

## BUELLIA

John A. Elix<sup>1</sup>

*auct. non* De Not., *Giorn. Bot. Ital.* 2 (1, 1): 174 (1846).

Thallus crustose, squamulose or effigurate-lobate, continuous to dispersed, rimose to areolate, 1–10 cm wide, corticate or not, rarely immersed in the substratum and inconspicuous. Prothallus absent or present as a thin dark brown or black marginal line, rarely spreading, but often extending between the areolae. Isidia absent; soredia or blastidia (not in Australia) present or absent. Upper surface white, grey-white to grey, yellow-grey, yellow-orange, yellow-green or brown. Photobiont not forming a continuous layer. Medulla present or absent; medulla usually white, rarely with yellow, orange or red pigments, often containing calcium oxalate (forming clusters of needle-shaped crystals in 10% H<sub>2</sub>SO<sub>4</sub>). Ascromata apothecial, immersed to sessile; disc dark brown to black, pruinose or not, plane to convex or rarely weakly concave; proper margin concolorous with the disc, usually persistent, becoming excluded in convex apothecia, ±with necrotic material remaining attached when emerging from the thallus (thalline veil), rarely with a collar of poorly differentiated thalline material (pseudolecanorine); thalline exciple very rarely present. Proper exciple thin and poorly differentiated (*aethalea*-type) to conspicuously thickened and differentiated into an inner and outer exciple. Epihymenium 5–20 µm thick, olive, brown to dark greenish blue or black; hypothecium 40–220 µm thick, usually deep reddish brown, more rarely pale brown, yellowish or colourless; hymenium 35–140 µm thick, colourless, rarely interspersed with oil droplets, amyloid. Paraphyses septate, simple or sparingly branched, apically swollen and with a distinct pigmented cap. Asci of *Bacidia*- or *Biatora*-type, clavate; apex wall layers thickened; apex amyloid, with a distinct axial mass, 2–16-spored. Ascospores olive to dark brown, 1-septate to submuriform, *Physconia*- or *Buellia*-type, uniformly thin-walled or with septal wall thickenings, oblong to ellipsoidal, rarely globose, 7–28 × 3.5–14.0 µm; outer wall smooth to strongly ornamented; spore ontogeny usually type-A, rarely type-B (see *Rinodina*); torus present or absent. Conidiomata laminal, immersed, globose or flask-shaped; conidiophores usually of type V (Vobis, 1980), very rarely type III or type VI, acrogenous. Conidia short-oblong to ellipsoidal, bacilliform, fusiform or filiform, 1.5–30.0 × 0.7–1.5 µm.

*Buellia s. str.* (formerly *Hafellia* Kalb, H.Mayrhofer & Scheid.) is one of the few well-delimited groups within *Buellia s. lat.* (Bungartz *et al.*, 2007; Elix, 2009). It is characterised by the *Callispora*-type ascospores, bacilliform conidia, often by a strongly oil-inspersed hymenium and the presence of norstictic acid, diploicin and atranorin or 4,5-dichlorolichexanthone (Elix, 2009). For nomenclatural reasons, the generic 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 the name was conserved against *Gassicurtia* Fée. The suggested replacement of a conserved type would have been the first case 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 sens. str.*

---

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

The residual species of *Buellia*, which are not closely related, must be excluded from *Buellia s. str.*, but a precise generic circumscription must await the results of molecular investigations.

The cosmopolitan *Buellia s. lat.* is currently thought to contain c. 370 species, 33 of which occur in Australia. These lichens grow on rock, soil, bark and wood.

### References

- Bungartz, F. & Nash III, T.H. (2004), The *Buellia aethalia*-group in the Greater Sonoran Desert Region with reference to similar species in North America, *Bryologist* 107: 441–458.
- Bungartz, F., Elix, J.A., Grube, U., Heininger, C. & Mayrhofer, H. (2011), A taxonomic revision of the *Buellia subalbula*-group in the Southern Hemisphere using fluorescence microscopy, *Biblioth. Lichenol.* 106: 21–39.
- Bungartz, F., Elix, J.A. & Nash III, T.H. (2004), The genus *Buellia sensu lato* in the Greater Sonoran Desert Region: saxicolous species with one-septate ascospores containing xanthonenes, *Bryologist* 107: 459–479.
- Bungartz, F., Nordin, A. & Grube, U. (2007), *Buellia*, *Lichen Fl. Greater Sonoran Desert Region 3*: 113–179.
- Bungartz, F., Scheidegger, C. & Nash III, T.H. (2002), *Buellia dispersa* A.Massal., a variable lichen species from semi-arid to arid environments of North America and Europe, *Biblioth. Lichenol.* 82: 19–35.
- Elix, J.A. (2009), New crustose lichens (lichenized Ascomycota) from Australia, *Australas. Lichenol.* 64: 30–37.
- Elix, J.A. (2009), *Buellia*, *Fl. Australia* 57: 495–508.
- Elix, J.A. (2009), New saxicolous species and new records of *Buellia sens. lat.* and *Rinodinella* (Physciaceae: Ascomycota) in Australia, *Australas. Lichenol.* 65: 10–19.
- Elix, J.A. (2010), A new species, combinations and synonymy of saxicolous species of *Buellia sens. lat.* and *Rinodinella* (Physciaceae: Ascomycota) in Australia, *Australas. Lichenol.* 66: 44–49.
- Foucard, T., Moberg R., & Nordin, A. (2004), *Buellia*, *Nordic Lichen Fl.* 2: 11–25 (2002); W.Gams, Report of the committee for fungi: 11, *Taxon* 53: 1067–1069.
- Grube, U., Mayrhofer, H. & Elix, J.A. (2004), Two new *Buellia* species (Physciaceae, Lecanorales) with red pigments from Australia, *Biblioth. Lichenol.* 88: 163–173.
- Marbach, B. (2000), Corticole und lignicole Arten der Flechtengattung *Buellia sensu lato* in den Subtropen und Tropen, *Biblioth. Lichenol.* 74: 1–384.
- Moberg, R., Nordin, A. & Scheidegger, C. (1999), Proposal to change the listed type of the name *Buellia nom. cons.* (Physciaceae, Ascomycota), *Taxon* 48: 143.
- Nordin, A., Owe-Larsson, B. & Elix, J.A. (1999), *Buellia aeruginosa*, a new Australian species with pluriseptate spores, *Mycotaxon* 71: 399–404.
- Scheidegger, C. (1993), A revision of European saxicolous species of the genus *Buellia* De Not. and formerly included genera, *Lichenologist* 25: 315–364.
- Trinkaus, U., Mayrhofer, H. & Elix, J.A. (2001), Revision of the *Buellia epigaea*-group (lichenized Ascomycetes, Physciaceae) 2. The species in Australia, *Lichenologist* 33: 47–62.
- Vobis, G. (1980), Bau und Entwicklung der Flechten-Pycnidien und ihrer Conidien, *Biblioth. Lichenol.* 14: 1–141.

## Key

1	Thallus growing on soil, bark or wood .....	2
1:	Thallus growing on rock.....	9
2:	Thallus growing on soil .....	3
2:	Thallus growing on bark or wood .....	7
3	Thallus P+ yellow-orange, K+ yellow then red; norstictic acid present.....	<b>30. B. subcoronata</b>
3:	Thallus P-; norstictic acid absent.....	4
4	Thallus UV-; pigmented medulla K+ pale red; xanthonces absent.....	<b>13. B. glomerulans</b>
4:	Thallus UV+ orange; medulla not pigmented, K-; xanthonces present .....	5
5	Ascospores > 9.5 µm wide; thallus effigurate-lobate.....	<b>12. B. georgei</b>
5:	Ascospores to 9.5 µm wide; thallus crustose to squamulose or effigurate-lobate.....	6
6	Thallus effigurate-lobate; arthothelin present; thuringione absent.....	<b>19. B. lobata</b>
6:	Thallus crustose to squamulose; arthothelin and thuringione present .....	<b>9. B. dijiana</b>
7	Thallus K-; norstictic acid absent; ascospores 6.5–12.0 × 3.5–5.5 µm.....	<b>25. B. schaeereri</b>
7:	Thallus K+ yellow then red; norstictic acid present; ascospores 12–28 × 7–13 µm .....	8
8	Thallus esorediate; 4,5-dichlorolichexanthonce present .....	<b>31. B. ventricosa</b>
8:	Thallus sorediate; 4,5-dichlorolichexanthonce absent .....	<b>14. B. griseovirens</b>
9	Ascospores submuriform .....	10
9	Ascospores 1-septate .....	11
10	Thallus K+ yellow then red, UV-; norstictic acid present; xanthonces absent.....	<b>5. B. bogongensis</b>
10:	Thallus K-, UV+ orange; norstictic acid absent; xanthonces present .....	<b>1. B. aeruginosa</b>
11	Apothecia remaining immersed, not emergent .....	12
11:	Apothecia superficial at maturity .....	13
12:	Thallus K+ yellow then red; norstictic acid present; atranorin absent .....	<b>2. B. aethalea</b>
12	Thallus K+ pale yellow; norstictic acid absent; atranorin present .....	<b>27. B. stellulata</b>
13:	Thallus K+ yellow then red; norstictic acid present .....	14
13:	Thallus K- or K+ yellow; norstictic acid absent .....	21
14	Lower medulla dark yellow-green to orange or dark red-brown; vioxanthin present.....	<b>32. B. vioxanthina</b>
14:	Lower medulla white; vioxanthin absent.....	15
15	Thallus and medulla UV+ yellow or orange; xanthonces present .....	<b>21. B. mammillana</b>
15:	Thallus and medulla UV-; xanthonces absent .....	16
16	Atranorin and chloroatranorin present .....	17
16:	Atranorin and chloroatranorin absent.....	19
17	Apothecia initially immersed, then adnate, often crowded and angular; prothallus prominent between areolae; thalli forming mosaics; thalline veil usually absent; medulla amyloid or not; ascospores 10–22 × 6–10 µm .....	<b>16. B. homophylia</b>
17:	Apothecia adnate or sessile, scattered; thalli not forming mosaics; thalline veil present; medulla amyloid; ascospores 10–16 × 5–7 µm.....	18
18	Excipulum and epihymenium dark blue-green in part, N+ dark red-violet.....	<b>26. B. spuria</b>
18:	Excipulum and epihymenium brown to olive-brown, N-.....	<b>20. B. maculata</b>
19:	Thallus on siliceous rocks.....	<b>18. B. kimberleyana</b>
19	Thallus on calcareous rocks .....	20
20:	Excipulum and epihymenium dark blue-green, N+ dark red-violet.....	<b>28. B. subalbula</b>
20:	Excipulum and epihymenium brown, N- or N+ pale red-brown.....	<b>3. B. albula</b>
21	Thallus on calcareous rocks .....	22
21:	Thallus on siliceous rocks.....	23
22:	Thallus K+ pale yellow, C-; atranorin present; xanthonces absent .....	<b>6. B. cinnabarina</b>
22:	Thallus K-, C+ orange; atranorin absent; xanthonces present .....	<b>33. B. xantholeuca</b>
23	Thallus UV-; xanthonces absent .....	24
23:	Thallus UV+ yellow or orange; xanthonces present.....	28
24:	Thallus bullate-areolate to squamulose; 2'-O-methylperlatolic acid present.....	<b>10. B. dispersa</b>
24:	Thallus not bullate-areolate to squamulose; 2'-O-methylperlatolic acid absent.....	25
25	Thallus K+ pale yellow; only atranorin and chloroatranorin present .....	<b>7. B. cranfieldii</b>
25:	Thallus K+ intense yellow, orange or pale red; stictic, hypostictic or psoromic acids present.....	26

- 26 Thallus K+ yellow then pale red; hypostictic and hyposalazinic acids present; ascospores subglobose to broadly ellipsoidal ..... **17. B. inturgescens**
- 26: Thallus K+ intense yellow or yellow-orange; stictic or psoromic acids present; ascospores oblong to ellipsoidal ..... 27
- 27 Thallus K+ yellow-orange; stictic acid present ..... **26. B. spuria**
- 27: Thallus K+ intense yellow; psoromic acid present ..... **24. B. psoromica**
- 28 Ascospores globose to subglobose, 7–9 × 6–7 μm ..... **8. B. desertorum**
- 28: Ascospores oblong to ellipsoidal, larger ..... 29
- 29 Lower medulla red, at least in part; ascospores *Physconia*-type ..... 30
- 29: Lower medulla not pigmented; ascospores *Buellia*-type or *Physconia*-type ..... 32
- 30: Epithyemium dark brown, N- ..... **23. B. polyxanthonica**
- 30 Epithyemium aeruginose, N+ red-violet ..... 31
- 31 Red pigmented lower medulla K+ dark yellow; inland ..... **22. B. molonglo**
- 31: Red pigmented lower medulla K+ deep purple; coastal ..... **15. B. halonia**
- 32 Apothecia immersed and lecanorine at first, soon becoming lecideine and adnate to sessile; stictic acid present; ascospores *Buellia*-type ..... **21. B. mammillana**
- 32: Apothecia lecideine, sessile throughout their development; stictic acid absent; ascospores *Physconia*-type to *Buellia*-type ..... 33
- 33 Asci 8-spored; hymenium not interspersed; ascospores 11–17 × 6.5–9.0 μm ..... **29. B. subarenaria**
- 33: Asci often with 5 or 6 spores; lower hymenium interspersed; ascospores 16–22 × 8–11 μm ... **4. B. arenaria**

**1. *Buellia aeruginosa*** A.Nordin, Owe-Larsson & Elix, *Mycotaxon* 71: 400 (1999)

T: near Melville Pt, 13 km SSE of Batemans Bay, N.S.W., 35°50'S, 150°12'E, alt. 1–8 m, on steep seashore cliffs facing E, 15 Mar. 1992, R.Moberg & B.Owe-Larsson A69:16; holo: UPS *n.v.*; iso: CANB.

Illustration: A.Nordin, B.Owe-Larsson & J.A.Elix, *op. cit.* 401, fig. 1.

Thallus crustose, continuous to rimose or areolate, 2–5 cm wide, up to 0.7 mm thick; areolae 0.5–2.0 mm wide, angular, ±plane to markedly convex; prothallus black or absent. Upper surface whitish to yellow-white, dull, epruinose; cortex 25–30 μm thick, with calcium oxalate crystals (H<sub>2</sub>SO<sub>4</sub>+); medulla 95–600 μm thick, with calcium oxalate (H<sub>2</sub>SO<sub>4</sub>+), I+ purple. Apothecia 0.2–0.6 mm wide, numerous, lecideine, immersed then sessile; disc black, concave to convex, white-pruinose, the pruina C+ orange; proper margin distinct, but excluded in strongly convex apothecia. Proper exciple 40–80 μm thick, dark brown; outer zone greenish black, N+ red-violet. Epithyemium 7–10 μm thick, greenish black, K- or weak blue-green, N+ red-violet; hymenium 80–90 μm thick, colourless in the central part, blue-green above and below, not interspersed; hypothecium 50–75 μm thick, dark brown; upper part with a greenish tinge, N+ orange-brown. Paraphyses 1.7–2.0 μm wide, simple to branched subapically; apices 3–4 μm wide, with dark green caps. Asci *Bacidia*-type, 8-spored. Ascospores submuriform, 4–6-celled, with 3 transverse septa and (usually) 1 longitudinal septum on either side of the median septum, olive-brown to brown, ellipsoidal, 14–17 × 7–10 μm; outer wall smooth. Pycnidia immersed or slightly protruding, c. 80 μm wide; conidia fusiform to bacilliform, 4–5 × 1 μm.

*Chemistry*: Thallus K-, C+ orange, P-, UV+ orange; containing isoarthothelin (major), 2,5-dichloronorlichexanthone (minor), 2,7-dichloronorlichexanthone (trace), arthothelin (trace), thiophanic acid (trace), asemone (trace).

A scattered endemic species on siliceous rocks in coastal areas of southern S.A. and southern N.S.W.

N.S.W.: Bermagui, *J.A.Elix* 36603 (CANB). S.A.: Stokes Bay, Kangaroo Is., *J.A.Elix* 19660 & *L.H.Elix* (CANB).

*Buellia aeruginosa* is characterised by the whitish to yellow-white thallus, the submuriform ascospores, the greenish black epithyemium and outer excipulum (N+ red-violet) and the presence of isoarthothelin and 2,5-dichloronorlichexanthone.

