# Revisions of British and Irish Lichens

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## Lichinales: Lichinaceae and Peltulaceae

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to compile new printed editions of the entire lichen biota of Britain and Ireland is extensive, and many parts are out-of-date even as they are published.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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# Lichinales: Lichinaceae and Peltulaceae

including the genera *Cryptothele*, *Ephebe*, *Euopsis*, *Lemmopsis*, *Lempholemma*, *Lichina*, *Metamelanea*, *Peltula*, *Phylliscum*, *Porocyphus*, *Psorotichia*, *Pterygiopsis*, *Pyrenocarpon*, *Pyrenopsis*, *Synalissa*, *Thermutis* and *Watsoniomyces*.

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# **LICHINACEAE** Nyl. (1854)

**Thallus** usually small, crustose, filamentous, squamulose or fruticose, strongly pigmented and often ± black, sometimes conspicuously gelatinous, the photobiont dispersed within the thallus. **Photobiont** cyanobacterial, either chroococcoid (*Gloeocapsa*) or filamentous (usually *Nostoc*, *Scytonema* or *Stigonema*), occasionally with additional loose associations with green algae. **Ascomata** often initially perithecial in appearance with punctiform openings, in some cases becoming apothecial with open discs. **Asci** thin-walled without distinguishable wall layers, mostly 8-spored. **Ascospores** ellipsoidal to ovoid, colourless, aseptate (sometimes appearing pseudoseptate). **Conidiomata** pycnidia, often with convoluted walls and weakly branched conidiophores. **Conidia** small, bacillar to ellipsoidal, colourless. **Chemistry**: no secondary substances detectable with TLC. **Ecology**: on rocks (rarely corticolous or overgrowing other lichens), sometimes marine.

One of the larger families of cyanobacterial lichens. Many species are inconspicuous and appear as nondescript black crusts, but play important roles as pioneers in inhospitable habitats (Jørgensen (2012). Phylogenetic studies of the family are sparse, and many genera remain largely defined using morphological characteristics. The Lichinales was considered to contain three families (Gloeoheppiaceae, Lichinaceae and Peltulaceae) by Lücking *et al*. (2016); members of the Lichinaceae and Peltulaceae are known to be present in Britain and Ireland. *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).

A useful key to families of the Lichinaceae was contributed by Schultz & Büdel (2002). *Lempholemma* is certainly heterogenous, and difficult to define at generic level; it is advisable to consult the key for that genus in addition to the general one below. 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***:
Díaz-Escandón *et al*. (2021), Henssen (1963), Jørgensen (2012), Jung *et al.* (2021), Prieto *et al*. (2008, 2019), Schultz & Büdel (2012), Schultz *et al*. (2001, 2015), Schumm & Aptroot (2023).

## Key to genera of the Lichinaceae and Peltulaceae

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

**2**(1) Thallus filamentous or minutely fruticose ..... 3
Thallus squamulose, minutely foliose or crustose ..... 8

**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 becoming apothecial with an exposed disc ..... 4

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

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

**6**(5) 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***

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

**8**(2) Thallus squamulose or minutely foliose ..... 9
Thallus crustose, areolate or granular ..... 12

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

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

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

**12**(8) Thallus inconspicuous, subgelatinous, hardly pigmented, ± endolithic ..... ***Watsoniomyces***
Thallus epilithic, strongly melanized ..... 13

**13**(12) 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 exciple present ..... ***Porocyphus***
Photobiont single-celled or in clusters, surrounded by a common, often coloured gelatinous sheath .... 14

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

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

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

**17**(15) Thallus ± areolate, surface and edges of areoles with granular, ± globose isidia; apothecia urceolate, with a true exciple open at the base ..... ***Psorotichia***
Thallus not isidiate; ascomata remaining perithecial with true exciple below the hymenium ..... 18

**18**(17) True exciple distinctly widened above, giving the ascomata a ‘fish-eye’ appearance; photobiont chroococcoid ..... ***Pyrenocarpon***
True exciple not widened above; photobiont *Nostoc*-like, but with cells in clusters ..... ***Lemmopsis***

## **CRYPTOTHELE** Th. Fr. (1860)

**Thallus** crustose, cracked-areolate; dark red-brown to black when dry, thallus anatomy loosely reticulate. **Photobiont** *Gloeocapsa*-like; cells and cell clusters near the upper surface with reddish brown, K+ purplish gelatinous sheaths; cells 10-20 µm diam. **Ascomata** perithecioid with a punctiform disc, periphysoids present around the ostiole, the hymenium K/I+ blue. **Hamathecium** either absent or with only a few short paraphyses. **Asci** clavate, tapering above (almost pointed), the walls thin, 8- to 32-spored, non-amyloid except for a K/I+ blue fuzzy outer coat. **Ascospores** aseptate, colourless, ellipsoidal. **Conidiomata** pycnidia. **Conidia** typically acicular, occasionally rod-shaped. **Chemistry**: no lichen products reported. **Ecology**: on moist siliceous rocks.

