Revisions of British and Irish Lichens

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Lichinales [revision 1]

Cover image: *Lichina pygmaea*, on siliceous intertidal granite rocks, Great Ganilly, Scilly Is.

Revisions of British and Irish Lichens is a free-to-access serial publication under the auspices of the British Lichen Society, that charts changes in our understanding of the lichens and lichenicolous fungi of Great Britain and Ireland. Each volume will be devoted to a particular family (or group of families), and will include descriptions, keys, habitat and distribution data for all the species included. The maps are based on information from the BLS Lichen Database, that also includes data from the historical Mapping Scheme and the *Lichen Ireland* database. The choice of subject for each volume will depend on the extent of changes in classification for the families concerned, and the number of newly recognized species since previous treatments.

To date, accounts of lichens from our region have been published in book form. However, the time taken to compile new printed editions of the entire lichen biota of Britain and Ireland is extensive, and many parts are out-of-date even as they are published. Issuing updates as a serial electronic publication means that important changes in understanding of our lichens can be made available with a shorter delay. The accounts may also be compiled at intervals into complete printed accounts, as new editions of the *Lichens of Great Britain and Ireland*.

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Revisions of British and Irish Lichens **vol. 58**

Lichinales [revision 1]

including the genera *Collemopsis, Forssellia*, *Lemmopsis*, *Lichina*, *Metamelanea*, *Paulia*, *Pyrenocarpon*, *Synalissa* and *Thelignya* (Lichinaceae), *Synalissina* (Lichinellaceae), *Allopyrenis*, *Peltula* and *Phylliscum* (Phylliscaceae), *Ephebe*, *Lempholemma*, *Porocyphus*, *Pyrenopsis*, *Thermutis* and *Watsoniomyces* (Porocyphaceae).

by

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This is a revision of the Lichinales account for LGBI3 (Cannon *et al.* 2024) to take into account of the new phylogeny of the group published by Prieto *et al*. (2024). The genus *Paulia* is also included.

The Lichinales/Lichinomycetes now include four families, the Lichinaceae, Lichinellaceae, Phylliscaceae and Porocyphaceae. *Euopsis* has been excluded from the earlier *Revision* and is now included in Cannon *et al.* (2025).

Key to genera of the Lichinales

1 Asci thick-walled when young, with rostrate dehiscence, usually polyspored; thalli variously shaped but often peltate or umbilicate ..... ***Peltula***
Asci thin-walled at all stages, mostly 8-spored 2

2(1) Thallus umbilicate, filamentous or minutely fruticose 3
Thallus squamulose, minutely foliose or crustose 9

3(2) Thallus forming dense swards on intertidal rocks associated with seaweeds and barnacles; apothecia ± globose, sunken in lobe apices ..... ***Lichina***
Thallus on terrestrial substrata, sometimes associated with bryophytes or other lichens; apothecia initially poriform but sometimes developing an exposed disc 4

4(3) Photobiont *Nostoc* ..... ***Synalissina***
Photobiont *Gloeocapsa*, *Scytonema* or *Stigonema* 5

5(4) Thallus umbilicate, strongly gelatinous ..... ***Paulia***
Thallus filamentous or minutely fruticose 6

6(5) Thallus minute and usually cushion-forming, with erect branching at least at the base 7
Thallus filamentous, copiously branched, decumbent and often mat-forming 8

7(6) Thallus coralloid branched, without main branches; on calcareous rocks ..... ***Synalissa***
Thallus irregularly but densely branched, with a few, stout, long, main branches and many small side branches; overgrowing mosses or lichens .....[Lichinodiales: Lichinodiaceae] ***Lichinodium***

8(6) Thallus often matted and spreading, the filaments > 50 µm diam.; photobiont *Stigonema* ..... ***Ephebe***
Thallus small, fluffy, the filaments < 15 µm diam.; photobiont *Scytonema* ..... ***Thermutis***

9(2) Thallus squamulose or minutely foliose 10
Thallus crustose, areolate or granular 13

10(9) Photobiont *Nostoc*, in at least predominantly foliose or strap-forming, sometimes radiating thalli ..... ***Lempholemma***
Photobiont *Gloeocapsa*, thallus small-squamulose 11

11(10) Thallus squamules inflated and hollow ..... ***Phylliscum***
Squamules not hollow 12

12(11) Hamathecium of simple to branched and anastomosing paraphyses, ± swollen and moniliform above; periphysoids absent; asci various ..... ***Allopyrenis*** and ***Pyrenopsis***
Hamathecium comprising a zone of periphysoids near to the ostiole; interascal filaments either absent or inconspicuous and much shorter than the asci ..... ***Phylliscum***

13(9) Thallus inconspicuous, subgelatinous, hardly pigmented, ± endolithic ..... ***Watsoniomyces***
Thallus epilithic, many strongly melanized 14

14(13) Photobiont *Calothrix*, with cells in chains; thallus red-brown-black, not pruinose, amorphous or indistinctly placodioid, subgelatinous when moist; apothecial disc poriform at first, later ± expanded, thalline margin present ..... ***Porocyphus***
Photobiont single-celled or in clusters, surrounded by a common, often coloured gelatinous sheath 15

15(14) Asci thick-walled, the inner wall I+ blue, apical dome I–; in one species apothecia with a broad thalline margin containing green algae (*Trebouxia*) ..... [Harpidiaceae] ***Euopsis***
Asci thin-walled; photobiont exclusively cyanobacterial 16

16(14) Ascomata with a clearly exposed disc from an early stage, sometimes umbonate or gyrose 17
Ascomata poriform, without a clearly exposed disc or if so expanding later and not umbonate or gyrose 19

17(16) Thallus of angular, isodiametric cells throughout; photobiont in vertical rows ..... ***Metamelanea***
Thallus cortex with cells in a fan-shaped arrangement; photobiont irregularly arranged 18

18(17) Thallus black, areolate and scurfy (mat-forming); apothecia finally elevated with a broad, prominent margin; on irrigated rocks ..... ***Forssellia***
Thallus greenish brown, ± continuous, smooth and shiny; apothecia abundant, remaining immersed in the thallus; ± submerged in lakes and streams ..... ***Thelignya***

19(16) Thallus dark purple-red; ascospores 7.5–10 (–15) × 5–7.5 µm, subglobose ..... ***Phylliscum***
Thallus dark brown to black; ascospores larger, ellipsoidal 20

20(19) Thallus ± areolate, surface and edges of areoles granular; apothecia with the exciple open at the base ..... ***Collemopsis***
Thallus granular or not; ascomata with exciple below the hymenium 21

21(20) Exciple distinctly widened above, giving the ascomata a 'fish-eye' appearance ..... ***Pyrenocarpon***
Aascomata urceolate-discoid with the exciple not clearly widened above ..... ***Lemmopsis***

LICHINACEAE Nyl. (1854)

Thallus usually small, blackish, usually swelling when wet, crustose or more rarely squamulose, foliose, fruticulose or filamentous, not endolithic; predominantly homoiomerous, rarely corticate but not dorsiventrally stratified. **Isidia** sometimes formed. **Soralia** very rare. **Hormocystangia** absent. **Photobionts** single-celled cyanobacteria with yellowish brown, rarely with reddish purple gelatinous sheaths or with filamentous cyanobacteria. **Ascomata** typical apothecia formed from ascogonia, either arising freely or within a tangle of generative hyphae, or rarely pycnoascocarps developing from conidiomata, apothecial in structure, with a thalline margin, with or without a distinct exciple. **Epithecium** colourless to pale yellow, reddish or brownish, rarely green. **Hymenium** sometimes divided by intrusions of sterile excipular hyphae and the apothecial disc then becoming umbonate or gyrose. **Hamathecium** of branched paraphyses, thin or robust, rarely becoming submoniliform. **Asci** thin-walled, usually releasing spores passively through apical ruptures, mostly 8-spored, more rarely

polysporous. **Ascospores** aseptate, usually broadly ellipsoidal, rarely subglobose or bean-shaped, walls usually thin. **Conidiomata** pycnidia, immersed to slightly elevated. **Conidiophores** unbranched. **Conidia** formed terminally, aseptate, ellipsoidal or bacilliform, rarely subglobose. **Chemistry**: no secondary substances detectable with TLC. **Ecology**: on rocks (rarely corticolous or overgrowing other lichens), sometimes marine.

As with other families of the Lichinales, many species are inconspicuous and appear as nondescript black crusts, but play important roles as pioneers in inhospitable habitats (Jørgensen (2012). The Lichinales was considered to contain three families (Gloeoheppiaceae, Lichinaceae and Peltulaceae) by Lücking *et al*. (2017a), but this arrangement has been extensively revised by Prieto *et al*. (2024) and that system is followed here.

Epiphloea Trevisan 1880 was included in the Heppiaceae (now part of the Lichinaceae) by Smith *et al*. (2009), but Schultz *et al.* (2015) transferred the genus to the Collemataceae (Peltigerales) and this arrangement was followed by Cannon *et al*. (2020). *Lichinodium* is now placed in its own family within the Leotiomycetes (Prieto *et al*. 2019). *Euopsis* has also been excluded from the Lichinales, being transferred to the Harpidiaceae, in an uncertain position within the Pezizomycotina (see Cannon *et al.* 2024).

A useful key to families of the Lichinales was contributed by Schultz & Büdel (2002), on which the following key was based. Thallus structures in many species of this group are difficult to describe and may be interpreted differently. The apothecium structures are all very similar.

Literature:
Cannon *et al.* (2024), Díaz-Escandón *et al*. (2021), Henssen (1963), Jørgensen (2012), Jung *et al.* (2021), Prieto *et al*. (2008, 2019, 2024), Schultz & Büdel (2012), Schultz *et al*. (2001, 2015), Schumm & Aptroot (2023).

COLLEMOPSIS Nyl. ex Crombie (1874)

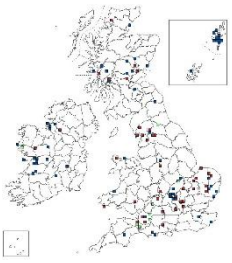
The genus as currently circumscribed is monotypic (Prieto *et al*. 2024), so the description of *C. schaereri* below constitutes that of the genus. *Psorotichia*, where this taxon was formerly placed, was found to contain several unrelated clades by those authors.

Differs from *Lemmopsis* in the mature apothecia having the exciple open at the base and not continuous with the hypothecium, although the significance of this feature requires further study. The genus is poorly understood and requires a modern revision; the number of species and their distribution is largely unknown. *Porocyphus* has *Calothrix* as photobiont.

Literature:
Ellis (1981), Gilbert *et al*. (2009), Jørgensen (2012), Prieto *et al.* (2015, 2024), Schultz (2007).

Collemopsis schaereri (A. Massal.) Cromb. (1874) **Nb**

Psorotichia schaereri (A. Massal.) Arnold (1869)



Thallus effuse, dull dark green (in shade) to dark brown or black, areolate, mostly *ca* 0.1 mm thick; areoles 0.3–0.7 mm across, often becoming detached at the edges and appearing subsquamulose, surface and margins of areoles often with granules 40–80 µm diam.; photobiont cells 5–7 µm diam. Apothecia pycnoascocarps (*fide* Prieto *et al.* 2024), 0.2–0.6 mm diam., at first immersed with a flat disc, later emergent with a ± convex disc; thalline margin crenulate to granular, usually persistent but sometimes excluded, pseudoparenchymatous, to *ca* 75 µm thick; exciple ± evident, paler than the disc, 25–50 µm thick at the upper surface, but soon narrowing below, of ± parallel hyphae which in the upper part have ellipsoidal lumina to 9 × 4.5 µm; disc reddish brown to black (then red-brown when wet); hymenium 95–150 µm tall, colourless, or yellowish brown in the uppermost part; paraphyses rather few, unbranched to sparingly branched, 1.5–2 µm diam., the upper one to

several cells swollen to 5 µm diam. Asci 80–120 × 12–17 µm, *Lichina* type, 8-spored. Ascospores (12–) 14–18 (–20) × 7–9 µm, ellipsoidal or ± ovoid. Conidia 3–4 × *ca* 1 µm. **BLS 1208**.

