conidiophores are occasionally branched in the lower part, conidia are quite variable, ranging from smooth and aseptate (as was described for *A. cladoniae*) to often verruculose and occasionally up to 3-septate, subhyaline to mostly light or medium brown, (5.0–)6.5–9.5(–12.8) × (2.5–)3.2–4.4(–5.7) μm, l/b = (1.4–)1.7–2.5(–3.6) (n = 157), solitary or occasionally in short chains.

This species was found on the podetia and/or basal squamules of *Cladonia* cf. *alaskana*, *C. amaurocraea*, *C. arbuscula*, *C. bellidiflora*, *C. cariosa*, *C. carneola*, *C. cervicornis*, *C. coccifera*, *C. coniocraea*, *C. cornuta*, *C. cyanipes*, *C. deformis*, *C. digitata*, *C. cf. ecmocyna*, *C. gracilis*, *C. mitis*, *C. ochrochlora*, *C. phyllophora*, *C. pocillum*, *C. pyxidata*, *C. rangiferina*, *C. stellaris*, *C. stricta*, *C. subulata*, *C. sulphurina*, *C. symphyocarpa*, *C. umbricola* and unidentified *Cladonia* species. In some cases it formed continuous black patches on the host thalli, but distinct pathogenicity not observed. The taxon is widely distributed in the Holarctic including the tundra biome, but not known from the polar desert biome. Here we report it for the first time from Mongolia. *Cladonia amaurocraea*, *C. bellidiflora*, *C. cariosa*, *C. cyanipes*, *C. stellaris*, *C. sulphurina* and *C. umbricola* are new host species.

Specimens examined. – **SPAIN. TOLEDO:** Aldeanueva de Barbarroja, 39°44'46"N, 5°02'00.0"W, elev. 480 m, 20.iii.2014, on *Cladonia cervicornis* (basal squamules, mostly their undersides), *R. Pino-Bodas s.n.* (H). **NORWAY. TROMS CO.:** Skibotndalen Valley, 69°19.4'N, 20°21.4'E, elev. 70 m, 6.viii.2003, on *C. cf. arbuscula* (podetia), *M.P. Zhurbenko 0331* (LE 309046); 69°13'N, 20°29'E, elev. 650 m, 8.viii.2003, on *C. coccifera* (basal squamules, occasionally podetia), *M.P. Zhurbenko 03109* (LE 309049). **RUSSIA. MURMANSK REGION:** Dal'ne-Zelenetskaya Bay, 69°07'N, 36°05'E, elev. 20 m, 22.viii.1997, on *C. bellidiflora* (basal squamules, podetia), *M.P. Zhurbenko 97413* (LE 308910); 5 km S of Dal'nie Zelentsy, 69°03'N, 36°05'E, elev. 100 m, 2.ix.1997, on *Cladonia* sp. (basal squamules, podetia), *M.P. Zhurbenko 97408* (LE 308899); Khibiny Mts., Mt. Vud'yavrchorr, 67°40'N, 33°32'E, elev. 900 m, 7.viii.1997, on *C. mitis* (podetia), *M.P. Zhurbenko 97412* (LE 308909); Mt. Kukisvumchorr, 67°42'N, 33°36'E, elev. 450 m, 9.viii.1997, on *C. arbuscula* (podetia), *M.P. Zhurbenko 9717a* (LE 308940a). **REPUBLIC OF ADYGEYA:** Caucasus, headwaters of Armyanka River, 44°00'33"N, 39°59'42"E, elev. 1680 m, 24.viii.2014, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 14275* (LE 308606); Guzeripl', 43°59'25"N, 40°08'56"E, elev. 770 m, 13.viii.2014, on *C. coniocraea* (basal squamules), *M.P. Zhurbenko 14274* (LE 308605). **KRASNODAR TERRITORY:** Caucasus, Lagonaki Upland, Mt. Fisht, 43°57'34"N, 39°55'48"E, elev. 1580 m, 17.viii.2014, on *C. cf. phyllophora* (podetial squamules), *M.P. Zhurbenko 14299* (LE 309043). **NENETS AUTONOMOUS AREA:** Bol'shezemel'skaya tundra, Ortin River, 67°50'04"N, 54°04'35"E, 28.vi.1999, on *C. rangiferina* (podetia), *O.V. Lavrinenko s.n.* (LE 308930). **KOMI REPUBLIC:** Northern Ural, Yanyupuner Range, 62°05'N, 59°06'E, elev. 800 m, 3.vii.1997, on *C. mitis* (decaying podetia), *M.P. Zhurbenko 97242b* (LE 210227b). **KRASNOYARSK TERRITORY:** Taimyr Peninsula, Uboinaya River mouth, 73°39'N, 82°22'E, elev. 15 m, 15.viii.1990, on *C. stricta* (basal squamules, podetia), *M.P. Zhurbenko 901085b* (LE 308571b); Taimyr Peninsula, Pyasina River mouth, 74°08'N, 86°44'E, 22.vii.1993, on *C. stricta* (podetia), *V.B. Kuvaev 1968* (LE 308517); Taimyr Peninsula, Levinson-Lessinga Lake, 74°24'N, 98°46'E, elev. 120 m, 28.viii.1995, on *C. stricta* (podetia), *M.P. Zhurbenko 95601* (LE 308932); 74°24'N, 98°38'E, elev. 150 m, 1.viii.1995, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 95213* (LE 309448); Taimyr Peninsula, Khatanga, 71°58'N, 102°27'E, 4.ix.1995, on *C. stricta* (podetia), *M.P. Zhurbenko 95595* (LE 308892); Eastern Sayan Mts., Kryzhina Range, Belyi Kitat River, 53°59'N, 95°27'E, elev. 1550 m, 5.vii.2009, on *C. digitata* (basal squamules, podetia), *M.P. Zhurbenko 0947b* (LE 308654b); elev. 1400 m, 7.vii.2009, on *C. phyllophora* (basal squamules, podetia), *M.P. Zhurbenko 0946b* (LE 308653b); 54°00'N, 95°29'E, elev. 1400 m, 20.vii.2009, on *C. rangiferina* (podetia), *M.P. Zhurbenko 0945a* (LE 308652a); Western Sayan Mts., Ergaki Nature Park, Bol'shaya Baklanikha River, 52°46'N, 93°19'E, elev. 1150 m, 24.vii.2010, on neighbouring *C. coccifera* and *C. sulphurina* (basal squamules, podetia), *M.P. Zhurbenko 1051a* (LE 308686a). **REPUBLIC OF TUVA:** Todzhinskaya trough, headwaters of Dugdu River, 24.vii.1999, on *C. deformis* (basal squamules), *N.I. Molokova s.n.* (LE 210263b). **TRANS-BAIKAL TERRITORY:** Sokhondinskii Reserve, Nar'ya Lake, elev. 1750 m, on *C. stellaris* (podetia), 11.1988, *A.A. Nikol'skii s.n.* (LE 308868). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Dal'negorsk, 44°35'48"N, 135°33'12"E, elev. 240 m, 18.viii.2013, on *C. pocillum* (basal squamules, podetia), *M.P. Zhurbenko 13145a* (H, LE 308494); Sikhote-Alin' Range, headwaters of Valinku River, 46.1440°N, 136.7073°E, elev. 1300 m, 26.viii.2013, on *C. pyxidata* (basal squamules, occasionally podetia), *Yu.V. Gerasimova s.n.* (LE 308697); Sikhote-Alin' Range, Yasnaya (Maisa) River, 45°14'22"N, 136°29'22.4"E, elev. 160 m, 24.viii.2013, on *C. coniocraea* (basal squamules), *M.P. Zhurbenko 13160* (LE 308636); Sikhote-Alin' Range, Zabolochennaya (Tun'sha) River, 45°13'42.8"N, 136°31'04.5"E, elev. 150 m, 26.viii.2013, on *Cladonia* sp. (basal squamules, podetia), *M.P. Zhurbenko 13170* (LE 308687). **SAKHALIN REGION:** Iturup Island, Baranovskogo volcano, 43°39'N, 131°55'E, 6.x.1996, on *C. coccifera* (basal squamules, podetia), *A.A. Dobrysh s.n.* (LE 308833). **CHUKOTKA AUTONOMOUS AREA:** Tamvatvaam River, 63°38'N, 174°50'E, 24.vii.1983, on *C. pocillum* (basal squamules), *I.I. Makarova s.n.* (LE 308835); Iskaten' pass, 66°35'N, 179°10'E, 4.vii.1971, on *C. coccifera* (podetia), *I.I. Makarova s.n.* (LE 308829); km 36 of road from Egvekinot to Iul'tin, 66°35'N, 179°10'E, 14.vii.1971, on *Cladonia* sp. (basal squamules), *I.I. Makarova s.n.* (LE 308749); 45 km WSW of Ust'-Chauna, Mt. Pynei, 3.vi.1951, on *C. amaurocraea* (podetia), *I. Shmorunova s.n.* (LE 308810b). **MONGOLIA. ARA-KHANGAI AIMAK:** watershed of Khukh-Sumein-Gol and Tsetserleg-Gol Rivers, Mt. Khairkhan, 47°15'N, 101°50'E, elev. 2400 m, 20.viii.1977, on *C. rangiferina* (podetia), *L.G. Biazrov 6551b* (LE 308851b); elev. 2100 m, 1.viii.1979, on *C. ochrochlora* (basal squamules, podetia), *L.G. Biazrov 3385b* (LE 308869b); headwaters of Khukh-Sum-Gol River, 47°15'N, 101°50'E, elev. 2000 m, 20.vii.1975, on *C. ochrochlora* (basal squamules), *L.G. Biazrov 6240* (LE 308843). **U.S.A. ALASKA:**

