

## *Tretomyces* gen. novum, *Byssocorticium caeruleum* sp. nova, and new combinations in *Dendrothele* and *Pseudomerulius* (Basidiomycota)

Heikki Kotiranta<sup>1,\*</sup>, Karl-Henrik Larsson<sup>2</sup>, Reima Saarenoksa<sup>3</sup> & Matti Kulju<sup>4</sup>

<sup>1)</sup> Finnish Environment Institute, Research Department, P.O. Box 140, FI-00251 Helsinki, Finland (\*corresponding author's e-mail: heikki.kotiranta@ymparisto.fi)

<sup>2)</sup> Natural History Museum, University of Oslo, P.O. Box 1172 Blindern, N-0318 Oslo, Norway

<sup>3)</sup> Finnish Museum of Natural History, Botanical Museum, P.O. Box 7, FI-00014 University of Helsinki, Finland

<sup>4)</sup> Ylispuuntie 13, FI-90420 Oulu, Finland

Received 1 June 2009, revised version received 30 Sep. 2009, accepted 13 Oct. 2009

Kotiranta, H., Larsson, K.-H., Saarenoksa, R. & Kulju, M. 2011: *Tretomyces* gen. novum, *Byssocorticium caeruleum* sp. nova, and new combinations in *Dendrothele* and *Pseudomerulius* (Basidiomycota). — *Ann. Bot. Fennici* 48: 37–48.

One new genus, *Tretomyces* K.H. Larss., Kotir. & Saaren., and two new species, *Tretomyces microsporus* Kotir., Saaren. & K.H. Larss., and *Byssocorticium caeruleum* Kotir., Saaren. & K.H. Larss. are described and illustrated. Three new combinations, *Tretomyces lutescens* (J. Erikss. & Ryvardeen) K.H. Larss., Kotir. & Saaren., *Dendrothele minutissima* (Höhn. & Litsch.) Kotir., K.H. Larss. & Saaren. and *Pseudomerulius montanus* (Burt) K.H. Larss., Kotir. & Kulju, are proposed.

Key words: Atheliaceae, Corticiaceae, fungi, new taxa, *Tapinella*, taxonomy

### Material and methods

The material studied is preserved in the herbaria C, FH, GB, H, JOE, K, OULU and/or in the reference herbarium of Heikki Kotiranta (H.K.).

Thirty spores per specimen were measured; the measurements were made in Cotton Blue (CB). Other mounting media used were Melzer's reagent (IKI) and 5% potassium hydroxide (KOH) (see Table 1). None of the measurements derive from spore prints.

The biological provinces and collecting sites in Finland are indicated according to the Finnish national uniform grid system (27°E), applied to

biological material by Heikinheimo and Raatikainen (1981).

The nomenclature for fungi follows Hjortstam (1998) and for vascular plants Hämet-Ahti *et al.* (1998). The authors of plant and fungus names are found in those publications and are not repeated here. The epithets “*Picea*” and “*spruce*” refer to *Picea abies*, “*Pinus*” to *Pinus sylvestris* and “*birch*” to *Betula* spp.

Eighteen specimens representing several genera in Atheliales (Hibbett *et al.* 2007) were selected for the phylogenetic analysis. *Leucogyrophana sororia* from Boletales and *Sistotrema oblongisporum* from Cantharellales were chosen

as outgroup in accordance with the results from several studies on basidiomycete phylogeny (e.g. Larsson *et al.* 2004, Larsson 2007). Specimens used in the phylogenetic analysis are listed in Table 2 together with their corresponding GeneBank numbers.

DNA from the nuclear ribosomal ITS and LSU regions were sequenced. Protocols for DNA extractions, PCR reactions, and sequencing follow Larsson and Larsson (2003) and Larsson and Örstadius (2008). Primers used to amplify the complete ITS region and the 5' end of the LSU region were ITS1F (Gardes & Bruns 1993) and LR21, LR0R and LR7 (Hopple & Vilgalys 1999). Primers used for sequencing were ITS1,

ITS3, ITS4 (White *et al.* 1990), Ctb6 (<http://plantbio.berkeley.edu/~bruns/>), Lr5 and LR3R (Hopple & Vilgalys 1999).

Sequences were aligned manually using the editor in PAUP\* (Swofford 2003). After aligning, the matrix had 1825 nucleotide sites including the gaps. The ITS2 region was deemed too variable and was excluded. Of the remaining 1042 sites, 773 were constant and 117 parsimony informative.

## Results

A heuristic maximum parsimony search with

**Table 1.** Spore dimensions of the studied specimens. The values set in boldface are for at least 90% of the spores. Abbreviations: *L* = spore length, *L\** = spore mean length, *W* = spore width, *W\** = spore mean width, *Q* = range of the variation in *L/W* ratio, *Q\** = quotient of the spore mean length and width (*L/W*), R.S. = Reima Saarenoksa, H.K. = Heikki Kotiranta.

	<i>L</i>	<i>L*</i>	<i>W</i>	<i>W*</i>	<i>Q</i>	<i>Q*</i>
<b><i>B. caeruleum</i></b>						
R.S. 09400 & H.K.	(4.5–) <b>4.8–5.5</b> (–5.9)	5.1	<b>4.4–5.2</b> (–5.7)	4.9	1–1.2	1
H.K. 16865 & R.S.	<b>4.7–5.5</b> (–5.8)	5	(4.3–) <b>4.5–5</b> (–5.4)	4.7	1–1.2	1.1
H.K. 20448 & R.S.	<b>4.4–5</b> (–5.2)	4.8	<b>4.2–5</b>	4.6	1–1.1	1
H.K. 22406 & R.S.	<b>4–5.1</b>	4.6	(3.8–) <b>4–4.8</b> (–5)	4.4	1–1.1	1
<b><i>T. lutescens</i></b>						
Hauerslev 4537	<b>3–3.2</b> (–3.4)	3.1	<b>2.5–2.9</b>	2.7	1–1.2	1.1
Stokland 14310	<b>3–3.4</b> (–4)	3.2	<b>2.7–3</b>	2.8	1–1.4	1.1
E. Larsson 39B–04	<b>2.8–3.5</b>	3.1	<b>2.5–3</b>	2.7	1–1.3	1.2
Lundell 3094	<b>3–3.5</b>	3.2	(2.5–) <b>2.7–3.1</b>	2.9	1–1.2	1.1
Hallenberg GB 22249	<b>3–3.5</b>	3.2	<b>2.5–3</b>	2.7	1.1–1.4	1.2
<b><i>T. microsporus</i></b>						
Hauerslev 1525	<b>2.1–2.7</b> (–3)	2.4	<b>1.9–2.3</b> (–2.6)	2.2	1–1.3	1.1
Junninen 3245c	<b>2–2.5</b> (–2.7)	2.3	<b>2–2.3</b> (–2.7)	2.2	1–1.1	1
Junninen 3410c	<b>2.1–2.7</b>	2.4	<b>1.9–2.4</b>	2.2	1–1.3	1.1
Høgholen 100/76	<b>2.1–2.5</b> (–2.7)	2.4	<b>1.9–2.3</b>	2.1	1–1.3	1.1
<b><i>D. minutissimum</i></b>						
v. Höhnelt 18.X.1903	(10.8–) <b>11–15</b> (–15.5)	13.4	(8.7–) <b>10–12.5</b> (–12.7)	11	1–1.6	1.2
H.K. 22298 & R.S.	(10.8–) <b>11–15.5</b> (–16)	13	(8.2–) <b>8.5–10.7</b> (–10.9)	9.7	1.1–1.8	1.3
H.K. 16682	(11.2–) <b>11.5–14</b> (–15)	12.6	(9–) <b>10–14.2</b> (–15.5)	11.5	0.9–1.6	1.1
H.K. 16694	(9.8–) <b>11–14.5</b>	12.4	<b>8–11</b> (–12.1)	9.8	1.1–1.5	1.3
H.K. 22297	(10.5–) <b>11.7–17</b> (–17.5)	13	(8–) <b>9–12</b>	10.2	1.1–1.8	1.3
H.K. 16658	(9.5–) <b>11.5–16.1</b> (–18.5)	13.2	(8–) <b>10–12.6</b>	11.5	0.9–1.7	1.2
H.K. 16659	(8.6–) <b>10–13.7</b> (–14.2)	11.8	(9–) <b>10–12.5</b> (–13)	11	0.9–1.2	1.1
P.Karst. 14.X.1888	(9.5–) <b>10.8–14.5</b> (–15)	11.9	(8–) <b>9–12.1</b>	10.5	1–1.4	1.1
H.K. 16641	(12.5–) <b>13–15</b> (–16)	14.3	(9.6–) <b>10.1–13.2</b> (–14)	12.3	1–1.4	1.2
H.K. 16646	(10–) <b>10.5–14</b> (–15)	12.3	(9.3–) <b>10–13.8</b> (–14.3)	11.7	0.9–1.2	1
H.K. 20369	(11.6–) <b>12.5–15</b> (–16)	13.5	(10–) <b>11–13.5</b> (–15)	11.9	0.9–1.5	1.1
<b><i>P. montanus</i></b>						
Junninen 2990	<b>2.8–3.2</b>	3	<b>1.9–2.3</b>	2.1	1.3–1.6	1.4
Junninen 2998a	<b>2.6–3.2</b>	2.9	<b>1.9–2.2</b> (–2.5)	2.1	1.2–1.5	1.4
Kulju 20/05	(2.8–) <b>2.9–3.1</b> (–3.3)	3	(1.8–) <b>1.9–2.1</b>	2	1.4–1.7	1.5
Kulju 85a/01	<b>2.8–3.1</b> (–3.3)	3	<b>1.9–2.3</b>	2.1	1.3–1.6	1.4
Kulju 16/03	<b>2.7–3.2</b> (–3.5)	3	<b>1.9–2.2</b>	2.1	1.2–1.7	1.4
Kulju 55/04	<b>3–3.6</b> (–3.8)	3.3	<b>2–2.5</b> (–2.7)	2.3	1.3–1.6	1.4