On dry to moist limestone, often in sheltered seepage tracks, on old mortared walls, the top of limestone boulders, or siliceous rocks if subjected to calcareous flushing. Scattered throughout Britain and Ireland.

A variable species in respect of the extent of thalline granules and the colour of the thallus.

FORSSELLIA Zahlbr. (1906)

Thallus dark brown to blackish, sometimes greyish pruinose, gelatinous when wet, crustose, rarely small-squamulose, fastened to the substratum by rhizohyphae, a basal gelatinous layer or a small umbilicus; not corticate, hyphae ± distinctly fan shaped or vertically arranged. **Photobiont** a single-celled cyanobiont, gelatinous sheaths yellowish brown, rarely reddish. **Apothecia** pycnoascocarps, partly immersed to sessile, with a distinct thalline margin and thin exciple. **Hymenium** K/I+ blue. **Hamathecium** of septate paraphyses. **Asci** thin-walled (*Lichina* type), 8-spored to polysporous. **Ascospores** aseptate, colourless, broadly ellipsoidal to globose, small. **Pycnidia** immersed to slightly elevated. **Conidiophores** unbranched. **Conidia** small, ellipsoidal, produced terminally. **Chemistry**: lichen products not detected by TLC. **Ecology**: usually on calcareous or mineral rich, rarely acidic, inclined rock in well–lit situations, also semi-aquatic along lake margins.

The genus currently contains four species (Prieto *et al*. 2024), only one of which occurs in our region. It was formerly part of the genus *Pterygiopsis*, and neither of the GBI species included in Gilbert & Purvis (2009) remain in that taxon.

Metamelanea is similar in many respects with the same type of photobiont, but does not have the cortical cells arranged in a fan shape and the apothecia are often umbonate or gyrose.

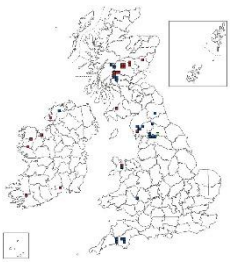
Literature:
Gilbert & Purvis (2009), Jørgensen (1990, 2012), Prieto *et al.* (2024).

Key to species formerly placed in *Pterygiopsis*

1 Thallus black, areolate and scurfy (mat-forming); apothecia finally elevated with a broad, prominent margin; on irrigated rocks ..... ***concordatula***
Thallus greenish brown, ± continuous, smooth and shiny; apothecia abundant, remaining immersed in the thallus; ± submerged in lakes and streams ..... ***Thelignya lacustris***

Forssellia concordatula (Nyl.) M. Schultz & M. Prieto (2024) **NT**

Pterygiopsis concordatula (Nyl.) P.M. Jørg. (2007)



Thallus to 3-5 cm diam., areolate, ± scurfy, black, effuse; photobiont cells 5–7 µm diam., K–, arranged in vertical rows towards the surface. Apothecia to 0.5 mm diam., blackish, at first ± immersed, finally distinctly superficial; thalline margin conspicuous, shining, black, smooth, composed of isodiametric cells, to 0.1 mm thick; exciple hardly visible; hymenium 70–90 µm tall, colourless, upper parts olivaceous brown, N–, I+ blue; paraphyses unbranched with enlarged brown apical cells. Asci 50–70 × 12–14 µm. Ascospores 8–14 × 6–9 µm. **BLS 1796**.

On irrigated non-calcareous rocks, such as seepages or at the margins of oligotrophic rivers and lakes; overlooked until recently, apparently widespread in N. and W. Britain and Ireland.

LEMMOPSIS (Vain.) Zahlbr. (1906)

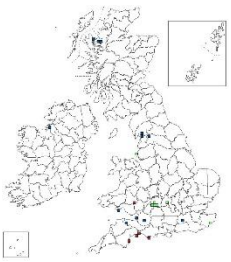
Thallus minute, thin, granular-crustose, black, pseudoparenchymatous, gelatinous when moist, not stratified, epinecral layer occasionally present. **Photobiont** cyanobacterial, chroococcoid with yellowish sheaths; cells globose to slightly ovoid, in clumps. **Ascomata** apothecia, sessile, urceolate-discoid; disc ± pore-like, red-brown. **Thalline margin** present but often poorly developed. **Exciple** robust, broad-rimmed, of anastomosing hyphae. **Hymenium** colourless, I+ blue. **Hypothecium** thin, pale golden brown. **Hamathecium** of paraphyses, slender, unbranched, septate, ± conglutinate. **Asci** narrowly clavate, thin-walled, 8-spored, K/I–. **Ascospores** aseptate, ovoid, thick-walled, colourless. **Conidiomata** unknown. **Chemistry**: lichen products not detected by TLC. **Ecology**: on calcareous rocks and clay soil.

Lemmopsis species are usually recognized by the minute reddish apothecia. *Psorotichia* has a weak or virtually absent exciple with a narrow rim, usually densely reticulate hyphae and a usually prominent thalline margin. In *Porocyphus* the apothecia develop from the pycnidia. *Lempholemma* has foliose, squamulose or a minutely fruticose growth habit with *Nostoc* randomly scattered throughout the thallus, and immersed to semi-sessile apothecia with an inconspicuous exciple. *Collema* s.l. and *Leptogium* s.l. (Peltigerales: Collemataceae) differ in containing *Nostoc*, possessing an exciple composed of isodiametric to elongated cells, and do not produce unicellular ascospores.

Literature:
Ellis (1981), Gilbert (2009), Jørgensen (2012), Lewis & Schultz (2019).

1 Apothecia dull red, paraphyses slightly conglutinate, spores 15–20 × 8–12 µm, two to three times as long as broad ..... ***arnoldiana***
Apothecia pale cream to pale yellow-brown, paraphyses strongly conglutinate, obscuring asci, spores 15-27 × 5-7.5 µm, three to five times as long as broad ..... ***oblongans***

Lemmopsis arnoldiana (Hepp) Zahlbr. (1906) **NT**

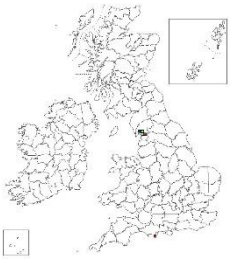


Thallus of rounded to subrectangular, gelatinized areoles to 0.6 mm diam., scattered or aggregated, forming a thin effuse dark-coloured crust, gelatinous when wet. Apothecia 0.4–0.5 (–0.7) mm diam., numerous, prominent, sessile with an urceolate, dull red disc; exciple prominent, dull yellow-brown to almost golden, the base thin, of isodiametric cells from which arise densely anastomosing hyphae running parallel to the sides of the hymenium. Asci mostly 70–80 µm in length. Ascospores (12–) 15–20 (–25) × 8–12 µm, aseptate, ovoid to broadly ellipsoidal. **BLS 0807**.

On shaded calcareous rocks in humid sites such as chalk pebbles on woodland floors, base of limestone boulders in grassland, crevices in limestone cliffs, when well-developed spreading to moss; rare but probably overlooked. Chiefly in S. England, extending to N. England (Cumbria, Morecambe Bay), S. & W. Wales, W. Scotland & W. Ireland.

Resembles a small crustose *Leptogium* but has aseptate spores. The yellow-brown to almost golden colour of the entire exciple differentiates this species from others in this and related genera. The species was contrasted with *Lempholemma syreniarum* (on bark of deciduous tree bases from Canada) by Lewis & Schultz (2019).

Lemmopsis oblongans (Nyl. ex Cromb.) A.L. Sm. (1918) **Nb**



Thallus semigranular, brown-black with obscure areolation. Apothecia pale cream to pale yellow-brown, the paraphyses densely conglutinate, asci variable, averaging 110 µm in length. Spores 15–27 × 5–7.5 µm, consistently narrower than in *L. arnoldiana* with a larger length/breadth ratio. **BLS 0809**.

On calcareous clay soil in rock crevices; recorded in the 19th century from limestone hills on both sides of the River Kent estuary, Westmorland, and recently refound to the SE of this area (Newbiggin Crags). Also recently recorded on a coastal landslip, Dorset (Isle of Purbeck). Endemic.

While some of the differences between the two species may be due to environmental

factors or chance variation, there remains sufficient doubt as to their conspecificity to justify the retention of both taxa. Fresh material of *L. oblongans* is required to resolve the problem.

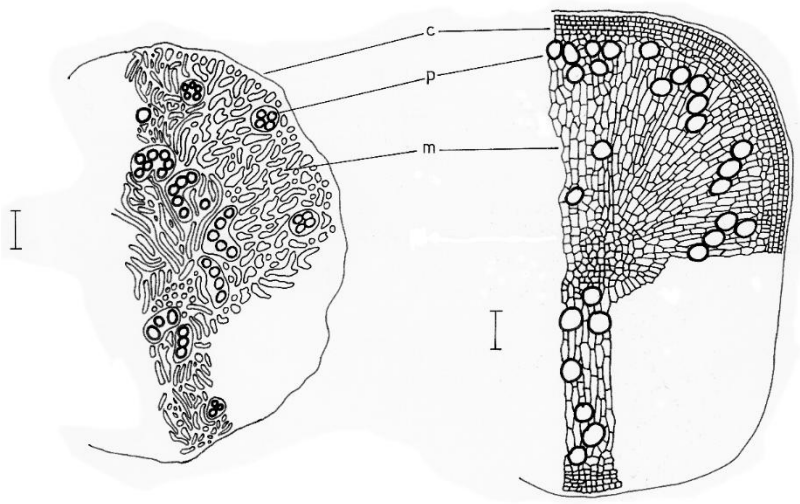
LICHINA C. Agardh (1817)

Thallus shrubby, ± erect, forming tufts, attached to rocks by an ± indistinct disc-like holdfast; lobes short, rounded or ± flattened, gelatinous when wet, dark olive-brown to black. Branches cylindrical or flattened, with a dense central strand, corticate. Cortex indistinct and gelatinous to well-defined and cartilaginous. **Photobiont** cyanobacterial, *Rivularia*. **Ascomata** apothecia, globose, terminal to subterminal in the apices of branches; disc poriform. **Hamathecium** of paraphyses, branched and anastomosed, becoming septate, with capitate apices. **Asci** 8-spored, thin-walled, deliquescing, not thickened at the apex; outer coat K/I+ blue. **Ascospores** colourless, aseptate, cylindric-ellipsoidal, thin-walled. **Conidiomata** pycnidia, with a single ostiole or chambered. **Conidia** globose or cylindrical. **Chemistry**: lichen products not detected by TLC. **Ecology**: on freshwater or maritime rocks, littoral or mesic supralittoral, usually inundated at some point in the tidal cycle.

Lichina pygmaea is anomalous in having a well-developed cortex. The two British and Irish species are marine, resembling diminutive brown seaweeds; there are also non-marine species assigned to the genus (Henssen 1969, Schultz 2017) although these appear not to be closely related to the marine clade. Ortiz-Álvarez *et al*. (2015) found that the photobionts of these species belong to *Rivularia* rather than *Calothrix*, with each species associated with distinct lineages. In addition, Chrismas *et al*. (2021) showed that *L. pygmaea* appears to be host to a complex range of cyanobacteria in addition to *Rivularia*, as well as chlorophytan algae.

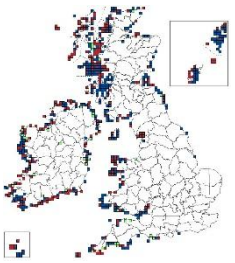
Literature:
Chrismas *et al*. (2021). Fletcher & Purvis (2009), Garrido-Benavent *et al.* (2023), Henssen (1969), Jørgensen (2012), Ortiz-Álvarez *et al.* (2015), Prieto *et al*. (2008), Schultz (2017).

1 Thallus forming erect, compact tufts to 0.5 cm tall; lobes terete, rounded in section, to 0.3 mm diam., dull, the cortex unorganized; in the upper *Verrucaria* zone ..... ***confinis***
Thallus forming loose, procumbent tufts of flattened, ± palmately divided branches to 1 cm long with lobes to 2 mm thick, shiny, the cortex cellular; in the lower *Verrucaria* zone ..... ***pygmaea***



Transverse section of *Lichina confinis* (left) contrasted with *L. pygmaea* (right) which shows the cortical cell arrangement (c = cortex, m = medulla, p = photobiont). Scale bar = 10 µm.

