

A survey of thelotremoid lichens (Ascomycota: *Ostropales*) in subantarctic regions excluding Tasmania

H. Thorsten LUMBSCH, Pradeep K. DIVAKAR,
María Inés MESSUTI, Armin MANGOLD and Robert LÜCKING

Abstract: Thelotremoid lichens (*Ostropales*, Ascomycota) with a trentepohlioid photobiont in Tierra del Fuego, the Falkland Islands, the South Island of New Zealand, and subpolar islands of the southern Hemisphere are studied. Twenty-five species are accepted, with three species described as new to science: *Melanotopelia blepharostoma* Lumbsch & Divakar, *Topeliopsis athallina* Lumbsch & Mangold and *Topeliopsis patagonica* Mangold & Lumbsch. The new combination *Topeliopsis novae-zelandiae* (Szatala) Lumbsch & Mangold is proposed.

Key words: *Graphidaceae*, identification key, new species, taxonomy, *Thelotremataceae*

Introduction

Thelotremoid lichens are a group of lichenized ascomycetes with crustose thalli that includes more than 1000 described species (Hale 1981; Frisch *et al.* 2006). The group was previously treated as the *Thelotremataceae* and is characterized by immersed-erumpent, rounded ascomata with unbranched to slightly branched paraphyses, mostly distoseptate ascospores, and mostly a trentepohlioid photobiont. The group has recently experienced major changes regarding its systematic and taxonomic concepts. Traditionally, *Thelotremataceae* was divided into large genera according to their spore septation and pigmentation following Müller Argoviensis (1887). Many workers have recognized this concept as artificial and

consequently, Hale (1980) suggested a revised classification based on Salisbury's previous studies (Salisbury 1972*a,b*, 1978) that relied on the use of excipular characters, such as pigmentation of the exciple and the presence of lateral paraphyses. The resulting classification was too schematic and thus Frisch *et al.* (2006) provided a major revision of generic concepts in *Thelotremataceae*. They abandoned the traditional concepts and proposed a classification based on combinations of several morphological character complexes. Their proposed classification is largely followed here, with modifications as suggested by Mangold *et al.* (2009). Phylogenetic studies employing DNA sequence data revealed that the *Thelotremataceae* is not monophyletic, but that several thelotremoid clades are nested within *Graphidaceae* (Staiger *et al.* 2006; Mangold *et al.* 2008). Consequently, the *Thelotremataceae* is now treated as a synonym of the latter family and taxa previously classified in *Thelotremataceae* are now referred to the informal group of thelotremoid lichens.

The centre of distribution of thelotremoid lichens is in tropical and subtropical regions. In fact, they represent one of the most important components of corticolous rain-forest microlichen biotas (Santesson 1952; Sipman & Harris 1989; Rivas Plata *et al.*

H. T. Lumbsch and R. Lücking: Department of Botany, The Field Museum, 1400 S. Lake Shore Drive, Chicago, IL 60605, USA. Email: tlumbsch@fieldmuseum.org

P. K. Divakar: Departamento de Biología Vegetal II, Facultad de Farmacia, Universidad Complutense de Madrid, Madrid 28040, Spain.

M. I. Messuti: Departamento de Botánica, Instituto de Investigaciones en Biodiversidad y Medioambiente (INIBIOMA CONICET-UN Comahue), Quintral 1250, 8400 San Carlos de Bariloche, Río Negro, Argentina.

A. Mangold: Ossastrasse 6, 12045 Berlin, Germany.

2008). However, some genera, such as *Chapsa* and *Thelotrema*, extend into temperate regions (Purvis *et al.* 1995). Other genera, such as *Melanotopelia* and *Topeliopsis*, occur in the tropics only at high altitudes and can be found in lower elevations in oceanic-temperate areas. These temperate thelotremoid taxa have recently received some attention. Purvis *et al.* (1995) revised the European taxa, Matsumoto (2000) monographed *Thelotrema* s. lat. species in Japan, and the Tasmanian species of *Chroodiscus* and allied genera were treated by Kantvilas & Vězda (2000). Despite these recent publications, we became aware of several taxonomic problems in our studies on thelotremoid lichens regarding species in extratropical regions of the Southern Hemisphere. Consequently, we have studied material of thelotremoid lichens with a trentepohlioid photobiont from subantarctic regions. The study area refers to the Antarctic floral region according to Walter & Breckle (1983). The Tasmanian species previously treated by

(Kantvilas & Vězda 2000) have already been studied by Mangold *et al.* (2009) and hence are not treated in detail here. In our studies we found three species that needed to be described as new and one species that needed to be transferred to another genus in order to follow the generic classification of Frisch *et al.* (2006). A total of 25 species is accepted here for the study area, a remarkable number for a group of lichens that is predominantly tropical in its distribution.

Material and Methods

Material from the following herbaria was examined for this study: ABL, AK, B, BCRU, BM, BRI, C, CANB, CANL, CHR, F, FH, G, GLAM, GZU, H, HO, LSU, MEL, MSC, NSW, NY, OTA, S, UPS, US and WELT. Sections of thalli and apothecia were cut using a razor blade and a freezing microtome, and examined in water and lactophenol cotton blue. Thin-layer chromatography was carried out using solvent system B' (Lumbsch 2002) and high-performance liquid chromatography according to Feige *et al.* (1993).

Key to the species of *Thelotremataceae* in subantarctic regions

- | | | |
|------|--|-----------------------------------|
| 1 | Ascospores transversely septate | 2 |
| | Ascospores muriform | 9 |
| 2(1) | Ascospores non- or rarely faintly-amyloid | 3 |
| | Ascospores strongly amyloid | 5 |
| 3(2) | Ascomata regenerating, with layered margins, exciple apically carbonized | |
| | Schizotrema zebrinum | |
| | Ascomata different, margin not layered but sometimes exfoliating, exciple hyaline to yellowish | 4 |
| 4(3) | Apothecia lepadinoid, margins not exfoliating | Thelotrema suecicum |
| | Apothecia chroodiscoid, with exfoliating margins | Chapsa minor |
| 5(2) | Ascomata perithecioid when young, becoming urceolate, constricted at base | 6 |
| | Ascomata lepadinoid, not perithecioid, not constricted at base | 7 |
| 6(5) | Ascospores up to 160 µm long; thallus K ⁺ yellowish brown, containing stictic acid | Topeliopsis patagonica |
| | Ascospores up to 110 µm long; thallus K ⁻ , lacking secondary metabolites | Topeliopsis subdenticulata |
| 7(5) | Thallus K ⁻ , lacking secondary metabolites | Thelotrema subtile |
| | Thallus K ⁺ yellow turning red, containing salazinic acid | 8 |
| 8(7) | Ascospores 25 – 45 × 7 – 9 µm | Thelotrema circumscriptum |
| | Ascospores 50 – 80 × 8 – 12 µm | Thelotrema hians |

- 9(1) Ascospores brown, non-amyloid **Thelotrema saxatile**
 Ascospores hyaline, rarely old spores brownish, amyloid or non-amyloid 10
- 10(9) Hamathecium with cone-shaped columella, lateral paraphyses absent 11
 Hamathecium lacking a columella, lateral paraphyses present 12
- 11(10) Ascospores up to 300 µm long, with appendix-like ends; apothecia with more or less
 annulate pore **Ocellularia bicuspidata**
 Ascospores up to 450 µm long, without appendices; apothecia lacking annulate pore
 **Ocellularia profunda**
- 12(10) Ascospores strongly amyloid 13
 Ascospores non-amyloid or rarely faintly amyloid 18
- 13(12) Asci 1–2-spored 14
 Asci 4–8-spored 17
- 14(13) Ascomata perithecioid when young, becoming urceolate, constricted at base, exciple
 fused 15
 Ascomata peri- to apothecioid, not constricted at base, exciple apically free
 **Thelotrema rugatulum**
- 15(14) Ascomata with reddish brown base, ascospores 100–210 µm long, forming ascoco-
 nidia; thallus lacking secondary metabolites **Topeliopsis muscigena**
 Ascomata with hyaline base; ascospores not forming ascocnidia; thallus containing
 the stictic acid chemosyndrome or lacking substances 16
- 16(15) Ascomata up to 0.8 mm diam.; ascospores 70 – 160 µm long, over bryophytes or
 rocks **Topeliopsis azorica**
 Ascomata up to 2 mm in diam.; ascospores 100 – 200 µm long, on bark
 **Topeliopsis novae-zelandiae**
- 17(13) Ascomata chroodiscoid; thallus growing on *Astelia* leaves; containing the succinpro-
 tocetraric acid chemosyndrome **Chapsa asteliae**
 Ascomata urceolate; thallus growing on bryophytes; lacking secondary metabolites
 **Topeliopsis decorticans**
- 18(12) Ascomatal margin entirely or apically carbonized 19
 Ascomatal margin hyaline to yellowish 21
- 19(18) Ascomatal margin multi-layered, on bark or wood . **Schizotrema schizolomum**
 Ascomatal margin not layered, on bryophytes or soil 20
- 20(19) Ascospores 110–140 µm long; thallus containing salazinic, protocetraric and norstic-
 tic acids **Melanotopelia blepharostoma**
 Ascospores 80–230 µm long; thallus containing the stictic acid chemosyndrome . .
 **Melanotopelia rugosa**
- 21(18) Ascomata chroodiscoid with recurved margins 22
 Ascomata urceolate or lepadinoid, margins not recurved 23
- 22(21) Ascomatal margin not or sparsely layered; containing the stictic acid chemosyn-
 drome **Chapsa megalophthalma**
 Ascomatal margin multi-layered; containing the protocetraric acid chemosyndrome
 **Chapsa lamellifera**
- 23(21) Ascomata lepadinoid, not or weakly constricted at base; lacking secondary metabo-
 lites, on bark or rocks **Thelotrema lepadinum**
 Ascomata urceolate, strongly constricted at base; containing the stictic acid chemo-
 syndrome 24

- 24(23) Thallus restricted to surrounding of ascomata, growing on leaves; ascospores 50–108 µm long **Topeliopsis athallina**
 Thallus larger, growing over bryophytes; ascospores 70–150 µm long
 **Topeliopsis macrocarpa**

The Species

Chapsa asteliae (Kantvilas & Vězda) **Mangold**

Flora of Australia 57: 653 (2009).—*Chroodiscus asteliae* Kantvilas & Vězda, *Lichenologist* 32: 328 (2000); type: Australia, Tasmania, Mt. Curly, *Kantvilas & Jarman* 38/85 (BM—isotype!).

(Fig. 1A & B)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K– to K+ yellowish brown, C–, PD+ orange-red; containing succinprotocetraric (major), protocetraric and fumarprotocetraric acids (traces).

Notes. *Chapsa asteliae* is characterized by a thin, corticate thallus and ascomata with layered margins and dark discs, and large, muriform, amyloid, and thick-walled ascospores, as well as the presence of succinprotocetraric acid. The species is similar to *C. lamellifera* and *C. minor*. The latter is readily distinguished by transversely septate ascospores. For differences to *C. lamellifera* see under that species.

Ecology and distribution. The species was described from Tasmania (Kantvilas & Vězda 2000) and is recorded here from Campbell Island, New Zealand, for the first time. It is a rare species growing on dead leaves of *Astelia* in heathlands and peat bogs.

Specimens examined. **New Zealand:** *Campbell Island:* between Tucker and Camp Coves, *Harris* 4661 (MSC); W of Camp Cove, *Harris* 5415 (MSC).

Chapsa lamellifera (Kantvilas & Vězda) **Mangold**

Flora of Australia 57: 653 (2009).—*Chroodiscus lamelliferus* Kantvilas & Vězda, *Lichenologist* 32: 336 (2000);

type: Australia, Tasmania, Ben Ridge, *Kantvilas* 105/81 (HO—holotype!).

(Fig. 1C & D)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K+ yellowish, C–, PD+ reddish; containing protocetraric acid, fumarprotocetraric acid (major to minor), and succinprotocetraric acid (minor).

