PYRENULA Ach. (1814) nom. cons.

Thallus crustose, immersed, or more rarely superficial, more or less continuous to sometimes areolate; pseudocyphellae sometimes present. **Photobiont** *Trentepohlia*, rarely apparently absent. **Ascomata** perithecia, immersed to erumpent, more or less globose to flattened, black. **Involucrellum** spreading laterally to developed around and closely adhering to the exciple, from which it is then not distinct, composed of filamentous hyphae interspersed with bark cells and often crystals. **Exciple** pigmented; pigment brown, K + darker brown (at least in British and Irish species), often containing colourless calcium oxalate crystals (insoluble in K, soluble in 10% HCl). **Ostiole** central or lateral. **Hymenium** with gel I – or + greenish blue in parts, sometimes densely inspersed with minute oil droplets, lateral parts sometimes with masses of orange-brown, K + purple-red pigment (anthraquinones). **Hamathecium** at first of branched and anastomosed, sparsely septate periphysoids; more or less unbranched paraphyses developing later and replacing the periphysoids; ostiole with periphyses. **Asci** cylindrical, long-stalked, multilayered in structure, apex thickened, with an internal apical beak and a refractive subapical cap, I –, discharge fissitunicate, the different wall layers extending to different extents. **Ascospores** ellipsoid to narrowly ellipsoid or broadly fusiform, apices rounded to apiculate, 3-septate to muriform, very thick-walled, distoseptate, cell lumina appearing lenticular to angular; colourless to olivaceous or dark brown, smooth-walled, without a perispore. **Conidiomata** pycnidia, more or less globose, black (pigment like exciple), unilocular or divided into chambers. **Conidia** more or less thread-like to strongly curved, simple, colourless. **Chemistry:** lichexanthone, unidentified anthraquinones, other unidentified substances, or lichen substances absent. **Ecology:** on more or less smooth bark surfaces in humid situations.

Classification: Chaetothyriomycetidae, Pyrenulales, Pyrenulaceae.

A predominantly tropical genus of about 200 species, poorly represented in Europe. Features used to identify the British and Irish species include: presence of pseudocyphellae (appearing as small whitish dots on thallus surface), size of perithecia (in most species it is sufficient to measure the diameter of the blackish perithecia *in situ*), and presence of anthraquinones. Anthraquinones can be detected by mounting a section of perithecium and thallus in water, and drawing K under the coverslip; anthraquinones will give a purplish-red solution; this reaction is often strong enough to be also easily seen under the dissecting microscope.

LITERATURE: Harris (1995).

1 Ascospores (1–)3-septate; perithecia various, not in radial groups 2
Ascospores muriform; perithecia large, with lateral ostioles, often arranged in radial groups ..... **4. hibernica**

2 Involucrellum not or slightly extended laterally, exciple pigmented throughout; ascospores often larger; photobiont present 3
Involucrellum much extended laterally; pigmented exciple not continuous below perithecial cavity; ascospores 10–17 µm long; photobiont probably absent .... **2. coryli**

3 Thallus immersed, UV – or + pale yellow or whitish (unidentified substances, lichexanthone absent); perithecia conspicuous, appearing black even when covered by a thin layer of bark 4
Thallus superficial, UV + yellow-orange (lichexanthone); perithecia immersed in thallus and visible only by the ostiole, sometimes exposed as black discs up to 0.38 mm diam. ..... **3 dermatodes**

4 Perithecia 0.2–0.4 mm diam., forming at most low projections in the thallus 5
Perithecia 0.4–1.2 mm diam., forming distinct projections in the thallus 6

5 Hymenium at sides with masses of an orange-brown pigment, K + purple-red solution ..... **9. nitidella**

Hymenium K – ..... **1. chlorospila**

6 Ostiole central 7
Ostiole lateral; thallus without pseudocyphellae, all parts of perithecium lacking K + purple-red substances ..... **7. aff. microtheca**

7 Perithecium with K + purple-red substances on upper surface or within hymenium; hymenium densely inspersed with oil droplets or not 8
Perithecium lacking K + purple-red substances; hymenium not inspersed 9

