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Ostropales: Graphidaceae

Cover image: *Thelotrema lepadinum*, on bark of *Fraxinus excelsior* in oak woodland, Wood of Cree, Kirkudbrightshire, Scotland.

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to compile new printed editions of the entire lichen biota of Britain and Ireland is extensive, and many parts are out-of-date even as they are published.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

including the genera Allographa, Clandestinotrema, Crutarndina, Diploschistes, Fissurina, Graphis, Leucodecton, Phaeographis, Schizotrema, Thelotrema and Topeliopsis.

by

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GRAPHIDACEAE Dumort. (1822)

Thallus crustose, continuous, immersed to superficial. **Photobiont** *Trentepohlia*. **Ascomata** apothecia, immersed to superficial, often elongate (lirelliform) and then sometimes branched or stellate, in other genera immersed beneath a thalline clypeus-like structure. **Thalline margin** present or absent. **True exciple** pale or black (brightly coloured in some tropical species), opaque, prominent and well-developed, sometimes longitudinally furrowed, striate or lacerate. **Hymenium** I–. **Hypothecium** thin, pale. **Hamathecium** of unbranched paraphyses, periphysoids sometimes present. **Asci** to 8-spored, K/I–, clavate to subcylindrical, not fissitunicate, dehiscence by an apical split. **Ascospores** transversely septate or muriform, sometimes I+ violet when mature, lumina rounded to lens-shaped, mostly colourless, but sometimes brown when overmature. **Conidiomata** pycnidia. **Conidia** rod-shaped, colourless.

A very large and morphologically diverse family, containing around 80 genera and 2000 species (Lücking *et al.* 2016), with the vast majority being tropical in distribution. The Thelotremataceae has frequently been separated from the Graphidaceae based on morphological features, but the apparently clear distinctions in ascoma structure are not mirrored in phylogenetic trees (see Kraichak *et al.* (2018) and Lücking (2019) for arguments for and against). Almost all of the larger genera as traditionally circumscribed are polyphyletic.

Literature:

Kraichak *et al.* (2018), Lücking (2019), Lücking *et al.* (2016), Lumbsch *et al.* (2014), Mangold *et al.* (2008b), Rivas Plata & Lumbsch (2011), Rivas Plata *et al.* (2008, 2011, 2012a, b, 2013), Staiger *et al.* (2006).

1	Ascomata unknown; a sterile crust Ascomata present	Schizotrema
2 (1)	Ascomata lirellate, ± superficial Ascomata round, immersed in the thallus	3
3 (2)	Ascospores becoming grey- to reddish brown in the ascus Ascospores colourless, sometimes pale brown when over-mature	Phaeographis 4
4 (3)	Ascomata pale, the true exciple not blackened Ascomata black, the exciple usually carbonized	Fissurina 5
5 (4)	Ascospores usually transversely septate Ascospores generally muriform	Graphis Allographa
6 (5)	Ascospores dark brown, muriform; thallus superficial; on rock, sometimes initially parasitic on other lichens	
7 (6)	Ascospores transversely septate Ascospores muriform	Crutarndina 8
8 (7)	Thallus inconspicuous, membranous to subgelatinous; apothecia becoming \pm erumpent Thallus often immersed in bark but usually conspicuous; apothecia remaining immersed	Topeliopsis 9
9 (8)	Upper part of inner wall of true exciple lined with hypha-like periphysoids Periphysoids lacking	Thelotrema 10
10 (9)	Ostiole narrow, almost closed	Leucodecton ndestinotrema

ALLOGRAPHA Chevall. (1824)

Morphologically similar to *Graphis* (q.v.), but tending to have robust, strongly prominent lirellae with a massive, carbonized exciple, and large to very large ascospores with rounded lumina. The genus is phylogenetically quite distinct.

There are two species from our region, and these are keyed out under Graphis.

Literature:

Benfield & Orange (2009), Berger et al. (2011), Lepista & Aptroot (2022), Lücking (2009), Lücking & Kalb (2018), Rivas Plata et al. (2011), Weerakoon et al. (2019).

Allographa anomala (Leight.) Aptroot & Weerakoon (2023)

Allographa ruiziana auct. br., non (Fée) Lücking & Kalb (2018)

Graphina ruiziana auct. br., non (Fée) Müll. Arg. (1887)

Thallus white to grey-green, continuous. Apothecia $0.5-2.2 (-3.2) \times 0.3-0.5 \text{ mm}$, markedly elevated, scattered or rarely contiguous, rarely branched, straight, slightly curved or somewhat flexuous; true exciple carbonaceous, well-developed, smooth, usually weakly furrowed, often shining, occasionally white-pruinose adjacent to the disc, continuing below the hymenium; disc thin and slit-like; hymenium 100-300 µm tall; paraphyses $1.5-2 \mu m$ diam., unbranched, not enlarged at the tips; hypothecium red-brown. Ascospores (28–) 30–45 (–50) × (12–) 15–18 μ m, muriform with more than 30 cells, with (6-)7(-8) transverse septa; perispore ca 3µm thick. Pycnidia occasional; conidia $2-4.5 \times ca$ 1 µm. No lichen substances detected by TLC. **BLS 0531**.

On smooth leached bark, especially of *Ilex*, young *Quercus* and *Sorbus* in mild, humid valleys, rarely on siliceous rocks in damp upland woods; locally frequent. W. Britain north to Westerness, W. Ireland and the Wicklow Mountains.

Distinguished by the short, notably elevated lirelliform apothecia with a narrow slit-like disc and the usually slightly but distinctly furrowed disc, which is the main character that distinguishes it from the pantropical A. ruiziana. See also A. pauciloculata, whose apothecia may cohabit the thallus of A. anomala. Young fresh Graphis elegans without a furrowed exciple can be separated in the field by its pinkish-yellow tinged and K+ red (crystals) thallus. It has been confused in the field with the non-lichenized Gloniopsis praelonga (Schwein.) Zogg (1962), which has somewhat similar ascomata, but I- ascospores without reduced lumina.

Also host to Taeniolella punctata M.S. Christ. & D. Hawksw. (1979).

Allographa pauciloculata (Coppins & P. James) Aptroot & Weerakoon (2023) Graphina pauciloculata Coppins & P. James (1978)

Thallus thin, smooth, pale grey or grey-green, continuous. Apothecia $0.5-1.5 \times 0.3-$ 0.5 mm, numerous, superficial, straight, slightly curved or flexuose, frequently tightly clustered but not overlapping; true exciple carbonaceous, well-developed, not furrowed, continuing below the hymenium; disc a narrow slit; hypothecium pale redbrown; paraphyses unbranched, ca 2 µm diam. Ascospores uniseriately arranged, 13- $15 \times 5-6 \,\mu$ m, submuriform with up to 6 cells, with 3–4 transverse and 1–2 longitudinal septa. Pycnidia numerous; conidia $4-6 \times 1-1.5 \,\mu\text{m}$. No lichen substances detected by TLC. BLS 0530.

On smooth bark of *Betula*, *Corylus*, *Quercus*, *Sorbus* and especially both young and ancient *Ilex* in open to extremely sheltered, moist woodlands; locally frequent. S.W. England and Cumbria, S.

and N. Ireland, rare in C. & N.W. Wales. Endemic. Lücking et al. (2009) observed that this species appears not to belong within Graphis sensu lato, and Lepista

& Aptroot (2016) suggested that it might belong in the genus *Glyphis* Ach. (1814). Its apothecia often occur on the same thallus as *Allographa anomala*, and this apparent parasitic relationship is in need of further study.

Differs from Allographa anomala in the smaller, often ± gnarled, tightly clustered apothecia and from Graphis inustuloides and A. anomala by the smaller, fewer-celled ascospores.



VU D2 IR



Nb IR

CLANDESTINOTREMA Rivas Plata, Lücking & Lumbsch (2012)

Thallus crustose, superficial, colour usually shades of cream or fawn; cortex usually developed, smooth; prothallus absent. **Soredia** and **isidia** absent. **Photobiont** *Trentepohlia*. **Ascomata** apothecia, urceolate to perithecioid, immersed, solitary; disc concave, immersed. **Thalline margin** indistinct. **True exciple** usually mostly carbonized, resembling a clypeus. **Epithecium** colourless to brown or black. **Hymenium** colourless, I–. **Hypothecium** colourless. **Hamathecium** of filamentous, unbranched paraphyses; periphysoids lacking. **Asci** subcylindrical, with a single functional wall layer, abruptly thickened at the apex, sometimes with a minute internal apical beak, K/I–, 8-spored. **Ascospores** narrowly ellipsoidal to broadly fusiform, septate or muriform, colourless, thick-walled with the lumina with angular, more or less diamond-like shapes, smooth, lacking a distinct perispore, I– or I+ weakly purple. **Conidiomata** unknown. **Chemistry**: most species with stictic (or norstictic) acid. **Ecology**: on bark, wood, or rarely rocks.