## 2. *Buellia aethalea* (Ach.) Th.Fr., *Lichenogr. Scand.* 2: 604 (1874)

*Gyalecta aethalea* Ach., *Lichenogr. Universalis* 669 (1810). T: Durham, Anglia [England]; lecto: H-ACH 66 *n.v.*, *fide* T.Foucard, R.Moberg & A.Nordin, *Nordic Lichen Fl.* 2: 70 (2002).

For further synonymy, see Foucard *et al.* (2002).

Illustrations: O.Galløe, *Nat. Hist. Danish Lichens* 4: pl. 27, 28 (1932); T.Foucard, R.Moberg & A.Nordin, *Nordic Lichen Fl.* 2: 90 (2002); F.Bungartz & T.H.Nash III, *Bryologist* 107: 444, fig. 1 (2004); T.H.Nash III, C.Gries & F.Bungartz, *Lichen Fl. Greater Sonoran Desert Region* 3: colour plates (2007).

Thallus crustose,  $\pm$ continuous to rimose-areolate, 1–3 cm wide; areolae 0.2–1.1 mm wide,  $\pm$ angular, plane or rarely weakly convex; prothallus usually conspicuous, black, surrounding the thallus, c. 0.2 mm wide, also  $\pm$ growing between the areolae, the thalli forming a mosaic. Upper surface grey-white, grey to dark grey or pale brown, dull, epruinose, corticate; cortex 10–15  $\mu$ m thick; medulla white, lacking calcium oxalate ( $\text{H}_2\text{SO}_4^-$ ), I+ purple or I-. Apothecia 0.1–0.7 mm wide, cryptolecanorine or lecideine, immersed, not becoming sessile, angular to comma-shaped, predominantly in the centre of areolae; disc black, plane, epruinose; proper margin thin, reduced, inconspicuous, occasionally surrounded by a thalline veil. Proper exciple 45–55  $\mu$ m thick; outer zone greenish black to brown-black or carbonaceous, K-, N+ red-violet or red-brown; inner zone colourless to pale brown. Epihymenium 8–13  $\mu$ m thick, dark greenish to olive-brown, K-, N+ red-violet to red-brown; hymenium 60–80  $\mu$ m thick, colourless, not interspersed; hypothecium 40–55  $\mu$ m thick, pale to dark brown. Paraphyses 2.0–3.5  $\mu$ m wide, simple to moderately branched; apices 4–5  $\mu$ m wide, with olive-brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to brown, broadly ellipsoidal, 11–18  $\times$  6–10  $\mu$ m,  $\pm$ constricted at the septum, with obtuse ends, uniformly thin-walled; outer wall weakly ornamented. Pycnidia rare, urceolate to globose; conidia bacilliform, 5.0–7.5  $\times$  1  $\mu$ m.

*Chemistry*: Thallus K+ yellow then red, P+ yellow-orange, C-, UV-; containing norstictic acid (major), conorstictic acid (minor).

Scattered on siliceous rocks in southern and eastern Australia (W.A., S.A. and N.S.W.); also in Europe, Macaronesia, North and South America, Africa, Asia, New Zealand and Antarctica.

W.A.: Hawkshead Lookout, Murchison River Gorge, Kalbarri Natl Park, 42.5 km ENE of Kalbarri township, *J.A.Elix* 33737(CANB). S.A.: Scotts Cove Lookout, 3 km E of Cape Borda, Kangaroo Is., *J.A.Elix* 19724 & *L.H.Elix* (CANB). N.S.W.: Ten Mile Ck, Goobang Natl Park, 1.5 km SSW of Gingham Gap, *J.A.Elix* 39357 (CANB).

This species is characterised by the grey-white, grey to dark grey or pale brown, crustose thallus, by the immersed, angular to comma-shaped apothecia, the prominent black prothallus, asci with 8 *Buellia*-type ascospores, the N+ red-violet to red-brown epihymenium and the presence of norstictic acid in the thallus.

## 3. *Buellia albula* (Nyl.) Müll.Arg., *Bull. Herb. Boissier* 2, App. 1: 71 (1894)

*Lecidea disciformis* f. *albula* Nyl., *Act. Soc. Linn. Bordeaux* 25: 65 (1864); *Lecidea disciformis* var. *albula* (Nyl.) Linds., *Trans. Linn. Soc. London* 25: 548 (1866); *Lecidea albula* Nyl., *Bull. Soc. Linn. Normandie*, sér. 2, 2: 517 (1868). T: Castlepoint (?), New Zealand, *W.Colenso* 5021; holo: H-NYL 9318 *n.v.*; iso: BM, WELT *n.v.*

*Buellia farinulenta* Müll.Arg., *Bull. Herb. Boissier* 1: 50 (1893). T: Warrnambool, Vic., on calcareous rock, Nov. 1885, *F.R.M.Wilson* 1417; lecto: G *n.v.*, *fide* F.Bungartz, J.A.Elix, U.Grube, C.Heininger & H.Mayrhofer, *Biblioth. Lichenol.* 106: 25 (2011); isolecto: NSW.

*Buellia pruinosa* Müll.Arg., *Bull. Herb. Boissier* 1: 51 (1893). T: Warrnambool, Vic., on calcareous rock, Nov. 1885, *F.R.M.Wilson* *s.n.*; lecto: G *n.v.*, *fide* Bungartz *et al.*, *loc. cit.*; isolecto: NSW.

*Buellia submaritima* Müll.Arg., *Bull. Herb. Boissier* 1: 51 (1893). T: Warrnambool, Vic., on calcareous rock, 1885, *F.R.M.Wilson* *s.n.*; lecto: NSW, *fide* Bungartz *et al.*, *op. cit.* 26.

*Buellia wilsoniana* Müll.Arg., *Bull. Herb. Boissier* 1: 51 (1893). T: Warrnambool, Vic., on limestone, *F.R.M.Wilson* 725; lecto: G *n.v.*, *fide* Bungartz *et al.*, *op. cit.* 26; isolecto: NSW.

*Dirinastrum australiense* Müll.Arg., *Bull. Herb. Boissier* 1: 54 (1893). T: Warrnambool, Vic., on calcareous rock, Nov. 1885, *F.R.M. Wilson* *s.n.*; iso: NSW *n.v.*

For further synonymy, see Bungartz *et al.* (2011).

Illustrations: R.B.Filson & R.W.Rogers, *Lichens of South Australia* 50, fig. 10C; 52, fig. 11J (1979), as *Buellia subalbula*.

Thallus crustose,  $\pm$ continuous to rimose or areolate, usually forming circular, effigurate or sublobate patches, 4–10 cm wide, thin or up to 0.5 mm thick; areolae 0.3–1.2 mm wide, angular,  $\pm$ plane to weakly convex; prothallus delimiting the thallus margin, distinctly blackened to pale gray or white and indistinct. Upper surface usually white, rarely grey, chalky, dull, heavily pruinose; cortex 50–80  $\mu$ m thick, with calcium oxalate crystals ( $H_2SO_4+$ ); medulla 200–500  $\mu$ m thick, white, filled with calcium oxalate crystals ( $H_2SO_4+$ ), I–. Apothecia 0.3–1.3 mm wide, lecideine, immersed, then adnate to sessile; disc black, usually with a dense fine grey-white pruina, plane, scarcely becoming convex with age; proper margin pale to dark grey, thick, persistent, not becoming excluded, weakly carbonised and typically whitish-pruinose, thus resembling a thalline margin. Proper exciple 50–100  $\mu$ m thick; outermost layer dark reddish brown; inner layer medium to pale red-brown, K–. Epihymenium 9–13  $\mu$ m thick, yellow-brown to dark brown, K–, N–; hymenium 40–50  $\mu$ m thick, colourless, not interspersed; hypothecium 75–100  $\mu$ m thick, deep reddish brown. Paraphyses 2–3  $\mu$ m wide, simple to moderately branched; apices 4–6  $\mu$ m wide, with brown to yellow-brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to brown, oblong to ellipsoidal, with obtuse ends, 10–15  $\times$  4.5–9.0  $\mu$ m, uniformly thin-walled; torus indistinct; outer wall smooth. Pycnidia rare, urceolate to globose; conidia bacilliform, 3–5  $\times$  1.0–1.5  $\mu$ m.

*Chemistry*: Thallus K+ yellow then red, P+ yellow or yellow-orange, C–, UV–; containing norstictic acid (major), conorstictic acid (minor),  $\pm$ arthothelin (minor or trace).

Very common on calcareous rocks in W.A., S.A., N.T., N.S.W., A.C.T., Vic. and Tas.; also in South America and New Zealand.

W.A.: Eyre Hwy, 4 km E of Balladonia, *J.A.Elix* 41645 (B, CANB). S.A.: Marne R., 8 km NE of Springton, Mount Lofty Ra., *J.A.Elix* 41992 (B, CANB). N.T.: Liddle Hills, 13 km N of Angus Downs HS, *J.A.Elix* 11177 & *L.A.Craven* (CANB). N.S.W.: Limestone Ck, 30 km NE of Cowra, *H.Streimann* 48869 (B, CANB). A.C.T.: Cotter Reserve, near junction of the Cotter and Paddys Rivers, 17 km WSW of Canberra, 5 Aug. 1977, *D.Verdon* (B, CANB). Vic.: 3 km E of Buchan, East Gippsland, *D. & H.Mayrhofer* 11552 & *E.Hierzer* (GZU). Tas.: Cave Beach, Flinders Is., *G.Kantvilas* 310/97 (HO).

Characterised by the thick, chalky white thallus with sublobate margins, subimmersed apothecia with greyish white-pruinose discs, the yellow-brown to dark brown, N–epihymenium and the presence of norstictic acid.

#### 4. *Buellia arenaria* Müll.Arg., *Bull. Herb. Boissier* 1: 52 (1893)

T: Lorne, [Vic.], on sandstone, 1892, *F.R.M.Wilson* 1044; holo: G n.v.; iso: NSW.

Thallus crustose,  $\pm$ continuous to rimose-areolate, 2–5 cm wide; areolae 0.2–0.5 mm wide, continuous to dispersed, angular or  $\pm$ rounded, plane to slightly convex; prothallus absent. Upper surface sordid white, cream or yellowish brown, ecorticate; medulla white, lacking calcium oxalate ( $H_2SO_4-$ ), IKI+ blue. Apothecia 0.3–0.7 mm wide, lecideine, scattered, sessile on or between areolae, constricted at the base; disc black, flat, dull, epruinose; proper margin moderate, entire. Proper exciple 35–75  $\mu$ m thick, dark brown to brown-black, K–, N+ reddish. Epihymenium 5–10  $\mu$ m thick, brown, N+ reddish; hymenium 60–75  $\mu$ m thick, colourless; lower part interspersed with oil droplets; hypothecium 200–300  $\mu$ m thick, dark brown to brown-black, K–, N+ reddish. Paraphyses 1–2  $\mu$ m wide, simple or sparsely branched; apices 4.0–5.5  $\mu$ m wide, with brown caps. Asci *Bacidia*-type, 8-spored, but often with only 5 or 6. Ascospores *Physconia*-type, 1-septate, brown to dark brown, ellipsoidal to oblong-ellipsoidal, 16–22  $\times$  8–11  $\mu$ m; torus absent, with septal wall thickenings; outer wall smooth or finely ornamented. Pycnidia not seen.

*Chemistry*: Thallus K+ yellow, C+ yellow or orange, P+ pale yellow or P–, UV+ orange; containing 2,5,7-trichloro-3-O-methylnorlichexanthone (major), atranorin (minor).

This very rare endemic species is only known from the type locality in southern Vic.

This lichen is very similar to *B. subarenaria* (q.v.), but it differs in having epruinose discs, often only 5 or 6 larger ascospores per ascus ( $16\text{--}22 \times 8\text{--}11 \mu\text{m}$  vs.  $11\text{--}17 \times 6.5\text{--}9.0 \mu\text{m}$ ), the interspersed lower hymenium, a thicker hypothecium ( $200\text{--}300 \mu\text{m}$  vs.  $100\text{--}150 \mu\text{m}$  thick) and a thinner hymenium ( $60\text{--}75 \mu\text{m}$  vs.  $80\text{--}100 \mu\text{m}$  thick).

##### **5. *Buellia bogongensis* Elix, *Australas. Lichenol.* 65: 10 (2009)**

T: Mt McKay, Bogong High Plains, Alpine Natl Park, 16 km SSE of Mt Beauty, Vic.,  $36^{\circ}52'S$ ,  $147^{\circ}14'E$ , alt. 1840 m, on exposed gneiss boulders in exposed subalpine grassland, 18 Feb. 1994, *J.A.Elix 40609* & *H.Streimann*; holo: CANB.

Illustration: J.A.Elix, *op. cit.* 18, fig. 1.

Thallus crustose, continuous to rimose or areolate, 2–4 cm wide, up to 0.8 mm thick; areolae 0.2–2.0 mm wide, angular,  $\pm$ plane; prothallus conspicuous, black, surrounding the thallus, c. 0.2 mm wide, also growing between areolae. Upper surface whitish to grey-white or grey, dull or glossy, epruinose; cortex 25–30  $\mu\text{m}$  thick, lacking calcium oxalate crystals ( $\text{H}_2\text{SO}_4^-$ ); medulla 95–400  $\mu\text{m}$  thick, lacking calcium oxalate ( $\text{H}_2\text{SO}_4^-$ ), IKI+ intense blue-purple. Apothecia 0.3–0.6 mm wide, lecideine, numerous, crowded and aggregated, round to angular-distorted, immersed in the thallus or between areolae, level with the thallus or slightly protruding; disc black, epruinose, plane; proper margin thin, black, almost completely reduced when immersed in the thallus. Proper exciple 50–75  $\mu\text{m}$  thick; outer zone broad, greenish black, N+ red-violet; central part dark brown, grading into the hypothecium. Epithymenium 7–10  $\mu\text{m}$  thick, dark greenish blue to greenish black, K– or K+ weak blue-green, N+ red-violet; hymenium 75–100  $\mu\text{m}$  thick, colourless in the central part, blue-green above, brown below, not interspersed; hypothecium 50–75  $\mu\text{m}$  thick, dark brown, N+ orange-brown. Paraphyses 1.7–2.0  $\mu\text{m}$  wide, simple to moderately branched; apices 2.5–4.0  $\mu\text{m}$  wide, with dark green caps. Asci *Bacidia*-type, 8-spored. Ascospores submuriform, 4–6-celled, with 3 transverse septa and (usually) 1 longitudinal septum on either side of the median septum, olive-brown to brown, elongate-ellipsoidal,  $15\text{--}23 \times 7\text{--}10 \mu\text{m}$ ; outer wall ornamented. Pycnidia not seen.

*Chemistry*: Cortex K+ yellow, P+ yellow, C–, UV–; medulla K+ yellow then red, P+ orange-red, C–, UV–; containing atranorin (minor), chloroatranorin (minor), norstictic acid (major), connorstictic acid (minor).

This very rare endemic species is only known from the type locality in eastern Vic.

Characterised by the whitish to grey-white or grey, areolate thallus, the immersed, often angular apothecia, the submuriform ascospores, the greenish black epithymenium and outer excipulum (N+ red-violet) and the presence of atranorin, norstictic and connorstictic acids in the thallus.

##### **6. *Buellia cinnabarina* U.Grube, in U.Grube, H.Mayrhofer & J.A.Elix, *Biblioth. Lichenol.* 88: 169 (2004)**

T: Parachilna Gorge, Flinders Ranges Natl Park, 19 km W of Blinman, S.A.,  $31^{\circ}07'S$ ,  $138^{\circ}31'E$ , 250 m, SW exposed rocks beside road, 7 Apr. 1986, *G.Rambold 5466*; holo: *M n.v.*

Illustrations: U.Grube, H.Mayrhofer & J.A.Elix, *op. cit.* 170, figs 4, 5; 171, fig. 6.

