

Some new species and a first checklist of corticioid fungi (*Basidiomycota*) from Chile

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Abstract *Gloeocystidiellum rajchenbergii*, *Hypochnicium patagonicum*, *Pteridomyces valdivianus*, and *Stereum greslebinii* are described as new species from the Chilean Patagonia. An annotated checklist of corticioid fungi from Chile, listing 94 species with notes on distribution and ecology, scheduled for regular update, is available from <http://corticioids.webs.com/checklists.htm>.

Keywords Argentina · Andes · Chile · *Corticiaceae* · Patagonia · Valdivian rainforest

Introduction

The Patagonian Andes represent a considerable diversity of ecosystems with a particular forest type, the Patagonian Andes forest. This vegetation community is present in the mountainous regions of southern Chile and southwestern Argentina belonging to the Antarctic floristic kingdom. It is dominated mainly by *Nothofagus* species mixed with other hardwoods and some endemic conifers. Within the Patagonian Andes forests, one particular forest community

characterized by low temperatures and high rainfall, the Valdivian rainforest, is located in the western slope of the Andes in Chile and extending into a small part of Argentina. It is floristically characterized by its dense understories of bamboos and ferns and for being mostly dominated by evergreen angiosperm trees, albeit deciduous and conifer trees are also common. In the last few years, we have surveyed some local areas in the Central Chilean Patagonia (Region X, Los Lagos, and Region XI, Aisén). Here, we describe four new species and present a preliminary checklist of corticioid fungi from the western slope of the Andes as supplementary material posted online.

Few studies about corticioid fungi have been focussed in the Chilean Patagonia, and only about a dozen species have been reported from Chile (Spegazzini 1887; Holubova-Jechova 1980; Hjortstam and Ryvarden 1993, 2007). In contrast, the Patagonian Andes forests of Argentina are well known with more than 200 species reported (Gorjón et al. 2011a, b, c; Greslebin 2001; Greslebin et al. 2004; Greslebin and Rajchenberg 1997a, b, 1998, 1999a, b, 2000, 2001, 2003).

Materials and methods

Macro- and microscopic examinations

For light microscopy studies, samples were mounted in 3 % potassium hydroxide (KOH), Melzer's reagent (IKI), sulfobenzaldehyde (SA), and 0.1 % cotton blue in 60 % lactic acid to determine cyanophily of basidiospore walls. Line drawings were made with a camera lucida attachment. Specimens are deposited in GB, SALA, CONC, and the herbarium of Centro de Investigación y Extensión Forestal Andino-Patagónico (CIEFAP) in Esquel, Argentina.

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Phylogenetic analysis

DNA extraction and amplification followed Hallenberg et al. (2006). The purification and sequencing of PCR products were performed by Macrogen (Seoul). Sequences were assembled in Sequencher© v. 4.1 (GeneCodes, Ann Arbor, USA) and GenBank accession numbers are listed in the species description of *G. rajchenbergii*. Sequences were automatically aligned using ClustalW Multiple Alignment as implemented in MEGA v.5 (Tamura et al. 2011). The alignment was then manually checked and improved. The final dataset included a total of 11 partial 5.8S and ITS2 sequences with an alignment length of 362 characters. The molecular phylogenetic analysis was performed using the neighbor-joining method; maximum parsimony method produce the same tree topology and minor differences in bootstrap values. The neighbor-joining bootstrap consensus tree was obtained from 1,000 replicates. The percentages of replicate trees in which the associated taxa clustered together in the bootstrap test are shown next to the branches (Felsenstein 1985). The phylogenetic tree was linearized assuming equal evolutionary rates in all lineages. The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the molecular phylogenetic tree. The evolutionary distances were computed using the maximum composite likelihood method and are in the units of the number of base substitutions per site (Tamura et al. 2004). All positions containing gaps and missing data were eliminated from the dataset (complete deletion option). There were a total of 266 positions in the final dataset. Phylogenetic analyses were conducted in MEGA5 (Tamura et al. 2011).

Taxonomy

Gloeocystidiellum rajchenbergii Gorjón & Hallenb., sp. nov.

Mycobank MB 564939

Ad Gloeocystidiellum tabacinum, G. compactum, G. formosanum et G. aspellum sed gloeocystidia minoribus, 40–70 × 5.5–7.5 μm et basidiosporae verrucosae, cylindraceae vel ellipsoideae, 6–7(–7.5) × 3–3.5 μm.