Seward Peninsula, 7 km NE of Nome, Newton Peak, 64°33'N, 165°22'W, elev. 250 m, 5.ix.2001, on *C. symphyocarpa* (both sides of basal squamules), *M.P. Zhurbenko 01102* (LE 309446); Seward Peninsula, 7 km ESE of Nome, 64°28'44"N, 165°16'03"W, elev. 5 m, 1.ix.2001, on *C. rangiferina* (moribund podetia), *M.P. Zhurbenko 0142b* (LE 308589b); Toolik Lake, 68°37'42"N, 149°35'52"W, elev. 770 m, 28.viii.2001, on *C. coccifera* (basal squamules, podetia), *M.P. Zhurbenko 01154* (LE 309051); on *C. trassii* (podetia), *M.P. Zhurbenko 01454* (LE 309054); Howe Island, 70°18'55"N, 147°59'35"W, elev. 17 m, 5.viii.2003, on *C. coccifera* (podetia and basal squamules), *D.A. Walker s.n.* (LE 308504a); Great Kobuk Sand Dunes, 67°06'N, 159°01'W, elev. 50 m, 4.viii.2000, on *C. symphyocarpa* (basal squamules), *M.P. Zhurbenko 00119a* (LE 309041a); 67°07'N, 159°03'W, elev. 40 m, 9.viii.2000, on *C. pyxidata* (basal squamules), *M.P. Zhurbenko 00110* (LE 309447); Susitna River, 62.338439°N, 150.226826°W, elev. 130 m, 2.viii.2013, on *C. cf. ecmocyna* (podetia), *G.V. Frost s.n.* (LE 308545); Fairbanks, 64°49.236'N, 147°45.498'W, 3.viii.2004, on *C. rangiferina* (podetia), *M.P. Zhurbenko 0476a* (LE 309053a); 64°49.583'N, 147°45.513'W, 9.viii.2004, on *C. cf. alaskana* (podetia), *M.P. Zhurbenko 04111* (LE 309044); 64°51.956'N, 147°52.494'W, elev. 170 m, 14.viii.2004, on neighbouring *C. cornuta* and *C. cyanipes* (podetia), *M.P. Zhurbenko 04158* (LE 309047); Goldstream Valley, 64°57.188'N, 147°42.775'W, 31.vii.2004, on *C. cornuta* (podetia), *M.P. Zhurbenko 0468b* (LE 309060b); on *C. cyanipes* (podetia), *M.P. Zhurbenko 0467b* (LE 309140b); Skyline Ridge, 64°55.270'N, 147°43.001'W, elev. 470 m, 31.vii.2004, on *C. gracilis* (podetia), *M.P. Zhurbenko 04378b* (LE 309055b); Tanana River, Bonanza Creek, 64°51.320'N, 147°49.189'W, elev. 150 m, 21.viii.2004, on *C. cornuta* (podetia including podetial squamules), *M.P. Zhurbenko 04265b* (LE 309057b); on *C. cyanipes* (podetia), *M.P. Zhurbenko 04263* (LE 309048); 25.viii.2004, on *C. pocillum* (basal squamules, occasionally podetia), *M.P. Zhurbenko 04280* (LE 309050); Denali National Park and Preserve, 63°43.35'N, 148°57.53'W, elev. 700 m, 17.viii.2004, on *C. subulata* (podetia), *M.P. Zhurbenko 04214a* (LE 309040a); on *C. cariosa* (basal squamules), *M.P. Zhurbenko 04219* (LE 309042); 20.viii.2004, on *C. pyxidata* (basal squamules), *M.P. Zhurbenko 04188a* (LE 309045a); 63°43'N, 149°07'W, elev. 900 m, 30.viii.2000, on *C. coccifera* (basal squamules), *M.P. Zhurbenko 00329* (LE 309052). **CANADA. BRITISH COLUMBIA:** Wells Gray Provincial Park, Raft Mt., 51°44'N, 119°50'W, elev. 2100 m, 3.viii.2002, on *Cladonia* sp. (basal squamules), *M.P. Zhurbenko 02315* (LE 308701); on *C. cf. stellaris* (podetia), *M.P. Zhurbenko 02310* (LE 308703); Battle Creek Valley, elev. 750 m, 5.viii.2002, on *C. ochrochlora* (podetia), *M.P. Zhurbenko 02402* (LE 308712); Philip Creek, 52°52'N, 120°00'W, elev. 800 m, 30.vii.2002, on *C. cf. cervicornis* (basal squamules, podetia), *M.P. Zhurbenko 02155a* (LE 308704a); Spahats Creek, 51°44'23"N, 120°00'23"W, elev. 770 m, 10.vii.2002, on *C. phyllophora* (podetia), *M.P. Zhurbenko 02281b* (LE 308727b); Columbia Mts., Glacier National Park, Beaver River, 51°18'N, 117°24'W, elev. 1100 m, 17.vii.2002, on *C. sulphurina* (podetia), *M.P. Zhurbenko 0215c* (LE 308706c); 51°15'N, 117°22'W, elev. 1150 m, 17.vii.2002, on *C. umbricola* (basal squamules), *M.P. Zhurbenko 02100a* (LE 308755). **NEWFOUNDLAND AND LABRADOR:** Newfoundland, Main River Provincial Park, 49°48'21"N, 57°21'26"W, 480 m, 7.ix.2011, on *C. carneola* (tips of podetia), *T. Ahti 70807* (H).

***Tremella cladoniae* Diederich & M.S. Christ.**

NOTES. – Lunate conidia were observed in LE 309191 and are here reported for this species for the first time (Diederich 1996). *Cladonia gracilis* is also a new host species.

Specimens examined. – **RUSSIA. MURMANSK REGION:** Iolgi-Tundry Mts., Maloe Glubokoe Lake, 67°12'40"N, 33°14'40"E, elev. 150 m, 23.vii.2001, on *Cladonia gracilis* (podetia), *I.S. Zhdanov s.n.* (LE 309191). **REPUBLIC OF BURYATIA:** Barguzin Range, Mt. Gol'makta, 53°55'11"N, 109°57'07"E, elev. 700 m, 28.viii.2002, on *C. pyxidata* (podetia), *M.P. Zhurbenko 02409* (LE 309187).

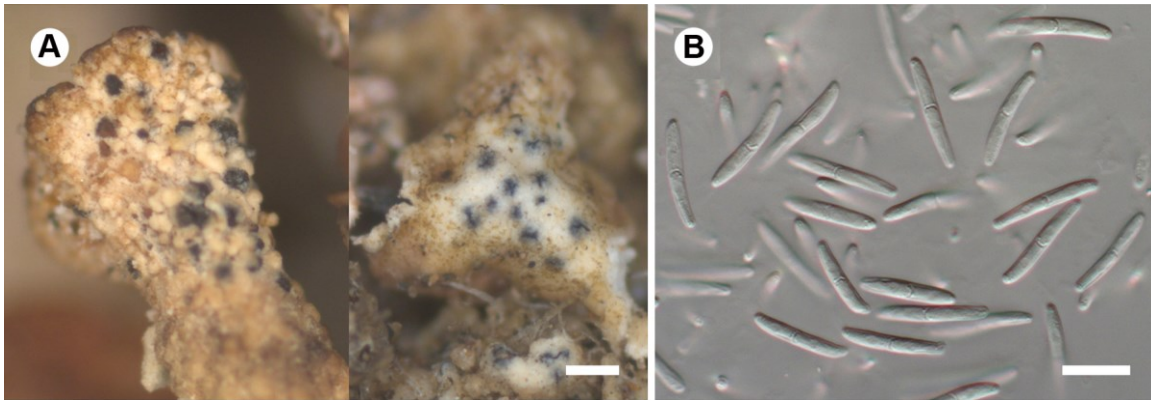


Figure 14. A presumably undescribed coelomycete growing on *Cladonia* spp. **A**, conidiomata (left, Biazrov 1609; right, Biazrov 4110). **B**, conidia in water (Biazrov 4110). Scale bars: A = 200 µm, B = 10 µm.

***Zwackhiomyces diderichii* D. Hawksw. & Iturr.**

DESCRIPTION. – *Ascomata* 75–180 µm in diameter, protruding in the upper part, dispersed to loosely aggregated; wall orangish brown or brown, pigmentation heterogeneous, with an olive grey tinge in K. *Interascal hyphae* hyaline, filiform, (0.5–)1–2(–3.5) µm in diameter, scarcely branched and anastomosed, apically not swollen. *Hymenial gel* I and K/I–. *Asci* subcylindrical to slightly wider in the center or lower half, apex sometimes truncate, (35–)38–52(–63) × (6.5–)7–9(–10.5) µm (n = 28, in water, I or K/I), 8-spored. *Ascospores* narrowly obovoid, upper cell wider and occasionally up to twice longer than the lower one, (8.0–)9.6–12.4(–15.0) × (2.6–)3.1–3.9(–4.7) µm, l/b = (2.4–)2.8–3.6(–4.4) (n = 128, in water or I), 1-septate, occasionally slightly constricted at the septum, wall smooth [according to Aptroot et al. (1997) ascospores have a granulose perispore, which was not observed], sometimes guttulate, irregularly biseriolate to diagonally uniseriate in the ascus.

NOTES. – We found this species on the podetia and/or basal squamules of *Cladonia arbuscula*, *C. coniocraea*, *C. ochrochlora*, *C. pocillum* and *C. rangiferina*. Heavy infections were observed to cause slight bleaching of host tissues. The species was previously known in Russia only from Karelia and Mordovia Republics (Alstrup et al. 2005, Urbanavichus & Urbanavichene 2014). *Cladonia arbuscula*, *C. pocillum* and *C. rangiferina* are new host species.

