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10 mm



5 mm

The New Zealand crustose endemic *Placopsis salazina* in Southland. The species is saxicolous and has a determinate thallus which lacks isidia, soredia, or a prothallus, and contains salazinic acid.

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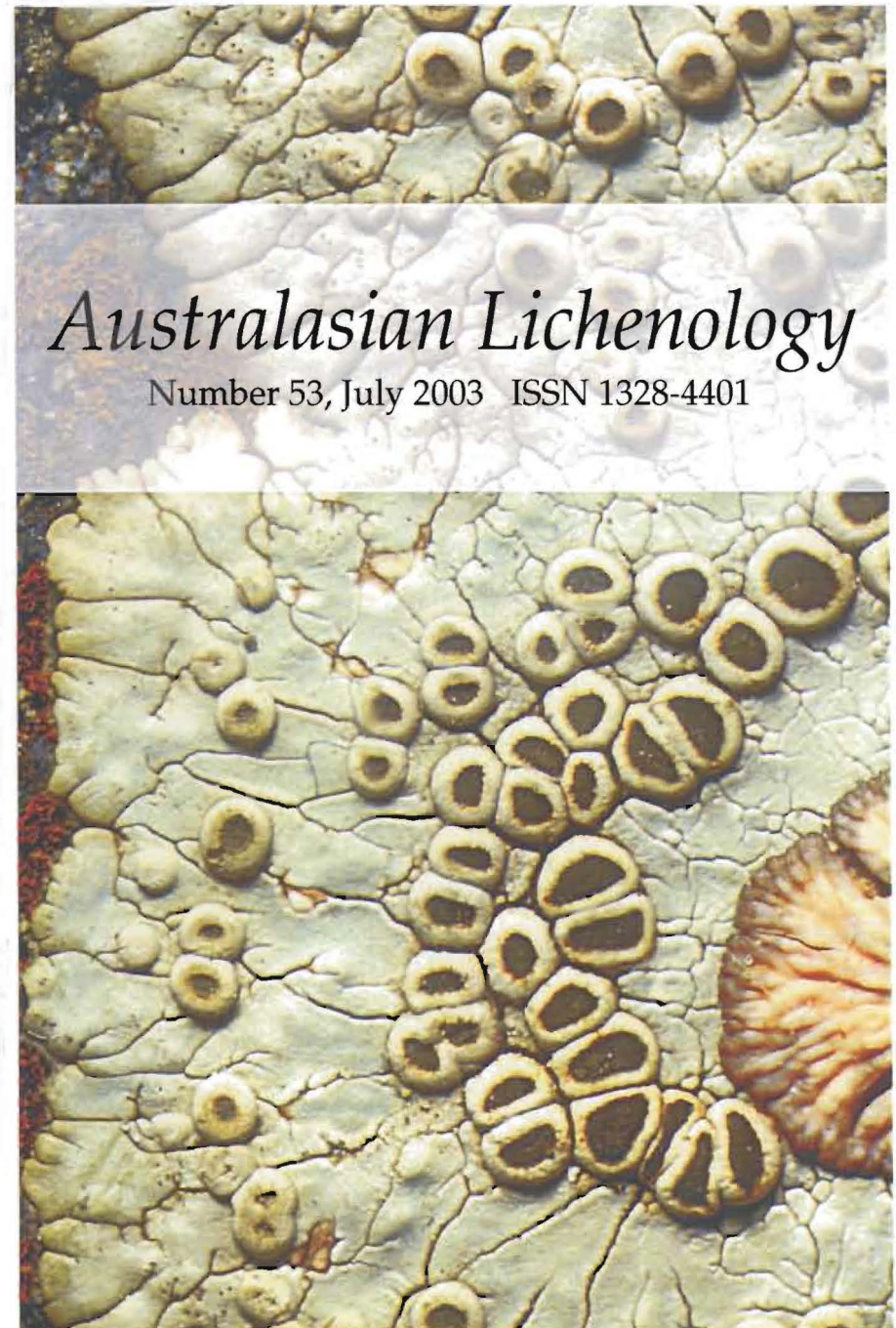
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ADDITIONAL LICHEN RECORDS FROM NEW ZEALAND

- Galloway, DJ (40)—*Buellia aethalea* (Ach.) Th. Fr., *Catillaria contristans* (Nyl.) Zahlbr., *Frutidella caesioatra* (Schaer.) Kalb, *Placynthium rosulans* (Th. Fr.) Zahlbr. and *Pseudocyphellaria mallota* (Tuck.) H. Magn. 20



Graphina hartmanniana Müll. Arg., an additional synonym
for *Dictyographa cinerea* (C. Knight & Mitt.) Müll. Arg.

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The genus *Dictyographa* (Müller 1893) is characterized by sessile, simple, black lirellae, hyaline, muriform ascospores, and anastomosing paraphyses. *Dictyographa cinerea* (C. Knight) Müll. Arg., described from New Zealand (Müller 1894), was recently reported from Australia (Archer 2000). A re-examination of a close-up photograph of the holotype of *Graphina hartmanniana* Müll. Arg. found it to be identical to a similar photograph of *D. cinerea*. This superficial identity was confirmed by reference to Müller's original description of *G. hartmanniana* (Müller 1882), and a later examination of the holotype of *G. hartmanniana* (Archer 1999). In particular, both species have conspicuous, sessile, simple black lirellae with completely carbonized proper exciples, they lack lichen compounds, and their ascospores are similar in size, viz.: *D. cinerea* 24–28 × 10–12 µm, 6–7 × 2–4-locular; *G. hartmanniana*: 19–25 × 6–8(–11) µm, 6–8 × 2-locular.

In the protologue to *G. hartmanniana*, Müller commented that the species resembled no other known species. The inconspicuous nature of *D. cinerea* could explain why no other specimens of "*G. hartmanniana*" have been collected since Müller's original publication. The species is now known from Queensland and New South Wales as well as New Zealand.

Dictyographa cinerea (C. Knight & Mitt.) Müll. Arg., *Bull. Herb. Boissier* 2 (Appendix 1), 78 (1894).

= *Opegrapha cinerea* C. Knight & Mitt., *Trans. Linn. Soc. London* 23, 101 (1860).
Type. New Zealand. Auckland, on trees, C. Knight. Lectotype: BM (Hayward 1977: 576).

= *Graphina hartmanniana* Müll. Arg., *Flora* 65, 503 (1882).

Type. Australia. Queensland, Toowoomba, C. Hartmann; holotype: G, isotype: MEL 515669.

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CORRIGENDA

- The specimen of *Sclerophyton rostratum* cited on page 19 of Archer & Elix's paper in Volume 52 should read *J.A.Elix 22607*, not *22606*.
The specimen of *Dictyographa cinerea* cited on page 32 of Archer's paper in Volume 47 should read *A. W. Archer G459*, not *G498*.

Notes on the heterogeneous genus *Psoroma s. lat.* in New Zealand

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Abstract: Recent changes in the circumscriptions of the genera *Pannaria* and *Psoroma* have led to the recognition of an increasing number of "green" species of *Pannaria* formerly included in *Psoroma*. Comments are made on current knowledge of the heterogeneous genus *Psoroma*, with special reference to New Zealand species. Five new combinations in *Pannaria* are here proposed, viz. *Pannaria allorhiza* (Nyl.) Elvebakk & D.J. Galloway, *Pannaria athroophylla* (Stirt.) Elvebakk & D.J. Galloway, *Pannaria durietzii* (P. James & Henssen) Elvebakk & D.J. Galloway, *Pannaria euphylla* (Nyl.) Elvebakk & D.J. Galloway and *Pannaria patagonica* (Malme) Elvebakk & D.J. Galloway.

Introduction

In the major temperate biomes of the Southern Hemisphere, viz. southern South America, south-east Australia, Tasmania and especially New Zealand, the family Pannariaceae is both highly speciose (often at a local as well as a regional level), and of considerable biomass, in forest, scrub, and grassland landscapes, with the following genera being represented there: *Degelia* Arv. & D.J. Galloway, *Erioderma* Fée, *Fuscoderma* (D.J. Galloway & P.M. Jørg.) P.M. Jørg. & D.J. Galloway, *Fuscopannaria* P.M. Jørg., *Leioderma* Nyl., *Pannaria* Delise ex Bory, *Parmeliella* Müll. Arg., *Psoroma* Ach. ex Michx., *Psoromidium* Stirt., *Santessonella* Henssen and *Siphulastrum* Müll. Arg.

Until relatively recently, the accepted circumscriptions of the genera *Pannaria* and *Psoroma* in the Southern Hemisphere were those of Galloway (1985) and Jørgensen & Galloway (1992). Subsequent studies on the Pannariaceae in both Northern and Southern Hemispheres have led to changes in these earlier views, although the process of generic delimitation in the Pannariaceae is still far from settled (Ekman & Jørgensen 2002).

Jørgensen (1994) defined *Pannaria* more narrowly as a mainly foliose and predominantly tropical or warm-temperate genus, having pannarin and related compounds as major secondary metabolites, apothecia with thalline margins, asci without amyloid apical structures, and partly amyloid hymenia. He segregated from *Pannaria s. str.* squamulose, cool-temperate taxa, usually having fatty acids and terpenoids as major secondary metabolites, and with variously marginate apothecia, hemiamyloid hymenia and asci with amyloid apical structures, and placed these in a new genus *Fuscopannaria* (Jørgensen 1994, 2000a, 2000b, 2002b; Jørgensen & Zhurbenko 2002). Later, he suggested that the large, leafy, subtropical species of *Psoroma* should be regarded as "green" species of *Pannaria*, and assigned the *Psoroma sphinctrinum* group to *Pannaria* (Jørgensen 2001). *Psoroma s. str.*, with *P. hypnorum* as generitype, refers to small-squamulose, terricolous, muscicolous or saxicolous taxa, without any demonstrable secondary chemistry (with the exception of *P. buchananii* and *P. fruticulosum*, always brownish through deposition of melanins in the upper cortex), and with an apical amyloid ring structure in the ascus apex (Jørgensen & Wedin 1994: 341). Until very recently, *Psoroma* was interpreted much more broadly than this (see references above), and it is now recognized that *Psoroma s. lat.* comprises several discordant elements.