Typus: Chile, X Region, Isla Grande de Chiloé, Chiloé National Park, Chanquin, Trail El Tepual, on unidentified wood, 25 Feb 2010, leg. L. & N. Hallenberg, coll. NH 16358. Holotype, GB; isotypes, CIEFAP, CONC. GenBank accession number JQ716940 (ITS sequence).

Etymology: Named in honour of Dr. Mario Rajchenberg (Argentina), in recognition of his contributions to the taxonomy of Patagonian fungi.

Basidiomata resupinate, effused, smooth, closely adnate, ceraceous-crustaceous, yellowish ochraceous, up to 400 μm thick, margin narrow, distinct and brownish orange, or thinning out (Fig. 1a, b). Thick specimens are stratified,

sometimes rimose, with a hyaline hymenial layer and light brownish layers below. Hyphal direction mainly vertical, hyphae densely packed and branched, with thickened walls and agglutinated, difficult to discern from each other, with single clamp connections. Hymenial layer with densely packed, clavate basidia and cystidia which may project 10–15 μm. Gloeocystidia cylindrical but basally inflated, obtuse, 40–70 × 5.5–7.5 μm, thick-walled, distinctly swelling in KOH, then thinning towards apex, contents yellow, granular, dark black in sulfobenzaldehyde. Basidia clavate, 15–20 × 5–5.5 μm, somewhat irregular in shape because of the dense hymenium and winding from the base towards the hymenial level, with a basal clamp, with thickened walls at base, apex rounded or swollen, with 4 sterigmata. Basidiospores cylindrical to ellipsoid with a straight adaxial side, 6–7(–7.5) × 3–3.5 μm, thin-walled, verruculose, amyloid (Fig. 2).

Distribution and ecology: Known from the Patagonian Andes forest of Chile, growing on dead wood of *Caldechuvia paniculata* (Cav.) D. Don (*Cunoniaceae*), *Nothofagus dombeyi* (Mirb.) Oerst. (*Nothofagaceae*), and unidentified hardwoods.

Comments: In outer appearance, the species seems close to *Conferticium* Hallenb., which is distinguished by lack of clamps, basidium repetition, and a strongly stratified, rimose basidiome. *Gloeocystidiellum rajchenbergii* is morphologically similar to *G. tabacinum* Sheng H. Wu, *G. compactum* Sheng H. Wu, *G. formosanum* Sheng H. Wu, and *G. aspellum* Hjortstam, which are closely related, distinguished by minute differences in spore size (Wu 1996). The compact basidiome, and the thick-walled gloeocystidia are important distinguishing characters of *G. rajchenbergii*. In micromorphology, the latter species is distinguished by shorter cystidia and slightly different spore size and spore shape. ITS sequences clearly distinguished *G. rajchenbergii* from Taiwanese representatives of *G. compactum* (AF506434), *G. formosanum* (AF506439), and *G. aspellum* (AF506432) (Fig. 3). In BLAST search, *G. rajchenbergii* shows highest match with the previous species, but this similarity was only 92–93 %. The previous species cluster in a different clade from *Gloeocystidiellum porosum* (Berk. & M.A. Curtis) Donk, the generic type of *Gloeocystidiellum*, as it was also previously indicated by Larsson and Larsson (2003). They showed that *G. porosum* clusters in an isolated clade with *Boidinia granulata* Sheng H. Wu and two unidentified specimens. Also, *Gloeocystidiellum clavuligerum* (Höhn. & Litsch.) Nakasone, a morphological closely related species, clusters in a diverse clade (Larsson and Hallenberg 2001; Larsson and Larsson 2003). Morphological features of the three clades overlap, sharing resupinate basidiomes with a smooth hymenophore, monomitic hyphal system with clamped hyphae, gloeocystidia that are either SA⁺ or SA[–], and ornamented amyloid basidiospores more or less ellipsoid. In agreement with Larsson and Larsson

Fig. 1 Basidiomes. **a** *Gloeocystidiellum rajchenbergii*, coll. NH 16358, holotype. **b** *G. rajchenbergii*, coll. SPG 3139. **c** *Hypochnicium patagonicum*, coll. SPG 3112, holotype. **d** *Pteridomyces valdivianus*, coll. NH 16298, holotype. **e, f** *Stereum greslebinii*, coll. SPG 2639, holotype; hymenophore excreting a red liquid when cutted and few seconds after touching. Bar 1 cm except (d) 1 mm