Notes. *Chapsa lamellifera* is readily identified by its large ascomata with a distinctly layered margin, muriform, hyaline, non-amyloid ascospores, and by the presence of the protocetraric acid chemosyndrome. The species is chemically similar to *C. asteliae*, which can be distinguished by smaller ascomata with greyish pruinose discs and narrower ascospores. *Chapsa minor* is also similar to *C. lamellifera* but readily distinguished by having transversely septate ascospores and by producing substances of the stictic acid chemosyndrome.

Ecology and distribution. The species is widely distributed in temperate Australasia, occurring in Tasmania, the South Island of New Zealand and subantarctic islands, where it grows on bark and wood, soil, debris or mosses. It occurs at altitudes ranging from sea level to 900 m in moist cool temperate rainforests.

Selected specimens examined. **New Zealand:** *Auckland Island:* above Ranui Cove, *H. A. Imshaug* 56201 (MSC); between head of Musgrave Inlet and Lake Hinemoa, *H. Imshaug* 56469 (MSC); head of N Harbour, *H. A. Imshaug* 57785 (MSC). *Campbell Island:* along road to old Tucker Station, *R. C. Harris* 4459, 4470 (MSC). *South Island:* Fiordland, Dusky Sound, *D. J. Galloway* (CHR-408259); Nelson, Denniston Plateau, 16 km E of Westport, *H. Streimann* 51140 (CANB); Westland, Croesus Track from end of Blackball Road, *Polly* (WELT-L6394). *Stewart Island:* Disappointment Cove, *D. J. Galloway* (CHR-378081).

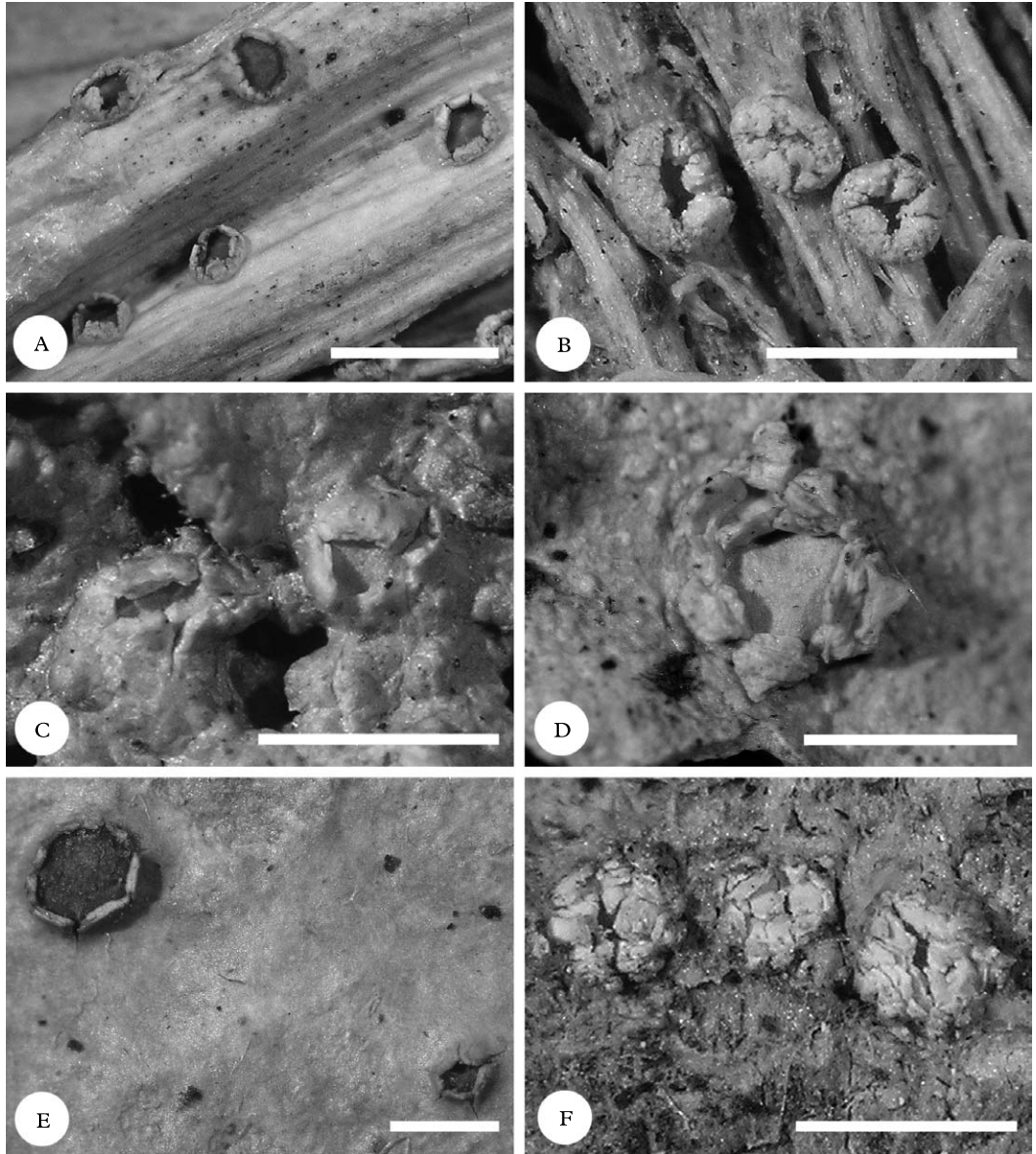


FIG. 1. Habit of *Chapsa* species. A & B, *C. asteliae* [Harris 5415 (MSC)]; C & D, *C. lamellifera* [Streimann 51140 (CANB)]; E, *C. megalophthalma* [12 v 1993, Malcolm (CANB)]; F, *C. minor* (Harris 5586 [MSC]). Scales: A–F = 1 mm.

***Chapsa megalophthalma* (Müll. Arg.)
Mangold**

Flora of Australia 57: 654 (2009).—*Thelotrema megalophthalmum* Müll. Arg., *Flora* 65: 500 (1882); type: Australia, Queensland, Toowoomba, Hartmann s.n. (BM—isotype!).—*Chroodiscus megalophthalmus* (Müll.

Arg.) Vězda & Kantvilas in Vězda, *Lich. Rar. Crit. Exsicc.* 3: 2 (1992).

(Fig. 1 E)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K+ yellowish becoming brown, C–, PD+ orange; containing stictic (major), constictic (major to minor), α -acetylhyconstictic, cryptostictic, α -acetylconstictic, hyposalazinic and hypostictic acids (traces).

Notes. *Chapsa megalophthalma* is easily distinguished by its smooth, often distinct greenish thallus in contrast to large, regenerating ascomata with bright, off-white rimmed flesh-coloured discs that become overgrown by a covering tissue. *Chapsa lamellifera* and *C. recurva* (G. Salisb.) A. Frisch are similar species. *Chapsa lamellifera* differs in having multi-layered ascomatal margins and larger ascospores, and by the presence of protocetraric acid. *Chapsa recurva* differs by having distinctly pruinose discs, larger (up to 68 μ m long) ascospores, and 2–4-spored asci.

Ecology and distribution. *Chapsa megalophthalma* grows on bark and siliceous rocks in shaded places in temperate rainforests. The species occurs in Australia (Mangold *et al.* 2009) and New Zealand. The growth on smooth, siliceous rocks is rather unusual.

Selected specimens examined. **New Zealand:** *South Island:* Fjordland, Lake Thomson, mixed *Nothofagus*-broad leaf forest, 25 iv 2000, A. Knight (OTA-53630); Fjordland, Secretary Island, ii 1959, Murray (OTA-50158); Marlborough, Mt. Stokes track, W. Malcolm 763 (CHR); Nelson, Brook waterfalls, 12 v 1993, W. Malcolm (BM, CANB, GZU, H). *North Island:* Wellington, 17 v 1989, B. W. Hayward & G. C. Hayward (AK-212481); D'Urville Island, 4 i 1988, B. W. Hayward & G. C. Hayward (AK-212485).

Chapsa minor (Kantvilas & Vězda) Mangold

Flora of Australia 57: 654 (2009).—*Chroodiscus minor* Kantvilas & Vězda, *Lichenologist* 32: 341 (2000); type: Australia, Tasmania, Weindorfers Forest, Kantvilas 16/88 (HO—holotype!).

(Fig. 1F)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K+ yellowish becoming brown, C–, PD+ orange; containing stictic,

hypostictic (major to minor), constictic (minor to trace), and cryptostictic acids (traces).

Notes. A similar species is *C. lamellifera*, which has similar layered ascomata and contains stictic acid. It can, however, be readily distinguished by its larger, muriform ascospores.

Ecology and distribution. *Chapsa minor* is a rare species, collected from the bark of several trees in cool temperate rainforests and open *Nothofagus* forests. It occurs in western Tasmania and Victoria (Mangold *et al.* 2009). The species is recorded here for the first time outside Australia. It also occurs in Campbell Island, the South Island of New Zealand and Patagonia (Messuti *et al.* 2010).

Specimens examined. **New Zealand:** *Campbell Island:* N slope of Filhol Peak, R. C. Harris 5586, 5598-B (MSC). *South Island:* Westland, Westland NP, Callery Gorge SE of Franz Joseph, R. C. Harris 6273 (MSC).

Melanotopelia blepharostoma Lumbsch & Divakar sp. nov.

Mycobank no. MB 513052

Melanotopelia rugosae similis sed ab hac specie ascoporis minoribus et acido salazinicis et acido protocetrarico continens differt.

Typus: Falkland Islands, East Falklands, Stanley, UTM 21F VC 3270, 200 ft, mosaic of *Empetrum* heath and peat bogs, 30 January 1968, H. A. Imshaug 41444 (MSC—holotypus).

(Fig. 2A)

Thallus endo- to episubstratic, pale off-white to grey. Surface dull to slightly glabrous, smooth, continuous. True cortex continuous, formed by periclinal hyphae, up to c. 30 μ m thick. *Photobiont* trentepohlioid; algal layer poorly developed, discontinuous, calcium oxalate crystals absent. Vegetative propagules not seen.

Ascomata conspicuous, up to c. 1 mm diam., roundish, perithecioid at first, becoming apothecioid with maturity, sessile, solitary to marginally slightly fused, distinctly emergent, subglobular to urceolate. *Disc* often becoming partly visible from the surface, whitish to pale brownish, epruinose,

