

PHYSICIACEAE

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Physciaceae Zahlbr., in H.G.A.Engler, *Syllabus*, 2nd edn 46 (1898).

Type: *Physcia* (Schreb.) Mich.

Thallus foliose, fruticose, squamulose, stipitate, crustose or evanescent, usually autonomous, rarely lichenicolous. Lobules, isidia and soredia present or absent. Upper cortex prosoplectenchymatous, paraplectenchymatous or absent. Photobiont a unicellular green alga, 5–20 µm diam., forming a continuous layer or not, the genus (where known) *Trebouxia*. Medulla poorly to well developed or absent, when present frequently containing lichen substances. Lower cortex prosoplectenchymatous, paraplectenchymatous or absent; lower surface with or without rhizines. Prothallus present or absent. Ascomata apothecia or mazaedia. Apothecia immersed, sessile or short-stalked, cryptolecanorine (immersed), lecanorine to lecideine, with a ±distinct exciple; disc (when present) ±round, plane to convex; disc brown to dark reddish brown or black. Thalline exciple present or absent. Proper exciple thin and weakly pigmented to well developed and dark-pigmented; composed of conglutinated radially-oriented hyphae. Epihymenium brown-black, brown or green; hymenium colourless or partly green, with or without oil droplets; hypothecium colourless, yellow-brown, brown or dark brown. Paraphyses simple or sparingly branched in the uppermost part; apices usually thickened, with a brown-pigmented cap. Asci clavate, of the *Lecanora*- or *Bacidia*-type, (2–) 8 (–16)-spored, usually with a well-developed amyloid tholus, with a paler conical axial mass and an ocular chamber. Ascospores 1–multiseptate, olive to brown, ellipsoidal, often with uneven wall thickenings. Conidiomata pycnidial, immersed or superficial. Conidia formed acrogenously or, usually, pleurogenously, ellipsoidal, bacilliform, fusiform or filiform.

This cosmopolitan family currently comprises c. 46 genera, 25 of which are known from Australia. Following recent molecular investigations, most of the mazaedioid Caliciaceae have been subsumed under Physciaceae and the family transferred to the order Teloschistales (Wedin *et al.*, 2002; Helms *et al.*, 2003; Miadlikowska *et al.*, 2006).

R.Moberg, Physciaceae, *Nordic Lichen Flora* 2: 7 (2002); M.Wedin, E.Baloch & M.Grube, Parsimony analyses on mtSSU and nITS rDNA sequences reveal the natural relationships of the lichen families Physciaceae and Caliciaceae, *Taxon* 51: 655–660 (2002); G.Helms, T.Friedl & G.Rambold, Phylogenetic relationships of the Physciaceae inferred from rDNA sequence data and selected phenotypic characters, *Mycologia* 95: 1078–1099 (2003); J.Miadlikowska, F.Kauff, V.Hofstetter, E.Fraker, M.Grube, J.Hafellner, V.Reeb, B.P.Hodkinson, M.Kukwa, R.Lücking, G.Hestmark, M.Garcia Ojalora, A.Rauhut, B.Büdel, C.Scheidegger, E.Timdal, S.Stenroos, I.Brodo, G.Perlmutter, D.Ertz, P.Diederich, J.C.Lendemer, P.May, C.L.Schoch, A.E.Arnold, C.Gueidan, E.Tripp, R.Yahr, C.Robertson & F.Lutzoni, New insights into classification and evolution of the Lecanoromycetes (Pezizomycotina, Ascomycota) from phylogenetic analyses of three ribosomal RNA- and two protein-coding genes, *Mycologia* 98: 1088–1103 (2006).

1	Thallus foliose	2
1:	Thallus crustose or stipitate	8
2:	Lower surface and margins without rhizines or with short sparse inconspicuous rhizines (1)	3
2:	Lower surface and/or margins distinctly rhizinate	4
3	Upper surface K+ yellow; atranorin present; thallus erhizinate (2)	2. DIRINARIA
3:	Upper surface K–; atranorin absent; thallus erhizinate or with short sparse inconspicuous rhizines	HYPERPHYSICIA

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4	Upper cortex prosoplectenchymatous (2:)	HETERODERMIA
4:	Upper cortex paraplectenchymatous	5
5	Upper surface brownish, K-, UV-; atranorin and lichexanthone absent (4:)	PHAEOPHYSCIA
5:	Upper surface greyish, K+ yellow or UV+ yellow, rarely K- or UV-; atranorin or lichexanthone usually present	6
6	Upper surface K-, UV+ yellow; lichexanthone present (5:)	3. PYXINE
6:	Upper surface K+ yellow or K-, UV-; lichexanthone absent	7
7	Upper surface glossy, often with patchy pruina; pseudocyphellae common (6:)	3. PYXINE
7:	Upper surface dull, evenly pruinose or epruinose; pseudocyphellae absent	PHYSICIA
8	Ascospores maturing in an apothecium (1:)	9
8:	Ascospores maturing in a mazaedium	21
9	Thallus with placodioid-lobate or radiate-plicate margins (8:)	10
9:	Thallus lacking placodioid-lobate or radiate-plicate margins	12
10	Thallus with placodioid-lobate margins; exciple lacking photobiont cells (9:)	DIPLOICIA
10:	Thallus with radiate-plicate margins; exciple containing photobiont cells	11
11	Conidia bacilliform; ascospore wall uniformly thin (10:)	DIMELAENA
11:	Conidia filiform; ascospore wall unevenly thickened	AUSTRALIAENA
12	Exciple containing photobiont cells (9:)	RINODINA
12:	Exciple lacking photobiont cells	13
13	Ascospore wall unevenly thickened (12:)	14
13:	Ascospore wall of uniform thickness	15
14	Ascospores with strong to weak subapical and septal wall thickenings (13:)	1. BUELLIA s. str.
14:	Ascospores with strong to weak apical wall thickenings only	CRATIRIA
15	Ascospore wall thin (13:)	RINODINELLA
15:	Ascospore wall uniformly thickened	16
16	Conidia filiform (15:)	AMANDINEA
16:	Conidia bacilliform, fusiform or absent	17
17	Conidia fusiform (16:)	GASSICURTIA
17:	Conidia bacilliform or absent	18
18	Thallus lichenicolous (17:)	MONEROLECHIA
18:	Thallus not lichenicolous	19
19:	Thallus growing on rock or soil (18:)	BUELLIA s. lat.
19:	Thallus growing on bark or wood	20
20	Disc epruinose; ascospore cell lumina funnel-shaped (19:)	SCULPTOLUMINA
20:	Disc red-pruinose; ascospore cell lumina hemi-ellipsoidal	STIGMATOCHROMA
21	Mazaedium distinctly stalked (8:)	CALICIUM
21:	Mazaedium immersed, sessile or with very short stalks	22
22	Ascospores 2-4-septate (21:)	HETEROCYPHELIUM
22:	Ascospores 1-septate	23
23	Ascomata cylindrical or conical; ascospores 10-13 x 4.5-6.0 µm (22:)	TYLOPHORON
23:	Ascomata discoid; ascospores 14-22 x 8-14 µm	CYPHELIUM

1. BUELLIA

Buellia De Not., *Giorn. Bot. Ital.* 2: 174 (1864), *nom. cons.*, named by De Notaris after his friend, Esperanzo Buelli.

Type: *B. disciformis* (Fr.) Mudd

Hafellia Kalb, H.Mayrhofer & Scheid., in K.Kalb, *Lich. Neotrop.* 9: 9 (1986). T: *H. parastata* (Nyl.) Kalb, H.Mayrhofer & Scheid. [= *B. parastata* (Nyl.) Zahlbr.]

Thallus crustose, superficial, thin, smooth to rugulose, continuous, membranous to rimose and areolate or scaly, 1-5 cm wide, 35-70 µm thick, corticate or not, rarely immersed and inconspicuous. Prothallus absent or present as a thin dark brown or black marginal line. Isidia and soredia absent. Upper surface white, grey-white to grey, yellow-grey, brown or

greenish. Photobiont a unicellular green alga; cells 8–14 µm diam., not forming a continuous layer. Medulla and lower cortex present or absent. Ascomata apothecial, orbicular, sessile or rarely subimmersed; disc dark brown to black, rarely pruinose, plane to convex or weakly concave; margin concolorous with the disc, usually persistent, becoming excluded in convex apothecia; thalline exciple absent; proper exciple carbonised, dark red-brown to ±black, consisting of radiating agglutinated hyphae, uniformly pigmented or with a paler inner zone. Epihymenium 10–30 µm thick, brown or greenish, K+ violet, yellow-green, olive or K–; hypothecium 50–170 µm thick, brown to dark brown, occasionally not differentiated from the exciple; hymenium 60–150 µm thick, colourless, often interspersed with oil droplets, amyloid. Paraphyses septate, 1–2 µm thick, simple or with short branches near the apices; apices clavate, 3–5 µm thick, usually brown-capitate, K+ purple or K–. Asci of *Lecanora*-type, clavate, 2–16-spored; apex wall layers thickened; apex amyloid, with a distinct axial mass. Ascospores olive to dark brown, 1–3-septate, thick-walled, *Callispora*-type, with weak to strong subapical and septal wall thickenings, ellipsoidal, 12–65 × 4–25 µm; outer wall smooth to strongly ornamented; torus present or absent. Conidiomata pycnidial, laminal, immersed, pyriform; conidiophores of type V (*sensu* Vobis, 1980), acrogenous. Conidia bacilliform or weakly clavate, 5–6 × 0.8–1.2 µm.

Buellia s. str. (formerly *Hafellia* Kalb, H.Mayrhofer & Scheid.) is one of the few well-delimited groups within *Buellia s. lat.* (Bungartz, 2008). It is characterised by *Callispora*-type ascospores, bacilliform or weakly clavate conidia, an often strongly oil-interspersed hymenium, and by the presence of norstictic acid, diploicin and congeners of 4,5-dichlorolichexanthone. For nomenclatural reasons, the name *Hafellia* must be regarded as a synonym of *Buellia s. str.* because *B. disciformis*, the conserved type of *Buellia*, shares all the typical characters of '*Hafellia*'. Thus, Moberg *et al.* (1999) suggested changing the listed type of *Buellia* to *B. aethalea* (Ach.) Th.Fr. However, *B. disciformis* had already been chosen as the type of *Buellia* when that name was conserved against *Gassicurtia* Fée. The suggested replacement of a conserved type would have been the first such action in the history of the Botanical Code. The proposal was not recommended by the Committee for Fungi (Gams, 2004), and the decision to reject the proposal of Moberg *et al.* (1999) was accepted by general vote at the International Botanical Congress in Vienna in 2005. Therefore, the species formerly included in *Hafellia* must now be regarded as *Buellia s. str.*, and the remaining species of *Buellia s. lat.*, which are not closely related, must be excluded from the genus.

Buellia s. str. is a pantropical and pantemperate genus currently thought to contain c. 30 species world-wide; 19 of them occur in Australia. Most grow on bark and wood, and one species is saxicolous.

G.Vobis, Bau und Entwicklung der Flechten-Pycnidien und ihrer Conidien, *Biblioth. Lichenol.* 14: 1–141 (1980); J.W.Sheard, The lichenized Ascomycete genus *Hafellia* in North America, *Bryologist* 95: 79–87 (1992); W.Pusswald, G.Kantvilas & H.Mayrhofer, *Hafellia dissa* and *H. levieri* (lichenized Ascomycetes, Physciaceae), two corticolous and lignicolous species in Tasmania, *Muelleria* 8: 133–140 (1994); W.Pusswald, *Die Gattung Hafellia (lichenisierte Ascomyceten, Physciaceae) in Australien*, Dissertation, Institut für Botanik, Karl Franzens Universität, Graz (1995); R.Moberg, A.Nordin & C.Scheidegger, Proposal to change the listed type of the name *Buellia nom. cons.* (Physciaceae, Ascomycota), *Taxon* 48: 143 (1999); B.Marbach, Corticole und lignicole Arten der Flechtengattung *Buellia sensu lato* in den Subtropen und Tropen, *Biblioth. Lichenol.* 74: 1–384 (2000); J.Etayo & B.Marbach, *Hafellia alisioae* and *H. gomerana* (lichenized Ascomycetes, Physciaceae), two new species from the Canary Islands, with a key to all known corticolous species, *Lichenologist* 35: 369–375 (2003); W.Gams, Report of the Committee for Fungi: 11, *Taxon* 53: 1067–1069 (2004); J.A.Elix, A new species of *Hafellia* (Physciaceae, lichenized Ascomycota) from Australia, *Australas. Lichenol.* 59: 36–37 (2006); J.A.Elix, Four new crustose lichens (lichenized Ascomycota) from Australia, *Australas. Lichenol.* 60: 14–19 (2007); J.A.Elix & P.M.McCarthy, A further new species of *Hafellia* (Physciaceae, lichenized Ascomycota) from Australia, *Australas. Lichenol.* 62: 20–22 (2008); J.A.Elix, Additional lichen records from Australia 67, *Australas. Lichenol.* 63: 2–9 (2008); F.Bungartz, *Buellia*, *Lichen Fl. Greater Sonoran Desert Region* 3: 113–179 (2008).

1	Thallus saxicolous.....	12. B. procellarum
1:	Thallus corticolous or lignicolous.....	2
2:	Epihymenium K+ violet (1:).....	3
2:	Epihymenium K-.....	5
3	Asci with 16 ascospores (2).....	11. B. pleiotera
3:	Asci with 8 ascospores.....	4
4	Thallus K+ red; norstictic acid present (3:).....	1. B. bahiana
4:	Thallus K-; norstictic acid absent.....	14. B. reagenella
5	Asci 2-spored (2:).....	6
5:	Asci 4- or 8-spored.....	7
6	Ascospores 38–61 × 15–24 µm (5).....	13. B. pseudotetrapla
6:	Ascospores 22–42 × 10–16 µm.....	5. B. dissa
7	Asci usually 4-spored; ascospores 28–45 × 14–18 µm (5:).....	18. B. tetrapla
7:	Asci usually 8-spored; ascospores usually smaller.....	8
8	Thallus K-; 4,5-dichlorolichexanthone present or lichen substances absent (7:).....	9
8:	Thallus K+ yellow or red; atranorin or norstictic acid present.....	12
9	4,5-Dichlorolichexanthone present (8).....	19. B. xanthonica
9:	Lichen substances absent.....	10
10:	Ascospores 30–38 × 12–16 µm (9:).....	7. B. levieri
10	Ascospores 12–20 × 5–9 µm.....	11
11:	Ascospores with a smooth outer wall, 1-septate (10:).....	9. B. microsporella
11:	Ascospores with a markedly ornamented outer wall, commonly 3-septate.....	8. B. metaphragmia
12	Thallus K+ red; norstictic acid present (8:).....	13
12:	Thallus K+ yellow; atranorin present.....	17
13	Ascospores more than 22 µm long (12).....	14
13:	Ascospores less than 22 µm long.....	15
14	Ascospores smooth, with strong subapical wall thickenings (13).....	6. B. fraudans
14:	Ascospores strongly ornamented, with weak subapical wall thickenings.....	16. B. subcrassata
15	Thallus glossy, thick, cartilaginous or subsquamulose; epihymenium K-; ascospores 12–18 × 4–6 µm (13:).....	15. B. rechingeri
15:	Thallus dull, thin; epihymenium K+ yellow-green or K-; ascospores 15–22 × 6–14 µm.....	16
16	Ascospores 6–8 µm wide; epihymenium K+ yellow-green, olive or K-; hafellic acid absent (15:).....	2. B. curatellae
16:	Ascospores 8–14 µm wide; epihymenium K-; hafellic acid present.....	17. B. subtropica
17	Ascospores less than 28 µm long, with weak subapical wall thickenings; diploicin absent (12:).....	4. B. disciformis
17:	Ascospores usually more than 28 µm long, with strong subapical wall thickenings; diploicin present... 18	
18:	Ascospore wall strongly ornamented; lumina straight (17:).....	3. B. demutans
18:	Ascospore wall smooth; lumina bent.....	10. B. parastata

1. Buellia bahiana Malme, *Ark. Bot.* 21A: 17 (1927)

Hafellia bahiana (Malme) Sheard, *Bryologist* 95: 82 (1992). T: Rio Vermelho, Bahia, Brazil, *G.O.A. Malme* 12; lecto: S, *fide* J.W. Sheard, *Bryologist* 95: 82 (1992).

For further synonymy see Marbach (2000).

Illustrations: J.W. Sheard, *op. cit.* 80, fig. 1; B. Marbach, *Biblioth. Lichenol.* 74: 254, fig. 120 (2000), both as *Hafellia bahiana*.

Thallus corticolous or lignicolous, 1–3 cm wide, thin, continuous, membranous to areolate, white, grey-white or pale grey, uneven or occasionally verrucose. Prothallus not apparent except when abutting other species (then black). Apothecia common, 0.1–0.7 mm wide, sessile, contiguous or not; disc black, epruinose, plane or slightly convex; margin black, narrow, persistent. Proper exciple dark brown to brown-black, paler internally. Epihymenium 10–15 µm thick, olive to blue-green or dark olive-green, K+ violet. Hymenium 65–85 µm thick, interspersed with oil droplets. Hypothecium 35–80 µm thick, dark brown. Asci 8-spored. Ascospores 1-septate, 13–20 × 5.5–8.0 µm, often slightly elongated at the ends, with strong subapical and septal wall thickenings; outer wall smooth. Pycnidia not seen.

Chemistry: Thallus K+ red, P+ yellow or yellow-orange; containing norstictic acid (major), connorstictic acid (minor or trace).

This mainly pantropical-subtropical species is common on bark and wood in coastal and hinterland forests in W.A., Qld and Tas. Also in Africa, North, Central and South America and the Pacific (the Hawaiian Islands, New Caledonia and Tahiti). Map 524.

W.A.: Nookaminne picnic area, 4 km W of Quairading, *J.A.Elix* 31791 (CANB). Qld: Forrest Beach, 18 km ESE of Ingham, *J.A.Elix* 36791 (CANB). Tas.: Moores Hill, *G.Kantvilas* 222/80 (HO).

This lichen is characterised by the white, grey-white or pale grey thallus, the 8-spored asci, the K+ violet epihymenium, the comparatively small ascospores with strong subapical and septal wall thickenings and a smooth outer surface, and by the presence of norstictic acid.

2. *Buellia curatellae* Malme, *Ark. Bot.* 21A: 18 (1927)

Hafellia curatellae (Malme) Marbach, *Biblioth. Lichenol.* 74: 255 (2000). T: Aricá, near Cuiabá, Mato Grosso, Brazil, "in cortice *Curatellae americanae*, in cerrado subruderali", 19 Nov. 1893, *G.O.A.Malme* 2012 (*Lich. Austroamer. Herb. Regnell.* 132); lecto: S, *vide* S.R.Singh & D.D.Awasthi, *Biol. Mem.* 6: 176 (1981).

For further synonymy see Marbach (2000).

Illustration: B.Marbach, *op. cit.* 258, fig. 122, as *Hafellia curatellae*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, membranous, finely rimose to deeply rimose and areolate, whitish, grey-white to grey or pale yellow-brown, weakly to markedly verrucose. Prothallus black or not apparent. Apothecia common, 0.1–0.7 mm wide, moderately immersed to sessile; disc black, epruinose, plane to convex; margin black, thick, narrow, or excluded in convex apothecia. Proper exciple brown-black, with or without a paler inner part. Epihymenium 10–15 µm thick, olive-brown or blackish green, K+ clear yellow-green, olive or K–. Hymenium 60–100 µm thick, interspersed with oil droplets. Hypothecium 80–120 µm thick, greenish black to dark olive-brown. Asci 8-spored. Ascospores 1-septate, 15–22 × 6–8 µm, with weak to moderately strong subapical wall thickenings; outer wall smooth or weakly ornamented. Pycnidia not seen.

Chemistry: Thallus K+ red, P+ yellow or yellow-orange; containing norstictic acid (major), connorstictic acid (minor or trace).

This pantropical-subtropical species occurs on bark and wood in coastal and inland forest and woodland in W.A., Qld and N.S.W. Also in South America, Africa, Papua New Guinea, New Caledonia and the Hawaiian Islands. Map 525.

W.A.: Bullfinch–Evanston road, 51.3 km N of Bullfinch, *J.A.Elix* 32503 (CANB). Qld: Glasshouse Mtns, Maleny, Sept. 1995, *K. & A.Kalb* (Herb. Kalb). N.S.W.: Barrington Tops Natl Park, NE of Scone, *K.Kalb* 21804 (Herb. Kalb).

This lichen is characterised by the whitish, grey-white to grey or pale yellow-brown thallus, the 8-spored asci, the olive-brown or blackish green epihymenium (reacting K+ clear yellow-green, olive or K–), the comparatively small ascospores with weakly to moderately strongly subapical wall thickenings and a smooth or weakly ornamented wall, and by the presence of norstictic acid.

3. *Buellia demutans* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 7: 348 (1931)

Lecidea demutans Stirt., *Trans. Roy. Soc. Victoria* 17: 71 (1881); *Hafellia demutans* (Stirt.) Pusswald, in B.Marbach, *Biblioth. Lichenol.* 74: 259 (2000). T: Qld, locality unknown, *F.M.Bailey* 82; holotype: BM.

Lecidea callispora C.Knight, *Trans. Linn. Soc. London, Bot.* 2: 45 (1882); *Buellia callispora* (C.Knight) J.Steiner, *Bull. Herb. Boissier*, sér. 2, 7: 645 (1907); *Hafellia callispora* (C.Knight) H.Mayrhofer & Sheard, in J.W.Sheard, *Bryologist* 95: 84 (1992). T: N.S.W. [neighbourhood of Sydney], *C.Knight* 23; lecto: WELT n.v., *vide* H.Mayrhofer, *Beih. Nova Hedwigia* 79: 532 (1984).

Lecidea restituta Stirt., in F.M.Bailey, *Queensland Agric. J.* 5: 39 (1899); *Buellia restituta* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 7: 400 (1931). T: near Brisbane, Qld, *F.M.Bailey* 163; holotype: GLAM n.v.; isotype: BM n.v.

Lecidea subconnexa Stirt., in F.M.Bailey, *Queensland Agric. J.* 5: 38 (1899); *Buellia subconnexa* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 7: 417 (1931). T: c. 60 miles [c. 95 km] W of Brisbane, Qld, on bark, 1892, *Mrs Heywood McEwen s.n.*; holotype: BM n.v.

For further synonymy see Marbach (2000).