Specimens examined. – **LITHUANIA.** Asveja Regional Park, 55.073°N, 25.419°E, 22.ix.2011, on *Cladonia coniocraea* (upper side of basal squamules), *F. Högnabba 220911-15b* (H). **RUSSIA. REPUBLIC OF BURYATIA:** Dzherginskii Reserve, Balan-Tamur Lake, 55°14'10"N, 111°42'15"E, 23.vii.2000, on *C. rangiferina* (podetia), *T.M. Kharpuksaeva s.n.* (LE 309134). **PRIMORYE TERRITORY:** Sikhote-Alin' Range, Zabolochennaya River, 45°16'13"N, 136°29'56"E, elev. 220 m, 21.viii.2013, on *C. rangiferina* (moribund bases of podetia), *M.P. Zhurbenko 13164* (LE 308642); 45°14'07"N, 136°30'34"E, elev. 160 m, 21.viii.2013, on *C. ochrochlora* (upper side of basal squamules), *M.P. Zhurbenko 13144* (LE 308495); Sikhote-Alin' Range, 2.5 km from confluence of Dzhigitovka River and Kabanii Creek up the road to a pass, 45°07'37"N, 135°51'56"E, elev. 680 m, 6.ix.2013, on *C. coniocraea* (damaged podetia and basal squamules), *M.P. Zhurbenko 13138a* (LE 308496). **U.S.A. ALASKA:** Kotzebue, 66°53'N, 162°31'W, elev. 30 m, 19.viii.2000, on *C. arbuscula* (podetia), *M.P. Zhurbenko 00160b* (LE 309070b); Goldstream Valley, 64°57.16'N, 147°42.83'W, 12.viii.2004, on *C. arbuscula* (moribund parts of podetia), *M.P. Zhurbenko 04135b* (LE 309144b). **CANADA. BRITISH COLUMBIA:** Columbia Mts., Mount Revelstoke National Park, 18.vii.2002, on *C. pocillum* (basal squamules), *M.P. Zhurbenko 02401* (LE 308709).

Unidentified coelomycete with bacilliform (0–)1(–3)-transseptate conidia

FIGURE 14

DESCRIPTION. – *Conidiomata* pycnidial, blackish in the visible parts, ampulliform, 100–150 µm in diameter, immersed to slightly erumpent, with an irregular opening up to 15–55 µm lengthways; wall

yellowish-brown, darker above, paraplectenchymatous, K-. Distinct *conidiophores* not observed. *Conidiogenous cells* possibly acro-pleurogenous. *Conidia* bacilliform with rounded ends, straight to slightly curved, (10.2–)13.2–16.6(–19.8) × (2.0–)2.2–2.6(–3.1) μm, l/b = (3.4–)5.4–7.4(–9.4) (n = 93), hyaline, smooth, (0–)1(–3)-transseptate. Heavy infections seemingly discolor the host thallus.

NOTES. – No fungus with conidia such as those described above is known to occur on *Cladonia*. Nonetheless better developed material is necessary before it can be formally described.

Specimens examined. – **MONGOLIA. ARA-KHANGAI AIMAK:** 40 km of Tevshrulekh, 47°40'N, 102°14'E, elev. 1500 m, petrophytic steppe, 1.viii.1980, on *Cladonia pocillum* (basal squamules), L.G. Biazrov 4110 (LE). **BULGAN AIMAK:** Mt. Tsetserleg-Ula, 47°30'N, 103°40'E, elev. 1950 m, *Ulmus* forest in a canyon, 29.vi.1972, on *C. pyxidata* (upper part of cups), L.G. Biazrov 1609 (LE).

KEY TO THE LICHENICOLOUS FUNGI GROWING ON *CLADONIA*

This key is based on data from Brackel (2014), Lawrey & Diederich (2016), Zhurbenko & Alstrup (2004), the present contribution and literature cited in the key. Potentially confusing lichenized fungi or non-obligately lichenicolous fungi that occur on *Cladonia* are also included. Species that are not host specific to *Cladonia* are given in square brackets. Authors of fungal names are provided only for species not listed in the main part of the text above. The sizes of diaspores are rounded to 0.5 μm.

The myxomycete *Listerella paradoxa* E. Jahn also occurs on species of *Cladonia* and is sometimes included in lists of lichenicolous fungi (example: Hafellner 2008). It is not included in the key below, but can be recognized by the following characters: fruit bodies dull blackish-brown with shining yellow ridges, sessile, pulvinate, up to 0.3 mm in diameter, covered by membranous peridium, with capillitium consisting of dark, flexuous threads with regular bead-like annulations; spores light brownish-gray, black in mass, faintly spinulose, 7–8 μm in diameter (Ing 1999).

Key to keys

1. Hyphae with clamp connections, or if efibulate, then forming deep pink, orange-red, rose or yellow to orange bulbils **Key 1 (Page 244)**
1. Hyphae without clamp connections; bulbils absent 2
 2. Spores produced in asci 3
 3. Ascomata apotheciid, rarely lirellate or stromatic **Key 2 (Page 245)**
 3. Ascomata perithecioid or sometimes catathecioid **Key 3 (Page 248)**
 2. Spores not produced in asci 4
 4. Conidia produced in pycnidia or stromata **Key 4 (Page 253)**
 4. Conidia not produced in pycnidia or stromata **Key 5 (Page 255)**

Key 1. Basidiomycetes

1. Fructifications bulbils; hyphae with or without clamp connections 2
 2. Bulbils deep pink, orange-red or rose, composed of thin-walled cells mainly up to 10 μm in diameter. Lit.: Diederich (1990), Diederich & Lawrey (2007), Hawksworth (1979) [*Marchandiomyces corallinus* (Roberge) Diederich & D. Hawksw.]
 2. Bulbils yellow to orange, composed of thick-walled cells 10–20 μm in diameter. Lit.: Lawrey et al. (2016) *Neoburgoa freyi*
1. Fructifications basidiomata, occasionally also sclerotia; hyphae with clamp connections 3
 3. Basidiomata agaricoid, differentiated into convex to plane brownish striate cap and cylindrical pruinose stem. Lit.: Antonin & Noordeloos (2004) [*Gamundia striatula* (Kühner) Raithelh.]
 3. Basidiomata not agaricoid 4

4. Basidiomata resupinate, pellicular, with orange-ochraceous irregularly folded hymenophore and scattered orange ovate sclerotia. Lit.: Thorn et al. (1998) **[*Leucogyrophana lichenicola* Thorn, Malloch & Ginns]**
4. Basidiomata different 5
5. Basidiomata usually elongate, sometimes roundish or tuberculate; mature basidia aseptate. Lit.: Diederich (1996), present paper ***Heterocephalacria bachmannii***
5. Basidiomata subglobose, pulvinate, tuberculate or irregular in form; mature basidia 1-septate 6
6. Basidiomata 0.1–2.2 mm in diameter; mature basidia mainly claviform, 20–36 μm long, with transverse septum; basidiospores subspherical, 7–10 \times 6–8 μm . Lit.: Diederich (1996) ***Tremella cladoniae***
6. Basidiomata 0.2–0.8 mm in diameter; mature basidia subspherical or rarely ellipsoid, 8.5–14 μm long, with longitudinal or rarely oblique or transverse septum; basidiospores ellipsoid, 5.5–7.5(–8) \times (3.5–)4–5.5 μm . Lit.: Diederich (1996) ***Tremella macroceratis* Diederich & Hafellner**

Key 2. Ascomycetes with apothecioid, rarely lirellate or stromatic ascomata

1. Ascomata lirellate, with a slit-like opening and a scarcely visible disc. Lit.: Ertz & Diederich (2003), present paper ***Opegrapha cladoniicola***
1. Ascomata different 2
2. Ascomata stromatic, multilocular, macroscopically resembling a single apothecium. Lit.: Ertz et al (2005) ***Plectocarpon cladoniae***
2. Ascomata different 3
3. Ascomata pin- or nail-like, consisting of heads at the tips of stalks 4
4. Apothecia light orange throughout; mazaedium absent; paraphyses present; ascospores hyaline. Lit.: Alstrup & Cole (1998) ***Bryoscyphus lichenicola* Alstrup & M.S. Cole**
4. Apothecia black, at least above; mazaedium present; paraphyses absent; ascospores pigmented 5
5. Stalks black; ascospores light brown, 1-septate, 6–7 \times 2–3 μm ; not lichenized; widespread. Lit.: Titov (2006) ***Chaenothecopsis parasitaster***
5. Stalks red; ascospores pale greenish, aseptate, (6–)7.5–8(10) \times (2–)2.5–3(–3.5) μm ; scarcely lichenized; known only from the type locality in China. Note: identification of *Cladonia* as a host lichen genus is uncertain. Lit.: Titov (2001), Wei & Titov (2001) **[*Chaenothecopsis vinosa* Titov]**
3. Ascomata different 6
6. Ascomata convex, rounded; exciple indistinct or (in '*Arthonia epicladonia*') poorly developed; paraphysoids branched and anastomosing; asci semi-fissitunicate, clavate to obovoid, stalked, usually with a K/I+ blue ring in the tholus; ascospores always or mainly septate 7
7. Hymenium covered by brown hairs 9–37 μm long. Lit.: Coppins & Aptroot (2009), Etayo (1996a), present paper **[*Arthonia coronata*]**
7. Hymenium not covered by hairs 8
8. Hymenium K+ purple; ascospores becoming gray. Lit.: Etayo (2002) ***Arthonia colombiana* Etayo**
8. Hymenium not K+ purple; ascospores hyaline or brown 9
9. Hymenium K+ dirty violet, then gray; ascospores brown, finely verrucose. Lit.: Brackel (2010b) ***Arthonia coniocraeae* Brackel**
9. Hymenium K–; ascospores hyaline, smooth-walled 10
10. Ascospores (0–)2-septate, (9.5–)10.5–13.5(–16) \times (3.5–)4–5(–6.5) μm . Lit.: Zhurbenko & Zhdanov (2013), present paper .. ***Arthonia cf. lepidophila***
10. Ascospores (0–)1-septate, of different size 11