8 Hymenium with lateral parts containing an abundant orange-brown pigment which is K + purple-red going into solution; not inspersed with oil droplets; thallus sometimes with pseudocyphellae ..... **8. nitida**
Hymenium without K + purple-red substances, but these present on outer surface of perithecial apex (sometimes sparse); inspersed with oil droplets; pseudocyphellae absent ..... **10. occidentalis**

9 Pseudocyphellae present; ascospores (24–)27–33(–36) µm long; perithecia not or scarcely flattened in section ..... **6. macrospora**
Pseudocyphellae absent; ascospores (14–)17–22(–26) µm long; perithecia often flattened in section ..... **5. laevigata**

1. Pyrenula chlorospila Arnold (1887)

Thallus olive-green to pale brown or fawn; pseudocyphellae 40–120 µm diam., white. Perithecia small, 0.2–0.4 mm diam., often rather densely arranged, forming very low projections in the thallus or not forming projections. Exciple containing colourless crystals. Hymenium not inspersed with droplets [?], without anthraquinones. Ascospores (25–)28–32(–35) × (9–)11-13(–14) µm, 3-septate. Thallus PD + faintly yellow, K + yellow, KC –, C–, UV– or + whitish (unidentified substance).

On smooth, shaded bark of deciduous trees, often with *P. macrospora*; locally abundant. S. and W. British Isles. Denmark, Portugal, France, Italy, Greece.

Distinguished in the field by the small perithecia which scarcely project from the thallus. Most pre-1980 records of *P. nitidella* refer to this species.

2. Pyrenula coryli A. Massal. (1852)

Mycopyrenula coryli (A. Massal.) Vain. (1921)

Thallus pale grey; pseudocyphellae more or less absent; probably lichenized. Perithecia 0.2–0.3 mm diam. and *c*. 0.1 mm high, with a laterally extending involucrellum; pigmented exciple not continuous below the perithecial cavity; anthraquinones absent. Ascospores 10–17 × 4–6 µm, 3-septate. Pycnidia scattered amongst the perithecia; conidia 20 × 0.5 µm, thread-like.

On *Corylus* bark, very rare. North Wales (Merioneth), N. and W. Scotland (Westerness, West Sutherland). C. and N. Europe, but rarely recorded this century.

In the field difficult to separate from species of *Arthopyrenia* and *Eopyrenula*. Sometimes treated in a separate genus due to the the non-lichenized habit, but other characters are similar to other species of *Pyrenula*.

3. Pyrenula dermatodes (Borrer) Schaer. (1850)

Thallus superficial, yellowish green to more or less orange-rust coloured, fading to pale yellow-brown in the herbarium, continuous to finely cracked or areolate; pseudocyphellae absent. Perithecia 0.2–

0.44 mm diam. (in section), completely immersed in thallus, forming at most very low projections, with only the grey ostiole *c*. 50–60 µm diam. visible from above, or sometimes perithecia becoming exposed as a black disc up to 380 µm diam. Hymenium not inspersed with oil droplets, without anthraquinones (K–). Ascospores 14–19 × 6.5–7.5(–8.5) µm, 3-septate. Conidia curved, *c*. 15 µm long. Thallus PD –, K ?+ orange-red in places, KC –, C –, UV + yellow-orange (lichexanthone).

On smooth bark of *Corylus*,*Crataegus*, *Fagus*, *Ilex* and *Sorbus* in oceanic woodlands, rarely on shaded siliceous rocks; very rare. N. Scotland (Knoydart in West Inverness), locally frequent in S.W. Ireland, extending north to Donegal; not known elsewhere in Europe. Macaronesia, India, China, South America.

Distinguished by the superficial, often cracked, thallus which is UV +, and by the (at least initially) very inconspicuous immersed perithecia.