Thallus crustose, continuous to rimose or areolate, 2–6 cm wide; areolae 0.4–0.8 mm wide, angular,  $\pm$ plane to weakly convex; prothallus absent. Upper surface white to creamy white, with a powdery to coarsely pruinose surface; cortex 70–80  $\mu\text{m}$  thick, with calcium oxalate crystals ( $\text{H}_2\text{SO}_4^+$ ); medulla 90–110  $\mu\text{m}$  thick, white, filled with calcium oxalate crystals ( $\text{H}_2\text{SO}_4^+$ ). Apothecia 0.50–1.25 mm wide, lecideine, immersed, becoming adnate to sessile; disc black, slightly white-pruinose, rarely epruinose, initially plane, becoming convex; proper margin thin, persistent. Proper exciple 70–100  $\mu\text{m}$  thick; outermost layer dark brown, thin, K–; inner layer pale brown to bright red, K+ yellow solution. Epithymenium 10–12  $\mu\text{m}$  thick, dark brown, K–, N–; hymenium 75–90  $\mu\text{m}$  thick, colourless, not interspersed; hypothecium c. 90  $\mu\text{m}$  thick, pale brown; subhypothecium 80–100  $\mu\text{m}$  thick, bright red, K+ yellow solution. Paraphyses 2–3  $\mu\text{m}$  wide, irregularly branched; apices 5–6  $\mu\text{m}$  wide, with brown or dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate,

brown, ellipsoidal, 13–19 × 6.5–8.0 µm, uniformly thin-walled; torus usually distinct; outer wall weakly ornamented. Pycnidia globose; conidiophores of type VI (Vobis, 1980); conidia bacilliform, 4–7 × 1 µm.

*Chemistry*: Cortex K+ yellow, P–, C–, UV–; medulla K–, P–, C–, UV–; containing atranorin (major), eumitrin U (major), secalonic acid A (minor), unknown secalonic acid derivative (minor), pannarin (minor or trace).

Endemic on limestone rocks in southern W.A., S.A., N.S.W. and Vic.

W.A.: Madura Pass, Eyre Hwy, *J.A.Elix 41656* (CANB). S.A.: 15 km E of Springton, overlooking the Marne R., *J.A.Elix 850* (CANB). N.S.W.: Blue Waterholes, Caves Ck, 42 km WNW of Adaminaby, *J.A.Elix 25810* (CANB). Vic.: Buchan–Gelantipy road, 6 km NNE of Buchan, *H.Streimann 39787A* (CANB).

*Buellia cinnabarina* is distinguished by its white to creamy white, crustose thallus with a powdery to coarsely pruinose surface, the bright red pigment below the hypothecium extending into the excipulum, *Buellia*-type ascospores and the presence of atranorin, eumitrin U and pannarin.

## 7. *Buellia cranfieldii* Elix, *Australas. Lichenol.* 66: 45 (2010)

T: Boyagin Rock, Boyagin Nature Reserve, 20 km NW of Pingelly, W.A., 32°28'S, 116°53'E, alt. 350 m, on large granite outcrop, 11 Sept. 1994, *J.A.Elix 40978*, *H.T.Lumbsch & H.Streimann*; holo: PERTH; iso: CANB.

Illustration: J.A.Elix, *op. cit.* 49, fig. 2.

Thallus crustose, ±continuous to areolate, 4–10 cm wide; areolae 0.4–0.8 mm wide, angular, ±plane to weakly convex; prothallus conspicuous or not, black, delimiting the thallus and c. 0.2 mm wide, also growing between areolae. Upper surface whitish to grey-white, grey or dark grey, dull, epruinose, phenocorticate; cortex 20–25 µm thick; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), 100–200 µm thick, occasionally filled with algal cells, IKI–. Apothecia 0.1–0.5 mm wide, lecideine, scattered, round or distorted by mutual pressure, immersed then adnate; disc very dark brown to black, epruinose, plane, rarely becoming slightly convex with age; proper margin thin, persistent, rarely becoming excluded, black or masked by a necrotic thalline veil. Proper exciple 25–55 µm thick, poorly differentiated; outer zone greenish black or carbonaceous, K–, N+ red-violet. Epithymenium 7–18 µm thick, aeruginose, K–, N+ red-violet; hymenium 40–50 µm thick, colourless, not interspersed; hypothecium 30–50 µm thick, pale brown to brown. Paraphyses 2.0–2.5 µm wide, simple to weakly branched; apices 3.0–3.5 µm wide, with brown or dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to brown, ellipsoidal, 10–14 × 5–8 µm, uniformly thin-walled; outer wall smooth. Pycnidia not seen.

*Chemistry*: Thallus K+ yellow, P+ yellow, C–, UV–; containing atranorin (major), chloroatranorin (minor).

A scattered endemic lichen on siliceous rocks in south-western W.A.

W.A.: Murchison River Gorge, Hawkshead Lookout, Kalbarri Natl Park, 42.5 km ENE of Kalbarri township, *J.A.Elix 33736* (CANB); Dryandra Woodland, Caernarvon Hills, 17 km NW of Narrogin, *J.A.Elix 39856* (CANB).

*Buellia cranfieldii* has a whitish to grey-white, grey or dark grey crustose thallus, asci with 8 *Buellia*-type ascospores and an aeruginose outer excipulum and epithymenium that react N+ red-violet. The thallus contains atranorin and chloroatranorin.

## 8. *Buellia desertorum* Müll.Arg., *Hedwigia* 31: 197 (1892)

T: Victoria Desert, W.A., on rock, *R.Helms 51*; holo: G n.v.; iso: MEL.

Thallus crustose, thick, ±continuous to rimose or areolate, up to 3 cm wide; areolae 0.1–0.4 mm wide, angular, subcontiguous, ±plane or concave towards the centre; prothallus inconspicuous or absent. Upper surface yellow to dull yellow-brown, matt to smooth and glossy; cortex 15–20 µm thick; medulla white, up to 100 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), I–. Apothecia 0.2–0.4 mm wide, lecideine, sessile, initially with a pale accessory thalline margin that is soon excluded, solitary or grouped; disc black, epruinose, initially

plane, convex with age, and with a distinct proper margin and the margin excluded. Proper exciple 35–50  $\mu\text{m}$  thick; outer part dark brown; inner part pale brown, K–. Epihymenium 5–10  $\mu\text{m}$  thick, dark brown to brown-black, N–; hymenium 35–50  $\mu\text{m}$  thick, colourless, not inspersed; hypothecium 50–100  $\mu\text{m}$  thick, dark brown, K–. Paraphyses 1.5–2.5  $\mu\text{m}$  wide, sparingly branched; apices 4–5  $\mu\text{m}$  wide, with brown caps. Asci *Bacidia*-type, usually 8-spored. Ascospores *Physconia*-type, 1-septate, brown, globose to subglobose, 7–9  $\times$  6–7  $\mu\text{m}$ , with median thickenings; torus indistinct; outer spore smooth to finely ornamented. Pycnidia not seen.

**Chemistry:** Thallus K+ yellow, P+ pale yellow, C+ orange, UV+ yellow or orange; containing atranorin (major), thuringione (major), chloroatranorin (minor).

A very rare endemic on siliceous rocks in inland W.A. and northern N.T.

N.T.: Murrenja Hills, 26 km NNE of mouth of Daly R., *J.A.Elix 27733*, *H.T.Lumbsch & H.Streimann* (CANB).

This species is characterised by the crustose, yellow to dull yellow-brown thallus, black apothecia with an initially pale, accessory thalline margin, very small, subglobose to globose ascospores, and by the presence of atranorin and thuringione.

**9. *Buellia dijiana*** Trinkaus, in U.Trinkaus, H.Mayrhofer & J.A.Elix, *Lichenologist* 33: 52 (2001)

T: between Morgan and Eudunda, c. 5 km SW of Morgan, Murray Region, S.A., 34°03'S, 139°37'E, on soil in mallee scrub, 12 Dec. 1996, *U.Trinkaus 414*; holotype: AD *n.v.*; iso: CANB, GZU *n.v.*

Illustrations: U.Trinkaus, H.Mayrhofer & J.A.Elix, *op. cit.* 53, fig. 1; 54, fig. 2B; 55, fig. 3C (2001).

Thallus crustose to granulose-subsquamulose, if coherent then forming single granules or squamules in the outer part of the thallus, non-effigurate to rarely subeffigurate, 4–10 cm wide; prothallus absent. Upper surface chalky to dirty white, dull, epruinose; cortex 60–90  $\mu\text{m}$  thick; medulla white, with calcium oxalate ( $\text{H}_2\text{SO}_4^+$ ), indistinct or up to 0.4 mm thick, merging with the substratum, occasionally with rhizinose strands. Apothecia 0.9–1.7 mm wide, lecideine, slightly immersed when immature, soon sessile; disc black, usually finely yellowish white-pruinose, plane but becoming convex; proper margin initially distinct, becoming excluded. Proper exciple 30–70  $\mu\text{m}$  thick, brown in the outer part, colourless within. Epihymenium 7–12  $\mu\text{m}$  thick, brown, K–, N–; hymenium 75–110  $\mu\text{m}$  thick, colourless, not inspersed; hypothecium 60–125  $\mu\text{m}$  thick, brown. Paraphyses 2–3  $\mu\text{m}$  wide, simple to weakly branched; apices 4–7  $\mu\text{m}$  wide, with brown or dark brown caps. Asci *Bacidia*-type, 8-spored, occasionally fewer. Ascospores *Buellia*-type, 1-septate, olive-green to brown, ellipsoidal, 14–21  $\times$  5.5–10.0  $\mu\text{m}$ , uniformly thin-walled; outer wall ornamented. Pycnidia immersed; wall brown in the upper part, paler below; conidia filiform, 13–25  $\times$  1  $\mu\text{m}$ .

**Chemistry:** Thallus K–, P–, C+ orange around the algal layer (in section), UV–; containing arthothelin (major), 4,5-dichloronorlichexanthone (minor), thiophanic acid (minor).

A common endemic lichen on soil in drier areas of southern W.A., S.A. and N.S.W.

W.A.: 80 km E of Balladonia, Eucla Division, *N.N.Donner 3104* (AD). S.A.: 5 km N of Fowlers Bay township, Eyre Penin., *N.N.Donner 7136* (AD); 4 km E of Chinamans Well, Yorke Penin., *J.A.Elix 3773* (CANB). N.S.W.: London Bridge, Googong Dam Foreshore Reserve, 18 km S of Queanbeyan, *J.A.Elix 33113 & H.Mayrhofer* (CANB).

Characterised by the crustose to subsquamulose, usually non-effigurate thallus, the pruinose apothecia and the presence of arthothelin.

**10. *Buellia dispersa*** A.Massal., *Sched. Crit.* 8: 150 (1856)

T: Nel fossato Granarolo, Italy, 22 Jan. 1853, *F.Baglietto*; lecto: VER *n.v.*, *fide* C.Scheidegger, *Lichenologist* 25: 356 (1993).

*Buellia retrovertens* Tuck., *Syn. N. Amer. Lich.* 2: 89 (1888). T: Rocky Mountains, Colorado, U.S.A., 1879, *Brandege* in Herb. Sprague [ex Tuckerman sheet No. 3282]; iso: FH *n.v.*

*Catolechia marginulata* Müll.Arg., *Hedwigia* 31: 195 (1892); *Buellia marginulata* (Müll.Arg.) Zahlbr., *Cat. Lich. Univ.* 7: 464 (1931). T: Everard Ra., S.A., ad saxa arenaria, *R.Helms* 96; holo: G n.v.; iso: MEL.

For further synonymy, see Scheidegger (1993), Bungartz *et al.* (2002).

Illustrations: C.Scheidegger, *Lichenologist* 25: 326, fig. 7A; 330, fig. 10C (1993); F.Bungartz, C.Scheidegger & T.H.Nash, *Biblioth. Lichenol.* 82: 25, figs 1–5; 26, figs 6–10; 31, figs 11–14; 32, figs 15–21 (2002); T.H.Nash III, C.Gries & F.Bungartz, *Lichen Fl. Greater Sonoran Desert Region* 3: colour plate (2007).

Thallus crustose, bullate-areolate to subsquamulose or squamulose, moderately thick,  $\pm$ continuous, to 10 cm wide; areolae and/or squamules dispersed, aggregated in irregular patches or forming rosettes with marginal lobes; areolae 0.2–1.0 mm wide; squamules 1.0–1.5 mm wide,  $\pm$ rounded to angular; prothallus absent. Upper surface ivory, grey to pale or dark brown, paler to whitish at the margins, often pruinose, usually dull, rarely glossy, smooth to deeply fissured; cortex 40–50  $\mu$ m thick; medulla white, with calcium oxalate ( $H_2SO_4+$ ), I–. Apothecia 0.3–1.0 mm wide, lecideine, sessile; disc black, usually epruinose, rarely with sparse white pruina, plane or becoming markedly convex with age; proper margin distinct, thin to thick, black, rarely becoming excluded. Proper exciple 40–60  $\mu$ m thick; outer zone dark brown; inner zone deep reddish brown, K–. Epithymenium 5–10  $\mu$ m thick, brown, K–, N–; hymenium 50–70  $\mu$ m thick, colourless, not interspersed; hypothecium 35–65  $\mu$ m thick, dark brown. Paraphyses 2–3  $\mu$ m wide, simple to moderately branched; apices 4–6  $\mu$ m wide, with brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, oblong to ellipsoidal, 9–19  $\times$  4.5–9.0  $\mu$ m; septal walls briefly thickened during spore ontogeny (*Physconia*-type); outer wall finely ornamented. Pycnidia immersed, urceolate to globose; conidia bacilliform, 5–6  $\times$  1  $\mu$ m.

**Chemistry:** Thallus K+ yellow, P+ pale yellow or P–, C–, UV–; containing atranorin (minor), chloroatranorin (minor), 2'-*O*-methylperlatolic acid (major),  $\pm$ confluent acid (minor).

Scattered on siliceous rocks in arid inland W.A., N.T., S.A. and Qld; also in Europe, Africa, Asia and North America.

W.A.: Lake Argyle road, 35 km SE of Kununurra, *J.A.Elix* 22485 & *H.Streimann* (CANB). N.T.: Wigleys Waterhole, MacDonnell Ra., 22 km N of Alice Springs, *J.A.Elix* 11137 & *L.A.Craven* (CANB). Qld: Windorah–Birdsville road, c. 96 km W of Windorah, *R.W.Purdie* 4561 (BRI, CANB).

This species is distinguished by the bullate to squamulose thallus with an ivory, grey to pale or dark brown upper surface, *Buellia*-type ascospores and the presence of atranorin and 2'-*O*-methylperlatolic acid.

### 11. *Buellia georgei* Trinkaus, H.Mayrhofer & Elix, *Lichenologist* 33: 55 (2001)

T: Wilbinga Grove, Yanchep S.F., roadside picnic area N of Yanchep Natl Park, W.A., on soft limestone, 27 Nov. 1996, *U.Trinkaus* 336 & *A.S.George*; holo: PERTH n.v.; iso: AD n.v., CANB, GZU n.v., HO n.v., M n.v., MEL n.v., UPS n.v.

Illustrations: U.Trinkaus, H.Mayrhofer & J.A.Elix, *op. cit.* 54, fig. 2A; 55, fig. 3A; 57, fig. 5.

Thallus subcrustose to effigurate, with short marginal lobes, often forming rosettes, 3–7 cm wide, up to 1.25 mm thick; prothallus absent. Upper surface chalky white, occasionally partly greyish due to an infection by the fungus *Lichenostigma*; cortex 30–100  $\mu$ m thick; medulla white, distinct, with calcium oxalate ( $H_2SO_4+$ ); lower surface with rhizinose strands not attached to the substratum. Apothecia 0.5–1.7 mm wide, lecideine or pseudolecanorine, slightly immersed when young, soon sessile; disc black, usually white-pruinose, plane to weakly convex; proper margin distinct,  $\pm$ excluded with age. Proper exciple 45–90  $\mu$ m thick, dark brown in the outer part, yellow within. Epithymenium 7–12  $\mu$ m thick, yellowish or brown, with distinct yellow crystals, K–, N–; hymenium 100–140  $\mu$ m thick, colourless, not interspersed; hypothecium 90–150  $\mu$ m thick, dark brown. Paraphyses 1–2  $\mu$ m wide, simple to moderately branched; apices 3–5  $\mu$ m wide, with brown or dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-green to dark brown, ellipsoidal, 16–24  $\times$  9.5–14.0  $\mu$ m, slightly constricted at the septum, uniformly thin-walled; outer wall coarsely ornamented. Pycnidia immersed; wall brown above, paler below; conidia filiform, 15–25  $\times$  1  $\mu$ m.