Clandestinotrema differs from *Ocellularia* (the latter genus not represented in our area) in the thickwalled and diamond-shaped lumina and the always-present carbonization in the exciple (Rivas Plata 2012a, b). There are around 17 species globally, mostly in humid subtropical ecosystems. A key to this and related lichens from our region can be found under *Thelotrema*.

Literature:

Rivas Plata et al. (2012a, b).

Clandestinotrema antoninii (Purvis & P. James) Rivas Plata, Lücking & Lumbsch (2012) **NE** Thallus wide-spreading, to 20 cm wide, usually thin, faintly rugose, shiny, grey or tinged brownish; cortex composed of a layer 5–10 μ m thick of dead collapsed unpigmented cells; medulla and photobiont zone without crystals. Apothecia 0.2–0.3 mm diam., apothecioid, half to almost completely immersed, true exciple carbonized; hymenium 100–160 μ m tall, colourless, without crystals. Asci usually 4- or 8-spored. Ascospores (25–) 30–40 (–47) × 13–18 μ m, ellipsoidal, muriform, colourless. Thallus C–, K+ orange, KC+ orange, Pd+ orange, UV– (stictic, hypostictic, constictic, menegazziaic acids). **BLS 2832**.

On bark, probably of *Corylus*; found only once in 1984, in North-east Yorkshire (VC62). Otherwise known only from Macaronesia.

The species is included in a key within the account of *Thelotrema* (q.v.). Potentially overlooked as *Pertusaria leioplaca* without close inspection.

CRUTARNDINA Parnmen, Lücking & Lumbsch (2012)

As this is a monotypic genus, the description below (*C. petractoides*) constitutes the generic description. It is distinguished from *Thelotrema* by its stellate-lacerate true exciple, and has been shown to be quite separate from that genus using molecular phylogenetic techniques.

Literature:

Frisch et al. (2006), James & Hawksworth (2009), Parnmen et al. (2012).

Crutarndina petractoides (P.M. Jørg. & Brodo) Parnmen, Lücking & Lumbsch (2012) Nb IR Thelotrema petractoides P.M. Jørg. & Brodo (1995)

Thallus cream, white or pale ochraceous, uniformly thin, somewhat immersed, \pm continuous, cortex an ill-defined superficial layer of necrotic cells mixed with sloughed bark cells interspersed with calcium oxalate crystals;

prothallus absent. Soredia and isidia absent. Photobiont *Trentepohlia*. Apothecia 0.4–0.7 (–0.8) mm diam., flattened, not immersed in warts, erumpent, urceolate; ostiolar opening to 0.3 mm diam.; true exciple free, white, \pm radially stellate-lacerate, partly obscuring the black to \pm densely grey-white pruinose apothecial disc; hymenium (90–) 100–120 (–130) µm, colourless, I–; hypothecium colourless; epithecium colourless to pale brown, encrusted with numerous small irregular crystals. Hamathecium of filamentous unbranched, rarely septate paraphyses; periphysoids lining the upper inner surface of the true exciple. Asci subcylindrical, with a single functional wall layer, abruptly thickened at the apex, sometimes with a minute internal apical beak, K/I–, (4-) 6- to 8-spored. Ascospores (30–) 35–50 (–55) × (7–) 8–10 µm,



cylindrical to broadly cylindric-fusiform with rounded ends, remaining colourless when mature, with (7-) 9–11 (–12) strongly thickened lateral distosepta and no longitudinal septa, I+ purplish blue, with a perispore that is constricted at the septa. Conidiomata not known. Thallus C–, K–, KC–, Pd–, UV– (no lichen products detected by TLC). **BLS 1412**.

An oceanic species on \pm shaded, smooth bark, mainly of *Corylus* and *Sorbus*, more rarely of other broadleaved trees, in sheltered woodlands and boggy areas in temperate rainforests; locally abundant. W. Scotland, W. & S.W. Ireland, very rare in N. Wales and Cumbria.

The flattened apothecia that are \pm level with the thallus surface, with a well-developed, stellate-lacerate true exciple and pruinose disc, plus the eroding thalline margin are useful field characters separating this species from *Thelotrema lepadinum*. British specimens were previously referred to *T. subtile* but this species appears to be restricted to eastern N. America.

Crutarndina petractoides is included in a key within the account of *Thelotrema* (q.v.). The species is occasionally infested by *Opegrapha brevis*.

DIPLOSCHISTES Norman (1853)

Thallus crustose, continuous to cracked-areolate, grey-white to dark grey or yellowish, smooth to verrucose, often pruinose; medulla I+ blue (variable). Photobiont Trebouxia. Ascomata apothecia, at first usually perithecium-like, later urceolate, immersed; disc black, sometimes pruinose. Thalline margin present, sometimes scarcely distinguished from the thallus, or thick and pruinose. True exciple united with the thalline margin, dark brown to black, of thick-walled swollen to globose cells immersed in a matrix below, extended into pale brown periphysoids at the upper inside margin, faintly septate, not swollen apically, often appearing as a fringe in surface view, and presumed to close the ascomatal opening under dry conditions. Epithecium colourless to black, sometimes with crystalline inclusions. Hymenium colourless, I-. Hypothecium colourless to dark brown or black. Hamathecium of flexuose, ± unbranched paraphyses, remotely septate, the apices not swollen, sometimes brown. Asci elongate-clavate to subcylindrical, the wall evenly thickened when mature, with a somewhat abrupt apical thickening with a thin internal apical beak or a downward convex swelling when young, lacking any apical apparatus, the contents K/I+ orange-red, the walls K/I-, not fissitunicate, (1-)4-8-spored. Ascospores broadly ellipsoidal, brown to dark brown or purple-black, blue-green when immature, muriform, smooth, lacking a distinct perispore, I± blue. Conidiomata pycnidia, in slightly raised warts, black. Conidiogenous cells unbranched or branched at the base, elongate-ampulliform; conidia arising apically. Conidia bacilliform to elongate-ellipsoidal, truncate to apiculate at the base, aseptate, colourless. Chemistry: para-depsides (e.g. lecanoric and diploschistesic acids). Ecology: on rocks, soil, mosses or lichens.

The ascospores are at first colourless and only transversely septate, and both pigmentation and septation develop progressively as they mature. Where possible, mature spores released from the asci should be examined to reduce the possibilities of misidentification.

Several species in this genus are of interest in that they are initially lichenicolous fungi. When the ascospores alight on a suitable host, they are thought to germinate to parasitize and kill the mycobiont in the 'host' lichen, taking over its photobiont and developing its own characteristic lichenized thallus in place of the initial host lichen.

Literature:

Fernández-Brime et al. (2013), Fletcher & Hawksworth (2009), Friedl (1987), Lumbsch (1988, 1989), Martín et al. (2003).

1	Apothecia resembling perithecia, the disc visible as a pore, 0.1–0.2 mm diam. 2 Apothecia urceolate, with ± open discs, usually >1 mm diam. 3
2 (1)	Thallus dull, yellow-white-grey, rimose-areolate, ascospores $18-32 \times 10-20 \ \mu m$
3 (1)	Thallus chalk-white to grey, densely pruinose, K-; hypothecium colourless; on calcareous rock
	Thallus pale or dark grey, not densely pruinose, K± yellow or red; hypothecium dark brown to black; on mosses or siliceous rocks
4 (3)	Thallus continuous, never with a yellow tinge, uneven, verrucose, K± yellow or red; asci 4-spored; ascospores with 5 transverse and 1–2 longitudinal septa; on <i>Cladonia</i> squamules, spreading to mosses or soil muscorum Thallus thick, dull, cracked-areolate, even to verrucose, often with a yellow tinge, K+ yellow; asci 4- or 8-spored; ascospores with 5–7 transverse and 2–3 longitudinal septa; or silicance reacts
	on sinceous rocks

Diploschistes actinostomus (Ach.) Zahlbr. (1892)

Thallus yellow-white-grey, rimose-areolate, areoles 0.5–1.5 mm diam., flat, thin, dull, not pruinose. Apothecia immersed, one per areole, the disc flat, poriform, black, with a thick true exciple, to 1 mm diam.; hymenium 120–160 μ m high. Asci cylindrical to subclavate; ascospores ellipsoidal, 4–8 per ascus, brown, muriform, with (4–)5(–6) transverse and 1–3 longitudinal septa, 20–26 × 11–15 μ m. Pycnidia immersed; conidia bacilliform, 4–7 × *ca* 1 μ m. Thallus C+ red, K–, KC–, Pd–, UV– (lecanoric, diploschistesic and orsellinic acids). **BLS 2385**.

Known from brick coping stones in two churchyards in Kent; very rare.

Diploschistes caesioplumbeus has an often darker, leaden-grey thallus, larger ascospores and is distinctly coastal. Unlike *D. caesioplumbeus*, *D. actinostomus* does not appear to be initially parasitic on other lichens.