Lichina confinis (Müller) C. Agardh (1821) **LC**

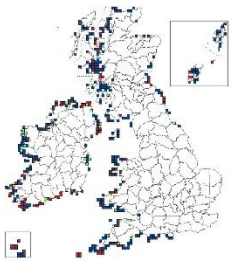


Thallus to 0.5 cm tall, erect, forming small compact 'areolate' tufts 5–10 mm diam., sometimes coalescing to form swards; lobes terete, to 0.3 mm diam., dichotomous, terminal branches to 3 mm long, dull, olive-brown to black; cortex a loose weft of soft, gelatinous hyphae indistinguishable from the medulla and containing several algal species in addition to the photobiont. Apothecia terminal, to 0.5 mm diam. Ascospores aseptate, colourless, 12–18 × 10–15 µm. **BLS 0851**.

On sheltered seashore rocks in the mesic-supralittoral zone, associated with *Flavoplaca marina*, *Hydropunctaria maura*, *Lecanora helicopis* etc. Common, especially on sunny sheltered shores, extending into small estuaries and creeks, becoming restricted to shade and crevices on exposed shores where it may occur many metres above high-water mark. Throughout coastal areas of Britain and Ireland, except for E. and S.E. England.

Unlikely to be confused with any other lichen except for *L. pygmaea* which is larger, has flattened lobes, a cellular cortex and is associated with barnacles. A morph with larger terminal branches, to 0.8 mm diam., which is weakly attached, decumbent, radially spreading, and pale grey to yellow at the base, overgrows *Hydropunctaria maura* in sheltered sea-lochs dominated by *Ascophyllum mackeii* in W. Scotland and S.W. Ireland. Its status is unknown. *Spilonema paradoxum* (Peltigerales: Coccocarpiaceae) resembles a minute *Lichina* but is non-marine.

Lichina pygmaea (Lightf.) C. Agardh (1821) **LC**



Thallus to 1 cm long, forming loose tufts of flattened and palmately divided branches to 2 mm thick, which may become terete towards the apices; the tufts are often wide-spreading, forming swards several metres across; the cortex is shiny, dark brown-black, composed of rectangular cells, several deep, with regular chains of photobiont cells restricted to the medulla and subcortical layers. Apothecia globose, terminal, poriform, to 2 mm diam. Ascospores 22–29 × 11–16 µm. **BLS 0852**.

Conspicuous in the littoral region of sunny, ± exposed shores, associated with red algae (*Hildenbrandia*) and fucoid algae, and often overgrowing barnacles and marine *Verrucaria* s.l. species, especially *Wahlenbergiella striatula*, usually inundated by the tides except in neap periods, locally abundant. Throughout coastal areas of N. and W. Britain and Ireland.

Resembles a very small, dark brown-black seaweed, and has been mistaken for the red alga *Catenella opuntia* which grows in shaded crevices, is soft, and the thallus is articulated like a string of beads. Its inundated habitat and large, shiny, cartilaginous lobes distinguish it from *L. confinis*.

METAMELANEA Henssen (1989)

Thallus crustose, rimose-areolate, blackish, brown or greyish, gelatinous when wet, areoles usually obtusely wedge-shaped, surface usually flat, smooth or rough to finely granulose or furfuraceous, not corticate, composed of densely aggregated colonies of lichenized photobionts arranged in vertical 'packets' or 'lobes', the hyphae usually densely reticulate, areoles dying from the base. **Photobionts** chroococcoid cyanobacteria with yellowish brown gelatinous sheaths. **Ascomata** apothecia, developing from a hyphal web between photobiont colonies, immersed to adnate, discs black or dark reddish brown, distinctly umbonate or divided and rough, dull or somewhat glossy. **Thalline margin** distinct or indistinct, usually separated from the exciple by a narrow slit. **Exciple** thin, usually blackish (but not carbonaceous) or brownish, basal parts often pale, rarely pale brown, of ± parallel, gelatinized hyphae. **Hamathecium** of septate sparingly branched and anastomosing paraphyses, apical cells somewhat clavate. **Hymenium** K/I+ blue, upper part dark brown or reddish brown. **Asci** ± cylindrical

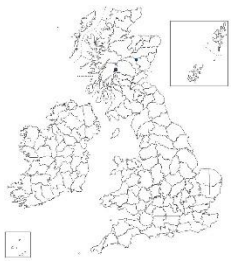
or narrowly clavate, thin-walled, K/I–, amyloid apex lacking, 8-spored. **Ascospores** aseptate, colourless, ellipsoidal, thin-walled. **Conidiomata** pycnidia, laminal, immersed in the thallus, sometimes superimposed, ellipsoidal, the wall colourless. **Conidiogenous cells** simple, slender, cells elongated. **Conidia** ellipsoidal or bacilliform. **Chemistry**: lichen products not detected by TLC. **Ecology**: on siliceous, usually base-containing rock, more rarely on calcareous rock, on inclined rock faces moistened by seeping water.

Metamelanea has an unusual and peculiar growth form, seen in cross section with colonies of lichenized photobionts forming densely aggregated vertical packets or lobes which die from their base, a special type of ascoma ontogeny, umbonate apothecial discs and a usually distinctly coloured exciple. The genus appears to be related to *Psorotichia* which is similar but has a different kind of apothecia and different thallus structure.

Three species are known, only one of which occurs in our area.

Literature:
Henssen (1989), Jørgensen (2012), Prieto *et al*. (2015), Schultz (2008, 2009).

Metamelanea umbonata Henssen (1989) **Nb**



Thallus blackish, crustose, areolate, areoles smooth or somewhat rough, 0.2–0.6 mm diam., *ca* 0.3 mm high, ± angular, attached with a strongly gelatinous base, areoles composed of numerous densely aggregated erect 'lobules' 12-35 µm in diam., hyphae forming a dense network, photobiont a chroococcoid cyanobacterium with a brownish gelatinous sheath. Apothecia adnate, 1–7 per areole, to 0.6 mm diam., the disc blackish, umbonate to gyrose, umbo to 120 µm diam. and 70 µm high, pigmented dark reddish brown on the upper part of the exciple; thalline margin entire, coronate, persisting, 70–80 µm thick; hymenium 90–150 µm high, K/I+ blue; subhymenium pale brownish, K/I+ blue. Asci long-cylindrical to obclavate, 8-spored. Ascospores aseptate, hyaline, broadly ellipsoidal, 11–13.5 × 8–9.5 µm, thin-walled. Pycnidia immersed, 110–140 µm high, 40–65 µm diam. Conidia small, rod-shaped, 2–3.5 × 1–1.5 µm. **BLS 2482**.

On basic siliceous rock and limestone in seepage tracks on steeply inclined, damp rock faces and beside streams, to *ca* 800 m altitude; rare. Scotland (Central Highlands, Perth, Angus).

Metamelanea umbonata is characterized by the adnate apothecia with a prominent coronate thalline margin, blackish, distinctly umbonate or gyrose discs and a blackish thallus composed of flat angular, obtusely wedge-shaped areoles. Some upland specimens identified as *Porocyphus coccodes* have proved to be *Metamelanea umbonata*. *Porocyphus* has a smooth, thinner thallus, smaller, sessile, often globose apothecia the discs of which remain poriform, or, if widened with brownish, smooth apothecial discs, lacking both an umbo and coronate thalline margin.

PAULIA Fée (1835)

Thallus small, blackish or greenish-brown, umbilicate, orbicular or deeply divided into lobes, attached to the substratum by scattered or aggregated rhizoidal strands. **Photobiont** Chroococcales; cells surrounded by a thick brown distinctly zonate gelatinous sheath. **Ascomata** apothecia, laminal, immersed or rarely adnate, discs urceolate or flat, brown or pale. **Exciple** absent. **Hymenium** eventually with a sterile central column, hymenial gel amyloid or not. **Hamathecium** of paraphyses, branched and anastomosing. **Asci** 8- or fewer-spored. **Ascospores** aseptate, colourless, thick-walled. **Conidiomata** pycnidia, immersed, small. **Conidia** thin, rod-like. **Ecology**: on limestone.

Paulia constitutes a monophyletic group, sister to *Pseudotichia* and *Pyrenocarpon* according to Prieto *et al*. (2024). They have rosette-shaped, peltate, squamulose-peltate and dwarf fruticose thalli, in contrast to *Pseudotichia* and *Pyrenocarpon* in which thalli are crustose. Only one species occurs in Britain and Ireland.

Literature:
Henssen (1986), Henssen & Tretiach (1995), Hitch (2021), Prieto *et al.* (2024), Schumm & Aptroot (2023).

Paulia glomerata Henssen & Tretiach (1995) **NE**
Thallus black, gelatinous when wet, forming small blackish cushions, ± irregularly rosette-shaped and attached by a central holdfast, usually consisting of numerous lobate flattened or globose squamules to *ca* 4 mm long and 2.8 mm broad, attached to the substratum by long pale branched rhizoidal strands. Photobiont coccoid, the cells 19–26 µm diam. with a very thick, yellowish-brown conspicuously concentric-layered gelatinous sheath. Isidia absent. Apothecia rare (not known in British material), to 1.3 mm across, first immersed then adnate, with a dark brown urceolate to flat disc, and a narrow thalline margin; hymenium 120–180 µm tall, non-amyloid. Paraphyses slightly branched and anastomosed. Asci (2–) 4–8-spored, subcylindrical. Ascospores aseptate, colourless, ellipsoidal to subglobose, 10–13 (–17) × 9.5–11 (–15) µm, thick-walled. Pycnidia pale, immersed, with convoluted walls. Conidia 3–4 × 1–1.5 µm, aseptate, bacilliform. **BLS 2799**.

On low, seasonally moist sloping limestone rocks; Wales (Glamorgan).

The only GB collection was mixed with *Synalissa ramulosa* which has copious small globose isidia and a cyanobiont with smaller reddish purple rather than yellowish brown cells.

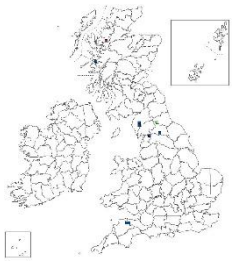
PYRENOCARPON Trevis. (1855)

As this is a monotypic genus the description below (of *P. thelostomum*) constitutes the generic description.

The genus *Pyrenocarpon* has been accepted for a characteristic species, differing from *Porocyphus* by the strongly thickened exciple.

Literature:
Coppins & Aptroot (2009), Ellis (1981), Jørgensen (2012), Prieto *et al.* (2024).

Pyrenocarpon thelostomum (Ach. ex J. Harriman) Coppins & Aptroot (2008) **Nb**
Pyrenocarpon flotowianum (Hepp) Trevis. (1855)



Thallus crustose, brown to reddish brown, minutely cracked-areolate, to 0.2 mm thick, with a chroococcoid photobiont, cells 5–7 µm diam., enclosed in pale brown sheaths. Apothecia frequent, perithecioid, hemispherical, to 0.3 mm diam., enveloped by a thick thalline covering, the disc eventually open and paler reddish brown, showing a pale persistent exciple between the hymenium and the thalline covering; hymenium I–, paraphyses branched and anastomosing, apices not swollen. Asci narrowly clavate, thin-walled, without internal amyloid structures. Ascospores colourless, aseptate, ellipsoidal, (13–) 17–20 × (5–) 9–12.5 µm. Conidiomata not known. Chemistry: no lichen substances reported by TLC. **BLS 1813**.

On rocks in streams in England (Exmoor, Pennines and N.W. England) and Scotland (Wester Ross, Westerness).

The fish-eye like apothecia (the appearance due to the prominent pale exciple) are diagnostic for this species.