11. Ascomata grayish to black, usually pruinose (better seen when wet); exciple present, but poorly developed; hymenium I+ blue; ascospores (12–)13.5–16.5(–18) × (3–)3.5–4.5(–5) µm. Source: A. Flakus, pers. comm., 2016.....	
..... ‘ <i>Arthonia epicladonia</i> (Nyl.) Alstrup & Zhurb.	
11. Apothecia black, epruinose; exciple absent; hymenium I+ red; ascospores shorter	12
12. Subhymenium light to medium brown/brownish orange; paraphysoids 1.5–3 µm wide, their end cells sometimes with distinct dark brown cap, usually enlarged up to 6 µm; ascospores (8–)10–13(–16.5) × (3.5–)4–5(–6.5) µm. Lit.: Hafellner (1999), present paper	<i>Arthonia digitatae</i>
12. Subhymenium medium brown; paraphysoids 2–4(–5) µm wide, their end cells often brown, enlarged up to 6(–8) µm; ascospores (8–)8.5–10(–12) × (3–)3.5–4(–4.5) µm. Lit.: Brackel (2015)	<i>Arthonia rangiformicola</i> Brackel & Etayo
6. Species with a different combination of characters	13
13. Ascomata urceolate, initially sometimes almost closed	14
14. Ascospores muriform. Note: usually starting its life cycle as a lichen parasite without an own thallus, later becoming an independent lichen. Lit. Fletcher & Hawksworth (2009)	[<i>Diploschistes muscorum</i> (Scop.) R. Sant.]
14. Ascospores transseptate	15
15. Ascospores mainly or always 1-septate	16
16. Ascospores 1-septate, acicular, helicoid or rarely straight, 22–31 × 1–2.5 µm; asci 16–32-spored; ascomatal disc brown. Lit.: Diederich (2004b)	[<i>Spirographa fusisporella</i> (Nyl.) Zahlbr.]
16. Ascospores (0–)1(–2)-septate, slightly fusiform or slightly clavate (tapering down), occasionally almost bacilliform, straight, (7–)9.5–12.5(–14.5) × 1.5–2 µm; asci 8-spored; ascomatal disc light to medium yellow or yellowish white. Lit.: Pino-Bodas et al. (in press)	<i>Cryptodiscus galaninae</i> Zhurb. & Pino-Bodas ined.
15. Ascospores with more than 1 septum	17
17. Ascomata fleshy, vinaceous, cinnamon or orange-brown; ascospores ellipsoid, (12–)15–20(–28) × (4–)4.5–5.5(–6.5) µm, 3-septate. Lit.: Zhurbenko & Etayo (2013)	[<i>Biazrovia stereocaulicola</i>]
17. Ascomata of different color; ascospores subcylindrical, longer and narrower, with more than 3 transsepta	18
18. Ascomata and disc light orange-yellow, with white pruinose rim above; hymenium more than 70 µm tall, I and K/I–; asci longer 70 µm; ascospores (37–)50–72.5(–87) × 1.5–2 µm, (5–)7–11-transseptate. Lit.: Pino-Bodas et al. (in press).....	<i>Cryptodiscus epicladonia</i> Zhurb. & Pino-Bodas ined.
18. Ascomata brownish black, without white rim; hymenium up to 70 µm tall, I+ red, K/I+ blue; asci up to 70 µm long; ascospores ca. 40–60 × 1.5–2 µm, presumably 4–5-septate. Lit.: Pino-Bodas et al. (in press); Rehm 1882, 1912; Saccardo 1889	<i>Stictis cladoniae</i> (Rehm) Sacc.
13. Ascomata not urceolate	19
19. Ascospores hyaline	20
20. Apothecial disc light to occasionally moderately pigmented	21
21. Ascospores aseptate	22

22. Asci with a K/I+ blue apical ring; ascospores $5-8 \times 1-2.5 \mu\text{m}$. Lit.: Kondratyuk & Galloway (1995), present paper *Peizizella ucrainica*
22. Asci with a K/I+ blue outer layer and K/I+ blue apical dome penetrated by a narrow canal surrounded by a K/I+ dark blue tube; ascospores $6-9 \times 2.5-4 \mu\text{m}$. Lit.: Brackel (2016)
..... *Micarea kemmleri* Brackel
21. Ascospores septate 23
23. Ascospores $11-18.5 \times 4.5-7.5 \mu\text{m}$, ellipsoid. Note: this is a lichen with a quite inconspicuous thallus, occasionally growing on other lichens. Lit.: Scheidegger (1985) [*Anzina carneonivea*]
23. Ascospores $(13.5-)17-23(-26) \times (2-)2.5-3(-3.5) \mu\text{m}$, cylindrical to slightly fusiform. Lit.: Hawksworth & Santesson (1990), Pino-Bodas et al. (in press)
Cryptodiscus cladoniicola (D. Hawksw. & R. Sant.) Pino-Bodas, Zhurb. & S. Stenroos ined. (\equiv *Lettauia cladoniicola* D. Hawksw. & R. Sant.)
20. Apothecial disc dark pigmented to black 24
24. Ascospores exclusively or mostly aseptate 25
25. Ascomata $50-250 \mu\text{m}$ in diameter, immersed, then superficial; epihymenium very distinct; asci K/I+ pale blue; ascospores aseptate, $(7-)8.5-10(-11) \times (2.5-)3-3.5(-4) \mu\text{m}$. Lit.: Diederich (2004a), present paper *Phaeopyxis punctum*
25. Ascomata $(30-)55-90(-120) \mu\text{m}$ in diameter, superficial; epihymenium indistinct; asci K/I-; ascospores $0(-1)$ -septate, $(5.5-)6-9(-11) \times 1.5-2(-3) \mu\text{m}$. Lit.: present paper .. *Brackelia lunkei*
24. Ascospores exclusively or mostly septate 26
26. Ascospores $12-28(?)$ -transseptate. Lit.: Santesson & Tønberg (1994) *Arthrorhaphis aeruginosa*
26. Ascospores $0-3$ -septate 27
27. Ascomata usually with a distinct stipe $40-100 \mu\text{m}$ tall, which is much paler than the disc; epihymenium distinct; asci with distinct external amyloid gelatinous cap; ascospores hyaline or rarely light brown, mainly $10.5-13 \times 3.5-4.5 \mu\text{m}$, $(0-)1$ -septate, smooth. Lit.: Pino-Bodas et al. (in press)
..... *Dactylospora ahtii* Zhurb. & Pino-Bodas ined.
27. Ascomata without a stipe or rarely with a stipe shorter than $40 \mu\text{m}$, concolorous with the disc; epihymenium indistinct; asci without distinct external amyloid gelatinous cap; ascospores hyaline, mainly $13-16.5 \times 5.5-6.5 \mu\text{m}$, $(0-)1(-3)$ -septate, granulate. Lit.: Alstrup & Hawksworth (1990), Pino-Bodas et al. (in press)..... *'Scutula' cladoniicola* Alstrup & D. Hawksw.
19. Ascospores pigmented 28
28. Ascospores strongly thickened at the apices and around the septum, with torus. Lit.: Alstrup & Hawksworth (1990)
..... [*Rinodina egedeana* (Linds.) Alstrup & D. Hawksw.]
28. Ascospores not thickened at the apices and around the septum, without torus 29
29. Ascomata strongly convex 30
30. Ascospores almost homopolar, with the upper cell slightly wider and of more or less the same length as the lower one, readily splitting into semi-spores even in the asci. Lit.: Hawksworth (1990), present paper *Abrothallus cladoniae*

30. Ascospores markedly heteropolar, with the upper cell much broader and up to 2.5 times longer than the lower one, only occasionally splitting into semi-spores. Lit.: Diederich (2003), present paper
..... *Abrothallus pezizicola*
29. Ascomata flat to somewhat concave 31
31. Ascospores $33\text{--}37 \times 12\text{--}14 \mu\text{m}$. Lit.: Alstrup & Olech (1993)
..... *Dactylospora cladoniicola* Alstrup & Olech
31. Ascospores smaller 32
32. Ascospores mainly 1-septate 33
33. Ascospores (0–)1-septate, hyaline or rarely light brown, $(7.5\text{--})10.5\text{--}13\text{--}16.5 \times (3\text{--})3.5\text{--}4.5\text{--}5.5 \mu\text{m}$. Lit.: Pino-Bodas et al. (in press)
..... *Dactylospora ahtii* Zhurb. & Pino-Bodas ined.
33. Ascospores (0–)1(–2)-septate, pale yellow-gray-olive-brown to medium brown, $(9\text{--})11\text{--}15\text{--}18.5 \times (3.5\text{--})4.5\text{--}6\text{--}7.5 \mu\text{m}$. Lit.: Pino-Bodas et al. (in press) *Dactylospora* sp.
32. Ascospores mainly with more transsepta 34
34. Ascospores (3–)5–7(–8)-transseptate, rarely with additional oblique septum, $(14\text{--})17\text{--}21.5\text{--}28 \times (4\text{--})4.5\text{--}6\text{--}7 \mu\text{m}$. Lit.: Triebel (1989), present paper
..... [*Dactylospora deminuta*]
34. Ascospores (0–)3-septate, $(9.5\text{--})12.5\text{--}17.5\text{--}19.5 \times (4\text{--})5\text{--}6\text{--}7.5 \mu\text{m}$. Lit.: present paper
..... *Dactylospora* sp.

Key 3. Ascomycetes with perithecioid or sometimes catathecioid ascomata

1. Ascomata catathecioid 2
2. Ascomata without ostiolar setae. Lit.: Hansen & Alstrup (1995), present paper
..... *Lichenopeltella cladoniarum* (see also *Lichenopeltella* sp. in the catalogue)
2. Ascomata with ostiolar setae 3
3. Ascomata 80–120 μm in diameter; asci 4(–8)-spored; ascospores (1–)3-septate, $(13\text{--})14\text{--}15.5\text{--}16 \times (3\text{--})3.5\text{--}4 \mu\text{m}$, with 3 pairs of setulae. Lit.: Brackel (2011)
..... *Lichenopeltella rangiferinae* Brackel
3. Ascomata 40–85 μm in diameter; asci 4–8-spored; ascospores 1-septate, $(11.5\text{--})12\text{--}14.3\text{--}15.5 \times 3\text{--}3.4\text{--}4.5 \mu\text{m}$, without setulae. Lit.: Brackel (2010a), present paper
..... *Lichenopeltella uncialicola*
1. Ascomata perithecioid 4
4. Ascomata pale to moderately pigmented, almost white, reddish brown, red, pink, cream, orange, saffron or yellow 5
5. Asci usually with four microspores, $(7\text{--})8.5\text{--}11.5\text{--}16.5 \times (3.5\text{--})4.5\text{--}5.5\text{--}7 \mu\text{m}$, and one macrospore, $(18.5\text{--})42.5\text{--}73\text{--}86 \times (7\text{--})18.5\text{--}33.5\text{--}40 \mu\text{m}$. Lit.: Hawksworth & Booth (1976), Zhurbenko (2014) [*Ovicuculispora parmeliae* (Berk. & M.A. Curtis) Etayo]
5. Ascospores not dimorphic 6
6. Ascomata mostly immersed, protruding only in the ostiolar area 7
7. Ascospores $(5\text{--})6\text{--}8 \times 2\text{--}3.5 \mu\text{m}$. Lit.: Motiejūnaitė & Kukwa (2008)
..... *Pronectria minuta* Motiej. & Kukwa
7. Ascospores longer than 8 μm 8