Differs from the superficially similar *Pyrenopsis* in having a highly gelatinous hamathecium composed of periphysoids and few paraphyses, usually slender asci with pointed tips, and acicular, not cylindrical to ellipsoidal conidia.

Only one named species is known from Britain and Ireland, but 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 *C. permiscens* (Nyl.) Hellb. but that species has 8-spored asci. *C. neglecta* Henssen 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***:
Gilbert & Schultz (2009), Jørgensen (2012), Orange (2003, 2013), Schultz & Büdel (2002).

**Cryptothele rhodosticta** (Taylor) Henssen (1990) **Nb IR**

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.

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.

## **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 a true 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;

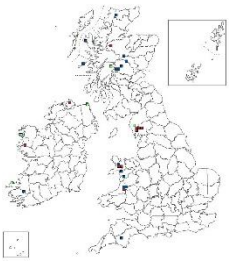
wall with K/I+ blue outer layer; apical dome absent. **Ascospores** aseptate or occasionally with 1 or 2 plasma bridges, ellipsoidal, colourless. **Conidiomata** pycnidia. **Conidiophores** branched, long-celled. **Conidiogenous cells** elongate-ampulliform. **Conidia** ellipsoidal to bacilliform, aseptate, 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 a mat 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**

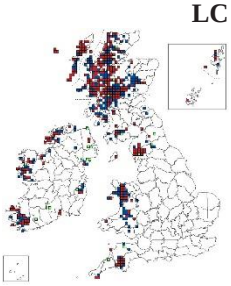


Like *E. lanata*, but thallus 5–10 (–30) mm diam., the filaments >50 µm diam. with numerous short spine-like lateral branches. Ascomata to 0·25 mm diam., rare, more prominent than in *E. lanata*, becoming subglobose, with an open disc and a blackish green exciple. Asci (8-)16-spored. Ascospores ovoid, 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. or *Stigmidium ephebes* (Henssen) D. Hawksw.

## **EUOPSIS** Nyl. (1875)

**Thallus** crustose, granular to minutely squamulose, dark reddish brown, gelatinous when moist; cortex not differentiated; hyphae forming a reticulate pattern around the cyanobacterial photobiont, but pseudoparenchymatous in parts with a green algal photobiont. **Photobiont** *Gloeocapsa*, sometimes also with *Trebouxia*; cells or cell-clusters of *Gloeocapsa* near the surface with red-brown, K+ purplish gelatinous sheaths. **Ascomata** apothecia, with a glossy brown disc. **Thalline margin** well-developed and elevated. **Exciple** narrow, of parallel compacted paraphysis-like hyphae. **Epithecium** pale brown. **Hymenium** colourless, I–. **Hypothecium** colourless or pale brownish, of interwoven hyphae. **Hamathecium** of sparingly branched septate paraphyses, slender, not moniliform. **Asci** cylindrical, thick-walled, 8-spored; inner wall of ascus and tholus K/I+ blue, apical dome K/I–. **Ascospores** aseptate, ellipsoidal, colourless, without a distinct perispore. **Conidiomata** pycnidia, immersed. **Conidiogenous cells** in chains. **Conidia** bacilliform. **Chemistry**: no lichen products detected by TLC. **Ecology**: on moist acid rocks, sometimes over mosses, soil or peaty debris.

Distinguished from *Pyrenopsis* by the open, disciform apothecia with glossy discs, asci that are partly K/I+ blue, and more slender paraphyses. *Psorotichia* has *Xanthocapsa* as its photobiont and asci which are completely K/I–.

*Euopsis* was transferred to the Harpidiaceae (Pezizomycotina families *incertae sedis*) by Lücking *et al*. (2017), based on nuSSU sequences submitted to Genbank in 2004, but research has not formally been published and we retain it in the Lichinaceae pending further studies. See also Rico (2022).

***Literature***:
Henssen et al. (1987), Jørgensen (2012), Jørgensen *et al.* (2009), Lücking *et al*. (2017), Rico (2022).

**1** Thalline margin uneven, whitish, containing green algae; thallus mainly granular, with whitish patches or dots.....***granatina***
Thalline margin crenulate-squamulose, red-brown, containing cyanobacteria; thallus minutely squamulose, uniformly red-brown .....***pulvinata***

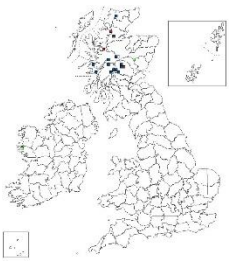
**Euopsis granatina** (Sommerf.) Nyl. (1875) **Nb**

Thallus reddish brown, with small whitish patches or dots, granular, often broken up into nodulose clumps to 1 cm diam.; photobiont *Gloeocapsa* (cells 10–20 µm diam.) but also with *Trebouxia* (cells 7–10 µm diam.) in the thalline margin and in patches in the thallus. Apothecia to 0.5 mm diam., disc open, flat to convex, shiny; thalline margin irregular, elevated, whitish, to 0.1 mm thick, pseudoparenchymatous, containing green algae; exciple 10–25 µm thick; hymenium 70–80 µm tall; hypothecium 60–70 µm tall. Asci 50–60 × 10–12 µm. Ascospores 9–12 × 5–7 µm. **BLS 1216**.