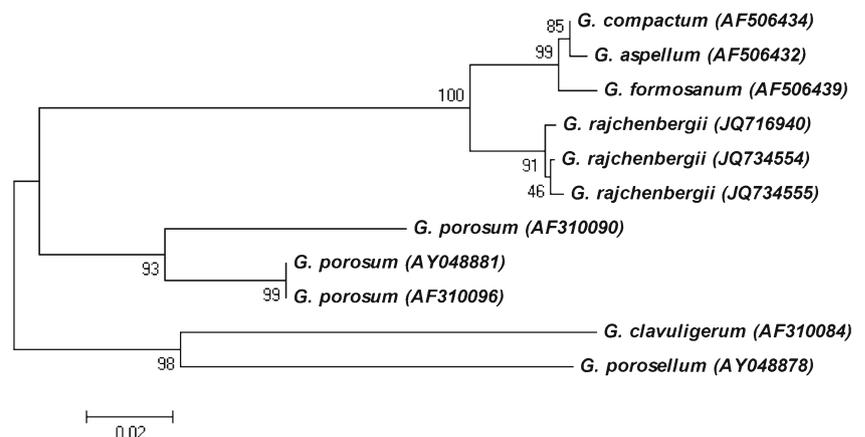


(2003), we think that it is actually impractical to introduce new genera for the previous clades.

Additional specimens examined: Argentina, Chubut, Lago Puelo National Park, Los Hitos, S2°05'25"S, 71°41'34"W, 400 m a. s. l., on *Nothofagus dombeyi*, 27 Apr 2011, leg. S.P. Gorjón, coll. SPG 3252 (CIEFAP). Chile, X

Region, Isla Grande de Chiloé, Chiloé National Park, Chanquin, Trail El Tepual, on unidentified wood, 25 Feb 2010, leg. L. & N. Hallenberg, coll. NH 16348, 16353 (GB) (GenBank accession numbers, ITS sequences, JQ734554 and JQ734555, respectively). Chile, X Region, Pumalín National Park, Cascadas Escondidas path, 42°40'36"S, 72°

Fig. 2 Neighbor-joining bootstrap tree. Bootstrap percentages (1,000 replicates) are shown next to the branches. The bar indicates the number of expected substitutions per position. GenBank accession numbers given in parentheses



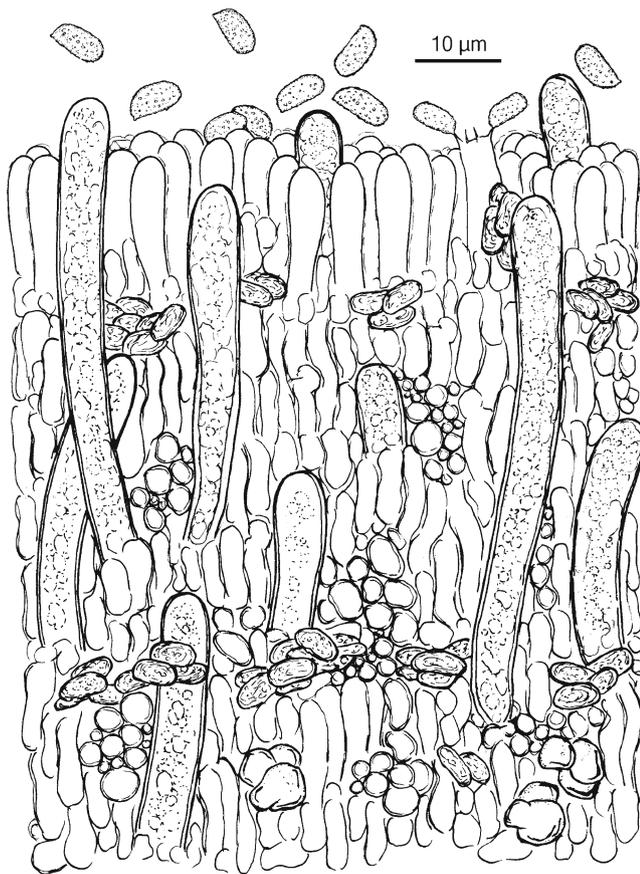


Fig. 3 *Gloeocystidiellum rajchenbergii*, coll. SPG 3139; microscopic elements

35°18'W, 300 m a. s. l., 5 Apr 2011, Valdivian rainforest, on *Caldcluvia paniculata*, leg. S.P. Gorjón, A. de Errasti & M. Rajchenberg, coll. SPG 3138, 3139, 3140, 3141, 3142 (CIEFAP, SALA).