SYNALISSA Fr. (1825)

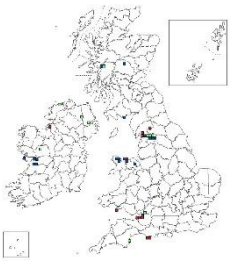
Thallus shrubby, with erect coralloid branches forming small cushions or swards, black when dry, dark red-brown and gelatinous when wet; not corticate, the hyphae forming ± angular patterns, enclosing the photobiont clusters; at the centre towards the base the hyphal core is devoid of photobiont cells. **Photobiont** *Gloeocapsa* in clusters. **Ascomata** apothecia, terminal, at first ± globose

with a prominent thalline margin surrounding a poroid disc; disc later ± expanding. **Hymenium** I–. **Hamathecium** of thin-walled narrow paraphyses. **Asci** cylindrical, 8- or (usually) multi-spored, thin-walled, K/I–. **Ascospores** broadly ellipsoidal to globose, aseptate, colourless. **Conidiomata** pycnidia, terminal, immersed; wall colourless. **Conidia** bacilliform, aseptate, colourless. **Chemistry**: no lichen products reported by TLC. **Ecology**: mainly on rocks.

The genus includes five species, of which only one occurs in our region. Of similar genera, shrubby forms of *Lempholemma* have the photobiont *Nostoc* and *Spilonema* (Peltigerales: Coccocarpiaceae) has *Stigonema*.

Literature:
Gilbert & Coppins (2009b), Jørgensen (2012), Prieto *et al.* (2024), Schultz & Büdel (2002).

Synalissa ramulosa (Hoffm. ex Bernh.) Fr. (1825) **VU**



Thallus forming small dense cushions, tufts or swards to 3 mm tall, consisting of stout, erect branches with blunt swollen ends in which apothecia or pycnidia may develop; photobiont cells 5–6 µm diam., often in small groups of two or three in the outer part of thallus and thalline margin, with reddish sheaths, I+ violet. Apothecia 0.2–0.5 (–0.8) mm diam.; disc often remaining pore-like, sometimes expanding and then reddish brown; thalline margin to 150 µm thick; exciple indistinct; hymenium to 125 µm tall, colourless; hypothecium to 40 µm thick, colourless to pale brown, of interwoven hyphae; paraphyses to 1 µm diam. Asci to 100 µm in length, 8- to 24-spored. Ascospores 7–10 (–12) × 6–9 µm. Conidia 3–4 × 1–1.5 µm. **BLS 1379**.

On damp limestone rocks, mainly coastal (in Britain, though not elsewhere in Europe). Usually in small soil-filled crevices growing among other lichens (e.g. *Catapyrenium* species, *Romjularia lurida*, *Thalloidima sedifolium*); at one site on the surface of limestone pavement, rare. S.W. & N. England, N. & S. Wales, W. Scotland, Ireland (the Burren and Sligo).

Often confused with *Lempholemma botryosum* which has *Nostoc* as photobiont. Some inland records from the Lancashire-Cumbria border require confirmation.

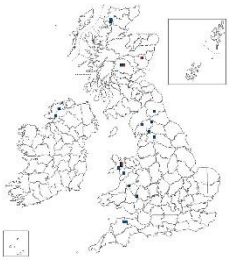
THELIGNYA A. Massal. (1855)

Thallus crustose, uniformly thin, granular, areolate or subsquamulose, fixed to the substratum by a basal gelatinous layer, rhizohyphae or minute stalk; homoiomerous, anatomy ± paraplectenchymatous or with an irregular, ± dense network of short-celled hyphae with ± isodiametric cells. **Photobionts** Rivulariaceae, with usually much bent and split filaments or with single-celled cyanobionts with thin, yellowish brown gelatinous sheaths. **Ascomata** apothecia, not pycnoascocarps, with a shallow or prominent thalline margin and a distinct exciple, discs usually sunken or concave, often narrow but becoming distinctly umbonate when fully developed; conspicuously black and emerald green in section, and then N+ blue or reddish to yellowish brown or pale. **Epithecium** blue–green or yellowish or reddish brown, hymenium K/I–. **Paraphyses** straight or ± irregular, branched and anastomosing, terminal cells slightly widened. **Asci** thin-walled, *Lichina* type, 8- or 16-spored. **Ascospores** small, aseptate, colourless. **Pycnidia** immersed or slightly elevated in small thallus warts, globose, the wall pale but apically often emerald green. **Conidia** aseptate, ellipsoidal, subglobose or bacilliform, produced terminally
on unbranched conidiophores. **Chemistry**: lichen products not detected by TLC. **Ecology**: in high montane sites but also along lowland river banks, often semi-aquatic, on siliceous rocks.

Four species were accepted by Prieto *et al*. (2024), only one of which occurs in Britain and Ireland. It was formerly placed in the polyphyletic genus *Pterygiopsis*.

Theligyna lacustris (P.M. Jørg. & R. Sant.) M. Schultz & M. Prieto (2024) **NT**

Pterygiopsis lacustris P.M. Jørg. & R. Sant. (1990)



Differs from *Forssellia concordatula* (also formerly placed in *Pterygiopsis*) in its olive-brown thallus (greenish when wet), that is smooth, filmy and irregularly cracked, forming a thin (100–125 µm thick) shiny film over the rock; photobiont cells 3–5 µm diam. Apothecia abundant, *ca* 0.3 mm diam., remaining immersed and '*Ionaspis*-like'; hymenium N+ blue-green, I–; paraphyses partly branched and anastomosing below and without enlarged apices above. Ascospores 8–12 × 7–8 µm. **BLS 1797**.

More or less submerged in lake margins and at the edge of oligotrophic streams; less common than *Forssellia concordatula* but with a similar distribution.

T. lacustris is usually easily recognized by the filmy thallus and the immersed, sunken apothecia said to have the appearance of fingerprints in dough.

LICHINELLACEAE M. Prieto & M. Schultz (2024)

Thallus blackish, rarely greyish pruinose, ranging from crustose, squamulose, squamulose-peltate and foliose to dwarf-fruticose, homoiomerous, not corticate. **Photobiont** single-celled cyanobacteria with yellowish brown sheaths or filamentous (*Nostoc*). True **soralia** absent, **isidia** present in some species, **hormocystangia** formed in some Nostoc-containing species. **Ascomata** either thallinocarps with reduced excipular and hymenial structures, then predominantly polysporous with *Lichinella* type asci, or formed from ascogonia, the hymenium with true paraphyses and a usually thin exciple, asci 8-spored, *Peccania* type. **Conidiomata** pycnidia, immersed to slightly elevated. **Conidia** ellipsoidal or short bacilliform, never filiform. **Chemistry**: no secondary metabolites detected by TLC. **Ecology**: on bare, often calcareous rocks, also in biological soil crusts.

Four genera are included by Prieto *et al.* (2024), of which only *Synalissina* occurs in our region. As with other families of the Lichinales, it is monophyletic but diverse in morphological terms.

SYNALISSINA Nyl. (1886)

Thallus blackish, sometimes greyish pruinose, small-foliose to small squamulose-peltate or dwarf fruticose, fastened to the substratum by rhizohyphae or a small umbilicus, distinctly swelling when wet, sometimes with terminal hormocystangia, rarely isidiate or phyllidiate. **Photobiont** *Nostoc.* **Apothecia** small, sessile or stalked on tips of delicate, upright branches, with a thick thalline margin and pale, thin exciple. **Hymenium** with septate paraphyses, KOH/Lugol+ blue. **Asci** *Peccania*-type, 8-spored. **Ascospores** aseptate. **Conidiomata** pycnidia, immersed to slightly elevated. **Conidia** small bacilliform to ellipsoidal. **Chemistry**: no secondary metabolites detected by TLC. **Ecology**: early colonizers of calcareous or mineral rich rocks.

Synalissina was reinstated for the *Lempholemma botryosum* group (Prieto *et al.* 2024).

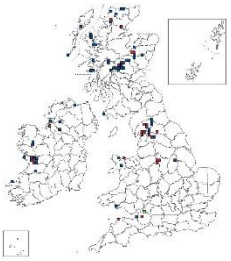
Literature:
Gilbert *et al*. (2009), Prieto *et al.* (2024).

1 Ends of some lobes swollen to form globular to cup-shaped hormocystangia ..... ***cladodes***
Hormocystangia absent 2

2(1) Thallus shortly filamentous, lobe ends not swollen ..... ***intricatum***
Thallus minutely shrubby, forming small tufts or flat cushions with cylindrical finger-like lobes around the margin ..... ***botryosum***

Synalissina botryosa (A. Massal.) M. Schultz & M. Prieto (2024) **Nb**

Lempholemma botryosum (A. Massal.) Zahlbr. (1924)



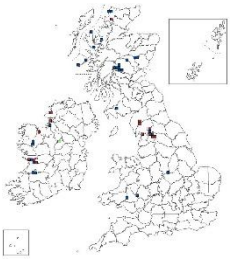
Thallus of dark aggregated short minutely shrubby, ± imbricate nodular cylindrical branched lobes forming small tufts or umbilicate cushions with a rough surface and lobes around the edge, mostly 1.5–3 mm diam.; lobes to 0.3 mm long, 0.15–0.2 mm wide, the surface of lobes minutely longitudinally striate, apices slightly swollen. Apothecia not seen in Britain and Ireland, but reported as being half-immersed with a pore-like disc, and containing ascospores 7–9 × 5–7 µm. **BLS 0810**.

On periodically wet exposed hard calcareous rocks, especially Carboniferous limestone where it is often in temporarily water-filled depressions in limestone pavements; also on damp mica schist cliffs in Scotland; local. In suitable habitats throughout W. & upland Britain and Ireland.

Some of the material referred below to *Lempholemma intricatum* may be a luxuriant morph of *L. botryosum*. *L. cladodes* differs in producing hormocystangia at the lobe tips. Sometimes confused with *Scytinium fragile* (Peltigerales: Collemataceae) and *Synalissa ramulosa*.

Synalissina cladodes (Tuck.) M. Schultz & M. Prieto (2024) **NT**

Lempholemma cladodes (Tuck.) Zahlbr. (1924)



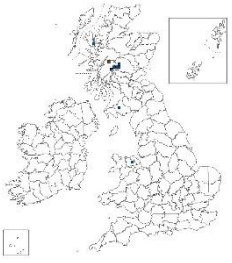
Thallus dark, cushion- or tuft-like to 5 mm diam., at first a rosette of short, flattened squamules which eventually elongate into cylindrical ± dichotomously branched minutely wrinkled lobes to 2 mm long and 0.1–0.2 mm wide; lobes ends swelling to produce globose isidium-like hormocystangia 0.15–0.3 mm diam., which eventually burst and become cup-like (see image). Apothecia unknown in Britain and Ireland, in American material reported as terminal or lateral, 0.1–0.4 mm diam., with a blackish convex disc, producing globose ascospores 15–20 µm diam. **BLS 0814**.

Found in water-filled depressions in Carboniferous limestone; also on damp basic cliffs, by waterfalls and on low flat acidic rock outcrops affected by blown shell-sand in machair; rare. Scattered in Cumbria and the Pennines, mid Wales, Highland and oceanic W. Scotland, W. Ireland.

A variable species which resembles *Lempholemma botryosum* in habit but differs in the conspicuous, swollen hormocystangia at the lobe tips. In water-eroded depressions it may form detached, globular balls to 8 mm diam.

Synalissina intricata (Arnold) Nyl. (1886) **NT**

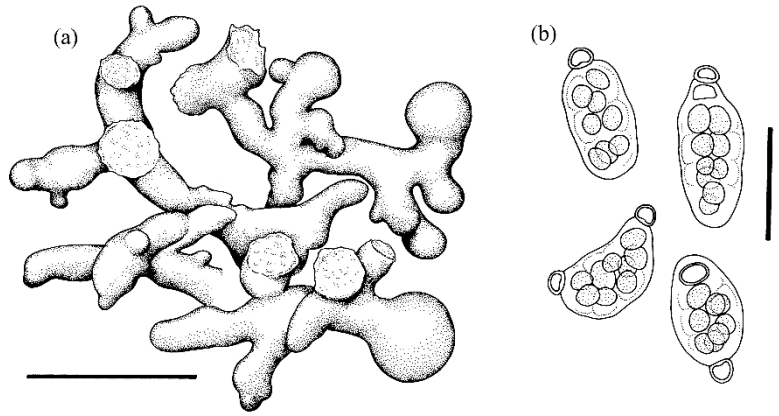
Lempholemma intricatum (Arnold) Zahlbr. (1924)



Thallus shrubby to filamentous, forming low cushions or mats to 3 cm across; lobes cylindrical, repeatedly dichotomously branched, decumbent, entangled, blackish, sometimes faintly longitudinally wrinkled, to 5 mm long and 0.12–0.2 mm wide. Apothecia rare, 0.15–0.2 mm diam., laminal or rarely terminal, ± globose, at first pore-like, later sometimes with a slightly expanded red-brown disc; paraphyses scanty, 1–2 µm diam., sparingly branched. Asci clavate, sometimes narrowing to a papilla-like apex. Ascospores 10–14 × 8–11 µm, broadly ellipsoidal to globose. Pycnidia *ca* 0.1 mm diam., immersed, laminal or subterminal; conidiogenous cells cylindrical, 15–23 × 1.5–2 µm; conidia 4–5 × 1–1.5 µm, fusiform. **BLS 0815**.