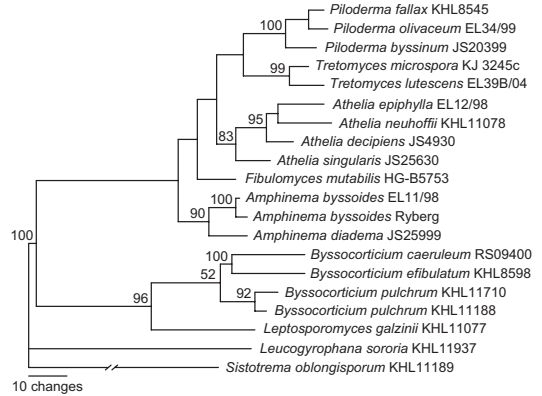
1000 random-addition sequence replicates and TBR branch swapping was performed in PAUP\*. All transformations were considered unordered and equally weighted and gaps were treated as a fifth character. Relative robustness of clades was assessed by bootstrap using 1000 heuristic search replicates with 100 random taxon addition sequence replicate.

The parsimony analysis generated two equally short, most parsimonious trees, one of which is shown in Fig. 1 as a phylogram. The ingroup is recovered as monophyletic as are the genera *Piloderma*, *Athelia*, and *Amphinema*. The new genus *Tretomyces* is also strongly supported and recovered as a sister group to *Piloderma*. The new species *Byssocorticium caeruleum* differs clearly from the other species included but monophyly of *Byssocorticium* is not supported.

## Taxonomy

***Byssocorticium caeruleum*** Kotir., Saaren. & K.H. Larss., *sp. nova* (Figs. 2–4)

*Fungus resupinatus, fructificatio byssoidea, caesia; systema hypharum monomiticum, hyphis efibulatis. Cystidia nulla. Basidia clavata vel*



**Fig. 1.** One of the two equally shortest trees from a heuristic maximum parsimony search of selected representatives from Atheliales. Shown is the phylogram with bootstrap values above 50% indicated on branches.

*subcylindracea, 22–30 × 6–7 µm. Sporae globosae, subglobosae vel pyriformes, 4.5–5.5 × 4.5–5.2 µm, laeves, tunicis incrassatis, non amyloideae, cyanophilae.*

**HOLOTYPE:** Finland. Varsinais-Suomi: Tammissaari, Tenhola, Lökkudden Nature Reserve, moist grass-herb forest on decorticated, hard *Quercus robur* branch on the ground, 60°02'N, 23°01'E (Grid 27°E 6665:278), 13.X.2000 *Saaren-okska* 09400 & Kotiranta (H).

**ETYMOLOGY:** *caeruleum* (lat.) refers to the blue colour of the basidiocarp.

**Table 2.** Specimens used for the phylogenetic analysis.

Name	Collection	Origin	Herbarium	GenBank no.
<i>Amphinema byssoides</i>	EL 11/98	Estonia	GB	AY463375/AY586626
<i>Amphinema byssoides</i>	Ryberg	Sweden	GB	GQ162810
<i>Amphinema diadema</i>	JS 25999	Norway	GB	GQ162811
<i>Athelia decipiens</i>	JS 4930	Norway	GB	AY463381/AY586632
<i>Athelia epiphylla</i>	EL 12/98	Estonia	GB	AY463382/AY586633
<i>Athelia neuhoffii</i>	KHL 11077	Sweden	GB	GQ162812
<i>Athelia singularis</i>	JS 25630	Norway	GB	GQ162813
<i>Byssocorticium caeruleum</i>	RS 09400	Finland	H	GQ162814
<i>Byssocorticium efibulatum</i>	KHL 8598	Norway	GB	GQ162815
<i>Byssocorticium pulchrum</i>	KHL 11710	Finland	GB	AY463388/AY586639
<i>Byssocorticium pulchrum</i>	KHL 11188	Sweden	GB	GQ162816
<i>Fibulomyces mutabilis</i>	HG-B 5753	Germany	GB	GQ162817
<i>Leptosporomyces galzinii</i>	KHL 11079	Sweden	GB	EU118642
<i>Leucogyrophana sororia</i>	KHL 11937	Sweden	GB	GQ162818
<i>Piloderma byssinum</i>	JS 20399	Norway	GB	DQ469281
<i>Piloderma fallax</i>	KHL 8545	Sweden	GB	DQ469285
<i>Piloderma olivaceum</i>	EL 34/99	Estonia	GB	DQ469289
<i>Sistotrema oblongisporum</i>	KHL 11189	Sweden	GB	GQ162819
<i>Tretomyces lutescens</i>	EL 39B/04	Sweden	GB	GQ162820
<i>Tretomyces microspora</i>	KJ 3245c	Finland	H	GQ162821