**Chemistry:** Thallus K–, P–, C+ orange around algal layer (in section), UV–; containing arthothelin (major), 4,5-dichloronorlichexanthone (minor or trace), thiophanic acid (minor or trace).

A common endemic species on limestone in southern W.A., S.A., N.S.W., A.C.T., Vic. and Tas.; rare on calcareous soil.

W.A.: 2.7 km N of Leeman, N of Perth, *U.Trinkaus* 353 (PERTH). S.A.: the Swingbridge, Marne R., Mount Lofty Ra., 15 km E of Springton, *J.A.Elix* 18858 & *L.H.Elix* (CANB). N.S.W.: London Bridge, Googong Dam Foreshore Reserve, 18 km S of Queanbeyan, *J.A.Elix* 33080 & *H.Mayrhofer* (CANB). A.C.T.: Cotter Caves, 20 km W of Canberra, *J.A.Elix* 9072 (CANB). Vic.: Nelson, *W.H.Ewers* 6279 (CANB). Tas.: W of township, Killiecrankie Bay, Flinders Is., *G.Kantvilas* 146/07 (CANB, HO).

This lichen is characterised by the subcrustose to effigurate thallus, rather large, coarsely ornamented ascospores and the presence of arthothelin.

## 12. *Buellia glomerulans* (Müll.Arg.) Zahlbr., *Cat. Lich. Univ.* 7: 464 (1931)

*Catolechia glomerulans* Müll.Arg., *Hedwigia* 31: 195 (1892). T: “Ad terram sabulosam rubidam”, near Wallangering, [W.A.], *R.Helms* 55; holo: G.

Thallus crustose, bullate-areolate to subsquamulose or squamulose, ±continuous, up to 5 cm wide and 0.4 mm thick; areolae and/or squamules dispersed, aggregated in irregular patches or forming rosettes with marginal lobes; areolae 0.2–1.0 mm wide; squamules 0.5–1.0 mm wide, ±rounded, broader at the margins of the thallus; prothallus not seen. Upper surface olive-brown to olive-black, dull or glossy; cortex 20–25 µm thick; medulla white, to 250 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), I–. Apothecia 0.5–0.6 mm wide, lecideine, scattered or crowded, rounded, sessile; disc black, epruinose, plane or rarely becoming weakly convex; proper margin thin, black, persistent, rarely becoming excluded. Proper exciple 35–45 µm thick, poorly differentiated; inner part colourless or pale brown; outer part dark red-brown to black-brown, K+ red-violet, N–. Epihymenium 4–10 µm thick, olive-brown to brown-black, N–; hymenium 50–90 µm thick, colourless, not interspersed; hypothecium 60–80 µm thick, dark reddish brown or brown-black. Paraphyses 1.5–2.5 µm wide, simple to moderately branched; apices 3–5 µm wide, with dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to dark brown, oblong to ellipsoidal, 12–14 × 5–6 µm; torus indistinct; outer wall ornamented. Pycnidia sparse; conidia bacilliform, 3–5 × 1 µm.

**Chemistry:** Thallus and medulla K–, P–, C–, UV–; excipulum K+ red-violet; containing cinnamomeic acid D (major).

This very rare endemic species is known only from the type locality in W.A.

*Buellia glomerulans* has an olive-brown to olive-black, bullate to squamulose thallus, black, lecideine apothecia, *Buellia*-type ascospores, a K+ red-violet excipulum and the pigment cinnamomeic acid D.

## 13. *Buellia griseovirens* (Turner & Borrer ex Sm.) Almborn, *Bot. Not.* 1952: 247 (1952)

*Variolaria griseovirens* Turner & Borrer ex Sm., *Engl. Bot.* 36: t. 2400 (1812). T: Statton Strawless heath, Norfolk, England; lecto: BM *n.v.*, *vide* A.Nordin, *Symb. Bot. Upsal.* 31(3): 342 (1996); isolecto: BM *n.v.*

Illustrations: V. Wirth, *Die Flechten Baden-Württembergs*, 2nd edn 193 (1995); A.Nordin, *op. cit.* 341, fig. 8B (1996); T.Foucard, R.Moberg & A.Nordin, *Nordic Lichen Fl.* 2: 92 (2002).

Thallus crustose, thin and ±immersed to thicker, superficial and rimose-areolate, 2–5 cm wide; prothallus pale brown to grey-black or absent. Upper surface pale grey, often with a greenish or brownish tinge, smooth to wrinkled, sorediate; soralia mostly discrete, 0.15–0.40 mm diam., often crowded and occasionally confluent, pale grey-green to ash grey, often with a blue tinge, pale yellow when abraded; soredia 15–25 µm diam.; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), K–, N–, IKI–. Apothecia very rare, 0.4–1.5 mm wide, lecideine, adnate to sessile; disc black, concave, plane or weakly convex, epruinose; proper margin black, thick, persistent, enclosing the disc in young apothecia. Proper exciple 80–120 µm thick; outer zone thin, dark brown; median part pale brown; inner zone dark brown to

carbonaceous, K+ yellow, N-. Epithymenium 7–12 µm thick, brown, K-, N-; hymenium 80–120 µm thick, colourless, not interspersed; hypothecium 140–220 µm thick, dark brown, K+ yellow, N-. Paraphyses 2–3 µm wide, simple to weakly branched; apices 4–6 µm wide, with brown to dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores submuriform, with 8–12 cells and 3 or 4 transverse septa, grey to brown, ellipsoidal, 13–28 × 7–13 µm, uniformly thin-walled; outer wall weakly ornamented. Pycnidia rare, immersed; conidia bacilliform, 4–6 × 1 µm.

*Chemistry*: Thallus K+ yellow or K+ yellow then red, P+ yellow or yellow-orange, C- or C+ yellow, UV-; containing atranorin (major), norstictic acid (minor or trace), ±connorstictic acid (trace).

Rare on bark in Tas.; also in Europe, North America, Asia, Africa and New Zealand.

Tas.: W of New Norfolk along Glenora road, *G.Kantvilas* 54/97 (HO); South Sister, *G.Kantvilas* 287/04 & *J.A.Elix* (HO); 2 km N of Stonehurst Sugarloaf, *G.Kantvilas* 348/03 (HO).

This lichen has a comparatively thin, pale grey thallus and prominent grey-green soralia with farinose soredia; the thallus contains atranorin and norstictic acid.

#### 14. *Buellia halonia* (Ach.) Tuck., *Lich. California* 26 (1866)

*Lecidea halonia* Ach., *Methodus* 47 (1803). T: Cape of Good Hope, Cape Province, South Africa, on hard maritime rock, *P.Osbeck s.n.*; lecto H-ACH 362 *n.v.*, *vide* F.Bungartz, J.A.Elix & T.H.Nash III, *Bryologist* 107: 462 (2004); isolecto: UPS-ACH *n.v.*

For further synonymy, see Bungartz *et al.* (2004).

Illustrations: I.M.Brodo, S.D.Sharnoff & S.Sharnoff, *Lichens of North America* 187, pl. 147 (2001); F.Bungartz, J.A.Elix & T.H.Nash III, *op. cit.* 463, fig. 2; T.H.Nash III, C.Gries & F.Bungartz, *Lichen Fl. Greater Sonoran Desert Region* 3: colour plate (2007).

Thallus crustose, ±continuous to rimose-areolate, 1–5 cm wide; areolae 0.5–1.1 mm wide, angular, ±plane to weakly convex; prothallus usually conspicuous, black, surrounding the thallus and ±visible between areolae. Upper surface yellow-green to pale yellow or yellow-brown, dull or glossy, epruinose, smooth; cortex 50–60 µm thick; medulla white in the upper part, the lower part occasionally with a rust-red, K+ purple pigment, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-. Apothecia 0.2–0.7 mm wide, lecideine, immersed, then adnate to sessile; disc black, plane or rarely convex, epruinose or yellow-pruinose; proper margin thin, persistent, rarely becoming excluded, black or covered by coarse thalline fragments when young. Proper exciple 55–75 µm thick, greenish black to brown-black or carbonaceous throughout, K-, N+ red-violet or red-brown. Epithymenium 10–15 µm thick, brown, K-, N-; hymenium 60–100 µm thick, colourless, not interspersed; hypothecium 100–150 µm thick, dark reddish brown. Paraphyses 1.7–2.1 µm wide, simple to moderately branched; apices 4–5 µm wide, with dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Physconia*-type, 1-septate, olive-brown to brown, oblong to ellipsoidal, 11.5–19.0 × 6–9 µm, usually not constricted at the septum, with median wall thickenings; outer wall weakly ornamented. Pycnidia globose, c. 0.2 mm wide; conidia bacilliform, 5–7 × 1.0–1.5 µm.

*Chemistry*: Thallus K-, C+ yellow-orange, P-, UV+ dull orange; medulla K-, C-, P-, UV-; chemical race 1 containing isoarthothelin (major), 2,5-dichloronorlichexanthone (trace), 2,7-dichloronorlichexanthone (trace), 5,7-dichloronorlichexanthone (trace), thiophanic acid (trace), ±secalonic acid A (minor), eumitrins X,Y (minor), ±atranorin (trace); chemical race 2 arthothelin (major), 2,4-dichloronorlichexanthone (trace), 2,5-dichloronorlichexanthone (trace), 4,5-dichloronorlichexanthone (trace), thiophanic acid (trace), ±secalonic acid A (minor), eumitrins X,Y (minor), ±atranorin (trace).

Scattered on coastal rocks in S.A., N.S.W. and Tas.; also in North and South America, South Africa and New Zealand.

S.A.: Kangaroo Is., *H.Streimann* 54946 (CANB, MSC). N.S.W.: Burrewarra Pt, 13 km S of Batemans Bay, *J.A.Elix* 9142 (CANB). Tas.: Cape Surville, *G.Kantvilas* 297/09 (HO).

Characterised by the yellow-green to pale yellow or yellow-brown, crustose thallus, the *Physconia*-type ascospores, the aeruginose excipulum that reacts N+ red-violet or red-brown, and the presence of isoarthothelin or arthothelin.

### 15. *Buellia homophylia* (C.Knight) Zahlbr., *Cat. Lich. Univ.* 7: 366 (1931)

*Lecidea homophylia* C.Knight, *Trans. Linn. Soc. London*, ser. 2, 2: 45 (1882). T: "Ad saxa", [neighbourhood of Sydney, N.S.W.], *C.Knight* 9; lecto: WELT, *fide* J.A.Elix, *Australas. Lichenol.* 66: 44 (2010).

*Lecidea homophylia* var. *amphibola* C.Knight, *Trans. Linn. Soc. London*, ser. 2, 2: 45 (1882); *Buellia homophylia* var. *amphibola* (C.Knight) Zahlbr., *Cat. Lich. Univ.* 7: 366 (1931). T: "Ad saxa", [neighbourhood of Sydney, N.S.W.], *C.Knight* 22/15; lecto: WELT, *fide* J.A.Elix, *loc. cit.*

*Lecidea homophylia* var. *emphytocarpa* C.Knight, *Trans. Linn. Soc. London*, ser. 2, 2: 45 (1882); *Buellia homophylia* var. *emphytocarpa* (C.Knight) Zahlbr., *Cat. Lich. Univ.* 7: 366 (1931). T: "Ad saxa", [neighbourhood of Sydney, N.S.W.], 28 July 1880, *C.Knight* 22/4; lecto: WELT, *fide* J.A.Elix, *loc. cit.*

*Buellia substellulans* Zahlbr., *Cat. Lich. Univ.* 7: 420 (1931); *Lecidea substellulata* C.Knight, in F.M.Bailey, *Syn. Queensland Fl.*, Suppl. 1: 75 (1886). T: *s. loc.*, Qld, F.M.Bailey; lecto: WELT, *fide* J.A.Elix, *loc. cit.*

*Lecidea substellulata* Nyl., *Flora* 69: 325 (1886), *nom. superfl.* T: "Saxa arenacea", [N.S.W.], *C.Knight*; holo: H-NYL 9232.

Illustration: J.A.Elix, *op. cit.* 49, fig. 1.

Thallus crustose, ±continuous to rimose-areolate, 2–5 cm wide; areolae 0.3–1.1 mm wide, angular, ±plane to weakly convex; prothallus usually conspicuous, black, surrounding the thallus, c. 0.2 mm wide, also growing between the areolae. Upper surface whitish to grey-white or grey, dull or glossy, epruinose; cortex 20–25 µm thick; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I+ purple or I-. Apothecia 0.2–0.6 mm wide, lecideine, immersed to adnate or rarely becoming sessile with age, often crowded and angular due to mutual pressure; disc black, plane or rarely convex, epruinose; proper margin thin, persistent, rarely becoming excluded, black or rarely masked by a necrotic thalline veil. Proper exciple 45–55 µm thick, poorly differentiated; outer zone greenish black to brown-black or carbonaceous, K-, N+ red-violet or red-brown. Epithymenium 7–10 µm thick, dark greenish to olive-brown, K-, N+ red-violet to red-brown; hymenium 35–45 µm thick, colourless, not interspersed; hypothecium 40–55 µm thick, reddish brown. Paraphyses 1.7–2.5 µm wide, simple to weakly branched; apices 4–5 µm wide, with dark green to olive-brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to brown, ellipsoidal, 10–22 × 6–10 µm, ±constricted at the septum, uniformly thin-walled when mature but with apical wall thickenings when young; outer wall smooth or finely ornamented. Pycnidia not seen.

**Chemistry:** Thallus K+ yellow then red, P+ yellow-orange, C-, UV-; containing atranorin (major), norstictic acid (major), connorstictic acid (minor).

This very common and variable endemic species occurs on siliceous rocks in all States and Territories.

W.A.: near summit of Mt Brown, 3 km SE of York, Darling district, *J.A.Elix* 31693 (CANB). N.T.: Native Gap, Hann Ra., 114 km N of Alice Springs, *J.A.Elix* 11184 & *L.A.Craven* (CANB). S.A.: along Saunders Ck, 6.5 km E of Springton, Mount Lofty Ra., *J.A.Elix* 23506, 23518 (CANB). Qld: Wallaman Falls road, Lannercost S.F., 27 km W of Ingham, *J.A.Elix* 15876 & *H.Streimann* (CANB). N.S.W.: Ten Mile Ck, 1.5 km SSW of Gingham Gap, Goobang Natl Park, *J.A.Elix* 39354 (CANB). A.C.T.: Aranda Bushland, Canberra Nature Park, 4 km W of Canberra, *J.A.Elix* 28732 (CANB). Vic.: Middle Mtn, 2 km NE of Suggan Buggan, East Gippsland, *D.Verdon* 3591 (CANB). Tas.: Esk Hwy, c. 7.7 km E of railway bridge, near Llewellyn Siding, *J.A.Elix* 28793 & *G.Kantvilas* (CANB).

*Buellia homophylia* is characterised by the whitish to grey-white or grey, crustose thallus, the immersed then adnate and commonly crowded, angular apothecia, the prominent black prothallus, *Buellia*-type ascospores, the N+ red-violet to red-brown epithymenium and the presence of atranorin and norstictic acid.

**16. Buellia inturgescens** Müll.Arg., *Hedwigia* 31: 197 (1892)

T: "graniticola in desertis Australiae occid., ad expeditionis Camp 14", [Pingeurrinna Hill, S.A.], *R.Helms 81*; holo: G.

Thallus crustose, thick,  $\pm$ continuous to rimose-areolate, to 2 cm wide and 0.3 mm thick; areolae 0.3–1.0 mm wide, angular, initially subcontiguous, then separated and becoming convex; prothallus not apparent. Upper surface off-white to pale yellow brown or yellowish grey, dull or glossy; cortex 15–25  $\mu$ m thick; medulla white, 100–280  $\mu$ m thick, lacking calcium oxalate ( $\text{H}_2\text{SO}_4^-$ ), I-. Apothecia 0.5–0.8 mm wide, lecideine, scattered,  $\pm$ round, adnate; disc black, epruinose, plane, becoming convex with age; proper margin thin, becoming excluded. Proper exciple 50–80  $\mu$ m thick, poorly differentiated; inner zone colourless; outer zone dark red-brown to black-brown, K-. Epihymenium 7–15  $\mu$ m thick, olive-brown to greenish black, K-, N+ red-brown; hymenium 60–70  $\mu$ m thick, colourless, not interspersed; hypothecium 45–65  $\mu$ m thick, pale to deep reddish brown K-. Paraphyses 1.8–2.2  $\mu$ m wide, simple to sparingly branched; apices 3.5–5.0  $\mu$ m wide with brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, subglobose to broadly ellipsoidal, 9–15  $\times$  6–8  $\mu$ m; torus indistinct; outer wall ornamented. Pycnidia not seen.