Detailed studies of *Pannaria s. lat.* and *Psoroma s. lat.* in the Southern Hemisphere are currently in progress and will be reported in detail elsewhere (Elvebakk in prep.). However, as part of revisionary work for the forthcoming second edition of *Flora of New Zealand Lichens* (Galloway in prep.), we here propose transferring five additional species of *Psoroma* to *Pannaria*, in line with present thinking. *Psoroma s. str.*, as pointed out by Jørgensen & Wedin (1999) and Jørgensen (2000a, 2002a) refers to the *Psoroma hypnorum* group of taxa, but there are at least two other groups of species within *Psoroma* that will eventually need formal recognition (Elvebakk, unpublished observations). As a first step towards clarifying the limits of *Psoroma s. lat.*, we here transfer five species currently in *Psoroma* to *Pannaria*, although *Pannaria* too might in the future also prove to be heterogeneous.

Pannaria allorhiza (Nyl.) Elvebakk & D.J. Galloway, comb. nov.

= *Lecanora allorhiza* Nyl., *Flora* 51: 373 (1868).

= *Psoroma allorhizum* (Nyl.) Hue, *Nouv. Arch. Mus. Hist. Nat. Paris*, Sér. 3, 3: 45 (1891).

Type: New Zealand. *Sine loco* [probably Wellington], *Charles Knight s. n.*; lectotype: H-NYL 30795 [fide Galloway (1985: 468)]; isolectotypes: BM, WELT.

= *Physcia regalis* Zahlbr., *Denkschr. Akad. Wiss. Wien Math.-Naturwiss. Kl.* 104: 379 (1941).

Type: New Zealand. Auckland, Rangitoto Island, on *Metrosideros tomentosa* in light forest, *H.H. Allan A105*; holotype: W; isotype: CHR 379831.

ILLUSTRATIONS: Malcolm & Galloway (1997: 107, 135 - as *Psoroma allorhizum*); Malcolm & Malcolm (2000: 40, 106 - as *Psoroma allorhizum*).

DESCRIPTION: Galloway (1985: 467–468 - as *Psoroma allorhizum*)

Chemistry: Several chemodemes reported, most commonly with vicanicin and occasionally with additional allorhizin (Elix *et al.* 1982: 2328).

DISTRIBUTION: New Zealand. Northland (Herekino, Waipoua, Omanaia, Tutamoe, Hen & Chickens Islands, Little Barrier Island, Great Barrier Island, Rakitu Island, Whangarei, Tokatoka, Mahurangi River, Waiheke Island), Auckland (Anawahata, Waitakere Range, Rangitoto), South Auckland (Great Mercury Island, Mt Maugatawhiri, Coromandel Peninsula, Kaimai Range, Slipper Island), Wellington (Kapiti Island), Nelson (Mt Robert, Te Rata, S of Karamea, Maruia), Marlborough (D'Urville Island, Chetwode Islands, Resolution Bay, Queen Charlotte Sound).

NOTES: *Pannaria allorhiza* is characterized by the relatively long, parallel lobes, with the central parts of the thallus having short, swollen, glomerulate isidia. It is a large species, endemic to northern New Zealand.

Pannaria athroophylla (Stirt.) Elvebakk & D.J. Galloway, comb. nov.

= *Psoroma athroophyllum* Stirt., *Rep. Trans. Glasgow Soc. Fld Nat.* 1: 21 (1873).

= *Psoroma subpruinatum* var. *athroophyllum* (Stirt.) C. Knight, *Trans. New Zealand Inst.* 7: 365 (1875).

= *Phloeopannaria athroophylla* (Stirt.) Zahlbr., *Denkschr. Akad. Wiss. Wien Math.-Naturwiss. Kl.* 104: 276 (1941).

Type: New Zealand. On bark of trees, Tinakori Hills, Wellington, *J. Buchanan* 45; lectotype: GLAM; isolectotype: WELT.

DESCRIPTION: Galloway (1985: 469–470 - as *Psoroma athroophyllum*).
Chemistry: The chemodeme with leprolomin and vicanicin is the most common, but there is in addition a second chemodeme with leprolomin and isovicanicin (Elix *et al.* 1982: 2327).

DISTRIBUTION: **New Zealand.** North Auckland (Herekino, Cavalli Islandas, Hen & Chickens Islands, Poor Knights Islands, Great Barrier Island, Little Barrier Island, Rakitu Island, Kaipara North Head), South Auckland (Whitianga, Red Mercury Island, Motuhora Island, Lake Rotoehu, Lake Rotoiti, Pureora), Wellington (Whakapapa, Kapiti Island, Waikanae, Wellington), Nelson (St Arnaud Range, Mt Glasgow), Marlborough (Chetwode Islands, D'Urville Island), Westland (Greymouth, Taramakau River), Canterbury (Waihi Gorge), Otago (Stoneburn, Trotter's Gorge, Mt Watkin, Mt Cargill, Flagstaff, Maungatua, Taieri Mouth, Akatore, Kaka Point, the Nuggets), Southland (Resolution I., Goose Cove, Dusky Sound, Borland Saddle, Stuart Mountains, Lake Te Anau, Cascade Creek, Grove-Bush, Forest Hill, Onawe Bush near Bluff). Stewart Island (Fern Gully, Anchorage Island, Port Pegasus). **Chatham Islands.** **Auckland Islands** (Terror Cove) **Campbell Island** (Tucker Cove, Mt Beeman).

NOTES: *Pannaria athroophyllum* is a New Zealand endemic species, characterized by irregularly branched marginal lobes, numerous phyllidia in central parts and a chemistry including leprolomin. A detailed study of its circumscription and delimitation from related taxa is in preparation.

Pannaria durietzii (P. James & Henssen) Elvebakk & D.J. Galloway, comb. nov. = *Psoroma durietzii* P. James & Henssen, *Lichenologist* 7: 143 (1975).
Type: **New Zealand.** Westland, South Hokitika Experimental Station, on *Weinmannia racemosa*, 1927, G. Einar and Greta Du Rietz 1570c; holotype: OTA; isotype: BM.

ILLUSTRATIONS: James & Henssen (1975: pl. 1 A-G - as *Psoroma durietzii*); Jørgensen & Galloway (1992: 283, fig. 97A - as *Psoroma durietzii*); Kantvilas & Jarman (1999: 127, 128 - as *Psoroma durietzii*); Purvis (2000: 59 - as *Psoroma durietzii*).

DESCRIPTION: Galloway (1985: 473 - as *Psoroma durietzii*).
Chemistry: K ± yellow, C-, KC ± yellow, Pd red; and reported as containing pannarin, zeorin and two unidentified pigments by Henssen & James (1975). Current studies indicate several chemodemes in the species, including porphyrilic acid and several terpenoids. Zeorin was not confirmed.

DISTRIBUTION: **New Zealand.** South Auckland (Kuratau), Wellington (Kaimanawa Range, Ruahine Range, Tararua Range, Rimutaka Range), Nelson (St Arnaud Range, West Bay, Lake Rotoiti), Westland (Stillwater, Haast), Canterbury (Lewis Pass, Arthur's Pass, Governor's Bush), Otago (Haast Pass, Lake Hawea, Olivine Valley, Routeburn Valley), Southland (Milford Sound, Cascade Cove, Dusky Sound, Lake Te Anau, Lake Manapouri, Wilmot Pass). Stewart Island (Butterfield's Beach, Glory Cove, Port Pegasus). **Auckland Islands** (Laurie Harbour, Ranui Cove, Terror Cove, Rose Island, Ewing Island, Enderby Island). **Campbell Island** (Mt Lyall, Mt Dumas, Mt Honey). Known also from south-east Australia and Tasmania (James & Henssen 1975; Kantvilas *et al.* 1985; Kantvilas & James 1987; Kantvilas 1989, 1994; Jørgensen & Galloway 1992; Kantvilas & Jarman 1999; McCarthy 2003) and from southern Chile (Galloway & Quilhot 1999).

NOTES: *Pannaria durietzii* is an austral species characterized by its long marginal lobes, and very characteristic placodioid to subfoliose cephalodia developing

numerous bluish soralia. These are produced on the lower surface at first but spread to the upper surface where they become confluent. The secondary chemistry is dominated by pannarin.

Pannaria euphylla (Nyl.) Elvebakk & D.J. Galloway, comb. nov.
= *Psoroma euphyllum* Nyl., *Syn. Meth. Lich.* 2: 21 (1863).
Type: **New Zealand.** *Sine loco.* *Sine collectoribus*, ex Herb. Churchill Babington; holotype: H-NYL 30800.

EXSICCATI: Vězda (1997: 2, No. 285).

ILLUSTRATIONS: Jørgensen & Galloway (1992: 283, fig. 97B - as *Psoroma euphyllum*); Malcolm & Galloway (1997: 107 - as *Psoroma euphyllum*); Kantvilas & Jarman (1999: 128 - as *Psoroma euphyllum*); Malcolm & Malcolm (2000: 104 - as *Psoroma euphyllum*); Malcolm & Malcolm (2001: 7 - as *Psoroma euphyllum*).

DESCRIPTION: Galloway (1985: 474 - as *Psoroma euphyllum*).
Chemistry: Reported as having pannarin and porphyrilic acid (Kantvilas & Jarman 1999: 190), compounds also confirmed for New Zealand specimens analysed.