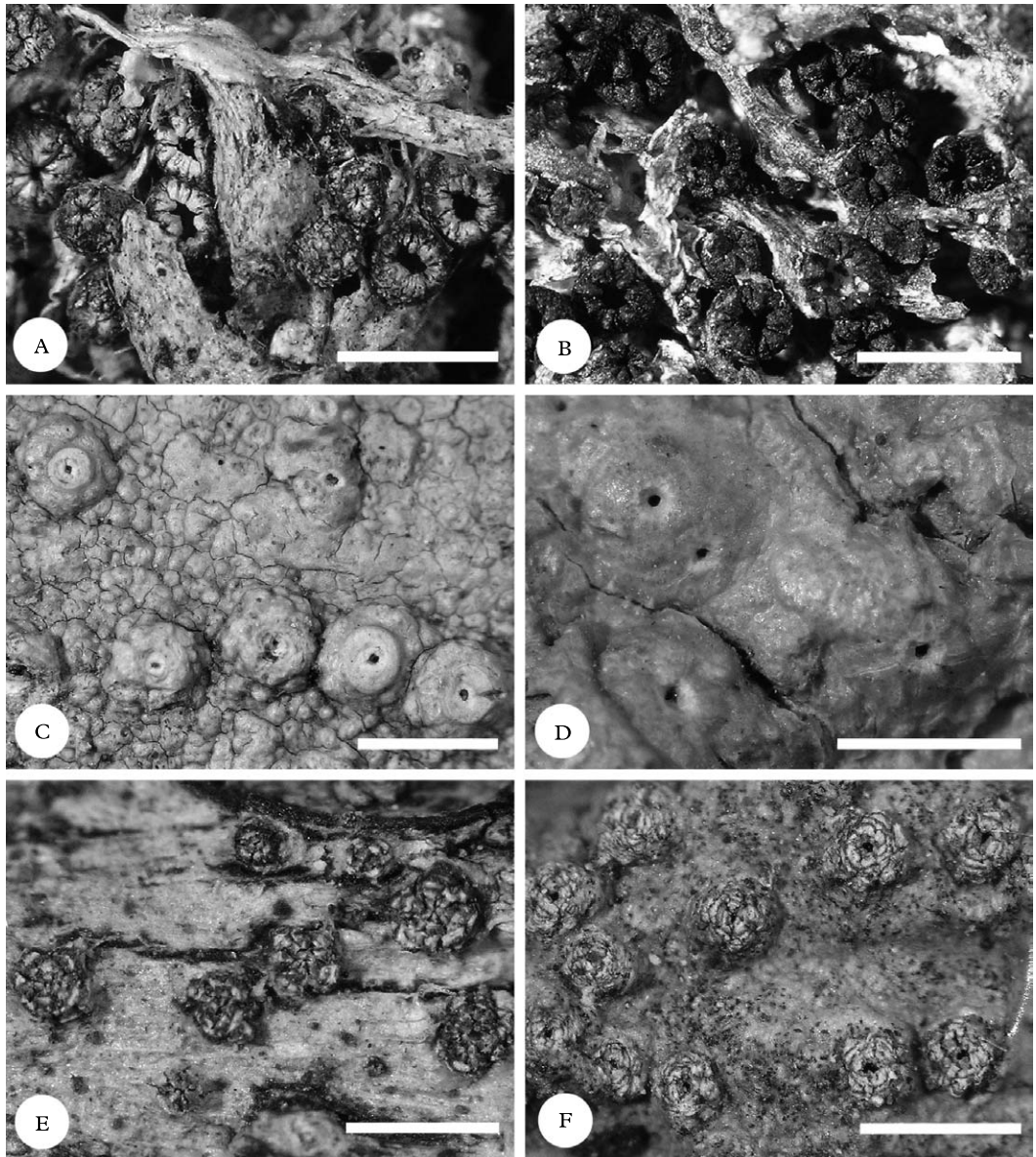


FIG. 2. Habit of *Melanotopelia*, *Ocellularia* and *Schizotrema* species. A, *M. blepharostoma* (MSC-holotype); B, *M. rugosa* [Imshaug 52580 (MSC)]; C, *O. bicuspidata* (Knight (OTA-58820)); D, *O. profunda* [Hale 66220 (US)]; E–F, *S. schizolomum* [Imshaug 56251 (MSC)]. Scales: A – F = 1 mm.

often distinctly cracked. *Proper exciple* not visible from the surface, pores small to gaping, star-shaped, pore margin entire to slightly split. Thalline rim in young ascomata whitish to pale greyish, entire, incurved. Proper exciple fused, hyaline internally,

dark-brown to carbonized marginally, non-amyloid. *Hymenium* non-inspersed, moderately conglutinated; *paraphyses* straight, distinctly parallel, unbranched, with slightly thickened tips, lateral paraphyses present, conspicuous, not clearly separated from

proper exciple, up to *c.* 50 µm long, columellar structures lacking. *Epihymenium* reddish or dark brown, granules or crystals absent. *Asci* 1(–3)-spored, tholus thick, thin when mature. *Ascospores* eumuriform, cell walls thin, endospore thin, sometimes with thin halo, hyaline to yellowish in decayed ascospores, non-amyloid, ellipsoid to irregular-fusiform with roundish ends, loci roundish to somewhat angular, predominantly irregular, 110–140 × 35–42 µm with multiple loci.

Chemistry. Thallus K+ yellowish becoming deep red, C–, PD+ orange; containing salazinic acid (major), norstictic acid (trace), and protocetraric acid (major).

Etymology. The name refers to the bryophyte genus *Blepharostoma* on which the new species was frequently collected.

Notes. This new species is characterized by eumuriform ascospores and the presence of salazinic and protocetraric acids. It is similar to *M. rugosa*, which, however, differs in having larger ascospores and in containing the stictic acid chemosyndrome. Another similar species is *M. toensbergii* Vězda & Kantvilas from the Pacific North-west of North America, which differs in having smaller apothecia and ascospores and lacking salazinic acid.

Ecology and distribution. The new species grows on bryophytes in heaths and peat bogs in Tierra del Fuego and the Falkland Islands.

Additional specimens examined. **Argentina:** *Tierra del Fuego:* Isla de los Estados, Bahía Capitan Canepa, *H. A. Imshaug* 52956 (MSC); Puerto Basil Hall, N of Puerto Abridado, *H. A. Imshaug* & *K. Ohlsson* 51370 (CANB); Puerto Basil Hall, Punta Passalacqua Peninsula N of Puerto Abridado, *H. A. Imshaug* 51370A (MSC); Puerto Cook/Puerto Vancouver, on ridge between the bays, *H. A. Imshaug* 51508 (MSC).—**Chile:** *Aysen (Region XI):* Puerto Island, *H. A. Imshaug* 43217 (MSC). *Magallanes y la Antártica Chilena Region (Region XII):* Brunswick Peninsula, Puerto Cutre, *H. A. Imshaug* & *R. C. Harris* 39394 (MSC); Brunswick Peninsula, Puerto Cutter, on Monte Condor, *H. A. Imshaug* & *R. C. Harris* 39463 (AK, MSC); Brunswick Peninsula, Punta Arenas, E of Mina Loreto on S side of Rio de las Minas, *H. A. Imshaug* 38939 (MSC); Cove of I. Chatham, *H. A. Imshaug* 44330 (MSC); E of I. Juan., *H. A. Imshaug* 44238 (MSC); W side of I Grant, *H. A.*

Imshaug 43697 (MSC).—**Falkland Islands:** *East Falklands:* Port William, *H. A. Imshaug* 41624 (MSC); Headwaters of Mullet Creek Stream, *H. A. Imshaug* 41461 (MSC); in stream valley NE of Sullivan House, *H. A. Imshaug* 42383 (MSC).

Melanotopelia rugosa (Kantvilas & Vězda) Lumbsch & Mangold

Lichenologist **40:** 44 (2008).—*Topeliopsis rugosa* Kantvilas & Vězda, *Lichenologist* **32:** 351 (2000); type: Australia, Tasmania, Reservoir Lakes, *Kantvilas* 177/86 (HO—holotype!).

(Fig. 2 B)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K+ yellowish becoming brown, C–, PD+ orange; containing constictic, stictic (majors), and cryptostictic acids (minor).

Notes. *Melanotopelia rugosa* is characterized by urceolate, dark ascomata with bright tips or pore margins, distinctly carbonized exciple; hyaline, eumuriform, large (up to 230 µm long) ascospores and by the presence of the stictic acid chemosyndrome. It is similar to *M. toensbergii*, which differs in having smaller ascomata with smaller pores, smaller ascospores (to 110 µm long), and containing protocetraric acid. The differences from *M. blepharostoma* are discussed under that taxon.

Ecology and distribution. It grows over bryophytes in subalpine moorland and bogs. The species occurs in Argentina, Australia, Chile, Falkland Island and New Zealand.

Specimens examined. **Argentina:** *Tierra del Fuego:* Isla de los Estados, Bahía Buen Suceso, *H. A. Imshaug* 50027, 50051 (MSC); Bahía Capitan Canepa, *H. A. Imshaug* 52879 (MSC); Bahía Crossley, headland at Bal. Tte., *H. A. Imshaug* 50734-B (MSC); Puerto Basil Hall, Punta Passalacqua Peninsula, N of Puerto Abridado, *H. A. Imshaug* 51370-B, 51381-B (MSC); Puerto Celular, peak on N side of cove, *H. A. Imshaug* 52580 (MSC); Puerto Cook, *H. A. Imshaug* 51580 (MSC); Puerto San Juan, Punta Lasserre Peninsula, *H. A. Imshaug* 52022 (MSC).—**Chile:** *Magallanes y la Antártica Chilena Region (Region XII):* E of Pta Brown, Pto Charrua, *H. A. Imshaug* 43604 (MSC).—**Falkland Islands:** *West Falklands:* Mt. Adam, *H. A. Imshaug* 41096 (MSC); W of N Lake, *H. A. Imshaug* 41118

(MSC); Port Howard, Mt. Maria, *H. A. Imshaug* 41292 (MSC).—**New Zealand:** *Auckland Island:* S side of Laurie Harbour, *H. A. Imshaug* 57491 (MSC). *Campbell Island:* Head of Garden Cove toward Filhol Peak, *R. C. Harris* 5198, 5203B, 5224 (MSC); on spur between Tucker and Camp Groves, *H. A. Imshaug* 46222 (MSC).

**Ocellularia bicuspidata (Müll. Arg.)
Mangold, Elix & Lumbsch**

Biblioth. Lichenol. **96:** 129 (2007).—*Thelotrema bicuspidatum* Müll. Arg., *Nuovo Giorn. Bot. Ital.* **23:** 395 (1891); type: Australia, Queensland, Sankey's Scrub (Brisbane), *Bailey* 631 (BRI-n. AQ721245!, US—istotypes!).

(Fig. 2C)

For a morphological description see Mangold *et al.* (2007, 2009).

Chemistry. Thallus K+ yellowish, C−, PD+ yellow; containing psoromic (major), 2'-O-demethylpsoromic (minor to trace) and subsoromic (trace) acids.

Notes. This species is distinguished by a dull, whitish-grey thallus, dark-rimmed ascoma margin, large, eumuriform, amyloid ascospores with long appendix-like ends and by the presence of psoromic acid. *Ocellularia grandis* (Hale) Hale and *O. subpraestans* (Hale) Hale are similar, but they have ascospores with roundish tips and different chemistries: *O. grandis* contains the hypoprotocetraric acid and *O. subpraestans* the stictic acid chemosyndrome.

Ecology and distribution. *Ocellularia bicuspidata* is a species occurring on bark in warm-temperate to tropical rainforests. It occurs in Australia and New Zealand.

Specimens examined: **New Zealand:** *South Island:* Nelson, Abel Tasman NP., Lookout Rock Track, *M. E. Hale* 66218 (US); *Wairoa, A. Knight* (OTA 58820).

**Ocellularia profunda (Stirt.) Mangold,
Elix & Lumbsch**

Biblioth. Lichenol. **96:** 204 (2007).—*Ascidium profundum* Stirt., *Trans. & Proc. Roy. Soc. Victoria* **17:** 70 (1881); type: Australia, Queensland, Brisbane, *Bailey* 131 (GLAM—holotype!).—*Thelotrema profundum* (Stirt.) Shirley, *Proc. Roy. Soc. Queensland* **6:** 191 (1889).

(Fig. 2D)

For a morphological description see Mangold *et al.* (2007, 2009).

Chemistry. Thallus K+ yellowish, C−, PD+ yellow; containing psoromic (major), 2'-O-demethylpsoromic (minor to trace) and subsoromic (trace) acids.

Note. This species is readily distinguished by small, pored, sunken ascomata with a cone-shaped columella, large, eumuriform ascospores and by the presence of psoromic acid. It is similar to *O. kalbii* (Müll. Arg.) Mangold, Elix & Lumbsch, which has smaller ascospores and lacks secondary compounds.

Ecology and distribution. *Ocellularia profunda* is a corticolous species and is widespread in warm temperate to tropical rainforests, rarely wet sclerophyllous forest, along the east coast of Australia from Queensland to New South Wales (Mangold *et al.* 2007, 2009). It is here reported from New Zealand for the first time.

Specimens examined. **New Zealand:** *South Island:* Nelson, Abel Tasman National Park, Lookout Rock Track, *M. E. Hale* 66220, 66221, 66222 (US).