Hypochnicium patagonicum Gorjón & Hallenb., *sp. nov.*
Mycobank MB 564940

Ad Hypochnicium aotearoae sed basidiosporae 8–10 × 7–8.5 μm (5.6–8.7 × 4.8–7.3 μm in H. aotearoae) et cystidia crassitunicatae prominentibus. Ad lignum arborum frondosarum.

Typus: Chile, X Region, lago Yelcho glacier path, 43°16' 33"S, 72°25'25"W, 150 m a. s. l., on bark of decayed wood of *Nothofagus dombeyi*, 4 Apr 2011, leg. M. Rajchenberg, A. de Errasti & S.P. Gorjón, coll. SPG 3112. Holotype, SALA; isotypes, GB and CIEFAP.

Etymology: Referring to the type locality in Patagonia.

Basidiomata resupinate, effused, hypochnoid, partly grandinioid with penicillate aculei, white to greyish, margin not differentiated (Fig. 1c). Hyphal system monomitic, generative hyphae with clamps, thin- to thick-walled, 3–4 μm wide, not encrusted. Cystidia numerous, originating from context, arising from thick-walled hyphae, forming central

axis of aculei, subcylindrical with an obtuse apex, 100–250 (–350) × 8–12 μm, projecting 50–100 μm above the basal layer, walls up to 3–4 μm thick, not encrusted, some with several adventitious septa (Fig. 4). Basidia narrowly clavate, sinuous, thin-walled, 40–60 × 6–8 μm, guttulate, with four stout sterigmata, and a basal clamp. Basidiospores broadly ellipsoid to subglobose, verrucose (ornamentation visible in Melzer's reagent, CB and water, seemingly smooth in KOH), thick-walled, 8–10 × (7–)7.5–8.5 μm, inamyloid, indextrinoid, cyanophilous, some with a big guttule (Fig. 5).

Distribution and ecology: Known from the Patagonian Andes forests of Chile, on bark of dead wood of *Nothofagus dombeyi*.

Comments: *Hypochnicium patagonicum* is morphologically similar to the *Hypochnicium punctulatum* complex, characterized by ornamented basidiospores and cystidia, but differing above all by the thick-walled and septate cystidia. *Hypochnicium aotearoae* Paulus, Nilsson & Hallenb., from New Zealand (Paulus et al. 2007) and

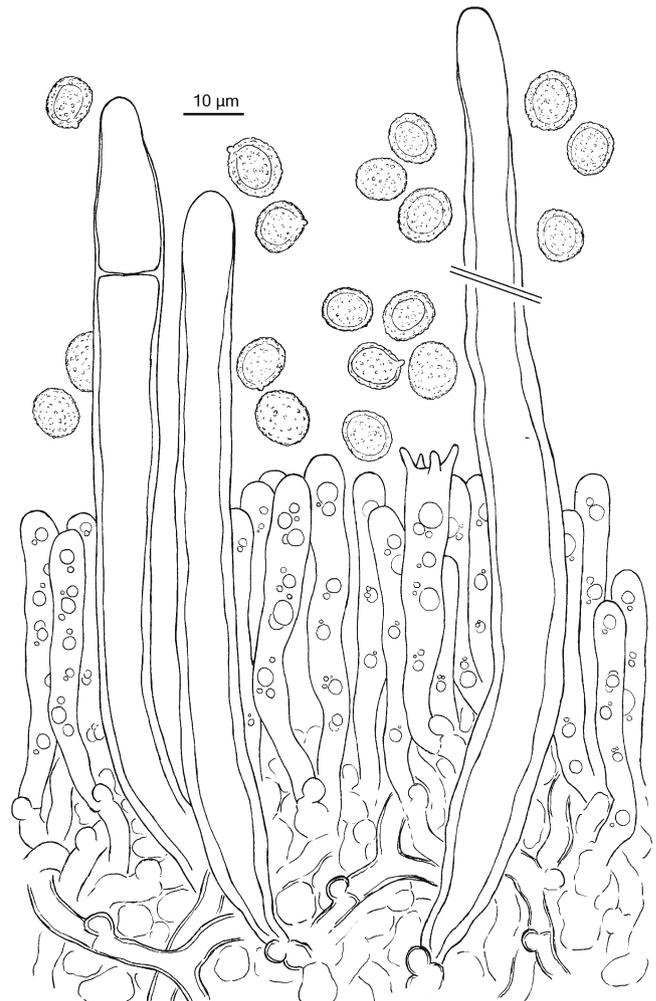


Fig. 4 *Hypochnicium patagonicum*, coll. SPG 3112, holotype; microscopic elements