On moist siliceous or slightly basic rocks; rare. S.W. England, Mid Wales, Scottish Highlands.

Generally smaller than *Euopsis pulvinata*, distinguished by the whitish thalline margins containing green algae and the white-dotted thallus.

**Euopsis pulvinata** (Schaer.) Vain. (1881) **Nb**



Thallus coarsely granular-areolate to squamulose, forming pulvinate patches to 2 cm diam., uniformly reddish brown; photobiont *Gloeocapsa*. Apothecia to 1 mm diam.; disc flat to convex, often shiny; thalline margin crenulate due to granular or subsquamulose outgrowths, concolorous with the thallus, sometimes becoming excluded, to 0.15 mm thick, without green algae; exciple 10–25 µm thick; hymenium 100–125 µm tall; hypothecium 70–80 µm tall. Asci 80–100 × 10–15 µm. Ascospores 10–15 (–17) × 5–8 µm. **BLS 1219**.

On moist siliceous rocks (especially mica-schist), often over dead or dying mosses or small accumulations of soil; rare. Scotland (C. Highlands, Mull), Ireland (Connemara).

## **LEMMOPSIS** (Vain.) Zahlbr. (1906)

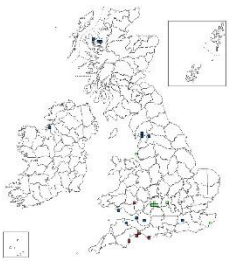
**Thallus** minute, thin, granular-crustose, black, pseudoparenchymatous, gelatinous when moist, not stratified, epinecral layer occasionally present. **Photobiont** cyanobacterial (*Nostoc*-like); cells globose to slightly ovoid, in clumps. **Ascomata** apothecia, sessile, urceolate-discoid; disc ± 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 below 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 mainly 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**

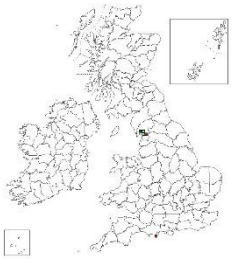


Thallus of rounded to subrectangular, gelatinized areoles to 0.6 mm diam., scattered or aggregated, forming a thin effuse dark-coloured crust, gelatinous when wet. Apothecia 0.4–0.5 (–0.7) mm diam., numerous, prominent, sessile with an urceolate, dull red disc; exciple prominent, dull yellow-brown to 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.

## **LEMPHOLEMMA** Körb. (1855)

**Thallus** crustose-warted, squamulose, foliose, minutely shrubby or shortly filamentous, blackish, or dark blue-green to olivaceous especially when wet, gelatinous; not layered, without a well-defined cortex. **Hormocystangia** present or not. **Photobiont** *Nostoc*; cells in chains, occasionally compressed and clustered. **Ascomata** apothecia, mainly laminal, ± globose, immersed to sessile. **Thalline margin** conspicuous. **Disc** pore-like, sometimes later expanding. **Exciple** usually thin and inconspicuous, rarely more than 20 µm thick at the sides, colourless, of compacted, parallel hyphae. **Hypothecium** shallow, colourless. **Hymenium** colourless, without a distinct epithecium. **Hamathecium** of scanty to numerous, unbranched or sparingly branched paraphyses without swollen apices; gel matrix I+ reddish, K/I+ blue. **Asci** 8-spored, clavate to cylindrical, without a distinct apical apparatus; wall K/I–, or blue in the outer part. **Ascospores** ellipsoidal to globose, aseptate, colourless, thin-walled but often with a distinct, gelatinous perispore that disperses in K. **Conidiomata** pycnidia, mostly laminal, globose, immersed. **Conidiogenous cells** slender, cylindrical. **Conidia** bacilliform, or with a swelling at one or both ends, or fusiform, straight or slightly curved, aseptate, colourless. **Chemistry**: no lichen products detected by TLC. **Ecology**: on rocks, mortar, bryophytes or soil, rarely corticolous, usually on substrata that are calcareous or subjected to basic flushing.

The genus is heterogeneous. The circumscription of most of the species is also uncertain and a critical revision is required. Apart from detailed anatomical aspects, the genus can be distinguished from most other gelatinous blue-green lichens with a similar appearance by its *Nostoc* photobiont – *Porocyphus* has *Calothrix*, *Pyrenopsis* has *Gloeocapsa*. Similar species of *Collema* s.l. (Peltigerales: Collemataceae) 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). The apothecia, pycnidia and hormocystangia of *Lempholemma* species are often inconspicuous and best observed in moistened thalli.