Illustrations: J.W.Sheard, *Bryologist* 95: 80, fig. 2 (1992), as *Hafellia callispora*; B.Marbach, *op. cit.* 262, fig. 124, as *Hafellia demutans*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, continuous or rimose, whitish, yellow-white, grey, grey-white or pale yellow-grey, smooth to weakly verrucose. Prothallus black or absent. Apothecia common, 0.5–0.9 mm wide, sessile, but occasionally initially erumpent in specimens with thicker thalli; disc black, epruinose, plane or slightly convex; margin black, moderately thick, persistent. Proper exciple dark brown. Epihymenium 10–20 μm thick, red-brown, K–. Hymenium 80–150 μm thick, densely inspersed with oil droplets. Hypothecium 150–200 μm thick, dark brown. Asci (4–) 8-spored. Ascospores 1-septate, 22–40 \times 9–14 μm , with strong subapical and septal wall thickenings; outer wall moderately strongly ornamented; lumina straight. Conidia bacilliform, c. 5 \times 1 μm .

Chemistry: Thallus K+ yellow, C–, P+ yellow; containing atranorin (major), diploicin (major), isofulgidin (minor), fulgidin (minor or trace).

Very common on bark and wood in coastal and hinterland areas of W.A., S.A., Qld, N.S.W. and Vic. Also in South America, South Africa, New Zealand and the Pacific (the Hawaiian Islands and New Caledonia). Map 526.

W.A.: along road to The Loop and Z-Bend, Kalbarri Natl Park, 24 km NE of Kalbarri township, *J.A.Elix* 33652 (CANB, PERTH). S.A.: Waterfall Gully, Mount Lofty Ra., 30 Sept. 1965, *A.C.Beauglehole* (MEL). Qld: Tin Can Inlet, Tin Can Bay, Wide Bay District, *J.A.Elix* 22808 (CANB). N.S.W.: Bermagui township, *J.A.Elix* 28838 (CANB). Vic.: 13.4 km NNW of Rheola, 1 Feb. 1964, *R.B.Filson* (MEL).

Buellia demutans is characterised by the whitish, yellow-white, grey, grey-white or pale yellow-grey thallus, asci generally with 8 rather large ascospores with strong septal and subapical wall thickenings and a moderately strongly ornamented outer surface, and by the presence of atranorin and diploicin. Rarely, some asci contain 4 spores, so that this species can be confused with *B. tetrapla*; however, some asci in the same apothecium will always contain 5–8 spores.

4. *Buellia disciformis* (Fr.) Mudd, *Man. Brit. Lich.* 216 (1861)

Lecidea parasema var. *disciformis* Fr., *Novae Sched. Crit.* 9 (1826); *Hafellia disciformis* (Fr.) Marbach & H.Mayrhofer, in B.Marbach, *Biblioth. Lichenol.* 74: 259 (2000). T: *Fries* 215A [centre specimen]; lecto: UPS, *fide* K.Kalb & J.A.Elix, *Mycotaxon* 68: 478 (1998).

Lichen parasemus Ach., *Prodr. Lich.* 64 (1799), *nom. illeg.*; *Lecidea parasema* (Ach.) Ach., *Methodus* 35 (1803), *nom. illeg.*; *Buellia parasema* (Ach.) De Not., *Giorn. Bot. Ital.* 2, 1: 198 (1846), *nom. inval.*; *Buellia parasema* (Ach.) Th.Fr., *Lichenogr. Scand.* 589 (1874), *nom. illeg.* T: ex agro Comensi, [Italy], *S.Garovaglio*; lecto: R–DE NOT, *fide* K.Kalb & J.A.Elix, *Mycotaxon* 68: 478 (1998).

Illustrations: B.Marbach, *op. cit.* 268, fig. 126, as *Hafellia disciformis*; I.M.Brodo, S.D.Sharnoff & S.Sharnoff, *Lichens of North America* 187, fig. 146 (2001).

Thallus corticolous or lignicolous, immersed to superficial, 3–4 cm wide, thin to thick, rimose, whitish or grey-white, smooth to weakly verrucose. Prothallus black or absent. Apothecia common, 0.3–1.3 mm wide, sessile; disc black, epruinose, plane or slightly convex; margin black, moderately thick, persistent. Proper exciple brown-black. Epihymenium 10–15 μm thick, brown to olive-brown, K–. Hymenium 100–120 μm thick, densely inspersed with oil droplets. Hypothecium 120–170 μm thick, dark brown, somewhat paler than the exciple. Asci 8-spored. Ascospores 1-septate, 17–28 \times 7–10 μm , with weak subapical wall thickenings; outer wall smooth. Conidia bacilliform, 5.5–8.5 \times 0.7–1.0 μm .

Chemistry: Thallus K+ yellow, C–, P+ yellow; containing atranorin (major), \pm fulgidin (trace), \pm fulgoicin (trace), \pm norfulgoicin (trace), \pm brialmontin 1 (trace), \pm brialmontin 2 (trace).

This cosmopolitan species grows on wood and bark in coastal and hinterland forests in Qld, N.S.W., Vic. and Tas. Also in Europe, Asia, Macaronesia, North America and the Pacific islands. Map 527.

Qld: Nanango Rd, Bunya Mountains State Forest, 64 km NE Dalby, *J.A.Elix* 37925 (CANB). N.S.W.: Bermagui Trig. Stn, *J.A.Elix* 28843 (CANB). Vic.: Goonmirk Rocks Rd, Errinundra Flora Reserve, 13 km S of Bendoc, *H.Streimann* 36615b (B, CANB). Tas.: 1.5 km W of Bicheno, *J.A.Curnow* 2530 (CANB).

This species is characterised by the immersed to superficial, white or grey-white thallus, the 8-spored asci, ascospores of intermediate size with weak, subapical wall thickenings and a smooth outer surface and by the presence of atranorin as the only major lichen substance.

5. *Buellia dissa* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 7: 357 (1931)

Lecidea dissa Stirt., *Trans. Glasgow Soc. Field Naturalists* 4: 94 (1875); *Rinodina dissa* (Stirt.) H.Mayrhofer, *Beih. Nova Hedwigia* 79: 532 (1984); *Hafellia dissa* (Stirt.) H.Mayrhofer & Sheard, in J.W.Sheard, *Bryologist* 95: 87 (1992). T: "ad ligna decorticata in Tasmania", 1875, *H.Paton s.n.*; holotype: GLAM n.v.; iso: BM.

Illustrations: H.Mayrhofer, *op. cit.* 531, fig. 21; 536, figs 26–28, as *Rinodina dissa*; W.Pusswald, G.Kantvilas & H.Mayrhofer, *Muelleria* 8: 134, figs 1, 2; 135, fig. 5 (1994), as *Hafellia dissa*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, continuous, membranous to areolate, white, grey-white or pale yellow-grey, uneven or occasionally verrucose. Prothallus not apparent. Apothecia 0.2–1.0 mm wide, sessile; disc black, epruinose, plane or becoming convex; margin black, moderately thick, persistent or excluded in convex apothecia. Proper exciple dark red-brown, paler in the inner part. Epihymenium 10–20 µm thick, brown to red-brown, K–. Hymenium 80–120 µm thick, interspersed with oil droplets. Hypothecium 140–160 µm thick, dark red-brown. Asci 2-spored. Ascospores 1-septate, 22–42 × 10–16 µm, with moderately strong subapical and septal wall thickenings; outer wall strongly ornamented. Conidia bacilliform, c. 5 × 1 µm.

Chemistry: Thallus K+ yellow, C–, P+ yellow; containing atranorin (major), diploicin (major), isofulgidin (minor), fulgidin (minor or trace).

Common in W.A., S.A., N.S.W., Vic. and Tas.; occurs on bark and dead wood in dry-sclerophyll forest. Also in South Africa. Map 528.

W.A.: Drovers Cave Natl Park, Jurien Rd, 6 km NE of Jurien Bay, *J.A.Elix* 28923 (CANB). S.A.: Corrynton Park Rd, 8 km W of Eden Valley, Mount Lofty Ra., *J.A.Elix* 37220 (CANB). N.S.W.: Apsley Falls, Oxley Wild Rivers Natl Park, 20 km E of Walcha, *J.A.Elix* 36274 (CANB). Vic.: Doncaster, 1 Sept. 1884, *F.M.Reader* (MEL). Tas.: 5 km S of Beaconsfield, *G.Kantvilas* 221/80 (HO).

Buellia dissa is characterised by the white, grey-white or pale yellow-grey thallus, bisporous asci, comparatively large ascospores with moderately strong septal and subapical wall thickenings and a strongly ornamented outer surface, and by the presence of atranorin and diploicin.

6. *Buellia fraudans* (Starbäck) Elix, *Fl. Australia* 57: 659 (2009)

Karschia fraudans Starbäck, *Bih. Kongl. Svenska Vetensk.-Akad. Handl.* 25, Afd. 3(1): 10 (1899); *Hafellia fraudans* (Starbäck) Pusswald, in B.Marbach, *Biblioth. Lichenol.* 74: 269 (2000). T: Santo Angelo prope Cachoeira, Rio Grande do Sul, Brazil, 26 Jan. 1893, *G.O.A.Malme* (*Fung. Regnell.* 215); holotype: S.

Illustration: B.Marbach, *op. cit.* 270, fig. 127, as *Hafellia fraudans*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, continuous to rimose and ±areolate, whitish, grey-white, grey or pale yellow-brown, weakly to markedly verrucose. Prothallus black or not apparent. Apothecia 0.2–1.1 mm wide, sessile; disc black, epruinose, plane or becoming convex; margin black, moderately thick, persistent or excluded in convex apothecia. Proper exciple dark red-brown, paler in the inner part. Epihymenium 10–20 µm thick, brown, K–. Hymenium 120–150 µm thick, interspersed with oil droplets. Hypothecium 40–60 µm thick, dark brown. Asci 8-spored, occasionally with fewer ascospores. Ascospores 1-septate, 22–34 × 8–14 µm, with strong subapical and septal wall thickenings; outer wall smooth. Pycnidia not seen.

Chemistry: Thallus K+ red, P+ yellow or yellow-orange; containing norstictic acid (major), connorstictic acid (minor or trace).

Occurs on bark and wood in hinterland forest in eastern Qld and N.S.W. Also in South America and the Hawaiian Islands. Map 529.

Qld: Lamins Hill Lookout, SE of Butchers Ck, Atherton Tableland, *H.Mayrhofer* 11926 & *E.Hierzer* (GZU). N.S.W.: Mount Hyland Nature Reserve, 20 km N of Hernani, *J.A.Elix* 36659 (CANB).

Buellia fraudans is characterised by the whitish, grey-white, grey or pale yellow-brown thallus, the usually 8-spored asci, the relatively large ascospores with strong subapical and septal wall thickenings and a smooth outer surface, and by the presence of norstictic acid. *Buellia subcrassata* is similar, but the ascospores have weak, subapical wall thickenings and a strongly ornamented outer surface.

7. *Buellia levieri* Jatta, *Boll. Soc. Bot. Ital.* 1910: 258 (1911)

Hafellia levieri (Jatta) Pusswald & Kantvilas, in W.Pusswald, G.Kantvilas & H.Mayrhofer, *Muelleria* 8: 138 (1994). T: "ad truncos prope Geeveston, [Tas.], alt. 800 p [240 m]", *W.A.Weymouth s.n.*; holo: NAP *n.v.*

Illustrations: W.Pusswald, G.Kantvilas & H.Mayrhofer, *op. cit.* 134, fig. 4; 137, fig. 7, as *Hafellia levieri*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, continuous to rimose and areolate, whitish, grey-white or pale yellow-grey, uneven to weakly verrucose. Prothallus black or not apparent. Apothecia scattered, 0.2–0.8 mm wide, sessile; disc black, epruinose, plane or slightly concave; margin black, thick and inrolled when young, moderately thick at maturity, persistent. Proper exciple dark red-brown, paler in the inner part. Epihymenium 10–20 μm thick, brown, K–. Hymenium 100–150 μm thick, interspersed with oil droplets. Hypothecium 40–60 μm thick, dark brown. Asci 8-spored, occasionally with fewer ascospores. Ascospores 1-septate, 30–38 \times 12–16 μm , with strong subapical and septal wall thickenings; outer wall smooth. Pycnidia not seen.

Chemistry: Thallus K–, C–, KC–, P–; no lichen substances detected.

Occurs on bark and wood in hinterland forest in W.A., Qld, N.S.W. and Tas. Also in South America. Map 530.

W.A.: 20 km S of Moora along Gingin Rd, 3 km E on Bullbarnet Rd, *J.A.Elix 37169* (CANB). Qld: Gambubal State Forest, Cons Plain, E of Emu Vale, *J.Hafellner 16369* & *G.N.Stevens* (GZU). N.S.W.: The Pinnacle, NE of Wiangaree, Tweed Ra., Border Ranges Natl Park, *J.Hafellner 19167*, *P.Merrottsy* & *R.W.Rogers* (GZU). Tas.: Little Fisher R., 1983, *G.Kantvilas* (HO).

This species is characterised by the whitish, grey-white or pale yellow-grey thallus, the 8-spored asci, comparatively large ascospores with very strong subapical and septal wall thickenings and a smooth outer surface, and by the absence of lichen substances.

8. *Buellia metaphragmia* (C.Knight) Elix, *Fl. Australia* 57: 660 (2009)

Lecidea metaphragmia C.Knight, *Trans. Linn. Soc. London, Bot.* 2: 44 (1882); *Hafellia metaphragmia* (C.Knight) Pusswald, in J.A.Elix, *Australas. Lichenol.* 63: 5 (2008). T: [neighbourhood of Sydney] N.S.W., "ad cortices arborum"; lecto: the illustration in C.Knight, *Trans. Linn. Soc. London, Bot.* 2: pl. 8, fig. 22 (1882), *vide* W.Pusswald, in J.A.Elix, *Australas. Lichenol.* 63: 5 (2008).

Thallus corticolous or lignicolous, 1–3 cm wide, thin, membranous, continuous to finely rimose and areolate, whitish or grey-white, densely covered with brown granules. Prothallus not apparent. Apothecia common, 0.2–0.4 mm wide, sessile; disc black, epruinose, plane to weakly convex, glossy; margin black, thick, prominent. Proper exciple brown-black. Epihymenium 10–20 μm thick, brown, K–. Hymenium 50–80 μm thick, not interspersed with oil droplets. Hypothecium 50–70 μm thick, brown. Asci usually 8-spored, rarely 4- or 6-spored. Ascospores 1–3-septate, 12–20 \times 5–9 μm , with strong subapical thickenings and weak septal wall thickenings; outer wall markedly ornamented. Pycnidia not seen.

Chemistry: Thallus K–, C–, P–; no lichen substances detected.

This endemic species occurs on bark and dead wood in dry-sclerophyll forest in W.A., N.S.W. and Vic. Map 531.

W.A.: Walebing, Quarrell Ra., Moora–New Norcia road, 22 km S of Moora, *J.A.Elix 37541* (CANB); 30 km W of Hyden and c. 30 km E of Kondinin, 18 Aug. 1994, A. & K.Kalb (Herb. Kalb 27725). N.S.W.: Mount Kaputar Natl Park, *P.Merrottsy 401* (BRI). Vic.: Copi Flats, Wyperfeld Natl Park, *M. & H.Mayrhofer 4696* (GZU).

Buellia metaphragmia is characterised by the small, multiseptate ascospores with strong subapical wall thickenings and angular lumina and by the absence of lichen substances.

The holotype (in WELT) was lost, and a supposed duplicate in H is a mixture of *Buellia tetrapla* and *Buellia* sp. In view of Knight's detailed protologue and excellent illustration, the latter was chosen as lectotype.

9. *Buellia microsporella* Elix, *Fl. Australia* 57: 660 (2009)

Hafellia microspora Pusswald, in J.A.Elix, *Australas. Lichenol.* 60: 17 (2007). T: Tuttaning Reserve, Pingelly, W.A., *J.Kruiskamp s.n.*; holo: MEL.

Illustration: J.A.Elix, *op. cit.* 19, fig. 4 (2007), as *Hafellia microspora*.

Thallus corticolous or lignicolous, 1.0–2.5 cm wide, thin, continuous, smooth to indistinctly areolate, whitish to pale grey or pale green, uneven or occasionally verrucose. Prothallus not apparent. Apothecia common, 0.1–0.4 mm wide, sessile; disc black, epruinose, plane or slightly convex; margin black, thin, usually persistent, becoming excluded in convex apothecia. Proper exciple dark brown to brown-black; rim more distinctly pigmented than the inner part. Epihymenium 10–20 μm thick, brown, K–. Hymenium 70–100 μm thick, not interspersed with oil droplets. Hypothecium 70–80 μm thick, brown. Asci 8-spored. Ascospores 1-septate, 12–17 \times 5–7 μm , with moderately strong subapical wall thickenings and narrow septal wall thickenings; outer wall smooth. Conidia bacilliform, c. 5 \times 1 μm .

Chemistry: Thallus K–, C–, KC–, P–; containing \pm brialmontin 1 (minor), \pm brialmontin 2 (minor).

This endemic species occurs on bark and wood in hinterland forest and woodland in W.A., S.A., Vic. and Tas. Map 532.

W.A.: Wotto Nature Reserve, First North Rd, 21 km by road NE of Eneabba, *J.A.Elix* 28873 (CANB, PERTH). S.A.: Dark Island Heath, near Keith, 30 Dec. 1982, *R.L.Specht* (BRI). Vic.: Dimboola, 18 July 1896, *F.Reader* (NSW). Tas.: summit of MacGregor Peak, *G.Kantvilas* 473/02 (NSW).

This lichen is characterised by a whitish to pale grey or pale green thallus, 8-spored asci, very small ascospores with moderately strong subapical wall thickenings and a smooth outer wall and by the absence of lichen substances or with accessory brialmontins 1 and 2. *Buellia reagenella* is morphologically similar, but it has a distinctly yellowish upper surface, a K+ violet reaction of the epihymenium, and it contains 4,5-dichlorolichexanthone.

10. *Buellia parastata* (Nyl.) Zahlbr., *Cat. Lich. Univ.* 7: 386 (1931)

Lecidea parastata Nyl., *Bull. Soc. Linn. Normandie*, sér. 2, 2: 92 (1868); *Hafellia parastata* (Nyl.) Kalb, H.Mayrhofer & Scheid., in K.Kalb, *Lich. Neotrop.* 9: 9 (1986). T: Lifou, Loyalty Islands, New Caledonia, *E.F.Déplanche s.n.*; holo: H-NYL 11071.

For further synonymy see Marbach (2000).

Illustrations: J.W.Sheard, *Bryologist* 95: 80, fig. 4 (1992); B.Marbach, *Biblioth. Lichenol.* 74: 273, fig. 128 (2000), both as *Hafellia parastata*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, continuous to rimose and areolate, whitish, yellow-white, grey, grey-white or pale yellow-grey, smooth or weakly verrucose. Prothallus black or absent. Apothecia scattered, 0.6–1.4 mm wide, sessile; disc dark brown, rarely black, epruinose, plane or slightly convex; margin black, moderately thick, persistent or partly excluded in convex apothecia. Proper exciple dark brown. Epihymenium 15–25 μm thick, brown, K–. Hymenium 80–150 μm thick, densely interspersed with oil droplets. Hypothecium 40–60 μm thick, dark brown. Asci 8-spored, rarely 4- or 6-spored. Ascospores 1-septate, 30–41 \times 12–21 μm ; lumina often bent, with very strong subapical and septal wall thickenings; outer wall smooth. Pycnidia not seen.

Chemistry: Thallus K+ yellow, C–, P+ yellow; containing atranorin (major), diploicin (major), isofulgidin (minor), fulgidin (minor or trace).

This pantropical species occurs on bark and dead wood in coastal and hinterland areas of Qld. Also in North, Central and South America, Africa, Asia and the Pacific (New Caledonia). Map 533.

Qld: Tandora, c. 25 km ENE of Maryborough, *J.Hafellner 18369 & R.W.Rogers* (BRI, GZU); c. 1 km NW of Forest Stn, Mount Mee State Forest, *J.Hafellner 16903 & G.N.Stevens* (GZU); end of Weir Rd, Kuranda, NW of Cairns, *H.Mayrhofer 11903 & E.Hierzer* (GZU).

Buellia parastata is characterised by the whitish to pale yellow-grey thallus, the mainly 8-spored asci, large ascospores with very strong septal and subapical wall thickenings and a smooth outer spore surface and by the presence of diploicin and atranorin. *Buellia demutans* differs in having ascospores with a strongly ornamented outer wall and straight lumina.

11. *Buellia pleiotera* Malme, *Ark. Bot.* 21A: 18 (1927)

Hafellia bahiana var. *pleiotropa* (Malme) Sheard, *Bryologist* 95: 82 (1992); *Hafellia pleiotera* (Malme) Marbach, *Biblioth. Lichenol.* 74: 274 (2000). T: Cuiabá, Mato Grosso, Brazil, 23 Dec. 1892, *G.O.A.Malme 2027B*; holotype: S.

For further synonymy see Marbach (2000).

Illustration: B.Marbach, *op. cit.* 277, fig. 131, as *Hafellia pleiotera*.

Thallus corticolous or lignicolous, 2–3 cm wide, thin, rimose and areolate, pale yellow-brown to yellow-grey, smooth or weakly verrucose. Prothallus not apparent. Apothecia 0.3–0.5 mm wide, sessile; disc black, epruinose, plane or becoming convex; margin black, moderately thick, persistent or excluded in convex apothecia. Proper exciple dark brown; inner zone somewhat paler. Epihymenium 10–15 µm thick, olive-green to blackish, K⁺ violet. Hymenium 90–100 µm thick, interspersed with oil droplets. Hypothecium 60–70 µm thick, brown-black. Asci 16-spored, rarely with 8 or 12 ascospores. Ascospores 1-septate, 12–18 × 5–7 µm, with weak subapical wall thickenings; outer surface smooth. Pycnidia not seen.

Chemistry: Thallus K⁺ red, P⁺ yellow or yellow-orange; containing norstictic acid (major), conorstictic acid (minor or trace), ±methylpseudonorstictate (trace).

Rare on bark in coastal forest in Qld. Also in Africa, South America and the Pacific (New Caledonia). Map 534.

Qld: near Minyama, Sunshine Coast, c. 100 km N of Brisbane, *K. & A.Kalb 19774* (Herb Kalb).

This lichen is characterised by the yellow-brown or yellow-grey thallus, mostly 16-spored asci, small ascospores with weak, subapical wall thickenings and a smooth outer surface, the K⁺ violet epihymenium and norstictic acid in the thallus. The broadly similar *B. bahiana* has 8-spored asci and ascospores with strong subapical and septal wall thickenings.

12. *Buellia procellarum* A.Massal., *Mem. Imp. Reale Ist. Veneto Sci.* 10: 64 (1861)

Rinodina procellarum (A.Massal.) H.Mayrhofer, *Beih. Nova Hedwigia* 79: 522 (1984); *Hafellia procellarum* (A.Massal.) H.Mayrhofer & Sheard, *Bryologist* 95: 87 (1992). T: Cape Bonae Spei [Cape of Good Hope], South Africa, *H.Wawra s.n.*; holotype: VER *n.v.*; isotype: W.