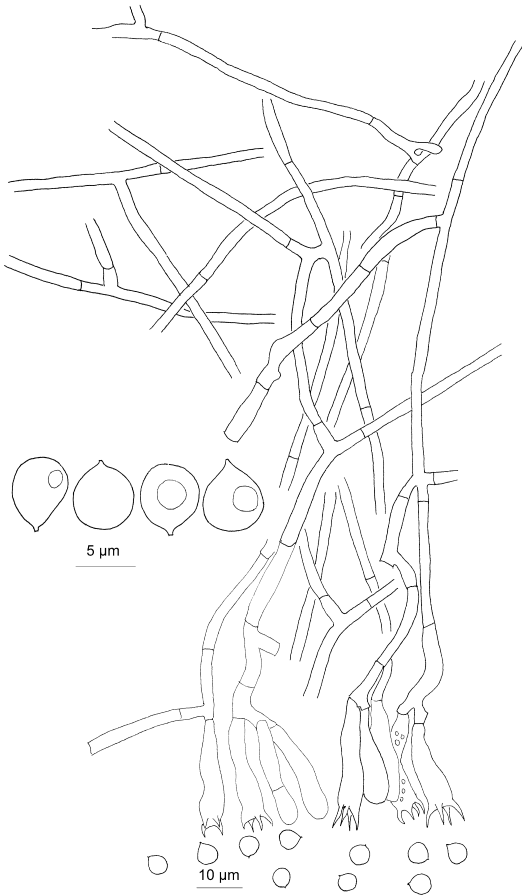


Fig. 2. *Byssocorticium caeruleum* (from the holotype). Section through basidiocarp and spores.

Basidiocarp resupinate, soft, hypochnoid or felt-like, fairly thick, loosely attached to the substrate. Hymenium when fresh turquoise blue, clay blue or dark ink-blue when dry, subiculum ink-blue, darker than the hymenium. Margin in vividly growing specimens delicately cottony, in old basidiocarps abrupt.

Hyphal system monomitic, all hyphae simple septate, IKI green, cyanophilous, sometimes slightly encrusted. Subicular hyphae with thickened walls, 2–2.5  $\mu\text{m}$  wide, contextual hyphae fairly thick-walled (up to 0.4  $\mu\text{m}$  thick) 3–3.5  $\mu\text{m}$  wide, anastomosing, subhymenial hyphae fairly thin-walled, (3.5–)4–4.5  $\mu\text{m}$  wide. Cystidia or hyphidia none. Basidia basally simple-septate, clavate or subcylindrical, (20–)22–30(–38)  $\times$  (5.5–)6–7  $\mu\text{m}$ , with four, up to 5  $\mu\text{m}$  long sterigmata. Spores globose, subglobose, pyriform or

drop-shaped, 4.5–5.5  $\times$  4.5–5.2  $\mu\text{m}$ , with slightly thickened wall, cyanophilous, IKI and KOH greenish, with a very small apiculus.

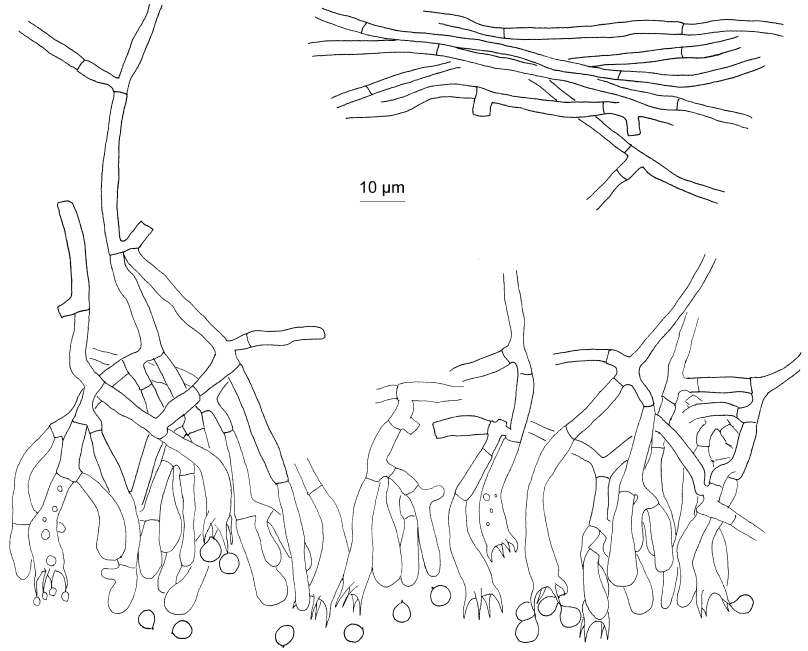
*Byssocorticium caeruleum* shares the bluish colour of *B. atrovirens* and *B. pulchrum*. It is distinguished from them in being simple-septate throughout and the spore size in the former is smaller, about 3.5–4  $\times$  3.3–4  $\mu\text{m}$  and in the latter larger, about 5.5–6  $\times$  5–5.6  $\mu\text{m}$  in Finnish material. *Byssocorticium efibulatum* is bluish as well, and without clamp connexions, but the spores are of the same size as in *B. atrovirens* (Hjortstam & Ryvardeen 1978). The results of the molecular phylogenetic analysis support the conclusion that *Byssocorticium caeruleum* is distinct from *B. efibulatum* and *B. pulchrum*. Other clampless species are *B. californicum* (Jülich 1972) and *B. neomexicanum* (Gilbertson & Budington 1970), both described from the United States. The spores of *B. californicum* are broadly ellipsoid, partly ovoid or pyriform, 3.5–4.2  $\times$  2.5–3.2  $\mu\text{m}$  (Jülich 1972), thus being smaller than in *B. caeruleum*.

*Byssocorticium neomexicanum* has thin-walled, ellipsoid spores, 5–7  $\times$  2.5–3.5  $\mu\text{m}$  (Gilbertson & Budington 1970, Jülich 1973) and does thus not fit in the concept of the genus. Later Jülich (1981) described the genus *Caerulium* with *B. neomexicanum* as the type species. The genus was accepted by Hjortstam (1998).

*Byssocorticium coprophilum* was chosen as the type species of the genus *Dacrybasidium* (Jülich 1981). However, due to the characteristic basidial cyanophilous granulation it was combined in *Cristinia* and *Dacrybasidium* is considered to be a synonym of *Cristinia* (Hjortstam & Grosse-Brauckmann 1993). Jülich (1981) combined also *Byssocorticium lutescens* in *Dacrybasidium*, a solution which was not accepted by Hjortstam (1993).

ADDITIONAL SPECIMENS EXAMINED (paratypes): **Finland.** Varsinais-Suomi: Tammisaari, Tenhola, Lökudden Nature Reserve, moist grass-herb forest on decorticated, hard *Quercus robur* branch on the ground, 60°02'N, 23°01' E (Grid 27°E 6665:278), 13.X.2000 Saarenoksa 09400 & Kotiranta (H, holotype, GB isotype) and same place and date, on advanced decayed, decorticated *Quercus*, Kotiranta 16865 & Saarenoksa (GB, H, H.K.), and approximately same place, dryish grass-herb forest, on relatively hard *Quercus* branch together with *Junghuhnia nitida*, 1.IX.2004 Kotiranta 20448 & Saarenoksa (H) and on relatively hard *Quercus* branch, 16.IX.2008 Kotiranta 22406 & Saarenoksa (H.K.).





