

PYXINE

John A. Elix¹

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.

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¹ Research School of Chemistry, Building 33, Australian National University, Canberra, Australian Capital Territory 0200.

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Key

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

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.*; holo: CANB; iso: 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.

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*; holo: 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*; holo: 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.

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.

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 restricted 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.

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.

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 *obscuracens*-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.

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.

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.Swincow & 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 \pm 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 $16\text{--}20 \times 5\text{--}7 \mu\text{m}$. 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.

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 \pm 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 \pm dense, furcate. Apothecia and pycnidia not seen.

Chemistry: Cortex K+ yellow, C–, KC–, P+ yellow, UV–; medulla K+ yellow \rightarrow 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.

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., $13^{\circ}07'S$, $130^{\circ}45'E$, 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 \pm 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 $12\text{--}15 \times 5.0\text{--}5.5 \mu\text{m}$. 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.

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.

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.*, *fide* T.D.V.Swinscow & 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.

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 sorediata* 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.*, *vide* 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.

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.*, *vide* 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 ±dense, furcate. Apothecia rare, *obscurascens*-type, 0.5–2.0 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-, 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.

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 ±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, ±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 ±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 12–18 × 6–7 µm. 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.

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 ±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 ±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, ±furcate. Apothecia *obscurascens*-type, 0.3–0.8 mm wide; disc epruinose. Internal stipe indistinct, short, white to brown, K-, P-. Ascospores 10–16 × 4.5–8.0 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).

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).

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 *coco*-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, ±distinctly pruinose; pruina punctiform towards the lobe apices; pseudocyphellae, isidia and dactyls absent. Soralia marginal (becoming linear and ±spreading) and laminal (orbicular); soredia granular. Medulla white. Lower surface pale grey to pale brown, distinctly greyish blue at the margins; rhizines ±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 × 5–9 μm (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.

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 ±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, ±furcate. Apothecia *coco*-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 × 5–9 µm. Conidia bacilliform, 3–4 × c. 1 µm.

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).

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.*; holo: 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, ±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 ±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 × 5–7 µm. 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.

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.

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.

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.

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.*; holotype: 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.

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.

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

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

Phycia 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*; lecto: PC *n.v.*, *fide* A.Aptroot, *loc. cit.*; isolecto: 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.

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.Swinscow & 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.Swinscow & 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 ±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 × 6–9 µm. Conidia bacilliform, 3–4 × c. 1 µm.

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.

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. soreliata*.

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

Catolechia pyxinoïdes 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. pyxinoïdes* examined were misidentifications of *P. microspora* (see also Kalb, 2004).