*Chemistry*: Thallus K+ yellow then pale red, P+ pale yellow or P-, C-, UV-; containing atranorin (minor), chloroatranorin (minor), hypostictic acid (major), hyposalazinic acid (minor).

A rare endemic on siliceous rocks in arid, inland Australia (N.T. and S.A.).

N.T.: Native Gap, Hann Ra., 114 km N of Alice Springs, *J.A.Elix 11194* & *L.A.Craven* (CANB).

Characterised by the off-white to pale yellow brown or yellowish grey, areolate thallus, small, *Buellia*-type, subglobose to broadly ellipsoidal ascospores and the presence of atranorin, hypostictic and hyposalazinic acids.

**17. Buellia kimberleyana** Elix, *Australas. Lichenol.* 65: 11 (2009)

T: Lake Argyle Rd, 31 km SE of Kununurra, W.A., 15°59'S, 128°56'E, alt. 160 m, on sandstone rocks along escarpment with *Eucalyptus*, *Xanthostemon* and *Buchanania*, 8 July 1991, *J.A.Elix 27791*, *H.T.Lumbsch* & *H.Streimann*; holo: PERTH.

Illustration: J.A.Elix, *op. cit.* 18, fig. 2.

Thallus crustose,  $\pm$ continuous to areolate, up to 3 cm wide and 0.3 mm thick; areolae 0.3–0.8 mm wide, angular,  $\pm$ plane to weakly convex; prothallus conspicuous or not, black, delimiting the thallus, c. 0.2 mm wide, rarely growing between the areolae. Upper surface yellowish grey to ochre or dark brown, matt; cortex 20–25  $\mu$ m thick; medulla white, 95–170  $\mu$ m thick, lacking calcium oxalate ( $\text{H}_2\text{SO}_4^-$ ), IKI-. Apothecia 0.1–0.5 mm wide, lecideine, scattered, rounded, initially immersed, then adnate, rarely becoming  $\pm$ sessile; disc brown-black to black, epruinose, plane, rarely becoming slightly convex; proper margin thin, persistent, rarely becoming excluded, black or masked by a necrotic thalline veil. Proper exciple 35–65  $\mu$ m thick, poorly differentiated; inner part colourless; outer part dark brown, K-. Epihymenium 7–20  $\mu$ m thick, olive-brown, K-, N+ weak red-brown; hymenium 50–55  $\mu$ m thick, colourless, not interspersed; hypothecium c. 40  $\mu$ m high, pale brown to reddish brown, K-. Paraphyses 1.7–2.5  $\mu$ m wide, simple to sparingly branched; apices to 3.5  $\mu$ m wide, with brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, ellipsoidal, 10–16  $\times$  4.5–5.5  $\mu$ m; torus indistinct; outer wall smooth. Pycnidia not seen.

*Chemistry*: Thallus K+ yellow then red, P+ yellow, C-, UV-; medulla K+ yellow then red, P+ yellow, C-, UV-; containing norstictic acid (major), connorstictic acid (minor).

A common endemic lichen on siliceous rocks in the Kimberley region of W.A. and in N.T.

W.A.: along road to Mount Joseph Yard, 25 km E of Lennard River Crossing on the Gibb River Rd, *J.A.Elix 22286*, *H.Streimann* & *D.J.Galloway* (CANB, PERTH); Gibb River Rd, 54 km NNE of Karunje Stn, *J.A.Elix 27864*, *H.T.Lumbsch* & *H.Streimann* (CANB). N.T.: Native Gap, Hann Ra., 114 km N of Alice Springs, *J.A.Elix 11196* & *L.Craven* (CANB); Bullo River Rd, Pinkerton Ra., 16 km NW of West Baines River Crossing on Victoria Hwy, *J.A.Elix 22069* & *H.Streimann* (CANB).

This species is characterised by the yellow-brown to dark brown thallus, the non-amyloid medulla, *Buellia*-type ascospores and the presence of norstictic acid. *Buellia spuria* var. *amblyogona* is morphologically and chemically similar, but the upper surface is white to grey-white, the medulla is amyloid, and the cortex contains atranorin.

**18. *Buellia lobata*** Trinkaus & Elix, in U.Trinkaus, H.Mayrhofer & J.A.Elix, *Lichenologist* 33: 58 (2001)

T: E side of the Murray R., Blanchetown, S.A., 34°21'S, 139°37'E, on soil, 12 Dec. 1996, *U.Trinkaus 406*; holo: AD *n.v.*; iso: CANB, GZU *n.v.*

Illustrations: U.Trinkaus, H.Mayrhofer & J.A.Elix., *op. cit.* 54, fig. 2C–F; 55, fig. 3B; 59, fig. 7.

Thallus 3–6 cm wide, up to 0.4 mm thick, subcrustose to effigurate-lobate, the marginal lobes with dark tips, with distinct plane lobes in the inner parts, often forming rosettes; prothallus absent. Upper surface white, dirty white to greyish due to an infection by the fungus *Lichenostigma*; cortex 20–50 µm thick; medulla white or indistinct, with calcium oxalate (H<sub>2</sub>SO<sub>4</sub>+); lower surface with rhizinoose strands not attached to the substratum. Apothecia 0.5–1.6 mm wide, lecideine, slightly immersed when young, soon sessile; disc black, usually epruinose or weakly white-pruinose, plane; proper margin distinct, becoming excluded. Proper exciple 40–80 µm thick, dark brown in the outer part, colourless within. Epithemium 7–10 µm thick, brown, K–, N–; hymenium 70–110 µm thick, colourless, not interspersed; hypothecium 70–140 µm thick, dark brown. Paraphyses 2–3 µm wide, simple to moderately branched; apices 4–7 µm wide, with brown or dark brown caps. Asci *Bacidia*-type, with 8 or fewer ascospores (often 2–6). Ascospores *Buellia*-type, 1-septate, grey-green to dark brown, ellipsoidal, 15–23 × 6.5–10.5 µm, uniformly thin-walled; outer wall ornamented. Pycnidia immersed; conidia filiform, 15–30 × 1 µm.

*Chemistry*: Thallus K–, P–, C+ orange, UV–; containing arthothelin (major), thuringione (major), 4,5-dichloronorlichexanthone (minor), thiophanic acid (minor or trace).

A common endemic on calcareous soils in southern W.A. and S.A.

W.A.: Eyre Hwy, Nullarbor Plain, 147 km W of Eucla, *H.T.Lumbsch 10745c*, *E.Lumbsch & J.Curnow* (CANB); Caiguna, *G.C.Bratt 67/248* (HO). S.A.: along the Maitland road, 7 km W of Ardrossan, Yorke Penin., *J.A.Elix 3724* (CANB); 8 km S of Black Hill township, *J.A.Elix 9355* (CANB).

This lichen is characterised by the subcrustose to effigurate thallus with distinct plane lobes in the inner part of the thallus, by the presence of arthothelin and thuringione and commonly fewer than 8 ascospores in the ascus.

**19. *Buellia maculata*** Bungartz, in F.Bungartz & T.H.Nash III, *Bryologist* 107: 454 (2004)

*Buellia stigmaea* Tuck., *Syn. N. Amer. Lich.* 2: 90 (1888), *nom. illeg., non Buellia stigmataea* Körb., *Syst. Lich. German.* 226 (1855). T: Chester Co., Pennsylvania, U.S.A., *Michener 209 ex Tuckerman Sheet No. 3281*; lecto: FH *n.v.*, *fide* F.Bungartz & T.H.Nash III, *loc. cit.*; isolecto: US *n.v.*

Thallus crustose, continuous at first, then rimose, rarely becoming areolate, to 5 cm wide and to 0.4 mm thick; prothallus conspicuous or not, black, delimiting the thallus. Upper surface white to whitish grey, dull, smooth and even; cortex 20–25 µm thick; medulla white, 150–350 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), I+ violet. Apothecia 0.2–0.5 mm wide, lecideine, scattered or up to 3 confluent, rounded, immersed, then adnate; disc black, epruinose, plane or rarely weakly convex with age; proper margin thin, persistent, rarely becoming excluded, black or masked by a necrotic thalline veil. Proper exciple 20–65 µm thick, poorly differentiated; inner part colourless; outer part dark brown to black-brown, K–, N–. Epithemium 10–15 µm thick, pale brown to olive-brown, N–; hymenium 70–80 µm thick, colourless, not interspersed; hypothecium 40–85 µm thick, deep red-brown to dark brown, K–. Paraphyses 1.7–2.5 µm wide, simple to moderately branched; apices 3–4 µm wide, with pale brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, oblong to ellipsoidal, 11–15 × 5–6 µm; torus indistinct; outer wall smooth to finely ornamented. Pycnidia not seen.

**Chemistry:** Thallus K+ yellow then red, P+ yellow, C-, UV-; medulla K+ yellow then red, P+ yellow-orange, C-, UV-; containing atranorin (major), norstictic acid (major), connorstictic acid (minor).

Rare on siliceous rocks in eastern Qld and N.S.W.; also in North America.

Qld: Burleigh Heads Natl Park, *J.A.Elix 1092* (CANB). N.S.W.: Nundera Pt, 1 km NE of Kialoa, *J.A.Elix 22962* (CANB).

*Buellia maculata* is characterised by the white to whitish grey thallus, the amyloid medulla, black apothecia that become adnate, a proper exciple and epihymenium lacking aeruginose pigment (N-), *Buellia*-type ascospores and the presence of atranorin and norstictic acid.

## 20. *Buellia mammillana* (Tuck.) W.A.Weber, *Mycotaxon* 27: 493 (1986)

*Rinodina mammillana* Tuck., *Proc. Amer. Acad. Arts Sci.* 7: 226 ('1866') [1868]. T: Honolulu, Oahu, Hawaiian Islands, on volcanic rocks, *Mann s.n.* ex sheet No. 2124a; holo: FH *n.v.*; iso: W *n.v.*

*Buellia australica* Räsänen, *Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo"* 20(3): 14 (1944). T: Korunda [Kuranda], near Cavins [Cairns], Qld, "ad saxa schistosa", Aug. 1893, *F.R.M.Wilson s.n.*; holo: H.

For further synonymy, see Bungartz *et al.* (2007).

Illustrations: F.Bungartz, J.A.Elix & T.H.Nash III, *Bryologist* 107: 466, fig. 3 (2004); T.H.Nash III, C.Gries & F.Bungartz, *Lichen Fl. Greater Sonoran Desert Region* 3: colour plate (2007).

Thallus crustose, ±continuous to rimose, rarely becoming areolate, to 5 cm wide, thin to moderately thick; prothallus distinct, black, delimiting the thallus. Upper surface pale greenish yellow or rarely grey, smooth and matt, rarely glossy, epruinose; cortex 20–25 µm thick; medulla white, 125–150 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I+ blue-purple. Apothecia 0.3–1.2 mm wide, *mammillana*-type (Bungartz *et al.*, 2007), initially lecanorine and immersed, becoming lecideine and adnate to sessile, crowded to scattered; proper margin initially inconspicuous, soon becoming distinct, brown, blackening at maturity; disc dark brown to black, epruinose, plane, becoming convex. Proper exciple 50–80 µm thick, dark brown to dark reddish brown in the outer part, colourless at first then brownish internally. Epihymenium 10–12 µm thick, brown, K-, N-; hymenium 70–90 µm thick, colourless, not interspersed; hypothecium c. 50 µm thick, dark reddish brown. Paraphyses 2–3 µm wide, simple to moderately branched; apices to 5 µm wide, with brown caps. Asci 8-spored, *Bacidia* type. Ascospores *Buellia*-type, brown, oblong to ellipsoidal, not curved, with obtuse ends, 10.5–18.5 × 5.5–10.0 µm; septal walls briefly thickened during spore ontogeny (*Physconia*-type); outer wall ornamented. Pycnidia rare, urceolate to globose; conidia fusiform, 6–14 × 1.0–1.5 µm.

**Chemistry:** Thallus and medulla K+ yellow, P+ yellow or P-, C-, UV+ yellow to orange; chemical race 1 containing atranorin (minor), 4,5-dichlorolichexanthone (minor), 4-chlorolichexanthone (trace), 4,5-dichloro-3-*O*-methylnorlichexanthone (trace), stictic acid (major), cryptostictic acid (minor), peristictic acid (trace), norstictic acid (trace), ±hypostictic acid (trace); chemical race 2 containing atranorin (minor), 4,5-dichlorolichexanthone (minor), 4-chlorolichexanthone (trace), 4,5-dichloro-3-*O*-methylnorlichexanthone (trace), norstictic acid (major), connorstictic acid (minor).

Scattered on siliceous rocks in northern N.T., Qld and N.S.W.; also in North, Central and South America, southern Africa, India and Norfolk Island.

N.T.: Tabletop Ra., Litchfield Natl Park, 56 km SW of Batchelor, *J.A.Elix 38713* (CANB). Qld: Mt Tinbeerwah, 37 km SE of Gympie, *J.A.Elix 35565* (CANB). N.S.W.: Grassy Head, 5 km N of Stuarts Pt, *J.A.Elix 21819A* (CANB).

This lichen is characterised by the apothecia having a thalline exciple that is replaced by a well-developed proper exciple at maturity.

**21. Buellia molonglo** U.Grube & Elix, in U.Grube, H.Mayrhofer & J.A.Elix, *Biblioth. Lichenol.* 88: 164 (2004)

T: Molonglo Gorge Reserve, 16 km SE of Canberra, A.C.T., 35°20'S, 149°15'E, rocks along river bank, 650 m, 24 Nov. 1999, *U.Trinkaus 993* & *J.A.Elix*; holo: CANB.

Illustrations: U.Grube, H.Mayrhofer & J.A.Elix, *op. cit.* 166, figs 1, 2; 167, fig. 3 (2004).

Thallus crustose, ±continuous to rimose or areolate, 2–6 cm wide; areolae 0.3–1.1 mm wide, angular, ±plane to weakly convex; prothallus usually present, black, delimiting the thallus. Upper surface greenish to yellowish or yellow-grey, smooth to waxy, epruinose; cortex 50–60 µm thick; medulla white, the lower part usually containing a bright red pigment, K+ dark yellow, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-). Apothecia 0.4–1.3 mm wide, lecideine, immersed, then adnate or sessile; disc black, plane or rarely convex, epruinose to sparsely yellowish grey-pruinose; proper margin prominent, persistent, rarely becoming excluded, black, in early stages often with coarse thallus fragments. Proper exciple 55–75 µm thick; outer zone greenish black to brown-black, N+ red-violet or red-brown; inner zone dark brown. Epihymenium 7–10 µm thick, greenish black to brown, K-, N+ red-violet to red-brown; hymenium 60–100 µm thick, colourless, not interspersed; hypothecium 100–150 µm thick, brown or lower part red. Paraphyses 1.7–2.1 µm wide, simple to weakly branched; apices 4–5 µm wide, with dark green to olive-brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Physconia*-type, 1-septate, olive-brown to brown, ellipsoidal, 14–19 × 7–8 µm, with weak apical and distinct median wall thickenings; ontogeny of type-B; outer wall weakly ornamented. Pycnidia globose, c. 0.2 mm wide; conidia bacilliform, 4.5–6.5 × 1 µm.

*Chemistry*: Thallus K-, C+ yellow-orange, P-, UV+ dull orange, medulla K-, C-, P-, UV-; containing isoarthothelin (major), 2,5-dichloronorlichexanthone (trace), 2,7-dichloronorlichexanthone (trace), 5,7-dichloronorlichexanthone (trace), thiophanic acid (trace), eumitrin U (minor), unknown secalononic acid derivative (minor), ±atranorin (trace).

A rare endemic on siliceous rocks in the A.C.T.

A.C.T.: Molonglo Gorge Reserve, 14 km SE of Canberra, *J.A.Elix 11778*, *P.W.James* & *D.Verdon* (CANB).

*Buellia molonglo* is characterised by the greenish to yellowish or yellow-grey, crustose thallus, the *Physconia*-type ascospores, the aeruginose outer excipulum and epihymenium reacting N+ red-violet, the red pigmented lower medulla and hypothecium and the presence of isoarthothelin.