**Fig. 3.** *Byssocorticium caeruleum* (from Kotiranta 16865 & Saarenoksa). Section through basidiocarp and spores.



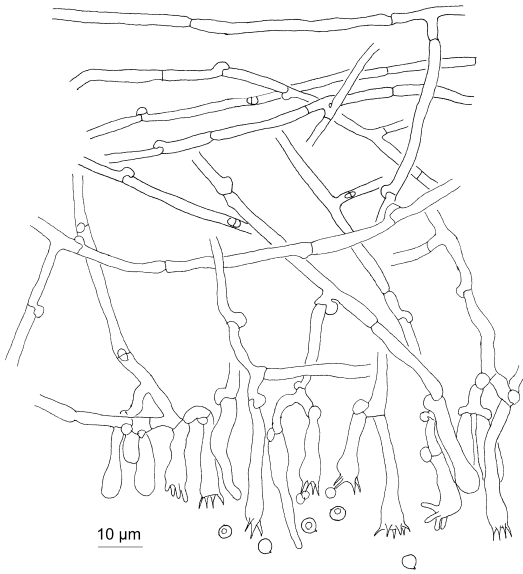
**Fig. 4.** *Byssocorticium caeruleum* in situ (Kotiranta 16865 & Saarenoksa). (Photo Heikki Kotiranta).

***Tretomyces*** K.H. Larss., Kotir. & Saaren.,  
*gen. novum*

*Fungus byssoideus, luteoochraceus vel argillaceus; systema hypharum monomiticum, hyphis partim fibulatis partim efibulatis. Cystidia nulla. Basidia clavata vel subcylindracea. Sporae glo-*

*bosae vel subglobosae, laeves, tunicis incrassatis, non amyloideae, cyanophilae.*

Basidiocarp byssoid, yellowish or greyish; hyphal system monomitic, hyphae partly clamped, partly simple septate. Cystidia none. Basidia clavate or subcylindrical. Spores globose or subglo-



**Fig. 5.** *Tretomyces lutescens* (from Lundell 3094, isotype). Section through basidiocarp showing basidia, a finger-like hyphidium and spores.

bose, smooth with thickened walls, inamyloid, cyanophilous.

**ETYMOLOGY:** *Tretomyces* (Gr.) from *tretos* = bored, perforated and *mykes* = fungus. The name refers to the porose-reticulate basidiocarp.

**GENERIC TYPE:** *Byssocorticium lutescens* J. Erikss. & Ryvar den

***Tretomyces lutescens* (J. Erikss. & Ryvar den) K.H. Larss., Kotir. & Saaren., *comb. nova* (Fig. 5)**

**BASIONYM:** *Byssocorticium lutescens* J. Erikss. & Ryvar den, Corticiaceae of North Europe 2: 185. 1973.

Basidiocarp effused, relatively thick, soft, felty, byssoid, hypochnoid, in thinnest parts arachnoid, porose-reticulate, loosely attached to the substrate. Hymenium smooth, gloomy, yellowish ochre to pale yellowish, subiculum slightly paler, margin with a few rhizomorphs.

Hyphal system monomitic, hyphae with clamp connexions but not at every septa, smooth, cyanophilous. Subicular hyphae straight, with thickened walls, clamps at many septa (60%), anastomosing, 2–3  $\mu\text{m}$  wide, contextual hyphae thinner-walled, 3–3.5  $\mu\text{m}$  wide, subhymenial hyphae thin-walled,

mostly short-celled, richly branched and clamped, (3–)3.5–4  $\mu\text{m}$  in diam. Cystidia none, but finger-like hyphidia sometimes present between basidia. Basidia normally basally clamped, when mature stalked, clavate, (13–)14.5–18  $\times$  4–4.5  $\mu\text{m}$  (rarely up to 28  $\mu\text{m}$  long) with 4 (very seldom 3 or 6), up to 4.5  $\mu\text{m}$  long, narrow sterigmata. Spores globose, subglobose, drop-shaped, ovoid or broadly ellipsoid, 3–3.5  $\times$  2.7–2.9  $\mu\text{m}$ , with thickened walls, CB+, IKI–, KOH hyaline.

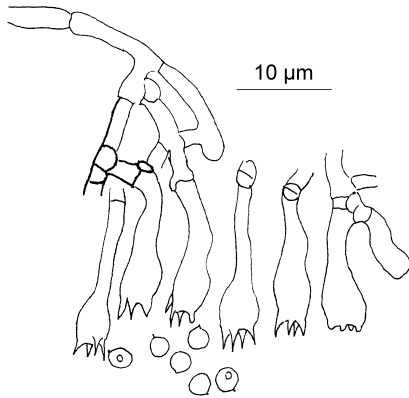
*Tretomyces lutescens* is characterized by a yellowish, soft, byssoid basidiocarp, monomitic hyphal system, hyphae with both clamped and simple septa, stalked, relatively small basidia and small, almost spherical, slightly thick-walled cyanophilous spores. As already stated by Eriksson and Ryvar den (1973) it lacks the typical bluish-green colour of *Byssocorticium* and on sight it reminds of *Amphinema*. Microscopically it is reminiscent of *Piloderma*, which, however, is simple-septate throughout (Eriksson & Ryvar den 1973).

**SPECIMENS EXAMINED:** **Denmark.** Sjælland: Tisvilde Hegn, on strongly decayed white rotted wood, 56°01'N, 12°05'E, 29.VIII.1965 *Hauerslev 4537* (GB 0052594). **Norway.** Akershus: Enebakk, Skredderstad, on advanced decayed *Picea abies*, 59°45'N, 11°08'E, 25.VIII.1997 *Stokland 14310 et al.* (GB 0052596), Akershus: Hurdal, Tømte, on hard, decorticated *Picea* and mostly on litter, 60°26'N, 11°04'E, 3.IX.2004 *E. Larsson 39B-04* (GB 005296). **Sweden.** Småland: Almersåkra par., Södratorp SE, on mosses and decayed *Betula* trunk, 59°05'N, 13°07'N, 21.X.1947 *Lundell* (GB 0052593, isotype), Småland: Ramskulla par., Norra Kivill Nat. Park, mixed *Picea–Pinus* forest with *Hylocomium splendens* and *Vaccinium myrtillus*, on decayed *Pinus* trunk, 57°45'N, 15°35'E, 15.X.1972 *Hallenberg* (GB 0052592).

***Tretomyces microsporus* Kotir., Saaren. & K.H. Larss., *sp. nova* (Figs. 6–7)**

*Fungus resupinatus, fructificatio byssoidea, argillacea; systema hypharum monomiticum, hyphis fibulatis vel efibulatis. Cystidia nulla. Basidia clavata vel subcylindracea, 10–15  $\times$  3.5–4.5  $\mu\text{m}$ . Sporae globosae vel subglobosae, 2–2.5  $\times$  2–2.3  $\mu\text{m}$ , laeves, tunicis incrassatis, non amyloideae, cyanophilae.*

**HOLOTYPE:** Norway. Hedmark, Løten, vest Grefsum, on *Pinus* bark 12.X.1976 *Høgholen 100/76* (K).



**Fig. 6.** *Tretomyces microsporus* (from the holotype). Basidia and spores.

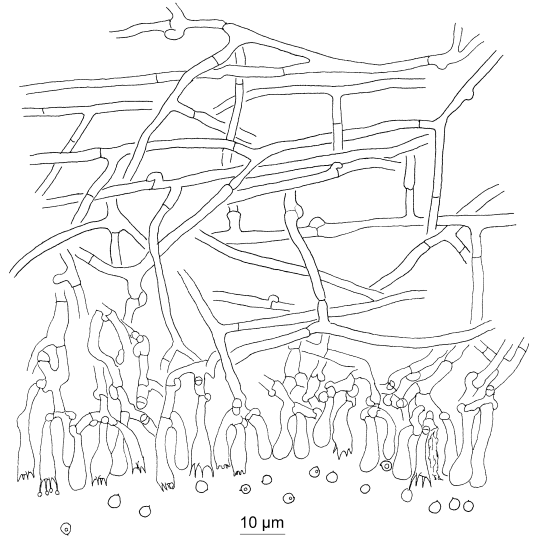
ETYMOLOGY: *microsporus* refers to the very small spores.