DISTRIBUTION: South Auckland (Kaingaroa Plains), Wellington (Mt Ruapehu near Whakapapa, Tararua Range), Nelson (Lake Rotoiti, near Springs Junction), Marlborough (Red Hill), Westland (Taramakau River, Kelly Ra.), Canterbury (Lewis Pass, Nina Valley), Otago (Haast Pass), Southland (Fowler Pass, Lake Thomson, Borland Burn), Stewart Island. Known also from Tasmania (Kantvilas *et al.* 1985; Kantvilas & James 1987; Kantvilas 1989, 1994; Jørgensen & Galloway 1992; Kantvilas & Jarman 1999; McCarthy 2003).

NOTES: *Pannaria euphylla* is an Australasian species, characterized by its cetrarioid growth habit. It is a pioneer species growing mostly on thin twigs, but the lobes are spreading and not appressed to the bark substrata as in other related species.

Pannaria patagonica (Malme) Elvebakk & D.J. Galloway, comb. nov.
= *Psoroma patagonicum* Malme, *Ark. Bot.* 20A(3): 13 (1925).
Type: Chile. Punta Arenas, "in cortice arborum", 21.xi.1893, P. Dusén; lectotype [here selected]: H.

= *Psoroma sphinctrinum* var. *dilatatum* Hue, *Nouv. Archs Mus. Hist. Nat. Paris*, Sér. 4, 8: 267 (1906).
Type: Chile. Prope Sandy Point [Punta Arenas], "ad cort. *Fagus antarctica*". W. Lechler, *Plantae Magellanicae* 998; lectotype [here selected]: BM.

DESCRIPTION: Galloway (1985: 479 - as *Psoroma patagonicum*).
Chemistry: Only the report of pannarin alone in material from South America (Quilhot *et al.* 1989) is reliable, and is confirmed also by our own analyses of South American collections.

DISTRIBUTION: **New Zealand.** Uncertain. Known from southern Chile (Malme 1925, Galloway & Quilhot 1999) and Argentina (Calvelo & Liberatore (2001).

NOTES: *Pannaria patagonica* is a very common species in southern South America. It is a large species (10–20 cm diam.) with radiating lobes, and abundantly fertile. In the field it is readily recognized by turning a deep lettuce green when moistened, in comparison with pannarin-containing species that show only a slight green

colour when wet. It was reported to be quite common in New Zealand (Galloway 1985: 479); however, current studies indicate that these records may refer to at least one undescribed species with deviating chemistry, but as yet only part of the material available for study has been analysed. Until this question is resolved, *Pannaria patagonica* is best considered a doubtful species in New Zealand.

Acknowledgements

We would both like to thank our friend Prof. Per Magnus Jørgensen (University of Bergen) for valuable discussions on generic delimitation in the Pannariaceae. The second author is grateful to Sue Gibb (Landcare Research, Lincoln) and to Mei Nee Lee (Auckland Institute and Museum) for information on collections of *Psoroma/Pannaria* in CHR and AK respectively. Funds to the second author were provided by the Foundation for Research Science and Technology (FRST Wellington, New Zealand) under Contract C09618.

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5-Methoxylecanoric acid, a new depside from *Melanelia glabratula*

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Abstract: The new depside 5-methoxylecanoric acid has been detected in extracts of *Melanelia glabratula* together with lecanoric acid.

Lecanoric acid (1) is a very common orcinol depside, widely distributed in many lichen genera (Huneck & Yoshimura 1996). A number of lecanoric acid derivatives which occasionally co-occur with (1) show a much more restricted taxonomic distribution and are sometimes genus- or species-specific. Diploschistes acid (3) is one such compound, known only from lichens of the genus *Diploschistes* Norman (Fig. 1). Similarly, 2'-*O*-methylevernic acid (4) has only been found in *Evernia prunastri* (L.) Ach. (Nicollier *et al.* 1979) and 5-chlorolecanoric acid (5) is restricted to some species of *Punctelia* (Elix & Wardlaw 2002). In this paper we describe the unambiguous total synthesis of 5-methoxylecanoric acid (2), and the natural occurrence of this compound together with lecanoric acid (1) in extracts of *Melanelia glabratula* (Lamy) Essl.

Materials and Methods

Chromatography

The lichen fragments were freed as far as possible from obvious organic substratum and extracted with warm acetone for thin-layer chromatography (TLC), or with warm methanol for high performance liquid chromatography (HPLC). Compounds were identified by TLC by using the methods standardized for lichen products (Culberson 1972, Culberson & Ammann 1979, Culberson & Johnson 1982, Elix & Ernst-Russell 1993) and by HPLC with retention index values (R_I) calculated from benzoic acid and solorinic acid controls (Elix & Wardlaw 2000, Feige *et al.* 1993). For TLC standard R_f values were determined in three independent TLC solvent systems: (A) toluene/dioxan/acetic acid (180:45:5); (B') hexane/*tert*-butyl methyl ether/formic acid (140:72:18); (C) toluene/acetic acid (170:30). For HPLC a Hewlett Packard HP 1050 Series System, a Phenomenex Hypersil 5 μ C18 column (250 by 4.6 mm) and a spectrometric detector operating at 254 nm with a flow rate of 1 ml/min were used. Two solvent systems were used: 1% aqueous orthophosphoric acid and methanol in the ratio 7:3 (A) and methanol (B). The run started with 100% A and was raised to 58% B within 15 min, then to 100% B within a further 15 min, followed by isocratic elution in 100% B for a further 10 min.

Lichen Material

Melanelia glabratula (Lamy) Essl.
ITALY, Sardinia, Sassari Province, Cape Orso, near Palau, 80 m, on granite rock, P.L. Nimis 7305, May 1986 (TSB); Passo del Limbara, 600 m, on acid rock, P.L. Nimis 7354, May 1986 (TSB).

Detection of the New Depside by Comparative Chromatography

Comparative HPLC and TLC of the total methanol extract of *Melanelia glabratula* indicated the presence of lecanoric acid (1) (major) and 5-methoxylecanoric acid (2) (minor), [standard TLC R_f values: R_f (A) 0.33; R_f (B') 0.40; R_f (C) 0.29; standard HPLC R_I 0.18; R_T = 21.35 min] and traces of atranorin (Fig. 2). The HPLC was coupled to a photodiode array detector for ultraviolet spectroscopic comparisons. By this means the spectra of the components eluting from the chromatogram were recorded and computer matched against a library of ultraviolet spectra re-

corded for the authentic lichen metabolites under identical conditions. For the above substances, the correlation of the ultraviolet spectra was greater than 99.9%.

Synthesis of 5-Methoxylecanoric Acid

The preparation of the synthetic intermediates 2,4-dibenzoyloxy-5-methoxy-6-methylbenzoic acid (Elix & Jayanthi 1977) and benzyl orsellinate (Elix & Norfolk 1975) have been described previously.

A solution of 2,4-dibenzoyloxy-5-methoxy-6-methylbenzoic acid (189 mg, 0.5 mmol) and benzyl orsellinate (129 mg, 0.5 mmol) in anhydrous toluene (4 ml) and trifluoroacetic anhydride (1.3 ml) was stirred at room temperature for 6 h. The solvent was removed and residual trifluoroacetic anhydride removed by azeotropic distillation with toluene. The residue was purified by radial chromatography over silica gel using 5% to 20% ethyl acetate/light petroleum as eluant. The second band yielded benzyl 2,4-di-*O*-benzyl-5-methoxylecanorate (240 mg, 80%) as colourless crystals, m.p. 120–122°. ^1H n.m.r. [CDCl_3] δ 2.35, 2.45, 2s, ArMe; 3.79, s, OMe; 5.02, 5.11, 2s, OCH₂; 5.41, s, CO₂CH₂; 6.42, 6.64, 2d, J 2.5 Hz, H3', H5'; 6.49, s, H3; 7.26–7.42, m, C₆H₅, 11.53, s, OH. Mass spectrum m/z 618 (M, 2%), 362 (39), 361 (78), 271 (10), 181 (24), 91 (100). A solution of benzyl 5-methoxy-lecanorate (62 mg) in ethyl acetate was stirred with 10% palladium on carbon (10 mg) in an atmosphere of hydrogen for 10 h. After filtration and concentration of the solution, 5-methoxylecanoric acid (28 mg, 80%) was obtained as colourless crystals m.p. 171° (Found: mol. wt. 348.0844. C₁₇H₁₆O₈ requires mol. wt. 348.0845). ^1H n.m.r. [CDCl_3] δ 2.59, 2.64, 2s, ArMe; 3.75, s, OMe; 6.49, s, H3; 6.62, 6.72, 2d, J 2.5 Hz, H3', H5'. Mass spectrum m/z 348 (M, 8%), 198 (6), 181 (100), 180 (31), 168 (28), 165 (18), 150 (54), 137 (12), 122 (34).

Discussion and Results

The natural occurrence of 5-methoxylecanoric acid (2) in the extracts of *Melanelia glabratula* has now been confirmed. Comparisons were conducted between the synthetic depside (2), the total acetone extracts of the *Melanelia* species by TLC in three independent solvent systems and by HPLC coupled to a photodiode array detector for ultraviolet spectroscopic comparisons. The HPLC of such an extract is shown in Fig. 2. By these means *Melanelia glabratula* was shown to contain lecanoric acid (1) (major), 5-methoxylecanoric acid (2) (minor/trace) and atranorin (minor/trace). In his monograph on the brown *Parmeliae*, Esslinger (1977) mentioned that *Melanelia glabratula* contained an unknown he termed TE-12. We have now confirmed that this unknown substance is identical with 5-methoxylecanoric acid, a substance Esslinger found was diagnostic for *M. glabratula*.