On water-flushed, slightly basic granite slabs or mica schist at 300-400 m alt.; very rare. N.W. England (Westmorland), S.W. (Kirkcudbright, Black Craig) & C. Highland Scotland (Breadalbane and Glen Coe), Western Isles (Skye), Wales (Snowdonia).

Of the British material, only that from Black Craig has pycnidia and apothecia, it also has slightly more robust and less distinctly wrinkled lobes than that from the Highlands; the latter may be a different species, and is perhaps closer to *L. botryosum*.



Synalissina cladodes.
(a) Branches of a moist thallus with old and developing hormocystangia. (b) Hormocysts (composed of cyanobacterial cells only). Scale bars a = 1 mm, b = 30 µm.

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PHYLLISCACEAE Th. Fr. (1860)

Thallus blackish, olive or dark reddish brown, corticate or not, rarely grey-pruinose or appearing greyish due to the presence of an epinecral layer; crustose, squamulose, peltate, or foliose to dwarf-fruticose, attached by rhizohyphae, tufts of rhizohyphae, a central umbilicus, or a gelatinous basal layer or holdfast. **Soralia** and/or **isidia** present in a few species. **Hormocystangia** absent. **Photobiont** single-celled cyanobacteria. **Ascomata** typical apothecia, or pycnoascocarps, perithecioid in some genera. **Thalline margin** present. **Epithecium** usually pale yellowish to reddish or brownish, rarely with conspicuous dark reddish brown blotches or colourless. **Hamathecium**: paraphyses usually present, rarely absent and then with periphysoids around the punctiform disc of perithecioid apothecia. **Asci** unitunicate with rostrate dehiscence (sometimes indistinctly so), *Peccania*, *Phyllisciella* or *Phylliscum* types, often polysporous. **Ascospores** aseptate, colourless. **Conidiomata** pycnidia. **Conidiophores** unbranched or branched. **Conidia** small-ellipsoidal, short-bacilliform or long-filiform, then bent or sigmoid. **Chemistry**: no secondary metabolites reported except for myeloconone D1 and D2 in one species. **Ecology**: on all rocky substrata, often on periodically wetted but well-lit rock surfaces, rarely semi-amphibious, common also in biological soil crusts, rarely on bark.

The family has also been referred to as the Peltulaceae. Six genera were included by Prieto *et al.* (2024), of which three have been reported from Britain and Ireland.

ALLOPYRENIS M. Schultz & M. Prieto (2024)

Thallus crustose, granulose, areolate to subsquamulose, dark reddish black, often attached to the substratum by a thin gelatinous basal layer; homoiomerous, not corticate. **Photobiont** a gloeocapsoid cyanobacterium with reddish, layered gelatinous sheaths. **Apothecia** usually small, often perithecioid with narrow, usually slightly concave discs, dark reddish brown to blackish, semi-immersed to sessile.

Thalline margin persisting, smooth, sometimes bulging. **Exciple** not present. **Epithecium** usually pale reddish brown, rarely colourless. **Subhymenium** with a rounded base. **Hymenium** K/I+ deep blue. **Hamathecium**: paraphyses distinct, often robust, usually straight, rarely bent, often becoming submoniliform with distinctly expanded terminal cells. **Asci** clavate, unitunicate with rostrate dehiscence, with a distinct K/I+ blue apical dome and distinct outer gelatinous cap, almost always 8-spored. **Ascospores** aseptate, colourless, broadly ellipsoidal, small. **Conidiomata** pycnidia, usually ± pyriform. **Conidia** small, ellipsoidal to short-bacilliform. **Chemistry**: no secondary metabolites detected by TLC. **Ecology**: on wet acidic, usually mineral-rich rock, temporarily inundated or on inclined rock faces moistened from seeping water.

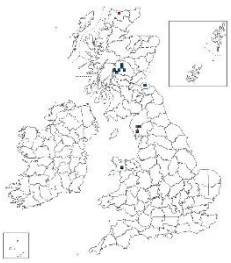
Species of *Allopyrenis* were formerly included in *Pyrenopsis* (Porocyphaceae), which has been demonstrated to be polyphyletic (Prieto *et al.* 2024). Two of the seven species are known to occur in Britain and Ireland.

Literature:
Gilbert & Coppins (2009a), Prieto *et al.* (2024).

1 Asci polyspored, containing 8–64 spores ..... ***grumulifera***
Asci 8-spored ..... ***impolita***

Allopyrenis grumulifera (Nyl.) M. Schultz & M. Prieto (2024) **Nb**

Pyrenopsis grumulifera Nyl. (1861)

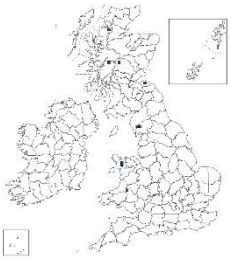


Thallus crustose, cracked-areolate, sometimes granular, brown-black or reddish, effuse; photobiont *Gloeocapsa* enclosed in red-brown sheaths, individual cells 10–15 (–20) µm diam. Apothecia 0.1–0.2 mm diam., immersed, perithecioid with a pore-like disc; hymenium 70–80 µm tall, with partly branched, anastomosing paraphyses. Asci 40–55 × 15–20 µm, broadly clavate, mostly multispored (64 or more), a few 8-spored asci sometimes present. Ascospores 4.5–7 × 2–3 µm, cylindric-ellipsoidal. Pycnidia not seen. **BLS 1674**.

On moist mica-schist rocks, usually above 700 m, but near sea-level on damp basalt in E. Lothian; rare. Scotland, English Lake District, N. Wales.

Allopyrenis impolita (Th. Fr.) M. Schultz & M. Prieto (2024) **Nb**

Pyrenopsis impolita (Th. Fr.) Forssell (1885)



Thallus brownish black, to *ca* 150 µm thick, crustose, areolate to ± squamulose; photobiont with cells 5–7 µm diam., enclosed in a brown sheath. Apothecia immersed in the thallus, to 0.2 µm diam., the disc eventually expanding; hymenium I+ blue. Asci ± cylindrical, 8-spored, the apex with an amyloid outer layer. Ascospores (5–) 8–10 × (5–) 7–8 µm, subglobose to globose. Pycnidia rare, immersed; conidia bacilliform. **BLS 1798**.

On water-flushed upland siliceous rocks; very rare. Scottish Highlands, E. Lothian, Lake District, N. and mid Wales.

Like *Pyrenopsis subareolata* but in that species the ascospores are broadly ellipsoidal and 11–14 × 8–9 µm in size.

PELTULA Nyl. (1853)

Thallus variously shaped, often peltate or umbilicate, squamulose or areolate, or fruticose (sometimes minutely so), sometimes lobed or ligulate, sometimes hollow, brown to black, not heavily gelatinized, the upper cortex poorly developed and often with a distinct epinecral layer, either attached to the substratum by a central holdfast, a rhizohyphal weft or true rhizines. **Soralia** or **isidia** present in some

species. **Photobiont** cyanobacteria, usually *Alliterella*, rarely also with green algae within the thallus. **Ascomata** typical apothecia, completely immersed or with a raised thalline margin, the disc brown to black, punctiform to widely opened. Exciple thin; epithecium brownish. **Hamathecium** of unbranched or anastomosing paraphyses, with a pigmented epithecium. **Asci** clavate to obclavate, unitunicate-rostrate with a distinct, fringed external tunica, the walls I+ red or I+ blue, K/I+ intensely blue, polysporous. **Ascospores** small, colourless, aseptate, thin-walled. **Conidiomata** pycnidial, immersed in the thallus, sometimes chambered or cerebriform. **Conidia** small, aseptate, colourless, ovoid to fusiform. **Chemistry**: no lichen substances detected by TLC in most species. **Ecology**: on rock or soil, often in arid environments.

Only one species is known from Britain and Ireland.

Literature:
Büdel (1987), Egea (1989), Jung *et al.* (2021), Kauff *et al.* (2018), Marques *et al*. (2013), Prieto *et al.* (2024), Yang *et al*. (2022).

Peltula euploca (Ach.) Poelt ex Pišút (1967) **NE**

Thallus to 12 mm diam., peltate-umbilicate, of scattered, individual squamules with down-rolled margins, olive-brown, not pruinose, attached to the substratum with a central holdfast; sometimes sorediate, the soralia bluish grey, marginal, occasionally laminal to submarginal; upper cortex poorly differentiated but with a distinct epinecral layer; photobiont layer well-differentiated; medulla with cavities (air pockets); lower cortex present. Apothecia often absent but numerous when present, the discs punctiform. Asci clavate, 32- to *ca* 100-spored. Ascospores ellipsoidal, 6–8 × 3–5 μm, colourless, aseptate.

On semi-inundated lakeside siltstone, Cumbria; only known from one modern British collection. Earlier reports appear to have been misidentifications.

Marques *et al*. (2013) emphasize the variability of this species. Yang *et al.* (2022) consider that the sorediate form of *Peltula euploca* (referred to as "*P. euploca* ssp. *sorediosa*") is phylogenetically distinct from non-sorediate populations, but that name appears never to have been published and the number of sequences obtained is small.

A lichenicolous species provisionally identified as *Didymellopsis pulposi* (Zopf) Grube & Hafellner but with broader ascospores is present on the British collection.

PHYLLISCUM Nyl. (1853)

Thallus dark red-brown to black, squamulose or crustose and cracked-areolate, when squamulose hollow, often rosette-shaped, forming small cushions attached by a minute umbilicus, subgelatinous to gelatinous when wet; not stratified, a network of angular-celled hyphae surrounding the photobiont, loosely reticulate in cross section, with no central hyphal strand. **Photobiont** *Gloeocapsa*-type; cells and cell clusters near the upper surface surrounded by 1–2 red, reddish-brown or purplish gelatinous sheaths, K+ purplish. **Ascomata** perithecioid apothecia with a punctiform disc, laminal, usually immersed, only visible as dark-centered depressions of the thallus. **Exciple** distinct (viewed in section). **Hymenium** K/I+ blue. **Hamathecium** absent or with a few short paraphyses, periphysoids lining the ostiole. **Asci** clavate, slender with pointed tips, 8- or polysporous, non-amyloid except for a K/I+ blue fuzzy outer coat. **Ascospores** aseptate, colourless, ellipsoidal, often appearing 1-septate due to plasma bridges that dissolve in K. **Conidiomata** pycnidia with colourless walls. **Conidia** born terminally, acicular. **Chemistry**: no lichen products detected by TLC. **Ecology**: on moist siliceous rocks.

The genus as described by Henssen (1963) was not uniform, and Prieto *et al.* (2024) found that the type of *Cryptothele* belongs in the *Phylliscum* clade.

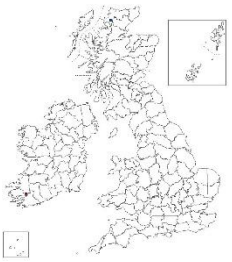
Orange (2003, 2013) refers to an undescribed taxon with asci containing at least 11–14 ascospores;

the ascospores are similar in size and shape to those of *P. permiscens* (Nyl.) M. Schultz & M. Prieto. but that species has 8-spored asci. *P. neglectum* (Henssen) M. Schultz & M. Prieto has polyspored asci, but the spores measure 7–8 × 2.5–3 µm, while those of the undetermined species measure 7.5–12.5 × 3.5–4.5 µm.