Buellia macrospora Müll.Arg., *Bull. Herb. Boissier* 1: 51 (1893). T: Vic., locality unknown, 1892, *F.R.M.Wilson 123*; holotype: G.

Buellia macrosporoides Müll.Arg., *Bull. Herb. Boissier* 3: 642 (1895). T: Thursday Island, Qld, 1887, *C.Knight 210*; lectotype: G *n.v.*, *fide* H.Mayrhofer, *Beih. Nova Hedwigia* 79: 522 (1984).

Illustration: H.Mayrhofer, *op. cit.* 36, fig. 24, as *Rinodina procellarum*.

Thallus saxicolous, 1–4 cm wide, thin, continuous to rimose or areolate, white, yellow-white, yellow-grey or grey, smooth. Prothallus brown-black, black or absent. Apothecia common, 0.2–1.2 mm wide, sessile, but occasionally slightly immersed; disc black, epruinose, plane or convex; margin black, moderately thick, persistent. Proper exciple dark brown to black. Epihymenium 10–20 µm thick, brown, K⁻. Hymenium 80–110 µm thick, interspersed with oil droplets. Hypothecium 60–75 µm thick, dark brown. Asci 4- or 6-spored or with fewer than 4 ascospores. Ascospores 1-septate, 22–40 × 10–18 µm, with strong subapical and septal wall thickenings; outer wall moderately strongly ornamented. Conidia bacilliform, 5–7 × c. 1 µm.

Chemistry: Thallus K⁺ yellow, C⁻, P⁺ yellow; containing atranorin (major), diploicin (major), isofulgidin (minor), fulgidin (minor or trace).

Very common on rocks in coastal and hinterland areas of S.A., Qld, N.S.W., A.C.T., Vic. and Tas. Also in South Africa. Map 535.

S.A.: 4 km W of Carey Gully along the Forest Range Rd, *J.A.Elix* 2822 (CANB). Qld: Mt Peregian, N of Coolum, *H.Mayrhofer* 11625, *E.Hierzer*, *G.N* & *N.Stevens* (CANB, GZU). N.S.W.: Morans Rock, Putty Rd, Colo, Hawkesbury District, *H.Mayrhofer* 11132 & *E.Hierzer* (CANB, GZU). A.C.T.: Aranda Bushland, Canberra Nature Park, 4 km W of Canberra, *J.A.Elix* 28735 (CANB). Vic.: Middle Mtn, 2 km NE of Suggan Buggan, East Gippsland, *D.Verdon* 3600 (CANB). Tas.: New Norfolk, *H.Mayrhofer* 10652, *E.Hierzer* & *G.Kantvilas* (CANB, GZU, HO).

Buellia procellarum is characterised by the saxicolous substratum, the white, yellow-white, yellow-grey or grey thallus, asci with 6 or fewer ascospores that are comparatively large with strong septal and subapical wall thickenings and a moderately strongly ornamented outer surface, and by the presence of atranorin and diploicin in the thallus. *Buellia demutans* is similar, but it is corticolous or lignicolous, and it usually has 8-spored asci.

13. *Buellia pseudotetrapla* (Pusswald) Elix, *Fl. Australia* 57: 660 (2009)

Hafellia pseudotetrapla Pusswald, in B.Marbach, *Biblioth. Lichenol.* 74: 280 (2000). T: Peckmans Plateau, Katoomba, N.S.W., *J.A.Elix* 3201; holo: CANB.

Illustration: B.Marbach, *op. cit.* 281, fig. 134, as *Hafellia pseudotetrapla*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, continuous, membranous to areolate, white, grey-white or pale yellow-grey, uneven or verrucose. Prothallus not apparent. Apothecia 0.2–1.2 mm wide, sessile; disc black, epruinose, plane or becoming convex; margin black, moderately thick, persistent or excluded in convex apothecia. Proper exciple brown. Epithymenium 10–20 μm thick, dark brown, K–. Hymenium 100–120 μm thick, interspersed with oil droplets. Hypothecium 40–50 μm thick, dark brown. Asci 2-spored, rarely 3-spored. Ascospores 1-septate, 38–61 \times 15–24 μm , with moderately strong subapical and septal wall thickenings; outer wall strongly ornamented. Pycnidia not seen.

Chemistry: Thallus K+ yellow, C–, P+ yellow; containing atranorin (major), diploicin (major), isofulgidin (minor), fulgidin (minor or trace).

This species is common on bark in hinterland forest in W.A., S.A., N.S.W., Vic. and Tas. Also in Central America. Map 536.

W.A.: Yellowdine Nature Reserve, along the Great Eastern Hwy, 56 km E of Southern Cross, *J.A.Elix* 32385 (CANB, PERTH). S.A.: Sandy Creek Natl Park, 5 km W of Lyndoch, *J.A.Elix* 4190 (CANB). N.S.W.: road between Echo Pt and Carrington Park, Blue Mtns, K. & A.Kalb 18886 (Herb. Kalb). Vic.: Cheltenham, Melbourne, 6 Jan. 1887, *F.R.M.Wilson* (NSW). Tas.: locality unknown, *R.B.Verreaux* 10283 (H).

Buellia pseudotetrapla is characterised by the white, grey-white or pale yellow-grey thallus, the 2 (–3)-spored asci, large ascospores with moderately strong septal and subapical wall thickenings and a strongly ornamented outer surface and by the presence of atranorin and diploicin. It is very similar to *B. dissa*, but its ascospores are significantly larger.

14. *Buellia reagenella* Elix, *Fl. Australia* 57: 660 (2009)

Hafellia reagens Pusswald, in B.Marbach, *Biblioth. Lichenol.* 74: 281 (2000). T: Lake Yealering, W.A., *J.A.Elix* 21700 & *M.V.Sargent*; holo: CANB.

Thallus corticolous or lignicolous, 1.0–2.5 cm wide, thin, continuous, smooth to indistinctly areolate, yellow-white to pale yellow-grey or yellow-green, uneven or occasionally verrucose. Prothallus a black line surrounding the thallus, or not apparent. Apothecia common, 0.1–0.5 mm wide, sessile; disc black, epruinose, plane or slightly convex; margin black, thin, usually persistent, becoming excluded in convex apothecia. Proper exciple dark brown to brown-black. Epithymenium 15–20 μm thick, dark brown, K+ violet. Hymenium 80–130 μm thick, interspersed with oil droplets. Hypothecium 40–50 μm thick, brown. Asci 8-spored or with fewer ascospores. Ascospores 1-septate, 12–20 \times 5–8 μm , with moderately strong subapical but narrow septal wall thickenings; outer wall smooth. Conidia bacilliform, c. 5 \times 1 μm .

Chemistry: Thallus K-, C-, KC-, P-; containing 4,5-dichlorolichexanthone (major), \pm brialmontin 1 (minor), \pm brialmontin 2 (minor).

Occurs on bark and wood in hinterland forest and woodland in W.A., N.S.W., Vic. and Tas. Also in South America. Map 537.

W.A.: Wotto Nature Reserve, First North Rd, 21 km by road NE of Eneabba, *J.A.Elix 28867* (CANB, PERTH). N.S.W.: Dangars Gorge, Oxley Wild Rivers Natl Park, 18.5 km SSE of Armidale, *J.A.Elix 36436* (CANB). Vic.: Rotamah I., The Lakes Natl Park, 7 May 1984, *J.H.Willis* (MEL). Tas.: summit of Mt Murray, *G.Kantvilas 181/06* (HO).

This species is characterised by the yellow-white to pale yellow-grey or yellow-green thallus, usually 8-spored asci, the K+ violet epihymenium, the comparatively small ascospores with moderately strong subapical but narrow septal wall thickenings and a smooth outer surface, and by the presence of 4,5-dichlorolichexanthone.

15. *Buellia rechingeri* Zahlbr., *Denkschr. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl.* 81: 274 (1907)

Hafellia rechingeri (Zahlbr.) Marbach, *Biblioth. Lichenol.* 74: 283 (2000). T: road between Assau and Sataua, Sawai [Savai'i], [Western] Samoa, 1905, *K & L.Rechinger 2644*; lecto: W, *fide* A.Mangold, *J.A.Elix & H.T.Lumbsch, Fl. Australia* 57: 660 (2009).

Illustration: B.Marbach, *op. cit.* 284, fig. 135, as *Hafellia rechingeri*.

Thallus corticolous or lignicolous, 2–5 cm wide, thick, glossy, cartilaginous or scaly, weakly rimose, white, pale grey or yellow-grey, smooth. Prothallus not apparent. Apothecia 0.3–0.5 mm wide, sessile; disc black, epruinose, plane or becoming convex; margin black, moderately thick, persistent or excluded in convex apothecia. Proper exciple dark brown; inner zone somewhat paler. Epihymenium 10–15 μ m thick, dark brown to blackish, K-. Hymenium 60–80 μ m thick, interspersed with oil droplets. Hypothecium 70–100 μ m thick, brown-black. Asci 8-spored. Ascospores 1-septate, 12–18 \times 4–6 μ m, with weak to moderately strong subapical wall thickenings; outer surface weakly ornamented. Pycnidia not seen.

Chemistry: Thallus K+ red, P+ yellow or yellow-orange; containing norstictic acid (major), connorstictic acid (minor or trace).

Occurs on bark and wood in hinterland forest in tropical W.A., N.T. and Qld; also in Western Samoa. Map 538.

W.A.: head of Donkey Ck, Donkey Escarpment, 27 km S of Drysdale River Stn, *J.A.Elix 28010* (CANB). N.T.: Howard Springs road, 34.5 km SE of Darwin, *J.A.Elix 37105* (CANB). Qld: road to Mt Fox, 43 km SW of Ingham, *H.Streimann 37125* (B, CANB).

Buellia rechingeri has a white to grey or pale yellow-grey thallus with a smooth, thick, cartilaginous or scaly upper surface, 8-spored asci, small ascospores with weak to moderately strong subapical wall thickenings and a weakly ornamented outer surface and norstictic acid in the thallus.

16. *Buellia subcrassata* (Pusswald) Elix, *Fl. Australia* 57: 660 (2009)

Hafellia subcrassata Pusswald, in B.Marbach, *Biblioth. Lichenol.* 74: 283 (2000). T: Kerry, Duck Creek Rd, near Lamington Natl Park, close to O'Reillys Mountain Resort, Qld, 18 Aug. 1993, *H.Mayrhofer 11385*, *E.Hierzer & R.W.Rogers*; holo: CANB.

Buellia disciformis var. *wilsonii* Räsänen, *Suom. Elain-ja Kasvit. Seuran Van. Tiedon. Pöytäkirjat* 3: 181 (1949). T: Landsborough, southern Qld, 1890, *F.R.M.Wilson s.n.*; holo: H.

Thallus corticolous or lignicolous, 2–5 cm wide, thin, continuous to rimose and areolate, white, grey-white, grey or pale yellow-grey, often with brown granules on the surface. Prothallus not apparent. Apothecia 0.2–0.9 mm wide, sessile; disc black, epruinose, plane or becoming convex; margin black, moderately thick at first, persistent or excluded in convex apothecia. Proper exciple dark red-brown, paler in the inner part. Epihymenium 10–20 μ m thick, brown, K-. Hymenium 120–150 μ m thick, interspersed with oil droplets. Hypothecium 40–60 μ m thick, dark brown. Asci 8-spored, occasionally with fewer ascospores. Ascospores

1-septate, 26–32 × 9–12 µm, with weak subapical and septal wall thickenings; outer wall moderately ornamented. Conidia bacilliform, 5–7 × c. 1 µm.

Chemistry: Thallus K+ red, P+ yellow or yellow-orange; containing norstictic acid (major), connorstictic acid (minor or trace), ±4,5-dichlorolichexanthone (trace).

Occurs on bark and wood in rainforest in south-eastern Qld and Tas.; also in Central America. Map 539.

Qld: on road to Bald Mtn, c. 7 km NE of Mt Colliery, E of Warwick, *J.Hafellner 17000 & G.N.Stevens* (GZU). Tas.: lower slopes, South Sister, *G.Kantvilas 267/04* (HO).

Buellia subcrassata is characterised by the white, grey-white, grey or pale yellow-grey thallus, usually 8-spored asci, moderately large ascospores with weak septal and subapical wall thickenings and a moderately ornamented outer surface and by the presence of norstictic acid. *Buellia fraudans* is very similar, but that species has thicker septal and subapical wall thickenings and slightly larger ascospores.

17. *Buellia subtropica* (Elix) Elix, *Fl. Australia* 57: 660 (2009)

Hafellia subtropica Elix, in J.A.Elix & P.M.McCarthy, *Australas. Lichenol.* 62: 20 (2008). T: Diehard Ck, Mann River Nature Reserve, 50 km E of Glen Innes, N.S.W., 1 May 2005, *J.A.Elix 37066*; holotype: CANB.

Illustrations: J.A.Elix & P.M.McCarthy, *op. cit.* 22, figs 1, 2, as *Hafellia subtropica*.

Thallus corticolous, 1–3 cm wide, thin, finely rimose to deeply rimose and areolate, whitish, grey-white to grey, weakly to markedly verruculose. Prothallus black or not apparent. Apothecia 0.2–1.2 mm wide, moderately immersed to sessile; disc black, epruinose, initially concave, becoming plane to weakly convex, ±tuberculate; margin black, thin or excluded in convex apothecia. Proper exciple brown-black, with or without a paler inner zone. Epithymenium 10–15 µm thick, olive-brown to dark brown, K–. Hymenium 70–120 µm thick, interspersed with oil droplets especially towards the base. Hypothecium 80–150 µm thick, brown-black. Asci 8-spored. Ascospores 1-septate, 16–23 × 8–14 µm, with weak subapical and septal wall thickenings; outer wall moderately ornamented. Pycnidia not seen. Fig. 169A.

Chemistry: Thallus K+ red, P+ yellow or yellow-orange; containing norstictic acid (major), hafellic acid (major), neopaludonic acid (trace), neosubpaludonic acid (trace), connorstictic acid (minor or trace).

This endemic species occurs on bark in montane forest in south-eastern Qld and north-eastern N.S.W. Map 540.

Qld: Nanango Rd, Bunya Mountains State Forest, 64 km NE of Dalby, *J.A.Elix 37958* (CANB). N.S.W.: Hakea Walk, Washpool Natl Park, Gibraltar Ra., 78 km E of Glen Innes, *J.A.Elix 37259* (CANB).

This lichen is characterised by the whitish, grey-white to grey thallus, the 8-spored asci, comparatively small ascospores with weak subapical wall thickenings, a moderately ornamented outer spore wall and by the presence of norstictic and hafellic acids in the thallus. *Buellia curatellae* has narrower ascospores (6–8 µm wide), an epithymenium that often reacts K+ clear yellow-green or olive, a ±smooth outer spore wall, and it contains only norstictic and connorstictic acids.

18. *Buellia tetrapla* (Nyl.) Müll.Arg., *Flora* 71: 139 (1888)

Lecidea tetrapla Nyl., *Flora* 69: 325 (1886); *Buellia callispora* var. *tetrapla* (Nyl.) J.Steiner, *Bull. Herb. Boissier*, sér. 2, 7: 645 (1907); *Hafellia tetrapla* (Nyl.) Pusswald, in B.Marbach, *Biblioth. Lichenol.* 74: 288 (2000). T: N.S.W., [neighbourhood of Sydney], *C.Knight s.n.*; holotype: H-NYL 10362 *p.p.*

Lecidea subrepleta Stirt., in F.M.Bailey, *Queensland Agric. J.* 5: 39 (1889); *Buellia subrepleta* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 7: 420 (1931). T: Jimbour, Qld, June 1895, *F.M.Bailey 11*; lectotype: GLAM *n.v.*, *fide* R.W.Rogers, *Austrobaileya* 1: 505 (1982).

Lecidea discors Stizenb., *Ber. Tätigk. St. Gallischen Naturwiss. Ges.* 1889/90: 173 (1891); *Buellia discolorans* (Stizenb.) Zahlbr., *Cat. Lich. Univ.* 7: 356 (1931); *Buellia discors* (Stizenb.) H.Magn., *Ark. Bot.*, ser. 2, 3(10): 374 (1954). T: prope Uitenhagen, Promontorium Bonae Spei [Cape of Good Hope], South Africa, *Krauss s.n.*; holotype: ZT.

For further synonymy see Marbach (2000).

Illustration: B.Marbach, *op. cit.* 290, fig. 137, as *Hafellia tetrapla*.

Thallus corticolous or lignicolous, 1–4 cm wide, thin, continuous, membranous to areolate, white, grey-white or pale yellow-grey, uneven or verrucose. Prothallus not apparent. Apothecia 0.2–1.2 mm wide, sessile; disc black, epruinose, plane or becoming convex; margin black, moderately thick, persistent or excluded in convex apothecia. Proper exciple brown. Epihymenium 10–20 µm thick, dark brown, K–. Hymenium 100–120 µm thick, interspersed with oil droplets. Hypothecium 40–50 µm thick, dark brown. Asci usually 4-spored, rarely 3-spored. Ascospores 1-septate, 28–45 × 14–18 µm, with strong subapical and septal wall thickenings; outer wall strongly ornamented. Pycnidia not seen.

Chemistry: Thallus K+ yellow, C–, P+ yellow; containing atranorin (major), diploicin (major), isofulgidin (minor), fulgidin (minor or trace).

Common on bark in hinterland forest and woodland in W.A., S.A., Qld, N.S.W., A.C.T. and Vic. Also in South America, South Africa, the Mascarene Islands (Réunion), New Zealand and the Hawaiian Islands. Map 541.

W.A.: Gwambygine Nature Reserve, 11 km S of York, *J.A.Elix 31735* (CANB). S.A.: Corrynton Park Rd, 8 km W of Eden Valley, Mount Lofty Ra., *J.A.Elix 37232* (CANB). Qld: Morans Falls track, O'Reillys, Lamington Natl Park, 20 May 1969, *S.Brownlie* (MEL). N.S.W.: Patonga Ck, 1 km NW of Patonga, *W.Pusswald 15* (CANB). A.C.T.: Molonglo Gorge Reserve, 7 Sept. 1995, *K.Kalb, J.A.Elix & G.Kantvilas* (CANB). Vic.: Lakes Entrance, 10 Nov. 1901, *R.A.Bastow* (MEL).

This species is characterised by the white to grey-white or pale yellow-grey thallus, usually 4-spored asci, rather large ascospores with strong septal and subapical wall thickenings and a strongly ornamented outer surface and by the presence of atranorin and diploicin. *Buellia dissa* has predominantly 2-spored asci and smaller ascospores.

19. *Buellia xanthonica* (Elix) Elix, *Fl. Australia* 57: 660 (2009)

Hafellia xanthonica Elix, *Australas. Lichenol.* 59: 36 (2006). T: First North Rd, Wotto Nature Reserve, 21 km by road NE of Eneabba, W.A., 5 May 2004, *J.A.Elix 28876*; holotype: PERTH; isotype: CANB.

Illustrations: J.A.Elix, *op. cit.* 38, figs 1–4, as *Hafellia xanthonica*.

Thallus corticolous or lignicolous, 1.0–2.5 cm wide, thin, continuous, smooth to indistinctly areolate, yellow-white to pale yellow-grey or yellow-green, uneven, occasionally verrucose. Prothallus appearing as a black line surrounding the thallus, or not apparent. Apothecia common, 0.4–1.5 mm wide, sessile; disc black, epruinose, plane or slightly convex; margin black, thin, usually persistent, becoming excluded in convex apothecia. Proper exciple dark brown to brown-black, the inner part somewhat paler. Epihymenium 10–20 µm thick, dark brown, K–. Hymenium 70–100 µm thick, interspersed with oil droplets. Hypothecium 60–80 µm thick, brown. Asci usually 8-spored, occasionally with fewer ascospores. Ascospores 1-septate, 14–35 × 6–15 µm, with moderately strong subapical but narrow septal wall thickenings; outer wall smooth. Pycnidia not seen. Plate 54. Fig. 169B.

Chemistry: Thallus K–, C–, KC–, P–; containing 4,5-dichlorolichexanthone (major), ±brialmontin 1 (minor), ±brialmontin 2 (minor).

Endemic on bark and wood in hinterland forest and woodland in W.A., N.S.W. and Tas. Map 542.

W.A.: Great Northern Hwy, 72 km NE of Wubin, *J.A.Elix 33487* (CANB). N.S.W.: Terraban Gap Nature Reserve, along Black Stump Way, 31 km E of Dunedoo, *J.A.Elix 36121* (CANB). Tas.: SE end of beach, Wineglass Bay, *G.Kantvilas 735/03* (HO).

Buellia xanthonica is characterised by the yellow-white to pale yellow-grey or yellow-green thallus, the mainly 8-spored asci, ascospores of intermediate size with moderately strong subapical but narrow septal wall thickenings and a smooth outer wall, and by the presence of 4,5-dichlorolichexanthone. *Buellia reagenella* is rather similar, but it has a K+ violet epihymenium and smaller ascospores.