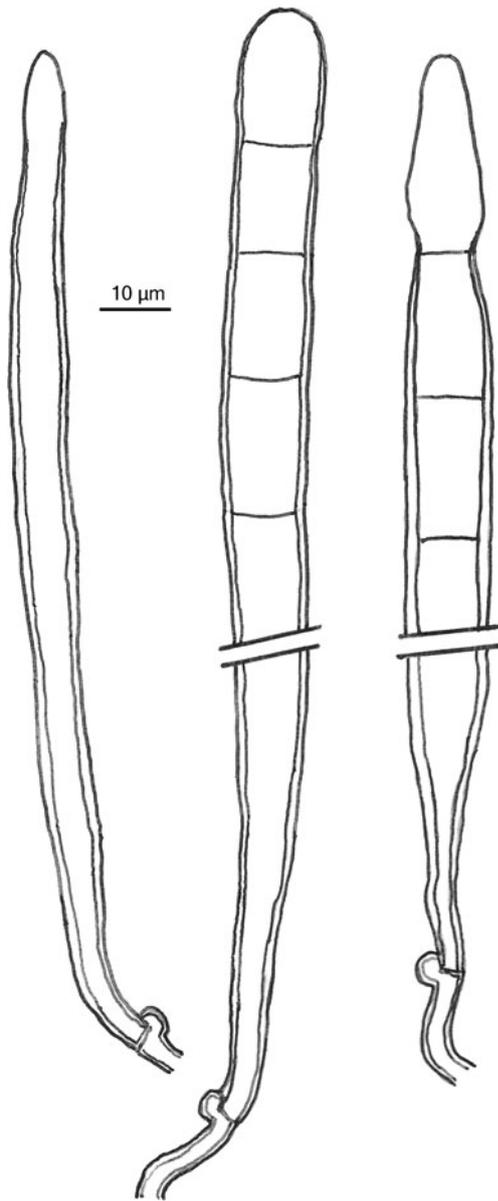


Fig. 5 *Hypochnicium patagonicum*, coll. SPG 3112, holotype; cystidia with secondary septa

Hypochnicium cystidiatum Boidin & Gilles from the Central African Republic (Boidin and Lanquetin 1971), differ primarily by smaller basidiospores and shorter and less thick-walled cystidia. *Hypochnicium guineensis* Tellería, M. Dueñas, Melo & M.P. Martín, a species recently described from Equatorial Guinea, differs in globose basidiospores and fusiform cystidia encrusted with hyaline to yellowish crystals (Tellería et al. 2010). There is also a likeness to *Nodotia aspera* Hjortstam, which has similarly shaped cystidia and hyphae but differing in smooth basidiospores and encrusted cystidia.

Additional specimens examined: *Hypochnicium aotearoae*. New Zealand, Bay of Plenty, Pinedale near Putaruru,

on fallen wood of *Pinus radiata*, Nov 1953, leg. J.M. Dingley s.n., PDD 12704 (holotype).

Pteridomyces valdivianus Gorjón & Hallenb., **sp. nov.**
Mycobank MB 564941

Ad Pteridomyces bisporus sed hyphae non fibulatae, cystidia presentis et basidiosporae 8–9×5–5.5 μm (9–10.5×6–8 μm in *P. bisporus*).

Typus: Chile, X Region, Entre Lagos, Puyehue National Park, Aguas Calientes, Trail Los Rápidos, 40°44'01"S 72°18'44"W, 500 m a. s. l., on dead stems of *Chusquea quila*, 22 Feb 2010, leg. L. & N. Hallenberg & S.P. Gorjón, coll. NH 16298. Holotype, GB; isotype, SALA.

Etymology: Referring to the Valdivian rainforest, the predominant forest community in the type locality.