Basidiocarp small, thin, soft, byssoid, porose-reticulate under the lens or almost smooth with a few minute warts, pale yellow, pale brownish or yellowish white, subiculum pale yellow ochre, darker than hymenium, margin distinct or with a few rhizomorphs or fine hyphal strands, easily detachable from the substrate.

Hyphal system monomitic, hyphae with clamp connexions but not at every septa, smooth, cyanophilous. Subicular hyphae sparingly branched, clamps at a few septa, but mostly simple septate, (1.5–)2–3  $\mu\text{m}$  wide, thin- to slightly thick-walled, cyanophilous. Contextual hyphae mostly simple septate, fairly thin-walled, (2–)2.5–3(–3.5)  $\mu\text{m}$  wide. Subhymenium relatively tight, hyphae richly branched and clamped, thin-walled, 2–3  $\mu\text{m}$  wide. Cystidia none. Basidia basally clamped, or occasionally simple septate, subcylindrical or clavate, fairly often stalked, (9.5–)10–15(–18)  $\times$  3.5–4.5(–5)  $\mu\text{m}$ , with four, up to 4  $\mu\text{m}$  long needle-like sterigmata. Spores very small, globose or subglobose, 2–2.5  $\times$  2–2.3  $\mu\text{m}$ , with a small apiculus, slightly thick-walled, CB+, IKI–.

Principally, *Tretomyces microsporus* is distinguished by its very small, globose, cyanophilous spores, monomitic hyphal system with both clamp connexions and simple septa, small basidia and the somewhat brownish basidiocarp. *Tretomyces lutescens* is more bright yellow and its spores are larger.

The Danish specimen grew together with *Ascocorticium vermisporum*, like one Finnish



**Fig. 7.** *Tretomyces microsporus* (from *Hauerslev 1525*). Section through basidiocarp with spores.

specimen. The habitats of the Finnish material are common, acid pine-dominated heath forest site types.

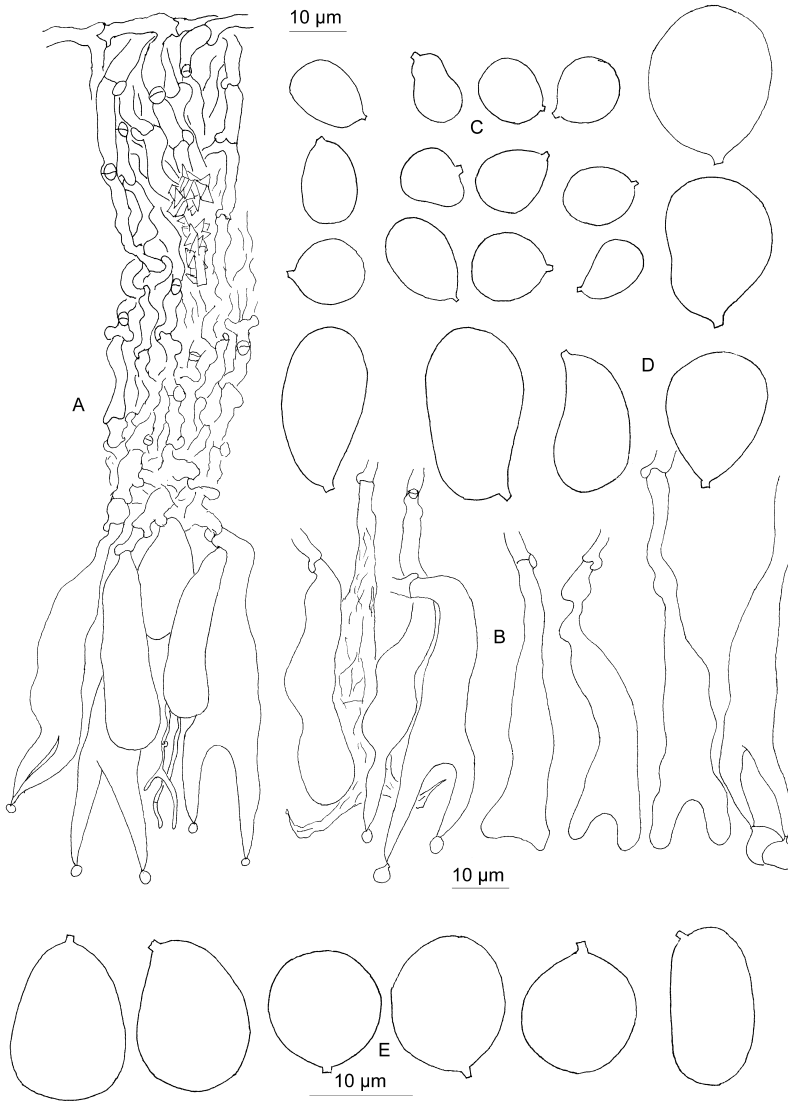
ADDITIONAL SPECIMENS EXAMINED (paratypes): **Denmark.** Falster, Bøtø, on advanced decayed *Pinus* needles together with *Ascocorticium vermisporum*, 54°38'N, 11°45'E, 8.X.1956 *Hauerslev 1525* (C). **Finland.** Pohjois-Karjala: Lieksa Tiiliniemi, 60–80 years old *Pinus sylvestris* dominated forest, on charred *Pinus* together with *Ascocorticium vermisporum*, *Sistotrema alboluteum* and *Trechispora farinacea*, 63°13'N, 30°55'E (Grid 27°E 70028:6584), 28.VIII.2002 *Junninen 3245c* (GB, H.K., JOE) and approximately same place, 35–40-year-old poor *Pinus* forest, on advanced decayed pine together with *Ceraceomyces microsporus* and *Phlebiella sulphurea*, Grid 27°E 70026:6576, *Junninen 3410c* (H., H.K., JOE). **Norway.** Hedmark, Løten, vest Grefsum, on *Pinus* bark, 60°49'N, 11°20'E, 12.X.1976 *Høgholen 100/76* (K, holotype).

***Dendrothele minutissima*** (Höhn. & Litsch.) Kotir., K.H. Larss. & Saaren., *comb. nova* (Fig. 8)

BASIONYM: *Corticium minutissimum* Höhn. & Litsch., *Wiesner Festschrift*: 65. 1908.

LECTOTYPE (selected here): Austria, Wien, Prater, on *Acer*, *Ulmus*, 18.X.1903 von *Höhnel* (FH).

Basidiocarp resupinate, relatively thick, closely adnate, orbicular, forming small patches, 1–2 mm across, white when young, later pale



**Fig. 8.** *Dendrothele minutissima* (A–C from Kotiranta 22297, D from Kotiranta 22298 & Saarenoksa, E from v. Höhnelt 18.X.1903, lectotype). — A: Section through basidiocarp. — B: Bisterigmatic basidia of different stages of development. C–E: Spores.

fawn or pale buff under the lens. Margin not differentiated, distinct.