**Schizotrema schizolomum (Müll. Arg.)
Mangold & Lumbsch**

Flora of Australia **57:** 657 (2009).—*Leptotrema schizoloma* Müll. Arg., *Nuov. Giorn. Botan. Ital.* **21:** 49 (1889); type: Argentina, Tierra del Fuego ("Fuegia"), Ushuaia, Beagle Channel, 1885, *Spegazzini* 101 [G—lectotype!, selected by Mangold *et al.* (2009)].

(Fig. 2E & F)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K−, C−, PD− or thallus K+ yellow to deep red, C−, PD+ orange; containing salazinic acid or lacking secondary metabolites.

Notes. *Schizotrema schizolomum* is characterized by regenerating, distinctly layered

and carbonized ascomata, and large, thin-walled, mainly non-amyloid, muriform ascospores. This species is similar to the tropical *S. guadeloupenensis* (Hale) Mangold, which, however, has smaller ascospores (up to 70 µm long) and contains either stictic acid or 'cinchonarum unknown'.

Ecology and distribution. The species grows on bark of various trees, especially *Nothofagus* spp. in cool-temperate rainforests of Tasmania, New Zealand, Argentina and also in Queensland (Australia).

Specimens examined. **Argentina:** Rio Negro: Puerto Blest, *M. I. Messuti* 4743 (BCRU).—**New Zealand:** Auckland Island: WNW of Chambres Inlet, *H. A. Imshaug* 56251 (MSC). *Stewart Island:* Port Pegasus, NW of Anchorage Island and SW of Tremulous Island, *H. A. Imshaug* 57824-B (MSC).

Schizotrema zebrinum Mangold

In A. Mangold, J.A. Elix & H.T. Lumbsch, *Flora of Australia* 57: 657 (2009); type: Australia, New South Wales, Mt. Warning NP., track from summit to parking lot, *Mangold* 19 e (CANB—holotype!; F, NSW—isoatypes!).

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K+ yellowish to yellow, C–, P+ reddish to orange; containing constrictic acid, conprotocetraric acid, stictic acid, protocetraric acid, fumarprotocetraric acid (all major to absent), hypoconstrictic acid, hypostictic acid; virensic acid (all minor to absent).

Notes. *Schizotrema zebrinum* is characterized by transversely septate, non-amyloid, hyaline ascospores. The species has a variable chemistry: most of the specimens have either the stictic acid or the protocetraric acid chemosyndrome, while a few specimens produce both chemosyndromes. *Schizotrema schizolomum* is morphologically similar, but differs in containing salazinic acid or lacking secondary metabolites and in having muriform ascospores.

Ecology and distribution. *Schizotrema zebrinum* was collected from the bark of various

trees in cool-temperate to warm-temperate and tropical montane rainforests. This is the first report from New Zealand; previously it was only known from Australia (Mangold *et al.* 2009).

Specimens examined. **New Zealand:** North Island: Wellington, Orongorongo River Valley, 5.3 miles SE of Eastbourne, *S. C. Tucker* 19090 (LSU). South Island: Westland, Alexander Range, Camp Creek; *M. Setzepfand* 514.1 (CHR).

Thelotrema circumscriptum C. Knight

Trans. New Zealand Inst. 15: 349 (1883); type: New Zealand, 1883, *C. Knight* s.n., (WELT-hb. Knight 35A: 2—lectotype, selected by Galloway 1985: 573; G—isolectotype!).—*Ocellularia circumscripta* (*C. Knight*) Dodge, *Nova Hedwigia* 19: 489 (1970).

(Fig. 3A)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K+ yellow becoming deep red, C–, PD+ orange; containing salazinic acid (major) and consalazinic acid (minor).

Notes. *Thelotrema circumscriptum* is distinguished by a thick, corticate thallus, emergent ascomata with free proper exciple, transversely septate, small, hyaline and amyloid ascospores, and by the presence of salazinic acid. It is similar to *T. hians*, which also contains salazinic acid. However, this taxon differs in having a thinner thallus, an apically more distinctly darkened exciple, and larger ascospores.

Ecology and distribution. *Thelotrema circumscriptum* grows on bark in cool-temperate to subtropical rainforests, often accompanied by *T. lepadinum*. It occurs in southern Argentina, Lord Howe Island, and New Zealand, where it has frequently been collected.

Specimens examined. **Argentina:** Neuquén: 5 km from Villa La Angostura, *M. I. Messuti* 4442 (BCRU).—**New Zealand:** Auckland Islands: between head of Smith Harbour and Norman Inlet, *H. A. Imshaug* 57245 (MSC); SW of Camps Cove, *H. A. Imshaug* 57443 (MSC). Ocean Island. *D. S. Horning* SA-485 (CHR-242358). South Island; Fiordland, Dusky Sound. 2 i 1900, *D. J. Galloway* s.n. (CHR-585904); Lake Rakatu,

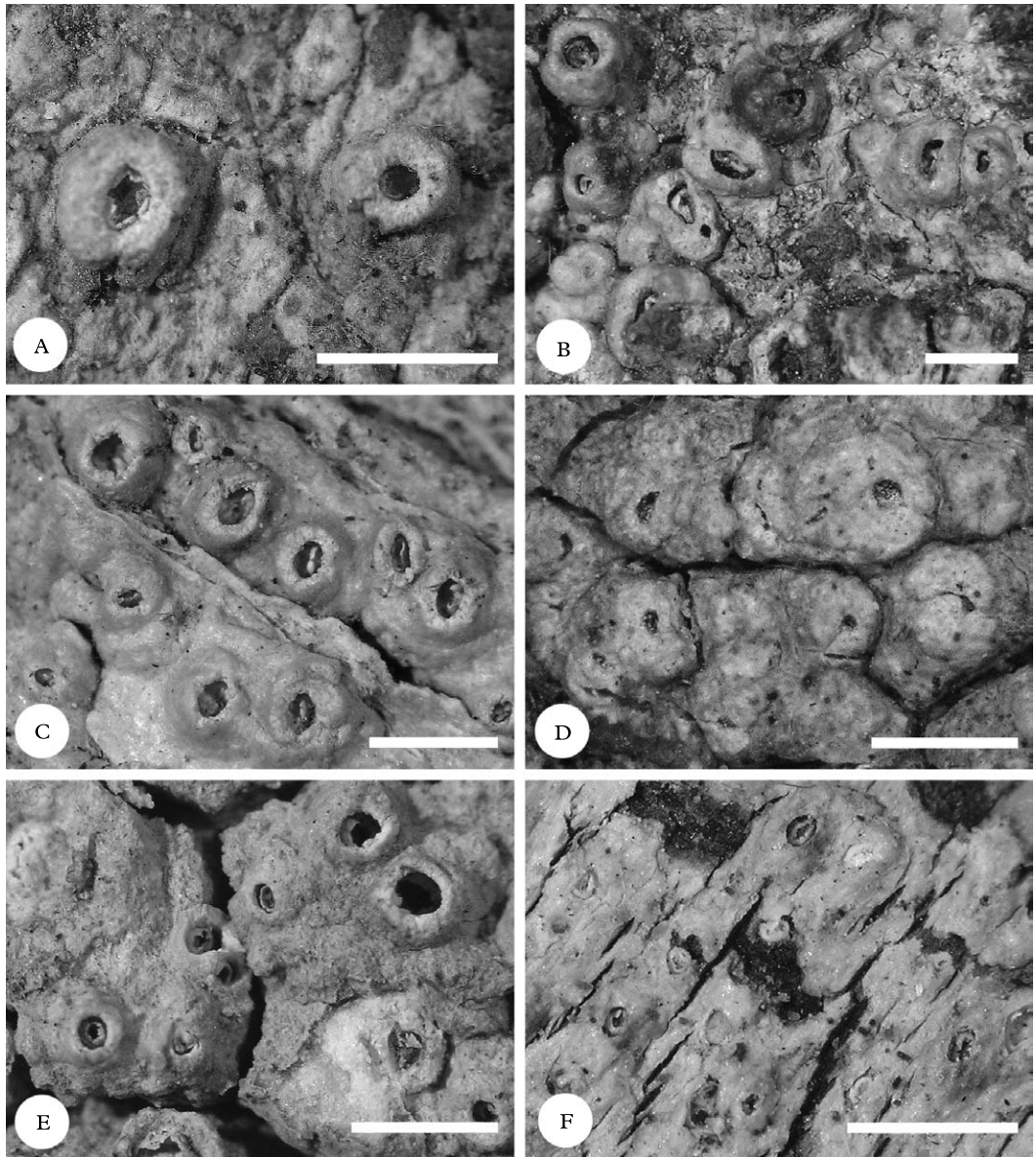


FIG. 3. Habit of *Thelotrema* species. A, *T. circumscriptum* [Imshaug 57443 (MSC)]; B, *T. hians* [Buchanan 206 (BM)]; C, *T. lepadinum* [Harris 5304 (MSC)]; D, *T. rugatulum* [Polly (WELT-L6752)]; E, *T. saxatile* [Elix 26241 (CANB)]; F, *T. subtile* [Imshaug 39061 (MSC)]. Scales: A–F = 1 mm.

11 iv 2002, *T. Paul* s.n. (CHR-584068), Nelson, Takaka Hill, *W. Martin* s.n. (CHR-585964); Otago, Abbots Hill, *J. S. Thomson* 1095 (CHR); Akatore Mouth, *W. Martin* 597 (CHR); Dunedin, Mihhiwaka, 29 viii 1953, *W. Martin* s.n. (CHR-585966), 29 viii 1954, *W. Martin* s.n. (CHR-585959); Flagstaff Hill, *J. S. Thomson* 1394 (CHR); Leith, Waitati Saddle, *J. S. Thomson* s.n.

(CHR); Silver Peaks near Dunedin, *H. H. Allan* s.n. (CHR-587179, 585971, 587182). Southland, Greenhills, 4 i 1900, *W. Martin* s.n. (CHR-585891), 11 v 1905, *W. Martin* s.n. (CHR-585901), 3 i 1966, *W. Martin* s.n. (CHR-479333), 27 iii 1967, *W. Martin* s.n. (CHR-585888); Invercargill, *W. Martin* 1292 (CHR), 5 i 1900, *D. J. Galloway* s.n. (CHR-585963), 31 i 1900,

W. Martin s.n. (CHR-585885), 2 iv 1954, *W. Martin* s.n. (CHR-585886), 24 xii 1956, *W. Martin* s.n. (CHR-585994), 24 xii 1965, *W. Martin* s.n. (CHR-585967, 585899), Invercargill, 16 x 1967, *D. J. Galloway* s.n. (CHR-585900), *W. Martin* s.n. (CHR-585893), 30 xii 1968, *W. Martin* s.n. (CHR-378912); Waikoa River, *D. J. Galloway* s.n. (CHR-378074, 585970, 585902); Westland, Greymouth, *W. Martin* 1354 (CHR); Haast, 18 v 1971, *P. Child* s.n. (CHR-445458); Taramakau River Catchment, 22 iii 2002, *T. Paul* s.n. (CHR-583540).

***Thelotrema hians* Stirt**

Journ. Linn. Soc. London, Bot. 14: 465 (1875); type: New Zealand, nr. Wellington, *Buchanan* 141 pr. p. (GLAM—lectotype!, selected here).—*Ocellularia hians* (Stirt.) Müll. Arg., *Bull. Herb. Boissier* 2(1): 74 (1894).

(Fig. 3B)

Thallus epi- to hypophloedal, thin, up to *c.* 100 µm high, pale yellowish to greenish grey. *Thallus* dull to slightly shiny, smooth, slightly fissured, continuous and smooth to slightly verrucose. True cortex lacking, covered by an ±non-continuous protocortex up to *c.* 25 µm thick. Algal layer moderately well developed, ±continuous, calcium oxalate crystals rather sparse, moderately large, scattered. Vegetative propagules not seen.