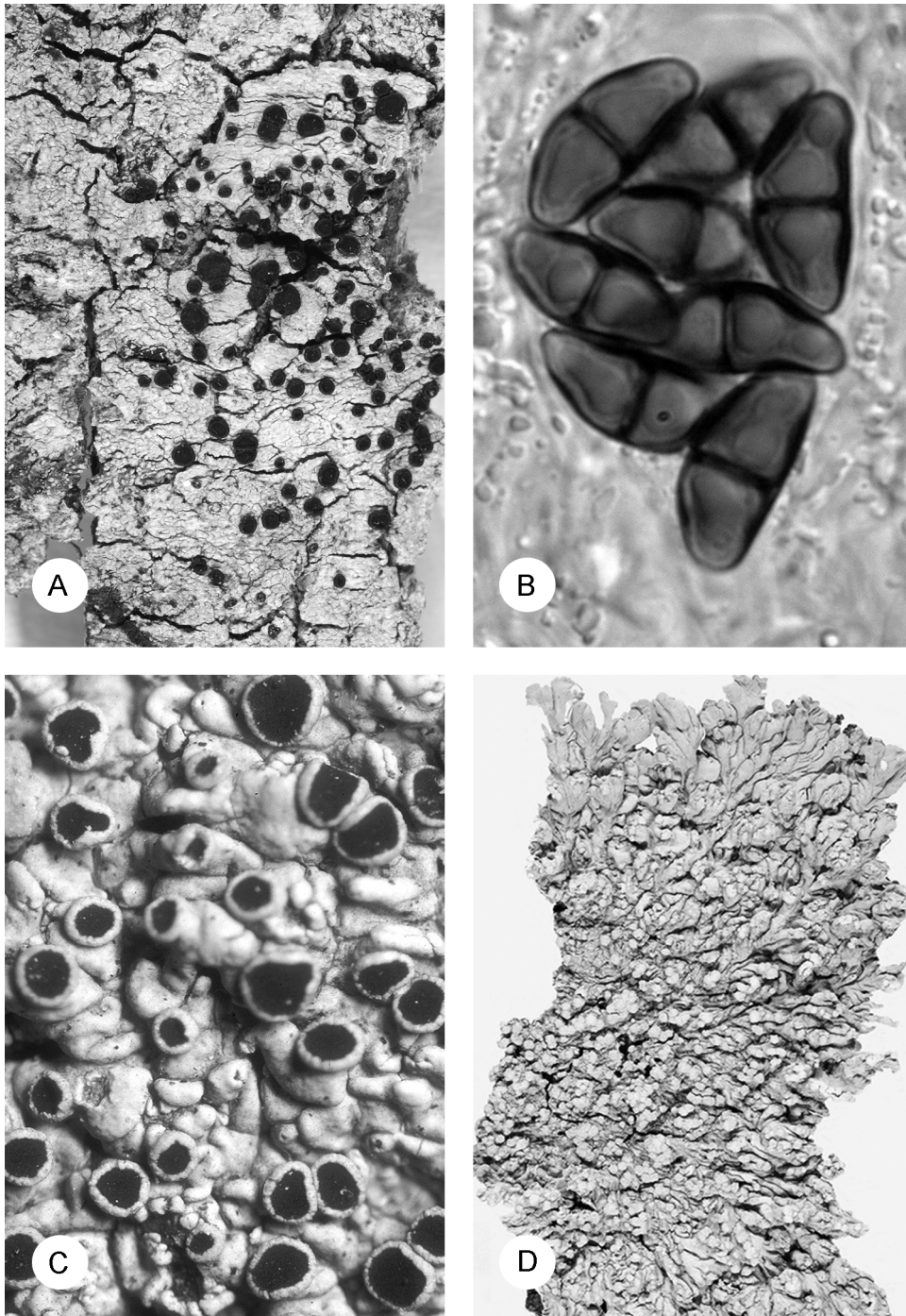


Figure 169. **A**, *Buellia subtropica* (holotype). **B**, Ascus and ascospores of *Buellia xanthonica* (holotype). **C**, *Dirinaria batavica*. **D**, *Dirinaria sekikaica* (holotype). Photographs: A, D by N.McCracken; B, C by W.M.Malcolm. [A and D reproduced from *Australas. Lichenol.* 62: 40 (2008); B from *Australas. Lichenol.* 59: 38 (2006); C from, *Key to the Genera of Australian Macrolichens* 51 (2004)]

2. DIRINARIA

Dirinaria (Tuck.) Clem., *Gen. Fungi* 84 (1909); from the crustose genus *Dirina* Fr. (Roccellaceae) and the Latin suffix *-arius* (indicating connection), in reference to the superficial resemblance of these genera.

Type: *D. picta* (Sw.) Schaer. ex Clem.

Thallus foliose, continuous, lobate, adnate to tightly adnate, 2–12 (–20) cm wide. Lobes irregular to radiating, discrete or confluent, 0.2–3.0 (–5.0) mm wide, eciliate; apices rounded to truncate or flabellate. Upper surface white, grey-white to bluish grey or ochre-yellow, plane to convex or concave towards the periphery, dull or glossy, pruinose or not; soredia, isidia and dactyls present or absent; pseudocyphellae absent; upper cortex paraplechtenchymatous, formed by vertically oriented hyphae. Medulla white or pale yellow to scarlet. Lower surface pale brown to brown-black or black, erhizinate, attached by hapters; lower cortex prosoplectenchymatous, formed by longitudinally arranged hyphae. Ascomata apothecial, laminal, orbicular, sessile to subpedicellate; disc black but often whitish to pale grey- or purple-pruinose; thalline exciple prominent or reflexed, well defined and persistent. Epihymenium pale brown to brown or red, K– or decolourising in K. Hymenium colourless to pale yellow, I+ blue. Hypothecium pale brown to brown or brown-black. Paraphyses septate, simple or with short branches near the apices; apices generally capitate, brown, K–. Asci of *Lecanora*-type, clavate, unitunicate, 8-spored; apex wall layers thickened, the apex amyloid, with a distinct axial mass. Ascospores brown, 1-septate, thick-walled, mischoblastiomorphic (*Dirinaria*-type), ellipsoidal, 10–24 × (4–) 5–9 (–10) μm. Conidiomata pycnidial, laminal, immersed in elevated warts; conidiophores of type VI (*sensu* Vobis, 1980), pleurogenous. Conidia bacilliform to fusiform.

Dirinaria is mainly a pantropical and subtropical genus with several species extending to temperate or oceanic regions; currently considered to contain c. 36 species world-wide, 13 are known from Australia. These lichens grow on bark, wood, mosses or rocks.

D.D.Awasthi, A monograph of the lichen genus *Dirinaria*, *Biblioth. Lichenol.* 2: 1–108 (1975); T.D.V.Swincow & H.Krog, The genus *Dirinaria* in East Africa, *Norweg. J. Bot.* 25: 157–168 (1978); G.Vobis, Bau und Entwicklung der Flechten-Pycnidien und ihrer Conidien, *Biblioth. Lichenol.* 14: 1–141 (1980); D.Allen, H.T.Lumbsch, S.Madden & H.Sipman, New Australian and Australian State lichen records and lichenicolous lichen reports, *J. Hattori Bot. Lab.* 90: 269–291 (2001); K.Kalb, New or otherwise interesting lichens I, *Biblioth. Lichenol.* 78: 141–167 (2001); K.Kalb, *Dirinaria*, *Lichen Fl. Greater Sonoran Desert Region* 2: 98–103 (2004); J.A.Elix, Four new lichens (lichenized Ascomycota) from tropical and subtropical Australia, *Australas. Lichenol.* 62: 35–40 (2008).

1	Thallus lacking vegetative propagules.....	2
1:	Thallus with soredia or dactyls	9
2:	Lower surface black (1)	3
2:	Lower surface white to pale brown.....	7
3	Thallus containing sekikaic acid (2).....	9. D. minuta
3:	Thallus containing divaricatic acid.....	4
4	Apothecial disc purple-pruinose (3:).....	11. D. purpurascens
4:	Apothecial disc epruinose or whitish-pruinose.....	5
5	Hypothecium pale brown to yellow-brown (4:).....	3. D. batavica
5:	Hypothecium brown to dark brown	6
6	Hymenium less than 80 μm thick; ascospores 13–18 × 5–8 μm (5:).....	13. D. subconfluens
6:	Hymenium more than 80 μm thick; ascospores 16–24 × 7–10 μm.....	5. D. confluens
7	Thallus loosely adnate; lobes 1–5 mm wide (2:).....	4. D. complicata
7:	Thallus tightly adnate; lobes 0.2–1.5 mm wide.....	8
8	Thallus containing divaricatic acid (7:).....	3. D. batavica
8:	Thallus containing sekikaic acid.....	9. D. minuta
9	Thallus containing sekikaic acid (1:).....	10
9:	Thallus containing divaricatic acid.....	11

- 10 Dactyls present; orbicular soralia absent (9) 6. **D. consimilis**
 10: Dactyls absent; orbicular soralia present 12. **D. sekikaica**
 11 Dactyls present; orbicular soralia absent (9) 1. **D. aegialita**
 11: Dactyls absent; orbicular soralia present 12
 12 Thallus ochre-yellow; C+ orange; xanthonenes present (11) 7. **D. flava**
 12: Thallus whitish to pale grey; C-; xanthonenes absent 13
 13 Apothecial disc purple-pruinose (12) 8. **D. melanoclina**
 13: Apothecial disc epruinose or whitish-pruinose 14
 14 Lobes contiguous; apices flabellate; thallus longitudinally plicate and rugose (13) ... 2. **D. applanata**
 14: Lobes slightly disjunct or adjacent; apices not flabellate; thallus not longitudinally plicate or rugose .
 10. **D. picta**

1. *Dirinaria aegialita* (Afzel. ex Ach.) B.J.Moore, *Bryologist* 71: 248 (1968)

Parmelia aegialita Afzel. ex Ach., *Methodus* 191 (1803); *Physcia aegialita* (Afzel. ex Ach.) Nyl., *Ann. Sci. Nat., Bot.*, sér. 4, 15: 43 (1861). T: Sierra Leone, ad lapides mari inundatos prope litora, *A.Afzelius s.n.* in Herb. Swartz; lecto: S n.v., fide D.D.Awasthi, *Biblioth. Lichenol.* 2: 64 (1975).

Dirinaria aspera (H.Magn.) D.D.Awasthi, *Bryologist* 67: 371 (1964); *Physcia aspera* H.Magn., in H.Magnusson & A.Zahlbruckner, *Ark. Bot.* 32A(2): 63 (1945). T: 1859 flow, N of Hualalai, Puuwaawaa region, Hawai'i, Hawaiian Islands, on bark, 11 Sept. 1938, *O.Selling 5668 (Hawaii Bog Survey)*; holo: S n.v.

Illustrations: D.D.Awasthi, *op. cit.* figs 38–41 (1975); I.M.Brodo, S.D.Sharnoff & S.Sharnoff, *Lichens of North America* 306, fig. 316 (2001).

Thallus 5–12 cm wide, loosely adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, plane to convex, but often concave towards the tips, 0.2–3.0 mm wide, distinctly flabellate towards the apices. Upper surface grey, bluish grey to yellow-grey or off-white, ±pruinose, dactylate and ±sorediate; dactyls clavate, bursting open at the apices and producing corticated granules and soredia, eventually apically crateriform. Medulla white in the upper part; lower medulla often orange, particularly towards the apices. Lower surface black in the centre, ±brown at the margins. Apothecia rare, sessile to ±constricted at base, 0.5–1.5 mm wide; disc black, rarely grey-pruinose. Epihymenium pale brown, 6–8 µm thick. Hymenium colourless, 80–90 µm thick. Hypothecium dark brown to brown-black, lentiform, 100–150 µm thick. Ascospores 16–22 × 7–9 µm. Conidia bacilliform, 4–5 × 0.8–1.0 µm.

Chemistry: Cortex K+ yellow, C-, KC-, P+ yellow; medulla K-, C-, KC-, P-; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3β-acetoxypopane-1β,22-diol (minor), ±unknown terpenes (minor).

Occurs on bark, wood and rocks in the N.T., Qld and N.S.W.; in monsoon vine forest and in coastal and montane rainforest. Also in Africa, Asia, North, Central and South America and the Pacific Islands. Map 543.

N.T.: Umbrawarra Gorge, 22 km SW of Pine Creek, *J.A.Elix* 22523 (CANB). Qld: O'Keefe Ck, Big Tableland, 26 km S of Cooktown, *J.A.Elix* 17321 & *H.Streimann* (CANB). N.S.W.: Evans Head, *J.A.Elix* 1098 (CANB).

This species is characterised by the thalline dactyls that burst open to become granulose and sorediate and by the presence of divaricatic acid.

2. *Dirinaria applanata* (Fée) D.D.Awasthi, in D.D.Awasthi & M.R.Agarwal, *J. Indian Bot. Soc.* 49: 135 (1970)

Parmelia applanata Fée, *Essai Crypt. Écorc.* 126 (1825). T: “supra Cinchonas nec non Insula Santo Domingo ad arbores et epidermidem Lauri Cassiae”, Peru; lecto: G n.v., fide A.Aptroot, *Fl. Guianas*, ser. E, 1: 18 (1987).

Placodium flavostramineum Müll.Arg., *Hedwigia* 34: 29 (1895); *Lecanora flavostraminea* (Müll.Arg.) Zahlbr., *Cat. Lich. Univ.* 5: 621 (1928). T: Vic., ‘ad saxa quartosa’, 1893, *F.R.M.Wilson* 331; holo: G n.v.

Parmelia redacta Stirt., *Trans. & Proc. New Zealand Inst.* 32: 76 (1899). T: Illawarra, N.S.W., 1882, *W.Kirton*; holo: GLAM n.v.; iso: BM.

For further synonymy see Awasthi (1975).

Illustrations: D.D.Awasthi, *Biblioth. Lichenol.* 2: figs 48–51 (1975); A.Aptroot, *Fl. Guianas*, ser. E, 1: 19, pl. 3 (1987); W.M.Malcolm & D.J.Galloway, *New Zealand Lichens: Checklist, Key, and Glossary* 121, fig. 66b (1997).

Thallus 5–10 cm wide, adnate to tightly adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, longitudinally plicate and rugose, plane to convex, \pm concave towards the tips, 0.5–2.0 mm wide, distinctly flabellate towards the apices. Upper surface grey, bluish grey to yellow-grey or off-white, \pm pruinose, sorediate; dactyls absent. Soralia laminal, hemispherical or becoming elongate, sometimes erose and crateriform; soredia farinose. Medulla white, rarely the lower medulla orange towards the apices. Lower surface black in the centre, \pm brown at the margins. Apothecia rare, sessile to \pm constricted at base, 0.5–1.5 mm wide; disc black, rarely sparsely grey-pruinose. Epithemium dark yellow-brown, c. 10 μ m thick. Hymenium colourless, 75–85 μ m thick. Hypothecium dark brown to brown-black, 160–200 μ m thick. Ascospores 15–22 \times 6–8 μ m. Conidia bacilliform, 3.5–5.0 \times 0.8–1.0 μ m.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3 β -acetoxypentane-1 β ,22-diol (minor), \pm unknown terpenes (minor).

In Australia this pantropical-subtropical species often extends into the temperate zone. It occurs on bark, wood and rocks from coastal areas to montane forests in all States and Territories except S.A. and Tas. Also on Lord Howe Island and Norfolk Island, several other Pacific islands, North, Central and South America, Asia and Africa. Map 544.

W.A.: Bird Observatory, Broome, *K.Ralston* 604 (MEL). N.T.: Darwin River Dam Recreation Park, 77 km S of Darwin, *J.A.Elix* 37526 (CANB). Qld: Three-Mile Ck, 5 km N of Townsville, *J.A.Elix* 20046 & *H.Streimann* (CANB). N.S.W.: Hakea Walk, Washpool Natl Park, Gibraltar Ra., 78 km E of Glen Innes, *J.A.Elix* 37256 (CANB). A.C.T.: Cowen Forest, 16 km E of Canberra, *J.A.Elix* 33203 (CANB). Vic.: Mallacoota, 1979, *D.Verdon* s.n. (CANB).

Dirinaria appanata is characterised by the contiguous, longitudinally plicate and rugose lobes with flabellate apices, the distinctly farinose soredia and the presence of divaricatic acid.

3. *Dirinaria batavica* D.D.Awasthi, *Biblioth. Lichenol.* 2: 42 (1975)

T: Batavia [Djakarta], Java, [Indonesia], on tile, 9 May 1941, *P.Groenhart* 1763; holotype: L, not located.

Illustrations: D.D.Awasthi, *op. cit.* figs 8, 16, 23; P.M.McCarthy & W.M.Malcolm, *Key to the Genera of Australian Macrolichens* 51 (2004).

Thallus 2–7 cm wide, very tightly adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, longitudinally plicate and rugose, \pm plane or slightly concave towards the tips, 0.2–0.8 (–1.0) mm wide, distinctly flabellate at the apices. Upper surface grey to yellow-grey at the periphery, grey-brown to dark brown towards the centre, \pm pruinose, becoming \pm subcrustose, verrucose and areolate in the centre; soredia and dactyls absent. Medulla white or the lower medulla yellow-orange in part. Lower surface pale brown to brown-black or black. Apothecia common, initially sessile, becoming substipitate, 0.1–0.5 mm wide; disc black, epruinose. Epithemium dark brown, c. 10 μ m thick. Hymenium colourless, 80–100 μ m thick. Hypothecium pale brown, 60–80 μ m thick. Ascospores 10–16 \times 4.5–6 μ m. Conidia bacilliform, 3.5–5.0 \times c. 0.8 μ m. Fig. 169C.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3 β -acetoxypentane-1 β ,22-diol (minor), \pm skyrin (minor), \pm unknown terpenes (minor).

Occurs on rocks in the Pilbara and Kimberley regions of W.A. and in coastal and hinterland areas of the N.T. and north-western Qld. Also in Indonesia. Map 545.

W.A.: along road to Mt Joseph Yard, 25 km E of Lennard River Crossing along the Gibb River Rd, *J.A.Elix* 22264 & *H.Streimann* (CANB); Skew Valley, S end of Burrup Penin., 400 m from Dampier Salt haul road, 7 Nov. 1983, *N.Sammy* (CANB). N.T.: Wangi Rd, Finiss Ra., 69 km SSW of Darwin, *H.Streimann* 8797 (CANB). Qld: Cloncurry–Townsville highway, 18 km ESE of Cloncurry, *J.A.Elix* 20685 & *H.Streimann* (CANB).

This species is characterised by the tightly adnate, saxicolous, \pm subcrustose thallus, the narrow lobes, the pale brown to black lower surface, the absence of soredia and dactyls and the presence of divaricatic acid.

4. *Dirinaria complicata* D.D.Awasthi, *Biblioth. Lichenol.* 2: 51 (1975)

T: 6 miles [c. 10 km] S of Ngong Hills, Kenya, on bark of *Acacia* in grove alongside watercourse, 29 Jan. 1953, *C.F.Hemming* 219; holo: EA *n.v.*

Illustration: D.D.Awasthi, *op. cit.* fig. 24.

Thallus 4–10 cm wide, loosely adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, longitudinally plicate and rugose, ultimately convoluted to folded and plicate-complicate, plane to convex, 1–5 mm wide, distinctly flabellate at the apices, \pm discrete to contiguous at the periphery. Upper surface white to pale grey or pale greenish grey, finely pruinose; soredia and dactyls absent. Medulla white. Lower surface white to pale yellow or pale brown. Apothecia common, crowded centrally, innate, then sessile and \pm constricted at base, 0.5–2.0 mm wide; disc black, epruinose. Epihymenium pale brown, c. 10 μ m thick. Hymenium colourless, 90–110 μ m thick. Hypothecium dark brown to brown-black, 180–200 μ m thick, lentiform. Ascospores 12–22 \times 6–10 μ m. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3 β -acetoxypentane-1 β ,2,2-diol (minor), \pm unknown terpenes (minor).

Occurs on rock and bark in *Eucalyptus* woodland in central Qld. Also in East Africa and Madagascar. Map 546.

Qld: Dawson Hwy, Staircase Ra., 18 km SE of Springsure, *H.Streimann* 52221 (B, CANB).

This species is characterised by the loosely adnate thallus, the comparatively broad lobes (1–5 mm wide), the white to pale brown lower surface, the absence of soredia and dactyls and the presence of divaricatic acid.

5. *Dirinaria confluens* (Fr.) D.D.Awasthi, *Biblioth. Lichenol.* 2: 28 (1975)

Parmelia confluens Fr., *Syst. Orb. Veg.* 1: 284 (1825). T: 'India Orientalis, ad cortices' (lost); India, Neelgherries [Nilgiri Hills], *Perrottet*; neo: H-NYL 31808 *n.v.*, *vide* D.D.Awasthi, *loc. cit.*; isoneo: BR, H-NYL 31809, M, PC, REN *n.v.*

Illustrations: D.D.Awasthi, *op. cit.* figs 2, 11, 20, 27, 29; K.Kalb, *Lichen Fl. Greater Sonoran Desert Region* 2: 100, fig. 8 (2004).

Thallus 3–10 cm wide, adnate to tightly adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, longitudinally plicate and rugose, plane to convex or occasionally concave towards the tips, 0.5–2.5 mm wide, distinctly flabellate at the apices, \pm discrete to contiguous at the periphery. Upper surface white to grey, lead-grey, bluish grey or yellow-grey, usually finely white-pruinose, rarely epruinose; soredia and dactyls absent. Medulla mostly white; lower medulla occasionally orange, especially towards the lobe tips. Lower surface black in the centre, brown towards the periphery. Apothecia common, crowded centrally, sessile to constricted at the base, 0.5–2.0 mm wide; disc black, epruinose or weakly grey-pruinose. Epihymenium pale brown, c. 10 μ m thick. Hymenium colourless to pale yellow, 80–110 μ m thick. Hypothecium dark brown to brown-black, 100–250 μ m thick, \pm lentiform. Ascospores 16–24 \times 7–10 μ m. Conidia bacilliform, 4–5 \times 0.8–1.1 μ m.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3 β -acetoxypentane-1 β ,2,2-diol (minor), \pm unknown terpenes (minor).

This pantropical-subtropical species occurs on bark, wood and rocks in coastal and montane forest and woodland in W.A., N.T., Qld, and N.S.W. Also in Africa, Asia, North, Central and South America and the Pacific Islands. Map 547.

W.A.: Great Northern Hwy, 3 km SW of Ord River Crossing, between Halls Creek and Turkey Creek, *J.A.Elix* 22387 & *H.Streimann* (CANB). N.T.: Manton Dam, 51 km SE of Darwin, *H.Streimann* 8752 (CANB, H,

MSC, US). Qld: Coochiemudlo I., Moreton Bay, *G.N.Stevens 1640* (BRI). N.S.W.: Park Beach, Coffs Harbour, *J.A.Elix 3413* (CANB).

Dirinaria confluens is characterised by the adnate thallus, the broad lobes, the black lower surface, the absence of soredia and dactyls and the presence of divaricatic acid. The relatively thick hymenium and larger ascospores distinguish it from *D. subconfluens*.

6. *Dirinaria consimilis* (Stirt.) D.D.Awasthi, in D.D.Awasthi & M.R.Agarwal, *J. Indian Bot. Soc.* 49: 135 (1970)

Physcia consimilis Stirt., *Proc. Roy. Philos. Soc. Glasgow* 11: 310 (1879); *Pyxine consimilis* (Stirt.) Stirt., *Trans. & Proc. New Zealand Inst.* 30: 395 (1898). T: near Chinsurah, India, on bark of *Artocarpus integrifolia* tree, *G.Watt 111*; lecto: GLAM *n.v.*, *vide* D.D.Awasthi, *Biblioth. Lichenol.* 2: 91 (1975); isolecto BM.

Illustrations: D.D.Awasthi, *op. cit.* figs 5, 52, 56.

Thallus 5–13 cm wide, adnate, subdichotomously to subpinnately lobate. Lobes radiating, contiguous, plane to convex but often concave towards the tips, 0.5–2.0 mm wide, distinctly flabellate towards the apices. Upper surface grey, bluish grey to yellow-grey or off-white, ±pruinose, dactylate and ±sorediate; dactyls clavate, bursting open at the apices and producing corticated granules and soredia, eventually apically crateriform. Medulla white in the upper part; lower medulla ±orange towards the apices. Lower surface black in the centre, pale brown at the margins. Apothecia rare, sessile, 0.5–1.5 mm wide; disc dark brown to brown-black, rarely grey-pruinose. Epiphytenium pale brown, 9–10 µm thick. Hymenium colourless, 70–80 µm thick. Hypothecium dark brown to brown-black, lentiform, 180–220 µm thick. Ascospores 14–23 × 6–8 µm. Conidia bacilliform, 4–5 × 0.8–1.0 µm.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), sekikaic acid (major), 4'-*O*-demethylsekikaic acid (minor), homosekikaic acid (trace), 3β-acetoxypopane-1β,22-diol (minor), ±unknown terpenes (minor).