Hyphal system monomitic, hyphae thin- to fairly thin-walled, CB+ (not strongly). Subicular hyphae tightly interwoven, richly clamped, (1.5–)2–3.5(–4)  $\mu\text{m}$ , often intermixed with large crystalline lumps which at least partly dissolve in CB. Subhymenial hyphae very difficult to see, richly branched and clamped, thin-walled, 2.5–3.5  $\mu\text{m}$  wide. Cystidia none, but sometimes narrow (1.5  $\mu\text{m}$ ), seldom branched, thin-walled hyphidia present between the basidia. Basidia basally clamped, clavate, (36–)40–60(–67)  $\times$  (8–)10–12  $\mu\text{m}$ , normally with two stout, 14–18

$\mu\text{m}$  (seldom up 27.5  $\mu\text{m}$ ) long and basally 4–5  $\mu\text{m}$  wide sterigmata. Spores large, very variable in shape, smooth, subglobose, globose, broadly ellipsoid, ovoid or pyriform, about 12–14  $\times$  10–12  $\mu\text{m}$ , with a large, 1  $\times$  1.5  $\mu\text{m}$ , apiculus, thin- to slightly thick-walled, CB(+), IKI–.

The other bisterigmatic species differ from our species in the following respects: *D. bispora* is dimitic, has abundant, richly branched dendrohyphidia and obovate spores, 11–13.5  $\times$  6–7.5  $\mu\text{m}$  (Burdshall & Nakasone 1983, Maekawa 1998), *D. commixta* has smaller and differently shaped spores, like those of *D. griseocana*, which, moreover, is simple septate and with abundant, richly



branched dendrohyphidia (Yurchenko & Kotiranta 2007). *Dendrothele citrisporella* has abundant dendrohyphidia, is simple septate and the spores are more or less citriform (Boidin *et al.* 1996).

Like many other *Dendrothele* species, *D. minutissima* grows on bark of living trees. The basidiocarps, however, are even smaller than in other related species and rarely exceed 2 mm in diameter. The species was described from Austria (von Höhnelt & Litschauer 1908) and apparently later not collected until the recent Finnish specimens were found. However, P. A. Karsten collected it already in 1888 and identified it as *Xerocarpus acerinus*.

In Finland *D. minutissima* is the most common *Dendrothele* species after *D. commixta*. While *D. commixta* almost solely grows on bark of cultivated *Salix fragilis* 'Bullata', *D. minutissima* inhabits also large cultivated *Salix alba* coll. trees in parks, but so far it has not been found on native willows.

**SPECIMENS EXAMINED:** **Austria.** Wien, Prater, on *Acer*, *Ulmus*, 48°12'N, 16°24'E, 18.X.1903 von Höhnelt (FH, lectotype). **Finland.** Uusimaa: Kerava, railway station park, on large (diam. 100 cm) *Salix fragilis* together with *Phellinus igniarius*, 60°24'N, 25°06'E (Grid 27°E 67008:3957), 17.X.2006 Kotiranta 22298 & Saarenoksa (H.K.), Sipoo, Söderkulla manor house park, on *Salix fragilis* 'Bullata', 60°18'N, 25°19'E, (Grid 27°E 6689:4065), 28.XI.1999 Kotiranta 16682 (H.K.), Siuntio, village centre, on *Salix alba* coll., 60°08'N, 24°13'E (Grid 27°E 66724:3461), 8.IV.2000, Kotiranta 16749 & Saarenoksa (H); Satakunta: Eura, Panelia, on *S. fragilis* 'Bullata', 61°13'N, 21°58'E (Grid 27°E 6812:2300), 6.II.2000 Kotiranta 16694 (H); Etelä-Häme: Hartola, Tainionvirta, gasoline station park, on *S. fragilis* 'Bullata', 61°33'N, 26°00'E (Grid 27°E 6829:447), 21.X.2004 Kotiranta 22297 (H.K.); Tammela church village park, on *Salix alba* coll., 60°48'N, 23°46'E (Grid 27°E 67484:3247) 27.XI.1999, Kotiranta 16658, 16659, 16660 (all on separate trees) (H), Tammela, Mustiala, on bark of *Acer platanoides*, 60°49'N, 23°46'E (Grid 27°E 67494:3243), 14.X.1888 P.A. Karsten (H), same place, on *S. fragilis* 'Bullata', 21.XI.1999 Kotiranta 16641, 16646 (on separate trees) (H); Etelä-Savo: Joutsa, road-side park, on *Salix alba* coll., 61°44'N, 26°06'E (Grid 27°E 68499:4528), 5.XII.2003 Kotiranta 20369 (H, H.K.).

***Pseudomerulius montanus* (Burt) Kotir., K.H. Larss. & Kulju, *comb. nova* (Figs. 9–10)**

**BASIONYM:** *Merulius montanus* Burt, Ann. Missouri Bot. Garden 4: 354. 1917.

**SYNONYM:** *Leucogyrophana montana* (Burt) Domański

Basidiocarp strictly resupinate, effuse, loosely attached, relatively thick, normally dozens of cm wide, sometimes even two metres wide along the wood, merulioid or wrinkled when fresh, smoothening on drying, but somewhat merulioid also in dry state, pale rose-brownish, ochre-coloured, olive greenish or dark brick-red with whitish pruina, soft and fragile when dry, cracking on drying and showing the open white texture of subiculum in young specimens, brownish or chamois in old ones. Margin without rhizomorphs, white or brownish, finely fibrillose (lens), distinct.

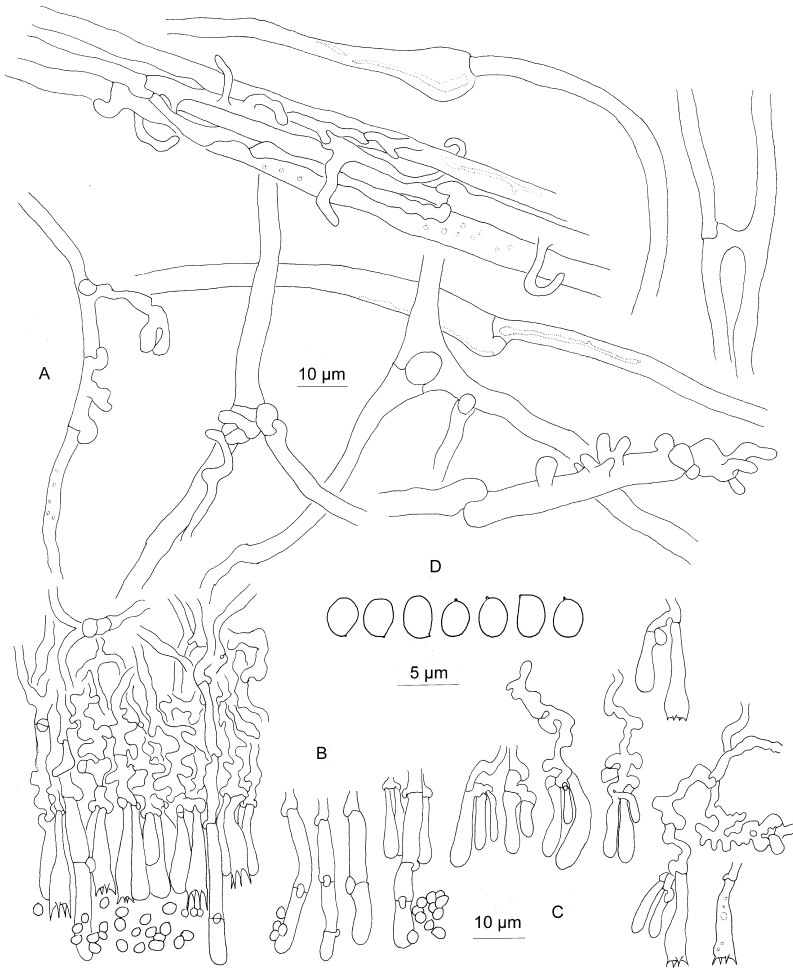
Hyphal system monomitic. Subicular hyphae clamped, very variable in width, the narrowest being only 2  $\mu\text{m}$  wide, but normally 5–7  $\mu\text{m}$  wide. Open, ansiform or ampullate clamps may be up to 12  $\mu\text{m}$  wide. Hyphae slightly swelling in KOH and sometimes also in IKI, very thin-walled, CB–, IKI–. Hyphal cords relatively abundant, formed by 1–5 wide hyphae and narrower ones, which sometimes are branches of the wide hyphae.