Ascomata conspicuous, up to *c.* 800 µm diam., apotheciod, solitary to sometimes marginally fused, becoming emergent, roundish, predominantly hemispherical to flattened urceolate, with the same surface as the thallus. Pores small to wide, up to *c.* 300 µm diam., roundish, entire to split, proper exciple superficially apically to entirely distinguishable, free, often shrunken, apically bright, darker towards the base, predominantly incurved. *Disc* becoming visible, greyish with whitish pruina. *Thalline* rim margin thin to thick, predominantly entire, ±roundish, incurved, concolorous with thallus to more often reddish brown. Proper exciple becoming free, thick, hyaline on the inside to predominantly pale yellowish brown to darkish brown towards the tips, often moderately amyloid at the base. *Hymenium* up to *c.* 150 µm high, clear, conglutinated; *paraphyses* interwoven, unbranched, tips thickened, lateral paraphyses present, conspicuous, up to *c.* 30 µm long, columellar

structures lacking. Epihymenium thin, with small greyish to hyaline, sometimes large greyish brownish granules. *Asci* 8-spored, tholus thick; *ascospores* transversely septate, with thick cell walls and endospore and thin halo, hyaline, amyloid, fusiform to clavate, ends narrowed-roundish to more rarely subacute, loci rather regular, predominantly roundish, subglobose to typically lentiform, end cells hemispherical to rarely cone-shaped, septa regular, 50–80 × 8–12 µm with 10–16 loci.

Pycnidia not seen.

Chemistry. *Thallus* K+ yellow becoming deep red, C–, PD+ orange; containing salazinic acid.

Notes. *Thelotrema hians* is characterized by a thin thallus, emergent ascomata with free proper exciple and transversely septate, amyloid, thick walled ascospores and by the presence of salazinic acid. *Thelotrema circumscriptum* is a similar species; for differences see under that taxon.

Ecology and distribution. So far only known from New Zealand, where it grows on bark.

Specimen examined. **New Zealand:** Locality not specified, *J. Buchanan* 206 (BM).

***Thelotrema lepadinum* (Ach.) Ach.**

Meth. Lich.: 132 (1803).—*Lichen lepadinus* Ach., *Lich. Suec. Prodr.:* 30 (1798); type: Sweden, Ostrogothia, *Acharius* s.n. (UPS-Ach.—lectotype, selected by Purvis *et al.* 1995: 344).—*Thelotrema flavescens* Darb. in *Nordenskjöld, Wiss. Ergebnisse Schwed. Südpolarexpedit.* 1901–1903, 4(4): 6 (1912); type: Chile, Tierra del Fuego, Navarin Island, *Skottsberg* s.n., 4. March 1902 (S—holotype!).

For additional synonyms and a morphological description see *Frisch et al.* (2006) and *Mangold et al.* (2009).

(Fig. 3C)

Notes. This species is characterized by emergent, large ascomata with free, basally yellowish proper exciple and an entire, roundish thalline rim margin, muriform, hyaline, non- to faintly amyloid, thick walled

ascospores and the absence of secondary compounds. Similar species include *T. subtile* and *T. suecicum*. They are, however, readily distinguished by smaller ascomata and transversely septate ascospores. *Thelotrema adjec-tum* Nyl. has similar ascospores but differs in its morphology.

Ecology and distribution. This is a common corticolous species that grows on bark in rainforests, heath shrubs and swamplands. It is a cosmopolitan species known from all continents except Antarctica (Frisch et al. 2006; Mangold et al. 2009). In the study area it is the most common thelotremoid species.

Selected specimens examined. **Argentina:** Chubut: Lago Puelo; *M. I. Messuti* 4432 (BCRU). Neuquén: Brazo Norte del Lago Correntoso; *M. I. Messuti* 4576 (BCRU). Río Negro: Brazo Tristeza, *M. I. Messuti* 4425 (BCRU). Tierra del Fuego: Bahía Primera, *H. A. Imshaug & K. Ohlsson* 52330 (UPS).—**Chile:** Araucanía (Region IX): *P. F. Cannon* 31 (BM). Los Lagos (Region X): *R. Santesson* 4205, 4253, 4265, 6918 a (S). Magallanes y la Antártica Chilena Region (Region XII): *P. Dusen* 42 (S), 6 i 1981, *K. Kalb* (BM, H).—**New Zealand:** Auckland Island: Enderby Island, NW corner of Sandy Bay; low forest, 19 xii 1995, *C. D. Meurk* (CHR-543341). Campbell Island: 1 mile W of S Point, S side of Perseverance Harbour, *R. C. Harris* 5304 (CANB). North Island: N Auckland, Haruru Falls, *J. A. Elix* 8087 (CANB). Stewart Island: Disappointment Cove, 29 ix 1969, *D. J. Galloway* (CHR-378076); Glory Cove, 15 ii 1967, *D. J. Galloway* (CHR-378913).

Thelotrema rugatum Nyl.

Bull. Soc. Linn. Normand. 2(7): 168 (1873); type: Andaman Islands, 1867, *Kurz* 57 (H-Nyl. 22495—lectotype!, selected by Hale 1972 in hb.).

(Fig. 3D)

For a morphological description see Mangold et al. (2009).

Chemistry. Thallus K⁻, C⁻, PD⁻; lacking secondary compounds.

Notes. This species is distinguished by asc-mata with an indistinctly free proper exciple, large, eumuriform, thin-walled, hyaline, \pm amyloid ascospores and by the absence of secondary compounds. It is similar to *T. conveniens* Nyl., which has immersed to emergent ascomata with apically free exciple, and large, muriform ascospores.

Ecology and distribution. *Thelotrema rugatum* grows on bark in temperate to tropical rainforests. It was previously known only from the Andaman Islands and Australia (Mangold et al. 2009); this is the first record for New Zealand.

Specimen examined. **New Zealand:** South Island, Nelson: 15 km NW Collingwood, *B. Polly* (WELT – L6752).

Thelotrema saxatile Knight

Trans. Proc. New Zealand Inst. 8: 327 (1876); type: New Zealand, 1 ii 1882, *C. Knight*, (WELT-hb. Knight 36: 12—lectotype, selected by Galloway (1985); BM—isolectotype!).—*Leptotrema saxatile* (Knight) Müll. Arg., *Bull. Soc. Bot. Belgique* 31: 35 (1892).—*Leptotrema monosporum* var. *saxatile* (Knight) Müll. Arg., *Bull. Herb. Boissier* 2(1): 75 (1894).

(Fig. 3E)

For a morphological description see Mangold et al. (2009).

Chemistry. Thallus K⁻, C⁻, PD⁻; lacking secondary compounds.

Notes. This taxon is characterized by an often dark, free exciple, 1(–2)-spored asci with large, eumuriform, brown, non-amyloid ascospores and by the absence of secondary compounds. The distinction of *T. saxatile* and *T. monosporum* Nyl. has been discussed by Lumbsch et al. (2008) and Mangold et al. (2009). Another similar *Thelotrema* lacking secondary metabolites and having large, brown, muriform ascospores is *T. conveniens*, which can be readily distinguished by its distinctly amyloid ascospores.

Ecology and distribution. *Thelotrema saxatile* grows on bark in temperate to tropical rainforests. It occurs in Australia (Mangold et al. 2009) and New Zealand.

Specimens examined. **New Zealand:** South Island: Canterbury, Banks Peninsula, Montgomery Reserve, *J. A. Elix* 26241 (CANB); Waihi Gorge, *Mason* 483c (OTA); locality not specified, *Colenso* 6227 (BM), *C. Knight* (BM, UPS).

Thelotrema subtile Tuck.

Amer. J. Arts Sci., ser. 2, 25: 426 (1858); type: U.S.A., Vermont, Brattleboro, *Frost* 150 pr. p., 1851

[FH-Tuck.—lectotype!, selected by Mangold *et al.* (2009); NY—isolectotype!].—*Ocellularia subtilis* (Tuck.) Riddle, *Mycologia* 15: 79 (1923).

(Fig. 3F)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K–, C–, PD–; lacking secondary compounds.

Notes. *Thelotrema subtile* is distinguished by a thin thallus, emergent, small apothecia with free proper exciple, small, transversely septate ascospores with a crenate surface and by the absence of secondary compounds. It is similar to *T. pseudosubtile* Mangold, which differs by its immersed to slightly raised ascomata with a less distinctly free proper exciple. *Thelotrema defossum* (Müll. Arg.) Mangold differs by having smaller ascospores (predominantly up to 30 µm with up to 11 loci).

Ecology and distribution. *Thelotrema subtile* grows on bark in cool-temperate rainforests and *Nothofagus* forests. It is a subcosmopolitan species (Frisch *et al.* 2006; Mangold *et al.* 2009).

Specimens examined. **Argentina:** Rio Negro: Laguna Frias, 700 m from Puerto Blest, *M. I. Messuti* & *I. N. de la Rosa* 4692 (BCRU).—**Chile:** Magallanes y la Antártica Chilena Region (Region XII): Brunswick Peninsula, Seno Otway, Bahía Camden; *H. A. Imshaug* 39061 (MSC).—**New Zealand:** North Island: Auckland, Hunua Range, Wairoa Loop Track, 12 ix 2003, *A. Knight* (OTA-58820). South Island: Fjordland, Wet Jack Arm, 4 xi 2002, *M. Renner* (CHR-580998); Kauri Reserve, Cascades, 5 ii 1949, *O. Selling* (S); Wellington, 1874, *S. Berggren* (S).

***Thelotrema suecicum* (H. Magn.) P. James**

Lichenologist 9: 186 (1977).—*Ocellularia suecica* H. Magn., *Bot. Not.* 1937: 125 (1937); type: Sweden, Bohuslän, 22 vi 1936, *Magnusson* (*Lich. sel. scand. exs.* 230) (BM—lectotype!, selected by James (1977); C, F—isolectotypes!).

(Fig. 4A)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K–, C–, PD–; lacking secondary compounds.

Notes. This taxon is characterized by a thin thallus, emergent, small apothecia with free proper exciple and hyaline, transversely septate, thick walled ascospores. Similar species are *T. defossum* and *T. subtile*. *Thelotrema defossum* can be distinguished by larger ascospores with regularly formed loci and thin septa. *Thelotrema subtile* has strongly amyloid ascospores, and less thickened cell walls that often show a crenate surface, larger loci and a brown pigmentation in older ascospores.

Ecology and distribution. The species grows on bark in cool-temperate rainforests. It is a subcosmopolitan species, recorded from Europe, North and South America (Purvis *et al.* 1995), Australia (Mangold *et al.* 2009), and is here recorded from New Zealand for the first time.

Specimens examined. **Argentina:** Neuquén: Puerto Blest, *M. I. Messuti* 4685 (BCRU); Parque Nacional Lanin, Secc Tromen, Rio Turbio, *M. I. Messuti* 206-P8, 4831 (BCRU); Villa La Angostura, *M. I. Messuti* 180-3 (BCRU), *M. I. Messuti* & *I. N. de la Rosa* 4491 (BCRU). **Rio Negro:** Villa Tacul, Llao-Llao; *M. I. Messuti* 4595 (BCRU).—**Chile:** Magallanes y la Antártica Chilena Region (Region XII): B. San Nicolas, *H. A. Imshaug* 45562 (MSC); Brunswick Peninsula, Forest Reserve Magallanes, 6 km W of Punta Arenas, *M. Wedin* 1186 (UPS); Brunswick Peninsula, Puerto Cutter, *H. A. Imshaug* 39520-C (MSC); Isla Riesco, Mina Elena, *R. Santesson* 2054 (S); Pto Gallant, *H. A. Imshaug* 45093-B (MSC).—**New Zealand:** Campbell Island: Head of Garden Cove toward Filhol Peak, *R. C. Harris* 5206 (MSC); S base of Lyall ridge, across from Shoal Point, *H. A. Imshaug* 46069 (MSC); S side of Perseverance Harbour, 1 mi W of S point, *R. C. Harris* 5443 (MSC). **South Island:** Wellington, vii 1875, *Berggren* (S).

***Topeliopsis athallina* Lumbsch & Mangold, sp. nov.**

Mycobank no. MB 513053

Topeliopsis patagonicae similis sed thallis inconspicuis et ascis 1–2-sporis differt.