This pantropical-subtropical species usually occurs on bark or wood and rarely on rocks in monsoon vine forest in the N.T. and in coastal and montane forest in Qld and N.S.W. Also in Africa and Asia. Map 548.

N.T.: Berry Springs Nature Park, 47 km S of Darwin, *J.A.Elix 37328* (CANB). Qld: Ellis Beach, 27 km N of Cairns, *J.A.Elix 2571* (CANB). N.S.W.: Grassy Head, *J.A.Elix 21845* (CANB).

This species is characterised by the dactyls that burst open to become granulose and sorediate and by the presence of sekikaic acid.

7. *Dirinaria flava* (Müll.Arg.) C.W.Dodge, *Beih. Nova Hedwigia* 38: 181 (1971)

Physcia flava Müll.Arg., *Hedwigia* 31: 277 (1892). T: NW of Red Hill, Ascension Island, 900 m, on rocks, July 1889, *H.J.Gordon 90*; lecto: BM, *vide* D.D.Awasthi, *Biblioth. Lichenol.* 2: 87 (1975); isolecto: G *n.v.*

For further synonymy see Awasthi (1975).

Illustrations: D.D.Awasthi, *op. cit.* figs 19, 57; P.M.McCarthy & W.M.Malcolm, *Key to the Genera of Australian Macrolichens* 51 (2004).

Thallus 2–6 cm wide, adnate to tightly adnate, pinnately to subdichotomously lobate. Lobes radiating, contiguous, becoming verrucose to subcrustose in the centre, plane to convex, 0.5–1.5 mm wide; apices discrete. Upper surface yellow to pale yellow-brown, tinged grey or blue-grey at the apices, delicately pruinose, sorediate; dactyls absent. Soralia laminal, globose to capitate, 0.2–0.3 mm wide, rarely erose and crateriform; soredia granular to, rarely, farinose. Medulla pale yellow to yellow. Lower surface brown-black. Apothecia very rare, sessile, 0.4–0.7 mm wide; disc dark brown to brown-black, epruinose. Epiphytenium pale brown, c. 8 µm thick. Hymenium colourless, 65–75 µm thick. Hypothecium dark brown, 90–125 µm thick, lentiform. Ascospores 10–15 × 4–7 µm. Pycnidia not seen. Plate 55.

Chemistry: Cortex K+ yellow, C+ orange-red, KC+ red, P–; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), arthothelin

(major), 4,5-dichloronorlichexanthone (minor), 3 β -acetoxypentane-1 β ,22-diol (minor), \pm unknown terpenes (minor).

Occurs on bark and rocks in coastal and montane forests in Qld and eastern N.S.W. Also in Africa and on Ascension Island (South Atlantic Ocean). Map 549.

Qld: Hervey Ra., 45 km SW of Townsville, *J.A.Elix 20456* & *H.Streimann* (BRI, CANB); Callide Lookout, Callide Ra., 15 km NE of Biloela, *J.A.Elix 34875* (CANB); Castle Hill, Townsville, *H.Streimann 31278A* (CANB). N.S.W.: Alum Mtn, Buladelah, *J.A.Elix 24596* (CANB).

This lichen is characterised by the yellow to yellow-brown upper surface, the globose to capitate soralia and the presence of divaricatic acid and arthothelin.

8. Dirinaria melanoclina (C.Knight) D.D.Awasthi, *Biblioth. Lichenol.* 2: 77 (1975)

Physcia melanoclina C.Knight, *Trans. Linn. Soc. London, Bot.* 2: 49 (1882). T: [near Sydney], N.S.W., 1880, *C.Knight 13*; lecto: WELT, *vide* D.D.Awasthi, *loc. cit.*; isolecto: H-NYL 31807, *M n.v.*

Illustration: D.D.Awasthi, *op. cit.* fig. 46.

Thallus 2–5 cm wide, adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, longitudinally weakly plicate, plane to convex to weakly concave, 0.5–1.0 mm wide; apices rounded, discrete. Upper surface grey, greenish grey to yellow-grey or off-white, epruinose, sorediate; dactyls absent. Soralia laminal, capitate, 0.5–1.0 mm wide; soredia farinose. Medulla white. Lower surface brown-black. Apothecia rare, sessile to \pm constricted at the base, 0.6–1.0 mm wide; disc red-brown to brown-black, purple-pruinose. Epithymenium dark brown, 10–15 μ m thick. Hymenium colourless, 65–75 μ m thick. Hypothecium dark brown-black, 140–160 μ m thick. Ascospores 16–20 \times 6–9 μ m. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3 β -acetoxypentane-1 β ,22-diol (minor), \pm unknown terpenes (minor).

Occurs on bark in coastal and hinterland forests in south-eastern Qld and eastern N.S.W. Also in South Africa. Map 550.

Qld: Coochiemudlo I., 28 km ESE of Brisbane, *R.Moberg & B.Owe-Larsson A97:1* (CANB); Serpentine Ck, Moreton Bay, *G.N.Stevens 1119* (BRI). N.S.W.: Forster, *J.A.Elix 3364b* (CANB); Tomaga R. estuary, c. 1 km S of Tomakin, *J.A.Elix 22635* & *K.Kalb* (CANB).

Dirinaria melanoclina is characterised by the purple-pruinose apothecia, the capitate soralia with farinose soredia and the presence of divaricatic acid.

9. Dirinaria minuta Kalb, *Biblioth. Lichenol.* 78: 145 (2001)

T: Keep River Natl Park, N.T., [40 km NE of Kununurra, W.A.], 15°50'S, 129°07'E, 9 Aug. 1995, *K. & A.Kalb 29565*; holotype: CANB; iso: Herb. Kalb.

Illustration: K.Kalb, *op. cit.* 146, fig. 3.

Thallus 2–3 cm wide, tightly adnate, subdichotomously to subpinnately lobate, becoming subcrustose, verrucose and areolate in the centre. Lobes radiating, contiguous, longitudinally plicate and rugose, \pm plane, 0.8–1.5 mm wide; apices rounded, discrete. Upper surface grey to yellow-grey or olive-grey, epruinose or with whitish pruina along the margins and on the surface of the lobe tips; soredia and dactyls absent. Medulla white, rarely lower medulla partly yellow-orange. Lower surface pale brown to brown-black or black. Apothecia common, sessile or constricted at the base, 0.3–0.8 mm wide; disc black, epruinose. Epithymenium brown, c. 10 μ m thick. Hymenium colourless, 70–90 μ m thick. Hypothecium pale yellow-brown, 30–40 μ m thick, lentiform. Ascospores 12–14 \times 4.5–5.5 μ m. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (trace), sekikaic acid (major), 4'-*O*-demethylsekikaic acid (minor), homosekikaic acid (trace), 3 β -acetoxypentane-1 β ,22-diol (minor), \pm unknown terpenes (minor).

Endemic; occurs on rocks in hinterland areas of the N.T. Map 551.

N.T.: Lichfield Natl Park, c. 100 km S of Darwin, K. & A. Kalb 25570 (Herb. Kalb).

Dirinaria minuta is characterised by the small, tightly adnate, saxicolous, \pm subcrustose thallus, often with a pale lower surface, the absence of soredia and dactyls and the presence of sekikaic acid. The morphologically similar *D. batavica* contains divaricatic acid.

10. *Dirinaria picta* (Sw.) Schaer. ex Clem., *Gen. Fungi* 323 (1931)

Lichen pictus Sw., *Nova Gen. Sp. Pl.* 146 (1788); *Parmelia picta* (Sw.) Ach., *Methodus* 211 (1803); *Physcia picta* (Sw.) Nyl., *Mém. Soc. Sci. Nat. Cherbourg* 3: 175 (1855); *Pyxine picta* (Sw.) Tuck., *Syn. N. Amer. Lich.* 1: 79 (1882). T: India Occidentalis, Jamaica, Swartz; lecto: S, Herb. Swartz ex Herb. Thunberg 26168 n.v., fide D.D. Awasthi, *Biblioth. Lichenol.* 2: 73 (1975); isolecto: UPS n.v.

Parmelia plumosa Taylor, *J. Bot. (Hooker)* 6: 173 (1847). T: Low Island, [near Tahiti, Society Islands], on bark, *Beechy*; lecto: FH-TAYL n.v., fide D.D. Awasthi, *loc. cit.*; isolecto: BM, H-NYL 31803 n.v.

Illustrations: D.D. Awasthi, *op. cit.* figs 1, 9, 10, 42–45; I.M. Brodo, S.D. Sharnoff & S. Sharnoff, *Lichens of North America* 307, fig. 318 (2001); K. Kalb, *Lichen Fl. Greater Sonoran Desert Region* 2: 103, fig. 11 (2004).

Thallus 2–8 cm wide, adnate to tightly adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, not longitudinally plicate, plane to convex, but \pm weakly concave near apices, 0.5–1.0 mm wide; apices discrete. Upper surface grey, bluish grey to yellow-grey or off-white, epruinose or very weakly pruinose, sorediate; dactyls absent. Soralia laminal, globose, \pm capitate, 0.5–1.0 mm wide; soredia farinose. Medulla mostly white; lower medulla rarely yellow near the lobe tips. Lower surface black in the centre, paler towards the lobe tips. Apothecia rare, sessile to \pm constricted at the base, 0.6–1.3 mm wide; disc black, epruinose. Epiphygium pale brown, 8–10 μ m thick. Hymenium colourless, 80–90 μ m thick. Hypothecium red-brown to brown-black, 120–200 μ m thick, lentiform. Ascospores 12–21 \times 5–9 μ m. Conidia bacilliform to fusiform, 3–4 \times 0.9–1.1 μ m.

Chemistry: Cortex K⁺ yellow, C⁻, KC⁻, P⁺ yellow; medulla K⁻, C⁻, KC⁻, P⁻; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3 β -acetoxypentane-1 β ,22-diol (minor), \pm unknown terpenes (minor).

In Australia this pantropical-subtropical species often extends into temperate regions; occurs on bark, wood and rocks from coastal areas to montane forest in W.A., N.T., Qld and N.S.W. Also on Christmas and Norfolk Islands, North, Central and South America, Asia, Africa and many Pacific islands. Map 552.

W.A.: 1 km N of Gnamagun Well, Cape Leveque, *K. Ralston* 606 (MEL). N.T.: Howard Springs Nature Park, 37.5 km SE of Darwin, *J.A. Elix* 36709 (CANB). Qld: Yorkeys Knob, 12 km N of Cairns, *J.A. Elix* 2643 (CANB). N.S.W.: Bermagui, *J.A. Elix* 28839 (CANB).

This species is characterised by the globose, \pm capitate soralia with farinose soredia and by the presence of divaricatic acid. *Dirinaria applanata* differs in having the central lobes becoming longitudinally plicate and rugose and the flabellate apices; the lobe apices of *D. picta* are discrete, and the central lobes not longitudinally plicate.

11. *Dirinaria purpurascens* (Vain.) B.J. Moore, *Bryologist* 71: 251 (1968)

Physcia purpurascens Vain., *Ann. Acad. Soc. Fenn.*, ser. A, 6: 68 (1915). T: Fair Plane, St Croix, West Indies, on bark, 1906, *Boergesen* 235; lecto: FH n.v., fide D.D. Awasthi, *Biblioth. Lichenol.* 2: 45 (1975).

Illustrations: D.D. Awasthi, *op. cit.* figs 14, 30, 31; A. Aptroot, *Fl. Guianas*, ser. E, 1: 22, pl. 5 (1987); I.M. Brodo, S.D. Sharnoff & S. Sharnoff, *Lichens of North America* 307, fig. 319 (2001).

Thallus 2–8 cm wide, adnate to tightly adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous to discrete, \pm weakly plicate, plane to weakly convex, 0.2–0.7 mm wide; apices flabellate or truncate and \pm discrete. Upper surface white to grey, greenish grey, or yellow-grey, usually finely white-pruinose; soredia and dactyls absent. Medulla predominantly white; lower medulla rarely orange towards the lobe tips. Lower surface black in the centre, brown towards the periphery. Apothecia common, crowded centrally, sessile to constricted at the base, 0.5–1.5 mm wide; disc black, purple-pruinose, pruina \pm evanescent with age. Epiphygium pale red, c. 10 μ m thick. Hymenium colourless, 80–90 μ m thick.

Hypothecium dark brown to brown-black, 70–80 μm thick, lentiform. Ascospores 11–20 \times 5–7 μm . Conidia bacilliform, 4–5 \times c. 1 μm .

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3 β -acetoxyhopane-1 β ,22-diol (minor), \pm unknown terpenes (minor).

This tropical-subtropical species occurs on bark, wood and rocks in hinterland forest and woodland in eastern Qld and N.S.W. Also in Africa and North, Central and South America. Map 553.

Qld: Mowbray R. estuary, 7 km S of Port Douglas, *J.A.Elix 17480* (CANB); Mt Farrenden, 26 km SSW of Charters Towers, *J.A.Elix 20553* (CANB); Proserpine R. valley, 20 km WSW of Proserpine, *J.A.Elix 21106* (CANB). N.S.W.: Diehard Ck, Mann River Nature Reserve, 50 km E of Glen Innes, *J.A.Elix 37060 p.p.* (CANB).

Dirinaria purpurascens is characterised by the narrow lobes (0.2–0.7 mm wide), the purple-pruinose discs, the thin hypothecium, the absence of soredia and dactyls and the presence of divaricatic acid.

12. *Dirinaria sekikaica* Elix, *Australas. Lichenol.* 62: 36 (2008)

T: Stuarts Pt, Old Macleay River estuary, N.S.W., 30°49'S, 153°00'E, alt. 1 m, on *Casuarina glauca* in strand vegetation adjacent to mangrove swamp, 18 Jan. 1987, *J.A.Elix 21346*; holo: CANB.

Illustration: J.A.Elix, *op. cit.* 40, fig. 2.

Thallus 5–10 cm wide, adnate to tightly adnate, pinnately to subpinnately lobate. Lobes radiating, contiguous, longitudinally plicate and rugose, plane to convex, \pm concave and distinctly flabellate towards the tips, 0.5–2.0 mm wide. Upper surface grey, bluish grey to yellow-grey or off-white, \pm pruinose, sorediate; dactyls absent. Soralia laminal, hemispherical or becoming elongate, occasionally erose and crateriform; soredia farinose. Medulla white, rarely the lower medulla orange towards the apices. Lower surface black in the centre, \pm brown at the margins. Apothecia rare, sessile to \pm constricted at the base, 0.5–1.5 mm wide; disc black, rarely sparsely grey-pruinose. Epithemium dark yellow-brown, c. 10 μm thick. Hymenium colourless, 75–85 μm thick. Hypothecium dark brown to brown-black, 160–200 μm thick. Ascospores 15–22 \times 6–8 μm . Conidia bacilliform, 3.5–5 \times 0.8–1.0 μm . Fig. 169D.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), sekikaic acid (major), 4'-*O*-demethylsekikaic acid (minor), 3 β -acetoxyhopane-1 β ,22-diol (minor), \pm unknown terpenes (minor).

Occurs on bark, wood and rocks in coastal and montane forest in south-eastern Qld and eastern N.S.W. Also in Africa. Map 554.

Qld: New England Hwy, 10 km NW of Crows Nest, c. 50 km N of Toowoomba, *K.Kalb 21459* & *R.W.Rogers* (Herb. Kalb). N.S.W.: c. 2 km N of Gloucester, *K. & A.Kalb 20362* (Herb. Kalb).

This species is characterised by the contiguous, longitudinally plicate and rugose lobes with flabellate apices, the distinctly farinose soredia and the presence of sekikaic acid.

13. *Dirinaria subconfluens* D.D.Awasthi, *Biblioth. Lichenol.* 2: 33 (1975)

T: New Caledonia, on bark, 1863–64, *E.Vieillard*; holo: H n.v.; iso: H n.v.

Illustrations: D.D.Awasthi, *op. cit.* figs 36, 37.

Thallus 3–20 cm wide, adnate to tightly adnate, pinnately to subdichotomously lobate. Lobes radiating, discrete to contiguous, not or very weakly plicate, plane to convex, 0.3–1.0 mm wide, discrete to contiguous at the periphery. Upper surface white to grey, greenish white or pale bluish grey, usually epruinose, rarely slightly white-pruinose; soredia and dactyls absent. Medulla mostly white; lower medulla rarely yellow-orange towards the lobe tips. Lower surface black. Apothecia common, crowded centrally, initially innate, then sessile or slightly constricted at the base, 0.5–1.5 mm wide; disc black, epruinose or weakly grey-pruinose. Epithemium pale brown, c. 10 μm thick. Hymenium colourless to pale yellow,

60–75 µm thick. Hypothecium dark brown, 70–150 µm thick, lentiform. Ascospores 13–18 × 5–8 µm. Conidia bacilliform, 4–5 × 0.8–1.1 µm.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), divaricatic acid (major), 3β-acetoxypentane-1β,22-diol (minor), ±unknown terpenes (minor).

Occurs on bark, wood and rocks in coastal and montane forests and woodland in the N.T. and Qld. Also in Asia, New Caledonia, Vanuatu, French Polynesia and the Hawaiian Islands. Map 555.

N.T.: Charles Darwin Natl Park, Winnellie, 6 km E of Darwin, *J.A.Elix 36859* (CANB). Qld: Forrest Beach, 18 km ESE of Ingham, *J.A.Elix 36795* (CANB).

Dirinaria subconfluens is characterised by the adnate thallus, the narrow lobes (0.3–1.0 mm wide) with a black lower surface, the absence of soredia and dactyls and the presence of divaricatic acid. *Dirinaria confluens* differs in having a plicate-rugose upper surface, a thicker hymenium (> 80 µm thick) and larger ascospores (16–24 × 7–10 µm).

3. PYXINE

Pyxine Fr., *Syst. Orb. Veg.* 1: 267 (1825); from the Latin *pyxis* (a cylindrical box), in reference to the dark exciple that encloses the apothecium.

Type: *P. soredata* (Ach.) Mont.

Thallus foliose, continuous, lobate, loosely to tightly adnate, 2–12 cm wide. Lobes irregular to radiating, discrete or contiguous, 0.2–2.0 (–5.0) mm wide, eciliate; apices rounded to truncate. Upper surface white, grey-white to bluish grey, lead-grey or yellow-grey, plane to convex, or concave towards the periphery, ±reticulately ridged, glossy or dull, usually pruinose; soredia, isidia and dactyls present or absent; pseudocyphellae usually present; upper cortex paraplechtenchymatous, formed by vertically orientated hyphae. Medulla white, yellow, orange, salmon-pink or scarlet. Lower surface usually brown-black or black, often paler towards the periphery, rarely grey-white or pale brown, rhizinate; rhizines simple or furcate; lower cortex prosoplectenchymatous, formed of longitudinally orientated hyphae. Ascomata apothecial, laminal, rounded, sessile or subpedicellate, with a distinct internal stipe that is colourless, brown or red; disc black, rarely pruinose; thalline exciple prominent or reflexed, either distinct and persistent (*physciaeformis*-type), or distinct in young apothecia, but becoming excluded, so that the apothecia appear lecideine (*cocoes*-type), or absent and all apothecia appearing lecideine (*obscurascens*-type); proper exciple present and persistent, ±blackened. Epihymenium bluish black, K+ purple. Hymenium colourless. Hypothecium brown to dark brown. Paraphyses septate, simple or with short branches near the apices; apices generally capitate, brown-black, K+ purple. Asci of *Bacidia*-type, clavate, with a well-developed amyloid tholus with a paler conical axial mass and an ocular chamber, 8-spored. Ascospores brown, 1–3-septate, thick-walled, ellipsoidal, mischoblastiomorphic (usually *Dirinaria*-type, rarely *Physcia*-type), 10–23 × 4–9 µm. Conidiomata pycnidial, laminal, immersed; conidiophores of type VI (*sensu* Vobis, 1980), pleurogenous. Conidia bacilliform, 3–4 × 0.8–1.2 µm.

Pyxine is a mainly pantropical to subtropical genus, with several species extending into temperate or oceanic regions; currently considered to comprise c. 65 species, 26 of which occur in Australia. These lichens grow on bark, wood, mosses or rocks.

T.D.V.Swincow & H.Krog, The genus *Pyxine* in East Africa, *Norweg. J. Bot.* 22: 43–68 (1975); R.Moberg, Studies on the Physciaceae (Lichens) 1. A new species of *Pyxine*, *Norweg. J. Bot.* 27: 189–191 (1980); G.Vobis, Bau und Entwicklung der Flechten-Pycnidien und ihrer Conidien, *Biblioth. Lichenol.* 14: 1–141 (1980); D.D.Awasthi, *Pyxine* in India, *Phytomorphology* 30: 359–379 (1982); R.W.Rogers, The genus *Pyxine* (Physciaceae, lichenized Ascomycetes) in Australia, *Austral. J. Bot.* 34: 131–154 (1986); R.W.Rogers, *Pyxine rugulosa* Stirton (Pyxinaceae, lichenised Ascomycetes) in Queensland, *Brunonia* 9:

229–232 (1986); K.Kalb, Brasilianische Flechten. 1. Die Gattung *Pyxine*, *Biblioth. Lichenol.* 24: 1–89 (1987); K.Kalb, *Pyxine* species from Australia, *Herzogia* 10: 61–69 (1994); D.Allen, H.T.Lumbsch, S.Madden & H.Sipman, New Australian and Australian State lichen records and lichenicolous lichen reports, *J. Hattori Bot. Lab.* 90: 269–291 (2001); K.Kalb, New or otherwise interesting lichens I, *Biblioth. Lichenol.* 78: 141–167 (2001); K.Kalb, *Pyxine*, *Lichen Fl. Greater Sonoran Desert Region* 1: 437–441 (2002); K.Kalb, New or otherwise interesting lichens II, *Biblioth. Lichenol.* 88: 301–329 (2004).