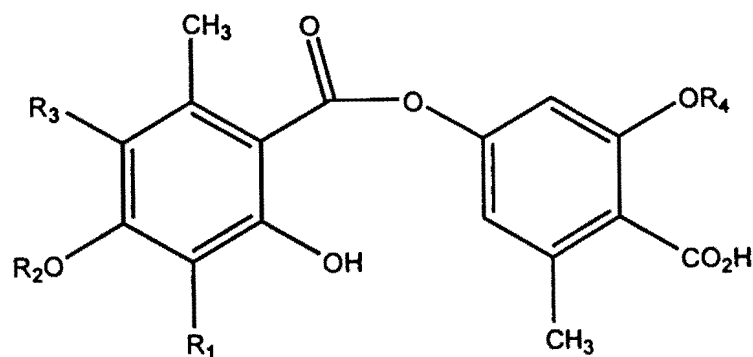
Acknowledgement

We thank Dr Paolo Giordani (Genoa) for organizing the loan of the material of *Melanelia glabratula*.

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| | R ₁ | R ₂ | R ₃ | R ₄ |
|-----|----------------|----------------|----------------|----------------|
| (1) | H | H | H | H |
| (2) | H | H | OMe | H |
| (3) | OH | H | H | H |
| (4) | H | Me | H | Me |
| (5) | H | H | Cl | H |

Fig. 1. Structure of depsides.

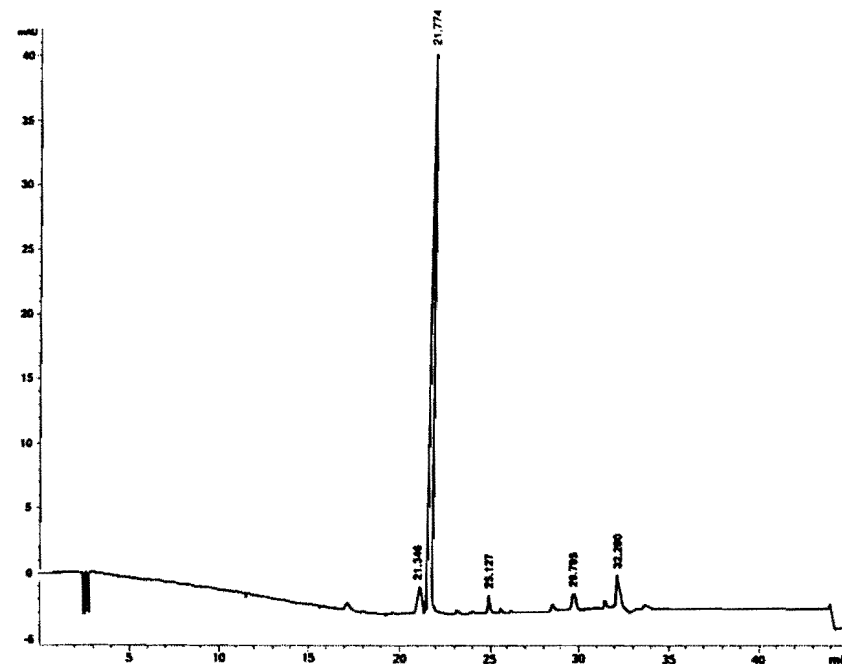


Fig. 2. HPLC of methanol extract of *Melanelia glabratula* (P.L. Nimis 7354). R_T 21.346 = 5-methoxylecanoric acid; R_T 21.774 = lecanoric acid; R_T 29.795 = atranorin; R_T 25.127, 32.280 = internal standards.

New species and new records of *Neofuscelia*
(Parmeliaceae, lichenized Ascomycota) from Australia

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Abstract: Two new species of *Neofuscelia* (Parmeliaceae) are described from southern Australia, namely *N. caparidensis* Elix and *N. ralstoniana* Elix. In addition, *N. ferrugata* (Nyl.) Elix and *N. petriseda* (Zahlbr.) Essl. are reported from Australia for the first time, and new state or territory records are listed for a further four species.

The lichen family Parmeliaceae is particularly well represented in Australia, and has been investigated intensively over the past 25 years (see Orchard 1994). However, the lichens of some less-accessible regions as well as some difficult species complexes remain to be studied. A detailed survey of the family in Australia is currently being undertaken, and two further new species are described here. Chemical constituents were identified by thin-layer chromatography (Culberson 1972, Culberson & Johnson 1982, Elix & Ernst-Russell 1993), high performance liquid chromatography (Feige *et al.* 1993, Elix & Wardlaw 2002), and comparison with authentic samples.

Neofuscelia caparidensis Elix, sp. nov.

Fig. 1

Thallus ut in *Neofuscelia franklinensis* sed sparsim rhizinatus, lobis separatis, angustioribus et ascosporis minoris differt.

Type: Western Australia. Cape Arid National Park, southern end of Yokinup Bay above Thomas River Beach, 33°51'S, 123°00'E, on E-facing Precambrian granite outcrop, *K. Ralston 2286*, 10.iv.2001; holo: MEL.

Thallus small-foliose to subcrustose, tightly adnate, saxicolous, to 2 cm wide. Lobes separate, almost flat to weakly convex, sublinear-elongate, subdichotomously to subirregularly branched, 0.2–0.5 mm wide. Upper surface dark brown to black-brown, somewhat paler and shiny at the lobe apices, dull and becoming rugose, fissured and areolate in older parts of the thallus, lacking isidia but developing lobules in the thallus centre; lobules simple, sublinear or papillate, 0.05–0.1 mm wide. Medulla white. Lower surface shiny, pale tan to brown, wrinkled; rhizines very sparse, simple, concolorous. Apothecia common, substipitate, 0.5–0.8 mm wide; disc weakly concave, becoming flat then ultimately convex; thalline exciple smooth, entire. Ascospores broadly ellipsoid, 6–8 × 4–5 µm. Pycnidia common, immersed. Conidia not seen.

Chemistry. Cortex K–, HN0₃+ blue-black, medulla K–, C+ pink, KC+ pink, P–, containing gyrophoric acid (major), lecanoric acid (minor/trace).

In many respects, *N. caparidensis* resembles *N. franklinensis* Elix in that both species contain medullary gyrophoric acid and have tightly adnate, small foliose to subcrustose thalli with a pale lower surface. However, the two species differ in a number of respects. Whereas *N. franklinensis* has closely contiguous lobes which lack rhizines, *N. caparidensis* has separate lobes which are sparsely rhizinate. In addition, *N. caparidensis* has narrower lobes (0.2–0.5 mm cf. 0.8–1.5 mm wide) and smaller ascospores (5–8 × 4–5 µm cf. 8–11 × 5–6 µm). The presence of gyrophoric acid and lobules are also reminiscent of *N. minuta* Essl., but that species has flat, contiguous lobes with a brown-black to black lower surface. At present the new species is only known from the type collection.

Neofuscelia ralstoniana Elix, sp. nov.

Fig. 2

Species *Neofusceliae imitatrixae* simili sed lobis lobulatis et lobulis subcylindricis differt.

Type: South Australia. Lake Gilles Nature Reserve, 33°02'S, 136°36'E, on soil surrounding salt lake, *K. Ralston 2345 & D. Ralston*, 18.iv.2001; holo: MEL; iso: CANB.

Thallus foliose, terricolous, loosely adnate, to 3 cm wide. Lobes imbricate, flat or slightly convex at the apices, becoming more strongly convex towards thallus centre, sublinear to subirregular, 0.8–1.5 mm wide, subirregularly branched, subascending at apices; lobules developing at periphery and within thallus, subterete to flattened, sublinear to sublinear-elongate, subdichotomously branched, 0.1–0.5 mm wide. Upper surface dark brown, paler at the thallus periphery, dull to slightly shiny at the apices, smooth or becoming rugulose, lacking cylindrical isidia. Medulla white. Lower surface brown-black to black, paler at the apices, moderately to densely rhizinate; rhizines black, simple or occasionally furcate, often tufted, slender; laciniae canaliculate, pale brown to black with concolorous rhizines. Apothecia not seen. Pycnidia common, immersed. Conidia bifusiform, 6–8 × 1 µm.
Chemistry. Cortex K–, HN0₃+ dark blue-green, medulla K–, C–, KC+ rose-red, P–, UV–; containing physodic acid (major).

This new species appears to be related to *Neofuscelia imitatrix* (Taylor) Essl. in that both have foliose, non-isidiate thalli with a black lower surface, and identical medullary chemistry. However, they can be separated clearly by their morphology. *Neofuscelia imitatrix* lacks lobules and is tightly adnate, whereas *N. ralstoniana* is lobulate and loosely adnate. Further, the lobules of *N. ralstoniana* are prominent and are subterete to flattened, whereas secondary laciniae of *N. imitatrix* are rarely prominent and are flat to weakly convex or concave. Morphologically, this new species closely resembles *N. leppii* Elix, but the latter differs in developing distinct isidia and in containing medullary aleatoronic acid. At present the new species is only known from the type collection, and is named in honour of the collectors Kathleen and David Ralston.

New Records of *Neofuscelia* for Australia

Neofuscelia delisei (Duby) Essl., *Mycotaxon* 7, 50 (1978).

This species was known previously from Europe, Asia, and north Africa, and in Australia from New South Wales, South Australia and the Australian Capital Territory (Elix 1994, McCarthy 2003). It is characterized by a loosely adnate thallus, black lower surface, absence of isidia, and presence of glomelliferic, glomellic, loxodellic and perlatolic acids in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED

Queensland. • Wyberba, junction of old Highway and Eukey road, 28°52'S, 151°53'E, 770 m, on granite rocks in *Eucalyptus-Callitris*-dominated forest, *J.A. Elix 35839*, 6.ix.1993 (CANB).

Neofuscelia delisiella Elix, *Mycotaxon* 71, 436 (1999).