Basidiomata effused, adnate, membranaceous, whitish, about 50 μm thick, regularly covered with minute, cylindrical hyphal pegs, projecting ca. 50 μm from hymenial surface, margin thinning out (Fig. 1d). Hyphal system monomitic, hyphae thin-walled, simple-septate; subiculum very thin, formed from a network of anastomosing hyphae, 1–2 μm wide; context hyphae intertwined and ordinarily ramified, 2–3 μm wide; subhymenium with densely ramified hyphae, producing a single-layered hymenium with densely packed hymenial elements. Hyphal pegs composed of projecting fascicle straight, scarcely branched hyphae, 2–2.5 μm wide, with embedded crystals. Leptocystidia abundant, fusoid but apex rounded, 24–31×3–5.5 μm, thin-walled, stalked. No dendrophyses observed. Basidia clavate, stalked, thin-walled, 18–28×5.5–6 μm, without basal clamp, with two sterigmata up to 9 μm long, attached close to each other at apex of basidia. Basidiospores ovoid to ellipsoid, with a straight adaxial side, 8–9×5–5.5 μm, smooth, thin-walled, filled with with oil drops, non-amyloid (Fig. 6).

Distribution and ecology: Known from the Patagonian Andes forest of Chile, growing on dead stems of *Chusquea quila* Desvoux (*Poaceae*).

Comments: The new species seems to be a good member of *Pteridomyces* Jülich by the basidiome with sterile hyphal pegs, clavate basidia, and smooth not reacting in Melzer's reagent basidiospores. However, the simple-septate hyphae and presence of cystidia are deviating features from the original generic circumscription. Morphologically, it is close to *P. bisporus* Boidin & Gilles. The latter species has, however, clamped hyphae, no leptocystidia and larger basidiospores. *Athelocystis* Hjortstam & Ryvarden is somewhat similar with simple-septate hyphae, pedunculate basidia, and cystidia but differing in a smooth hymenophore, capitate cystidia, and pip-shaped basidiospores (Hjortstam and Ryvarden 2010).

Stereum greslebinii Gorjón & Hallenb., **sp. nov.**
Mycobank MB 564942

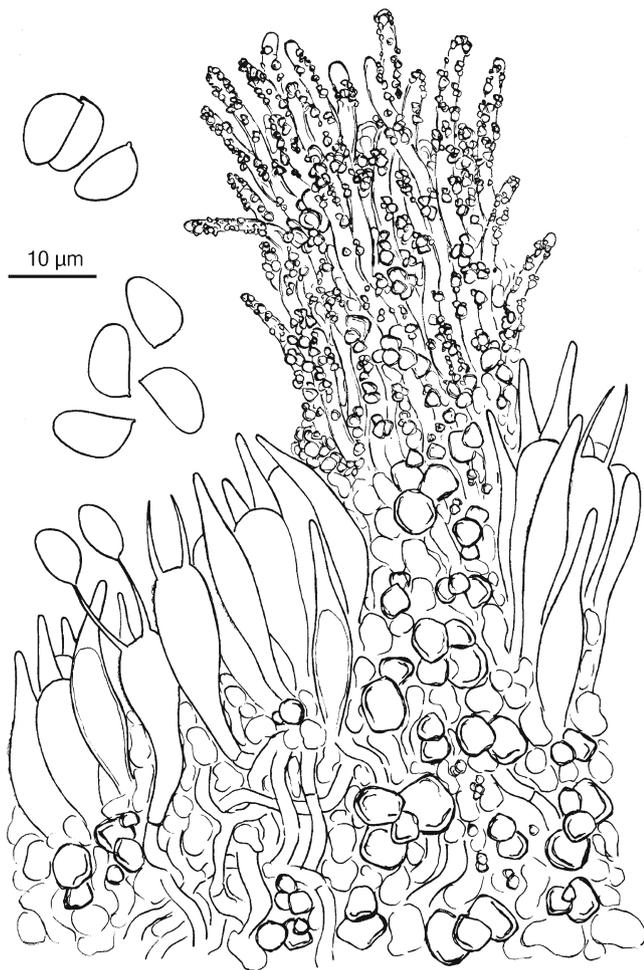


Fig. 6 *Pteridomyces valdivianus*, coll. NH 16298, holotype; microscopic elements

Ad Stereum gausapatum sed basidiosporae $4.5\text{--}6 \times 2.5\text{--}3 \mu\text{m}$ ($6\text{--}10 \times 3.5\text{--}4.5 \mu\text{m}$ in *S. gausapatum*). *Ad lignum arborum frondosarum*.