Diploschistes caesioplumbeus (Nyl.) Vain. (1921)

Thallus areolate, whitish to pale lead-grey or pale blue-grey, shiny, the areoles regular, smooth, flat, not pruinose, prothallus dark grey. Apothecia 0.1–0.2 mm diam., resembling perithecia, immersed, the opening depressed, with marginal excipular hairs visible as a white fringe around the opening; hymenium 170–200 µm tall; hypothecium colourless. Asci 100–120 × 15–20 µm, (4–) 8-spored. Ascospores (21–) $30-45 (-54) \times 11-24 \mu m$, with (4–) 5–9 transverse and 2–5 longitudinal septa. Pycnidia immersed, resembling the apothecia; conidia 5–7 × 1–1.5 µm. Thallus C+ red, K–, KC+ red, Pd–, UV– (lecanoric acid). **BLS 0492**.

On sunny, often nutrient-rich siliceous rocks on seashores in the xeric-supralittoral zone; local. W. & S.W. Britain, Channel Is, a few scattered records in Ireland; scarce. Initially lichenicolous on *Lecanora gangaleoides*, killing the mycobiont and taking over its photobiont to produce an independent lichenized thallus.





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The thallus colour and immersed apothecia resemble some *Aspicilia* s.l. species but the latter differ in microscopic features and the thalli are never C+ red. *Diploschistes caesioplumbeus* has sometimes been confused with *D. actinostomus*, which has a consistently paler, white-grey thallus, generally shorter ascospores, and is not known to be initially lichenicolous.

Reported lichenicolous fungi are *Lichenothelia rugosa* (G. Thor) Ertz & Diederich (2013) and a single report of *Pyrenidium actinellum* Nyl. (1865).

Diploschistes gypsaceus (Ach.) Zahlbr. (1892)

Thallus cracked to areolate, grey to chalk-white, densely white-pruinose, prothallus white. Apothecia 2–5 mm diam., urceolate; disc pruinose; hymenium 120–190 μ m tall; hypothecium colourless. Asci 90–130 × 20–30 μ m, 4-spored. Ascospores 25–40 × 10–17 μ m, with 4–7 transverse and 1–2 longitudinal septa. Thallus C+ red, K–, Pd–, UV– (lecanoric acid). **BLS 0493**.

On hard, often vertical calcareous rocks, especially limestones, in somewhat shaded and damp situations, associated with *Gyalecta jenensis*. Mostly frequently found in limestone areas with substantial cliffs, scattered through Britain, also W. Ireland (Galway, Connemara); scarce.

This name has been misapplied by some non-British authors to *D. diacapsis* (Ach.) Lumbsch (1988), which is confined to soil in desert regions and is K+ yellow to red, C+ red (diploschistesic and lecanoric acids).

Diploschistes muscorum (Scop.) R. Sant. (1980)

Thallus white to pale grey, continuous, weakly areolate, the surface uneven, \pm coarsely verrucose, scabrid, not pruinose, prothallus white. Apothecia 1–2 mm diam., urceolate; disc black, \pm densely white-pruinose; thalline margin slightly raised above the thallus; hymenium 75–120 µm tall; hypothecium dark brown. Asci 65–80 × 12–15 (–20) µm, 4-spored. Ascospores (20–) 25–35 (–40) × (8–) 12–15 (–18) µm, with 5 transverse and 1–2 longitudinal septa. Thallus C+ red, K– or K \pm yellow or red (diploschistesic acid always detectable by TLC), Pd–, UV– (diploschistesic and lecanoric acids). **BLS 0494**.

Initially parasitic on *Cladonia* squamules and podetia, especially of *C. pocillum* and *C. rangiformis* on calcareous soil, wall tops or base-rich dunes, but on other species in more acid habitats such as neutral heath soils or gravel pits; local. Also rarely on *Stereocaulon* species. Local, throughout Britain and Ireland but infrequent in the north and west.

It causes the host cortex to crack exposing the white *Diploschistes* thallus; sometimes the apothecia are also visible through the host cortex which takes on a C+ red reaction. The initially parasitic granules develop into independent thalli which may spread over adjacent mosses and rock.

Diploschistes scruposus (Schreb.) Norman (1853)

Thallus thick, white to pale grey, often with a yellow or yellow-green tinge when in shaded habitats, continuous to coarsely cracked-areolate, the surface uneven to verrucose, scabrid, not pruinose, prothallus white. Apothecia urceolate, (1-) 1.5–3 mm diam.; disc black, white-pruinose; thalline margin raised above the thallus; hymenium 90–125 µm tall; hypothecium dark brown to black. Asci 90–110 × 20–25 µm, 4- or 8-spored. Ascospores (20–) 22–40 × 10–18 µm, with (4–) 5–7 transverse and (1–) 2–3 longitudinal septa. Pycnidia crateriform; conidia bacilliform, 4–6 × *ca* 1 µm. Thallus C+ red, K± yellow, Pd–, UV– (diploschistesic and lecanoric acids, or lecanoric acid alone; both chemotypes occur in Great Britain). **BLS 0495**.

On siliceous or somewhat basic rocks and walls, often in nutrient-enriched sites; rarely abundant. Throughout Britain and Ireland.

Diploschistes scruposus has been found to be phylogenetically diverse by Fernández-Brime *et al.* (2013). Some British records will refer to *D. muscorum* which was in the past regarded as a variety of *D. scruposus* [var. *bryophilus* (Ehrh. ex Ach.) Müll. Arg. (1892)].

Reported lichenicolous fungi are Lichenothelia rugosa and Polycoccum arnoldii (Hepp) D. Hawksw. (1979).







FISSURINA Fée (1825)

Thallus crustose, continuous, immersed to superficial, whitish (pale to yellow-brown or olive green in non-British taxa), smooth and glossy. **Photobiont** *Trentepohlia*. **Ascomata** apothecia, immersed to superficial, elongate (lirelliform), simple, branched or stellate. **Thalline margin** absent. **True exciple** pale (rarely carbonized), sometimes inconspicuous when viewed from the surface. **Hymenium** I–, colourless. **Hypothecium** thin, pale. **Hamathecium** of unbranched paraphyses. **Asci** 1- to 8-spored, K/I–, clavate to subcylindrical, non-fissitunicate, dehiscence by an apical split. **Ascospores** transversely septate (sometimes muriform in extralimital species), mostly I+ violet when mature, lumina rounded to lens-shaped, colourless but sometimes brown when overmature, often with a gelatinous sheath. **Conidiomata** pycnidia. **Conidia** rod-shaped, colourless. **Chemistry**: β -orcinol depsidones in some species; old apothecia of some species sometimes with a K+ purple anthraquinone. **Ecology**: on bark, rarely on rock. **Distribution**:

Fissurina was separated from *Graphis* by Staiger (2002) on morphological grounds, and confirmed as phylogenetically distinct by Staiger *et al.* (2006) and Rivas Plata *et al.* (2012a). It is included in a different major clade from *Graphis* within the Graphidaceae by Lumbsch *et al.* (2014) and Lücking *et al.* (2016). However, *Fissurina* was shown to be polyphyletic by Rivas Plata *et al.* (2013) and as the only British representative of the genus has not been sequenced to date, its placement remains provisional. There are around 160 known species, mostly tropical and subtropical with a few temperate outliers.

Literature:

Lumbsch et al. (2014) and Lücking et al. (2016), Rivas Plata et al. (2013), Staiger et al. (2006), van den Boom et al. (2023).

Fissurina alboscripta (Coppins & P. James) Staiger (2002)

Graphis alboscripta Coppins & P. James (1992) Thallus smooth, continuous to faintly rugose or scurfy-pruinose, often mosaic-forming, white-grey to grey, containing numerous blunt-edged crystal clusters, K–. Apothecia *ca* 2×0.3 –0.5 mm, numerous, unbranched or 2- to 3-branched, rarely stellate, when abundant forming a closed reticulum, elongate, serpentine, the margin white, becoming tumid; disc slit-like, often scurfy, ± exposed; true exciple not blackened, the upper edge with minute brown crystals dissolving in K. Ascospores (15–) 16–19 × (6–) 7–8 (–9) µm, 3-septate, broadly ellipsoidal to slightly clavate. Thallus C–, K+ pale yellow, KC–, Pd+ pale yellow, UV–; apothecia Pd+ deep yellow (psoromic and 2'-*O*-demethylpsoromic acids). **BLS 1702**.



In the hyperoceanic *Graphidion* community on smooth bark of *Corylus, Fraxinus* and *Ilex*, in coastal temperate rainforests. W. Scotland. Endemic.

The non-carbonized exciple, K+ and Pd+ pale yellow thallus and Pd+ deep yellow apothecia distinguish *F*. *alboscripta* from British species of *Graphis*, and it is included in a key to that genus below. *G. inustuloides* (syn. *Graphina anguina* auct.) has a white thalline rim round the lirellae, muriform ascospores, and is Pd–. A *Fissurina* that did not react with Pd was recently observed in Ireland, but unfortunately not collected; it could represent an additional species, but it is not known which one.