1	Thallus with isidia, soredia or dactyls	2
1:	Thallus lacking vegetative propagules.....	15
2:	Thallus with cylindrical or squamiform isidia (1).....	3
2:	Thallus with soredia or erumpent dactyls.....	5
3	Thallus with squamiform isidia (2)	12. P. endochrysa
3:	Thallus with cylindrical isidia.....	4
4	Medulla white, K+ red; norstictic acid present (3:).....	9. P. cylindrica
4:	Medulla yellow to orange, K–; norstictic acid absent	15. P. keralensis
5	Dactyls present, occasionally becoming sorediate; well-defined soralia absent (2:)	6
5:	Dactyls absent; well-defined soralia present.....	8
6	Upper cortex UV+ yellow, K–; lichexanthone present (5)	19. P. physciaeformis
6:	Upper cortex UV–, K+ yellow; atranorin present	7
7	Medulla yellow to yellow-orange or yellow-brown, K–; norstictic acid absent (6:).....	8. P. coralligera
7:	Medulla white, K+ red; norstictic acid present	22. P. retirugella
8	Soralia and pseudocyphellae vivid red (5:).....	3. P. coccifera
8:	Soralia and pseudocyphellae not vivid red	9
9	Upper cortex UV+ yellow, K–; lichexanthone present (8:).....	10
9:	Upper cortex UV–, K+ yellow or violet; atranorin present or absent	11
10	Medulla white (9).....	4. P. cocoes
10:	Medulla yellow, salmon-orange or yellow-brown.....	26. P. subcinerea
11	Upper cortex K+ violet (under microscope); lower surface white to pale brown; atranorin absent (9:).....	17. P. nubila
11:	Upper cortex UV–, K+ yellow; lower surface black; atranorin present	12
12:	Medulla K+ red; norstictic acid present (11:).....	13
12:	Medulla K–; norstictic acid absent	14
13	Ascospores 12–17 µm long (12).....	13. P. fallax
13:	Ascospores 16–22 µm long.....	7. P. copelandii
14	Soredia coarse; internal stipe of apothecium orange, K+ red (12:).....	25. P. sorediata
14:	Soredia farinose; internal stipe of apothecia white, K–.....	14. P. farinosa
15	Upper cortex UV+ yellow, K–; lichexanthone present (1:).....	16
15:	Upper cortex UV–, K+ yellow; atranorin present.....	20
16	Medulla white (15).....	17
16:	Medulla yellow or orange	18
17	Lobes 0.2–0.4 mm wide; internal stipe of apothecia white, K– (16)	16. P. microspora
17:	Lobes 0.7–1.2 mm wide; internal stipe of apothecia red, K+ purple	18. P. petricola
18:	Medulla orange; apothecia of <i>obscurascens</i> -type (16:).....	5. P. cognata
18:	Medulla yellow; apothecia of <i>cocoes</i> -type	19
19	Lobes 0.5–0.8 mm wide; medulla uniformly yellow (18:).....	1. P. australiensis
19:	Lobes 0.5–1.5 mm wide; upper medulla yellow; lower medulla white	2. P. berteriana
20	Medulla white (15:).....	21
20:	Medulla yellow or orange	22
21	Pseudocyphellae present; norstictic acid absent (20).....	24. P. schmidtii
21:	Pseudocyphellae absent; norstictic acid present (±minor)	6. P. convexior
22:	Pseudocyphellae absent (20:).....	23. P. rugulosa
22:	Pseudocyphellae present	23
23	Internal stipe of apothecium white, K– (22:).....	24
23:	Internal stipe of apothecium orange, K+ reddish.....	25
24	Ascospores broadly ellipsoidal, 10–14 × 6–7 µm (23).....	11. P. elixii

- 24: Ascospores narrowly ellipsoidal, 12–16 × 5–6 μm 21. *P. pungens*
 25: Upper medulla orange, K+ red, P–; lower medulla yellow-orange, K– (23:) 10. *P. desudans*
 25: Medulla uniformly deep orange, K+ red, P+ purple 20. *P. plumea*

1. *Pyxine australiensis* Kalb, *Herzogia* 10: 61 (1994)

T: near Minyama, Sunshine Coast, c. 100 km N of Brisbane, Qld, 26°41'S, 153°08'E, on trees along the shore, K. & A. Kalb *s.n.*; holotype: CANB; isotype: Herb. Kalb *n.v.*

Illustrations: K. Kalb, *op. cit.* 62, fig. 1; 63, fig. 2.

Thallus 5–10 cm wide, adnate to tightly adnate, subdichotomously lobate. Lobes radiating, discrete to ±contiguous, plane to convex, but often slightly concave towards the tips, 0.5–0.8 mm wide, subrotund at the apices. Upper surface white to greenish grey or yellow-grey, sparsely pruinose at the lobe tips or epruinose; dactyls, isidia and soredia absent. Pseudocyphellae distinct, marginal and laminal, subreticulate. Medulla pale yellow. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *cocoes*-type, 0.5–1.5 mm wide; disc epruinose. Internal stipe distinct, white, K–, P–. Ascospores 16–22 × 6–8 μm. Pycnidia not seen.

Chemistry: Cortex K–, UV+ yellow; medulla K– or K+ pale red, C–, KC–, P– or P+ orange; containing lichexanthone (major), triterpenes (major or minor), unknown pigment (minor or trace).

Common on bark and wood, on rarely rocks, in coastal, hinterland and monsoon forests in W.A., N.T., Qld and N.S.W. Also in South America. Map 556.

W.A.: Couchman Ra., 16 km NW of King Edward River Stn (Doongan Stn), *J.A.Elix* 27976, *H.T.Lumbsch* & *H.Streimann* (CANB). N.T.: Howard Springs, 1982, *G.N.Stevens* (BRI). Qld: Red Falls, Lolworth Ck, 58 km WNW of Charters Towers, *J.A.Elix* 20510 & *H.Streimann* (CANB). N.S.W.: Park Beach, Coffs Harbour, *J.A.Elix* 3418 (CANB).

This species is characterised by the cortical lichexanthone, the absence of vegetative propagules, the uniformly yellow medulla and apothecia of the *cocoes*-type with a white internal stipe. *Pyxine berteriana* has somewhat broader lobes (0.5–1.5 mm) and a medulla that is only yellow in part. The two species contain very different arrays of triterpenes (Kalb, 1994).

2. *Pyxine berteriana* (Fée) Imshaug, *Trans. Amer. Microscop. Soc.* 76: 254 (1957)

Circinaria berteriana Fée, *Essai Crypt. Écorc.* 128 (1825). T: [Martinique], on bark of *Quassia*; holotype: G *n.v.*

Pyxine meissneri Tuck. ex Nyl., *Ann. Sci. Nat., Bot., sér.* 4, 11: 205 (1859). T: Cuba, *C.Wright*, *Lich. Cub.* 95: lecto: FH *n.v.*, *fide* H.A. Imshaug, *Trans. Amer. Microscop. Soc.* 76: 254 (1957).

Pyxine cocoes var. *endoxantha* Müll.Arg., *Flora* 65: 318 (1882). T: Balade, New Caledonia, 1881, *E.Vieillard*; holotype: G *n.v.*

Illustrations: R.W. Rogers, *Austral. J. Bot.* 34: 144, fig. 16 (1986); K. Kalb, *Biblioth. Lichenol.* 24: pl. 16 (1987); I.M. Brodo, S.D. Sharnoff & S. Sharnoff, *Lichens of North America* 617, fig. 748 (2001).

Thallus 5–10 cm wide, adnate to tightly adnate, subdichotomously lobate. Lobes radiating, discrete to ±contiguous, plane to convex, but often slightly concave towards the tips, 0.5–1.5 mm wide, subrotund at the apices. Upper surface white to greenish grey or yellow-grey, sparsely pruinose at the lobe tips or epruinose; dactyls, isidia and soredia absent. Pseudocyphellae distinct, marginal and laminal, subreticulate. Medulla pale yellow in upper part; lower medulla white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *cocoes*-type, 0.5–2.0 mm wide; disc epruinose. Internal stipe distinct, white, K–, P–. Ascospores 15–22 × 6–8 μm. Pycnidia not seen.

Chemistry: Cortex K–, UV+ yellow; medulla K– or K+ pale red, C–, KC–, P– or P+ orange; containing lichexanthone (major), triterpenes (major or minor), unknown pigment (minor or trace).

Rare on bark, wood and rock in montane forest in south-eastern Qld and north-eastern N.S.W. Also in North, Central and South America, Africa, New Caledonia and the Galapagos Islands. Map 557.

Qld: Bunya Mountains State Forest, 46 km S of Kingaroy, *J.A.Elix 38654* (CANB). N.S.W.: Diehard Ck, Mann River Nature Reserve, 50 km E of Glen Innes, *J.A.Elix 37044* (CANB).

This species is characterised by the presence of cortical lichexanthone, the absence of vegetative propagules, the yellow upper medulla (white below) and apothecia of the *cocoes*-type with a white internal stipe. It is often confused with *P. australiensis*, but that species has narrower lobes and a uniformly yellow medulla.

3. *Pyxine coccifera* (Fée) Nyl., *Mém. Soc. Sci. Cherbourg* 5: 108 (1857)

Parmelia coccifera Fée, *Essai Crypt. Écorc.* 126 (1825). T: ad corticem Alcornocae; holo: G n.v.

Illustrations: R.W.Rogers, *Austral. J. Bot.* 34: 138, fig. 8; 144, fig. 17 (1986).

Thallus 2–6 cm wide, adnate to loosely adnate, subdichotomously lobate. Lobes radiating, discrete to ±weakly contiguous, plane to convex, but often slightly concave towards the tips, 0.4–1.2 mm wide, subrotund at the apices. Upper surface grey to yellowish grey or dull yellow, sparsely pruinose at the lobe tips or epruinose; dactyls and isidia absent. Pseudocyphellae bright red, marginal and laminal, subreticulate, often developing into soralia. Soralia marginal and laminal, orbicular to linear, ±becoming excavate, producing bright red and grey granular soredia. Medulla pale yellow in upper part; lower medulla white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia very rare, *obscurascens*-type, 0.5–1.5 mm wide; disc epruinose or weakly pale grey-pruinose. Internal stipe distinct, pale yellow in the upper part, white below, K–, P–. Ascospores 14–18 × 6–8 µm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, UV–; medulla K–, C–, KC–, P–; red-pigmented medulla K+ purple, C+ purple-brown, KC+ violet, P–; containing atranorin, chloroatranorin, chiodectonic acid, methyl pyxinate, methyl 3-*O*-methylpyxinate, 25-acetoxy-20,24-epoxydammerane-3-one, 25-acetoxy-20,24-epoxydammerane-3β-ol, ±unknown terpenes (trace).

Occurs on rocks and dead wood in coastal and hinterland areas of the Kimberley region of northern W.A., northern N.T. and north-eastern Qld. Also in South America and Africa. Map 558.

W.A.: Prince Regent River Reserve, NW Kimberley, *A.George 12301* (PERTH). N.T.: Tabletop Ra., Litchfield Natl Park, 25 km SW of Batchelor, *J.A.Elix 27530*, *H.T.Lumbsch & H.Streimann* (CANB, MEL). Qld: Jourama Falls, Paluma Range Natl Park, 23 km S of Ingham, *J.A.Elix 37203* (CANB).

Pyxine coccifera is characterised by the vivid red-pigmented soralia and pseudocyphellae.

4. *Pyxine cocoes* (Sw.) Nyl., *Mém. Soc. Sci. Cherbourg* 5: 108 (1857)

Lichen cocoes Sw., *Nov. Gen. Sp. Pl.* 146 (1788); *Coccocarpia pellita* var. *cocoes* (Sw.) Zahlbr., *Cat. Lich. Univ.* 3: 286 (1925). T: Jamaica, on *Cocos*, Swartz; holo: S n.v.; iso: H-ACH 379 n.v.

For synonymy see Kalb (1987).

Illustrations: R.W.Rogers, *Austral. J. Bot.* 34: 138, fig. 5; 144, figs 14, 18 (1986); K.Kalb, *Biblioth. Lichenol.* 24: 19, fig. 6 (1987); I.M.Brodo, S.D.Sharnoff & S.Sharnoff, *Lichens of North America* 618, fig. 749 (2001).

Thallus 3–10 cm wide, adnate, dichotomously lobate. Lobes radiating, discrete to ±contiguous, plane to slightly convex or concave, 0.4–0.8 mm wide, subrotund to truncate at the apices. Upper surface white to yellowish white, pale yellow-brown or grey, patchily pruinose; pruina glistening; dactyls and isidia absent. Pseudocyphellae usually retracted to the margins, rarely laminal or becoming reticulately confluent, often developing into soralia. Soralia marginal and laminal, orbicular to linear, ±coalescing into extensive patches; soredia granular. Medulla uniformly white. Lower surface black in the centre, paler towards the periphery; rhizines ±dense, furcate. Apothecia rare, *cocoes*-type, 0.4–1.4 mm wide; disc epruinose. Internal stipe distinct, reddish brown in the upper part and K+ purple, P–; lower part white, K–, P–. Ascospores 15–18 × 6–7 µm. Conidia bacilliform, 3–4 × c. 1 µm.

Chemistry: Cortex K⁻, UV⁺ yellow; medulla K⁻, C⁻, KC⁻, P⁻; containing lichexanthone (major), ±unknown terpenes (traces).

This mainly pantropical lichen grows on rock, wood and bark in coastal and hinterland forests in northern W.A., N.T. and Qld. Also on Lord Howe Island, Norfolk Island, Christmas Island, Africa, Asia, North, Central and South America and on many Pacific islands. Map 559.

W.A.: Repulse Pt, South Disaster Bay, Dampier Penin., *K.Kenneally 7650* (PERTH). N.T.: Condor Pt, Melville I., *H.Streimann 42472* (CANB, U). Qld: Green I., 27 km NE of Cairns, *J.A.Elix 2591* (CANB).

This lichen is characterised by the cortical lichexanthone, punctiform or coalescing soralia, the white medulla and apothecia of the *cocoes*-type with an internal stipe that is reddish brown (K⁺ purple) in the upper part.

5. *Pyxine cognata* Stirt., *Proc. Roy. Philos. Soc. Glasgow* 11: 311 (1879)

T: Nilgherries [Nilgiri], India, *A.Watt s.n.*; holo: BM.

Pyxine berteriana var. *himalaica* D.D.Awasthi, *Phytomorphology* 30: 366 (1982). T: Almora district, on way to Kasardevi, Uttar Pradesh, India, c. 1930 m, on bark, 12 June 1956, *D.D.Awasthi 3476*; holo: *n.v.*

Illustrations: D.D.Awasthi, *op. cit.* 365, fig. 3C; K.P.Singh & G.P.Sinha, *Lichen Fl. Nagaland* 334, figs 9, 10; 430, fig. 6 (1994), both as *P. berteriana* var. *himalaica*.

Thallus 2–6 cm wide, adnate to tightly adnate, subdichotomously lobate. Lobes radiating, discrete to ±contiguous, plane to slightly concave, in older thalli becoming slightly convex in the centre, 0.3–1.0 mm wide, subrotund to truncate at the apices. Upper surface white to whitish grey or grey-brown, pruinose in extended patches near the apices, the pruina ±glistening; dactyls, isidia and soredia absent. Pseudocyphellae not prominent, usually restricted to the margins, rarely laminal or becoming subreticulate, often obscured by spreading pruina. Medulla orange in upper part; lower medulla white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *obscurascens*-type, 0.3–1.0 mm wide; disc epruinose. Internal stipe distinct; upper part orange-red, K⁺ purple, P⁻; lower part much paler or white, K⁻, P⁻. Ascospores 13–20 × 6–7 μm. Pycnidia not seen.

Chemistry: Cortex K⁻, UV⁺ yellow; medulla K⁻ or K⁺ pale red, C⁻, KC⁻, P⁻ or P⁺ orange; containing lichexanthone (major), triterpenes (major or minor), unknown pigment (minor or trace).

Rare on bark in hinterland forest in south-eastern Qld. Also in Asia and South America. Map 560.

Qld: c. 12 km NNE of Mt Mowbullin, Bunya Mtns, 14 Aug. 1988, *K.Kalb & R.W.Rogers* (Herb. Kalb).

Pyxine cognata is characterised by the cortical lichexanthone, the absence of vegetative propagules, the partly orange medulla and apothecia of the *obscurascens*-type with an orange-red, K⁺ purple internal stipe. *Pyxine berteriana* is similar, but it has broader, sparsely pruinose lobes and a medulla that is partly yellow. The two species contain very different arrays of triterpenes (Kalb, 1987, pl. 11).

6. *Pyxine convexior* (Müll.Arg.) Swinscow & Krog, *Norweg. J. Bot.* 22: 52 (1975)

Pyxine cocoes var. *convexior* Müll.Arg., *Bot. Jahrb. Syst.* 20: 262 (1894). T: Usambara, Deutsche Ost-Afrika [Tanzania], *C.H.E.W.Holst 3137*; holo: G *n.v.*

Illustration: R.W.Rogers, *Austral. J. Bot.* 34: 144, fig. 20 (1986).

Thallus 2–5 cm wide, adnate to loosely adnate, irregularly to subdichotomously lobate. Lobes radiating, discrete, ±plane to convex, 0.5–0.8 mm wide, subtruncate at the apices. Upper surface white to pale grey, sparsely pruinose at the lobe tips or epruinose, faintly white punctate-maculate; pseudocyphellae, dactyls, isidia and soredia absent. Medulla uniformly white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *cocoes*-type, 0.5–2.0 mm wide; disc epruinose. Internal stipe distinct, white, K⁻, P⁻. Ascospores 15–20 × 6–8 μm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C-, KC-, P+ yellow, UV-; medulla K- or K+ yellow → red, C-, P+ yellow or orange; containing atranorin (major), chloroatranorin (trace), norstictic acid (minor or trace).

This rare species occurs on bark and rock in northern W.A. and north-eastern Qld. Also in East Africa. Map 561.

W.A.: Erskine Ra., Great Northern Hwy, between Derby and Fitzroy Crossing, *J.A.Elix* 22332 & *H.Streimann* (CANB). Qld: Tully Falls Rd, Ravenshoe State Forest, 18 km ESE of Ravenshoe, *J.A.Elix* 16155 & *H.Streimann* (CANB).

This lichen is characterised by the narrow, convex lobes, the cortical atranorin and medullary norstictic acid (sometimes present only in trace amounts), the absence of pseudocyphellae and vegetative propagules, the white medulla and apothecia of the *cocoes*-type with a white, K- internal stipe.

7. *Pyxine copelandii* Vain., *Philipp. J. Sci.*, sect. C, 8: 110 (1913)

T: Capiz, Panay, Philippines, "ad corticem arboreum frondosarum", 10 Jan. 1904, *E.B.Copeland s.n.*; holo: TUR-V 08703 *n.v.*

Illustration: R.W.Rogers, *Austral. J. Bot.* 34: 138, fig. 4 (1986), as *P. retirugella*.

Thallus 2–5 cm wide, adnate, subdichotomously lobate. Lobes radiating, discrete to ±imbricate, plane to slightly convex, 0.3–0.6 mm wide, subrotund to truncate at the apices. Upper surface white to yellowish white or yellowish grey, sparsely pruinose at the lobe tips or epruinose; dactyls and isidia absent. Pseudocyphellae distinct, marginal and laminal, irregular or very rarely becoming reticulate. Soralia laminal or sometimes subapical, orbicular, crateriform, with the sides raised and the surface plane to somewhat convex; soredia farinose, white. Medulla uniformly white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia rare, *obscurascens*-type, 0.4–1.1 mm wide; disc epruinose. Internal stipe distinct, white, K-, P-. Ascospores 16–22 × 6–8 µm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C-, KC-, P+ yellow, UV-; medulla K+ yellow → red, C-, P+ orange; containing atranorin (minor), chloroatranorin (minor), norstictic acid (major), testacein (minor), unknown terpenes (minor).

Occurs on bark in coastal and montane forests in north-eastern Qld and north-eastern N.S.W. Also in Asia and Papua New Guinea. Map 562.

Qld: Mossman–Mount Molloy road, 1 km S of Lions Lookout, 20 km N of Mount Molloy, *J.A.Elix* 36876 (CANB). N.S.W.: Park Beach, Coffs Harbour, *J.A.Elix* 3376 (CANB).

Pyxine copelandii is characterised by the white to yellowish white or yellowish grey upper surface with laminal, orbicular soralia, the white medulla, colourless stipe and the presence of atranorin, norstictic acid and testacein. *Pyxine fallax* is very similar, but it has shorter ascospores (13–17 µm long), and it contains a different cohort of triterpenes.

8. *Pyxine coralligera* Malme, *Bih. Kongl. Svenska Vetensk.-Akad. Handl.* 23: 40 (1897)

T: near São Jeronymo, Serra da Chapada, Mato Grosso, Brazil, ad rupes aprices, 3 June 1894, *G.O.A.Malme* [*Exped. Prim. Regnell. Lichens* 2749c]; lecto: *S n.v.*, fide T.D.V.Swinscow & H.Krog, *Norweg. J. Bot.* 22: 53 (1975).

For synonymy see Kalb (1987).

Illustration: H.Kashiwadani, *Bull. Natl. Sci. Mus. Tokyo*, B, 3: 66, pl. 1, fig. 1 (1977).

Thallus 3–10 cm wide, loosely adnate, subdichotomously lobate. Lobes radiating, discrete to ±imbricate, plane to slightly convex, 0.5–1.0 mm wide, subrotund to truncate at the apices. Upper surface pale to dark grey, weakly pruinose towards the lobe tips or epruinose; isidia absent. Pseudocyphellae laminal, irregular to linear or becoming ±reticulate subapically. Dactyls mainly laminal, occasionally marginal, scattered or clustered, nodular to subcylindrical or clavate, short, ±branched, pustulate, bursting apically to produce granular soredia. Medulla creamy yellow to yellow-orange or yellow-brown. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia rare, *obscurascens*-

type, 0.5–1.0 mm wide; disc epruinose. Internal stipe distinct, pale yellow to yellow-orange or yellow-brown, K+ greenish, P+ dirty orange-brown. Ascospores 16–20 × 5–7 μm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K–, C–, P+ orange; containing atranorin (minor), chloroatranorin (minor), testacein (major), unknown terpenes (minor).

Very rare on bark in hinterland forest in the N.T. Also in Africa, Asia, South America and Papua New Guinea. Map 563.

N.T.: below Florence Falls, Litchfield Natl Park, 42 km SW of Batchelor, *J.A.Elix 37688* (CANB).

This species is characterised by the pustulate dactyls, cortical atranorin, the pale yellow to yellow-orange or yellow-brown medulla, *obscurascens*-type apothecia, an internal stipe that is concolorous with the medulla, and by the presence of medullary testacein and a characteristic array of triterpenes. It is morphologically very similar to *P. retirugella*, but the latter differs in containing additional norstictic acid and a different suite of triterpenes.

9. *Pyxine cylindrica* Kashiw., *Bull. Natl. Sci. Mus. Tokyo, B*, 3: 66 (1977)

T: about 3 km W of Lae, Morobe District, Papua New Guinea, coconut tree plantation, *H.Kashiwadani 12382*; holo: TNS *n.v.*

Illustration: H.Kashiwadani, *loc. cit.* pl. 1, fig. 2.