Previously this rare species was known only from the type locality in Victoria (Elix 1999). It is characterized by a small, tightly adnate thallus, narrow (0.2–0.8 mm wide), sublinear-elongate lobes with a black lower surface, a lack of isidia, and the presence of perlatolic, stenosporic, glomelliferic and 2-*O*-methylglomelliferic acids in the medulla. A detailed description is given in Elix (1999).

SPECIMENS EXAMINED

Australian Capital Territory. • Brindabella Range, Smokers Flat, 33 km SW of Canberra, 35°31'S, 148°55'E, on granite rocks in subalpine herbfield, *J.A. Elix* 30478, 30492, 12.iv.2001 (CANB).

Neofuscelia petriseda (Zahlbr.) Essl., *Mycotaxon* 7, 51 (1978).

Previously known from New Zealand (Esslinger 1977, Galloway 1985), this species appears closely related to *N. stygioides* (Nyl. ex Cromb.) Essl., but differs in having a more loosely adnate thallus, more discrete and dissected lobes, and a pale lower surface (dark brown to black in *N. stygioides*). It has been suggested that these two species intergrade (Kantvilas *et al.* (2002), but I do not believe that to be the case. A detailed description is given in Esslinger (1977) and Galloway (1985).

SPECIMENS EXAMINED

Victoria. • Basalt Hill, Bogong High Plains, Alpine National Park, 20 km SE of Mt Beauty, 36°53'S, 147°18'E, 1650 m, on basalt rocks in exposed, alpine grassland, *J.A. Elix* 40423 & *H. Streimann*, 17.ii.1994 (CANB); • Mt McKay, Alpine National Park, 16 km SSE of Mt Beauty, 36°52'S, 147°14'E, 1840 m, on granite rocks in alpine grassland, *J.A. Elix* 40503, 40531 & *H. Streimann*, 18.ii.1994 (CANB); • Pretty Valley, Alpine National Park, 18 km SSE of Mt Beauty, 36°53'S, 147°14'E, 1840 m, on granite rocks in *Eucalyptus pauciflora* woodland, *J.A. Elix* 40594 & *H. Streimann*, 18.ii.1994 (CANB).

Neofuscelia perrugata (Nyl.) Elix, *Australasian Lichenology* 51, 8 (2002).

This species was known previously from temperate northern, central and southern Europe, Asia Minor and North Africa (Elix 2002). It is part of the *Neofuscelia pulla* complex, and is characterized by a ± tightly adnate thallus, a black lower surface, absence of isidia, and presence of divaricatic, stenosporic, oxostenosporic and ± gyrophoric acids in the medulla. The segregation of the three taxa formerly included in *Neofuscelia pulla sensu* Esslinger has been discussed previously (Elix 2002). A detailed description follows.

Thallus foliose, ± tightly adnate, 5–8 cm wide. Lobes contiguous to imbricate, flat to weakly convex, sublinear, 1–3 mm wide, without laciniae. Upper surface yellow-brown to red-brown or dark brown, dull to shiny at the lobe apices, smooth to weakly rugulose at the thallus margins, becoming markedly rugose on older lobes, without isidia. Medulla white. Lower surface black, brown in a narrow marginal zone; rhizines sparse to moderate, simple, black. Apothecia common, sessile to substipitate, 2–5 mm wide; disc concave, becoming flat or undulate with age, red-brown to dark brown; thalline exciple smooth, margin entire, crenulate. Ascospores 7–10 × 4.5–6 µm. Pycnidia common, immersed. Conidia weakly bifusiform, 5–7 × 1 µm.

Chemistry: cortex K–, HN0₃+ blue-green; medulla K–, C–, KC–, P–, UV–; containing divaricatic acid (major), stenosporic acid (minor), and oxostenosporic acid (minor) in the medulla together with gyrophoric acid (major, minor or absent), lecanoric acid (minor, trace or absent) and atranorin (trace or absent).

SPECIMEN EXAMINED

New South Wales. • Bondi State Forest, 45 km S of Bombala along the Cann Valley Hwy, 37°08'S, 149°18'E, on granite rocks in dry sclerophyll forest, *J.A. Elix* 5410, 23.xi.1978 (CANB).

Neofuscelia subverrucella (Essl.) Essl., *Mycotaxon* 7, 53 (1978).

This species was previously known from South Australia (Elix 1994, McCarthy 2003). It is characterized by an adnate thallus, cylindrical isidia, a pale tan lower surface, and divaricatic acid in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED

Western Australia. • Site 17, Wanjarri Nature Reserve, 27°26'30"S, 120°42'50"E, on rocks in sandy breakaway, *C.S. Fang & R.J. Cranfield* 44/94, 30.viii.1994 (PERTH).

Neofuscelia verisidiosa (Essl.) Essl., *Mycotaxon* 7, 53 (1978).

This species was previously known from New Zealand and southern Africa, and in Australia from Western Australia, South Australia, New South Wales, the Australian Capital Territory, Victoria and Tasmania (Elix 1994, McCarthy 2003). It is characterized by an adnate thallus, cylindrical isidia, a black lower surface, and alecronic and α-collatolic acids in the medulla. A detailed description is given in Elix (1994).

SPECIMENS EXAMINED

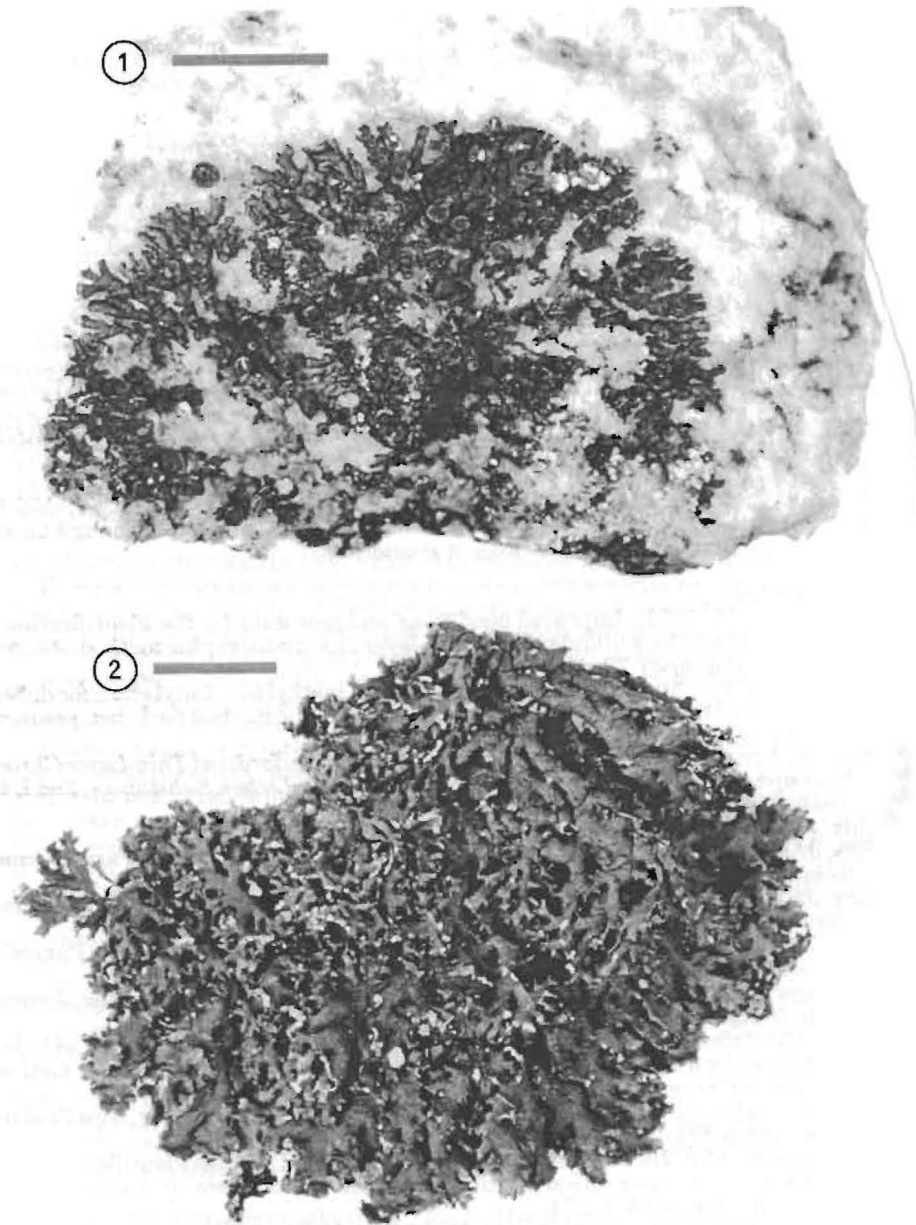
Queensland. • Isla Gorge National Park, 27 km NNE of Taroom, 25°10'S, 149°59'E, 220 m, on sandstone rocks in dry monsoon scrub, *J.A. Elix* 35174, 31.viii.1993 (CANB); • Robinson Gorge, Expedition National Park, 73 km NW of Taroom, 25°17'S, 149°09'E, 400 m, on sandstone rocks in steep gorge with palms and *Callistemon* shrubs, *J.A. Elix* 35235, 35232, 35239, 35242, 35264, 1.ix.1993 (CANB).

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Figures 1–2. New species of *Neofuscelia*: 1, *N. caparidensis* (holotype in MEL); 2, *N. ralstoniana* (holotype in MEL). Scale bar = 5 mm.

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Additional lichen records from New Zealand 40.

Buellia aethalea (Ach.) Th. Fr., *Catillaria contristans* (Nyl.) Zahlbr., *Frutidella caesiopatra* (Schaer.) Kalb, *Placynthium rosulans* (Th. Fr.) Zahlbr. and *Pseudocyphellaria mallota* (Tuck.) H. Magn.

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Abstract: *Pseudocyphellaria mallota* and four bipolar lichens *Buellia aethalea*, *Catillaria contristans*, *Frutidella caesiopatra* and *Placynthium rosulans*, formerly regarded as endemic to southern South America (Argentina and Chile), are reported from southern New Zealand for the first time.