**22. Buellia polyxanthonica** Elix, *Australas. Lichenol.* 64: 31 (2009)

T: Umbrawarra Gorge, 22 km SW of Pine Creek, N.T., 13°57'56"S, 131°41'52"E, alt. 210 m, on sheltered sandstone rock in steep-sided rocky gorge with *Melaleuca*, *Ilex* and *Ficus*, 8 Aug. 2005, *J.A.Elix 38860*; holo: CANB.

Illustration: J.A.Elix, *op. cit.* 36, fig. 2.

Thallus crustose, thin, ±continuous to areolate, to 7 cm wide; areolae 0.1–0.4 mm wide, angular, ±plane; prothallus conspicuous, black, delimiting the thallus, also ±growing between the areolae. Upper surface yellow to dull or deep yellow-green, matt to smooth and glossy; cortex 20–40 µm thick; medulla white, to 250 µm thick, with intermittent patches of a deep red pigment, especially in lower parts, the pigment dissolving in K to give a pale purple solution. Apothecia 0.1–0.5 mm wide, lecideine, numerous, round, sessile, solitary or grouped; disc black, epruinose, ±plane and with a distinct proper margin, becoming convex and with an excluded margin. Proper exciple 35–50 µm thick; outer part dark brown; inner part pale brown K-. Epihymenium 5–10 µm thick, dark brown, K+ forming a deep yellow solution, N-; hymenium 35–50 µm thick, colourless, not interspersed; hypothecium 50–100 µm thick, dark brown, K-. Paraphyses 1.5–2.5 µm wide, sparingly branched; apical cells 4–5 µm wide, with brown caps, N-. Asci *Bacidia*-type, usually 8-spored. Ascospores *Physconia*-type, 1-septate, brown, ellipsoidal, 12–20 × 6–8 µm, with median thickenings; torus indistinct; outer wall finely ornamented. Pycnidia not seen.

*Chemistry*: Thallus K-, P-, C+ orange, UV+ yellow or orange; medulla K-, P-, C-, UV-; containing di-*O*-methylthiophanic acid (major), ±thuringione (major or minor), ±thiophanic

acid (major or minor),  $\pm$ 3-*O*-methylthiophanic acid (major),  $\pm$ arthothelin (trace),  $\pm$ isoarthothelin (trace),  $\pm$ asemone (trace),  $\pm$ 2,7-dichlorolichexanthone (trace),  $\pm$ 3-*O*-methylasemone (trace),  $\pm$ 6-*O*-methylarthothelin (minor or trace), unknown red pigment (minor or trace).

A common endemic lichen on siliceous rocks in the Kimberley region of W.A. and in northern N.T.

W.A.: Lake Argyle road, 31 km SE of Kununurra, *J.A.Elix* 27792, 27807, *H.T.Lumbsch* & *H.Streimann* (CANB); Gibb River Rd, 45 km SSE of Wyndham, *J.A.Elix* 28071, *H.T.Lumbsch* & *H.Streimann* (B, CANB). N.T.: Tabletop Ra., Litchfield Natl Park, 56 km SW of Batchelor, *J.A.Elix* 38707, 38712 (CANB, DNA); Robin Falls, 15 km S of Adelaide River township, *J.A.Elix* 37852 (CANB).

Characterised by the yellow to yellow-green thallus, the presence of numerous xanthenes and a red-pigmented lower medulla. *Buellia molonglo* differs in having a more continuous thallus, larger apothecia, a different red medullary pigment and a different array of xanthenes.

### 23. *Buellia psoromica* Elix, *Australas. Lichenol.* 65: 13 (2009)

T: Beverley–Mawson road, 26 km NE of Beverley, W.A., 32°00'29"S, 117°08'38"E, alt. 270 m, on laterite rocks in remnant *Eucalyptus* woodland, 22 Apr. 2004, *J. A. Elix* 31780; holotype: PERTH.

Illustration: *J.A.Elix*, *op. cit.* 19, fig. 3

Thallus crustose,  $\pm$ continuous to rimose or areolate, 2–5 cm wide; areolae 0.3–1.1 mm wide, angular,  $\pm$ plane to weakly convex; prothallus conspicuous, black, surrounding the thallus, c. 0.2 mm wide, also growing between the areolae. Upper surface whitish to grey-white or grey, matt or glossy, epruinose; cortex 20–25  $\mu$ m thick; medulla 95–110  $\mu$ m thick, white, lacking calcium oxalate ( $H_2SO_4$ -), IKI+ intense purple. Apothecia 0.2–0.6 mm wide, lecideine, numerous, round, immersed to adnate or rarely becoming  $\pm$ sessile; disc black, epruinose, plane, rarely becoming slightly convex; proper margin thin, persistent, rarely excluded with age, black or masked by a necrotic thalline veil. Proper exciple 45–55  $\mu$ m thick; outer zone greenish black to brown-black, K-, N+ red-violet or red-brown; inner zone dark brown. Epihymenium 7–10  $\mu$ m thick, dark greenish brown, K-, N+ red-violet; hymenium 35–45  $\mu$ m thick, colourless, not interspersed; hypothecium c. 50  $\mu$ m thick, reddish brown. Paraphyses 1.7–2.5  $\mu$ m wide, simple to weakly branched; apices 4–5  $\mu$ m wide, with dark green caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, ellipsoidal, 11–16  $\times$  6–9  $\mu$ m, with apical wall thickenings when immature,  $\pm$ constricted at the septum; outer wall faintly ornamented. Pycnidia not seen.

*Chemistry*: Thallus and medulla K+ yellow, P+ yellow, C-, UV-; containing psoromic acid (major), atranorin (major or minor), chloroatranorin (minor), 2'-*O*-demethylpsoromic acid (minor), subpsoromic acid (trace).

A scattered endemic on siliceous rocks in W.A., N.T. and the A.C.T.

N.T.: Macdonnell Ra., 1 km N of Glen Helen Tourist Camp near Alice Springs, *J.A.Elix* 11260 & *L.A.Craven* (CANB). A.C.T.: Murrumbidgee R., 1 km downstream from Casuarina Sands, *J.A.Elix* 918 *p.p.* (CANB).

This lichen has a whitish to grey-white thallus, a conspicuous black prothallus, an amyloid medulla, a dark green epihymenium (N+ red-violet), a reddish brown hypothecium, and the thallus contains atranorin and psoromic acid.

### 24. *Buellia schaeferi* De Not., *Giorn. Bot. Ital.* 2: 199 (1846)

T: Switzerland, *Schaefer* [*Lich. Helv. Exsicc.* No. 200]; lecto: *E n.v.*, *fide* T.Foucard, R.Moberg & A.Nordin, *Nordic Lichen Fl.* 2: 71 (2002).

*Amandinea endachroa* (Malme) Marbach, *Biblioth. Lichenol.* 74: 66 (2000); *Buellia endachroa* Malme, *Ark. Bot.* 21A: 13 (1927). T: Quinta, "prope Rio Grande oppidum", Rio Grande do Sul, Brazil, 6 Dec. 1892, *G.O.A.Malme* 736; holotype: *S n.v.*

Illustrations: O.Galløe, *Nat. Hist. Danish Lichens* 4: pl. 18 (1932); B.Marbach, *Biblioth. Lichenol.* 74: 67, fig. 17 (2000), as *Amandinea endachroa*; T.Foucard, R.Moberg & A.Nordin, *op. cit.* 94.

Thallus crustose, discontinuous and irregular or continuous, weakly rimose-areolate, verruculose or granulose, 2–4 cm wide, lacking a prothallus, with or without a distinct cortex. Upper surface white to grey or olive-brown. Apothecia 0.1–0.4 mm wide, lecideine or biatorine, immersed or soon becoming sessile; disc very dark reddish brown to black, plane to convex, epruinose; thalline exciple initially prominent and concolorous with the thallus, soon reduced or excluded; proper margin narrow to excluded. Proper exciple 20–25  $\mu\text{m}$  thick, K–; outer zone brown. Epihymenium 5–10  $\mu\text{m}$  thick, olive-brown to brown, K–, N–; hymenium 35–70  $\mu\text{m}$  thick, colourless, not interspersed; hypothecium 50–70  $\mu\text{m}$  thick, dark reddish brown to almost colourless. Paraphyses 1.7–1.8  $\mu\text{m}$  wide, simple to branched; apices 4–5  $\mu\text{m}$  wide, with brown or dark brown caps. Asci clavate, *Bacidia*-type, 8-spored, rarely 16-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to brown, ellipsoidal, 6.5–12.0  $\times$  3.5–5.5  $\mu\text{m}$ , uniformly thin-walled; outer wall smooth. Pycnidia immersed, globose, black, 50–70  $\mu\text{m}$  diam.; conidia short-oblong to ellipsoidal, 1.5–3.0  $\times$  0.5–1.0  $\mu\text{m}$ .

*Chemistry*: Thallus K– or K+ pale yellow, C–, P–, UV–; no lichen substances detected, or traces of atranorin present.

Rare on bark or wood in eastern N.S.W.: also in North, Central and South America, Asia, Africa, Europe and Macaronesia.

N.S.W.: Lowdown Forest Park, 14 km from Majors Creek, *L.Tibell 11966* (UPS).

Characterised by the indistinct thallus, asci with 8 or 16 very small, *Buellia*-type ascospores, short-oblong to ellipsoidal conidia, and either no lichen substances or with only traces of atranorin.

## 25. *Buellia spuria* (Schaer.) Anzi, *Cat. Lich. Sondr.* 87 (1860)

*Lecidea spuria* Schaer., *Lich. Helvet. Spicil.* 3: 127 (1828). T: Ad saxa granitica, 1823, *Scheicher* sub *Lecidea atro-alba*, Hepp [*Flechten Europas* No. 33], an Alpenfindlingen, Zürich, Switzerland, *Hepp*; neo: BERN *n.v.*, *vide* C.Scheidegger, *Lichenologist* 25: 356 (1993).

*Buellia lactea* (A.Massal.) Körb., *Parerga Lich.* 183 (1860); *Catolechia lactea* A.Massal., *Ric. Auton. Lich. Crost.* 84 (1852). T: Monte Bolca, Veneto, Italy, on basalt, 1849, *A.Massalongo s.n.*; holo: MOD *n.v.*

*Buellia krempelhuberi* Zahlbr., *Cat. Lich. Univ.* 7: 374 (1931); *Buellia exilis* (Kremp.) Müll.Arg., *Flora* 70: 61 (1887), *nom. illeg., non Buellia exilis* (Flörke) Kremp., *Denkschr. K. Bayer. Bot. Ges.* 4: 202 (1861); *Lecidea exilis* Kremp., *Verh. K.K. Zool.-Bot. Ges. Wien*, B, 30: 346 ('1880') [1881], *nom. illeg., non Lecidea exilis* (Flörke) Nyl., *Acta Soc. Linn. Bordeaux* 21: 382 (1856). T: Rockhampton, Qld, *Thozet 892*; holo: M.

For further synonymy, see Scheidegger (1993), Bungartz *et al.* (2007).

Thallus crustose,  $\pm$ continuous to rimose and areolate, to 7 cm wide, to 1 mm thick; areolae 0.1–0.3 mm wide, angular,  $\pm$ plane; prothallus conspicuous or not, black, delimiting the thallus and growing between the areolae. Upper surface white to whitish grey, dull or glossy; cortex 20–25  $\mu\text{m}$  thick; medulla white, 55–150  $\mu\text{m}$  thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), I+ violet. Apothecia 0.2–1.0 mm wide, lecideine, scattered or up to 3 confluent, rounded, immersed to adnate, rarely sessile; disc black, epruinose, plane or rarely becoming weakly convex; proper margin thin, persistent, rarely becoming excluded, black or masked by a necrotic thalline veil. Proper exciple 20–65  $\mu\text{m}$  thick, poorly differentiated; inner zone colourless; outer zone dark brown to greenish brown, K–, N+ pale violet. Epihymenium 14–18  $\mu\text{m}$  thick, green to olive-brown, N+ pale violet; hymenium 50–90  $\mu\text{m}$  thick, colourless, not interspersed; hypothecium to 40  $\mu\text{m}$  thick, dark brown, K–. Paraphyses 2.0–3.5  $\mu\text{m}$  wide, simple to moderately branched; apices 4–6  $\mu\text{m}$  wide, with brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, oblong to ellipsoidal, 9–18  $\times$  4.5–7.5  $\mu\text{m}$ ; torus indistinct; outer wall finely ornamented. Pycnidia usually sparse; conidia bacilliform, 4.5–6.0  $\times$  1.0–1.5  $\mu\text{m}$ .

Two varieties are separated by thallus chemistry.

Thallus and medulla K+ yellow > red; norstictic (crystals) and connorstictic acids present ..... **25a. var. amblyogona**  
 Thallus and medulla K+ yellow or dark yellow; stictic, constictic and acids present (no crystals)..... **25b. var. spuria**

**25a. *Buellia spuria* (Schaer.) Anzi var. *amblyogona* (Müll.Arg.) Elix, *Australas. Lichenol.* 65: 16 (2009)**

*Buellia amblyogona* Müll.Arg., *Bull. Herb. Boissier* 3: 641 (1895). T: Thursday Is., Qld, *C.Knight s.n.*; holo: G.

**Chemistry:** Thallus K+ yellow then red, P+ yellow, C–, UV–; medulla K+ yellow then red, P+ yellow-orange, C–, UV–; containing atranorin (major), norstictic acid (major), conorstictic acid (minor).

Scattered on siliceous rocks in the Kimberley region of W.A. and in the N.T., Qld and N.S.W.; also in North America.

W.A.: Lake Argyle road, 35 km SE of Kununurra, *J.A.Elix 22470 & H.Streimann* (CANB). N.T.: Surprise Creek Falls, Litchfield Natl Park, 17 km N of Daly River road, *J.A.Elix 39225* (CANB); Bullo River Rd, Pinkerton Ra., 16 km NW of West Baines River Crossing on Victoria Hwy, *J.A.Elix 22069 & H.Streimann* (CANB). Qld: Salvator Rosa Section, Nooga R. campground, Carnarvon Natl Park, *B.Barnsley 1671* (CANB). N.S.W.: Bare Bluff, 20 km N of Coffs Harbour, *J.A.Elix 3538, 3539* (CANB).

**25b. *Buellia spuria* (Schaer.) Anzi var. *spuria***

Illustrations: O.Galløe, *Nat. Hist. Danish Lichens* 4: pl. 25 (1932); I.M.Brodo, S.D.Sharnoff & S.Sharnoff, *Lichens of North America* 188, pl. 148 (2001); F.Bungartz & T.H.Nash III, *Bryologist* 107: 450, fig. 4 (2004).

**Chemistry:** Thallus K+ yellow, P+ yellow, C–, UV–; medulla K+ dark yellow, P+ yellow-orange, C–, UV–; containing atranorin (major), stictic acid (major), constictic acid (minor), cryptostictic acid (minor), menegazziaic acid (minor).

Scattered on siliceous rocks in northern and eastern Australia (W.A., N.T., S.A. and Qld); also in Europe, Macaronesia, Asia, North and Central America, Africa and New Zealand.

W.A.: Mt Cockburn South, Cockburn Ra., 45 km S of Wyndham, *J.A.Elix 22418 & H.Streimann* (B, CANB, PERTH). N.T.: Umbrawarra Gorge, 22 km SW of Pine Creek, *J.A.Elix 38848, 38866, 38871* (CANB). Qld: Cloncurry–Townsville Hwy, 18 km ESE of Cloncurry, *J.A.Elix 20692, 20693 & H.Streimann* (CANB).

**26. *Buellia stellulata* (Taylor) Mudd, *Man. Brit. Lich.* 216 (1861)**

*Lecidea stellulata* Taylor, in W.Mackay, *Fl. Hibernica* 2: 118 (1836). T: Carig Mountains, Kerry, Ireland, *T.Taylor*; lecto: BM n.v., *fide* T.Foucard, R.Moberg & A.Nordin, *Nordic Lichen Fl.* 2: 71 (2002).

[*Buellia prothallina auct. non* (Kremp.) Vain.: R.B.Filson, *Checklist Austral. Lichens* 11, 1983]

For further synonymy, see Scheidegger (1993) and Bungartz *et al.* (2007).