Typus: Chile, X Region, Entre Lagos, Puyehue National Park, Aguas Calientes, Trail Los Rápidos, $40^{\circ}44'01''\text{S}$, $72^{\circ}18'44''\text{W}$, 500 m a. s. l., on decayed wood of *Nothofagus dombeyi*, 22 Feb 2010, L. & N. Hallenberg & S.P. Gorjón, coll. SPG 2639. Holotype, SALA; isotypes, GB and CIEFAP.

Etymology: Named in honour of Dra. Alina G. Greslebin (Argentina), in recognition of her contributions to the taxonomy of the Patagonian corticioid fungi.

Basidiomata resupinate to effuse-reflexed, orbicular at first, upper sterile surface finely tomentose, zonate, ochraceous to brownish, hymenophore smooth to tuberculate, yellow to orange or with a shade of brown, excreting abundantly a reddish liquid when touched or cut, context ochraceous, up to 200 μm thick, separated from the tomentum by a dark line, margin abrupt, whitish (Fig. 1e, f). Hyphal system dimitic, generative hyphae simple-septate, thin- to

thick-walled, 2–3 μm wide, skeletal hyphae thick-walled, 3–4 μm wide, usually ending in pseudocystidia, all hyphae strongly glued together. Cystidia of two kinds: 1) pseudocystidia slightly thick-walled, variable in length, usually more than 100 μm long and about 4–6 μm wide, with reddish to brownish, granular contents; 2) acutocystidia, length difficult to discern and 2–4 μm wide, with pointed apex and slightly projecting. Basidia narrowly clavate, $20\text{--}30 \times 4\text{--}5 \mu\text{m}$, with four sterigmata, with a simple basal septum. Basidiospores cylindrical, $4.5\text{--}6 \times 2.5\text{--}3 \mu\text{m}$, smooth, thin-walled, hyaline, amyloid (Fig. 7).

Distribution and ecology: Known from the Patagonian Andes of Chile and Argentina growing on dead wood of *Nothofagus dombeyi*, *N. obliqua* (Mirb.) Oerst., and *Luma apiculata* (DC.) Burret (*Myrtaceae*).

Comments: *Stereum greslebinii* is easily recognized in the field by the effuse-reflexed basidiomes with a yellowish brown to ochraceous hymenial surface, and the strong and conspicuous “bleeding” and bruising reactions when touched or cut. Microscopically it seems close to *Stereum gausapatum* (Fr.) Fr. by the presence of acutocystidia but differs in smaller basidiospores. Although there are many doubtful species described in *Stereum* under different names, there is an enormous lack of knowledge about

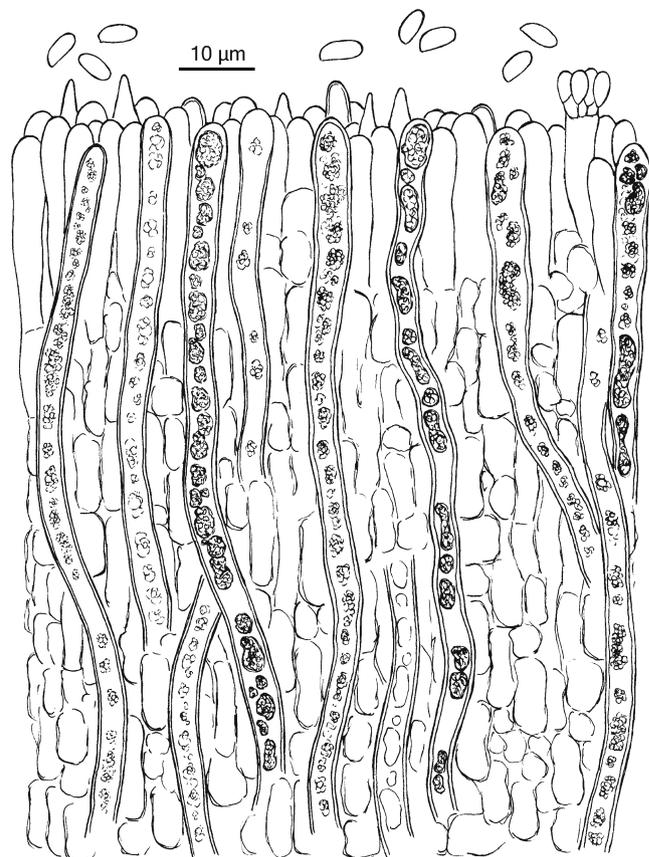


Fig. 7 *Stereum greslebinii*, coll. SPG 2639, holotype; microscopic elements

species diversity in the southern hemisphere and reference monographies (Cunningham 1956; Ryvarden 2010) gave no clue as to the identity of the present species.