Typus: New Zealand, Campbell Island, Summit of Mt. Azimuth, *H. A. Imshaug* 46560 (MSC—holotypus).

(Fig. 4B & C)

Thallus endo- to episubstratic, pale brown, mostly reduced to the area surrounding the

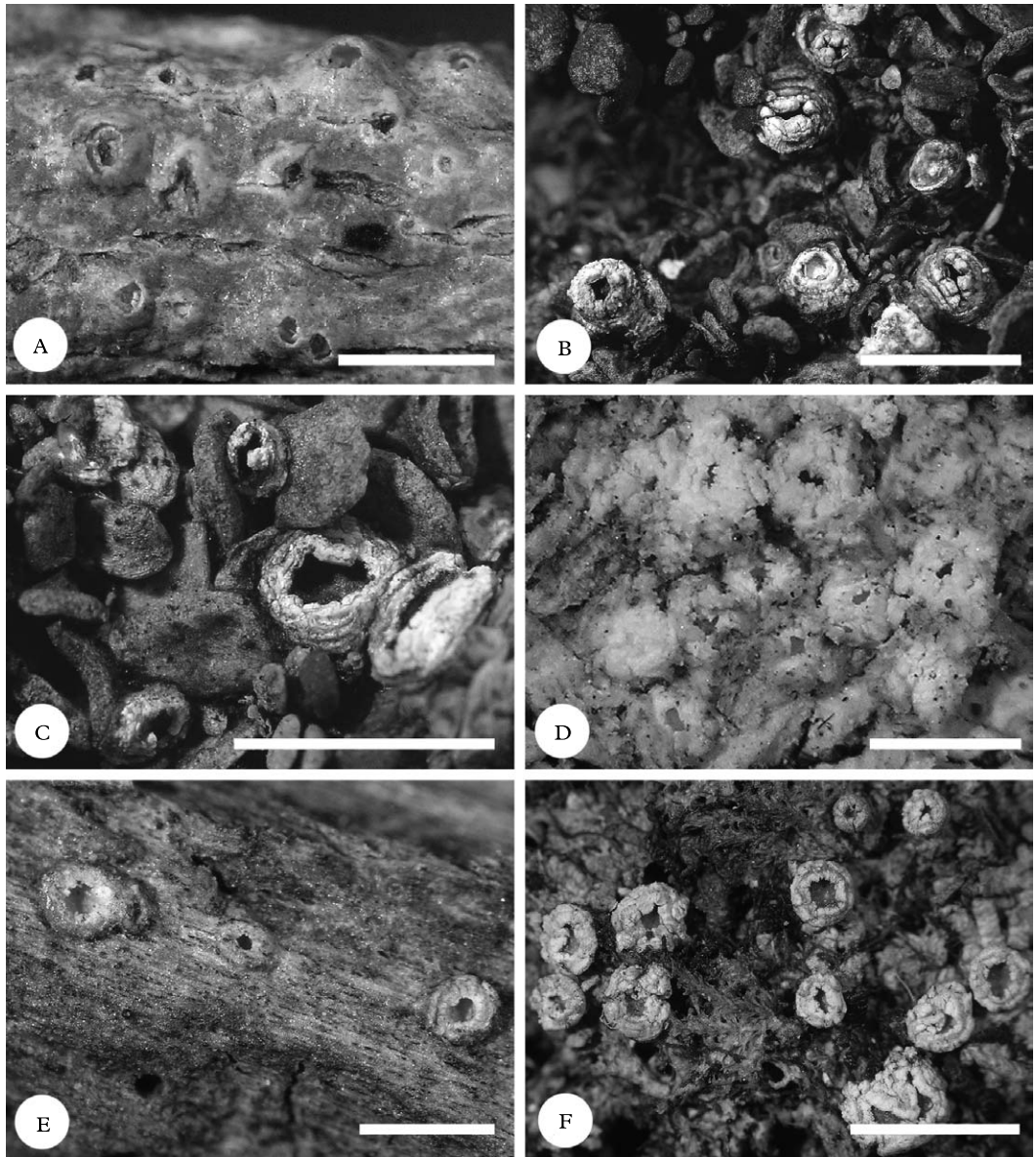


FIG. 4. Habit of *Thelotrema* and *Topeliopsis* species. A, *Thelotrema suecicum* [Imshaug 45562 (MSC)]; B–F. *Topeliopsis* species; B & C, *T. athallina* (MSC–holotype); D, *T. azorica* [Messuti 4485 (BCRU)]; E, *T. decorticans* [Tibell 9975 (UPS)]; F, *T. macrocarpa* [Imshaug 52950 (MSC)]. Scales: A–F = 1 mm.

apothecia; surface dull, continuous. Thallus covered by a protocortex up to *c.* 20 μ m thick. Algal layer discontinuous, poorly developed, calcium oxalate crystals lacking. Vegetative propagules not seen.

Ascomata conspicuous, up to *c.* 1 mm diam., roundish, perithecioid when young, becoming apothecioid with age, sessile, solitary to marginally slightly fused, emergent, subglobular when young, becoming

urceolate. *Disc* usually not visible from surface, pale flesh-coloured, pruinose. Pores small to moderately wide, irregular to star-shaped with split pore margin in younger ascomata, in older ascomata often roundish with entire pore margin, proper exciple not visible from surface. Thalline rim margin coarsely cracked to slightly lacerate, thalline rim apically pruinose, whitish to off-white, incurved. *Proper exciple* fused, thick, hyaline internally, pale yellowish to greyish marginally, internal exciple distinctly amyloid. *Hymenium* non-inspersed, conglutinated; *paraphyses* straight, distinctly parallel, unbranched, with unthickened tips, lateral paraphyses conspicuous, not clearly separated from the proper exciple, up to *c.* 35 μm long, columellar structures absent. *Epihymenium* hyaline, without granules or crystals. *Asci* 1-2-spored, tholus thick in young asci, thin or not visible at maturity; *ascospores* eumuriform, cell walls thick, endospore thin to thick, hyaline to yellowish, non-amyloid, broadly ellipsoid, with roundish ends, loci large, angular to cuboid to irregular, transverse septa thin, distinct, regular to slightly irregular, 50–108 \times 25–30 μm with numerous loci.

Chemistry. Thallus K⁺ yellowish becoming brown, C⁻, PD⁺ orange; containing stictic acid (major) and constictic acid (trace).

Etymology. Derived from *thallinus* (thal-line), referring to the lack of a well-developed thallus.

Notes. The new species is readily distinguished by a thallus that is reduced to areas surrounding the ascomata, 1–2-spored asci with eumuriform ascospores, and the presence of the stictic acid chemosyndrome. A similar species is *Chapsa asteliae*, which is readily distinguished by the ascoma morphology with layered margins, amyloid ascospores, and the presence of succinprotocetraric acid. *Topeliopsis patagonica* is similar in containing the stictic acid chemosyndrome, but has 8-spored asci and larger, transversely septate ascospores.

Ecology and distribution. The new species is known only from two localities on the sub-antarctic islands, where it grows on leaves of higher plants on summits (above 500 m alt.) over cliffs and rocky outcrops.

Additional specimen examined. **New Zealand:** Auckland Island: Summit of peak just S of Mt. Easton, H. A. Imshaug 56640 (MSC).

Topeliopsis azorica (P. James & Purvis) Coppins & Aptroot

Lichenologist 40: 372 (2008).—*Ramonia azorica* P. James & Purvis, *Arquipelago* 11A: 11 (1993); type: Azores, Faial, 14 April 1992, Purvis & P. James s.n. (BM—*isotype!*).

(Fig. 4D)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K⁻, C⁻, PD⁻; containing stictic acid (major), *u*-acetylconstictic (major or trace), hypoconstictic, hypostictic (minors or traces), cryptostictic and hyposalazinic acids (traces); or lacking secondary substances.

Notes. *Topeliopsis azorica* is characterized by large, hyaline, amyloid ascospores, and a short hymenium. *Topeliopsis elixii* Frisch & Kalb and *T. muscigena* are similar species. The latter can be distinguished by ascomata with reddish brown bases, larger ascospores that turn brownish with age and generate ascoconidia. *Topeliopsis elixii* contains the hypoconstictic chemosyndrome.

Ecology and distribution. In the study area it grows on bark in *Nothofagus* forests. Thus far the taxon is known from Australia, Argentina, Chile, the Azores, and Scotland.

Specimens examined. **Argentina:** Neuquén: Istmo de Quettrihue, M. I. Messuti & I. N. de la Rosa 4754 (BCRU). *Tierra del Fuego:* Sierra Alvear, Lago Escondido, M. I. Messuti 4485 (BCRU).—**Chile:** Magallanes y la Antártica Chilena Region (Region XII): Brunswick Peninsula, Rio Tres Brazos, H. A. Imshaug & K. Ohlsson 49677 (CANB, GZU, MSC, US); Punta Arenas, ii 1906, R. Thaxter (NY).

**Topeliopsis decorticans (Müll. Arg.)
Frisch & Kalb**

Lichenologist 38: 44 (2006).—*Thelotrema decorticans* Müll. Arg., *Bull. Herb. Boissier* 1: 54 (1893); type: Black Spur, Vic, 1888, Wilson '514' (G—lectotype!, NSW—isolectotype!).

Topeliopsis corticola Kalb, *Mycotaxon* 79: 322 (2001); type: Australia, New South Wales, Mt. Wilson, Blue Mnts. NP, K. & A. Kalb 20462 (CANB—holotype).

(Fig. 4E)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K⁻, C⁻, PD⁻. No secondary compounds detectable by TLC.

Notes. This taxon is characterized by 8-spored asci with muriform, hyaline, thick walled, amyloid ascospores and by the absence of secondary metabolites. Other *Topeliopsis* species with muriform ascospores have distinctly larger ascospores and 1–2-spored asci.

Ecology and distribution. The species grows on epiphytic mosses, rarely on wood, bark or on siliceous rock in cool temperate rainforests. It was known only from Australia (Mangold *et al.* 2009) and is recorded here for the first time from New Zealand.

Specimen examined. New Zealand: South Island: Westland, Arthur's Pass NP, 4 km N of Otira; L. Tibell 9975 (UPS).

**Topeliopsis macrocarpa (C. W. Dodge)
Mangold & Lumbsch**

Flora of Australia 57: 659 (2009).—*Thelotrema macrocarpum* C. W. Dodge, *Nova Hedwigia* 19: 457 (1971); type: New Zealand, Auckland Islands, B. A. Fineran 1434b (CANU—holotype, not seen).

Chroodiscus australis Kantvilas & Vězda, *Lichenologist* 32: 331 (2000); type: Argentina, Isla de los Estados, H. Imshaug 51381A (HO—holotype!, MSC—isotype!).

(Fig. 4F)

Thallus thin, endo- to episubstratic, pale grey; surface dull, continuous, somewhat gelatinous and translucent when moist. Cortical structures absent. Algal layer discontinuous and poorly developed, calcium oxalate crystals lacking. Vegetative propagules not seen.

Ascomata conspicuous, up to *c.* 1.2 mm diam., roundish, perithecioid when young, becoming apothecioid, sessile, solitary to sometimes marginally fused, distinctly emergent, subglobose first, becoming (depressed-) urceolate. **Disc** orange-brown to olive-brown, concave, smooth, epruinose, mostly obscured by the exciple. Pores irregular to more often star-shaped to somewhat roundish, at first opening as ±regularly radiating cracks, in older ascomata with deeply split, dentate, and lobed pore margin, proper exciple visible from the surface, whitish to pale brown. Thalline rim coarsely lacerate, distinctly lobed, rarely somewhat eroded, off-white to pale brownish, whitish pruinose. **Proper exciple** fused, thick, pale yellowish, amyloid. **Hypothecium** pale yellowish to yellow, amyloid, medulla below hypothecium hyaline. **Hymenium** up to *c.* 200 µm high, non-inspersed, strongly conglutinated; **paraphyses** straight, unbranched, parallel to slightly interwoven, tips unthickened to slightly thickened, lateral paraphyses present, not clearly separated from exciple, conspicuous, up to *c.* 40 µm long, columellar structures absent. **Epihymenium** orange-brown to brownish in older stages, without granules. **Asci** 1-spored, tholus thick, thin when mature; **ascospores** eumuriform, cell walls and endospore thin, non-halonate, hyaline, amyloid, broadly ellipsoid to fusiform, transverse septae thin, 70–150 × 26–45 (–56) µm with multiple loci.