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

**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, minutely shrubby or shortly filamentous; isidia absent ..... 2

**2**(1) Thallus minutely shrubby to shortly filamentous; lobes 1–5 mm long ..... 3
Thallus crustose-warted, squamulose, foliose or cushion-like; lobes less than 0.5 mm long ..... 5

**3**(2) Ends of some lobes swollen to form globular to cup-shaped hormocystangia ..... ***cladodes***
Hormocystangia absent ..... 4

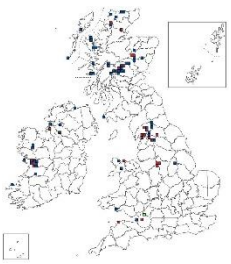
**4**(3) Thallus shortly filamentous, lobe ends not swollen ..... ***intricatum***
Thallus minutely shrubby, forming small tufts or flat cushions with cylindrical finger-like lobes around the margin ..... ***botryosum***

**5**(2) Thallus of dark flattened squamules or umbilicate cushions; apothecia absent ..... 6
Thallus forming a spreading granular, nodular or foliose crust; small apothecia usually present initially with a poriform disc ..... 7

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

**7**(5) 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 botryosum** (A. Massal.) Zahlbr. (1924) **Nb**

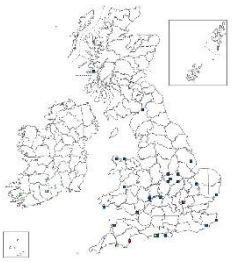


Thallus of dark aggregated short minutely shrubby, ± imbricate nodular cylindrical branched lobes forming small tufts or umbilicate cushions with a rough surface and lobes around the edge, mostly 1.5–3 mm diam.; lobes to 0.3 mm long, 0.15–0.2 mm wide, the surface of lobes minutely longitudinally striate, 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*.

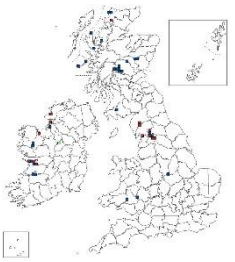
**Lempholemma chalazanum** (Ach.) de Lesd. (1910) **Nb**



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 cladodes** (Tuck.) Zahlbr. (1924) **NT**



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 Europe, 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**.

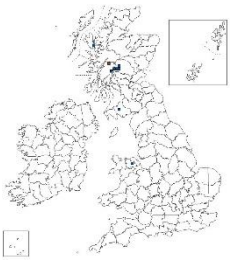
Found in water-filled depressions in Carboniferous limestone; also on damp basic cliffs, by waterfalls and on low flat acidic rock outcrops affected by blown shell-sand in machair; rare. Scattered in Cumbria and the Pennines, mid Wales, Highland and oceanic W. Scotland, W. Ireland.

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.

**Lempholemma intricatum** (Arnold) Zahlbr. (1924) **NT**

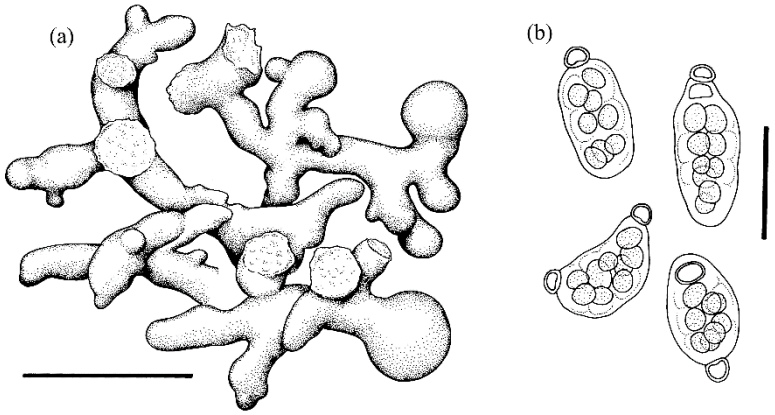
Thallus shrubby to filamentous, forming low cushions or mats to 3 cm across; lobes cylindrical, repeatedly dichotomously branched, decumbent, entangled, blackish, sometimes faintly longitudinally wrinkled, to 5 mm long and 0.12–0.2 mm wide. Apothecia rare, 0.15–0.2 mm diam., laminal or rarely terminal, ± 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. 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*.




*Lempholemma 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.

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

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

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

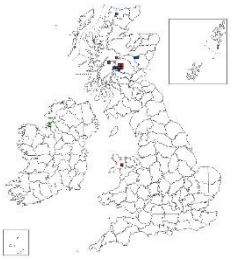
Thallus dark olivaceous to blackish, nodular-granular, or spreading to 5 cm diam. or more and then often with irregularly rounded foliose lobes (to 3 mm wide) at the edge, the centre of the thallus with irregular ridges which are often warted, dark olivaceous to blackish. Apothecia 0.2–0.3 mm diam., 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. A population from Glen Coe has been found to harbour a *Didymellopsis*-like lichenicolous fungus with extremely large spores with a broad gelatinous perispore.