Introduction

During recent fieldwork undertaken for the forthcoming second edition of *Flora of New Zealand Lichens*, the forests of the lower Routeburn Valley (44°44'S, 168°19'E) were investigated for possible southern limits of some cyanobacterial lichens (Galloway 2003). On a previous visit to Chinaman's Flat in the Dart Valley in November, 1998, a population of *Erioderma soreliatum* was discovered, at that time the most southerly record in New Zealand of this species. The forests of the lower Routeburn are west and a little to the south of Chinaman's Flat, and *Erioderma soreliatum* was duly found on basal trunks of *Phyllocladus asplenifolius* var. *alpinus*, just as across the valley in the Dart. However, what makes the Routeburn forests of considerable lichenological phytogeographic interest was the discovery, on the bark of mountain beech (*Nothofagus solandri* var. *cliffortioides*) and within sight of the Kinloch Routeburn road, of a population of the cyanobacterial lichen *Pseudo-cyphellaria mallota*, presumed until now to be endemic to southern South America (Galloway 1986, 1992). Notes on this species are given below together with its co-occurring cyanobacterial species, five of which represent the most southern records in New Zealand. The Routeburn was visited by the Swedish lichenologists G. Einar and Greta Du Rietz 76 years ago in February, 1927 (Galloway 2003), but none of the cyanobacterial lichens discussed below appears to have been collected by them at that time (unpublished observations).

Recent visits to a site above Skier's Rock at 1333 m on the Waikaia Bush Road at the southern end of the Old Man Range also disclosed three additional bipolar taxa new to the New Zealand mycobiota, *Buellia aethalea*, *Catillaria contristans* and *Frutidella caesiopatra*. A fourth very easily overlooked bipolar species new to New Zealand and to the Southern Hemisphere, *Placynthium rosulans*, was rare in water seepages on schist outcrops near the Poolburn Reservoir in Central Otago.

Buellia aethalea (Ach.) Th. Fr., *Lichenogr. Scand.* 1, 604 (1874).
= *Gyalecta aethalea* Ach., *Lichenogr. Universalis* 669 (1810).

Illustrations: Foucard (1990: 91); Dobson (2000: 80).

DESCRIPTION

Thallus crustose, uniform, areolate, spreading in irregular patches, (0.5–)1–3 cm diam., with a prominent black prothallus visible at margins and between areolae, often forming mosaics. Areolae small, 0.1–0.6(–1) mm diam, flat, angular, white to grey-white or discoloured brownish. Apothecia immersed, cryptolecanorine or zeorine, round to somewhat angular, 0.2–0.5(–0.8) mm diam., disc plane to subconcave, black, epruinose, with or without a thin proper margin, concolorous with disc. Epithecium greenish to olive-brown, 8–13 µm thick. Hymenium colourless, 60–80 µm tall. Hypothecium colourless to brownish. Ascospores 1-sep

tate, greenish to dark brown when over-mature, broadly oblong with rounded apices, slightly constricted at septum, 12–15 × 6.5–8.5 µm.

Chemistry: K+ yellow-orange, C–, KC–, Pd+ yellow-orange; containing norstictic and stictic acids.

NOTES

Buellia aethalea is a bipolar species characterized by the small, mosaic-forming white thallus, clearly delimited by a black prothallus and spreading in small rosettes or in irregular patches on smooth quartz veins, where it contrasts vividly with the dark thalli of *Sporastatia testudinea* and the bright yellow-green thalli of parasitic *Rhizocarpon pusillum*. It has a characteristic chemistry and 1-septate, greenish to dark brown ascospores.

It has a rather scattered occurrence on smooth quartz veins in schist outcrops in tussock grassland on the Old Man Range in Central Otago, in high-alpine habitats, and is less frequent than the two co-occurring lichens mentioned above. However, it has not yet been looked for more widely in high-alpine habitats in Central Otago. It is known also from Great Britain, Europe, Scandinavia, North America, Antarctica and Australia (Purvis *et al.* 1992, Santesson 1993, Nimis 1993, Schiedegger 1993, Scholz 2000, Øvstedal & Lewis Smith 2001, McCarthy 2003).

SPECIMEN EXAMINED

Otago: • Old Man Range, south end, above "Skier's Rock", Waikaia Bush Road, on schist outcrop in grassland, on bands of quartz (south-facing), with *Sporastatia testudinea* and *Rhizocarpon pusillum*, 1333 m, 27.iv.2003, D.J. Galloway 5442 pr. p. (CHR 534042).

Catillaria contristans (Nyl.) Zahlbr., *Cat. Lich. Univ.* 4(1), 35 (1926).
= *Lecidea contristans* Nyl., *Flora* 48, 354 (1895).

DESCRIPTION

Thallus warty-granular with discrete, globose or glomerulate areolae, whitish to pale to dark grey or grey-brown, or green-grey, without a prothallus, spreading irregularly over plant debris on soil, 0.5–1.5 cm diam. Areolae 0.05–0.3(–0.5) mm diam. Photobiont cells large, rounded, 13–16 µm diam. Apothecia prominent, convex to subglobose, sometimes conglomerate, 0.2–0.6(–1) mm diam., black, matt or glossy, epruinose, sometimes with a basal, whitish, byssoid collar in young fruits; proper margin inconspicuous, excluded at maturity. Epithecium olive or greenish to 8.5 µm thick. Hymenium 40–60 µm tall, pale aeruginose in upper parts, colourless to pale brownish below. Paraphyses strongly coherent, surrounded by a gel coat, 1.6–2.5(–3) µm diam., not noticeably swollen or pigmented at apices. Hypothecium red-brown to blue-black in thick sections. Asci clavate, 32–40 × 11–13.5 µm. Ascospores ellipsoid to ovoid-oblong, (0–)1-septate, 1.1–3.5 × 3–5 µm.

Chemistry: TLC nil; no secondary compounds detected.

NOTES

Catillaria contristans is a bipolar species growing on decaying plant debris on soil in snow banks, amongst colonies of *Arthrorhaphis alpina* and *Lepraria incana*. It is characterized by the scattered, globose to glomerulate areolae spreading over decaying vegetation on alpine soils, the globose, black apothecia, the olive or greenish epithecium, the pale aeruginose (in upper parts) hymenium, the thick red-brown to blackish hypothecium, and the ellipsoid to ovoid-oblong, 1-septate ascospores. It is a rather inconspicuous species known elsewhere from Great Britain, Europe, Scandinavia, Iceland, Tasmania, South Orkney Is., South Shetland Is. and Antarctica (Purvis *et al.*, 1992; Santesson 1993; Nimis 1993; Kantvilas 1994, 1996; Scholz 2000; Gilbert 2000; Øvstedal & Lewis Smith 2001; Hafellner & Türk 2001; Coppins 2002; McCarthy 2003).

SPECIMEN EXAMINED

Otago: • Old Man Range, south end, above "Skier's Rock", Waikaia Bush Road, on decaying vegetation on exposed, damp soil in snowbank close to road, associated with *Arthrorhaphis citrinella* and *Lepraria incana*, 1333 m, 27.iv.2003, D.J. Galloway 5448 (CHR 534083).

Frutidella caesioatra (Schaer.) Kalb, *Hoppea*, *Denkschr. Regensb. Bot. Ges.* 55: 582 (1994).

= *Lecidea caesioatra* Schaer., *Naturw. Anzeiger der Allgem. Schweiz. Ges. Gesammt. Naturw.* 2: 10 (1818).

Illustrations: Foucard (1990: pl. 177 as *Lecidea caesioatra*); Kalb (1994: 583, fig. 1).

DESCRIPTION

Thallus rather thick, of densely crowded, subglobose, isidioid, nodular or papillate granules, 0.1–0.2 mm diam., grey to dark grey or blackish, eroding whitish or with a violet tinge, without a marginal prothallus, developed in patches 1–3 cm diam., on living leaves of mosses, especially *Andreaea*. Apothecia sessile or sub-immersed in granules, (0.3–)0.5–1(–1.2) mm diam., convex, sometimes conglomerate-tuberculate, bluish black with a blue-grey bloom (10× lens) especially when moist; proper exciple reflexed, colourless to dull yellowish in section, of radiating conglutinated hyphae. Epithecium bright blue-green to olivaceous-brown, 10–15 µm thick, K–. Hymenium 60–90 µm tall, colourless below, blue-green above. Hypothecium hyaline to reddish brown to almost violet, K+ reddish orange. Paraphyses strongly conglutinated, 1.5–2 µm thick, simple or sparsely branched, apices not swollen. Asci *Bacidia*-type, 50–60 × 15–20 µm. Ascospores simple, colourless, ellipsoid (12–)15–20(–25) × 5–8(–9) µm, contents granular or vacuolate, not halonate. Pycnidia immersed or semi-immersed, globose to subpyriform, apically pigmented. Conidia filiform, 15–25 × 0.7–1 µm.

Chemistry: Thallus K+ weakly yellow, C–, KC+ orange, Pd–; containing sphaerophorin (major), thiophanic acid (minor) and atranorin (minor) (Kalb 1994, Sipman *et al.* 1998, Knoph & Leuckert 1999).