Illustrations: O.Galløe, *Nat. Hist. Danish Lichens* 4: pl. 22–24 (1932); T.Foucard, R.Moberg & A.Nordin, *Nordic Lichen Fl.* 2: 94 (2002); F.Bungartz & T.H.Nash III, *Bryologist* 107: 452, fig. 5 (2004).

Thallus crustose, thin to moderately thick, ±continuous to rimose and areolate, to 8 cm wide; areolae 0.2–0.5 mm wide, angular, ±plane; prothallus conspicuous, black, surrounding the thallus and growing between the areolae, the thalli ±forming mosaics. Upper surface white to pale grey, dull or glossy; cortex 10–15 µm thick; medulla white, 75–90 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), I–. Apothecia 0.2–0.5 mm wide, lecideine, scattered to confluent, rounded, immersed, rarely adnate or sessile; disc black, epruinose, concave, plane or rarely becoming weakly convex; proper margin thin, persistent, rarely excluded with age, black or masked by a necrotic thalline veil that is often raised above the level of thallus. Proper exciple 15–25 µm thick, poorly differentiated; inner zone colourless; outer zone dark brown to greenish brown, K–, N+ pale violet. Epihymenium c. 10 µm thick, greenish brown to dark brown, N+ violet; hymenium 45–70 µm thick, colourless, not interspersed; hypothecium 35–50 µm thick, dark brown, K–. Paraphyses 1.7–2.5 µm wide, simple to moderately branched; apices 3.5–4.0 µm wide, with brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, oblong to ellipsoidal, 8–15 × 4.5–8.5 µm; torus indistinct; outer wall finely ornamented. Pycnidia rare, globose to urceolate; conidia bacilliform, 3.5–5.0 × 0.5–1.0 µm.

**Chemistry:** Thallus and medulla K+ yellow, P+ pale yellow or P–, C–, UV–; containing atranorin (major), confluentiaic acid (major) and/or 2'-*O*-methylperlatolic acid (minor).

Common on coastal rocks in southern S.A., eastern N.S.W. and in Vic.; also also known from Europe, Macaronesia, Africa, Asia, North and South America, Lord Howe Island and New Zealand.

S.A.: 2 km W of Peake, opposite Lindner Rd, *J.A.Elix 43489* (CANB). N.S.W.: Burrill L., *J.A.Elix 21548* (CANB). Vic.: Cape Conran, 18 km E of Marlo, *J.A.Elix 5278* (CANB).

*Buellia stellulata* is characterised by the white to whitish grey thallus, the non-amyloid medulla, black, immersed apothecia, *Buellia*-type ascospores, a dark brown to greenish brown epihymenium and outer excipulum (N+ violet) and by the presence of atranorin,  $\pm$ confluent acid and  $\pm 2'$ -*O*-methylperlatolic acid.

## 27. *Buellia subalbula* (Nyl.) Müll.Arg., *Rev. Mycol.* 2: 79 (1880)

*Lecidea subalbula* Nyl., *Bull. Soc. Linn. Normandie*, sér 2, 2: 516 (1868). T: "ad rupes calcareas, prope Mossâmedes, in regione sterilissima; magis evoluta in Capo Negro", Montes Negros, Benguella, Angola, 1859, *F.M.J.Welwitsch*; lecto: H-NYL 9319a, *fide* F.Büngartz & T.H.Nash, *Biblioth. Lichenol.* 88: 51 (2004); isolecto: H-NYL 9319b; epi: Kalkhügel südl. des Swakoprivers, östl. Swakopmund, Swakopmund, Namibia, 1 Mar. 1989, *V.Wirth & D.Wessels 18702* (STU), *fide* F.Büngartz, *J.A.Elix*, *U.Grube*, *C.Heininger* & *H.Mayrhofer*, *Biblioth. Lichenol.* 106: 31 (2011).

Illustration: F.Büngartz, *J.A.Elix*, *U.Grube*, *C.Heininger* & *H.Mayrhofer*, *op. cit.* 342, fig. 6A–D.

Thallus crustose, thin to thick,  $\pm$ continuous, rimose to  $\pm$ areolate, usually forming distinct circular, subeffigurate to sublobate patches, 4–10 cm wide, to 0.5 mm thick; areolae 0.4–0.8 mm wide, angular,  $\pm$ plane to weakly convex; prothallus delimiting the thallus, pale grey to black, or whitish and indistinct. Upper surface white or, rarely, grey, chalky, dull, heavily pruinose; cortex 50–80  $\mu$ m thick, with calcium oxalate crystals ( $H_2SO_4+$ ); medulla white, 200–500  $\mu$ m thick, filled with calcium oxalate crystals ( $H_2SO_4+$ ), I–. Apothecia 0.3–0.9 mm wide, lecideine, immersed, then adnate to sessile; disc black, epruinose or whitish-pruinose, plane, soon becoming convex; proper margin black, thin, rarely persistent, usually excluded with age. Proper exciple 50–100  $\mu$ m thick; outer zone strongly carbonised, distinctly bluish green to greenish black, N+ red-violet; inner zone colourless to pale red-brown, K–. Epihymenium 9–15  $\mu$ m thick, bluish green to greenish black, K–, N+ red-violet; hymenium 40–50  $\mu$ m thick, colourless, not interspersed; hypothecium 75–100  $\mu$ m thick, deep reddish brown. Paraphyses 2–3  $\mu$ m wide, simple to moderately branched; apical cells 4–6  $\mu$ m wide; caps brown, with a diffuse aeruginose pigment (N+ violet). Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to brown, oblong to ellipsoidal, with obtuse ends, 9–13  $\times$  4–8  $\mu$ m, uniformly thin-walled; torus indistinct; outer wall initially faintly ornamented, later smooth. Pycnidia rare, globose; conidia bacilliform, 2–4  $\times$  1.0–1.5  $\mu$ m.

*Chemistry*: Thallus K+ yellow then red, P+ yellow or yellow-orange, C–, UV– or UV+ orange in part; containing norstictic acid (major), connorstictic acid (minor).

Rare on calcareous rocks in the A.C.T. and Tas.; also in South America and southern Africa.

A.C.T.: Cotter Caves, 20 km W of Canberra, *J.A.Elix 9066* (CANB). Tas.: Fossil Cliffs, Maria Is., *G.Kantvilas 190/00* (HO).

This lichen is characterised by the thick, chalky white thallus with subeffigurate margins, immersed then sessile to adnate apothecia with black, epruinose to greyish white-pruinose discs, the bluish green to greenish black, N+ red-violet outer exciple and epihymenium and the presence of norstictic acid.

## 28. *Buellia subarenaria* Müll.Arg., *Bull. Herb. Boissier* 1: 52 (1893)

T: Kew, [Vic.], on sandstone, *F.R.M.Wilson 1386*; lecto: *G n.v.*, *fide* H.Mayrhofer, *Beih. Nova Hedwigia* 79: 516 (1984); isolecto: NSW.

*Rinodina brattii* H.Mayrhofer, *Beih. Nova Hedwigia* 79: 515 (1984). T: Grass Tree Hill, N of road from Risdon Vale to Richmond, NE of Hobart, Tas., 42°46'45"S, 147°22'26"E, 26 Nov. 1981, *H.Mayrhofer 3303* & *G.Kantvilas*; holo: *GZU n.v.*; iso: *MEL n.v.*

Illustrations: H.Mayrhofer, *op. cit.* 513, fig. 8; 519, fig. 12, as *Rinodina brattii*; M.Kaschik, *Biblioth. Lichenol.* 93: 123, fig. 80 (2006), as '*Rinodina*' *brattii*.

Thallus crustose, ±continuous to rimose-areolate, 2–5 cm wide; areolae 0.3–1.1 mm wide, angular, ±plane to weakly convex; prothallus black-brown or absent. Upper surface yellowish, pale green brown to yellow-brown; cortex 20–25 µm thick; medulla white, 20–25 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I+ purple or I-. Apothecia 0.3–1.0 mm wide, lecideine, immersed at first, then adnate to sessile, scattered to contiguous; disc black, plane to strongly convex, often pale grey-pruinose; proper margin thin, entire to subcrenate, becoming excluded. Proper exciple 45–55 µm thick, brown-black, K-, N+ reddish. Epihymenium 5–10 µm thick, brown, N+ reddish; hymenium 80–100 µm thick, colourless, not interspersed; hypothecium 100–150 µm thick, brown-black. Paraphyses 1.4–1.6 µm wide, contiguous; apices 3–5 µm wide, with brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Physconia*-type tending towards *Buellia*-type, 1-septate, olive-brown to brown, ellipsoidal, 11–17 × 6.5–9.0 µm; torus absent, with septal wall thickenings; outer wall smooth. Pycnidia immersed, punctiform; conidia bacilliform, 5–6 × 0.7–1.0 µm.

*Chemistry*: Thallus K+ yellow, C+ yellow or orange, P+ pale yellow or P-, UV+ orange; containing 2,5,7-trichloro-3-*O*-methylnorlichexanthone (major), atranorin (minor), ±pannarin (minor).

This scattered species occurs on siliceous rocks in southern W.A., eastern Qld, Vic. and Tas.); also in New Zealand.

W.A.: Mondurup Peak, Stirling Ranges Natl Park, *G.Rambold 5341* (M). Qld: S exposed ridge of Mt Cordeaux, Cunninghams Gap Natl Park, *J.Hafellner 15359* & *R.W.Rogers* (GZU). Vic.: Little R., *F.R.M.Wilson 1438* (G). Tas.: Kingston, *G.C.Bratt 1920* & *M.H.Bratt* (HO).

Characterised by the yellowish, pale green-brown to yellow-brown thallus with frequent lecideine apothecia, usually with pruinose discs, *Physconia*- to *Buellia*-type ascospores and the presence of atranorin and 2,5,7-trichloro-3-*O*-methylnorlichexanthone.

## 29. *Buellia subcoronata* (Müll.Arg.) Malme, *Ark. Bot.* 21A: 23 (1927)

*Catolechia subcoronata* Müll.Arg., *Hedwigia* 31: 195 (1892). T: "Ad terram Australia desert occident.", Depot 1, [Mt Illilinna, S.A.], *R.Helms 26*; syn: G; isosyn: MEL.

Illustration: D.J.Eldridge & M.E.Tozer, *Practical Guide to Soil Lichens and Bryophytes of Australia's Dry Country* 36, fig. 4.14 (1997).

Thallus squamulose, 2–4 cm wide, up to 1 mm thick; squamules adnate, orbicular to somewhat irregular, often crowded, plane to irregularly undulate or bullate, ultimately reticulately grooved; prothallus absent. Upper surface white, dirty white, olive-green to olive-brown or yellow-brown; cortex 25–50 µm thick; medulla white, 250–900 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-); lower side with rhizinose strands not directly attached to the substratum. Apothecia 0.8–1.0 mm wide, lecideine, erumpent, with an accessory thalline margin that becomes markedly dentate-coronate but excluded with age; disc black, epruinose, plane to markedly convex; proper margin distinct, thin to moderately thick, becoming excluded. Proper exciple 50–100 µm thick, dark brown in the outer part, colourless within. Epihymenium 8–13 µm thick, dark brown to brown-black, K-, N-; hymenium 50–60 µm thick, colourless, not interspersed; hypothecium 25–75 µm thick, dark brown to brown-black. Paraphyses 2–3 µm wide, simple to moderately branched; apices 4–6 µm wide, with brown or dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, brown, oblong to ellipsoidal, 12–20 × 5–10 µm, uniformly thin-walled; outer wall ornamented. Pycnidia immersed; conidia filiform, 12–20 × 1 µm.

*Chemistry*: Thallus K+ yellow or yellow then red, C-, P+ yellow or yellow-orange, UV-; three chemical races have been observed: 1, containing atranorin (minor), chloroatranorin (minor), norstictic acid (major), connorstictic acid (minor); 2, containing norstictic acid (major), connorstictic acid (minor); and 3, containing atranorin (major), chloroatranorin (minor).

A common endemic on soils in southern and central Australia (W.A., N.T., S.A. and N.S.W.).

W.A.: Bullfinch–Evanston road, 24.7 km N of Bullfinch, *J.A.Elix 32476* (CANB). N.T.: Liddle Hills, 13 km N of Angus Downs HS, *J.A.Elix 11178* & *L.A.Craven* (CANB). N.S.W.: Brennans Rd, Lincoln S.F., 15 km ENE of Bellodoran, 21 km SE of Gilgandra, *J.A.Elix 38455* (CANB).

This species has a white, dirty white, olive-green to olive-brown or yellow-brown squamulose thallus and erumpent apothecia with an accessory, markedly dentate-coronate thalline margin. The thallus contains atranorin and/or norstictic and connorstictic acids.

### 30. *Buellia ventricosa* Müll.Arg., *Flora* 66: 79 (1883)

T: Mt Macedon, [Vic.], Nov. 1882, *Moffat*; holotype: G n.v.

Thallus crustose, weakly verrucose, ±continuous to rimose-areolate, 1–3 cm wide; prothallus absent. Upper surface dirty white to yellow-white; cortex 10–15 µm thick; medulla white, 20–25 µm thick, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-. Apothecia 0.2–0.4 mm wide, lecideine, sessile to adnate; disc black, plane to concave, epruinose; proper margin moderately to very broad, persistent. Proper exciple 50–70 µm thick, dark brown to brown-black, paler internally, K-. Epihymenium 5–10 µm thick, olive-green to olive-brown, K-; hymenium 100–120 µm thick, colourless, densely interspersed with oil droplets; hypothecium 80–100 µm thick, carbonaceous. Paraphyses 1.6–1.8 µm wide, simple to branched; apices 3.0–3.5 µm wide, with brown or dark brown caps. Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-green to olive-brown, broadly ellipsoidal to subglobose, 12–14 × 10–11 µm, uniformly thin-walled; outer wall smooth. Pycnidia not seen.

*Chemistry*: Thallus K+ yellow then red, C-, P+ yellow-orange, UV-; containing norstictic acid (major), connorstictic acid (minor), 4,5-dichlorolichexanthone (minor).

A rare endemic species on bark in southern and eastern Vic.

Vic.: Goonmirk Rocks Rd, Errinundra Natl Park, 20 km SE of Bonang, *J.A.Elix 39865A* (CANB).

Characterised by the dirty white to yellow-white crustose thallus, the broadly ellipsoidal to subglobose, *Buellia*-type ascospores, the densely interspersed hymenium and the presence of norstictic acid and 4,5-dichlorolichexanthone.

### 31. *Buellia vioxanthina* Elix, *Australas. Lichenol.* 64: 32 (2009)

T: near summit of Mt Leswell, 32 km S of Cooktown, Qld, 15°46'S, 145°15'E, alt. 440 m, on granite in *Eucalyptus*-dominated woodland, 5 July 1984, *J.A.Elix 17356* & *H.Streimann*; holotype: BRI.

Illustration: *J.A.Elix, op. cit.* 37, fig. 3.

Thallus crustose, ±continuous to areolate, up to 5 cm wide and 0.4 mm thick; areolae 0.1–0.5 mm wide, angular, ±plane to convex; prothallus conspicuous, black, delimiting the thallus, c. 0.2 mm wide, also growing between the areolae. Upper surface whitish to grey-white or grey to yellowish or greenish grey, matt to glossy, rarely becoming eroded and somewhat granular; cortex 20–25 µm thick; upper medulla colourless to pale yellow, 100–150 µm thick; lower medulla dark yellow-green to orange or dark red-brown, 125–150 µm thick, K-. Apothecia 0.3–1.0 mm wide, lecideine, numerous, rounded, adnate, solitary or rarely in groups of 2–4; disc black, epruinose or rarely slightly white-pruinose, plane, rarely becoming slightly convex. Proper exciple 50–80 µm thick; outermost layer dark brown, thin, due to the pigmented caps of the outermost hyphal cells; inner zone paler brown, K-. Epihymenium 10–12 µm thick, dark brown, K-, N-; hymenium 70–90 µm thick, colourless, not interspersed; hypothecium c. 50 µm thick, greenish yellow to pale reddish brown; subhypothecium dark red-brown, 80–100 µm thick. Paraphyses 2–3 µm wide, sparingly branched from the base; apices 4–5 µm wide, with brown caps (N-). Asci *Bacidia*-type, usually 8-spored. Ascospores *Buellia*-type, 1-septate, brown, oblong to broadly ellipsoidal, 12–16 × 5–8 µm, with apical and septal wall thickenings when young; torus usually distinct; outer wall finely ornamented to smooth. Pycnidia not seen.