4. Pyrenula hibernica (Nyl.) Aptroot (2003)

Pyrenula chilensis auct., non (Fée) R.C. Harris (1989), *Parmentaria chilensis auct., non* Fée (1838)

Thallus immersed, pale olive-green or yellow-buff, sometimes with white dots, smooth, continuous; with age becoing rougher and rarely cracked. Perithecia 1–1.2 mm diam., black, arising 1–1.5 mm below the surface; only the pale ostiole visible at surface, or perithecia visible through translucent surface of thallus; occurring singly, or radially arranged in groups of 2 to 5; ostioles lateral, often joined, visible as a pale yelow- or orange-brown depression or disc at surface of thallus. Asci 4–8-spored. Ascospores muriform, brown when mature, (57–)70–135(–140) × (24–)26–47(–55) µm, oblong to fusiform-ellipsoid. Pycnidia c. 2 mm dia,m., divided into chambers. Conidia 24–27 × 1 µm. Thallus PD –, K –, KC –, C –, UV + light yellow (lichen products not tested by TLC).

On smooth bark of *Corylus* and *Ilex* in very sheltered, moist ravines at *c*. 100 m altitude; very rare. N. Wales (Merioneth: Ceunant Llennyrch), W. Scotland (Westerness: Loch Sunart), S.W. Ireland (Kerry: Killarney). Canary Islands, Azores (erroneously reported from N. & S. America).

Distinguished by the large, immersed perithecia with lateral ostioles, arranged in groups, and the muriform ascospores. The perithecia are very striking when visible through the upper layers of the thallus, but sometimes they are very inconspicuous, detectable in surface view only by the pale ostioles.

5. Pyrenula laevigata (Pers.) Arnold (1885)

Thallus immersed, silvery or cream to pale yellow-brown; pseudocyphellae absent. Perithecia 0.45–0.66 mm diam., forming projections in the thallus, somewhat flattened in section, with an involucrellum separable from the exciple and spreading somewhat. Hymenium not containing anthraquinones, K –. Ascospores (14–)17–22(–26) × (7–)8–9(–11) µm, 3-septate. Pycnidia black, up to *c*. 100 µm diam., scattered or in lines. Conidia 10–19 × *c*. 0.5 µm, curved. Thallus PD–, K + yellow [why?], KC –, C –, UV –.

On smooth bark, especially of *Corylus*, in oceanic woodlands; local. S.W. England (N. Devon), N. Wales (Cardigan, Merioneth), W. Scotland, S.W. Ireland (Clare, Kerry, Cork). Macaronesia (Canary Islands), Europe, E. North America.

This status of this taxon in the British Isles deserves closer study, as the species is primarily continental in distribution. A K + fleeting blue reaction has been reported in the hymenium of this species, but has not been detected in British or Irish material.

6. Pyrenula macrospora (Degel.) Coppins & P. James (1980)

Thallus olivaceous or fawn to dark brown; pseudocyphellae 40-120 µm diam., white. Perithecia (0.4–)0.5-0.9(–1.2) mm, forming convex projections. Exciple containing numerous colourless crystals.

Hymenium not containing anthraquinones. Ascospores (24–)27–33(–36) × (8–)10-13 µm, 3-septate. Pycnidia visible as dark dots 100-180 µm diam., frequent, mostly in young parts of thallus, often clustered along junctions between adjacent thalli. Conidia curved, 10–16 × 0.8 µm. Thallus PD + faintly yellow, K + yellow, KC –, C –, UV – or weak yellow (unidentified substance).

On smooth, more or less shaded bark of deciduous trees, locally common. Throughout south and west British Isles. Strongly oceanic; Macaronesia (Tenerife, Madeira), Europe from Scandinavia to Portugal, Turkey.

The commonest British species of the genus. Most pre-1980 records of *P. nitida* from Britain and Ireland region refer to this species. Distinguished in the field from most other species by the large perithecia and presence of pseudocyphellae. The rare *P. nitida* differs in the K + red substance flanking the inner exciple and the smaller ascospores. Often grows with *P. chlorospila*, which differs in the smaller perithecia which scarcely form projections in the thallus.