Thallus 2–5 cm wide, adnate, subdichotomously lobate. Lobes radiating, discrete to ±imbricate, plane to slightly convex, 0.3–0.6 mm wide, subrotund to truncate at the apices. Upper surface white to yellowish white or yellowish grey, sparsely pruinose at the lobe tips or epruinose; dactyls and soredia absent. Pseudocyphellae distinct, marginal and laminal, irregular or very rarely becoming reticulate. Isidia laminal, cylindrical, simple or sparingly branched, 0.3–0.8 mm tall, c. 0.1 mm wide. Medulla white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia and pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K+ yellow → red, C–, P+ orange; containing atranorin (minor), chloroatranorin (minor), norstictic acid (major), testacein (minor), unknown terpenes (minor).

Very rare on bark in hinterland forest in eastern Qld. Also in South and East Asia and Papua New Guinea. Map 564.

Qld: between Breakneck Ck and Quandong Ck, 24 km WSW of Proserpine, *J.A.Elix 21164* & *H.Streimann* (CANB).

This lichen is characterised by the cylindrical isidia, the white medulla and the presence of atranorin, norstictic acid and testacein. *Pyxine keralensis* is morphologically similar, but it has a yellow-orange medulla and it lacks norstictic acid and testacein.

10. *Pyxine desudans* Kalb, *Herzogia* 10: 62 (1994)

T: Litchfield Natl Park, c. 100 km S of Darwin, N.T., 13°07'S, 130°45'E, alt. 200 m, in monsoon forest with large sandstone outcrops, 9 Sept. 1992, K. & A.Kalb *s.n.*; holo: CANB; iso: Herb. Kalb *n.v.*

Illustration: K.Kalb, *op. cit.* 63, fig. 3.

Thallus 2–5 cm wide, adnate to tightly adnate, subdichotomously lobate. Lobes radiating, discrete to contiguous, plane to convex, often slightly concave towards the tips, 0.5–1.0 mm wide, truncate at the apices. Upper surface grey to grey-brown, with patchy pruina at the lobe tips or epruinose; dactyls, isidia and soredia absent. Pseudocyphellae distinct, marginal and laminal, large and patch-like. Medulla orange in the upper layer; lower medulla yellow-orange. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *cocoes*-type, 0.3–0.6 mm wide; disc epruinose. Internal stipe distinct; upper part orange, K+ wine-red, P–; lower part yellow, K–, P–. Ascospores 12–15 × 5.0–5.5 μm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C-, KC-, P+ yellow, UV-; upper medulla K+ wine-red, C-, P-, lower medulla K-, C-, KC-, P-; containing atranorin (minor), chloroatranorin (minor), unknown terpenes (minor), unknown pigment (trace).

Endemic on rocks in northern W.A. and in hinterland areas of the N.T. and eastern Qld. Map 565.

W.A.: Donkey Escarpment, head of Donkey Ck, 27 km S of Drysdale River Stn, *H.Streimann 48483* (CANB). N.T.: Umbrawarra Gorge, 22 km SW of Pine Creek, *J.A.Elix 28081*, *H.T.Lumbsch & H.Streimann* (B, CANB). Qld: just E of entrance to Carnarvon Natl Park, 90 km NNW of Injune, *J.A.Elix 34218* (CANB).

Pyxine desudans is characterised by the small, tightly adnate, saxicolous thallus, the absence of soredia, isidia and dactyls, the yellow-orange to orange medulla, cortical atranorin and the small ascospores. *Pyxine plumea* is similar, but the medulla is orange throughout, and it reacts K+ blackberry to wine-red and P+ purple.

11. *Pyxine elixii* Kalb, *Herzogia* 10: 64 (1994)

T: Hervey Range, 45 km SW of Townsville, Qld, 19°26'S, 146°24'E, alt. 350 m, on granite rock in dry-sclerophyll forest, 20 June 1986, *J.A.Elix 20424*; holo: CANB; iso: Herb. Kalb.

Illustration: K.Kalb, *op. cit.* 65, fig. 4.

Thallus 2–3 cm wide, adnate to loosely adnate, subdichotomously lobate, dying centrally so that mature thalli sometimes appearing ring-like. Lobes radiating, discrete to contiguous or imbricate, convex, 0.2–0.6 mm wide, subrotund at the apices. Upper surface grey to dark grey or grey-black, with very sparse pruina at the lobe tips or epruinose; dactyls, isidia and soredia absent. Pseudocyphellae distinct, laminal, forming a dense network on the upper surface of the lobes. Medulla orange. Lower surface black in the centre, paler towards the margin; rhizines moderately dense, ±furcate. Apothecia common, *obscurascens*-type, 0.5–0.8 mm wide; disc epruinose. Internal stipe distinct, whitish to dirty brown, K-, P-. Ascospores 10–14 × 6–7 µm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C-, KC-, P+ yellow, UV-; medulla K+ violet, C-, P+ purple; containing atranorin (minor), chloroatranorin (minor), unknown terpenes (minor), unknown pigment (minor).

Known only from the type locality in north-eastern Qld; grows on rock. Map 566.

Pyxine elixii is characterised by the small, loosely adnate to adnate saxicolous thalli, the absence of soredia, isidia and dactyls, the orange medulla, the cortical atranorin and small ascospores. *Pyxine pungens* is similar, but it has narrowly ellipsoidal ascospores (12–16 × 5–6 µm).

12. *Pyxine endochrysin* Nyl., *Lich. Japon.* 34 (1890)

T: Hirosima [Hiroshima], Japonia [Japan], 1879, *E.Almquist s.n.*; lecto: H-NYL 31782 *n.v.*, *vide* T.D.V.Swincow & H.Krog, *Norweg. J. Bot.* 22: 54 (1975).

Illustrations: I.Yoshimura, *Lichen Fl. Japan in Colour* pl. 2, fig. c; pl. 4, fig. 19 (1977).

Thallus 3–8 cm wide, adnate to loosely adnate, subdichotomously lobate. Lobes radiating, contiguous to imbricate, plane to slightly concave, 0.6–1.3 mm wide, subrotund to truncate at the apices. Upper surface yellowish grey to brownish grey, lead grey or blue-grey, distinctly pruinose, the pruina punctiform towards the lobe apices; dactyls and soredia absent. Pseudocyphellae distinct at the margins, often grey-pruinose and becoming reticulate. Isidia marginal, nodulose to squamulose or lobulate, not branched, fragile and readily eroded, not sorediate. Medulla lemon-yellow to yellow-brown or yellow-orange above; lower part white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, black to blue-black, furcate. Apothecia very rare, *obscurascens*-type, 0.5–1.5 mm wide; disc epruinose. Internal stipe distinct; upper part dark orange, K+ crimson, P-; lower part whitish, K-, P-. Ascospores 14–19 × 6–8 µm. Conidia bacilliform, 3–4 × c. 1 µm.

Chemistry: Cortex K+ yellow or K-, C-, KC-, P+ pale yellow or P-, UV-; medulla K-, C-, P-; containing atranorin (minor or trace), chloroatranorin (trace), unknown terpenes (major), unknown pigment (minor).

Very rare on rock in hinterland rainforest in eastern Qld. Also in Africa, Asia and Micronesia. Map 567.

Qld: Rainforest Discovery Track, Dicks Tableland, c. 5 km SE of Eungella, c. 60 km W of Mackay, K. & A. Kalb (Herb Kalb 25436).

This species is characterised by the nodular to squamulose or lobulate marginal isidia, the absence of soredia and dactyls, the yellow to yellow-orange medulla, prominent marginal pseudocyphellae and the presence of cortical atranorin. *Pyxine soredata* is superficially similar, but it is invariably sorediate.

13. *Pyxine fallax* (Zahlbr.) Kalb, *Biblioth. Lichenol.* 88: 315 (2004)

Parmelia fallax Zahlbr., *Ann. Mycol.* 10: 87 (1912). T: Kalimoa Valley, Oahu, Hawaiian Islands, *J.F. Rock* 89; lecto: W n.v., fide K. Kalb, *Biblioth. Lichenol.* 78: 160 (2001).

Pyxine patellaris Kurok., *Bull. Natl. Sci. Mus. Tokyo, B*, 12: 689 (1969). T: between Okumura and Ohgiura, Chichijima Island, Bonin Islands, *H. Inoue 19027*; holo: TNS n.v.

Illustrations: S. Kurokawa, *op. cit.* 692, pl. 2, fig. 2, as *P. patellaris*; K. Kalb, *op. cit.* 321, fig. 11 (2004).

Thallus 2–5 cm wide, adnate, subdichotomously lobate. Lobes radiating, discrete to ±imbricate, plane to slightly convex, 0.3–0.6 mm wide, subrotund to truncate at the apices. Upper surface white to yellowish white or yellowish grey, sparsely pruinose at the lobe tips or epruinose; dactyls and isidia absent. Pseudocyphellae distinct, marginal and laminal, irregular or very rarely becoming reticulate. Soralia laminal or occasionally apical, orbicular, crateriform, with the sides raised and the surface plane to somewhat convex; soredia farinose, white. Medulla uniformly white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia rare, *obscurascens*-type, 0.4–1.1 mm wide; disc epruinose. Internal stipe distinct, white, K-, P-. Ascospores 13–17 × 6–8 µm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C-, KC-, P+ yellow, UV-; medulla K+ yellow → red, C-, P+ orange; containing atranorin (minor), chloroatranorin (minor), norstictic acid (major), testacein (minor), unknown terpenes (minor).

Occurs on bark in coastal and montane forest in northern N.T., eastern Qld and N.S.W. Also in SE Asia, the Bonin Islands and the Hawaiian Islands. Map 568.

N.T.: Gungarre Forest Walk, South Alligator, Kakadu Natl Park, K. & A. Kalb (Herb. Kalb 30628). Qld: Mossman–Mount Molloy road, 1 km S of Lions Lookout, 20 km N of Mount Molloy, *J.A. Elix 36879* (CANB); Tully Gorge, 49 km NW of Tully, *J.A. Elix 36993* (BRI). N.S.W.: Patonga via Gosford, *G.N. Stevens 2315* (BRI).

Pyxine fallax is characterised by the white to yellow-white or yellowish grey upper surface with laminal, orbicular soralia, the white medulla, colourless stipe and the presence of atranorin, norstictic acid and testacein. *Pyxine copelandii* is very similar, but it has longer ascospores (16–22 µm long), and it contains a different cohort of triterpenes.

14. *Pyxine farinosa* Kashiw., *Bull. Natl. Sci. Mus. Tokyo, B*, 3: 67 (1977)

T: Yap Island, Caroline Islands, Micronesia, *F. Fujikawa 52*; holo: TNS n.v.

Pyxine linearis R.W. Rogers, *Austral. J. Bot.* 34: 143 (1986); *Pyxine retirugella* f. *sorediosa* Müll. Arg., *Bull. Herb. Boissier* 4: 91 (1896). T: Qld. locality unknown, 1887, *C. Knight 16*; lecto: G n.v., fide R.W. Rogers, *loc. cit.*

Illustrations: H. Kashiwadani, *op. cit.* 70, pl. 2, fig. 1; R.W. Rogers, *op. cit.* 138, fig. 13; 144, figs 15, 22, as *P. linearis*.

Thallus 2–5 cm wide, adnate, subdichotomously lobate. Lobes radiating, discrete to imbricate, plane to slightly convex, 0.3–1.2 mm wide, subtruncate at the apices. Upper surface white to yellowish white or yellowish grey, sparsely pruinose at the lobe tips or epruinose; dactyls and isidia absent. Pseudocyphellae ±distinct, marginal and laminal,

irregular or becoming reticulate. Soralia laminal or occasionally apical, orbicular, subglobose; soredia farinose, white to yellow-white. Medulla pale yellow to yellow-orange. Lower surface black in the centre, paler towards the margin; rhizines \pm dense, furcate. Apothecia rare, *obscurascens*-type, 0.5–2.0 mm wide; disc epruinose. Internal stipe distinct, white, K–, P–. Ascospores $13\text{--}17 \times 6\text{--}8 \mu\text{m}$. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), unknown terpenes (minor), unknown pigment (minor).

Corticolous in coastal and hinterland forests in northern N.T. and eastern Qld. Also in South and East Asia, Papua New Guinea and Micronesia. Map 569.

N.T.: Curtain Falls, Litchfield Natl Park, 38 km WSW of Batchelor, *J.A.Elix 27578* (CANB). Qld: Lannercost State Forest, Wallaman Falls road, 27 km W of Ingham, *J.A.Elix 15840* & *H.Streimann* (CANB); Eimeo Beach, near Mackay, *G.N.Stevens 1967* (BRI).

This species is characterised by the white to yellowish white or yellowish grey upper surface with laminal, orbicular soralia, the yellow to yellow-orange medulla, colourless stipe and the presence of atranorin and triterpenes. *Pyxine fallax* is similar, but it has a uniformly white medulla, and it contains norstictic acid and testacein.

15. *Pyxine keralensis* D.D.Awasthi, *Phytomorphology* 40: 372 ('1980') [1982]

T: Pivavara Road railway station, Ernakulum, Kerala, India, on bark of tree, 28 Nov. 1973, *K.P.Singh 73.352*; holo: LWU *n.v.*

Pyxine isidiolenta R.W.Rogers, *Austral. J. Bot.* 34: 142 (1986). T: Little Ramsay Bay, Hinchinbrook I., Qld, on bark of *Heritiera littoralis* at sea level, 18 Aug. 1975, *A.B.Cribb 1138*; holo: MEL; iso: BM, BRI *n.v.*

Illustrations: D.D.Awasthi, *op. cit.* 369, fig. 5B; R.W.Rogers, *op. cit.* 138, fig. 10; 144, fig. 21, as *Pyxine isidiolenta*.

Thallus 2–8 cm wide, loosely adnate, subdichotomously lobate. Lobes radiating, discrete to \pm imbricate, plane to slightly convex, 0.3–0.7 mm wide, subrotund to truncate at the apices. Upper surface pale yellowish white to yellowish grey or pale grey, epruinose; dactyls and soredia absent. Pseudocyphellae distinct, marginal and laminal, irregular and linear or becoming reticulate. Isidia laminal, cylindrical, simple or sparingly branched, \pm clustered, 0.2–0.5 mm tall, 0.05–0.1 mm thick. Medulla pale yellow to yellow-orange. Lower surface brown-black in the centre, paler towards the margin; rhizines \pm dense, short, simple or furcate. Apothecia rare, *obscurascens*-type, 0.5–1.4 mm wide; disc epruinose. Internal stipe distinct, yellow, K+ red, P–. Ascospores $12\text{--}18 \times 6\text{--}7 \mu\text{m}$. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K–, C–, P–; containing atranorin (minor), chloroatranorin (minor), unknown terpenes (minor).

Common on bark in coastal forests of the N.T. and eastern Qld. Also in South and East Asia. Map 570.

N.T.: Field I., at mouth of South Alligator R., *E.Hegerl 3110* (BRI). Qld: Newell Beach, 5 km NE of Mossman, *J.A.Elix 17445* & *H.Streimann* (CANB); Hinchinbrook I., *G.N.Stevens 3440* (BRI); Eimo Beach Ck, Sunset Beach, *G.N.Stevens 1867* (BRI).

Pyxine keralensis is characterised by the cylindrical isidia, the yellow to yellow-orange medulla and the presence of atranorin and triterpenes. *Pyxine cylindrica* is morphologically similar, but it has a white medulla and additional norstictic acid and testacein.

16. *Pyxine microspora* Vain., *Philipp. J. Sci.*, sect. C, 8: 110 (1913)

T: prope Cabayan, Benguet Province, Luzon, Philippines, *R.C.McGregor*; holo: TUR-V 8804 *n.v.*; iso: BM *n.v.*

Illustrations: D.D.Awasthi, *Phytomorphology* 30: 369, fig. 5D (1982); R.W.Rogers, *Austral. J. Bot.* 34: 144, fig. 23 (1986), both as *Pyxine minuta*.

Thallus 1–4 cm wide, tightly adnate, subdichotomously lobate. Lobes radiating, discrete to \pm contiguous, plane to slightly concave, 0.2–0.5 mm wide, subrotund to truncate at the apices. Upper surface white to pale grey, greenish grey, yellowish grey or brownish grey, sparsely

pruinose at the lobe tips or epruinose; dactyls, soredia and isidia absent. Pseudocyphellae \pm distinct, marginal and sometimes laminal, irregular or very rarely becoming reticulate. Medulla uniformly white. Lower surface black in the centre, paler towards the margin; rhizines dense, short, \pm furcate. Apothecia *obscurascens*-type, 0.3–0.8 mm wide; disc epruinose. Internal stipe indistinct, short, white to brown, K–, P–. Ascospores 10–16 \times 4.5–8.0 μ m. Pycnidia not seen.

Chemistry: Cortex K–, UV+ yellow; medulla K– or K+ pale red, C–, KC–, P– or P+ orange; containing lichexanthone (major), triterpenes (major or minor).

Occurs on rock in coastal and hinterland forest in northern N.T. and eastern Qld. Also in Asia, Africa, South America and the central Pacific island of Onotoa (Kiribati). Map 571.

N.T.: Arnhem Land, 19 km ENE of Jabiru, *H.Streimann 42201* (B, CANB). Qld: Kinduro, along Bruce Hwy, 56 km N of Townsville, *J.A.Elix 15427* & *H.Streimann* (CANB); Ingham–Kangaroo Hills road, 36 km SW of Ingham, *J.A.Elix 20392* & *H.Streimann* (CANB); Hervey Ra., 45 km SW of Townsville, *J.A.Elix 20459* & *H.Streimann* (CANB); Pryde Ck, between Mt Glorious and L. Wivenhoe, 29 Aug. 1995, *K. & A.Kalb* (CANB).

This lichen is characterised by the small, tightly adnate thalli with very narrow lobes, the absence of soredia, isidia and dactyls, the white medulla, and *obscurascens*-type apothecia with an indistinct internal stipe. *Pyxine petricola* has larger thalli, broader lobes and *cocoes*-type apothecia with an internal stipe that is reddish in the upper part.

17. *Pyxine nubila* Moberg, *Norweg. J. Bot.* 27: 189 (1980)

Culbersonia nubila (Moberg) Essl., *Lichen Fl. Greater Sonoran Desert Region* 1: 164 (2002). T: Lake Naivasha Hotel, Rift Valley Province (K3), Kenya, 0°46'S, 36°24'E, alt. c. 2000 m, 1979, *R.Moberg 4488a*; holo: UPS *n.v.*

Illustrations: R.Moberg, *loc. cit.* fig. 1A, B.

Thallus 5–10 cm wide, loosely adnate, irregularly lobate. Lobes radiating, contiguous to imbricate, undulate to slightly concave, 2.5–5.0 mm wide; apices rounded, often slightly ascending. Upper surface grey to blue-grey, \pm distinctly pruinose; pruina punctiform towards the lobe apices; pseudocyphellae, isidia and dactyls absent. Soralia marginal (becoming linear and \pm spreading) and laminal (orbicular); soredia granular. Medulla white. Lower surface pale grey to pale brown, distinctly greyish blue at the margins; rhizines \pm dense, concolorous, furcate. Apothecia not seen in Australian material; reported to be very rare, *physciaeformis*-type, 0.5–1.5 mm wide; disc epruinose. Internal stipe distinct, white, K–, P–. Ascospores 16–20 \times 5–9 μ m (Moberg, 1980). Pycnidia not seen.

Chemistry: Cortex K+ purple (visible under microscope), C–, KC–, P–, UV–; medulla K–, C–, KC–, P–; containing unknown pigment in cortex (minor or trace).

Rare on rocks in south-eastern Tas. Also in Arizona (U.S.A.), Peru, East Africa and Arabia. Map 572.

Tas.: Clifton Vale Rd, 6 km W of Kempton, *J.A.Elix 40359* & *G.Kantvilas* (CANB).

This species is characterised by the pale grey to pale brown lower surface (all other species have a black lower surface, at least in the centre of the thallus), the grey to blue-grey upper surface, marginal and laminal soralia and the absence of atranorin, lichexanthone and terpenes.

18. *Pyxine petricola* Nyl., in J.M.Crombie, *J. Bot. London* 14: 263 (1876)

T: Island of Rodriguez, 9 Dec. 1874, *I.B.Balfour 2391* (Transit of Venus Expedition); holo: BM *n.v.*

Pyxine subvelata Stirt., *Trans. & Proc. New Zealand Inst.* 30: 396 (1898). T: Jimbour, Qld, June 1895, *F.M.Bailey s.n.*; holo: BM.

For further synonymy see Kalb (1987).

Illustrations: D.D.Awasthi, *Phytomorphology* 30: 375, fig. 6C (1982); R.W.Rogers, *Austral. J. Bot.* 34: 149, fig. 24 (1986); T.D.V.Swincow & H.Krog, *Macrolichens of East Africa* 270, fig. 133(1988).

Thallus 2–6 cm wide, adnate to loosely adnate, subdichotomously lobate. Lobes radiating or irregular, contiguous to imbricate, plane to concave, rarely convex, 0.7–1.2 mm wide,

subrotund to truncate at the apices. Upper surface white to pale grey, greenish grey or yellowish grey, pruinose in patches, matt or glossy; dactyls, soredia and isidia absent. Pseudocyphellae \pm distinct, marginal and laminal, usually restricted to the peripheral parts of the lobes, rarely becoming reticulate. Medulla uniformly white. Lower surface black in the centre, paler towards the margin; rhizines dense, short, \pm furcate. Apothecia *cocoes*-type, 0.5–1.5 mm wide; disc epruinose. Internal stipe distinct; upper part rose to orange-red, K+ purple, P–; lower part white, K–, P–. Ascospores 14–20 \times 5–9 μ m. Conidia bacilliform, 3–4 \times c. 1 μ m.

Chemistry: Cortex K–, UV+ yellow; medulla K–, C–, KC–, P–; containing lichexanthone (major), triterpenes (major or minor).

Occurs on rock and bark in coastal and hinterland forest in western W.A. and eastern Qld. Also in Asia, Africa, South America and the Pacific (Hawaiian Islands and Micronesia). Map 573.

W.A.: Monkey Mia, Peron Penin., Shark Bay, *N.Sammy s.n.* (PERTH). Qld: Mt Bohle, 34 km SW of Charters Towers, *J.A.Elix 20632* & *H.Streimann* (CANB); Mt Walker, 15 km S of Hughenden, *J.A.Elix 20702* & *H.Streimann* (CANB); Dawson Hwy, Staircase Ra., 18 km SE of Springsure, *J.A.Elix 34280* & *H.Streimann* (CANB); Leichhardt Hwy, Isla Gorge Natl Park, 26 km NNE of Taroom, *H.Streimann 52667* (B, CANB, H, NY).

Pyxine petricola is characterised by the adnate to loosely adnate thallus, the absence of soredia, isidia and dactyls, the white medulla, cortical lichexanthone and *cocoes*-type apothecia with an internal stipe that is reddish in the upper part.