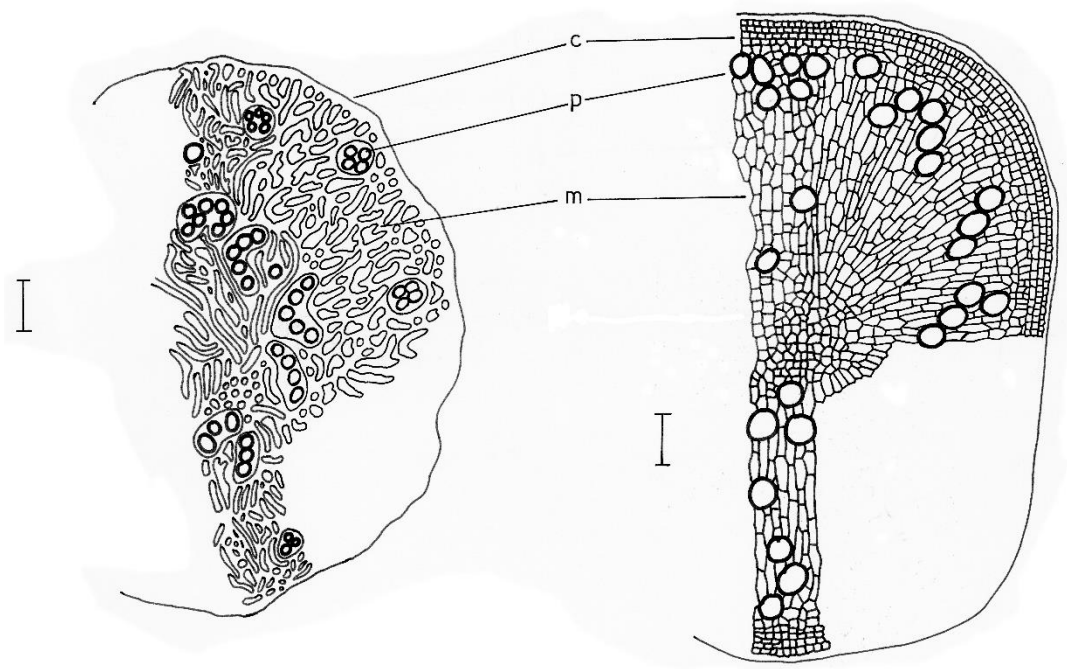
## **LICHINA** C. Agardh (1817)

**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. Cortex indistinct and gelatinous to well-defined and cartilaginous. **Photobiont** cyanobacterial, *Rivularia*. **Ascomata** apothecia, globose, immersed 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) that *L. pygmaea* appeared to be host to a complex range of cyanobacteria in addition to *Rivularia*, as well as chlorophytan algae.

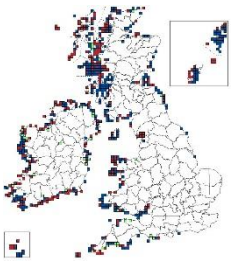
***Literature***:
Chrismas *et al.* (2021). Fletcher & Purvis (2009), Garrido-Benavent *et al.* (2023), Henssen (1969), Jørgensen (2012), Ortiz-Álvarez *et al.* (2015), Prieto *et al.* (2008), Schultz (2017).

**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**

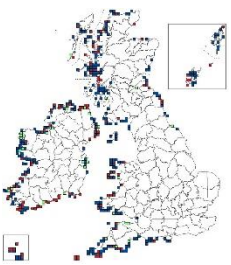


Thallus to 0.5 cm tall, erect, forming small compact 'areolate' tufts 5–10 mm diam., sometimes coalescing to form swards; lobes terete, to 0.3 mm diam., dichotomous, terminal branches to 3 mm long, dull, olive-brown to black; cortex a loose weft of soft, gelatinous hyphae indistinguishable from the medulla 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, dark reddish 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 or reddish 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 anastomising 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. Sequences are not available, but it may be related to *Psorotichia* which is similar but has a different kind of apothecia and different thallus structure.

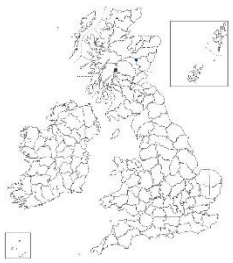
Three species are known, only one of which occurs in our area.

***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 widenened with brownish, smooth apothecial discs, lacking both an umbo and coronate thalline margin.

## **PHYLLISCUM** Nyl. (1853)

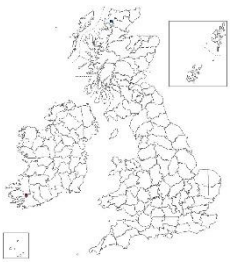
**Thallus** dark, squamulose, hollow, often rosette-shaped, forming small cushions attached by a minute umbilicus, subgelatinous to gelatinous when wet; not stratified, a network of angular-celled hyphae surrounding the photobiont, loosely reticulate in cross section, with no central hyphal strand. **Photobiont** *Gloeocapsa*-type; cells and cell clusters near the upper surface surrounded by 1–2 red, reddish-brown or purplish gelatinous sheaths, K+ purplish; cells large, to 40 µm diam. **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** I+ blue. **Hamathecium** absent, periphyses present around the ostiole. **Asci** slender with pointed tips, 8- or polysporous. **Ascospores** aseptate, 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), is not uniform, but *P. demangeonii* is its type species. Molecular data are sparse, but the genus appears not to be closely related to the core Lichinaceae clade (Díaz-Escandón *et al*. 2021).