GRAPHIS Adans. (1763)

Thallus crustose, effuse, immersed to superficial. **Photobiont** *Trentepohlia*. **Ascomata** apothecia, immersed to superficial, elongate (lirelliform), simple, branched or stellate, the disc slit-like or closed. **Thalline exciple** absent. **True exciple** usually black, opaque, prominent and well developed,

sometimes longitudinally furrowed. **Hymenium** colourless, I-. **Hypothecium** thin, pale or dark. **Hamathecium** of unbranched paraphyses. **Asci** to 8-spored, K/I–, clavate to subcylindrical, non-fissitunicate, dehiscence by an apical split. **Ascospores** transversely septate or muriform, I+ violet when mature, lumina rounded to lens-shaped, colourless, but sometimes brown when overmature. **Conidiomata** pycnidia. **Conidia** cylindrical to ellipsoidal, colourless. **Chemistry**: β -orcinol depsidones in some species; old apothecia of some species sometimes with a K+ purple anthraquinone. **Ecology**: on bark, rarely on rock. **Distribution**: *ca* 390 species, tropical and subtropical with a few temperate outliers.

The genus has been used for species of the Graphidaceae with colourless, transversely septate ascospores. This artificial generic delimitation has been replaced by a phylogenetics-based classification, resulting in the species of *Graphina* accepted by Benfield & James (2009) being placed *Allographa* or *Graphis*, while *Graphis alboscripta* is transferred to *Fissurina* Fée (1824). *Graphis* as currently circumscribed is highly diverse, and traditionally recognized species such as *G. scripta* have been shown to be complexes of taxa. British material has been revised significantly in preparation of this treatment, with several newly recognized species for our region. Many of these are likely to be significantly under-recorded.

Phaeographis differs in the brown ascospores and in British species, flat lirellae with inconspicuous, scarcely raised margins and more broadly expanded discs. The ascospores of *Graphis* are colourless at maturity but may become brown when over-mature. In the field, members of the group superficially resemble *Opegrapha* species, which have fissitunicate asci, I– ascospores and anastomosed hamathecial elements (paraphysoids).

Literature:

Benfield & Orange (2009), Benfield *et al.* (2009a), Kraichak *et al.* (2015), Lepista & Aptroot (2016, 2022), Lücking (2009), Lücking & McCune (2012), Lücking *et al.* (2009), Neuwirth & Aptroot (2011), Rivas Plata *et al.* (2011, 2013), Seavey & Seavey (2011), Staiger (2002), van den Boom *et al.* (2023), Weerakoon *et al.* (2019).

Key to the British species of Allographa, Fissurina and Graphis

1	Ascospores only transversely septate
	Ascospores muriform
2 (1)	Lirellae becoming striate; hymenium not inspersed
	Lirellae not striate (try both options for young material); hymenium often inspersed with oil droplets5
3 (2)	Ascospores conspicuously thick-walled (wall usually > 2 μ m thick); thallus KOH+ yellow \rightarrow red;
	thalline cover absent Graphis elegans
	Ascospores not conspicuously thick-walled (wall $\leq 2 \ \mu m$ thick); thallus KOH4
4 (3)	Apothecia covered by a thin layer of thallus, laterally carbonized
5 (2)	Hymenium inspersed with oil droplets; thallus KOH + yellow→red; disc open
	Hymenium not inspersed; thallus K- or K+ pale yellow7
6 (5)	Disc white-pruinose
	Disc not pruinose Graphis handelii
7 (5)	Ascospores 3-septate
	Ascospores 5- to 15-septate

8 (7)	Apothecia elongate, serpentine, the margin white, becoming tumid; ascospores always with three transverse septa
	Apothecia slightly curved or flexuose, frequently tightly clustered; true exciple carbonaceous, well-developed; ascospores often submuriform
9 (7)	Apothecia <i>ca</i> 0.2 mm wide; thallus partly ecorticate
10 (9)	Discs not, or hardly, visible, nearly concealed by the labia; with or without a narrow thallus margin to 0.1 mm broad; ascospore lumina elliptical, lentiform or rarely irregular, interlocular plates I+ blue
11 (10)	Discs not pruinose, dark brown; ends of apothecia rounded; ascospore lumina elliptical to lentiform
12(9)	Discs grey- to white-pruinose, widely open; lirellae $0.15-0.4$ mm broad; thallus margin narrow, to 0.1 mm thick; ascospores constricted at the septa
13 (1)	Apothecia emergent; disc becoming open, often pruinose

14(13) Ascospores muriform; apothecia usually somewhat striate......*Allographa anomala* Ascospores submuriform; apothecia not striate, usually partly crowded*Allographa pauciseptata*

Graphis chlorotica A. Massal. (1871)

Similar to *Graphis scripta*, but the ascomata are only apically carbonized, striate and covered by a thin layer of thallus. Ascospores $ca 25 \times 8 \mu m$, 7-septate (30–40 × 5–8 μm and 7- to 13-septate *fide* Weerakoon *et al.* 2019). Hamathecium not inspersed with oil droplets. **BLS 1833**.

Found in 1977 on bark of *Corylus* in Argyll (Cowal peninsula) but only recently recognized as British during a study of fungarium specimens for the update of the Graphidaceae. The type is from Indonesia, so it is possible that the British specimen is a morphological look-alike. The species is illustrated in Van den Boom *et al.* (2023).

Graphis crebra Müll. Arg. (1882)

Similar to *Graphis scripta*, but the thallus has a K+ yellow \rightarrow red (crystals) reaction (as with *G. elegans*), the hymenium is inspersed with oil droplets, and the disc is pruinose and exposed in mature ascomata. The lirellae are not striate, the exciple is laterally carbonized, and the ascospores are 6- to 11-septate and 29–42 × 7–9 µm (Lepista & Aptroot 2016). **BLS 2838.**

Recently found on bark of a young Quercus tree in S. Devon in an oceanic ravine (VC3).

A pantropical species but recently reported from Portugal (illustrated in Lepista & Aptroot 2016) and now S. England. Potentially overlooked for *G. scripta*, or for apparently young specimens of *G. elegans*. It differs from *G. handelii* in the pruinose disc. Sequence data for a South African specimen was provided by Medeiros & Lutzoni (2022), but further work is needed to confirm the monophyly of this species.

Graphis elegans (Borrer ex Sm.) Ach. (1814)

Thallus smooth and thin or uneven to cracked, \pm glossy, continuous, pale to dark grey with a yellowish-orange tinge when fresh. Apothecia unbranched or branched, short or elongate, straight or curved; true exciple black, 5– $20 \times 2-4$ mm, each side with 1–6 longitudinal furrows, disc persistently slit-like; orange stains in the thallus and sometimes old apothecia K+ purple. Ascospores $32-55 \times 6-12 \mu m$, (8–) 10–12-septate, fusiform-cylindrical. Thallus C–, K+ yellow→red (crystals), Pd+ yellow becoming orange (reactions often patchy), UV– (norstictic acid). **BLS 0532**.

NE

LC

On moderately smooth, slightly shaded and usually acidic bark on a wide range of trees, usually in woods, rarely on shaded siliceous rocks; frequent. Throughout Britain and Ireland but absent from large parts of C. England, a relict in ancient woodlands of the Midlands.

Young specimens without furrows in the exciple can be distinguished from *G. scripta* by the K+ yellow—red reaction. Thalli should be carefully examined for the small (0.3–1.5 × 0.2–0.5 mm), generally unbranched apothecia of *Melaspileopsis diplasiospora*.

Graphis furcata Fée (1825)

Similar to *Graphis scripta*, but the ascomata are slender (to 0.2 mm wide) with entirely closed and non-inspersed hymenia and the thallus is partly ecorticate. Ascospores $ca 20 \times 6 \mu m$, 7-septate (25–35 × 7–10 μm , 5–9-septate *fide* Lücking *et al.* 2009). Hamathecium not inspersed with oil droplets. **BLS 2834.**

Found before 1892 on bark of an unidentified tree in Dolgellau (VC 48) but only recently recognized as British. The species appears to have a very broad, primarily tropical distribution, and may include morphological lookalikes. A South African specimen was illustrated by Medeiros & Lutzoni (2022), and one from the Azores by Van den Boom *et al.* (2023).

Graphis handelii Zahlbr. (1930)

Similar to *Graphis scripta* (i.e. with non-striate lirellae), but the thallus has a K+ yellow—red (crystals) reaction (as with *G. elegans*), and the hymenium is inspersed with oil droplets and \pm exposed in mature ascomata. Mature ascospores of British material measure 25–45 × 7–9 µm and are 6- to 9-septate. **BLS 2768**.

Recently found on the acid bark of older *Ilex* and *Fagus* in the New Forest in oldgrowth woodlands (S. Hampshire).

A pantropical species but recently reported from Portugal (there with rather smaller ascospores; illustrated by Lepista & Aptroot 2016) and now S. England. Potentially overlooked for *G. scripta*, or for apparently young specimens of *G. elegans*. *G. crebra* is similar but has pruinose hymenia.

Graphis inustuloides Lücking (2012)

Graphina anguina auct. europ.