Additional specimens examined: Argentina, Chubut, Los Alerces National Park, 42°44'35"S, 71°44'32"W, 330 m a. s. l., on decayed wood of *Nothofagus dombeyi*, 30 Mar 2011, leg. S.P. Gorjón, coll. SPG 3049. Argentina, Río Negro, El Bolsón, Azul river bridge, 42°00'31"S, 71°35'23"W, 300 m a. s. l., on decayed wood of *Nothofagus dombeyi*, 13 May 2010, leg. S.P. Gorjón, coll. SPG 2757. Argentina, Neuquén, between Queni and Nothue lakes, 40°07'58"S, 71°40'08"W, 1,025 m a. s. l., on decayed wood of *Nothofagus obliqua*, 18 May 2010, leg. S.P. Gorjón, coll. SPG 2836. Chile, X Region, Puyehue, Entre Lagos, sendero de Chile, 40°39'49"S, 72°08'40"W, 450 m a. s. l., on decayed wood of *Luma apiculata*, 21 Feb 2010, leg. S.P. Gorjón & N. Hallenberg, coll. SPG 2617. Chile, X Region, Entre Lagos, Puyehue National Park, Aguas Calientes, Trail Los Rápidos, 40°44'01"S, 72°18'44"W, 500 m a. s. l., 22 Feb 2010, Valdivian rainforest, on *Nothofagus dombeyi*, leg. L. & N. Hallenberg & S.P. Gorjón, coll. NH 16293.

Checklist of corticioid fungi from Chile

The complete checklist, scheduled for regular update, is available for free downloading from the website: <http://corticioids.webs.com/checklists.htm>. It includes 94 species of corticioid fungi with data on distribution and substrata.

According to Hjortstam and Ryvarden (2007) only 11 species of corticioid fungi have been reported from Chile: *Aleurodiscus antarcticus* (Speg.) Ryvarden, *Aleurodiscus triviale* (Speg.) Greslebin, *Amyloathelia aspera* Hjortstam and Ryvarden, *Botryobasidium chilense* Hol.-Jech., *Coniophora eremophila* Lindsey & Gilb., *Dentipellis leptodon* (Mont.) Maas Geest., *Gloeosoma vitellinum* (Lév.) Bres., *Podoserpula pusio* (Berk.) D.A. Reid, *Stereum hymenoglium* Speg., *Trechispora byssinella* (Bourdot) Liberta, and *Trechispora subsphaerospora* (Litsch.) Liberta.

In this study, some species, known from the Patagonian Andes in Argentina, were also present in the Chilean Patagonian Andes. The following species are known only from the Patagonian region: *Dendrothele lemkei* Gresl. & Rajchenb., *Hyphodontia crassisporea* Gresl. & Rajchenb., *H. gamundiae* Gresl. & Rajchenb., *H. hjortstamii* Gresl. & Rajchenb., *H. magnifica* Gresl. & Rajchenb., *H. nesporina* Hallenb. & Hjortstam, *Nothocorticium patagonicum* Gresl. & Rajchenb., *Rhizochaete brunnea* Gresl., Nakasone & Rajchenb., and *Punctulariopsis subglobispora* (Hallenb. & Hjortstam) Ghobad-Nejhad.

Aleurodiscus parmuliformis G. Cunn., *Hyphodontia australis* (Berk.) Hjortstam, and *Phlebia columellifera* (G. Cunn.) Duhem, are present in Patagonia and Australia

and/or New Zealand, displaying a typical austral geographical distribution.

New records from the Chilean Patagonia include *Botryobasidium bondarzevii* (Parmasto) G. Langer, previously known from Brazil, Venezuela, and Guyana in South America. *Coniophora submembranacea* (Berk. & Broome) Sacc., known from Sri Lanka, Singapore, and Mexico was unknown from South America, as well as *Scytinostroma decidens* Boidin, Gilles & Lanq., so far known from Africa.

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