Chemistry. Thallus K⁺ yellow, C⁻, PD⁺ orange; containing stictic, cryptostictic acid (trace), peristictic acid (trace).

Notes. *Topeliopsis macrocarpa* is characterized by 1-spored asci with large, muriform, non-amyloid ascospores and by the presence of the stictic acid chemosyndrome. It is similar to *T. tasmanica* (Kantvilas & Vězda) Mangold, which was previously regarded as a subspecies of *T. macrocarpa* (Galloway 2001; Kantvilas & Vězda 2000). However, *T. tasmanica* differs in having 2–4-spored asci with smaller (up to 100 µm long), non-amyloid ascospores. Further, the ascomata of *T. tasmanica* open more widely to expose the disc,

while the discs in *T. macrocarpa* are usually obscured by the margin. The foliicolous *T. athallina* differs in having smaller ascomata and smaller ascospores.

Ecology and distribution. The species is widely distributed and common in southern South America and also occurs in Campbell Island and the South Island of New Zealand. It grows over peaty soil or mosses in heathlands or bogs.

Selected specimens examined. **Argentina:** Tierra del Fuego: Isla de los Estados, Bahía Buen Suceso, *H. A. Imshaug* 49988 (MSC); Bahía Capitan Canepa, *H. A. Imshaug* 52950 (MSC); Puerto Basil Hall, Punta Passalacqua Peninsula, N of Puerto Abrigado, *H. A. Imshaug* 51381 (MSC); Puerto Vancouver, head of inner bay, *H. A. Imshaug* 52135 (MSC); Isla Grande, Bahía Valentin, *H. A. Imshaug* 50324 (MSC).—**Chile:** Araucanía (Region IX): Parque Nacional Conguillío, Los Paraguas, *B. J. Coppins*, *D. J. Galloway*, *G. Guzman* & *P. W. James* 5310 (BM). Los Lagos (Region X): Osorno, Refugio Antillanca, *H. A. Imshaug* 42923 (MSC); Parque Nacional Puyehue, Antillanca, *B. J. Coppins*, *D. J. Galloway*, *G. Guzman* & *P. W. James* 5095, 5326 (BM). Magallanes y la Antártica Chilena Region (Region XII): Isla Desolacion, Puerto Churruca, *H. A. Imshaug* 44796 (MSC).—**New Zealand:** Campbell Island: Mt. Lyall pyramid, *H. A. Imshaug* 46495-B (MSC); S slope of Mt. Hoeny above SE Harbour, *H. A. Imshaug* 47384 (MSC); W summit of Mt. Lyall, *R. C. Harris* 4787 (MSC). South Island: Southland, Sylvan Cove, Port Pegasus, *D. J. Galloway* (OTA-59746).—**Falkland Islands:** East Falklands: Mt. Osborne, *H. A. Imshaug* 39951 (MSC); Stanley, Goat Ridge, *H. A. Imshaug* 41496 (MSC); Stanley, Mt. Kent, *H. A. Imshaug* 40443 (MSC). West Falklands: Hill Cove, E French Peak, *H. A. Imshaug* 40996, 40999 (MSC); Port Howard, Mt. Maria, *H. A. Imshaug* 41284, 41285, 41295, 41360, 41361, 41362 (MSC).

Topeliopsis muscigena (Stizenb.) Kalb

Mycotaxon 79: 322 (2001).—*Thelotrema muscigenum* Stizenb., *Jahresber. St. Gall. nat. wiss. Ges.* 1888/89: 247 (1890); type: South Africa, Cape Province, August 1887, McOwan (H-Nyl-22438—isotype!).

(Fig. 5A & B)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K–, C–, PD–; lacking secondary substances.

Notes. *Topeliopsis muscigena* is distinguished by 1(–2)-spored asci with large,

eumuriform, amyloid and hyaline ascospores that become pigmented with age and form ascoconidia in the final stages of their development, and by the lack of secondary metabolites. Another similar species that produces ascoconidia is *T. elixii*, which differs mainly by the presence of hypoconstictic and hyposalazinic acids.

Ecology and distribution. *Topeliopsis muscigena* grows on bryophytes, more rarely on wood or bark and over rocks in cool-temperate rainforests or (sub)alpine to coastal heath- or moorlands. It is known from southern Africa, Australia, India and New Zealand (Kantvilas & Vězda 2000; Frisch *et al.* 2006; Mangold *et al.* 2009). This is the first record for Argentina.

Specimens examined. **Argentina:** Neuquén: Villa La Angostura, *M. I. Messuti* 4763 (BCRU); 6 km from Villa La Angostura, *M. I. Messuti* 4442 (BCRU). Rio Negro: Puerto Blest, *M. I. Messuti*, 4835 (BCRU).—**New Zealand:** Campbell Island: W of Camp Cove, *R. C. Harris* 5367 (MSC). North Island: Hunua Ra, Auckland, *A. Knight* (OTA-58054). South Island: Canterbury, Boyle River Lodge, ix 1981, *F. J. Walker* (BM, CANB, H); 9.5 km SSE of Arthur's Pass, Bealy Spur; *L. Tibell* 10095 (UPS); Westland Co., 8 miles W of Turiwhate; *R. C. Harris* 6329 (MSC).

Topeliopsis novae-zelandiae (Szatala) Lumbsch & Mangold comb. nov.

Mycobank no. MB 513055

Thelotrema novae-zelandiae Szatala, *Borbasia* 1: 56 (1939); type: New Zealand, Gisbourne, near Lake Waikaremoana, 1932, *J. Jablonsky* T55 (BP—holotypus!).

(Fig. 5C & D)

Thallus epi- to hyposubstratic, pale yellowish grey to greyish green; surface shiny, smooth, continuous. True cortex continuous, up to *c.* 15 µm thick, consisting of periclinal hyphae. Algal layer poorly to well developed, discontinuous to continuous, calcium oxalate crystals not seen. Vegetative propagules not seen.

Ascomata conspicuous, up to *c.* 2 mm diam., roundish, perithecioid when young, becoming apothecioid with age, sessile, solitary to marginally slightly fused, distinctly

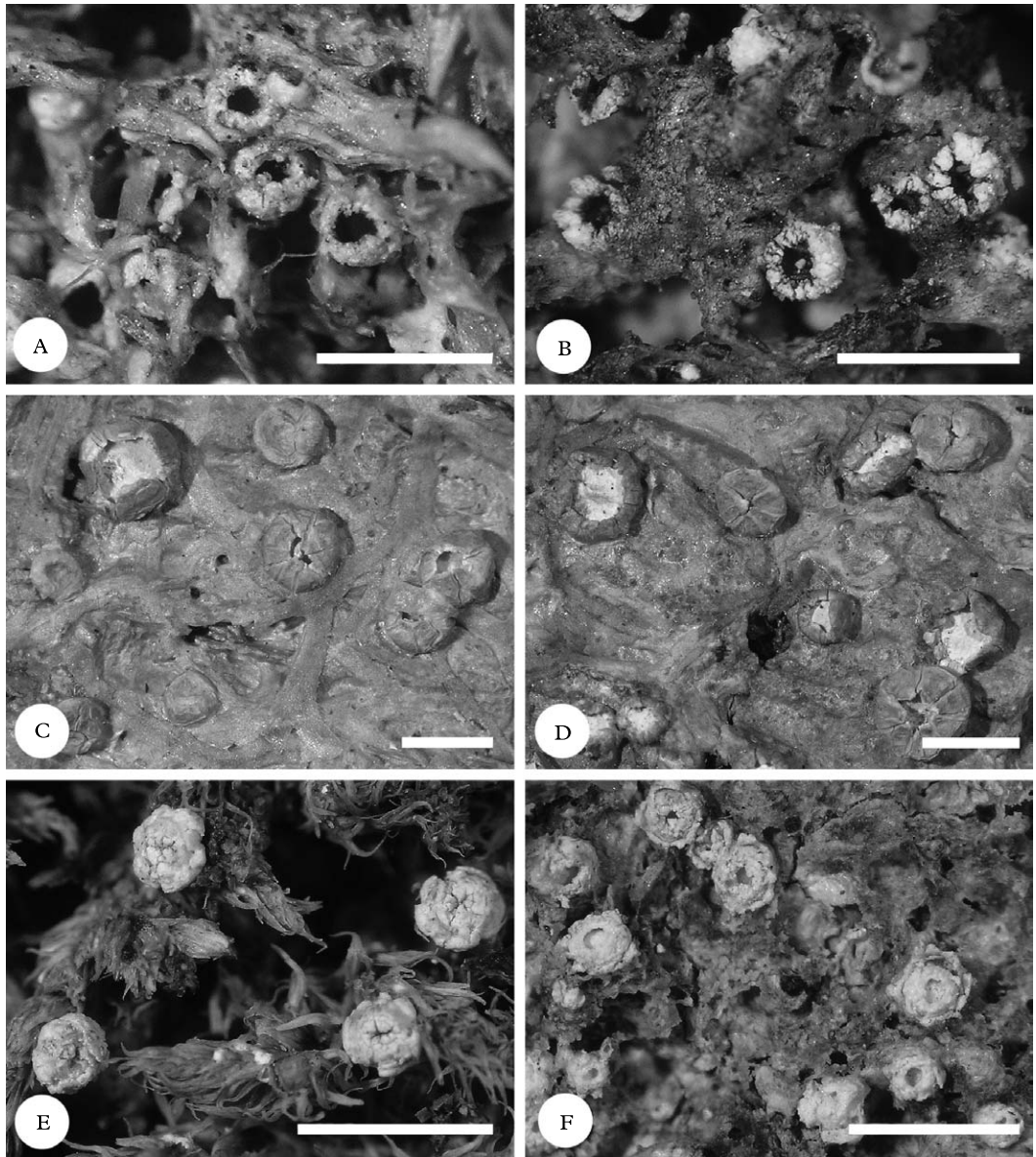


FIG. 5. Habit of *Topeliopsis* species. A & B, *T. muscigena* [Harris 6329 (MSC)]; C & D, *T. novae-zelandiae* [Elix 7119b (CANB)]; E, *T. patagonica* (MSC-holotype); F, *T. subdenticulata* [Mayrhofer 8972 (GZU)]. Scales: A – F = 1 mm.

emergent, subglobular. *Disc* visible from surface, flesh-coloured in younger ascomata, pale to dark brownish grey in older ascomata, pruinose. Pores small to moderately wide, irregular to star-shaped, pore margin split, proper exciple not visible from surface. Thalline rim margin coarsely cracked to

slightly lacerate, thalline rim epruinose, whitish to off-white, incurved, base smooth, conspicuously pale brown. *Proper exciple* fused, thick, pale yellowish internally to hyaline marginally, apically sometimes dark brown, internal exciple and subhymenium distinctly amyloid. *Hymenium* non-inspersed,

conglutinated; paraphyses straight, parallel, unbranched, with slightly thickened tips, lateral paraphyses present, inconspicuous, not clearly separated from proper exciple, up to *c.* 40 μm long, columellar structures absent. *Epihymenium* hyaline, without granules, with small crystals. *Asci* 1(–2)-spored, tholus thick. *Ascospores* eumuriform, cell walls in younger stages somewhat thickened, thin at maturity, endospore thin, with thin halo, hyaline to yellowish, strongly amyloid, cylindrical to roundish-fusiform with roundish to slightly roundish ends, loci predominantly roundish to slightly angular, transverse septa thin, distinct and \pm regular, 100–200 \times 25–52 μm with multiple loci.

Chemistry. Thallus K+ yellowish becoming brown, C–, PD+ orange; containing stictic acid (major), constictic, cryptostictic and *a*-acetylhyppoconstictic acids (minors).