Graphis britannica Staiger (2002)

Thallus thin, smooth or faintly rimose-cracked, white-grey, \pm delimited. Apothecia 0.5–1.2 × 0.1–0.2 mm, \pm immersed in the thallus, flat or slightly elevated, branched or not, straight, curved or flexuose; true exciple thin and often inconspicuous, not furrowed, black, not continuing below the hymenium; disc narrow and slit-like or narrowly exposed and \pm white-pruinose; hypothecium pale. Ascospores (20–) 25–50 (–60) × (9–) 12–16 (–20) µm, muriform with more than 20 cells, with 7–11 transverse septa. Conidia 6–9 × 2–3 µm. No lichen substances detected by TLC. **BLS 0529**.

On smooth bark of deciduous trees in open or sheltered habitats. Widespread in Britain and Ireland, but rare in N. Scotland & C. & E. England.

Graphis anguina in its original circumscription is a species from tropical South America now referred to as *Thalloloma anguinum* (Mont.) Trevis. (1853), and the name was misapplied for *G. inustuloides* by European authors (see Staiger 2002, Lücking & McCune 2012).

In the field, often distinguished from *Graphis scripta* s.l. by the white rim of thallus pushed up around the exciple, but *G. betulina* also shows this character so examination of ascospores is necessary for confirmation. *Phaeographis dendritica* is K+ red (crystals), KC+ red, Pd+ yellow to orange and has brown, non-muriform ascospores. Occasionally host to *Arthonia graphidicola*, which is more often found on *Graphis scripta*.

Graphis leptoclada Müll. Arg. (1882)

Thallus off-white to pale fawn, thin, surface smooth and dull; lirellae numerous, striate, semi-immersed to sessile, with a negligible thalline margin, straight, curved or sinuous, sometimes branched, 1-3 (-4) mm long, 0.2–0.3 mm wide; true exciple only laterally carbonised; ascospores $40-55 \times 9-11 \mu m$, 9- to 13-septate. No lichen substances detected by TLC. **BLS 2835**.





11

NE

NE

Recently found on bark of a tree in Westerness (VC97).

A pantropical species but recently reported from Portugal. Similar to *Graphis scripta* in chemical reaction (i.e. K-), but ascomata are striate, with a lateral thallus margin. Potentially overlooked for G. scripta, or for apparently young specimens of G. elegans.

Graphis scripta (L.) Ach. (1809) s. lat.

Thallus smooth or slightly uneven, whitish green to green-grey or yellowish. Apothecia unbranched or branched, elongate, $5-25 \times 1-2$ mm; true exciple black, not furrowed; disc narrow, erumpent, exposed even when dry, \pm whitish pruinose. Ascospores $25-70 \times 6-10 \mu m$, 5- to 15-septate, fusiform-cylindrical. Pycnidia rare; conidia $2-5 \times ca$ 1 µm. Lichen products not detected by TLC. **BLS 0533**.

On moderately shaded, smooth bark of a wide range of trees. Throughout Britain and Ireland, a relict in ancient woodlands of the Midlands.

Considered to be a species complex (see Neuwirth & Aptroot 2011, Kraichak et al. 2015), and all four recognized species occur in our area (see below). The species can be distinguished morphologically and phylogenetically. British material has been

examined and all species were present in the past and are still present, although they are not equally common. Two or three different species frequently co-occur on one tree. Young specimens are difficult to identify but most mature specimens and most specimens in dried collections can be assigned to one or other of the species without too much trouble. However, damp specimens cannot be identified in the field. See the key above for a summary of the differences between the species.

The lirellae of G. elegans s. lat. and G. scripta s. lat. are extremely variable in shape, from short, deeply immersed and simple, to well-developed and serpentine or in stellate clusters; on young bark the apothecia tend to be \pm parallel to the circumference of the branches, growing most rapidly in the direction that the bark is expanding. G. inustuloides has a white thalline rim round the lirellae (but see G. betulina below) and muriform spores.

Commonly parasitized by Stigmidium microspilum (Körb.) D. Hawksw. (1975), which forms discrete blackish blotches on the thallus, and quite frequently by Taeniolella punctata. In oceanic areas, it is also host to Arthonia graphidicola (Arthoniaceae).

Graphis betulina (Pers.) Gray (1821)

Thallus white, grey to pale brown, mostly uneven, deeply cracked, areolate, rarely smooth. Ascomata elongate, curved, wavy or branched, rarely stellate, to 8 mm in length and 0.1-0.3 mm broad; ends of lirellae acute, but never bifurcated; discs concealed or visible, pruinose to non-pruinose, surrounded by a conspicuous thick white thallus margin (ca 0.2 mm broad) filled with calcium oxalate crystals; true exciple black, 15–45 µm thick. Ascospores but often becoming pale brown, 6–8 per ascus, 5- to 11-septate, $15-45\times5-9$ µm, the lumina mostly lentiform, rarely elliptic or angular in section. Thallus K-. BLS 2862.

This is one of the two less common species, characterized in particular by the broad white surround to the lirellae.

Graphis persoonii P.M. Kirk & Arcadia (2023)

Graphis macrocarpa (Pers.) Zahlbr. (1924), non G. macrocarpa G. Mey. (1825)

Thallus grey to brown, cracked, uneven. Ascomata straight, curved or branched; lirellae to 6 mm in length and 0.1-0.45 mm broad, with rounded or rarely with acute ends; young ascomata elliptical or rounded, mature lirellae elongate; discs exposed, non-pruinose, dark brown, shiny; thallus margin absent or appearing at the base of ascomata only; mostly erumpent, sometimes prominent and then with cracks along the base; true exciple 25–60 µm thick, black, the inner part frequently reddish brown. Ascospores 4–8 per ascus, 7- to 13septate, $15-42 \times 5-12 \mu m$, the lumina irregular, elliptical or lentiform in section. Thallus mostly K-, sometimes K+ dirty reddish-brown. BLS 0533.

This is one of the two less common species. It differs from G. scripta in its conspicuously open, dark brown, non-pruinose discs, rather short ascomata and a reduced thallus margin. Referred to as Graphis macrocarpa (Pers.) Röhl. (1813) by Neuwirth & Aptroot (2011), but this combination appears not to exist.

Graphis pulverulenta (Pers.) Ach. (1809)

Thallus grey, white or usually pale yellowish-brown, uneven and cracked along the lirellae. Ascomata

NE

LC

12



elongate, curved, often stellate, to 10 mm long and 0.15–0.4 mm broad; discs visible, conspicuously whitepruinose on mature ascomata; true exciple black or partly white-pruinose. Ascospores 7- to 12- (to 14)-septate, $15-56 \times 5-12 \mu$ m, the lumina mostly lentiform, rarely rounded or angular in section. Thallus mostly K–, rarely K+ brown. **BLS 2864**.

This is one of the two most common species of *Graphis scripta s. lat.*; it was considered by Neuwirth & Aptroot (2011) to be much more frequent than *G. scripta s. str.* It is especially common on mature *Fagus*, *Carpinus* and *Corylus* trees.

Graphis scripta (L.) Ach. (1809) s. str.

Thallus brownish, grey or white; uneven, cracked or smooth. Ascomata elongate, curved or sometimes branched the branches sometimes markedly parallel; ends of apothecia rounded, not forked; lirellae closed, to 10 mm long; discs invisible or visible only as a slit; true exciple black and often shiny, 15–40 μ m thick, often with a narrow white thallus margin to 0.1 mm broad. Ascospores 6–8 per ascus, 5- to 13-septate, 20–63 × 5–12 μ m, the lumina elliptical, lentiform (or in old specimens irregular) in cross section. Thallus K–. **BLS 2865**.

This is one of the two most common species, along with *G. pulverulenta*; it occurs on a wide variety of tree species, also as a pioneer.

LEUCODECTON A. Massal. (1860)

Thallus crustose, superficial, usually shades of cream or fawn; cortex usually weakly developed, smooth or nodulose, sometimes with large irregularly arranged or rarely columnar internal crystals; prothallus absent. Soredia and isidia occasionally present. Photobiont Trentepohlia. Ascomata apothecia, urceolate to perithecioid, immersed, solitary to aggregated, often in raised warts; disc concave to flat, black, sometimes pruinose. Thalline margin distinct, sometimes with a double margin and/or opening through irregular splits. True exciple usually free from the thalline margin and distinct as an internal ring when viewed from above, colourless or brown above, smooth, composed of \pm densely conglutinated, irregular intertwined hyphae. **Epithecium** colourless to brown or black. Hymenium colourless, I-. Hypothecium colourless. Hamathecium of filamentous, unbranched, rarely septate paraphyses; periphysoids lacking. Asci subcylindrical, with a single functional wall layer, abruptly thickened at the apex, sometimes with a minute internal apical beak, K/I-, 1- to 8- spored. Ascospores narrowly ellipsoidal to broadly fusiform, septate or submuriform, colourless or becoming brown, thin-walled when young, the walls often thick and laminated with the cells ± lenticular, smooth, lacking a distinct perispore, I- or I+ weakly purple. Conidiomata unknown. Chemistry: most species with stictic (or norstictic) acid. Ecology: on bark, wood, or rarely rocks.