8. Ascospores (8–)10–13.5(–16) × (2.5–)3–4(–5) μm, verruculose. Lit.: Zhurbenko & Alstrup (2004), present paper ***Pronectria tibellii***
8. Ascospores (11–)12.5–17.5(–20) × (2.5–)3–3.5 μm, smooth-walled. Lit.: present paper ***Pronectria sp.***
6. Ascomata superficial 9
9. Ascospores bicaudate, muriform 10
10. Asci 4-spored; ascospores (45–)54–75(–92) × (17–)23.5–32.5(–40) μm, becoming pale salmon to yellow brown at maturity. Lit.: Zhurbenko (2009c).....
..... **[*Paranectria alstrupii* Zhurb.]**
10. Asci 8-spored; ascospores (22–)25–32(–36) × (9–)11–14(–15) μm, consistently hyaline. Lit.: Hawksworth (1982)
..... **[*Paranectria oropensis* (Ces.) D. Hawksw. & Piroz.]**
9. Ascospores without cauda, not muriform 11
11. Ascomata in the upper part with white, straight, aseptate hairs up to 100 μm long; ascospores not ellipsoid, up to 21-septate 12
12. Ascospores long fusiform, sometimes slightly curved, 26–30 × 3–5 μm, (0?–)1-septate. Lit.: Alstrup & Svane (1998)
..... ***Trichonectria cladoniicola* (Alstrup & Svane) Alstrup**
12. Ascospores long fusiform, cylindrical, vermiform or sigmoid, 45–85 × 5–8 μm, 11–21-septate. Lit.: Rossman et al. 1999
..... **[*Trichonectria hirta* (A.Bloxam) Petch]**
11. Ascomata without such hairs or hairs shorter and septate; ascospores ellipsoid, 1-septate 13
13. Ascospores 6.5–8.5(–9.5) × 3.5–4.5(–5) μm. Lit.: Cole & Hawksworth (2001) ***Nectriopsis cladoniicola* M.S. Cole & D. Hawksw.**
13. Ascospores (9–)9.5–12.5(–15) × (3.5–)3.5–4.5(–5) μm. Lit.: Brackel & Zimmermann (2012) ***Nectriopsis cariosae* Brackel & D.G. Zimmermann**
4. Ascomata exclusively or mostly dark to black 14
14. Ascomata with a beak several times longer than its main body; asci with a wall soon disintegrating during spore maturation; ascospores paler at the ends, doliiform. Lit.: Etayo (2008) .
..... ***Sypastospora cladoniae* Etayo**
14. Ascomata without a long beak; asci with persistent wall; ascospores not as above 15
15. Ascomata with setae or with projecting long brown septate hyphae 16
16. Ascomata with long, brown, septate projecting hyphae. Lit.: Matzer & Hafellner (1990), present paper ***Roselliniella cladoniae***
16. Ascomata with setae 17
17. Ascospores bicaudate. Lit.: present paper ***Biciliopsis cladoniae***
17. Ascospores without cauda 18
18. Ascospores medium to dark brown, discoid. Lit.: present paper
..... **[*Coniochaeta sp.*]**
18. Ascospores hyaline or occasionally light brown, not discoid 19
19. Ascomata mainly 100–130 μm in diameter, superficial; setae usually more than 25 μm long, macroscopically always conspicuous, subulate, with acute apex; asci mostly subcylindrical, tholus with tiny marginal and central indentations; ascospores 1-septate, (6.5–)8.5–10.5(–13) × (1.5–)2–2.5(–3) μm. Lit.: Hawksworth (1975b), present paper ***Niesslia cladoniicola***
19. Ascomata mainly 50–80 μm in diameter, usually more or less immersed; setae usually up to 25 μm long, sometimes much reduced and macroscopically inconspicuous, more or less isodiametric, with rounded apex; asci clavate, obclavate or ellipsoid, tholus without marginal

indentation; ascospores 0(–1)-septate, (6.5–)9–12.5(–15) × (2–)3–4(–5) µm. Lit.: present paper	<i>Niesslia keissleri</i>
15. Ascomata without setae or projecting hyphae	20
20. Dark vegetative hyphae macroscopically clearly visible (× 10) and abundant	21
21. Vegetative hyphae often associated with brown, branched, flexuous, crest-like superficial stripes 40–80 µm wide, occasionally fusing in wider irregular patches; ascomata 25–35(–50) µm in diameter, superficial. Lit.: Hansen & Alstrup (1995), present paper	<i>Sphaerellothecium cladoniicola</i>
21. Vegetative hyphae not associated with such stripes; ascomata (25–)45–60(–70) µm in diameter, immersed to superficial. Lit.: Zhurbenko & Alstrup (2004)	<i>Sphaerellothecium cladoniae</i>
20. Dark vegetative hyphae macroscopically inconspicuous (× 10)	22
22. Ascospores hyaline	23
23. Ascospores ca. 165–175 × 1 µm, filamentous. Lit.: Candoussau et. al. (2007)	[<i>Neobarya lichenophila</i> (Ferd. & Winge) Lowen & Samuels]
23. Ascospores up to 35 µm long, not filamentous	24
24. Ascomata gelatinous, glossy; asci dehiscing by longitudinal splits, with wall entirely I and K/I+ blue. Note: the species of <i>Epigloea</i> presented below are rather algicolous, associated with algal films overgrowing various substrates including lichens	25
25. Asci 8-spored; ascospores ellipsoid, oblong or somewhat sole or shoe-like, with rounded ends, (0–)1-septate, (8–)9.5–12.5(–15) × (3.5–)4–5(–7) µm. Lit.: Döbbeler (1984), Zhurbenko (2010a)	[<i>Epigloea soleiformis</i>]
25. Asci up to 50-spored; ascospores bacilliform with rounded ends or occasionally fusiform with acute ends, 1-septate, (6–)7–10(–11.5) × 1.5(–2) µm. Lit.: Döbbeler (1984)	[<i>Epigloea bactrospora</i> Zukal]
24. Without such combination of characters	26
26. Asci (8–)16-spored. Lit.: present paper	<i>Neolamyia ahtii</i>
26. Asci up to 8-spored	27
27. Interascal filaments absent	28
28. Asci 30–48 × 10–17 µm; ascospores (9–)11.5–14.5(–16.5) × (3–)3.5–4(–5) µm. Lit.: Zhurbenko & Diederich (2008), present paper	<i>Stigmatidium cladoniicola</i>
28. Asci 17–25 × 7–9 µm; ascospores (6–)6.5–7 × 2–2.5 µm. Lit.: Van den Boom (2016)	<i>Stigmatidium subcladoniicola van den Boom</i>
27. Interascal filaments present	29
29. Interascal filaments sparsely branched	30
30. Apical part of the ascal wall K/I (Melzer)+ blue; ascospores 3-septate, 13–14 × 5–5.5 µm. Lit.: Alstrup & Olech (1993) .	<i>Stellifraga cladoniicola</i> Alstrup & Olech
30. Asci K/I–; if ascospores 3-septate, then longer	31
31. Ascospores (0–)1-septate, (12–)13–16.5(–19) × (3.5–)4.5–5.5(–6) µm; exciple purplish brown. Lit.: Zhurbenko & Vershinina (2014)	<i>Cercidospora</i> sp.
31. Most ascospores with more than one septum, exciple only rarely purplish brown	32

32. Ascospores (0–)1–3-septate, (11–)13.5–17.5(–22) × (2.5–)4–5(–6) μm; exciple mainly olive to brown, sometimes partly reddish purple brown, grayish olive or blue-green. Lit.: Alstrup (1997), present paper	
.....	<i>Cercidospora cladoniicola</i>
32. Ascospores (1–)3–5(–6)-septate, (14–)18.5–25(–33) × (4–)4.5–6(–9) μm; exciple emerald to glaucous green. Lit.: Hafellner (1987), Zhurbenko (2012a), Zhurbenko & Triebel (2003)	[<i>Cercidospora punctillata</i> (Nyl.) R. Sant.]
29. Interascal filaments densely branched and anastomosed	33
.....	
33. Asci I+ blue, ascospores muriform	34
34. Distinctly lichenized. Note: the species mainly grows over bryophytes and only occasionally on lichens. Lit.: Mayrhofer & Poelt (1985)	
.....	[<i>Protothelenella leucothelia</i>]
34. Not lichenized or occasionally indistinctly lichenized	35
35. Lichenized thallus absent; ascospores with (0–)3–5(–7) transversal or oblique septa and usually 1 longiseptum in central segments, (14.5–)19.5–26(–31.5) × (6–)8.5–11.5(–16) μm. Lit.: Mayrhofer (1987), Zhurbenko & Alstrup (2004), present paper	
.....	<i>Protothelenella santessonii</i>
35. Lichenized thallus absent or membrane-like; ascospores with up to 10 transversal or oblique septa and 1 longiseptum in central segments, (22–)24.5–29(–33) × 6.5–7.5(–10) μm. Note: the species mainly grows over bryophytes and only occasionally on lichens. Lit.: Mayrhofer & Poelt (1985), Zhurbenko & Alstrup (2004)	
.....	[<i>Protothelenella sphinctrinoidella</i> (Nyl.) H. Mayrhofer & Poelt]
33. Asci I–, ascospores 1-septate	36
36. Ascomata 75–180 μm in diameter; ascospores narrowly obovoid with a somewhat wider upper cell, (8–)9.5–12.5(–15) × (2.5–)3–4(–4.5) μm. Lit.: Aptroot et al. (1997), present paper	
.....	<i>Zwackhiomyces diderichii</i>
36. Ascomata 300–425 μm in diameter; ascospores broadly fusiform, apices generally somewhat pointed, 12–19 × 3–5 μm. Note: known only from the type in the Subantarctic. Lit.: Hawksworth & Itturiaga (2006)	
.....	<i>Zwackhiomyces cladoniae</i> (C.W. Dodge) Diederich
22. Ascospores pigmented	37
37. Interascal filaments present	38