NOTES

Frutidella caesioatra is characterized by the crowded, clustered, pale greyish white, nodular, isidioid or papillate thallus, developing in spreading patches on living *Andreaea*, the scattered, convex to tuberculate-conglomerate, bluish black to greyish apothecia, with a fine, grey-blue bloom, *Bacidia*-type asci, simple, non-halonate ascospores, and sphaerophorin and thiophanic acid as secondary compounds. It grows on sloping schist blocks in alpine grassland, amongst cushions of the mosses *Andreaea* and *Racomitrium lanuginosum*, and it is apparently parasitic on them (see Poelt 1985: 247), in exposed, high-alpine sites at bases of tors and in snowbanks or areas of late snow-lie (Gilbert 2000, Fryday 2001). It is still very poorly known and collected in New Zealand. At the southern end of the Old Man Range it appears to be moderately common, and it should be looked for more widely in snow-bank vegetation and amongst *Andreaea* mats on exposed schist blocks in fellfield and alpine grassland. Associated lichens include *Bartlettia fragilis*, *Caloplaca tornoensis*, *Lecidella wulfenii*, *Lepraria neglecta*, *Megaspora verrucosa*, *Pseudephebe pubescens*, *Rhizocarpon geographicum*, *R. grande*, *R. pusillum*, *Rinodina olivaceobrunnea* and *Sporastatia testudinea*. According to Kalb (1994: 584), *Frutidella caesioatra* belongs to the alpine association *Caloplacetum nivalis* (Kalb 1970: 81–82). It is an arctic-alpine species also known from Great Britain, the European Alps, Scandinavia, Svalbard, Greenland and North America, Aus-

tralia (Victoria), South Georgia, South Orkney Is., South Shetland Is. and Antarctica (Vainio 1933, Kalb 1970, Poelt 1985, Hertel & Rambold 1988, Purvis *et al.* 1992, Santesson 1993, Nimis 1993, Kalb 1994, Wirth 1995, Esslinger & Egan 1995, Thomson 1997, Elvebakk & Hertel 1997, Sipman *et al.* 1998, Hansen 2000, Gilbert 2000, Scholz 2000, Hafellner & Türk 2001, Øvstedal & Lewis Smith 2001, Coppins 2002).

SPECIMENS EXAMINED

Otago: • Old Man Range, south end, above "Skier's Rock", Waikaia Bush Road, on schist outcrop in grassland, parasitizing leaves of *Andreaea*, on damp, sloping ledges and faces, 1333 m, 27.iv.2003, 9.v.2003, D.J. Galloway 5445, 5446, 5363 (CHR 534045, 534046, 534054).

Placynthium rosulans (Th. Fr.) Zahlbr., *Cat. Lich. Univ.* 3(2), 235 (1925).
= *Lecothecium rosulans* Th. Fr., *Bot. Notiser* 1863, 12 (1863).

Illustrations: Gyelnik (1940: tab. 6, fig. 3); Foucard (1990: pl. 257).

DESCRIPTION

Thallus orbicular, rosette-forming, 2–5 mm diam., occasionally forming confluent patches to 15 mm diam., loosely attached centrally, margins free and lifting from substratum, without a marginal prothallus. Lobes flabellate, narrow, 0.2–0.5(–0.8) mm wide, 1–1.5 mm long, plicate-radiating, contiguous or separated by narrow cracks, convex, surface olive-green to olive-brown, unchanged when moist, matt, emaculate, epruinose, margins slightly blackened, thickened, incised or minutely lobulate, without isidia. Apothecia solitary or occasionally 2(–3) together, central, sessile, constricted at base, 0.2–0.8(–1.0) mm diam., round to subirregular, disc plane to subconvex, matt or slightly granular-sooty (10× lens), epruinose, black when dry, dark red-brown when moist; proper margin persistent, entire, raised slightly above surface of disc, slightly shining, concolorous with disc. Epithecium dark brown-black to black, 8–15 µm thick, densely conglutinate, unchanged in K. Hymenium colourless, 65–85 µm tall. Paraphyses simple, septate, 1.5 µm thick, expanding to 3–5 µm at apices, distinctly moniliform with 3–6 terminal cells. Hypothecium densely interwoven, opaque, pale brownish pink, unchanged in K, 80–100 µm thick. Asci cylindrical-clavate, 55–62 × 16–20 µm, 8(–10)-spored. Ascospores simple, ovoid, colourless, contents granular-vacuolate, 11.5–13.5 × 6.5–8.2 µm. *Chemistry*: TLC nil; all reactions negative.

NOTES

Placynthium rosulans is a bipolar species characterized by the small, orbicular, dull olive-green to olive-brown thallus with plicate-radiating, flabellate lobes, the sessile, dark red-brown to black apothecia, dark-brown to black epithecium, colourless hymenium, 65–85 µm tall, 8(–10)-spored asci, simple, ovoid, granular-vacuolate ascospores, 11.5–13.5 × 6.5–8.2 µm, and habitat of damp seepage areas of schist outcrops in subalpine grassland. In this habitat it seems genuinely rare, the few specimens found to date associating with the moss *Andreaea* sp. and the lichens *Aspicilia caesiocinerea*, *Lecanora lugubris*, *Lepraria neglecta*, *Neofuscelia epheboides*, *N. petriseda*, *Neuropogon ciliatus*, *Ramboldia petraeoides*, *Rhizocarpon geographicum*, *R. grande*, *R. superficiale* and *Xanthoparmelia mougeotina*. Known also from Scandinavia and the European Alps (Fries 1863, Gyelnik 1940, Degelius 1943, Foucard 1990, Santesson 1993, Nimis 2003, Scholz 2000, Hafellner & Türk 2001). New Zealand material clearly matches the Scandinavian seepage form of *P. rosulans* (P.M. Jørgensen, *pers. comm.*).

SPECIMENS EXAMINED

Otago: *Poolburn Reservoir, on schist outcrop in grassland, 0.2 km S of fishing huts, beyond airstrip, south-facing slopes in water seepage cracks, rare, 750 m, 30.iv.2003, *D.J. Galloway 5357, 5358 pr. p.* (CHR 534048, 534049).

Pseudocyphellaria mallota (Tuck.) H. Magn., *Acta Horti Gothoburg.* 14, 7 (1940). = *Sticta crocata* var. *mallota* Tuck., *Syn. N. Amer. Lich.* 1, 101 (1882). For additional synonymy, see Galloway (1986: 136, 1992: 169).

Illustrations: Galloway (1986: 137, fig. 13; 138, fig. 14); Galloway *et al.* (1995: 49, lam. VI); Galloway (2003: 10, fig. 2).

DESCRIPTION

Thallus rather small, orbicular, 1–3 cm diam., corticolous, rather closely attached over most of lower surface, margins ±free. Lobes (2–)5–10(–15) mm diam., usually rather narrow, lacinate to rounded, imbricate, undulate, margins ragged, incised, often subsaccendent, sinuous, white-tomentose to densely granular-yellow-sorediate, often eroded below and yellow-sorediate, or with scattered to confluent yellow pseudocyphellae, rarely with dense, clustered phyllidia. Upper surface dark brownish or blue-grey, tinged reddish when moist, buff-brown or lurid grey-brown when dry, undulate, without faveolae, finely to coarsely wrinkled-uneven, coriaceous, verrucose-areolate (10× lens), sparsely to densely white-tomentose, tomentum white, silky, glistening, especially at margins (10× lens), sorediate. Soredia granular, yellow to greyish yellow, in laminal (also marginal), coarsely erumpent, rounded verruciform soralia (0.2–1 mm diam.), often eroded-yellow. Medulla white. Lower surface whitish to pale pinkish buff, glabrous and minutely wrinkled centrally, ±densely white-tomentose at margins, sometimes densely and uniformly tomentose from margins to centre, tomentum short, thick, woolly, whitish to pale buff to greyish, stouter and more entangled than hairs of upper surface. Pseudocyphellae yellow, vivid, conspicuous in a ±continuous zone at margins, rather rare and scattered centrally, flat, 0.1–0.4 mm. diam., round to irregular. Apothecia and pycnidia not seen in New Zealand material.

Chemistry: Calycin, pulvinic acid, pulvinic dilactone and several unidentified compounds.

NOTES

Pseudocyphellaria mallota is characterized by a white medulla, a cyanobacterial photobiont, orbicular to irregular, rather ragged lobes with coarsely erumpent, laminal and marginal, yellow soralia containing yellow, granular soredia, a coriaceous to minutely verrucose-areolate upper surface which is sparsely to densely white-tomentose, a white medulla, eroded-yellow pseudocyphellate to sorediate margins to the lobes on the lower surface, and a pale, whitish to pinkish buff, tomentose lower surface with scattered and often rather sparse, yellow pseudocyphellae. It is distinguished from *P. halei* (Galloway 1993) by the yellow pseudocyphellae, the yellow soralia and a chemistry dominated by pulvinic acid derivatives rather than hopane tripterpenoids. Until now it was thought to be endemic to southern South America, including Chile, Juan Fernández and Argentina (Galloway 1986, 1992; Galloway *et al.* 1995; Galloway & Quilhot 1999).

A diverse assemblage of cyanobacterial lichens co-occurs with *P. mallota* in this humid habitat and includes the following: *Coccocarpia palmicola* and *C. pellita*, *Degelia duplmarginata*, "*Dendriscoaulon dendriothamnoides*", *Erioderma sorediatum*, *Fuscoderma amphibolum*, *F. applanatum*, *F. limbatum*, *Pseudocyphellaria ardesiaca*, *P. nermula*, *P. pubescens* (both green and cyanobacterial forms and as photosymbiodemes), *P. sericeofulva*, *Sticta fuliginosa* and *S. limbata*, the last-named being parasitized by the lichenicolous fungus *Abrothallus parmel-*

iarum (see Schaechtelin & Werrier 1926, Hertel 1971, Hawksworth 1983, Alstrup & Hawksworth 1990, Bernasconi *et al.* 2002). Of those lichens, several have their most southerly records in the Routeburn, including *Erioderma sorediatum*, *Fuscoderma limbatum* (Jørgensen & Galloway 1989: 300, formerly the most southerly record being from the Boyle River), *Pseudocyphellaria ardesiaca* (Galloway 1988: 63, previously Mt Peel), and *Pseudocyphellaria nermula* (Galloway 1988: 212, previously the Boyle River).