Leucodecton differs from *Thelotrema* in lacking periphysoids, but in common with that genus has an exciple composed of irregular intertwined hyphae and a weakly developed or absent thallus cortex. Apothecial anatomy is varied, ranging from broadly exposed through irregular splits to \pm poroid. A key to this and related lichens from our region can be found under *Thelotrema*.

Literature:

Frisch et al. (2006), James & Hawksworth (2009), Lücking & Breuss (2012), Parnmen et al. (2012), Rivas Plata et al. (2010).

Leucodecton isidioides (Borrer) Lücking & Breuss (2012)

NE

Thelotrema isidioides (Borrer) R. Sant. (1980)

Thallus forming small patches amongst mosses and other lichens, rarely wide-spreading, then up to 5 cm diam., usually thin, rather rugose, matt, with frequently coalescing vertucae forming a \pm continuous thick coarsely nodulose, abundantly fertile inner crust which is \pm coarsely rimose, especially around individual groups of

verrucae, pale grey-brown to yellow-fawn, often with a faint pink to red tinge when fresh; cortex composed of a layer $5-10 \,\mu\text{m}$ thick of dead collapsed unpigmented cells; medulla and photobiont zone interspersed with numerous minute crystals. Apothecia 0.2-0.3 mm diam., \pm perithecioid, half to almost completely immersed, one per areole, only the black mouth of the ostiole visible and \pm protuberant; true exciple colourless to pale red-brown, becoming deeper brown-red, opaque towards the ostiole, containing crystals (K+ dissolving); hymenium 100-160 µm tall, colourless, without crystals. Asci usually 8-spored. Ascospores (27-) 34-40 (-45) \times 13-18 μ m, ellipsoidal, muriform, colourless, only tardily becoming grevish brown and then often shrivelled, with 7-9 (-11) transverse and 1-3 longitudinal septa. Thallus C-, K+



orange, KC+ orange, Pd+ orange, UV- (stictic, hypostictic, hypoconstictic acids). BLS 1409.

On hard, siliceous rocks; apparently extinct in Britain and Ireland, known only from the original collection made in the 19th century. S.W. Ireland (W. Cork, Glengariff). In the Azores, it is mainly associated with very leached, acid bark or wood and branches of Juniperus azorica in relict woodland; there it is only very rarely recorded on basalt. It should be searched for on *Ilex* lignum in Ireland.

The species is included in a key within the account of *Thelotrema* (q.v.).

PHAEOGRAPHIS Müll. Arg. (1882)

Thallus crustose, thin, hyphae I+ blue in European species. Photobiont Trentepohlia. Ascomata apothecia, unbranched, \pm branched or stellate, lirellate, immersed or somewhat emergent. **Thalline** margin inconspicuous. True exciple thin, black, continuing below the hymenium or not (lateral walls vertical to divergent). Disc expanded, brown to black, matt, sometimes white-pruinose. Hymenium colourless, I-, with crystalline inclusions. Hamathecium of paraphyses, unbranched, apical cells clavate, brownish. Asci 8-spored, Graphis-type, K/I-. Ascospores colourless, soon becoming pale to red-brown within the ascus, I+ purple, transversely multiseptate with lens-shaped cells. Conidiomata pycnidia. Conidia ellipsoidal, straight or slightly curved. Chemistry: either none detected by TLC, or β -orcinol depsidones, lichexanthone, or isohypocrellin. **Ecology**: mostly on smooth bark of deciduous (rarely coniferous) trees in light to moderate shade, rare on mosses and rock.

Phaeographis is characterized by ascomata with divergent, mostly poorly developed and rarely carbonized exciples, open brownish-grey to dark brown discs, often with a white pruina and ascospores that become brown, I+ red or red-brown. Graphis differs in the colourless ascospores (though these may be shrivelled and brown-walled when over-mature) and, in British species, lirellae mostly with conspicuous, often raised margins and closed discs.

Staiger (2002) removed Phaeographis lyellii from that genus and transferred it to Leiorreuma Eschw. (1824). However, Rivas Plata et al. (2012a) found that both Phaeographis and Leiorreuma are polyphyletic as currently circumscribed, and suggested that the latter genus along with ten others could logically be subsumed into a broadly defined Phaeographis s.lat. As P. lyellii has not been sequenced to date, it is here retained in its traditional position.

Literature:

Benfield et al. (2009b), López de Silanes & Álvarez (2003), Rivas Plata & Lumbsch (2011), Rivas Plata et al. (2012), Staiger (2002).

1	Thallus greenish white or pale silver-grey; K+ yellow→red (the reaction is often patchy or slow);	
	ascospores 5- to 9-septate	2
	Thallus yellowish or olive-green, K± brownish; ascospores 3- to 5-septate	3
2(1)	True exciple closed at the base; ascospores (5-) 7- to 9-septate	lritica

3(1) Apothecia emergent; thalline margin conspicuous, white; hymenium 95–120 μm tall; ascospores 24–35 μm long, 5-septatelyellii Apothecia immersed; thalline margin indistinct; hymenium 45–70 μm tall; ascospores 16–25 μm long, 3- to 5-septateinusta

Phaeographis dendritica (Ach.) Müll. Arg. (1882)

Thallus thin to moderately thick, wide-spreading or in patches, pale green-grey but sometimes tinged yellowish, often white-powdery, matt or glossy, smooth and even to cracked-areolate. Apothecia $0.5-3 \times 0.3-0.5$ mm, flat, \pm level with the thallus, variable, scattered, elongate, straight, curved, stellate or dendritically branched; disc 0.15-0.3 mm wide, ends usually acute, \pm thinly white-pruinose; true exciple thin, entire, continuous below the hymenium; lateral walls $10-15 \,\mu$ m thick; hymenium 90–120 μ m tall. Ascospores (26–) 30–40 (–45) × 6–9 μ m, (5–) 7– to 9 (–10)-septate. Thallus C–, K+ yellow→red (crystals), KC+ red, Pd+ yellow to orange (reactions often patchy), UV– (norstictic and connorstictic acids). **BLS 1100**.

On the bark of deciduous trees and shrubs in moderate shade and more typical of trunks and old trees than *P. smithii*; locally frequent. S.W. Britain, extending along the south coast, and throughout Ireland. There is probably some over-recording in the northern edges of its range. The single confirmed record from W. Scotland is on a *Rhododendron* plant that was apparently introduced from S.W. England.

The apothecia of *P. dendritica* are very variable, ranging from short and almost square in outline to branched and stellate; the disc is usually widely exposed. *Graphis inustuloides* has narrower lirellae with a thalline rim, muriform ascospores, and a Pd– and K– thallus. Specimens of *Graphis scripta* with shrivelled brown-walled ascospores have often been misidentified as *P. dendritica*.

Occasionally infected with ascomata of *Stictographa lentiginosa* which has small $(0.1-0.5 \times 0.1-0.2 \text{ mm})$, generally unbranched lirellae. Also host to *Tremella phaeographidis* Diederich *et al.* (1996), which produces brown, gall-like basidiomata on the thallus. Requiring further study are a taxon close to *Arthonia graphidicola* (in N. Cornwall), *Lichenostigma* cf. *alpinum* (R. Sant., Alstrup & D. Hawksw.) Ertz & Diederich (2013) and *Taeniolella* cf. *hawksworthiana* Heuchert *et al.* (2016).

Phaeographis inusta (Ach.) Müll Arg. (1881)

Thallus thin, glossy or matt, pale grey to pale yellowish-brown, sometimes with an olivaceous tinge when fresh. Apothecia grey-black, matt, 0.1-0.25 mm wide, arthonioid, stellate, immersed with an indistinct thalline margin; true exciple thin, entire, lateral walls $12-15 \,\mu$ m thick broadening to $25 \,\mu$ m above; hymenium $45-75 \,\mu$ m tall. Ascospores $16-25 \times 7-9 \,\mu$ m, 3- to 5-septate. No lichen products detected by TLC. **BLS 1101**.

On deciduous trees, especially *Corylus* generally and *Alnus* in Wales, in wellestablished woods; locally frequent but absent or rare in other areas. S. England, W. Wales, rare and localised in W. Ireland, recently recorded in N.W. England (Westmorland). Appears to be spreading in lowland England into abandoned coppices as the *Corylus* bushes age.

The apothecia lack a white thalline rim and are usually more stellate than *P. lyellii*. The shorter, 3- to 5-septate ascospores separate *P. inusta* from specimens of *P. dendritica* or *P. smithii* giving poor K and Pd reactions.

Similarly from *Graphis scripta*, which also has somewhat narrower lirellae with a slitlike disc.