38. Ascospores submuriform with 3 transsepta and 1(–2) longisepta in central segments. Lit.: Halici et al. (2008)	
..... <i>Dacampia cladoniicola</i> Halici & A.Ö. Türk	
38. Ascospores transseptate	39
39. Ascomatal wall partly blue-green/green near ostiole; ascospores (19–)21.5–25.5(–28) × (8.5–)9–11(–11.5) µm, (1–)3-septate, sometimes with paler end cells. Lit.: Navarro-Rosinés & Roux (2007), present paper	[<i>Pyrenidium actinellum</i> s. lat.]
39. Ascomatal wall without blue-green/green parts; ascospores smaller, mainly with fewer than 3 septa, with concolorous end cells	40
40. Ascospores (6.5–)8.5–10.5(–14) × (3–)3.5–4.5(–5.5) µm, (0–)1(–3)-septate. Note: <i>Polycoccum laursenii</i> might be a heterotypic synonym of <i>Didymocyrtis consimilis</i> Vain. (Ertz et al. 2015). Lit.: Zhurbenko & Alstrup (2004), present paper	<i>Polycoccum laursenii</i>
40. Ascospores mainly longer than 11 µm	41
41. Ascomata more or less superficial at maturity. Lit.: Hawksworth & Diederich (1988)	
..... <i>Polycoccum cladoniae</i> Diederich & D. Hawksw.	
41. Ascomata immersed to slightly protruding	42
42. Ascomata 100–130 µm in diameter, with a neck 40–70 µm tall, scattered; ascospores 16.5–24(–28) × 4.5–5.5(–6) µm, (1–)3-septate. Lit.: present paper	
..... <i>Leptosphaeria</i> sp.	
42. Ascomata 30–70(–120) µm in diameter, without distinct neck, aggregated in groups; ascospores (12–)13–15(–17) × (4.5–)5–6(–7.5) µm, 1(–2)-septate. Lit.: Etayo & Diederich (1998), Flakus et al. (2008), present paper	<i>Polycoccum microcarpum</i>
37. Interascal filaments absent	43
43. Hymenial gel I–; ascospores 9–11.5 × 3–4 µm, 1(–3)-transseptate. Lit.: Etayo & Diederich (1998)	
..... <i>Sphaerellothecium cinerascens</i> Etayo & Diederich	
43. Hymenial gel I+ red; ascospores larger, with transversal and at least rarely with longitudinal septa	44
44. Ascospores (16.5–)20–24.5(–28.5) × (5.5–)7.5–9.5(–10.5) µm, muriform, with 3–8 transsepta and 1(–2) longitudinal or oblique septa in most segments. Lit. Triebel (1989), present paper	[<i>Merismatium</i> cf. <i>nigritellum</i>]
44. Ascospores smaller, if submuriform, then with less number of transsepta	45
45. Ascospores usually just transseptate, with (0–)1–3(–4) transsepta, rarely with 1(–2) longitudinal or oblique septa in central segments, (9.5–)11.5–14.5(–16.5) × (3.5–)4–5.5(–7) µm. Lit.: Alstrup (1997), Triebel (1989), Zhurbenko & Kobzeva (2014), present paper	[<i>Merismatium decolorans</i> (? syn. <i>Merismatium cladoniicola</i>)]
45. Ascospores often submuriform, with longitudinal septa in central segments	46

46. Ascospores (10.5–)12.5–17(–21) × (6–)7–8.5(–12) μm, with 2–6 trans- or oblique septa and 0–3 longisepta in central segments. Lit.: Triebel (1989), present paper [Merismatium coccisporum]
46. Ascospores generally smaller 47
47. Ascospores (8–)10–13(–16) × (4–)5–6.5(–7.5) μm, with 3–4 transsepta and sometimes 1–2 longisepta. Lit. Triebel (1989) [Merismatium heterophractum (Nyl.) Vouaux]
47. Ascospores 10.5–14.5 × 5.5–7 μm, with 3 transsepta and sometimes 1–2 longisepta in central segments. Lit.: Etayo & Sancho (2008) [Merismatium coccotremicola Etayo]

Key 4. Coelomycetes

1. Conidiomata stromatic 2
2. Conidia mainly 10–15 × 8.5–11 μm in diameter, composed of 8–17 cells (in optical section 6–10 cells) Lit.: Ertz et al. (2014) [Lichenostigma alpinum s. lat.]
2. Conidia mainly 14–23 × 10–16 μm in diameter, composed of 14–35 cells (in optical section 10–21 cells) Lit.: Ertz et al. (2014) [Lichenostigma maureri]
1. Conidiomata not stromatic 3
3. Conidiomata pycnidoid to sporodochioid (particularly at later stages) 4
4. Conidia very light to medium bluish green, angular subglobose, occasionally oblong or ovoid, aseptate. Lit.: present paper *Caeruleoconidia biazrovii*
4. Conidia not bluish green, bacilliform to filiform, septate 5
5. Conidia mainly 3–6-septate, mainly 35–71 μm long. Lit.: Diederich & Van den Boom (2013), present paper *Hainesia longicladoniae*
5. Conidia mainly 1-septate, shorter 6
6. Conidia mainly 12–16 μm long. Lit.: Diederich & Van den Boom (2013), present paper *Hainesia brevicladoniae*
6. Conidia mainly 17–25 μm long. Lit.: Zhurbenko & Brackel (2013), present paper [Hainesia cf. bryonorae]
3. Conidiomata never sporodochioid 7
7. Mature conidiomata containing spherical, elongate ellipsoid or obpyriform, (1–)2–4(–5)-celled macroconidia and subcylindrical, 1-celled microconidia. Lit.: Diederich & Sérusiaux (2003) *Stromatopogon cladoniae* Diederich & Sérus.
7. Conidiomata always with one kind of conidia 8
8. Conidiophores mainly composed of more than one cell; conidia hyaline, aseptate 9
9. Conidia reniform, lacrimiform, sometimes ellipsoid or oblong. Lit. Hawksworth (1981), present paper *Lichenosticta alcicorniaria*
9. Conidia Y-shaped 10
10. Main conidial axis (from the truncate base to the point at the apex where the conidium bifurcates) usually 6–11.5 × 1.5–2 μm, divergent apical arms gradually tapered. Lit.: Hawksworth (1976) [Cornutispora lichenicola D. Hawksw. & Sutton]
10. Main conidial axis usually 6.5–9 × 2–2.5 μm, divergent apical arms with bulbous bases and very narrow tubular apices. Lit.: Gierl & Kalb (1993), Punithalingam (2003) [Cornutispora ciliata Kalb]
8. Conidiophores mainly composed of one conidiogenous cell; conidia hyaline or pigmented, aseptate or septate 11

11. Conidia hyaline or (very rarely in *Epicladonia sandstedei*) light brown 12
12. Filiform paraphyses developing between the conidiogenous cells present; conidia with a minuscule apiculus bearing 2–3 divergent extracellular appendages. Lit.: Brackel (2009), Van den Boom et al. (1998) [*Pseudorobillarda peltigerae* Diederich]
12. Paraphyses absent; conidia without such appendages 13
13. Conidia often appearing H-shaped, with four cylindrical arms. Lit.: Diederich et al. (2001)
..... *Cladoniicola staurospora* Diederich, Van den Boom & Aptroot
13. Conidia without arms 14
14. Conidiogenous cells with 1–3 phialides. Lit.: Hawksworth (1981), Kocourková (2000)
..... *Keissleriomyces sandstedeanus* (Keissler) D. Hawksw.
14. Conidiogenous cells not polyphialidic 15
15. Conidia mostly lens-shaped, occasionally obpyriform or limoniform. Lit.: Hawksworth (1981), present paper
..... *Bachmanniomyces uncialicola*
15. Conidia not lens-shaped 16
16. Pycnidial wall K+ olivaceous; conidia usually slightly curved. Lit.: Diederich et al. (2012b)
..... [*Briancoppinsia cytospora* (Vouaux) Diederich, Ertz, Lawrey & van den Boom]
16. Pycnidial wall not K+ olivaceous; conidia usually straight ... 17
17. Pycnidial wall of *textura intricata*; conidiogenous cells annellate; conidia rounded at the apex and truncated at the base by a scar, usually not biguttulate 18
18. Conidia (0–)1-septate; usually inducing distinct galls. Lit.: Hawksworth (1981), present paper
..... *Epicladonia sandstedei*
18. Conidia exclusively or mainly aseptate; distinct galls absent 19
19. Conidia mainly narrower than 3 μm , (6.5–)7.5–8.5(–9.5) \times (2–)2.5–3(–3.5) μm , fusiform to occasionally almost oblong, aseptate; pycnidial wall partly blue-green or olivaceous green. Lit.: Hawksworth (1981), Ihlen & Wedin (2006), present paper *Epicladonia simplex*
19. Conidia mainly broader than 3 μm , (5.5–)7–9(–14.5) \times (2.5–)3–4(–4.5) μm , narrowly ellipsoid, oblong or slightly narrowly ovoid, occasionally rather irregular in shape, aseptate or in some specimens up to 10% 1-septate; pycnidial wall not blue-green or olivaceous green. Lit.: Hawksworth (1981), Sérusiaux et al. (2003), present paper
..... *Epicladonia stenospora* s. lat.
17. Pycnidial wall of *textura angularis*; conidiogenous cells not annellate; conidia rounded at both ends, usually biguttulate 20
20. Conidia 4–5 \times 1 μm . Lit.: Etayo (1996b), Hawksworth (1981) [*Phoma lichenis* Pass.]
20. Conidia broader 21
21. Conidia mainly 4–5 \times 1.5–2 μm . Lit.: Diederich et al. (2007) *Phoma grumantiana*
21. Conidia broader 22