*Chemistry*: Thallus K+ yellow, P+ yellow, C-, UV-; medulla K+ yellow then red, P+ orange-red, C-, UV-; containing norstictic acid (major), atranorin (major or minor), chloroatranorin (minor), connorstictic acid (minor), vioxanthin (minor), norvioxanthin (minor).

A scattered endemic on siliceous rocks in northern W.A., N.T. and Qld.

W.A.: King Edward R., 54 km NNW of King Edward River Stn (Doongan Stn), *J.A.Elix 27958*, *H.T.Lumbsch & H.Streimann* (CANB). N.T.: Wangi Falls, Litchfield Natl Park, 74 km SW of Batchelor, *J.A.Elix 38027* (CANB). Qld: Jourama Falls, Paluma Range Natl Park, 23 km S of Ingham, *J.A.Elix 37211* (CANB).

*Buellia vioxanthina* is characterised by the usually whitish to grey-white thallus, adnate apothecia with black discs, a yellow-green to orange or red-pigmented lower medulla and/or subhypotheecium and the presence of atranorin, norstictic acid and vioxanthin.

**32. *Buellia xantholeuca* Bungartz & U.Grube, in F.Bungartz, J.A.Elix, U.Grube, C.Heininger & H.Mayrhofer, *Biblioth. Lichenol.* 106: 32 (2011)**

T: Wanna, Lincoln Natl Park, 18 km S of Port Lincoln, S.A., 34°54'S, 135°52'E, alt. 25 m, on limestone rocks among scattered low shrubs, 22 Sept. 1994, *J.A.Elix 41788*; holotype: CANB; isotype: B.

Illustrations: F.Bungartz, J.A.Elix, U.Grube, C.Heininger & H.Mayrhofer, *op. cit.* 432, fig. 6E–H; 434, fig. 8A, B.

Thallus crustose, continuous to rimose but not areolate, usually forming circular sublobate patches, 4–8 cm wide; prothallus delimiting the thallus, distinctly blackened to pale gray, or white and indistinct. Upper surface white or often with a yellowish tinge, chalky, dull, heavily pruinose; cortex 70–80 µm thick, with calcium oxalate crystals (H<sub>2</sub>SO<sub>4</sub>+); medulla white, filled with calcium oxalate crystals (H<sub>2</sub>SO<sub>4</sub>+), I– 90–110 µm thick. Apothecia 0.3–1.2 mm wide, lecideine, immersed then adnate to sessile; disc black, usually with a dense fine white pruina, plane or weakly convex with age; proper margin white to pale grey, thick, persistent, hyaline to very weakly pigmented, but typically not carbonised and whitish-pruinose, thus resembling a thalline margin. Proper exciple 70–100 µm thick; outer layer hyaline to very weakly carbonised with low concentrations of a brown pigment (N–); inner layer pale to deep red-brown, K–. Epihymenium 9–13 µm thick, pale brown to brown, K–, N–; hymenium 40–50 µm thick, colourless, not interspersed; hypothecium c. 90 µm thick, deep reddish brown. Paraphyses 2–3 µm wide, simple to moderately branched; apices 4–6 µm wide, with brown caps (N–). Asci *Bacidia*-type, 8-spored. Ascospores *Buellia*-type, 1-septate, olive-brown to brown, oblong to broadly ellipsoidal, with obtuse ends, 11–20 × 6–10 µm; septum narrow, slight thickening of the septum during spore ontogeny; torus indistinct; outer wall smooth. Pycnidia rare, urceolate to globose; conidia bacilliform, 4–5 × 1.0–1.5 µm.

**Chemistry:** Thallus K–, C– or C+ bright yellow, KC–, P–; medulla K–, C+ orange, KC+ dull orange to red, P–, UV+ bright orange; containing 2,5,7-trichloro-3-*O*-methylnorlichexanthone (major), thiophanic acid (major or absent), isoarthothelin (minor).

A scattered endemic species on calcareous rocks in southern W.A. and S.A.

W.A.: Eyre Hwy, 22 km ENE of Mundrabilla, *J.A.Elix 41660* (CANB); Old Coast Rd, c. 40 km S of Mandurah, *U.Trinkaus 689* (GZU). S.A.: near Saltia Hill, Southern Flinders Ra., 17 km ENE of Port Augusta, *J.A.Elix 41871* (B, CANB).

*Buellia xantholeuca* is characterised by the thick, chalky white to yellowish white thallus with sublobate margins, immersed then adnate to sessile apothecia with black, white-pruinose discs, the hyaline to weakly carbonised outer part of the excipulum and the presence of xanthonones.

### Doubtful and Excluded Names

*Baculifera remensa* (Stirt.) Marbach, *Biblioth. Lichenol.* 74: 144 (2000)

*Buellia parasema* var. *vulgata* Th.Fr., *Lichenogr. Scand.* 2: 590 (1874); *Buellia disciformis* var. *vulgata* (Th.Fr.) H.Olivier, *Fl. Lich. Orne* 2: 219 (1884).

Reported as *B. parasema* var. *vulgata* from Victoria (J.Müller, *Ann. K. K. Naturhist. Hofmus.* 7: 302, 1892; J.Müller, *Bull. Herb. Boissier* 1: 50, 1893) and Queensland (F.M.Bailey, *Bot. Bull. Dept Agric. Queensland* 3: 28, 1891), no Australian material has been examined.

*Baculifera remensa* is restricted to Central and South America and the Hawaiian Islands (Marbach, 2000: 144).

*Buellia abstracta* (Nyl.) H.Olivier, *Bull. Acad. Intern. Géogr. Bot.* 12: 176 (1903)

*Buellia meiosperma* auct. non (Nyl.) Müll.Arg., *Revue Mycol.* 9: 86 (1887); *Lecidea meiosperma* Nyl., *Ann. Sci. Nat. Bot.*, sér. 4, 15: 49 (1861); *Buellia subdisciformis* var. *meiosperma* (Nyl.) J.Steiner, *Verh. K.K. Zool.-Bot. Ges. Wien*, B, 62: 363 (1907).

Reported from Victoria by J.Müller (*Bull. Herb. Boissier* 1: 53, 1893), this exclusively Northern Hemisphere species has an immersed thallus, very narrow ascospores, and it contains norstictic acid (M.Giralt, F.Bungartz & J.A.Elix, *Mycol. Progr.* 10: 115–119, 2011). No authentic material has been seen from Australia.

*Buellia aeruginascens* (Nyl.) Zahlbr., *Cat. Lich. Univ.* 7: 331 (1931)

Reported from Queensland by J.Hafellner, R.B.Filson & R.W.Rogers (*Nova Hedwigia* 48: 229–235, 1989), this was almost certainly a misidentification of *Cratiria aggreadiens* or *C. melanochlora* (fide B.Marbach, *Biblioth. Lichenol.* 74: 328, 2000).

*Buellia cretacea* Müll.Arg., *Flora* 72: 512 (1889)

This species was reported from Western Australia by F.R.M.Wilson (*Victorian Naturalist* 6: 180, 1890). However, no material has been seen, and the report of this South American species is probably a misidentification of *Buellia albula*.

*Buellia diploimmoides* Müll.Arg., *Flora* 64: 524 (1881)

Reported from Victoria by J.Müller (*Bull. Herb. Boissier* 1: 53, 1893), the type of this saxicolous species is from Brazil, and no authentic Australian collections have been located.

*Buellia disciformis* var. *cinereoferruginea* (C.Knight) Zahlbr., *Cat. Lich. Univ.* 7: 352 (1931)

*Lecidea disciformis* var. *cinereoferruginea* C.Knight, in J.Shirley, *Proc. Roy. Soc. Queensland* 6: 182 (1889).

According to the protologue, this lichen occurred on bark in Indooroopilly and Kelvin Grove (now suburbs of Brisbane, Queensland). However, the only specimen in the Knight herbarium (WELT) is labelled *J.Shirley 71*, Moreton Bay. Filson (*Index to Type Specimens of Australian Lichens: 1800–1984* 115, 1986) claimed it to be the holotype, but this is incorrect, as it is growing on rock and has much larger ascospores than those described for the type ( $8 \times 3 \mu\text{m}$ ).

*Buellia epigaea* (Hoffm.) Tuck., *Gen. Lich.* 185 (1872)

Reported from Western Australia (N.Sammy, *Mycotaxon* 35: 417–428, 1989) and South Australia (R.B.Filson & R.W.Rogers, *Lichens of South Australia* 61, 1979), a revision of this species group in Australia by Trinkaus *et al.* (*Lichenologist* 33: 47–62, 2001) confirmed that *B. epigaea* s. str. is confined to the Northern Hemisphere, and that Australian reports has been misidentifications of *B. dijiana*, *B. georgei* or *B. lobata*.

*Buellia erubescens* Arnold, *Verh. K.K. Zool.-Bot. Ges. Wien*, B, 25: 493 (1875)

*Buellia parasema* var. *saprophila* (Ach.) Körb., *Syst. Lich. German.* 288 (1855).

Reported from Queensland by F.M.Bailey (*Bot. Bull. Dept Agric. Queensland* 3: 20–32, 1891) and from an unspecified Australian locality (B.J.Coppins, C.Scheidegger & A.Aptroot, *Lichens of Great Britain and Ireland*, 2nd edn 233, 2009), no authentic material has been seen from Australia. This species occurs in Europe, North and Central America, Macaronesia, Asia and Africa.

*Buellia fuliginosa* Müll.Arg., *Bull. Herb. Boissier* 1: 50 (1893)

T: Mt Macedon, Vic., on dead *Eucalyptus* timber, 1891, *F.R.M. Wilson 1691 p.p.*; holo: G n.v.

This lichen does not belong to *Buellia* as the apothecia form a mazedium. Thus, it is possibly a species of *Calicium*.

*Buellia hypomelaena* Müll.Arg., *Nuovo Giorn. Bot. Ital.* 21: 361 (1889)

Reported from Victoria by J.Müller (*Bull. Herb. Boissier* 1: 53, 1893). The type of this saxicolous species is from Brazil, and no authentic Australian collections have been located.

*Buellia innata* Müll.Arg., *Proc. Roy. Soc. Edinburgh* 11: 465 (1882)

This saxicolous lichen was reported from Queensland by F.M.Bailey (*Bot. Bull. Dept Agric., Queensland* 3: 29, 1891). The type is from Socotra (Yemen), and no authentic Australian collections have been located.

*Buellia ocellata* (Flot.) Körb., *Syst. Lich. German.* 224 (1855)

Reported from Victoria (P.M.McCarthy, *Checklist Austral. Lichens*, 4th edn 15, 1991), this lichen is known from Europe, North America, Macaronesia, Asia and Africa. However, no authentic material has been confirmed from Australia, and the previous record was probably based on a misidentification of the common and closely related *B. halonia*.

*Buellia parasema* var. *rugulosa* (Schaer.) Körb., *Syst. Lich. German.* 228 (1855)

This lichen was reported from Mount Gravatt, now a suburb of Brisbane, Queensland, by F.M.Bailey (*Bot. Bull. Dept Agric. Queensland* 3: 28, 1891). However, the type material has not been located, and the identity of this European taxon is uncertain. Indeed, supposedly authentic European collections [L.Mudd, *Exsicc.* nos 188, 191, 192 (1860), *vide* A.L.Smith, *Monogr. Brit. Lichens* 2: 204, 1926) included *Diplotomma alboatra* as well as *Buellia disciformis*.

*Buellia perexigua* Müll.Arg., *Bull. Herb. Boissier* 1: 53 (1893)

T: Erskine River, Vic., on sandstone, *F.R.M. Wilson 1039*; holo: G.

The type specimen is referable to the lichenicolous fungal genus *Dactylospora* (Ascomycota, Dactylosporaceae).

*Buellia rimulosa* Müll.Arg., *Flora* 71: 543 (1888)

Originally described from Brazil, and subsequently reported from Queensland (F.M.Bailey, *Bot. Bull. Dept Agric. Queensland* 8: 100, 1893), no authentic Australian collections have been located.

*Buellia russa* (Hue) Darb., *Brit. Antarct. Terra Nova Exped. 1910, Nat. Hist. Rep., Bot.* 3: 64 (1923)

This species was reported from Victoria by Filson (*Checklist Austral. Lichens* 12, 1983), but it is now considered to be an Antarctic endemic (D.Øvstedal & R.I.Lewis-Smith, *Lichens of Antarctica and South Georgia* 126, 2001).

*Buellia subareolata* Müll.Arg., *Rev. Mycol. (Toulouse)* 10: 68 (1888)

This saxicolous lichen, first described from Paraguay, was reported from Mt Mistake, Queensland by F.M.Bailey (*Bot. Bull. Dept Agric. Queensland* 8: 100, 1893). However, no authentic Australian collections have been located.

*Buellia subdisciformis* (Leight.) Vain., *Étud. Class. Lich. Brésil* 1: 167 (1890) var. *subdisciformis*

Although this lichen has been reported from New South Wales (W.Nylander, *Flora* 69: 325, 1886), Queensland (J.Shirley, *Proc. Roy. Soc. Queensland* 6: 189, 1889), Victoria (R.B.Filson, *Checklist Austral. Lichens* 12, 1983), Western Australia (R.N.Richardson & D.H.S.Richardson, *W. Australian Herb. Res. Notes* 7: 27, 1982), and from unspecified Australian localities (e.g. B.J.Coppins, C.Scheidegger & A.Aptroot, *Lichens of Great Britain and Ireland*, 2nd edn 238, 2009), no authentic material has been seen from Australia. Earlier reports were misidentifications of *B. homophylla* which differs from *B. subdisciformis* in having an aeruginose, N+ red-violet or red-brown epihymenium and an I+ purple medulla, whereas *B. subdisciformis* has a N– epihymenium and a non-amyloid medulla.

*Buellia talcophila* (Ach.) Körb., *Syst. Lich. German.* 230 (1855)

Reported from Victoria by J.Müller (*Bull. Herb. Boissier* 1: 53, 1893), this is *Karschia talcophila* (Ach.) Körb. (Ascomycota, Dothideomycetes, *incertae sedis*), a lichenicolous fungus.

*Buellia tetrapla* var. *nigrocincta* Müll.Arg., in F.M.Bailey, *Bot. Bull. Dept Agric. Queensland* 5: 33 (1892).

T: Bellenden-Ker, Qld, on bark.

The type material could not be located, but according to the description this lichen differs from var. *tetrapla* in having a black prothallus (normally not apparent in this species). However, its identity cannot be confirmed until the type is examined.

*Chromofulvea dialyta* (Nyl.) Marbach, *Biblioth. Lichenol.* 74: 152 (2000)

*Buellia dialyta* (Nyl.) Tuck., *Gen. Lich.* 187 (1872).

Reported from Queensland by R.B.Filson (*Checklist Austral. Lichens* 10, 1983, as *Buellia dialyta*), this record was almost certainly a misidentification, this lichen being restricted to North America and Japan (Marbach, 2000).

*Gassicurtia elizae* (Tuck.) Marbach, *Biblioth. Lichenol.* 74: 233 (2000)

*Lecidea elizae* Tuck., *Amer. J. Sci. Arts*, ser. 2, 25: 428 (1858); *Buellia elizae* (Tuck.) Tuck., *Lich. California* 25 (1866).

This lichen was reported from Queensland by R.B.Filson (*Checklist Austral. Lichens* 10, 1983, as *Buellia elizae*). According to Marbach (2000), this species is known only from North America, Japan and Kenya. The Australian report was possibly a misdetermination of *G. catasema*, since both species are isidiate and contain barbatic acid (*G. elizae* lacks the lichexanthone that is present in *G. catasema*).

*Stigmatochroma metaleptodes* (Nyl.) Marbach, *Biblioth. Lichenol.* 74: 319 (2000)

*Buellia rosellotincta* (Nyl.) Vain., *Cat. Afr. Pl. Welwitsch* 2(2): 413 (1901).

This lichen is known from South America, SE Asia, Papua New Guinea and New Caledonia (Marbach, 2000: 152). Although it has been reported from Queensland (Filson, 1983: 12, as *Buellia rosellotincta*), no Australian collections can be confirmed.