7. Pyrenula aff. microtheca R.C. Harris (1989)

Thallus immersed, pale yellow-grey; pseudocyphellae absent. Perithecia 0.54–0.8 mm diam., forming projections in thallus; ostiole excentric to lateral. Hymenium not inspersed, anthraquinones absent (K –). Ascospores (17–)20–25(–27) × (7.5–)8–10.5(–11.5) µm, 3-septate. Thallus PD –, K –, C –, UV – (lichen substances absent). [?]

On smooth bark, rare. N. Wales (Merioneth), N.W. England, W. Scotland, S.W. Ireland.

Possibly conspecific with *Pyrenula microtheca*, which is known from N. America. Distinguished from all British and Irish species except *P. hibernica* by the lateral ostioles.

8. Pyrenula nitida (Weigel) Ach. (1814)

Thallus olive brown to dark brown or yellow-brown; pseudocyphellae often absent, but sometimes frequent, 50–75 µm diam., whitish. Perithecia 0.6–0.8(–1) mm diam. Exciple containing colourless crystals. Outer part of hymenium adjacent to exciple with orange-brown (by transmitted light) masses of anthraquinone, K + purple-red going into solution. Hymenium with oil drops sparse or absent. Ascospores (17–)19–24(–26) × 6–8(–9) µm, 3-septate. Conidia *c*. 16.5–19 × 0.8 µm, curved. Thallus PD –, K + orange-red, KC + reddish, C–, UV – (unidentified anthraquinones).

On smooth, dry, shaded bark of old deciduous trees, including *Carpinus* and *Fagus*; very rare. S. England (Buckingham, E. Kent, Hampshire, Sussex). Europe, avoiding highly oceanic areas.

Most pre-1980 British records of this species refer to *P. macrospora*. *P. nitida* is primarily a continental species, as reflected by its distribution in Britain.

9. Pyrenula nitidella (Flörke ex Schaer.) Müll. Arg. (1885)

Thallus olive-brown to fawn; pseudocyphellae 50–75 µm diam., often sparse, whitish. Perithecia 0.2–0.3(–0.35) mm diam. Hymenium not inspersed with oil droplets, at sides with K + purple-red material. Ascospores (20–)22–26(–28) × (8–)8.5–11(–12) µm, 3-septate. Thallus PD –, K + yellow to pale orange in parts, KC –, C –, UV – (unidentified anthraquinones).

On smooth bark of deciduous trees; extinct. Known from only two certain records; England (N.E. Yorkshire), Scotland (E. Perthshire). Europe. Most pre-1980 records of this species in Britain and Ireland refer to *P. chlorospila*, which differs in the lack of anthraquinones in the perithecia.

10. Pyrenula occidentalis (R.C. Harris) R.C. Harris (1987)
Pyrenula harrisii Hafellner & Kalb (1992)

Thallus immersed, yellow-brown to orange-brown; pseudocyphellae absent; surface K + purple-red in parts in section. Perithecia 0.4–0.8 mm diam., forming projections in the thallus. Exciple usually with

K + purple-red pigment associated with the upper outside wall. Hymenium densely inspersed with minute oil droplets c. 0.5–2.5 µm diam., thus appearing cloudy; anthraquinones absent (K –). Ascospores (1–)3-septate, (17–)18–22 × (7–)8.5–10.5(–11) µm. Conidia *c*. 20 µm long, curved. Thallus PD + pale orange, K + yellowish to + purplish in parts, KC –, C –, UV – (unidentified anthraquinones).

On smooth bark, particularly of *Corylus*, *Ilex* and *Sorbus*, in more or less shaded, constantly humid woodland and sheltered stream valleys; local. Mid and N. Wales, W. Scotland, S.W. Ireland (Cork, Kerry). Norway, W. North America, South Africa.

Anthraquinones are responsible for the K + purple-red reaction in the thallus and on the outer surface of the exciple (but not the inner surface); small rusty patches of anthraquinone can sometimes be seen on the thallus surface under a dissecting microscope. This species has been much confused with *P. laevigata*, which differs in the paler thallus, absence of anthraquinones, and the hymenium which is not inspersed with droplets.

Literature:

Harris, R.C. (1995) *More Florida lichens, including a 10¢ tour of the Pyrenolichens*. New York: privately published.