	22. Conidia (3.5–)4–4.5 × 2.5–3 µm. Lit.: Ertz et al. (2015)	
	[<i>Didymocyrtis consimilis</i> Vain. s. lat., population on <i>Cladonia pocillum</i>]	
	22. Conidia longer	23
	23. Conidia broadly ellipsoid, mainly 4.5–6 × 2.5–3 µm, l/b = 1.7–2.2. Lit.: Diederich et al. (2007), Ertz et al. (2015)	
	[<i>Didymocyrtis cladoniicola</i>]	
	23. Conidia elongate ellipsoid, mainly 5.5–7 × 2–2.5 µm, l/b = 2.3–3.0. Lit.: Diederich et al. (2007), present paper	
	[<i>Didymocyrtis foliaceiphila</i>]	
11. Conidia pigmented		24
	24. Pycnidial wall partly greenish brown and dark bluish, K+ aeruginose. Lit.: Lawrey et al. (2011)	<i>Lichenoconium aeruginosum</i>
	24. Pycnidial wall brown throughout, K+ olivaceous	25
	25. Pycnidia mainly 30–50 µm in diameter; conidiogenous cells mainly up to 5 µm tall; strong pathogen. Lit.: Hawksworth (1977) ..	[<i>Lichenoconium erodens</i>]
	25. Pycnidia more than 50 µm in diameter; conidiogenous cells mainly more than 5 µm tall; weak pathogen	26
	26. Conidia mainly 2.5–3.5 × 2–2.5 µm, light to sometimes medium yellowish brown or occasionally subhyaline, pale in mass, usually indistinctly verruculose, often obovoid, attenuated and truncated at the base. Lit.: Hawksworth (1977), Lawrey et al. (2011), present paper.....	
	[<i>Lichenoconium pyxidatae</i>]	
	26. Conidia mainly 3.5–4 × 2.5–3.5 µm, light to mainly medium brown, usually distinctly verruculose, only occasionally obovoid, attenuated and truncated at the base. Lit.: Hawksworth (1977), Lawrey et al. (2011), present paper	[<i>Lichenoconium usneae</i>]

Key 5. Hyphomycetes

1. Conidiophores 15–25(–45) µm long, bearing above a cluster of conidiogenous cells that are initially enclosed in a hyaline, subspherical, membranous enveloping sheath 20–40 µm in diameter, finally disappearing. Lit.: Hawksworth & Etayo (2010)	
[<i>Calongeomyces gibelluloides</i> (D. Hawksw. & Etayo) D. Hawksw. & Etayo]	
1. Conidiogenous cells and conidia never enclosed in an enveloping sheath	2
2. Conidiophores at least sometimes sporodochioid (particularly at later stages)	3
3. Conidiomata pycnidoid to sporodochioid	4
4. Conidia very light to medium bluish green, angular subglobose, occasionally oblong or ovoid, aseptate. Lit.: present paper	<i>Caeruleoconidia biazrovii</i>
4. Conidia not bluish green, bacilliform to filiform, septate	5
5. Conidia mainly 3–6-septate, mainly 35–71 µm long. Lit.: Diederich & Van den Boom (2013), present paper	<i>Hainesia longicladoniae</i>
5. Conidia mainly 1-septate, shorter	6
6. Conidia mainly 12–16 µm long. Lit.: Diederich & Van den Boom (2013), present paper	<i>Hainesia brevicladoniae</i>
6. Conidia mainly 17–25 µm long. Lit.: Zhurbenko & Brackel (2013), present paper ..	[<i>Hainesia cf. bryonorae</i>]
3. Conidiomata constantly sporodochioid	7

7. Conidia with unevenly thickened wall with darker thickenings. Lit.: Etayo & Diederich (1996) ***Milospium lacoizquetae* Etayo & Diederich**
7. Conidia with evenly thickened and evenly pigmented wall 8
8. Conidia olive gray, with wall 1–2 µm thick. Lit.: present paper
..... ***Sclerococcum crassitunicatum***
8. Conidia brown, with wall up to 1 µm thick 9
9. Conidia (5.5–)7–18.5(–30) × (3.5–)5.5–13.5(–23.5) µm, ca. 2–50-celled. Lit.: present paper ***Sclerococcum epicladonia***
9. Conidia smaller, 1- or occasionally 2-celled 10
10. Sporodochia 7–20(–30) µm in diameter; conidia aseptate, 2.2–3 µm in diameter, smooth-walled, adhering in indistinct chains. Lit.: Diederich (2010), Diederich et al. (2013) ***Cladophialophora cladoniae***
10. Sporodochia (37–)49–79(–97) µm in diameter; conidia 0(–1)-septate, (3–)4–5(–5.5) × (3–)3.5–4.5(–5) µm (aseptate) or 5.5–7 × 3.5–5 (1-septate), with indistinctly verruculose wall, not adhering in chains. Lit.: present paper
..... ***Cladophialophora cf. cladoniae***
2. Conidiophores never sporodochioid 11
11. Conidia hyaline 12
12. Colonies very inconspicuous; conidiophores protruding, pale brown, 20–47 µm long, 1–3-septate, ending at the top by a lageniform phialide gradually narrowing to a deep cylindrical collarette 1.5–2 µm wide; conidia cylindrical with truncate ends, aseptate, 2.5–4 × 0.5–0.8 µm. Lit.: Christiansen (1993)
..... ***Chalara lichenicola* M.S. Christ.**
12. Species with a different combination of characters; conidia larger 13
13. Conidia 0–1-septate. Lit.: Hawksworth (1979), present paper
[*Acremonium lichenicola* W. Gams, see *Acremonium* sp. 2 in the catalogue above]
13. Conidia aseptate 14
14. Conidia (4–)4.5–5.5(–6.5) × 2–2.5(–3) µm, oblong. Note: possibly not truly lichenicolous. Lit.: present paper **[*Acremonium* sp. 1]**
14. Conidia 12–18 × 2–2.5 µm, elongate-cylindrical. Lit.: Hawksworth (1979) ...
[*Trichonectria rubefaciens* (Ellis & Everh.) Diederich & Schroers. anamorph, syn. *Acremonium rhabdosporum* W. Gams]
11. Conidia pigmented 15
15. Conidiophores immersed in the host tissues; conidia pale brown, subspherical to ellipsoid, 3–4.5 × 2.5–4 µm, 0(–1)-septate, in chains composed of up to 20 conidia. Lit.: Diederich (1990), Hawksworth & Cole (2002)
..... **[*Intralichen lichenum* (Diederich) D. Hawksw. & M.S. Cole]**
15. Conidiophores superficial; conidia different 16
16. Conidia in a well-defined head at the apex of the stipe 17
17. Conidiophores aggregated in synnemata; conidia cuneiform, 7.5 × 3.5–4 µm, smooth. Lit.: Alstrup & Hawksworth 1990, Diederich et al. (2012a)
..... **[*Graphium aphthosae* Alstrup & D. Hawksw.]**
17. Conidiophores not aggregated in synnemata; conidia spherical, 7–11 µm in diameter, verruculose to shortly echinulate. Note: the species mainly grows on dead herbaceous plants and only occasionally on lichens. Lit.: Ellis (1971)
..... **[*Periconia digitata* (Cooke) Sacc.]**
16. Conidia not in a well-defined head at the apex of the stipe 18
18. Conidiogenous cells polyblastic 19
19. Conidia (0–)3-septate, 9–14 × 3–4 µm. Lit.: Hawksworth (1979)
..... **[*Pseudocercospora lichenum* (Keissl.) D. Hawksw.]**
19. Conidia 0–2(–3)-septate 20

20. Conidia aseptate, 2–5(–7) × 2–3.5(–4) µm, broadly obovoid, occasionally subglobose, apex rounded, base rounded to somewhat attenuated, with rather inconspicuous basal hilum, arising singly; conidiogenous loci and hila not coronate. Lit.: Braun et al. (2009)
 ***Ramichloridium cladonicola* U. Braun & Heuchert**
20. Conidia 0–2(–3)-septate, 3.5–16 × 3–8 µm, subglobose, limoniform to ellipsoid-subcylindrical, ends rounded to slightly attenuated, with a single basal and 1–4 terminal hila, arising in branched acropetal chains; conidiogenous loci and hila coronate (with convex central dome surrounded by a raised rim). Lit.: Brackel (2009), Heuchert & Braun (2006)
 **[*Cladosporium licheniphilum* Heuchert & U. Braun]**
18. Conidiogenous cells monoblastic 21
21. Conidiogenous cells percurrently proliferating 22
22. Seccession schizolytic; conidia smooth-walled to often verruculose. Lit.: Diederich (1992), Zhurbenko & Braun (2013), present paper
 ***Taeniolella beschiana***
22. Seccession rhexolytic; conidia consistently smooth-walled 23
23. Conidiophores (70–)95–235(–250) µm long; conidia 11–21 × 5.5–10 µm, often minutely apiculate, (0–)1-septate, thin-walled, light brown, apical and basal cells more or less similar, basal cell mostly not collapsing. Lit.: Zhurbenko et al. (2015b)
 ***Endophraggiella stordeuriana***
23. Conidiophores (57–)66–107(–125) µm long; conidia (12.5–)15–16(–17.5) × (5–)6–7.5(–8.5) µm, non-apiculate, 1(–2)-septate, the apical cell brown to dark brown, thick-walled, 1.5–2 times larger than the basal cell, which is light brown to subhyaline, thin-walled, much smaller and often collapsed. Lit.: Brackel & Markovskaja (2009), Zhurbenko et al. (2015b)
 **[*Endophraggiella franconica* Brackel & Markovsk.]**
21. Conidiogenous cells not proliferating 24
24. Mycelium developing inside host's hyphae; conidia 0(–1)-septate, 7–8 × 3.5–4 µm (aseptate) or 11–14 × 3.5–4.5 µm (1-septate). Lit.: Alstrup (1993b) ***Taeniolella cladonicola* Alstrup**
24. Intracellular mycelium absent; conidia 1–2-septate, 8.5–12 × 5.5–6 µm. Lit.: Zhurbenko & Alstrup (2004) ***Taeniolella strictae* Alstrup**

DISCUSSION

Together with *Lecanora* s. lat., *Peltigera* and *Pseudocyphellaria*, *Cladonia* is one of the most 'hospitable' lichen genera for lichenicolous fungi (Lawrey & Diederich 2016). The key presented above includes 138 species of fungi known to occur on *Cladonia* worldwide, 128 (93% of the total number) of which are obligately lichenicolous, and 89 (64%) are known exclusively from this host genus. The ratio of 'host species to lichenicolous fungi species' for *Cladonia* is approximately 3.7. The species found on *Cladonia* that are not exclusively lichenicolous are *Anzina carneonivea*, *Coniochaeta* sp., *Epigloea soleiformis*, *E. bactrospora*, *Periconia digitata*, *Protothelenella leucothelia*, *P. sphinctrinoidella* and possibly *Acremonium* sp. 1. *Diploschistes muscorum* is an obligate juvenile parasite of lichens. Most of the species (95%) included in the key are non-lichenized, while *D. muscorum* and *P. leucothelia* produce a well-developed lichenized thallus (at least at later stages), and *A. carneonivea*, *Chaenothecopsis vinosa* and *P. sphinctrinoidella* are scarcely lichenized. *Epigloea bactrospora*, *E. soleiformis* and possibly *Graphium aphthosae* can be considered as algicolous species. Of the 128 species of lichenicolous fungi, seven (5% of the total number) are basidiomycetes and 121 (95%) are ascomycetes, of which 46 (36%) are represented by anamorphs.