SPECIMEN EXAMINED

Otago: *Lower Routeburn Valley, track to Sylvan Lake, on bark of mountain beech, beside a small stream close to the Kinloch-Routeburn Road, 400 m, 23.ii.2003, *D.J. Galloway 5563* (CHR 534001).

Bipolar lichens in New Zealand

A characteristic feature of the lichen mycobiotas of the summits of currently non-glaciated ranges in southern New Zealand (especially the Central Otago mountains and the foothills and outlying ranges of the Southern Alps in Canterbury, Marlborough and Nelson) is the occurrence of a suite of bipolar lichens, several of which occupy similar habitats in non-glaciated regions of the southern Andean cordillera in Tierra del Fuego, as well as in the old, glaciated, weathered mountain landscapes of Scotland, northern Scandinavia, the high Arctic and North America. A bipolar, amphitropical or antitropical distribution is one in which taxa are present in the Northern and Southern Hemispheres, and in particular at high latitudes, i.e. in the boreal and austral zones, but absent or largely absent from the tropics. Bipolar distributions are found in a large range of systematic groups, both terrestrial and marine, in fish, Mollusca, Foraminifera, Coleoptera, flowering plants, and bryophytes, as well as in lichens. Evidence suggests that bipolar patterns in some groups at least is an ancient phenomenon (see for example, White 1986; Howes 1991; Crame 1993, 1997; Meyerhoff *et al.* 1996; Humphries & Parenti 1999; Shi & Grunt 2000; Øvstedal & Lewis Smith 2001).

It is significant that nearly all bipolar lichens occupy essentially the same habitats in both hemispheres—alpine or tundra type biomes, either grassland or fellfield, often with cushion vegetation, fens and bogs. Dwarf scrub can be present, but trees are generally absent. Bipolar lichens are frequently found in periglacial environments, especially in the Subantarctic islands. The alpine regions in which bipolar lichens and mosses are found have long histories of stable, open, unchanged habitats. They are areas of long isolation and are often unusual habitats in areas of high ecological and geographical diversity. In New Zealand, the Central Otago mountain top landscapes are good examples of bipolar habitats. Many if not all present-day bipolar lichen habitats were glaciated in the Pleistocene over the past 1–2MA, with many areas ice-free only in the last 15000 years.

In the New Zealand lichen mycobiota, bipolar lichens (Du Rietz 1926, 1929; Galloway & Bartlett 1986; Galloway & Aptroot 1995) are found in the following families (Eriksson *et al.* 2003): *Acarosporaceae*, *Agyriaceae*, *Arthoniaceae*, *Arthrorhaphidaceae*, *Bacidiaceae*, *Brigiatiaceae*, *Caliciaceae*, *Candelariaceae*, *Catillariaceae*, *Cladoniaceae*, *Collemataceae*, *Coniocybaceae*, *Dacampiaceae*, *Dactylosporaceae*, *Dothideales incert. sed.*, *Epigloaceae*, *Icmadophilaceae*, *Lecanoraceae*, *Lecideaceae*, *Megasporaceae*, *Pannariaceae*, *Parmeliaceae*, *Peltigeraceae*, *Pertusariaceae*, *Phyllachoraceae*, *Placynthiaceae*, *Porpidiaceae*, *Psoraceae*, *Rhizocarpaceae*, *Teloschistaceae*, *Thrombiaceae*, *Umbilicariaceae* and *Verrucariaceae*. At the species level, 134 taxa of bipolar lichens and lichenicolous fungi (*) are recorded from New Zealand, comprising c. 8% of the total lichen flora.

New Zealand's bipolar taxa are *Alectoria nigricans*, *Arthrorhaphis alpina*, *A. citrinella* var. *citrinella*, **A. grisea*, *Arthonia cinereopruinosa*, **A. epiphyscia*, *A. lapidicola*, **A. molendoi*, *Bacidia bagliettoana*, **B. killiasii*, *Bellemeria alpina*, *B.*

subsorediza, *Brigantiaea fuscolutea*, **Buellia adjuncta*, *B. aethalea*, *Caloplaca ammiospila*, *C. biatorina*, *C. caesiorufella*, *C. cerina*, *C. chrysodeta*, *C. chrysopteralma*, *C. concilians*, *C. crenulatella*, *C. rubelliana*, *C. saxicola*, *C. torwensis*, *C. xantholyta*, *Candelariella subdeflexa*, *Carbonea vitellinaria*, *C. vorticosa*, *Catapyrenium cinereum*, *C. daedalum*, *Catillaria contristans*, **Cercidospora tryptelata*, *Cetrariella delisei*, *Cladonia earneola*, *C. ecmocyna*, *C. gracilis* subsp. *vulnerata*, *C. sulphurina*, *C. uncialis*, *Clauzadea monticola*, *Clauzadeana macula*, **Clypeococcum grossum*, **Dactylospora acarosporae*, **D. australis*, **D. frigida*, **D. parasitica*, *Dermatocarpon luridum*, *Epigloea soleiformis*, *Frutidella caesioatra*, *Icmadophila ericetorum*, *Immersaria athroocarpa*, *Lecanora bicincta*, *L. cavicola*, *L. intricata*, *L. swartzii*, *Lecidea diducens*, *L. lapicida* subsp. *lapicida*, *L. lapicida* subsp. *pantherina*, *L. swartioidea*, **L. verruca*, *Lecidella wulfenii*, *Lecidoma demissum*, *Lepraria eburnea*, *L. membranacea*, *L. neglecta*, *L. vouauxii*, *Leptogium plicatile*, **Lichenochora xanthoriae*, *Massalongia carnosa*, *Megaspora verrucosa*, *Miriquidica deusta*, *M. nigroleprosa*, **Muellerella pygmaea*, *Mycobilimbia hypnorum*, *Myxobilimbia lobulata*, *Ochrolechia xanthostoma*, *Neofuscelia subhosseana*, *Pannaria hookeri*, *Peltigera lepidophora*, *P. malacea*, *P. neckeri*, *P. neopolydactyla*, *Pertusaria dactylina*, *Physcia semipinnata*, *Placynthiella oligotropha*, *Placynthium rosulans*, **Polycoccum pulvinatum*, **P. squamarioides*, *Porpidia platycarpoides*, *P. superba*, *Pseudephebe minuscula*, *P. pubescens*, *Psoroma hypnorum*, *Racodium rupestre*, *Rhizocarpon copelandii*, *R. dispersum*, *R. eupetraeum*, *R. geminatum*, *R. geographicum* subsp. *arcticum*, *R. grande*, *R. hochstetteri*, *R. lavatum*, *R. lecanorinum*, *R. polycarpum*, **R. pusillum*, *R. reductum*, *R. submodestum*, *R. subpostumum*, **Rimularia insularis*, *R. psephota*, **Rinodina insularis*, *R. olivaceobrunnea*, *R. roscida*, *Schaereria fabispora*, *S. fuscocinerea*, *Sclerophora amabilis*, *Solorina crocea*, *S. spongiosa*, *Sporastatia testudinea*, *Staurothele fissa*, *Tetramelas papillata*, **Thamnogalla crombei*, *Thelomma ocellatum*, *Thrombium epigaeum*, *Trapeliopsis pseudogranulosa*, *Tuckermannopsis chlorophylla*, *Umbilicaria grisea*, *U. krascheninnikovii*, *U. nylanderiana*, *U. subglabra*, *U. umbilicarioides*, *U. virginis*, *Verrucaria aquatilis*, *V. ceuthocarpa*, *V. morgacea*, *V. mucosa*, *V. rheitrophila*, *V. striatula*, *Xanthoria elegans* and × *polycarpa*.

How are these bipolar lichen distributions explained? This was discussed in a preliminary way by Galloway & Aptroot (1995), and at present biogeographers suggest two major frameworks: (1) *Vicariance models*. Allopatric speciation resulting from some kind of geographical barrier separating a formerly continuous population. Rafting of fragments from earlier landmasses such as Gondwana, and/or the accretion of terranes of exotic origin. There are several competing scenarios, but as yet none has been rigorously tested, partly because alpine lichens of the Southern Hemisphere and of tropical mountains are still not adequately and accurately known, nor is the geology of composite present-day landmasses known with certainty. (2) *Long-distance dispersal*. This is now much more fashionable in discussions of plant distributions in the Southern Hemisphere than it was a decade or so ago (see for example Pole 2001). The alpine vegetation for the South Island of New Zealand, although physically isolated in the southern ocean for some 80MY and with a high degree of endemism, is nevertheless comparatively young, adaptive radiation having occurred after long-distance dispersal during the late Miocene to early Pleistocene (McGlone *et al.* 2001, Lee *et al.* 2001). Unlike the flowering plants of alpine New Zealand, the alpine lichens have apparently not speciated *in situ* at all, with only a few endemic taxa developed such as *Labyrinthina* (Malcolm *et al.* 1995). Some undoubtedly have arrived in relatively recent times in the West Wind Drift, but others could well be truly Gondwanan or even earlier relicts.

The persistence of lichen communities in extreme, high-alpine environments at high latitudes in both hemispheres is a well-recognized phenomenon (Galloway & Aptroot, 1995, Adler & Calvelo 2002), but still without a single unifying explanation. Recent developments in phylogenetic systematics of fungi have shown that the lichenized state is indeed a very ancient symbiosis stretching back to the very beginnings of the colonization of the earth by living systems, and that lichen associations are the likely ancestors of free-living Ascomycete fungal lines (Lutzoni *et al.* 2001). There is evidence that gains of lichenization often are followed by losses. It is axiomatic that earth and life evolved together, so in seeking an explanation for the phenomenon of bipolarity in lichens, increasingly more sophisticated (and hopefully cheaper) molecular methods, plus advances in knowledge of composite geological areas, will be powerful tools to help provide some realistic answers.

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