Subhymenium thick in old specimens, hyphae very thin-walled, richly branched, 2–2.5(–3)  $\mu\text{m}$  wide, sometimes rough in KOH because of crystalline matter. Clamps collapse partly and disappear in old subhymenium and as a result of this, the subhymenial hyphae bear very short "side-branches", which are the remnants of old clamps. Cystidia rare or fairly common, constant, with 2–3 clamps, up to 38  $\mu\text{m}$  long from subhymenium, 4–5  $\mu\text{m}$  wide, projecting up to 17  $\mu\text{m}$  over the basidia, very thin-walled, CB–, IKI–, KOH–, and often very difficult to observe. Basidia forming a dense palisade, subcylindrical or subclavate, basally clamped, (14–)20–26(–31)  $\times$  (3.5–)4–5  $\mu\text{m}$ , with four, needle-like, up to 5  $\mu\text{m}$  long sterigmata. Spores smooth, ellipsoid or broadly ellipsoid, 3  $\times$  2  $\mu\text{m}$ , with a negligible apiculus and with thickened walls, CB+ (strongly), dextrinoid, KOH– (in masses yellowish).

The spores of the type specimen (see below) are somewhat larger, *viz.* 2.8–4  $\times$  2–2.8  $\mu\text{m}$ , but otherwise it is similar to the Finnish specimens.

This species grows in very typical Finnish habitats — acid pine-dominated heath forest site





**Fig. 9.** *Pseudomerulius montanus* (from Kulju 85a/01). — **A:** Section through basidiocarp and spores. — **B:** Thin-walled cystidia. — **C:** Basidia of different stages of development. — **D:** Spores.



**Fig. 10.** *Pseudomerulius montanus* in situ (from Kulju 55/04). (Photo Pekka Helo).

types on relatively small, advanced decayed, decorticated pines. Noteworthy is, that two of the specimens grew together with *Tubulicrinopsis ellipsospora*, a recently described species (Kotiranta *et al.* 2007).

*Pseudomerulius montanus* is relatively easy to identify. There is no species with such small ellipsoid, dextrinoid and strongly cyanophilous spores combined with ampullate and ansiform clamps, thin, clamped cystidia and hyphal strings in subiculum. All of the collections bear masses of spores, even so much that they obscure the view in microscope. The original description of Burt (1917) and later Ginns (1968) do not mention cystidia and the first who recognized them was Grosse-Brauckmann (1987) in German material. The cystidia are so thin-walled and easily collapsed, that they are easily overlooked.

*Pseudomerulius (Leucogyrophana) montanus* has been found also in adjacent Russia, Karelian Republic, Paanajärvi National Park in Regio kuusamoënsis (Ks) (Krutov & Ruokolainen 2008).

The genus *Pseudomerulius* (Jülich 1979) fits best for this species, because the type species of the genus, *P. aureus* bears similar microscopical characteristics especially in its subicular hyphal structure. The ansiform clamps and in KOH swelling hyphae are familiar also to *P. aureus* (see Eriksson *et al.* 1981: 1220). All the hitherto studied specimens of *P. montanus* are strictly resupinate and the bright orange colour of the hymenium of *P. aureus* is lacking. Also the shape of the spores is quite different from those of *P. aureus*, which besides lacks cystidia. Another species accepted to the genus by Jülich (1979) and Hjortstam (1998) is *P. elliotii*. Masee's (1892) painting shows a resupinate, orange fungus with small oblong-ellipsoid spores. Masee does not mention cystidia, but the hymenium resembles that of *P. montanus*: "[...], texture rather byssoid, yet subgelatinous when moist, the wrinkles or folds of the hymenium vague". According to the description of Ginns (1976) *P. elliotii* is strictly resupinate, has no cystidia and the spores are "IKI-, short-oblong, in profile adaxially flattened or slightly concave,  $3.5\text{--}4.5 \times (1.5\text{--})2 \mu\text{m}$ ". Also Ginns' drawings (p. 108) show spores different from those of *P. montanus*.

*Pseudomerulius aureus* and *P. montanus* are related to *Tapinella atrotomentosa* and *Bondarzewomyces taxi* and belong to a group within Boletales tentatively called the *Tapinella* family (Larsson 2007).

**SPECIMENS EXAMINED.** **Finland.** Pohjois-Karjala: Lieksa, Karjula, poor 35–40-year-old *Pinus sylvestris*-dominated forest, on fairly advanced decayed, decorticated pine together with *Gloeophyllum sepiarium*, *Phlebiella sulphurea*, *Trichaptum fuscoviolaceum* and *Tubulicrinopsis ellipsospora*, 63°23'N, 30°08' E (Grid 27° E 70397:6567), 22.VIII.2002 Junninen 2990 (H, JOE, H.K.) and same date and nearly the same place, on advanced decayed, decorticated *Pinus sylvestris* together with *Sistotremastrum suecicum* and *Trechispora farinacea*, Junninen 2998a (H, JOE, H.K.); Kainuu: Vaala, Rokua Nat. Park, *Pinus sylvestris* dominated heath forest site type, on advanced decayed, decorticated pine (18 cm in diam.), 64°33'N, 26°21' E (Grid 27°E 7161808:477180), 16.VIII.2005 Kulju 20/05 (H, H.K., OULU); Oulun Pohjanmaa: Oulu, Pikkarala, Asemakylä, young *Pinus sylvestris* dominated poor heath forest site type, on decorticated, advanced decayed small pine (8 cm in diam.), 64°54'N, 25°46' E (Grid 27°E 7202038:441280), 31.VIII.2003, Kulju 16/03 & Punnek (OULU, H.K.) and together with *Tubulicrinopsis ellipsospora*, 2.IX.2001 Kulju 85a/01 (H, GB, JOE, OULU, H.K.). Oulu, Pikkarala, Palokangas, fairly young *Pinus sylvestris* dominated poor forest, on very advanced decayed, decorticated pine (diam. 10 cm), 64°54'N, 25°44' E (Grid 27°E 7202343:440137), 20.X.2004 Kulju 55/04 (OULU, H.K.). **Germany.** Hessen: Hinterer Odenwald, Rotes Wasser, on *Pinus strobus*, 16.X.1983 Hjortstam, K.H. Larsson 4670. Grosse-Brauckmann 2139 (Herb. K.H. Larsson and H. Grosse-Brauckmann). **USA.** Idaho, Priest River, on *Pinus*, 3.VI.1913 Weir 8006 (MBG 54914, BPI, type).

## Acknowledgements

Kaisa Junninen (Joensuu) is very warmly thanked for lending us her specimens. Kurt Hjortstam (Gothenburg) encouraged us already years ago to describe a new genus for *Byssocorticium lutescens* and he is especially gratefully thanked, as well as Teuvo Ahti and Tuomo Niemelä (both Helsinki) who helped us with the Latin descriptions. Terhi Rytteri (Helsinki) is very warmly thanked for her invaluable help with the technical problems we had. Research grants from the Ministry of Environment (YM131/5512/2002 to Basidiomycete Research Group, Helsinki) and the Swedish Taxonomy Initiative (ArtDatabanken dha 91/04 to K.-H. Larsson) helped us to carry out this study.