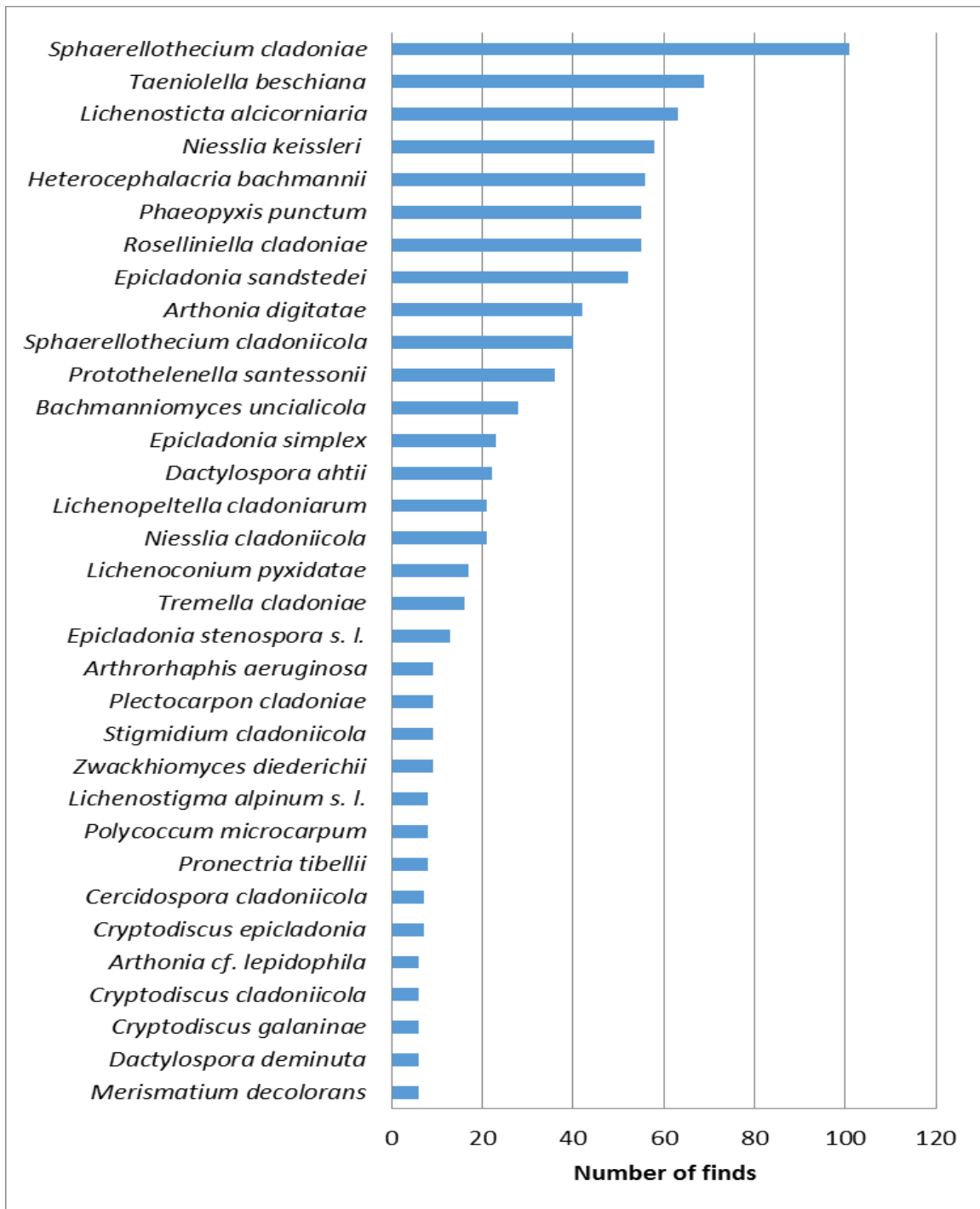


Figure 15. The most common lichenicolous fungi growing on *Cladonia* in the arctic and boreal regions of the Northern Hemisphere.

The actual diversity of lichenicolous fungi growing on *Cladonia* is expected to be much higher than summarized here. It is noteworthy that about 28% of cladoniicolous fungi have been recognized or described in the past 12 years. About 100 specimens examined by us could not be assigned to a given taxon with certainty and had to be left unnamed. These were not included in the synoptic key. Among these are numerous specimens with sterile dark green spots on basal squamules and occasionally podetia of various *Cladonia* species, many specimens of heterobasidiomycetes with morphological characters that are difficult to observe, a *Trimmatostroma*-like hyphomycete, a hyphomycete associated with *Roselliniella cladoniae* (Figure 10), a coelomycete with bacilliform (0–)1(–3)-transseptate conidia briefly described and illustrated above (Figure 14), and pycnidia associated with *Phaeopyxis punctum* (see notes under that species). Additionally, there are a number of reports of fungi from *Cladonia* species pending revision that were also not included in the key. These include *Arthonia* cf. *molendoi* (Frauenf.) R. Sant. (Alstrup & Hawksworth 1990), *A. pelvetii* (Hepp) H. Olivier (Alstrup & Hawksworth 1990), *Galloea cladoniicola* Alstrup & Søchting (Alstrup & Søchting 2009, Seifert et al 2011), *Hypoxylon lichenicolum* Höhn. (Höhnel 1927), *Lichenopeltella* sp. (Aptroot et al. 1997: 86–87), a species of *Lichenostigma* subgen. *Lichenogramma* (Zhurbenko & Brackel 2013), *Llimoniella groenlandiae* (Alstrup & D. Hawksw.) Triebel & Hafellner (Alstrup 1991), a *Monocillium* state of *Niesslia cladoniicola* (Hawksworth 1979), *Physalospora cladoniae* (Stein) Vouaux (Hoffmann & Hafellner 2000, Roux & Gueidan 2002), *Pseudocercospora lichenum* (Keissl.) D. Hawksw. (Hawksworth 1979), *Sclerococcum* sp. (Spribille et al. 2010), *Scutula cladoniarum* (Müll. Arg.) Rambold & Triebel ined. (Alstrup & Hawksworth 1990, Rambold & Triebel 1992), *Spilium epicladonia* H. Olivier (Diederich & Sérusiaux 2003), *Stigmatidium* sp. 1 (Brackel 2015), *Verrucaster lichenicola* Tobler (Hawksworth 1981), *Vouauxiomyces* sp. 1 (Etayo & Sancho 2008) and *Zwackhiomyces dispersus* (Körb.) Triebel & Grube (Alstrup & Hawksworth 1990).

Seven of the 65 species (11% of the total number) of obligately lichenicolous fungi documented herein are described as new to science. For comparison, similar revisions of lichenicolous fungi found on the macrolichen genera *Stereocaulon* and *Thamnia* revealed 14% and 30% of new species respectively (Zhurbenko 2010a, 2012a).

The most common lichenicolous fungi that grow on *Cladonia* in the comparatively well-studied arctic and boreal regions of the Holarctic are presented in Figure 15. Their frequency was estimated based on 1095 occurrences of which 614 were documented in the present paper and 481 were compiled from the literature (Alstrup 1993a, 1997, 2004; Alstrup & Ahti 2007; Alstrup & Cole 1998; Alstrup & Hawksworth 1990; Alstrup & Olech 1993; Alstrup et al. 2000, 2005, 2008, 2009; Berger 2000; Brackel 2010a, 2011; Christiansen 1993; Diederich 1996, 2003; Diederich et al. 2007; Dillman et al. 2012; Ertz et al. 2005; Etayo & Breuss 1998; Hansen & Alstrup 1995; Hawksworth 1981; Heiðmarsson et al. 2012; Himelbrant et al. 2013; Ihlen & Wedin 2005, 2006; Matzer & Hafellner 1990; Motiejūnaitė & Kukwa 2008; Pippola & Kotiranta 2008; Rambold & Triebel 1990; Spribille et al. 2010; Stepanchikova & Himelbrant 2011; Titov 2006; Zhurbenko 1998, 2001, 2004, 2008, 2009a, 2009b, 2012b, 2013; Zhurbenko & Alstrup 2004; Zhurbenko & Brackel 2013; Zhurbenko & Braun 2013; Zhurbenko & Davydov 2000; Zhurbenko & Diederich 2008; Zhurbenko & Dillman 2010; Zhurbenko & Hafellner 1999; Zhurbenko & Himelbrant 2002; Zhurbenko & Laursen 2003; Zhurbenko & Pospelova 2001; Zhurbenko & Santesson 1996; Zhurbenko & Vershinina 2014; Zhurbenko & Yakovchenko 2014; Zhurbenko & Zhdanov 2013; Zhurbenko & Zheludeva 2015; Zhurbenko et al. 2005, 2012a, 2012b, 2015b).

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