Literature:
Díaz-Escandón *et al*. (2021), Gilbert (2009), Gilbert & Schultz (2009), Henssen (1963), Orange (2003, 2013), Prieto *et al.* (2024), Schultz & Büdel (2002).

1 Thallus squamulose, rosette-forming; asci multispored ..... ***demangeonii***
Thallus crustose, effuse; asci 8-spored ..... ***rhodostictum***

Phylliscum demangeonii (Moug. & Mont.) Nyl. (1855) **Nb**

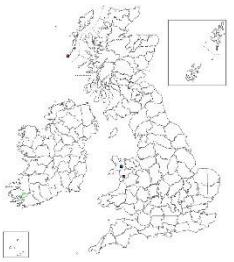


Thallus of grey-black squamulose rosettes or small cushions composed of overlapping rounded lobes, gelatinous when wet, marginal lobes slightly elongate; individual thalli to 8 mm across, ± umbilicate, often coalescing in swards. Apothecia abundant, to 0.8 mm diam., forming flattened or ± depressed hemispheres with a central punctiform disc in the thallus surface; they give the thallus surface a tessellated appearance. Asci (8-)16(-24) -spored, with pointed tips. Ascospores 7–10 × 4–5 µm. Conidia 4–7 × 1–2 µm. **BLS 1970**.

A single record from an acid boulder by a waterfall in N.W. Scotland, and in S.W. Ireland (S. Kerry) on riverside rocks; it should be looked for in seepage tracks. Easily recognized by the ± inflated umbilicate squamules with punctiform ascomata.

Phylliscum rhodostictum (Taylor) M. Schultz & M. Prieto (2024) **Nb IR**

Cryptothele rhodosticta (Taylor) Henssen (1990)



Thallus crustose, dark purple-red, thin, effuse, continuous or cracked, the surface uneven but slightly glossy. Apothecia up to 3 per areole, forming convex projections 0.2–0.4 mm diam., with a pore appearing as a small closed pit or becoming slightly expanded; hymenium 100–125 µm tall, with conspicuous hymenial gel which is I+ red, K/I+ blue. Asci 70–100 × 12–15 µm, tapering above, 8-spored. Ascospores 7.5–10 (–15) × 5–7.5 µm, subglobose, thin-walled. Pycnidia appearing as minute projections, *ca* 100 µm diam.; conidia cylindrical, straight, 2.9–3.3 × *ca* 1.2 µm. **BLS 1839**.

On periodically submerged acid rocks in upland areas; rare. N. Wales (Snowdonia), Ireland (Co. Kerry), Scotland (Outer Hebrides). Known with certainty only from our region, France & S.W. Norway; the name has been misapplied elsewhere.

It has the look of a *Verrucaria* that has been painted red. *Pyrenopsis subareolata* has been misidentified as this species; it has asci that are cylindric-clavate rather than tapering above.

POROCYPHACEAE Körb. (1855)

Thallus usually blackish and distinctly swelling when wet, rarely subgelatinous and then olivaceous, rarely greyish pruinose, very diverse in growth form ranging from crustose to squamulose, squamulose-peltate, foliose, dwarf fruticose, filamentous or endolithic; attached to the substratum by rhizohyphae, tufts of rhizohyphae, an umbilicus or gelatinous holdfasts; homoiomerous, rarely corticate and dorsoventrally stratified. **Isidia** rare, **soralia** very rare. **Hormocystangia** absent. **Photobionts** various single-celled or filamentous cyanobacteria. **Ascomata** predominantly pycnoascocarps, rarely typical apothecia. Apothecia with exciple well-developed or absent, disc open

or narrow and then appearing perithecioid, rarely umbonate. **Epithecium** colourless, faintly yellowish to pale reddish or brownish. **Paraphyses** always present. **Asci** prototunicate with *Lichina* and *Peccania* types, thin-walled and mostly releasing spores passively through apical ruptures, or asci unitunicate-rostrate with a distinct amyloid apical dome and active ascospore discharge, 8-spored, rarely polysporous. **Ascospores** aseptate, usually broadly ellipsoid, rarely subglobose or bean-shaped, walls usually thin. **Conidiomata** pycnidia, immersed to slightly raised. **Conidia** aseptate, ellipsoidal or short-bacilliform, rarely globose. **Chemistry**: no secondary metabolites detected by TLC. **Ecology**: on various rocks, sporadically or seasonally wetted and usually in well-lit situations, sometimes amphibious to inundated, also in biological soil crusts, rarely on bark.

Literature:
Prieto *et al.* (2024).

EPHEBE Fr. (1825)

Thallus filamentous (small-fruticose in some non-GBI species), carpet-forming, in decumbent intricately branched brown-black tufts, attached by a holdfast, without a cellular cortex; hyphae external to the photobiont when young or irregularly reticulate, later forming a central strand or with elongated to rounded cells. **Photobiont** *Stigonema* in chains, I–. **Ascomata** developing from pycnidia, apothecial in structure, with an exciple but without a thalline margin, solitary or rarely aggregated, immersed in lateral swellings on the branches; discs punctiform. **Hymenium** gelatinous, the upper part brown, I+ blue-green, K/I+ blue. **Hypothecium** dense. **Hamathecium** of septate paraphyses, sparsely branched, the apices thickened. **Asci** 8- to 16-spored, cylindrical to obclavate, thin-walled; wall with K/I+ blue outer layer; apical dome absent. **Ascospores** aseptate or occasionally with 1 or 2 plasma bridges, ellipsoidal, colourless. **Conidiomata** pycnidia. **Conidiophores** branched, long-celled. **Conidiogenous cells** elongate-ampulliform. **Conidia** ellipsoidal to bacilliform, aseptate, colourless. **Chemistry**: no lichen products detected by TLC. **Ecology**: on damp siliceous rocks, often in seepage tracks or semi-aquatic.

The coarse multicellular (I–) filaments separate it from *Cystocoleus*, *Racodium* and *Thermutis* which have thin filaments that are surrounded by a tight hyphal collar. Furthermore, *Cystocoleus* and *Racodium* have *Trentepohlia* (I+ blue-black) whereas *Thermutis* has *Scytonema* (I–). *Spilonema* (Peltigerales: Coccocarpiaceae) differs in the filaments resting on a dark hypothallus. *Polychidium* (Peltigerales: Massalongiaceae) has corticate lobes that are not appressed; *P. muscicola* resembles *Ephebe* in the loosely woven, dark filaments but is more red-brown, usually glossy and not olive-black, and of a firmer texture, forming a coarser, more ascending thallus.

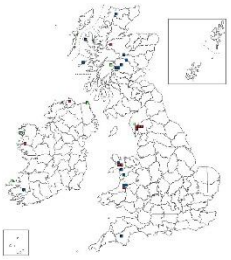
Literature:
Fletcher & Gilbert (2009), Henssen (1963), Jørgensen (2012), Thüs & Schultz (2009).

1 Thallus 20–30 (–50) mm diam., with only a few short, spine-like lateral branchlets; asci 8-spored ..... ***lanata***
Thallus 5–10 (–30) mm diam., with numerous short, spine-like lateral branchlets; asci (8-)16-spored ..... ***hispidula***

Ephebe hispidula (Ach.) Horw. (1913) **NT**
Like *E. lanata*, but thallus 5–10 (–30) mm diam., the filaments >50 µm diam. with numerous short spine-like lateral branches. Ascomata to 0·25 mm diam., rare, more prominent than in *E. lanata*, becoming subglobose, with an open disc and a blackish green exciple. Asci (8-)16-spored. Ascospores ovoid, 7–9.5 × 4–5 µm. Conidia

bacilliform, 2–3 × 1–2 µm. **BLS 0508**.

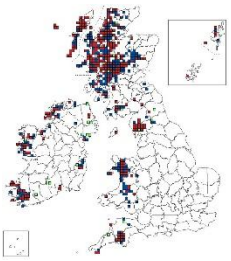
On damp siliceous rocks, lakesides and riversides, frequently submerged, in mountains; rare. England (Cumbria, Devon), N. & W. Wales, Scottish Highlands and Islands, Ireland (mainly near the coast).



Normally sterile, and then distinguished from *E. lanata* by the smaller thallus size and numerous spine-like branchlets, which give it a distinctly woolly-hairy appearance. *E. perspinulosa* Nyl. (1876) has not yet been recorded from Britain and Ireland but could well occur; it has yet smaller thalli to 5 mm diam., ascomata with a poorly developed exciple and 8-spored asci (Jørgensen 2012).

Ephebe lanata (L.) Vain. (1888) **LC**

Thallus 20–30 (–50) mm diam., carpet-forming, consisting of soft coarse cylindrical much-branched, decumbent and sometimes matted filaments, >50 µm diam., irregularly branched but with only occasional short spine-like branches, dark green to brown, rarely black, somewhat shiny. Ascomata to 0.25 mm diam., rare, occurring as minute globose concolorous structures in swellings on the branches, without a clearly differentiated thalline margin, exciple narrow. Asci 8-spored. Ascospores ovoid, 11–18 × 3.5–6 µm, 0(-1)-septate. Conidia bacilliform, 3–4.5 × 1.2–1.7 µm. **BLS 0509**.



On inundated rocks in streams, and in depressions and seepage tracks on siliceous rocks and boulders, often with aquatic *Verrucaria s.l.*, *Ionaspis lacustris*, etc.; locally frequent. Upland Britain and Ireland.

The thalli frequently form carpets on semi-inundated, flat rock slabs and boulders, often overgrowing other lichens. Very occasionally, thalli are parasitized by *Paranectria affinis* Sacc. (1878) or *Stigmidium ephebes* (Henssen) D. Hawksw. (1975).

LEMPHOLEMMA Körb. (1855)

Thallus blackish, minutely granulose, filmy subfoliose to squamulose-peltate, distinctly swelling when wet due to delicate, loose hyphae embedded in copious gel, fastened to the substratum by rhizohyphae or a small umbilicus; not corticate, homoiomerous. **Photobiont** *Nostoc.* **Apothecia** pycnoascocarps, immersed to semi-immersed, rarely sessile, zeorine with a thick thalline margin and pale, thin exciple. **Hymenium** K/I+ blue. **Hamathecium** of septate paraphyses. **Asci** *Lichina* type, 8-spored. **Ascospores** aseptate, ellipsoidal, sometimes guttulate. **Pycnidia** immersed to slightly raised. **Conidia** small, bacilliform. **Chemistry**: no secondary metabolites detected by TLC. **Ecology**: on calcareous soils, over mosses or directly on calcareous rocks, in exposed to somewhat shaded, rarely moist situations.

Much reduced in response to phylogenetic analysis by Prieto *et al.* (2024), who divided the genus as traditionally circumscribed into six. The *L. botryosum* group has now been transferred to *Synalissina* (Lichinellaceae). One species, *L. radiatum*, was included in *Lempholemma* by Gilbert *et al*. (2009) but has not been examined using molecular methods, and it retained here provisionally.

The *Nostoc* photobiont provides a useful pointer for identification, alongside *Synalissina*. For field identification, *Lempholemma* can be contrasted with similar species of *Collema* s.l. (Peltigerales: Collemataceae) which have septate to muriform ascospores and more robust hyphae. *Leptogium* s.l. has a thallus with a well-defined cellular cortex and muriform ascospores. Both of these differ further in the type of pycnidium (with conidia formed laterally on branched conidiophores).

Literature:

Gilbert *et al*. (2009), Henssen (1968), Jørgensen (2012), Lewis & Schultz (2019), Prieto *et al.* (2024).