***Literature***:
Díaz-Escandón *et al*. (2021), Gilbert (2009), Henssen (1963), Jørgensen (2012), Orange (2013).

**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; it should be looked for in seepage tracks.

Easily recognized by the ± inflated umbilicate squamules with punctiform ascomata.

## **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** *Calothrix*, with filaments often much disrupted and modified, appearing unicellular. **Ascomata** apothecia, developing as normal apothecia or 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 (in pycnoascocarps) 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.

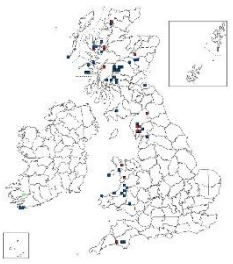
Other cyanophilic lichen genera with aseptate spores and poriform apothecia may be separated by their cyanobionts; *Pyrenopsis* (*Gloeocapsa*), *Pterygiopsis* (chroococcoid), *Lempholemma* (*Nostoc*), *Psorotichia* (chroococcoid). Other genera have discoid apothecia when mature. *Lemmopsis* is crustose 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*.

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

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**

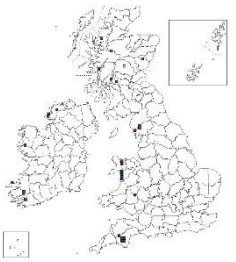


Thallus very dark brown to black, rimose, forming angular areoles 0.6–1.5 mm diam., surface smooth, matt, flat; photobiont filaments mostly disrupted; cells mostly 6–8 µm diam., arranged in short, vertically orientated chains or clusters. Apothecia 0.3–0.5 mm diam., immersed, visible as slight bumps, with thick thalline margins, 1/4 width of disc; disc poriform, expanding to a flat, black disc, often umbonate; true 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**

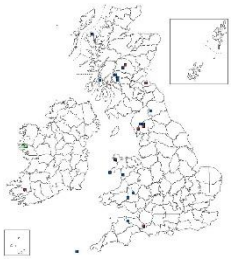


Thallus initially crustose, later becoming cracked-areolate when the areoles may have elevated margins and thus appear sublobulate, very closely appressed, radiating, forming ± circular patches to 6 cm diam., the centre continuous, the lobes to 1.5 mm long and 0.2–0.3 mm wide, very dark brown; lobe surface 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.

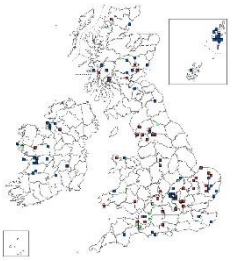
## **PSOROTICHIA** A. Massal. (1855)

**Thallus** crustose, granular-areolate to subsquamulose, dark greenish to black, gelatinous, not corticate, pseudoparenchymatous ± throughout. **Photobiont** *Chroococcidiopsis* (‘*Xanthocapsa*‘), cells single or in small groups surrounded by a thin gelatinous sheath which is yellowish brown near the thallus surface. **Ascomata** apothecia, ± immersed, urceolate to flat or slightly convex. **Thalline margin** present, concolorous with the thallus. **Exciple**, when visible, usually paler than the disc, in section colourless or pale brownish, well-developed laterally especially in the upper part but narrowing below, open at the base; disc red-brown to brown-black. **Hymenium** colourless, I+ blue. **Hypothecium** wedge-like. **Hamathecium** of thin, unbranched or (especially above) sparingly branched paraphyses, with one to several swollen apical cells. **Asci** (4-)8-spored, cylindrical to narrowly clavate, thin-walled, K/I–, without apical thickening. **Ascospores** aseptate, ellipsoidal, colourless, without a distinct perispore. **Conidiomata** pycnidia, immersed in small warts. **Conidia** bacilliform, aseptate, colourless. **Chemistry**: no lichen products reported by TLC. **Ecology**: usually on calcareous rocks.

Differs from *Lemmopsis* in the mature apothecia having the true 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 the photobiont. *Euopsis* has *Gloeocapsa* as its photobiont and asci which are K/I+ blue. *Psorotichia diffundens* and *P. pyrenopsoides* have been shown to be forms of *Porocyphus coccodes.*

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

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



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 granular isidia 40–80 µm diam.; photobiont cells 5–7 µm diam. Apothecia 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. 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 number of isidia produced and the colour of the thallus.