## References

Boidin, J., Lanquetin, P. & Duhem, B. 1996: Contribution à la connaissance du genre *Dendrothele* (Basidiomycotina,

- Aphylophorales). — *Bull. Soc. Mycol. France* 112: 87–126.
- Burdsall, H. H. & Nakasone, K. K. 1983: Species of effused Aphylophorales (Basidiomycotina) from the southeastern United States. — *Mycotaxon* 17: 253–268.
- Burt, E. A. 1917: *Merulius* in North America. — *Ann. Mo. Bot. Garden* 4: 305–362.
- Eriksson, J., Hjortstam, K. & Ryvarden, L. 1981: *The Corticiaceae of North Europe 6. Phlebia to Sarcodontia*. — Fungiflora, Oslo.
- Eriksson, J. & Ryvarden, L. 1973: *The Corticiaceae of North Europe 2. Aleurodiscus to Confertobasidium*. — Fungiflora, Oslo.
- Gardes, M. & Bruns, T. D. 1993: ITS primers with enhanced specificity for basidiomycetes — application to the identification of mycorrhizas and rusts. — *Mol. Ecol.* 2: 113–118.
- Gilbertson, R. L. & Budington, A. B. 1970: Three new species of wood-rotting fungi in the Corticiaceae. — *Mycologia* 62: 673–678.
- Ginns, J. H. 1968: The genus *Merulius* 1. Species proposed by Burt. — *Mycologia* 60: 1211–1231.
- Ginns, J. H. 1976 (1975): *Merulius*: s.s. and s.l., taxonomic disposition and identification of species. — *Can. J. Bot.* 54: 100–167.
- Grosse-Brauckmann, H. 1987: Über einige seltene resupinate Basidiomyceten. — *Zeitschr. Mykol.* 53: 81–92.
- Hämet-Ahti, L., Suominen, J., Ulvinen, T. & Uotila, P. (eds.) 1998: *Retkeilykasvio*, 4th ed. — Finnish Mus. Nat. Hist., Bot. Mus., Helsinki.
- Heikinheimo, O. & Raatikainen, M. 1981: Ruutukoordinaattien ja paikannimien käyttö Suomessa [Grid references and names of localities in the recording of biological finds in Finland]. — *Notul. Entomol.* 61: 133–154. [In Finnish with English summary].
- Hibbett, D. S., Binder, M., Bischoff, J. F., Blackwell, M., Cannon, P. F., Eriksson, O. E., Huhndorf, S., James, T., Kirk, P. M., Lücking, R., Lumbsch, T., Lutzoni, F., Matheny, P. B., McLaughlin, D. J., Powell, M. J., Redhead, S., Schoch, C. L., Spatafora, J. W., Stalpers, J. A., Vilgalys, R., Aime, M. C., Aptroot, A., Bauer, R., Begeerow, D., Benny, G. L., Castlebury, L. A., Crous, P. W., Dai, Y., Cheng, G., Gams, W., Geiser, D. M., Griffith, G. W., Gueidan, C., Hawksworth, D. L., Hestmark, G., Hosaka, K., Humber, R. A., Hyde, K., Ironside, J. E., Kõljalg, U., Kurtzman, C. P., Larsson, K.-H., Lichtwardt, R., Longcore, J., Miadlikowska, J., Miller, A., Moncalvo, J. M., Mozley-Standridge, S., Oberwinkler, F., Parmasto, E., Reeb, V., Rogers, J. D., Roux, C., Ryvarden, L., Sampaio, J. P., Schüssler, A., Sugiyama, J., Thorn, R. G., Tibell, L., Untereiner, W. A., Walker, C., Wang, Z., Weir, A., Weiss, M., White, M. M., Winka, K., Yao, Y. J. & Zhang, N. 2007: A higher-level phylogenetic classification of the Fungi. — *Mycol. Res.* 111: 509–547.
- Hjortstam, K. 1998 (1997): A checklist to genera and species of corticioid fungi (Basidiomycotina, Aphylophorales). — *Windahlia* 23: 1–54.
- Hjortstam, K. & Grosse-Brauckmann, H. 1993: Two new species of *Cristinia* (Basidiomycotina, Aphylophorales) and a survey of the genus. — *Mycotaxon* 47: 407–410.
- Hjortstam, K. & Ryvarden, L. 1978: Notes on Corticiaceae (Basidiomycetes) 3. — *Mycotaxon* 7: 405–410.
- Hopple, J. S. Jr. & Vilgalys, R. 1999: Phylogenetic relationships in the mushroom genus *Coprinus* and dark-spored allies based on sequence data from the nuclear gene coding for the large ribo-somal subunit RNA: divergent domains, outgroups, and monophyly. — *Mol. Phylogen. Evol.* 13: 1–19.
- Jülich, W. 1972: Monographie der Athelieae (Corticiaceae, Basidiomycetes). — *Willdenowia (Beih.)* 7: 1–283.
- Jülich, W. 1973: Studien an resupinaten Basidiomyceten 2. — *Persoonia* 7: 381–388.
- Jülich, W. 1979: Studies in resupinate Basidiomycetes 6. — *Persoonia* 10: 325–336.
- Jülich, W. 1981: Higher taxa of Basidiomycetes. — *Bibl. Mycol.* 85: 1–485.
- Kotiranta, H., Hjortstam, K., Miettinen, O. & Kulju, M. 2007: *Tubulicrinopsis* gen. novum (Basidiomycota, Aphylophorales) and notes on *Amauromyces pallidus*. — *Ann. Bot. Fennici* 44: 128–134.
- Krutov, V. I. & Ruokolainen, A. V. 2008: *Paanajärven kansallispuiston käävökäslajisto*. — Petrozavodsk, Kareliya. [In Russian and Finnish].
- Larsson, E. & Larsson, K.-H. 2003: Phylogenetic relationships of russuloid basidiomycetes with emphasis on aphylophoralean taxa. — *Mycologia* 95: 1037–1065.
- Larsson, E. & Östadius, L. 2008: Fourteen coprophilous species of *Psathyrella* identified in the Nordic countries using morphology and nuclear rDNA sequence data. — *Mycol. Res.* 112: 1165–1185.
- Larsson, K.-H. 2007: Re-thinking the classification of corticioid fungi — *Mycol. Res.* 111: 1040–1063.
- Larsson, K.-H., Larsson, E. & Kõljalg, U. 2004: High phylogenetic diversity among corticioid homobasidiomycetes. — *Mycol. Res.* 108: 983–1002.
- Maekawa, N. 1998: Taxonomic study of Japanese Corticiaceae (Aphylophorales) IV. — *Rep. Tottori Mycol. Inst.* 36: 1–12.
- Massee, G. 1892: Some West Indian fungi. — *J. Bot.* (London) 30: 161–164 + 3 pls.
- Swofford, D.L. 2003: *PAUP\*. Phylogenetic Analysis Using Parsimony (\* and Other Methods)*. Version 4. — Sinauer Associates, Sunderland, MA.
- von Höhnelt, F. & Litschauer, W. 1908: *Österreichische Corticieen*. — Wiesner-Festschrift, Wien.
- White, T. J., Bruns, T., Lee, S. & Taylor, J. W. 1990: Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. — In: Innis, M. A., Gelfand, D. H., Sininsky, J. J. & White, T. J. (eds), *PCR protocols: A guide to method and applications*: 315–322. Acad. Press, New York.
- Yurchenko, E. O. & Kotiranta, H. 2007: Rare corticioid fungi (Basidiomycetes, Aphylophorales) from northern Belarus. — *Mycena* 7: 20–47.