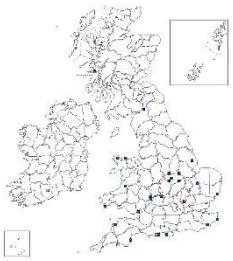
1 Thallus with strap-like channelled lobes, 5–15 mm long and 0.2–0.6 mm wide; globose to clavate isidia clustered in the centre ..... ***radiatum***
Thallus without strap-like channelled lobes; crustose-warted, squamulose, foliose or cushion-like; lobes less than 0.5 mm long 2

2(1) Thallus of dark flattened squamules or umbilicate cushions; apothecia usually absent 3
Thallus forming a spreading granular, nodular or foliose crust; small apothecia usually present initially with a poriform disc 4

3(2) Ends of some lobes becoming swollen, with globular to cup-shaped hormocystangia ..... ***cladodes***
Ends of lobes scarcely swollen; hormocystangia absent ..... ***botryosum***

4(2) Thallus frequently with rounded marginal foliose lobes to 3 mm wide; ascospores 9-16 µm long, globose to broadly ellipsoidal ..... ***polyanthes***
Thallus granular-nodulose; ascospores 20-33 µm long, ellipsoidal ..... ***chalazanum***

Lempholemma chalazanum (Ach.) de Lesd. (1910) **Nb**



Like *L. polyanthes*, but thallus smaller (to *ca* 1 cm diam.), entirely granular-nodulose and lacking distinct marginal lobes; apothecial discs immersed, long remaining pore-like, ascospores 20–33 × 10–13 µm, ellipsoidal (mostly at least twice as long as broad), and conidia slightly broader (2–3 × 1–1.5 µm). **BLS 0813**.

On crumbling mortar of wall tops and along the string course of church buildings, usually among or overgrowing acrocarpous bryophytes, occasionally on bare calcareous soil; rare or overlooked. S. Britain and Ireland.

Lempholemma polyanthes (Bernh.) Malme (1918) **Nb**

?*Lempholemma chalazanellum* (Nyl.) Zahlbr. (1924)
?*Lempholemma chalazanodes* (Nyl.) Zahlbr. (1924)

Thallus dark olivaceous to blackish, nodular-granular, or spreading to 5 cm diam. or more and then often with irregularly rounded foliose lobes (to 3 mm wide) at the edge, the centre of the thallus with irregular ridges which are often warted, dark olivaceous to blackish. Apothecia 0.2–0.3 mm diam., often aggregated along the ridges or lobe ends, ± globose, almost fully to a quarter immersed, with a red-brown pore-like to expanded disc; hymenium 100–130 µm tall; paraphyses numerous, 1.5–2 µm diam. Asci cylindrical to cylindric-clavate, the ascospores uniseriate at least in the upper part of the ascus. Ascospores (8–) 9–16 (–20) × 8–12 (–15) µm, subglobose to broadly ellipsoidal, with a gelatinous perispore that disperses in K. Pycnidia frequent; conidia 2–3 × 0.5–1 µm, bacilliform. **BLS 0817**.

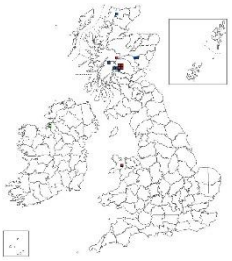
On limestone and mortar, usually over mosses; habitat varies from walls to rocks beside streams; frequent. Throughout Britain and Ireland.

Maps: *L. chalazanellum* (left), *L. chalazanodes* (centre), *L. polyanthes* (right)

A broad concept is used here for *L. polyanthes* pending a critical revision, following Jørgensen (2012). Typical *Lempholemma polyanthes* has a spreading ± lobate foliose thallus (resembling moribund *Lathagrium auriforme*)

and mainly subglobose ascospores, *ca* 9–16 µm diam. Specimens sometimes referred to *Lempholemma chalazanodes* [**BLS 0812**] have a similar habit but mainly broadly ellipsoidal ascospores, 12–20 × 8–12 (–15) µm. Those referred to *L. chalazanellum* (Nyl.) Zahlbr. [**BLS 0811**] have mainly ellipsoidal ascospores but a much reduced, nodular-granular thallus growing directly on crumbly mortar and occurring mainly in low rainfall, eastern areas. *L. chalazanum* (q.v.) has larger ascospores and grows in drier habitats.

Lempholemma radiatum (Sommerf.) Henssen (1968) **NT**



Thallus forming neat rosettes to 2–3 cm diam. or in larger mats, consisting of elongated strap-like ± channelled, repeatedly dichotomously branched lobes, 5–15 mm long and 0.2–0.6 mm wide; upper surface of lobes brown to blackish, with clusters of globose to clavate isidia or lobules, sometimes also with globular hormocystangia; lower surface pale brown or greenish, and often with a central ± winged nerve-like structure and bundles of white attachment hyphae; lobe ends usually with an elongate-clavate swelling. Apothecia not known in Europe; reported from North America as lateral, half-immersed, *ca* 0.3 mm diam., with a pore-like disc and ellipsoidal ascospores 14-23 × 8-12 µm in size. Pycnidia frequent, ± immersed; conidia 3–5 × *ca* 1 µm, bacilliform or swollen at one or both ends, sometimes slightly curved. **BLS 0818**.

On basic rocks, especially calcareous mica-schists, soil or overgrowing moribund bryophytes on moist ledges or in periodically water-flushed situations, mostly at over 700 m alt.; rare. Scotland (Central Highlands and Ben Hope) with one record from N. Wales (Snowdonia).

The neat prostrate strap-like, channelled and isidiate lobes make this an easily recognized species. Its phylogenetic position has not been established, and it appears not to be closely related to *Pycnolemma polycarpum* (syn. *Lempholemma polycarpum*) which also has radiating thallus lobes but which are not channelled (see Prieto *et al.* 2024, Schultz 2005).

A population from Glen Coe has been found to harbour a *Didymellopsis*-like lichenicolous fungus with extremely large spores with a broad gelatinous perispore.

POROCYPHUS Körb. (1855)

Thallus crustose, granular, areolate, subsquamulose to placodioid, or minutely shrubby-isidiate, dark-coloured, gelatinous, not corticate, non-layered, hyphae short-celled and with a fan- or fountain-like arrangement spreading out from the base of the thallus, where they sometimes form a narrow compact pseudoparenchymatous layer. **Photobiont** species of Rivulariaceae, with filaments often much disrupted and modified, appearing unicellular. **Ascomata** apothecia, developing from pycnidia (pycnoascocarps), immersed to sessile, often concolorous with the thallus or pinkish. **Thalline margin** persistent or becoming excluded to reveal the exciple; disc poriform, expanding with age. **Exciple** colourless or brown in the upper part, usually distinct above, but narrowing and often indistinct below, composed of parallel hyphae. **Hypothecium** colourless or pale brown. **Hamathecium** of richly branched and anastomosed paraphyses, sometimes intermixed with elongated conidiophores, gel I+ yellow to blue. **Asci** ± cylindrical, thin-walled, K/I–, without a thickened apex or amyloid structures, mostly 8-spored. **Ascospores** aseptate, ellipsoidal, colourless, perispore absent. **Conidiomata** pycnidia, immersed in the thallus or in thalline warts; wall colourless. **Conidiogenous cells** slender, cylindrical. **Conidia** globose to shortly ellipsoidal, aseptate, colourless. **Chemistry**: lichen products not detected by TLC. **Ecology**: on inundated or damp calcareous and siliceous rocks.

Other cyanophilic lichen genera with aseptate spores and poriform apothecia may be separated by their cyanobionts; *Pyrenopsis* (*Gloeocapsa*), *Pterygiopsis* (chroococcoid), *Lempholemma* (*Nostoc*), *Psorotichia* (chroococcoid). Other genera have discoid apothecia when mature. *Lemmopsis* is crustose with a markedly gelatinous thallus when wet. A specimen from Ben Lawers and attributed to

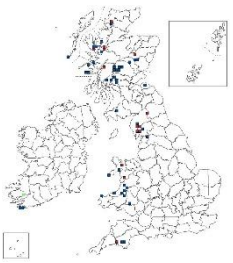
Porocyphus rehmicus (A. Massal.) Zahlbr. has proved to be *Pyrenopsis furfurea*, according to Fletcher & Schultz (2009).

Literature:
Ellis (1981), Fletcher & Schultz (2009), Henssen (1963), Jørgensen (2012), Prieto *et al*. (2024).

1 Thallus crustose, rimose, or minutely shrubby 2
Thallus placodioid, of closely appressed radiating nodulose lobes ..... ***kenmorensis***

2(1) Thallus minutely shrubby-isidiate, apothecia pink-brown ..... ***leptogiella***
Thallus smooth, rimose, apothecia minute, black..... ***coccodes***

Porocyphus coccodes (Flot.) Körb. (1855) **Nb**

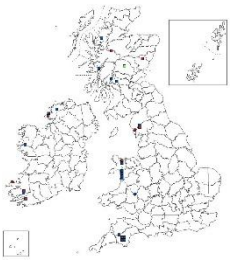


Thallus very dark brown to black, rimose, forming angular areoles 0.6–1.5 mm diam., surface smooth, matt, flat; photobiont filaments mostly disrupted; cells mostly 6–8 µm diam., arranged in short, vertically orientated chains or clusters. Apothecia arising from pycnidia, 0.3–0.5 mm diam., immersed, visible as slight bumps, with thick thalline margins, 1/4 width of disc; disc poriform, expanding to a flat, black disc, often umbonate; exciple to 20 µm thick above, to 10 µm thick below; hymenium 100–130 µm tall, brown in the upper part; hypothecium 40–55 µm high. Asci 55–80 × 9–11 µm, 8-spored. Ascospores 11–15 × 7–12 µm. Conidia 2–2.5 × 1–1.5 µm. **BLS 1184**.

On damp siliceous rocks by freshwater lakes and streams, or on flushed rock faces, mainly upland, descending to sea level in W. Scotland; rare. N. & W. Britain, S.W. Ireland.

The apothecia are obvious, black and larger than in *Porocyphus leptogiella*. The disrupted *Calothrix* filaments may superficially resemble *Nostoc* cells and care must be taken in separating it from other crustose, cyanophilic lichens such as *Psorotichia* and *Pyrenopsis*. It has been confused with *Metamelanea umbonata* (q.v.) and many early records, especially from seashores, have proven to be *P. leptogiella*.

Porocyphus kenmorensis (H.B. Holl ex Nyl.) Henssen (1974) **NT**



Thallus initially crustose, later becoming cracked-areolate when the areoles may have elevated margins and thus appear sublobulate, very closely appressed, radiating, forming ± circular patches to 6 cm diam., the centre continuous, the lobes to 1.5 mm long and 0.2–0.3 mm wide, very dark brown; lobe surface and ends becoming coarsely nodulose and pycnidiate, sometimes densely so, the nodules *ca* 0.2 mm diam.; photobiont filaments well visible and arranged in a fan-shaped manner as are the hyphae. Apothecia arising from pycnidia, to 0.3 mm diam.; thalline margin thin, soon receding; disc dark orange-brown; exciple to 90 µm thick above, 10–15 µm below; hymenium 180–240 µm tall; hypothecium 45–160 µm tall. Asci 75–120 × 9.5–17.5 µm, 8-spored. Ascospores 12–21 × 8–12 µm. Conidia 2.5–3.5 × *ca* 1 µm. **BLS 1185**.

On periodically inundated siliceous rocks in or by lakes and streams; rare. S.W. England (S. Devon, Dartmoor), Scotland (Highlands), N. Wales, W. Ireland (Kerry, Galway, Connemara).

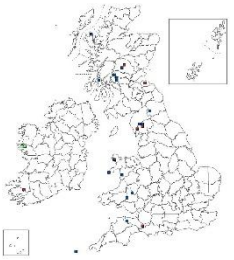
The thallus may resemble a small *Collema* s.l. or *Lempholemma*. Lobes are sometimes obliterate and randomly arranged so that the radiating character is obscured, however, the coarse nodules are always present.

Porocyphus leptogiella (Nyl.) L.T. Ellis (1981) **NT**

Thallus very dark brown to black, of areoles *ca* 1 mm diam., composed of upright conglutinated densely branching cylindrical lobes (or granules) resembling isidia, 25–50 µm diam.; prothallus filmy, dark brown; photobiont cells 5–7.5 µm diam., arranged in clumps. Apothecia small and very inconspicuous unless wetted, to 0.1–0.2 mm diam., developing on the lobe tips, pale pink when young, becoming dark brown; thalline margin thin, disappearing; hymenium *ca* 140 µm high; paraphyses unbranched or some forked within the same apothecium, some with apical cell(s) swelling to 2.5-4 µm diam. Asci 70-80 µm in length, 8-spored. Ascospores 12–14 × 6–8 µm. Pycnidia unknown. **BLS 0808**.