Notes. This species is characterized by large ascomata, a shiny thallus, 1(–2)-spored asci, eumuriform ascospores, and by the presence of the stictic acid chemosyndrome. The species is hardly confused with another species. Stictic acid is also present in *Topeliopsis athallina*, *T. macrocarpa*, and *T. patagonica*. The latter is readily distinguished by transversely septate ascospores, while *T. athallina* has smaller ascospores and smaller ascomata. *Topeliopsis macrocarpa* has smaller ascomata and smaller ascospores.

Ecology and distribution. The species occurs on bark and among bryophytes in temperate rainforests. The species occurs in New Zealand and has also been recorded from Sri Lanka (Hale 1981).

Specimens examined. **New Zealand:** South Island: Canterbury, Banks Peninsula, Mt. Sinclair, *f. A. Elix* 7119b (CANB); Canterbury, Banks Peninsula, Otepotu Scenic Reserve, *f. A. Elix* 26256 (CANB); Westland, Arthur's Pass NP, 4 km N of Otira; *L. Tibell* 9984 (UPS).

***Topeliopsis patagonica* Mangold & Lumbsch sp. nov.**

Mycobank no. MB 513054

Topeliopsis athallinae similis sed thallis griseis vel albo-griseis et ascis 8-sporis differt.

Typus: Chile, Prov. Magallanes, Isla Desolación, *Imshaug & Ohlsson* 44750 (MSC—holotypus).

(Fig. 5E)

Thallus endo- to episubstratic, pale grey to whitish grey or inconspicuous; surface dull, rough, continuous. Thallus covered by a discontinuous protocortex up to *c.* 30 μm thick. Algal layer discontinuous and poorly developed, calcium oxalate crystals usually abundant and of variable size, scattered or in clusters. Vegetative propagules not seen.

Ascomata conspicuous, up to *c.* 1 mm diam., roundish, peri- to apothecoid, sessile, predominantly solitary, emergent and subglobose to urceolate. *Disc* not visible from the surface. Pores small to moderately wide, usually ragged and irregular to star-shaped, pore margin distinctly split, incurved, proper exciple not visible from the surface, roundish to somewhat irregular, \pm entire, incurved, pale brownish to reddish-brown. Thalline rim margin thick, with same colour and structure as rest of thalline rim, thalline rim lacerate, coarsely whitish pruinose to squamulose, often eroded, somewhat exfoliating with age and becoming slightly layered, off-white. *Proper exciple* predominantly fused, in eroded ascomata tips sometimes apically exposed, thick, hyaline to pale yellowish internally, pale orange to reddish brown marginally, usually distinctly amyloid towards the base and subhymenium. *Hymenium* non-inpersed, conglutinated; paraphyses unbranched, \pm straight, parallel to slightly interwoven with unthickened, lateral paraphyses not clearly separated from exciple, inconspicuous, up to *c.* 45 μm long, columellar structures absent. *Epihymenium* hyaline, without granules or crystals. *Asci* 8-spored, tholus thick, thin when mature; *ascospores* transversely septate, cell walls thick, in younger ascospores distinctly halonate, hyaline, strongly amyloid, bacillar-fusiform to fusiform, with narrowed-rounded to subacute ends, loci angular, septae thin, regular, 90–160 \times 20–26(–31) μm with 12–17 loci.

Chemistry. Thallus K+ yellowish becoming brown, C–, PD+ orange; containing stictic acid.

Etymology. The name refers to the distribution of the new species in Patagonia.

Notes. This new species is similar to *T. subdenticulata* and was included in the circumscription of that species by Frisch & Kalb (2006). It differs, however, in having larger ascospores and contains the stictic acid chemosyndrome and is therefore regarded as a distinct species here. A similar species is *T. darlingtonii* A. Frisch & Kalb, which, however, is readily distinguished by having smaller ascospores.

Ecology and distribution. It grows on bark and over bryophytes in cool-temperate rainforests or open *Nothofagus* forests and is currently known only from southern South America.

Specimens examined. **Chile:** *Magallanes y la Antártica Chilena Region (Region XII):* Brunswick Peninsula, Puerto Cutter, *H. A. Imshaug* 39400, 39430 (MSC); E shore of Pto Bueno, *H. A. Imshaug* 44552 (MSC); Head of Pto Bueno, *H. A. Imshaug* 44526-B (MSC); Isla Desolacion, Bahia Tuesday, *H. A. Imshaug* 44750 (MSC); Puerto Churruca, *H. A. Imshaug* 44785 (MSC, US).

***Topeliopsis subdenticulata* (Zahlbr.) A. Frisch & K. Kalb**

Lichenologist **38**: 44 (2006).—*Ocellularia subdenticulata* Zahlbr., in Skottsberg (ed.), *The Natural History of Juan Fernandez and the Easter Island 2, Botany*: 329 (1924); type: Chile, Juan Fernandez Islands, Masafuera, C. & I. Skottsberg s.n. (W—holotype).—*Thelotrema subdenticulatum* (Zahlbr.) Salisb., *Lichenologist* **5**: 267 (1972).

Topeliopsis vezdae Kalb, *Mycotaxon* **79**: 323 (2001); type: Australia, New South Wales, Styx River SF., Kalb & Williams 19199 (CANB—holotype!).

(Fig. 5 F)

For a morphological description see Mangold *et al.* (2009).

Chemistry. Thallus K⁻, C⁻, PD⁻; lacking secondary substances.

Notes. *Topeliopsis subdenticulata* is characterized by large, transversely septate, thick-walled, hyaline, amyloid ascospores and the lack of secondary metabolites. It is similar to *T. darlingtonii*, which is readily distinguished

by smaller ascospores (up to 60 µm long, with up to 16 loci) and the presence of the stictic acid.

Ecology and distribution. This species occurs mainly on epiphytic mosses, rarely on bark and dead wood in cool temperate rainforests or wet sclerophyll forests. It occurs in South America, Australia and New Zealand.

Specimens examined. **New Zealand:** *South Island:* Canterbury, Arthur Pass NP, Waimakariri Valley, *H. Mayrhofer & H. Hertel* 8972 (GZU); Canterbury, Boyle River area, Lake Summer Forestry Park, *J. Johnston & R. Elder* 3417, 3440, 3441, 3442, 3443, 3445 (CANB); Otago, Tuapeka West, Knights Bush, *A. Knight* (OTA-59967). *Stewart Island:* Glory Cove, *D. J. Galloway* (CHR-378080).

We wish to thank Alan Fryday (East Lansing) for his support of this project. He invited HTL to study *Thelotrema* at MSU and was very helpful in all stages of this project. This study was supported by a NSF grant (DEB-0516116) to The Field Museum (PI: HTL, co-PI: RL), the Universidad Nacional del Comahue and CONICET (MIM) and the Spanish Ministry of Science and Innovation through a Ramon y Cajal grant (RYC02007-01576) to PKD.

REFERENCES

- Feige, G. B., Lumbsch, H. T., Huneck, S. & Elix, J. A. (1993) Identification of lichen substances by a standardized high-performance liquid-chromatographic method. *Journal of Chromatography* **646**: 417–427.
- Frisch, A. & Kalb, K. (2006) The lichen genus *Topeliopsis*, additions and corrections. *Lichenologist* **38**: 37–45.
- Frisch, A., Kalb, K. & Grube, M. (2006) Contributions towards a new systematics of the lichen family Thelotremaaceae. *Bibliotheca Lichenologica* **92**: 1–539.
- Galloway, D. J. (2001) *Thelotrema macrocarpum* C. W. Dodge belongs in *Chroodiscus*. *Australasian Lichenology* **49**: 16–17.
- Hale, M. E. (1980) Generic delimitation in the lichen family Thelotremaaceae. *Mycotaxon* **11**: 130–138.
- Hale, M. E. (1981) A revision of the lichen family Thelotremaaceae in Sri Lanka. *Bulletin of the British Museum (Natural History), Botany Series* **8**: 227–332.
- James, P. W. (1977) Distribution maps of lichens in Britain. Map. 24. *Thelotrema monosporum* Nyl. *Lichenologist* **9**: 181–183.
- Kantvilas, G. & Vězda, A. (2000) Studies on the lichen family Thelotremaaceae in Tasmania. The genus *Chroodiscus* and its relatives. *Lichenologist* **32**: 325–357.
- Lumbsch, H. T. (2002) Analysis of phenolic products in lichens for identification and taxonomy. In *Protocols in Lichenology. Culturing, Biochemistry, Ecophysiology*

- and Use in Biomonitoring (I. Kranner, R. Beckett and A. Varma, eds): 281–295. Berlin: Springer.
- Lumbsch, H. T., Mangold, A., Martin, M. P. & Elix, J. A. (2008) Species recognition and phylogeny of *Thelotrema* species in Australia (Ostropales, Ascomycota). *Australian Systematic Botany* **21**: 217–227.
- Mangold, A., Elix, J. A. & Lumbsch, H. T. (2007) *Ocellularia* species with a cone-shaped columella in Australia. *Bibliotheca Lichenologica* **96**: 193–208.
- Mangold, A., Martin, M. P., Lücking, R. & Lumbsch, H. T. (2008) Molecular phylogeny suggests synonymy of Thelotremataceae within Graphidaceae (Ascomycota: Ostropales). *Taxon* **57**: 476–486.
- Mangold, A., Elix, J. A. & Lumbsch, H. T. (2009) *Thelotremataceae*. *Flora of Australia* **57**: 195–420.
- Matsumoto, T. (2000) Taxonomic studies of the Thelotremataceae (Graphidales, lichenized Ascomycota) in Japan. (1) Genus *Thelotrema*. *Journal of the Hattori Botanical Laboratory* **88**: 1–50.
- Messuti, M.I., Codesal, P.L., Mangold, A., Lücking, R. & Lumbsch, H.T. (2010) New or interesting *Chapsa* and *Topeliopsis* species (Ascomycota: Ostropales) from Argentina. *Lichenologist* **42**: 191–195.
- Müller Argoviensis, J. (1887) Graphideae Feeanae. *Memoires de la Société Physique Histoire Naturelle Geneve* **29**: 1–80.
- Purvis, O. W., Jørgensen, P. M. & James, P. W. (1995) The lichen genus *Thelotrema* Ach. in Europe. *Bibliotheca Lichenologica* **58**: 335–360.
- Rivas Plata, E., Lücking, R. & Lumbsch, H. T. (2008) When family matters: an analysis of Thelotremataceae (lichenized Ascomycota: Ostropales) as bio-indicators of ecological continuity in tropical forests. *Biodiversity and Conservation* **17**: 1319–1351.
- Salisbury, G. (1972a) *Thelotrema* Ach. sect. *Thelotrema*. 1. The *T. lepadinum* group. *Lichenologist* **5**: 262–274.
- Salisbury, G. (1972b) *Thelotrema* sect. *Thelotrema* 2. The *T. platycarpum* group. *Revue Bryologie et Lichenologie* **38**: 281–290.
- Salisbury, G. (1978) Thelotremata Achariana et Feeana. *Nova Hedwigia* **29**: 405–427.
- Santesson, R. (1952) Foliicolous lichens I. A revision of the taxonomy of the obligately foliicolous, lichenized fungi. *Symbolae Botanicae Upsalienses* **12**: 1–590.
- Sipman, H. J. M. & Harris, R. C. (1989) Lichens. In *Tropical Rain Forest Ecosystems* (H. Lieth and M. J. A. Werger, eds): 303–309. Amsterdam: Elsevier Science Publishers.
- Staiger, B., Kalb, K. & Grube, M. (2006) Phylogeny and phenotypic variation in the lichen family Graphidaceae (Ostropomycetidae, Ascomycota). *Mycological Research* **110**: 765–772.
- Walter, H. & Breckle, S. W. (1983) *Ökologie der Erde. Band 1. Grundlagen*. Stuttgart: G. Fischer Verlag.

Accepted for publication 25 August 2009