Phaeographis lyellii (Sm.) Zahlbr. (1905)

Leiorreuma lyellii (Sm.) Staiger (2002)

Thallus thin, in patches or mosaics, yellow-brown to dark olive-green, waxy or glossy, smooth or sparingly cracked, occasionally white-pruinose in parts. Apothecia black-brown, \pm emergent, broad, flat, elongate, flexuose, unbranched, branched or stellate; thalline margin conspicuous, white-powdery, mainly comprising of large crystals; true

Nb IR









exciple entire, dark brown, lateral walls $25-35 \,\mu\text{m}$ thick, broadening to *ca* 60 μm above; disc 0.15–0.5 mm wide, broadly expanded, \pm finely pruinose; hymenium 90–120 μm tall. Ascospores (20–) 24–35 × 7–9 μm , (3-)5-septate. Conidia 8–10 × *ca* 4.5 μm , ellipsoidal, straight or slightly curved. No lichen products detected by TLC. **BLS 1102**.

On \pm shaded, smooth bark of deciduous trees, especially saplings, in humid situations in old woods, rare on wayside trees; rare. S.W. England, W. Wales, S.W. Ireland.

Recognized by the yellow-green-olive, waxy thallus and flat but raised apothecia, with clear white powdery margins. Can be host to *Tremella phaeographidis*.

Phaeographis smithii (Leight.) de Lesd. (1910)

Like *P. dendritica* but with a smoother, continuous, only sparingly cracked thallus. Apothecia usually shorter, less branched, rarely radiating; thalline margin inconspicuous; true exciple colourless or absent at the base; hymenium $80-100 \,\mu\text{m}$ tall. Ascospores $25-40 \times 7-9.5 \,\mu\text{m}$, 5- to 7-septate. Thallus C–, K+ yellow→ red (crystals), KC+ red, Pd+ orange (reactions often patchy), UV– (norstictic and connorstictic acids). **BLS 1103**.

On mainly smooth bark of broad-leaved trees and shrubs, more rarely on conifer branches, in moderate shade; usually in woods. More typical of twigs than *P. dendritica*, especially where their ranges overlap. W. Britain, rare in Scotland but with scattered records north to W. Ross; throughout Ireland. Recolonising rapidly into areas

of lowland England, where it was lost in the 20th century and appearing in totally new areas such as S.E. Scotland. A vertical cut across the apothecia is sufficient to show the lack of excipular tissue below the hymenium. This can be done on damp material in the field with a good lens (\times 20 best).

Along with *P. dendritica*, host to *Tremella phaeographidis* Diederich *et al.* (1996), likewise to a taxon close to *Arthonia graphidicola* in N. Cornwall.



Phaeographis apothecial sections. (a) *P. smithii*; (b) *P. dendritica*. Scale bar = $100 \,\mu$ m.

LC

SCHIZOTREMA Mangold & Lumbsch (2009)

Thallus immersed to superficial, usualy pale. **Photobiont** trentepohlioid. **Prothallus** inconspicuous, brown. **Soralia** sometimes present, discrete, punctiform. **Ascomata** [not present in GBI material] \pm rounded, immersed in the thallus with a thick layered thalline rim that may exfoliate with age. **True exciple** multilayered, dark brown to black, non-amyloid or amyloid at the base, lined with hypha-like periphysoids. **Hymenium** conglutinated, non-amyloid. **Hamathecium** of unbranched paraphyses, the tips not thickened. **Asci** 1- to 8-spored, clavate, not blueing in iodine. **Ascospores** transversely septate or muriform, hyaline to yellowish (or brown at late maturity), sometimes with a thin gelatinous sheath. **Conidiomata** not known.

Only one species is known from Britain and Ireland, and that is not known to produce ascomata. Much of the description above is taken from the original account (Mangold & Lumbsch 2009). *Schizotrema* is characterized especially by a layered thalline margin that can exfoliate with age, and a dark true exciple.

Literature:

Ertz et al. (2019), Mangold & Lumbsch (2009), Wolseley & Hawksworth (2009).

Schizotrema quercicola (Coppins & P. James) Ertz, Frisch & Sanderson (2019)

Schismatomma quercicola Coppins & P. James (1989)

Thallus thin, pale brownish grey to greyish white, slightly vertucose, often overgrown with chlorococcoid algae; soralia scattered, punctiform, 0.2–0.5 (–0.7) mm diam., discrete, not becoming confluent, pink-grey when fresh but becoming whitish in dried collections. Apothecia and pycnidia unknown. Thallus and soredia C–, K–, KC–, Pd+ orange, UV– (fumarprotocetraric acid, \pm protocetraric acid and an unidentified substance). **BLS 1585**.

On acid bark on old tree trunks, particularly of *Quercus, Fagus, Ilex* and *Alnus*, rarely on lignum, often associated with *Loxospora elatina* and *Thelotrema lepadinum*, widespread in ancient woodlands. W. and S. Britain, a few records from E. England (Suffolk), scattered in Ireland. Endemic.

Formerly included in the quite unrelated genus *Schismatomma*, due to broad similarities in thallus characters, but now known to belong to the primarily tropical genus *Schizotrema* (Ertz *et al.* 2019). It has a superficial resemblance to *Pertusaria pupillaris*, which has a chlorococcoid photobiont and does not contain *Trentepohlia* (i.e. is not orange when scratched). The obligately lichenicolous *Arthonia invadens* occurs on this species.

THELOTREMA Ach. (1803)

Thallus crustose, superficial, sometimes \pm immersed, usually shades of cream or fawn; cortex continuous or exfoliating, sometimes with internal crystals; prothallus absent. **Isidia** and **soredia** absent. **Photobiont** *Trentepohlia*. **Ascomata** apothecia, urceolate to perithecioid, immersed, often in raised warts; disc concave to flat, often gaping, black, sometimes pruinose. **Thalline margin** distinct, entire or eroding, usually incurved. **True exciple** commonly free from the thalline margin and distinct as an internal ring when viewed from above, colourless or brown above, rarely closely adhering to it, sometimes striate, composed of \pm densely conglutinated, intertwined short-celled hyphae. **Epithecium** colourless to brown or black. **Hymenium** colourless, I–. **Hypothecium** colourless. **Hamathecium** of filamentous, unbranched, rarely septate paraphyses; periphysoids lining the upper inner surface of the true exciple. **Asci** subcylindrical, with a single functional wall layer, abruptly thickened at the apex, sometimes with a minute internal apical beak, K/I–, 1- to 8- spored. **Ascospores**



LC IR

narrowly ellipsoidal to broadly fusiform, septate or muriform, colourless or brown, the walls often thick and laminated with the cells \pm lenticular, smooth, lacking a distinct epispore, I+ purplish. **Conidiomata**, when present, pycnidia. **Conidia** bacilliform, aseptate, colourless. **Chemistry**: very variable, a wide range of depsidones, anthraquinones and unidentified substances reported; however, no lichen substances are detected by TLC in many species. **Ecology**: on bark, wood, or rarely rocks, in humid situations.

As defined on the basis of exciple structure rather than ascospore colour and septation, *Thelotrema* comprises about 100 mainly tropical species. Based on a molecular phylogenetic study by Parnmen et al. (2012), *T. petractoides* was transferred to the monotypic *Crutarndina*, and *T. isidioides* was transferred to the predominantly tropical genus *Leucodecton* by Lücking & Breuss (2012).

Lichenicolous fungi associated with *Thelotrema* include *Opegrapha thelotrematis* (on both species) and *Skyttea nitschkei* (on *T. lepadinum*), and more rarely *Arthonia thelotrematis* and *Taeniolella toruloides*. *Stenocybe septata* is sometimes found growing through the thallus of *Thelotrema* species.

Literature:

Frisch *et al.* (2006), James & Hawksworth (2009), Lücking & Breuss (2012), Parnmen *et al.* (2012), Rivas Plata *et al.* (2010).

1	Ascospores muriform; apothecia within blister-like structures partially raised above the thallus
2 (1)	Ascospores large, $60-140 \times 15-40 \ \mu\text{m}$; no lichen substances or pigment; apothecia with a double
	Ascospores small, $20-45 \times 10-15 \mu m$; stictic acid present; apothecia simple
3 (2)	Ascospores remaining colourless when mature, $60-120 \times 15-25 \ \mu m$
4 (3)	Ascoma medulla whitishlepadinum Ascoma medulla with yellow, K+ reddish pigmentlueckingi
5 (2)	Ostiole narrow, almost closed; ascospores pale brown when mature

Thelotrema lepadinum (Ach.) Ach. (1803)

Thallus thin to thick (to 2 mm in thickness), smooth, \pm uneven, usually continuous, greyish fawn to pale ochraceous, mainly superficial, medulla in section with numerous crystals (calcium oxalate) which are particularly well-developed in the thalline margin of the ascomata. Apothecia numerous, discrete, \pm evenly dispersed, (0.6–) 1–2 mm diam., immersed in hemispherical warts, urceolate, ostiolar opening to 0.5 mm diam., white; thalline margin entire; true exciple free, \pm conspicuous when viewed through the ostiole, colourless, not striate; disc blackish, often \pm white-grey pruinose, normally visible through an irregular hole in the true exciple; hymenium (120–) 140–190 (–200) µm tall. Asci (1-) 2- to 4- (to 8-) spored. Ascospores broadly fusiform, (30–) 60–135 (–150) × (10–) 15–25 (–33) µm, remaining colourless when mature, with (8–) 10–15



(-19) transverse and 1-3 (-5) longitudinal septa, I± weakly purple, with a thick gelatinous coating. Thallus and medulla C-, K-, KC-, Pd-, UV- (lichen products not detected by TLC but sometimes with internal crystals K+ yellow changing to red). **BLS 1410**.