## **PTERYGIOPSIS** Vain. (1890)

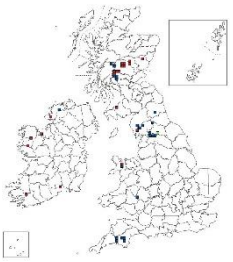
**Thallus** crustose, blackish, closely adpressed; rhizines absent; hyphae with ± round cells arranged in a fan-like fashion. **Photobiont** chroococcoid, with a brownish gelatinous sheath, clusters of cells present throughout the thallus. **Ascomata** apothecia, parietal, ± immersed to sessile; disc brown, punctiform. **Thalline margin** distinct, of isodiametric cells. **Exciple** inconspicuous. **Hymenium** gelatinous. **Hamathecium** of paraphyses, unbranched or branching and anastomosing, with thickened apices with external brown pigmentation. **Asci** 8-spored, thin-walled, K/I+ red-brown, without internal amyloid structures, I–. **Ascospores** aseptate, subglobose, colourless. **Conidiomata** not seen. **Chemistry**: lichen products not detected by TLC. **Ecology**: saxicolous, semi-aquatic to aquatic.

*Metamelanea* is similar in many requests 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. *Pterygiopsis* may well be polyphyletic, but sequence data are sparse.

***Literature***:
Gilbert & Purvis (2009), Jørgensen (1990, 2012).

**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 ..... ***lacustris***

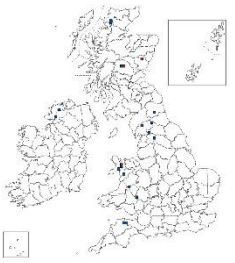
**Pterygiopsis concordatula** (Nyl.) P.M. Jørg. (2007) **NT**



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.

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



Differs from *P. concordatula* 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 P. *concordatula* but with a similar distribution.

These two species of *Pterygiopsis* differ in external characteristics, the iodine reaction of the hymenium and type of paraphyses. *P. lacustris* is usually easily recognized by the filmy thallus and the immersed, sunken apothecia said to have the appearance of fingerprints in dough.

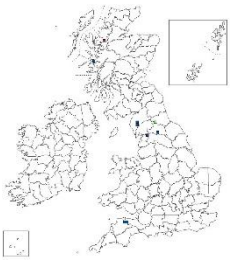
## **PYRENOCARPON** Trevis. (1855)

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 true exciple.

***Literature***:
Coppins & Aptroot (2009), Ellis (1981), Jørgensen (2012).

**Pyrenocarpon thelostomum** (Ach. ex J. Harriman) Coppins & Aptroot (2008) **Nb**



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 true exciple) are diagnostic for this species.

## **PYRENOPSIS** (Nyl.) Nyl. (1858)

**Thallus** crustose, effuse, granular-areolate or minutely squamulose, blackish but with a reddish tinge (especially when wet), ± gelatinous when moist; cortex not differentiated, composed of isodiametric cells throughout. **Photobiont** *Gloeocapsa*-like; cells or cell clusters near the upper surface with reddish brown, K± purplish, gelatinous sheaths. **Ascomata** apothecia, perithecium-like; disc pore-like to rarely urceolate, orange-brown to blackish. **Thalline margin** prominent, persistent. **Exciple** very thin (mostly less than 15 µm thick), often inconspicuous. **Hymenium** colourless, or pale brownish above, I+ blue-green or reddish brown. **Hypothecium** colourless or pale brownish. **Hamathecium** of unbranched or branched thick paraphyses, which are often ± moniliform above. **Asci** broadly clavate, 8- or multispored; of two types, either unitunicate-rostrate, with a K/I+ blue apical dome (*P. furfurea*) or with the ascus apex not thickened (*P. subareolata*). **Ascospores** aseptate, ellipsoidal to globose, colourless, without a distinct perispore. **Conidiomata** pycnidia, immersed; wall colourless. **Conidia** shortly ellipsoidal to bacilliform, aseptate, colourless. **Chemistry**: no lichen products reported. **Ecology**: on rocks, rarely on soil, in moist situations.

A poorly understood genus (collections are often poorly developed), requiring a thorough revision. *Euopsis* has disc-like apothecia from an early stage, a different ascus structure and usually more slender paraphyses (that are not moniliform). *Cryptothele* has a hamathecium composed of periphysoids, not paraphyses. *Porocyphus* has *Calothrix* as its photobiont, with filaments often much disrupted and modified, appearing unicellular rather than in clusters. *Psorotichia* has K/I– asci and photobionts with yellowish brown gelatinous sheaths.