On shaded, base-enriched rock, usually upland but extending to the seashore in crevices (mesic supralittoral zone); rare. S.W. England, N. Pennines, N. & S. Wales, C. & W. Scotland, W. Ireland. ? Endemic.

Many records of *Porocyphus coccodes* have proved to be this species, especially in England and Wales and on the seashore. The conglutinate branching cylindrical isidium-like lobes and minute pink apothecia, when young, are distinctive. *P. leptogiella* is close to forms of *P. rehmicus* found in continental Europe and forms composed of minute, isidioid granules should be carefully checked against the latter.



PYRENOPSIS (Nyl.) Nyl. (1858)

Thallus crustose, granulose, areolate to subsquamulose, rarely coralloid, dark reddish brown to blackish, often attached to the substratum by a gelatinous basal layer; homoiomerous, not corticate. **Photobiont** *Gloeocapsa*-like with reddish, layered gelatinous sheaths. **Apothecia** pycnoascocarps, small and perithecioid with narrow, usually slightly concave discs, sometimes becoming expanded, dark reddish or brownish, sometimes blackish, usually semi immersed to sessile, rarely stalked. **Thalline margin** persistent, smooth, sometimes bulging. **Exciple** absent or thin and inconspicuous. **Epithecium** pale reddish brown or colourless. **Hypothecium** with rounded base or inversely conical. **Hymenium** K/I+ deep blue. **Hamathecium** of paraphyses, robust, usually straight, usually sparsely branched and anastomosing, often becoming submoniliform. **Asci** usually narrowly clavate, unitunicate-rostrate, with a distinct K/I+ blue apical dome and distinct outer gelatinous cap, 8-spored. **Ascospores** aseptate, colourless, broadly ellipsoidal, small. **Pycnidia** subglobose to pyriform. **Conidia** small and ellipsoidal to shortly bacilliform. **Chemistry**: no secondary metabolites detected by TLC. **Ecology**: in montane regions on wet acidic, usually mineral-rich rocks along streams or on inclined rock faces moistened from seeping water, usually in well-lit situations, rarely on mineral soil and debris.

Pyrenopsis as treated by Gilbert & Coppins (2009a) has been found to be polyphyletic and has been divided into four by Prieto *et al.* (2024), with *P. grumulifera* and *P. impolita* transferred to *Allopyrenis* (Phylliscaceae). *Porocyphus* can be confused with *Pyrenopsis* but has *Calothrix* as its photobiont, with filaments often much disrupted and modified, appearing unicellular rather than in clusters. *Collemopsis* has K/I– asci and photobionts with yellowish brown gelatinous sheaths.

Pyrenopsis phylliscella has not been sequenced, so its position within this genus remains provisional.

Literature:
Gilbert & Coppins (2009a), Jørgensen (2012), Prieto *et al.* (2024), Schultz & Büdel (2002).

1 Asci with pointed tips; hamathecium highly gelatinous, consisting only of periphysoids; conidia acicular ..... ***Phylliscum rhodostictum***
Ascus tips not pointed; hamathecium consisting of paraphyses; conidia cylindrical to ellipsoidal 2

2(1) Thallus distinctly squamulose, usually with ± elongate, finger-like lobe extensions; ascomata eventually opening, apothecium-like ..... ***furfurea***
Thallus crustose to small-squamulose, cracked-areolate; ascomata remaining perithecioid 3

3(2) Asci polyspored, containing 8–64 spores ..... ***Allopyrenis grumulifera***
Asci 8-spored 4

4(3) Ascomata minute, numerous, crowded, 2–15 per areole; spores 5–7 × *ca* 3 µm ..... ***phylliscella***
Ascomata dispersed, scattered, one per areole; spores >7 × 3 µm 5

5(4) Spores subglobose, (5–) 8–10 × (5–)7–8 µm ..... ***Allopyrenis impolita***
Spores ellipsoidal, 11–14 × 8–9 µm ..... ***subareolata***

Pyrenopsis furfurea (Nyl.) Leight. (1865) **Nb**

Thallus thick, deeply cracked-areolate to minutely subsquamulose, 1–1.5 mm diam., often with extended finger-like lobes, brown-black, reddish when moist; photobiont chroococcoid, single or pairs of cells in broad brownish sheaths, cells 7–10 (–20) µm diam. Apothecia frequent, to 0.3 mm diam., perithecioid to urceolate; sessile; disc punctiform or slightly expanded, chestnut-brown; hymenium 75–100 µm tall, I+ brown turning blue-green; paraphyses submoniliform, 2–2.5 µm diam. Ascospores 10–12 (–18) × 7–10 µm, broadly ellipsoidal to subglobose. Pycnidia not seen. **BLS 1212**.

On moist mica-schist rocks, above 700 m alt.; very rare. N. Scotland (Perth, Breadalbane). Occurs amongst moss or plant debris elsewhere in the world.

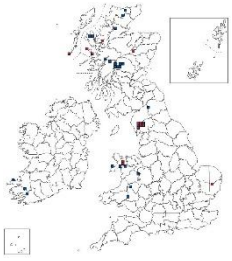
Specimens with a well-developed thallus and expanded, urceolate apothecia resemble a small species of Collemataceae such as *Scytinium subtile*.

Pyrenopsis phylliscella Nyl. (1875) **Nb IR**

Thallus of small discrete flattened, irregularly rounded squamules 0.5–0.9 mm diam. and 0.3–0.4 mm thick, dark brown. Apothecia minute, numerous and crowded, 2–15 per squamule, punctiform, with a distinct thalline margin; hymenium I+ blue. Asci 8-spored. Ascospores 5–7 × *ca* 3 µm, cylindric-ellipsoidal. Pycnidia not reported. **BLS 1218**.

On quartzite boulders in a mountain stream in Scotland (Perth), also on igneous rocks in N. Wales (Snowdon); rare. Endemic.

Pyrenopsis subareolata Nyl. (1861) **Nb**



Thallus cracked-areolate, reddish brown or blackish; photobiont chroococcoid, with single or clustered cells, individual cells 5–7 µm diam., enclosed in brownish sheaths. Apothecia common, immersed but often raised to form low projections, to 0.2 mm diam., disc deeply concave, like a broad pit (when dry); hymenium 100–125 µm tall, I+ strongly blue turning red-brown; hamathecium of branched and anastomosing paraphysoids, abundant among the asci, to 2 µm diam.; apical cells to 3.3 µm diam. Asci 70–100 × 12–15 µm, cylindric-clavate, the wall thickened above, without amyloid apical structures, 8-spored. Ascospores 11–14 × 8–9 µm, broadly ellipsoidal. Pycnidia to 100 µm diam.; conidia *ca* 2 × 1 µm. **BLS 1220**.

On moist siliceous rocks, including lake margins, in upland areas; rare. Scotland, England & Wales extending very locally to S.W. Ireland (Kerry).

A number of at least superficially similar entities are included here, all of which require critical study. *Cryptothele rhodosticta* differs from *P. subareolata* in the acuminate asci and I+ blue, not blue-green to brown, hymenium.

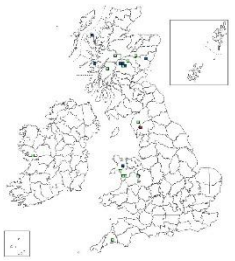
THERMUTIS Fr. (1825)

As this is a monotypic genus the description below (*T. velutina*) constitutes the generic description.

The *Scytonema* photobiont distinguishes *Thermutis* from other fruticose lichens with cyanobacterial photobionts. *Spilonema* (Peltigerales: Coccocarpiaceae) has a dark hypothallus and apothecia with a black, distinct exciple.

Literature:
Fletcher & Giavarini (2009), Henssen (1963), Jørgensen (2012).

Thermutis velutina (Ach.) Flot. (1850) **NT**



Thallus filamentous, brown-black to black, to 10 mm diam., filaments erect, forming button-like cushions, lacking rhizoidal hyphae, each a filament of photobiont with fungal hyphae loosely interwoven, knobbly and obscured within the gelatinous sheath of the photobiont; filaments to 15 µm diam., radiating, unbranched or sparingly false-branched, cells penetrated by short, capitate haustoria. Ascomata apothecia, arising from pycnidia, lateral on filaments, globose, 0.2–0.5 mm. diam., sessile, disc poriform, distinctly swollen, 50–70 µm thick, brown at the outer edge, colourless within; hymenium 100–150 µm tall, colourless or brown in the upper part, I+ blue; hamathecium of unbranched septate paraphyses, the apices swollen; hypothecium 80–130 µm tall, colourless. Asci cylindrical, 60–100 × 5.5–7 µm, 8(-12)-spored, thin-walled, apical dome K/I+ blue. Ascospores aseptate, ellipsoidal, colourless, 9–15 × 5–7 µm. Conidiomata pycnidia, lateral, red-brown; conidiogenous cells narrow; conidia aseptate, globose, colourless, 1–1.5 µm diam. **BLS 1413**.

On calcareous and base-enriched siliceous rocks in damp gullies and ravines, also in the spray zones of waterfalls, montane; rarely recorded. N.W. England (Lake District), N. Wales, Scotland (C. Highlands, Mull, Skye), W. Ireland.

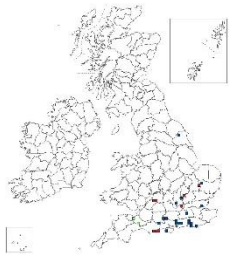
Easily mistaken for non-lichenized *Scytonema* cushions, but readily identified when sterile by the thin hyphae with capitate haustoria ramifying around the photobiont sheath. The identity of the photobiont and narrowness of the filaments distinguish it from *Spilonema* and small specimens of *Ephebe* and *Polychidium*. *Cystocoleus* and *Racodium* have *Trentepohlia* (I+ blue-black chloroplasts).

WATSONIOMYCES D. Hawksw., M. Powell & T. Sprib. (2021)

Watsoniomyces is monotypic, so the description of *W. obsoletus* below constitutes that of the genus. Its phylogenetic position requires more detailed analysis, but it was found to occupy a clade sister to that containing *Lichina* (Díaz-Escandón *et al*. 2021). Its inconspicuous, subgelatinous, hardly pigmented ± endolithic thallus easily distinguishes the genus from other genera of Lichinaceae.

Watsoniomyces obsoletus (Nyl.) D. Hawksw., M. Powell & T. Sprib. (2021) **LC NS IR**

Lecidea lichenicola auct. br., *non* (A.L. Sm. & Ramsb.) D. Hawksw. (1978)



Thallus inconspicuous, immersed, sometimes granular and greenish white due to superficial algae; surface subgelatinous, with an orange hue from included algal cells evident when fresh or moistened; prothallus absent. Photobiont *Scytonema*, but *Trebouxia* and *Chlorella* may also be present. Apothecia partially immersed to sessile, sometimes immersed below, pinkish to reddish brown, finally sometimes ± black, ± closed and perithecioid at first but finally expanded with a ± flat disc, 0.1–0.2 (–0.35) mm diam.; thalline margin absent; exciple persistent, colourless to creamy, pale orange-brown in section, more densely pigmented near the upper (outer) edge, with angular crystalline inclusions, becoming irregularly dentate; epithecium orange-brown to red-brown, K–; hymenium to 150 µm tall; hypothecium colourless to pale orange-brown; paraphyses unbranched to sparsely branched, the apices not swollen or capitate. Asci 50–70 × 12–14 µm, obpyriform, somewhat attenuated towards the apex; apex thickened, K/I–; outer gelatinous coat K/I+ blue, 8-spored. Ascospores (12–) 16–19 × (5–) 6–8 µm, elongate-ellipsoidal to fusiform, with conspicuous oil drops, sometimes pseudoseptate, the contents I+ yellow-orange. Conidiomata not seen. Chemistry unknown. **BLS 0740**.

On chalk pebbles in disturbed habitats (e.g. around rabbit burrows); localized. S. & S.E. England, S.E. Yorkshire. Possibly endemic.

This species was included in Aptroot *et al*. (2009) as *Lecidea lichenicola*, but subsequent location and examination of the type of that name revealed it to be a synonym of *Trapelia glebulosa* (Díaz-Escandón *et al*. 2021).

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