On smooth and sometimes rougher bark of deciduous trees, rarely on siliceous rocks. Considered to be an indicator species of ancient woodland sites and can reach densities of over 400 occupied trees per ha in long-undisturbed sites. Scattered in suitable habitats throughout Britain and Ireland. The shape of the apothecia is very

variable; in dry situations on smooth bark of deciduous trees they are regularly volcano-like, smooth with a narrow opening; in moist, often shaded, sites the apothecia are larger and become more open and ulcerose with a thick, prominent, somewhat scurfy rim. Could be confused with the rarer *Thelotrema macrosporum* in oceanic habitats.

Commonly parasitized by Skyttea nitschkei (Körb.) Sherwood et al. (1981); also host to Arthonia thelotrematis, Opegrapha thelotrematis and Taeniolella toruloides Heuchert & Diederich (2016), and with a single record of the plurivorous Marchandiomyces corallinus (Roberge) Diederich & D. Hawksw. (1990).

Thelotrema lueckingii Breuss (2013)

Thallus thickish, yellowish white to greyish green, uneven to verrucose. Cortex K+ quickly brownish red. Medulla white to yellowish, with numerous large crystals, K+ brownish red (but slower reacting than the cortex). Apothecia similar to those of *Thelotrema lepadinum*: numerous, immersed in thalline warts. Thalline warts to 2 mm in diam., broadly adnate or basally slightly constricted, rounded, apically incurved, ostiolar opening to 0.5 mm diam.; medulla yellowish, containing large crystals. True exciple externally yellow, K+ red, the margin split to lacerate: disc blackish, usually greyish pruinose; hypothecium colourless; hymenium: colourless, clear, 140-170 µm tall; periphysoids to 30 µm long; epithecium minutely granular. Ascospores 2-4 (-6) per ascus, muriform, widely fusiform, with a thick outer wall, $55-110 \times 15-28 \mu m$, remaining colourless, with a gelatinous perispore. BLS 2818.

On bark of mature trees in Scotland, N. Wales, Hampshire and Devon, likely to be widespread.

Similar to Thelotrema lepadinum in almost all details but deviating by the partly citrine yellow medulla (especially in the warts); the pigment reacts K+ red.

This species was recently described from Macaronesia but already (around 150 years ago), Leighton depicted specimens with the characteristic vellow medulla from Britain on his herbarium sheets. The description is based on that of Breuss (2013).

Thelotrema macrosporum P.M. Jørg. & P. James (1995)

Thallus pale grey-green, often somewhat white-marbled when fresh, becoming ochraceous when dry, forming small to large superficial patches which are rather thick, (to 130 µm in thickness); medulla with coarse calcium oxalate crystals. Apothecia (0.7-) 0.8-1.2 (-1.5) mm diam., immersed in hemispherical warts, somewhat flattened at their summits, urceolate, the ostiolar opening usually narrow, 0.2-0.4 (-0.7) mm wide; true exciple colourless, inconspicuous when seen through the ostiole; thalline margin entire; hymenium (100–) 140–200 μ m tall. Asci 130–170 × 40–55 μ m, 1- (to 2-) spored. Ascospores (70–) 90–120 (–160) \times (15–) 25–40 (–50) μ m, broadly fusiform with rounded ends, opaque grey-brown when mature, with 16-22 (-24) transverse and numerous longitudinal septa, I-, with a gelatinous coat. Thallus and medulla C-, K-, KC-, Pd-, UV- (lichen



products not detected by TLC). BLS 1411. A hyperoceanic species on smooth bark, especially twigs of Corylus and Sorbus, in sheltered boggy

undisturbed ancient woodlands; very local. W. Scotland, rare in W. Ireland. Resembles T. lepadinum, but with a grey-green thallus and with apothecia with a narrower opening; microscopic examination is necessary for certain identification. However, the large, dark ascospores can be visible with a ×20 lens and are often scattered over the surface of the thallus and particularly around the ostioles looking like tiny mouse droppings. Previously referred to in Europe as T. monosporum but that is a species of tropical S.E. Asia.

Host to Opegrapha thelotrematis as well as two undescribed species: Endococcus sp. (spores pale brown, 9- $11 \times 5.5-6.5 \,\mu\text{m}$) and Lichenochora sp. (spores colourless, 1-septate, $7-8 \times ca 5 \,\mu\text{m}$).

TOPELIOPSIS Kantvilas & Vězda (2000)

Thallus crustose, usually immersed, cortex not differentiated, non-layered, effuse. Photobiont Trentepohlia. Ascomata apothecia, urceolate, at first immersed with the exciple overtopping and

hiding the hymenium except for a minute pore, later \pm erumpent and the exciple splitting radially and exposing the sunken pinkish or grey-white disc. True exciple well-developed laterally, hyphal in construction, externally usually with a thin thalline layer, internally with hyaline periphysoids. Hymenium colourless, I-. Hamathecium of paraphyses, slender, numerous, septate, unbranched, apices not swollen. Asci 1- to 8-spored, clavate to \pm cylindrical, apex rounded, with a single, thin (>1 µm) wall layer, K/I-. Ascospores 13- to 35-septate or muriform, variously shaped, colourless, smooth-walled, sometimes with a distinct perispore. Conidiomata unknown. Chemistry: stictic or hypostictic acids, or no lichen products detected by TLC. Ecology: on mosses, soil, bark or wood, rarely on rock.

Superficially similar to the genus Ramonia (q.v.), which differs in the exciple that is composed of angular cells. There is only one British species.

Literature:

Coppins & Aptroot (2009), Frisch & Kalb (2006), Kantvilas & Vězda (2000), Mangold et al. (2008a), Rivas Plata et al. (2010).

Topeliopsis azorica (P. James & Purvis) Coppins & Aptroot (2008)

Thallus immersed in bark or encrusting mosses, very thin, membranous to subgelatinous, \pm continuous, pale green-grey, smooth, \pm shiny; prothallus absent; hyphae thin, much branched, penetrating moss leaf cells. Apothecia 0.3–0.7 mm diam. urceolate, numerous, mostly discrete, rarely 1- to 3-contiguous, often rather evenly spaced, adnate; disc deeply concave, partly to almost completely occluded; true exciple of small elongate compacted rather ill-defined cells, pale straw-coloured, surface very irregular, of necrotic cells intermixed with small crystal clusters (?calcium oxalate); thalline margin pure white in the upper half, pink below, scabrid, indistinctly radiately fissured or pleated; epithecium colourless, non-granular; hymenium 150–180 μ m tall; hypothecium thin, ca 20 μ m tall, \pm opaque, black;

paraphyses ca 2 µm diam., not swollen at the apices, numerous, unbranched, conglutinated. Asci 1-spored (rarely 2-spored), narrowly cylindrical and becoming ellipsoidal. Ascospores (100-) 120-135 (-140) × (27-) 35-45 µm, cylindric-ellipsoidal with rounded apices, richly muriform, colourless, K/I+ blue, perispore absent. No lichen products detected by TLC. BLS 2420.

On bark or spreading over mosses on Betula and Sorbus; very rare. Scotland (Knoydart, West Invernessshire) and S.W. Ireland (Killarney).

In the field T. azorica resembles a rather robust Crutarndina petractoides with emergent apothecia, but has large, richly muriform ascospores, with only one or two spores per ascus, as opposed to the 9- to 11-septate spores and 6- to 8-spored asci of C. petractoides. T. azorica is better placed in Topeliopsis because of its K/I+ blue ascospores and the lack of small, thin-walled, angular cells in the exciple.

Nomenclature

Allographa anomala (Leight.) Aptroot & Weerakoon, comb. nov. Basionym: Opegrapha anomala Leight., Ann. Mag. nat. Hist., ser. 2 19: 129 (1857). Typification: On holly, Ireland: co. Kerry, Glengariffe [sic.], rec. June 1889; H. Piggot s.n. (BM 000660465 holotype of Opegrapha anomala Leight.).

Allographa pauciloculata (Coppins & P. James) Aptroot & Weerakoon, comb. nov. **IF 901182** Basionym: Graphina pauciloculata Coppins & P. James, Lichenologist 10: 198 (1978). Typification: On bark of Ilex, United Kingdom: Devon, Merrivale, Vixen Tor, in wood by Walkham River, 15 Sept. 1971, F. Rose & B.J. Coppins (BM 001242327 - holotype of Graphina pauciloculata Coppins & P. James).



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