***Literature***:
Jørgensen (2012), Schultz & Büdel (2002).

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

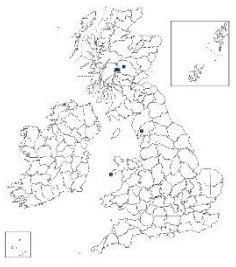
**2**(1) Thallus distinctly squamulose, usually with ± elongate, finger-like lobe extensions; ascomata eventually opening, apothecium-like ..... ***furfurea***
Thallus crustose to small-squamulose, cracked-areolate; ascomata remaining perithecioid ..... 3

**3**(2) Asci polyspored, containing 8–64 spores ..... ***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 ..... ***impolita***
Spores ellipsoidal, 11–14 × 8–9 µm ..... ***subareolata***

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

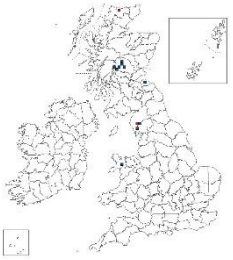


Thallus thick, deeply cracked-areolate to minutely subsquamulose, 1–1.5 mm diam., often with extended finger-like lobes, brown-black, reddish when moist; photobiont chroococcoid, single or pairs of cells in broad brownish sheaths, cells 7–10 (–20) µm diam. Apothecia frequent, to 0.3 mm diam., perithecioid 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*.

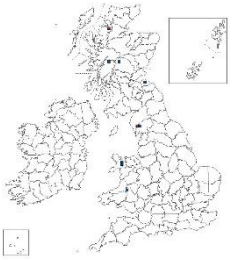
**Pyrenopsis grumulifera** Nyl. (1861) **Nb**



Thallus crustose, cracked-areolate, sometimes granular, brown-black, 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.

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

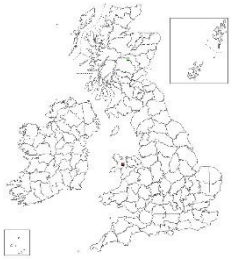


Thallus brownish black, to *ca* 150 µm thick, crustose, areolate to ± squamulose; photobiont with cells 5–7 µm diam., enclosed in a brown sheath. Apothecia immersed in the thallus, to 0.2 µm diam., the disc eventually expanding; hymenium I+ blue. Asci ± cylindrical, 8-spored, the apex with an amyloid 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 *P. subareolata* but the ascospores are (5–) 8–10 × (5–) 7–8 µm in size and subglobose to globose, and the asci have an external amyloid cap.

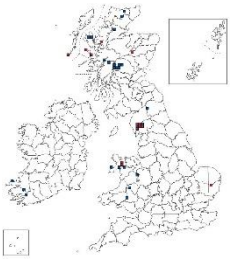
**Pyrenopsis phylliscella** Nyl. (1875) **Nb IR**



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.

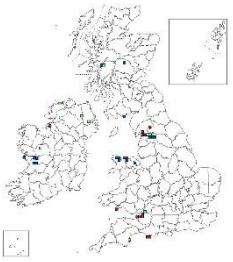
## **SYNALISSA** Fr. (1825)

**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 (2009), Jørgensen (2012), 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. 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.

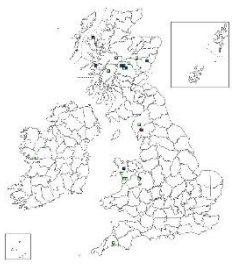
## **THERMUTIS** Fr. (1825)

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 true 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, lateral on filaments, globose, 0.2–0.5 mm. diam., sessile, disc poriform, true exciple 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.

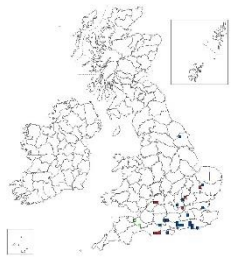
Easily mistaken for non-lichenized *Scytonema* cushions, but readily identified when sterile by the thin hyphae with capitate haustoria ramifying around the photobiont sheath. The identity of the photobiont and narrowness of the filaments distinguish it from *Spilonema* and small specimens of *Ephebe* 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).

# **PELTULACEAE** Büdel (1986)

The Peltulaceae comprises the single genus *Peltula*, so the generic description below constitutes that of the family. The thallus form is varied but often peltate or umbilicate with a narrowed stem, and the asci are thick-walled when young (perhaps with rostrate dehiscence) rather than thin-walled as in the Lichinaceae.

## **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 with a distinct stalk or with rhizoids. **Soralia** or **isidia** present in some species. **Photobiont** cyanobacteria, usually *Alliterella*, rarely also with green algae within the thallus. **Ascomata** immersed in the thallus, initially ± perithecial in form but becoming ± apothecial in many species, often formed from pycnidia, the peridium often not well-defined, with or without a thalloid margin. **Hamathecium** of unbranched or anastomosing paraphyses, with a pigmented epithecium. **Asci** with a thickened apex when young, often thin-walled when mature, polysporous, without well-defined apical structures, usually with a I+ gelatinized outer layer. **Ascospores** small, colourless, aseptate, thin-walled. **Conidiomata** pycnidial, immersed in the thallus, sometimes chambered or cerebriform. **Conidia** small, usually ellipsoidal or cerebriform. **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), Yang *et al*. (2022).

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

Thallus to 12 mm diam., scattered to confluent, peltate with revolute and sometimes ± lobulate margins, olive-brown, not pruinose, attached to the substratum with a central stem; 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.

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