19. *Pyxine physciaeformis* (Malme) Imshaug, *Trans. Amer. Microscop. Soc.* 76: 257 (1957)

Pyxine meissneri var. *physciaeformis* Malme, *Bih. Kongl. Svenska Vetensk.-Akad. Handl.* 23(3): 36 (1897). T: Corumbá, Mato Grosso, Brazil, in silva minus densa, in declivibus collis, 10 Aug. 1894, *G.O.Malme 3880*; lecto: S *n.v.*, *fide* K.Kalb, *Biblioth. Lichenol.* 24: 61 (1987); isolecto: UPS *n.v.*

Pyxine cocoes var. *caesiopruinosa* Nyl., *Syn. Meth. Lich.* 2: 2 (1863); *Pyxine caesiopruinosa* (Nyl.) Imshaug, *Trans. Amer. Microscop. Soc.* 76: 262 (1957). T: Carolina and Georgia, U.S.A., *H.W.Ravenel s.n.*; holotype: H-NYL 31760 *n.v.*; iso: UPS *n.v.*

Illustrations: K.Kalb, *op. cit.* pl. 19.

Thallus 2–5 cm wide, adnate to loosely adnate, subdichotomously lobate. Lobes radiating, contiguous to imbricate, plane but often slightly concave towards the tips, 0.4–1.0 mm wide, subrotund at the apices. Upper surface ivory-coloured to grey or blue-grey, pruinose; pruina punctiform towards the lobe tips, or forming larger plates within the thallus, matt or glossy; isidia absent. Pseudocyphellae rarely well developed, marginal or laminal, often slightly ridged. Dactyls laminal and marginal, scattered or clustered, nodular to subcylindrical, short, \pm branched, pustulate, bursting apically to produce granular soredia. Medulla yellow to yellow-orange in the upper part, white below. Lower surface black in the centre, paler towards the margin; rhizines \pm dense, furcate. Apothecia common, *physciaeformis*-type, 0.5–2.5 mm wide; disc grey-pruinose when immature. Internal stipe distinct, white, K–, P–. Ascospores 13–19 \times 5–7 μ m. Pycnidia not seen.

Chemistry: Cortex K–, UV+ yellow; medulla K+ orange-red or purple, C–, KC–, P– or P+ orange-red; containing lichexanthone (major), triterpenes (major or minor), unknown pigment (minor or trace).

Very rare on bark in coastal woodland in south-eastern N.S.W. Also in Africa and South America. Map 574.

N.S.W.: Tomaga R. estuary, c. 1 km S of Tomakin, 4 Aug. 1988, *K.Kalb* & *J.A.Elix* (Herb. Kalb).

This lichen is characterised by the adnate to loosely adnate thalli, the pustulate dactyls, the yellow to yellow-orange upper medulla, cortical lichexanthone and *physciaeformis*-type apothecia with a white internal stipe. *Pyxine retirugella* is morphologically similar, but it contains cortical atranorin and has *obscurascens*-type apothecia.

20. *Pyxine plumea* Kalb, *Herzogia* 10: 66 (1994)

T: Mt Tinbeerwah, between Coory and Tewanin, c. 50 km SE of Gympie, Qld, 26°22'S, 152°59'E, alt. 280 m, on low sandstone outcrops in a dry *Eucalyptus* forest with *Casuarina*, 25 Aug. 1992, K. & A. Kalb s.n.; holo: CANB; iso: Herb. Kalb n.v.

Illustration: K. Kalb, *op. cit.* 65, fig. 5.

Thallus 2–5 cm wide, adnate to tightly adnate, subdichotomously lobate. Lobes radiating, discrete to contiguous, plane to convex towards the centre, 0.4–1.0 mm wide, subtruncate at the apices. Upper surface whitish grey to ash-grey, with punctiform pruina at the lobe tips or epruinose; dactyls, isidia and soredia absent. Pseudocyphellae ±distinct, marginal and laminal, becoming reticulate. Medulla deep orange throughout. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *cocoes*-type, 0.5–1.0 mm wide; disc epruinose. Internal stipe distinct; upper part orange, K+ blood-red, P–; lower part yellow-orange, K+ dull purple, P–. Ascospores 13–15 × 5.5–6.0 μm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K+ blackberry-red to wine-red, C+ blood-red, P+ purple; containing atranorin (minor), chloroatranorin (minor), unknown terpenes (minor), unknown pigment (minor).

Occurs on rocks and bark in coastal and hinterland forests of eastern Qld; endemic. Map 575.

Qld: Kuranda Ra., SE of Kuranda, 23–24 Aug. 1988, K. & A. Kalb (Herb. Kalb); Machans Beach, N of Cairns, along Barron R., 26 Aug. 1988, K. & A. Kalb (Herb. Kalb).

Pyxine plumea is characterised by the small, tightly adnate, saxicolous thallus, the absence of soredia, isidia and dactyls, the deep orange medulla, the cortical atranorin and small ascospores. *Pyxine desudans* is similar, but the medulla is orange in the upper part (K+ wine-red, P–) and yellow-orange below (K–, P–).

21. *Pyxine pungens* Zahlbr., *Ann. Cryptog. Exot.* 1: 210 (1928)

T: Buitenzorg, Java, [Indonesia], *C. van Overeem* 23; holo: W n.v.; iso: O n.v.

Illustrations: R.W. Rogers, *Austral. J. Bot.* 34: 149, fig. 25 (1986); K. Kalb, *Biblioth. Lichenol.* 24: pl. 21 (1987).

Thallus 3–10 cm wide, adnate, subdichotomously lobate. Lobes radiating, contiguous or rarely imbricate, plane to convex but often slightly concave towards the tips, 0.5–1.2 mm wide, subrotund to subtruncate at the apices. Upper surface whitish grey to yellowish grey or grey-brown, pruinose towards the lobe tips or epruinose; dactyls, isidia and soredia absent. Pseudocyphellae ±distinct, marginal and laminal, becoming reticulate. Medulla deep orange to yellow-orange in the upper part; lower medulla white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *cocoes*-type, 0.5–1.5 mm wide; disc epruinose. Internal stipe distinct, white, K–, P–. Ascospores 12–16 × 5–7 μm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K+ purple to purple-brown, C+ red-brown, P+ purple-brown; containing atranorin (minor), chloroatranorin (minor), unknown terpenes (minor), unknown pigment (minor).

Occurs on rocks and bark in the Kimberley region of northern W.A. and in coastal and hinterland forest in eastern Qld. Also in South and East Asia and South America. Map 576.

W.A.: King Leopold Ra., 3 km NW of Silent Grove, 63 km NE of Lennard R. Crossing, *J.A.Elix* 22247 & *H.Streimann* (CANB). Qld: slopes of Mt Whitfield, Cairns, *J.A.Elix* 2558 (CANB); Wilsons Beach, 17 km SE of Proserpine, *J.A.Elix* 20994 & *H.Streimann* (CANB); Whitecliff Gorge, 56 km NNE of Hughenden, *J.A.Elix* 20750 & *H.Streimann* (CANB).

Pyxine pungens is characterised by the adnate, saxicolous or corticolous thalli, the absence of soredia, isidia and dactyls, the deep orange to yellow-orange medulla, cortical atranorin and the small ascospores. *Pyxine plumea* is similar, but the medulla is orange throughout and the internal stipe of the apothecia is orange in the upper part (K+ blood-red) and yellow-orange below (K+ dull purple).

22. *Pyxine retirugella* Nyl., *Ann. Sci. Nat., Bot.*, sér. 4, 11: 240 (1859)

T: Nukahiva [Marquesas Islands], ad cortices ad saxa, coll. *unknown*; holo: H-NYL 31789 *n.v.*

Pyxine consocians Vain., *Philipp. J. Sci.*, sect. C, 8: 110 (1913). T: Comiran Island, Sulu Sea, Philippines, ad cortices arboris frondosae, Sept. 1910, *E.D.Merrill 7167 p.p.*; holo: TUR-V *n.v.*; iso: BM *n.v.*

Illustrations: D.D.Awasthi, *Phytomorphology* 30: 368, fig. 4C (1982); R.W.Rogers, *Austral. J. Bot.* 34: 138, fig. 11; 144, fig. 19 (1986), both as *P. consocians*.

Thallus 2–5 cm wide, adnate, subdichotomously lobate. Lobes irregular, discrete to contiguous or imbricate, plane to weakly convex but often slightly concave towards the tips, 0.3–1.0 mm wide, subrotund at the apices. Upper surface whitish to pale greenish grey or yellow-grey, pruinose towards the lobe tips or epruinose; isidia absent. Pseudocyphellae marginal and laminal, irregular, linear or becoming reticulate. Dactyls laminal and marginal, scattered or clustered, nodular to subcylindrical, short, ±branched, pustulate, bursting apically to produce granular soredia. Medulla white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia rare, *obscurascens*-type, 0.5–2.5 mm wide; disc grey-pruinose when immature. Internal stipe distinct, white to pale brown, K–, P–. Ascospores 17–22 × 6–9 µm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K+ yellow → red, C–, P+ orange; containing atranorin (minor), chloroatranorin (minor), norstictic acid (major), testacein (minor), unknown terpenes (minor).

Occurs on bark, rarely on rocks, in coastal and montane forest in the N.T., noeastern Qld and north-eastern N.S.W. Also in Africa, Asia, Christmas Island (Indian Ocean) and several Pacific islands. Map 577.

N.T.: Berry Springs Nature Park, 47 km S of Darwin, *J.A.Elix 37316* (CANB); Charles Darwin Natl Park, Winnellie, 6 km E of Darwin, *J.A.Elix 36848* (CANB). Qld: S face of Mt Coolum, *R.W.Rogers 8031* (BRI). N.S.W.: Moss Garden Walk, the Head Rd, Qld–N.S.W. border, *G.N.Stevens 3855* (BRI).

This lichen is characterised by the adnate thalli, pustulate dactyls, white medulla, cortical atranorin and *obscurascens*-type apothecia with a white to pale brown internal stipe. *Pyxine physciaeformis* is morphologically similar, but it contains cortical lichexanthone and has *physciaeformis*-type apothecia.

23. *Pyxine rugulosa* Stirt., *Trans. & Proc. New Zealand Inst.* 30: 396 (1898)

T: near Jimbour, Qld, *F.M.Bailey s.n.*; holo: BM *n.v.*

Illustration: R.W.Rogers, *Brunonia* 9: 230, fig. 1A–C (1986).

Thallus 2–4 cm wide, adnate, subdichotomously lobate. Lobes radiating, discrete to contiguous or rarely imbricate, plane to convex but often slightly concave towards the tips, 0.3–1.2 mm wide, subrotund to subtruncate at the apices. Upper surface white to whitish grey, becoming markedly convex and rugose in the centre, densely pruinose, particularly towards the lobe tips; pseudocyphellae, dactyls, isidia and soredia absent. Medulla yellow to pale yellow in the upper part; lower medulla white. Lower surface black in the centre, paler towards the margin; rhizines ±dense, furcate. Apothecia common, *cocoes*-type, 0.4–1.0 mm wide; disc epruinose. Internal stipe distinct, white, K–, P–. Ascospores 15–25 × 5–7 µm. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; pigmented medulla K+ purple brown, C–, P–; white medulla K–, C–, KC–, P–; containing atranorin (minor), chloroatranorin (minor), unknown terpenes (minor), unknown pigment (minor).

Endemic on bark in northern W.A. and inland areas of eastern Qld. Map 578.

W.A.: Gundarra Ck, West Kimberley, *W.O.'Sullivan 51A* (CANB, PERTH); Mt Cockburn South, Cockburn Ra., 45 km S of Wyndham, *J.A.Elix 22423 & H.Streimann* (CANB). Qld: 30 km S of Taroom, *R.W.Rogers 7796* (MEL).

Pyxine rugulosa is characterised by the small, adnate, corticolous thallus, the absence of pseudocyphellae, soredia, isidia and dactyls, the pale yellow to yellow upper medulla,

cortical atranorin and the large ascospores. *Pyxine pungens* is similar, but the medulla is deep orange to yellow-orange, and the ascospores are significantly smaller.

24. *Pyxine schmidtii* Vain., *Hedwigia* 46: 170 (1907)

T: prope Lem Dan, Ko Chang I., Thailand, ad truncos arboreum in silva, *J.Schmidt s.n.*; holotype: TUR-V 8695 *n.v.*
Pyxine papuana Kashiw., *Bull. Natl. Sci. Mus. Tokyo, B*, 3: 68 (1977). T: Wau, Mt Kaindi, Morobe District, Papua New Guinea, 1300 m alt., *H.Kashiwadani 10658*; holotype: TNS.
Illustration: H.Kashiwadani, *op. cit.* 70, pl. 2, fig. 2, as *P. papuana*.

Thallus 4–10 cm wide, adnate, subdichotomously lobate. Lobes radiating, discrete or rarely contiguous and imbricate, plane to convex but often slightly concave towards the tips, 0.5–1.2 mm wide, subrotund at the apices. Upper surface white to whitish grey, pruinose, especially towards the lobe tips; dactyls, isidia and soredia absent. Pseudocyphellae marginal and laminal, irregular to linear or becoming reticulate. Medulla white. Lower surface black in the centre, paler towards the margin; rhizines \pm dense, furcate. Apothecia common, *obscurascens*-type, 0.5–2.0 mm wide; disc epruinose. Internal stipe distinct, white to brown, K–, P–. Ascospores 16–20 \times 6–8 μ m. Pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K–, C–, P+ orange-red; containing atranorin (minor), chloroatranorin (minor), testacein (major), unknown terpenes (minor).

Rare on bark in coastal forest in north-eastern Qld. Also in SE Asia and Papua New Guinea. Map 579.

Qld: Edmund Kennedy Natl Park, 10 km NNE of Cardwell, *J.A.Elix 37775* (CANB); Machans Beach, N of Cairns, along Barron R., 26 Aug. 1988, K. & A.Kalb *s.n.* (Herb. Kalb).

This species is characterised by the adnate thalli, the absence of dactyls, soredia, isidia and norstictic acid and the presence of cortical atranorin, medullary testacein and *obscurascens*-type apothecia.

25. *Pyxine soreliata* (Ach.) Mont., in R. de la Sagra, *Hist. Phys. Cuba, Bot. Pl. Cell.* 2: 188 (1842)

Lecidea soreliata Ach., *Syn. Meth. Lich.* 54 (1814). T: in America septentrionale, *Mühlenberg*; lectotype: H-ACH 378 *n.v.*, *fide* R.Moberg, *Symb. Bot. Upsal.* 34(1): 287 (2004); isotype: S, UPS *n.v.*

Physcia glaucovirescens Nyl., *Syn. Meth. Lich.* 1(2): 419 (1860); *Pyxine glaucovirescens* (Nyl.) Aptroot, *Cryptogamie, Bryol. Lichénol.* 9: 146 (1988). T: Morton [Moreton] Bay, [Qld], *Verreaux 1846*; lectotype: PC *n.v.*, *fide* A.Aptroot, *loc. cit.*; isotype: H.

For further synonymy see Kalb (1987).

Illustrations: D.D.Awasthi, *Phytomorphology* 30: 375, fig. 6E (1982); R.W.Rogers, *Austral. J. Bot.* 34: 138, figs 6, 7; 149, fig. 27 (1986); I.M.Brodo, S.D.Sharnoff & S.Sharnoff, *Lichens of North America* 619, fig. 751 (2001).

Thallus 3–8 cm wide, adnate to loosely adnate, subdichotomously lobate. Lobes radiating, contiguous to imbricate, plane to slightly concave, 0.6–1.3 mm wide, subrotund at the apices. Upper surface yellowish grey to brownish grey, lead-grey or blue-grey, distinctly pruinose; pruina punctiform towards lobe apices; dactyls and isidia absent. Pseudocyphellae distinct at the margins, often grey-pruinose and becoming reticulate. Soralia initially marginal, developing from fissures, then laminal and orbicular, occasionally becoming corticate and developing into pseudoisidia; soredia granular, dirty white or grey. Medulla lemon-yellow above; lower part yellow-brown or yellow-orange. Lower surface black in the centre, paler towards the margin; rhizines \pm dense, black to blue-black, furcate. Apothecia very rare, *obscurascens*-type, 0.5–1.4 mm wide; disc epruinose. Internal stipe distinct; upper part dark orange, K+ red, P–; lower part whitish, K–, P–. Ascospores 14–19 \times 6–8 μ m. Conidia bacilliform, 3–4 \times c. 1 μ m.

Chemistry: Cortex K+ yellow or K–, C–, KC–, P+ pale yellow or P–, UV–; medulla K–, C–, P–; containing atranorin (minor or, usually, trace), chloroatranorin (trace), unknown terpenes (major), unknown pigment (minor).

Common on rocks, bark and over mosses in coastal, monsoon and montane forest in northern N.T., eastern Qld and N.S.W. Also in Europe, North, Central and South America, Africa, Asia and the Pacific islands. Map 580.

N.T.: Umbrawarra Gorge, 22 km SW of Pine Creek, *J.A.Elix 28134* (CANB). Qld: 15 km S of Stanthorpe along Hwy 15, *J.A.Elix 2662* (CANB); Tinaroo Perimeter Rd, 14 km NE of Atherton, *H.Streimann 16989* (CANB). N.S.W.: Shelleys Beach, Port Macquarie, *J.A.Elix 1084* (CANB); Bungonia Ck, below canyon, 30 km E of Goulburn, *J.A.Elix 4911* (CANB); Wollomombi Falls, Oxley Wild Rivers Natl Park, 40 km E of Armidale, *J.A.Elix 36528* (CANB).

This species is characterised by the coarse, dirty white to grey, granular soredia, the absence of isidia and dactyls, the yellow to yellow-orange medulla, the prominent marginal pseudocyphellae and the presence of cortical atranorin. *Pyxine endochrysin* is superficially similar, but it is esorediate and has nodular to squamulose or lobulate, marginal isidia.

26. *Pyxine subcinerea* Stirt., *Trans. & Proc. New Zealand Inst.* 30: 397 (1898)

T: Qld, locality unknown, *F.M.Bailey 22*; holo: BM *n.v.*

Pyxine meissneri var. *sorediosa* Müll.Arg., *Flora* 62: 290 (1879). T: Djur, Seriba Ghattas, Africa, ad saxa Brauneisenstein, 1877, *Schweinfurth s.n.*; lecto: G *n.v.*, *fide* R.W.Rogers, *Austral. J. Bot.* 34: 152 (1986).

Physcia melanenta C.Knight, *Trans. Linn. Soc. London, Bot.* 2: 48 (1882). T: [neighbourhood of Sydney], N.S.W., ad saxa, 1880, *C.Knight s.n.*; syn: WELT *n.v.*, M *n.v.*

Pyxine chrysanthoides Vain., *Ann. Acad. Sci. Fenn.*, Ser. A, 6(7): 71 (1915). T: Morne Rouge, Antilles, 480–600 m, *E.A.Vainio s.n.*; lecto: TUR-V *n.v.*, *fide* T.D.V.Swincow & H.Krog, *Norweg. J. Bot.* 22: 65 (1975).

For further synonymy see Kalb (1987).

Illustrations: R.W.Rogers, *op. cit.* 138, fig. 9; 149, fig. 28; K.Kalb, *Biblioth. Lichenol.* 24: pl. 28 (1987); T.D.V.Swincow & H.Krog, *Macrolichens of East Africa* 273, fig. 135 (1988).

Thallus 3–8 cm wide, adnate to loosely adnate, subdichotomously lobate. Lobes radiating, contiguous to imbricate, plane but often slightly concave towards the tips, 0.3–1.5 mm wide, subrotund to subtruncate at the apices. Upper surface yellowish grey to grey to brownish grey or olive-grey, pruinose; pruina densely punctiform towards the lobe tips or forming larger plates within the thallus, often glistening; dactyls and isidia absent. Pseudocyphellae distinct at the margins, often spreading laminally, rarely reticulate. Soralia marginal or submarginal and linear, then laminal and punctiform, often coalescing; soredia farinose. Medulla very thin, yellow above, white below. Lower surface black in the centre, paler towards the margin; rhizines \pm dense, furcate. Apothecia common, *obscurascens*-type, 0.3–1.5 mm wide; disc epruinose. Internal stipe indistinct; upper part red-brown, K+ purple, P–; lower part white, K–, P–. Ascospores 13–22 \times 6–9 μ m. Conidia bacilliform, 3–4 \times c. 1 μ m. Plate 56.

Chemistry: Cortex K–, UV+ yellow; medulla K+ orange-red or purple, C–, KC–, P– or P+ orange-red; containing lichexanthone (major), triterpenes (major or minor), unknown pigment (minor or trace).

Occurs on rock, wood and bark in coastal and hinterland forest in south-western W.A., south-eastern Qld and eastern N.S.W. This mainly pantropical species often extends into subtropical and temperate regions. Map 581.

W.A.: Cosy Corner, 10 km NW of Augusta, *J.A.Elix 10772* & *L.H.Elix* (CANB); Perron Pt, Harvey Estuary, S of Mandurah, 19 Nov. 2000, *E.McCrum* (CANB). Qld: Injune–Taroom road, 5 km E of Injune, *J.A.Elix 34026* (CANB); 1.6 km N of Dunwich, North Stradbroke I., *R.W.Rogers 2038* (BRI). N.S.W.: 2 km N of Coffs Harbour, *J.A.Elix 1285* (CANB); Kurnell, Botany Bay, *J.A.Elix 2907* (CANB); eastern shore of Wallaga L., 5 km N of Bermagui, *J.A.Elix 4557* (CANB).

Pyxine subcinerea is characterised by the marginal soralia with farinose soredia, the yellow medulla, *obscurascens*-type apothecia and the presence of lichexanthone in the upper cortex.

Excluded Names

Pyxine albovirens (Meyer) Aptroot, *Fl. Guianas*, ser. E, 1: 42 (1987)

Lecidea albovirens Meyer, *Prim. Fl. Esseq.* 295 (1818).

No specimens seen from Australia. An earlier report was a misidentification of *P. physciaeformis* (Kalb, 2004).

Pyxine eschweileri (Tuck.) Vain., *Étud. Class. Lich. Brésil* 1: 56 (1890)

Pyxine cocoes var. *eschweileri* Tuck., *Proc. Amer. Acad. Arts* 12: 167 (1877).

No specimens seen from Australia. An earlier report was a misidentification of *P. soredata*.

Pyxine pyxinoides (Müll.Arg.) Kalb, *Biblioth. Lichenol.* 24: 66 (1987)

Catolechia pyxinoides Müll.Arg., *Flora* 64: 509 (1881); *Pyxine minuta* Vain., *Acta Soc. Fauna Fl. Fenn.* 7: 156 (1890).

No material seen from Australia, and reports in the literature are almost certainly in error. All Australian specimens labelled as *P. pyxinoides* examined were misidentifications of *P. microspora* (see also Kalb, 2004).