

Endocarpon Hedwig
(VERRUCARIALES: STAUROTHELACEAE)

After Fink (1935), Poelt (1969), and others

Rev. 5/94

Thallus squamulose to rarely foliose, adpressed to ascending; upper cortex paraplectenchymatous; lower cortex occasionally present; attached by rhizoids. Perithecia immersed; ostiole erect, slightly projecting; true exciple dark throughout; hymenium with 1- or 2-celled algae (same kind as in thallus), l+ reddish or bluish, K/l+ blue; paraphyses absent (gelatinizing); periphyses numerous; asci clavate, saccate, or globose, fissitunicate (unitunicate according to Rogers), thick walled, 1-2(-8) spored; apex with a chitinioid plug staining red in Congo Red; spores multiseptate to muriform, hyaline to yellowish brown, thin walled. Pycnidia immersed, without involucrellum; conidiogenous cells elongate-ampulliform, enteroblastic; fulcrum exobasidial; pycnosporos cylindrical-bacilliform, straight, simple, colorless. No substances. Photobiont Pleurococcus, Stichococcus. On earth banks, calcareous soil, or rock.

Distinguished from Catapyrenium, Dermatocarpon and Placidiosis in having algal cells within the perithecial cavity, and in having muriform spores. Some species presently placed in this genus probably belong in Staurothele, but I do not understand what distinguishes Endocarpon from that genus except having a squamulose thallus (not a very good character by itself).

There appear to be some discrepancies in the descriptions of some species as given by different authors, which need to be resolved.

I. Growing directly on rock.
Thallus areolate or squamulose.

1. Thallus areolate-squamulose, crustose. [also see other Staurothele spp.]. 2

1. Thallus squamulose. (E. pusillum v. pallidum and E. adscendens may also key out here--see terricolous species). 3

2. Thallus dark, dusky olive green to blackish, discrete or in confluent patches, 3-8 mm across, minutely rimulose. Perithecia 1-2 in minute thalline verrucae, immersed, the apex dull black, the ostiole hardly visible; wall obscurely brown, dimidiate; hymenium pallid, globose; paraphyses distinct [?--according to Hasse, but this seems unlikely for a member of the Verrucariales!], filiform, subclavate above. Asci 80-100 x 29-32 μ m, the wall thickened at apex. Spores 2, colorless then brownish, ovoid to oblong-ovoid, 33-48 x 13-21 μ m, with

7-11 transverse septa and 2-4 longitudinal septa, the cells subglobose. Hymenial gel I+ coppery brown. On argillaceous schist, S. California. (*Staurothele drummondii*--syn.: *E. wilmsoides*)

2. Thallus paler, olivaceous-cinerascent, effuse, thin, of subverruculose squamules, loosely aggregated, the fertile ones being slightly larger, containing one or two ascocarps, these subimmersed, dull black, the ostiole barely visible; excipulum dark, dimidiate; hymenium pale, globose, 240-270 μm diam.; hymenial algae numerous; asci saccate-clavate or clavate, 120-140 x 24-28 μm , the wall slightly thickened above; spores 2-3, oval to oblong, muriform, pale brownish, 26-55 x 10-20 μm , 7-13-septate transversely, 3-4-septate longitudinally. Hymenial gel I+ sordid greenish. On argillaceous schist, S. California. *Staurothele catalepta* (syn. *Endocarpon monicae*)

3. Spores 40-52 x 16-20 μm , pale. Thallus of thickish brown squamules with lobulate circumference. Hymenial gelatin yellow in iodine. Thallus to 3 cm across, squamulose, solitary or composed of loosely aggregated squamules; squamules lobate or "mono-lobed", adnate, 1-5 mm across; lobes rotund, 0.2-0.5 mm wide, contiguous; upper surface brown, a little glossy, smooth, almost flat to slightly concave; lower surface with rhizohyphae, lacking rhizines, mostly almost black. Perithecia laminal, common, immersed, usually projecting on the upper and/or lower surfaces of thallus. Pycnidia laminal, somewhat common, immersed, indistinct. Thallus 100-200 μm thick. Upper cortex 15-40 μm thick, brown in uppermost part, otherwise hyaline, eu- to subparaplectenchymatous; lumina of hyphae 3-10 μm high, 3-5(-8) μm wide, larger in the middle ones of the layer, \pm in vertical rows; walls of hyphae thin, 0.5-1 μm thick, but ca. 2 μm thick in uppermost ones. Algal layer 30-50 μm thick. Medulla composed of spherical hyphal cells 4-7 μm thick, with or without filamentous hyphae 2-3 μm thick. Lower cortex ca. 15 μm thick, dark brown to almost black, weakly differentiated from medulla, paraplectenchymatous (\pm loose); lumina of hyphae almost isodiametric, 4-6 μm wide; walls of hyphae ca. 1 μm thick. Perithecia almost spherical to doliform, 200-230 μm high, 210-220 μm wide; exciple dark brown to almost black, 15-20 μm thick; subhymenium ca. 20 μm thick; periphyses 20-40 μm long; hymenium ca. 160 μm diam.; hymenial algae spherical, 2-3 μm across; asci clavate, ca. 70 x 15 μm ; spores 2, hyaline to very pale brown, muriform, ellipsoid, (25-)27-40(-43) x 11-18(-20) μm . Pycnidia of the *Staurothele*-type; pycnospores bacilliform, 4-5.5 x ca. 1 μm . On soil, rocks, concrete. Southern California. *E. petrolepideum* (Nyl.) Hue [combination incorrectly attributed to Hasse]

3. Spores mostly over 20 μm wide, pale or dark. Thallus of ascending to erect squamules, almost subfruticose. Hymenial algae ellipsoid. 4

4. Spores soon dark, 35-50 x 18-24 μm . Squamules crowded and imbricate, ashy brown to blackish. Thallus caespitose, almost dwarf

fruticose, composed of short (to ca. 1.3 cm tall but often less, to 0.6 cm according to Poelt), ascending to almost erect, very slender, crowded, rounded, finger-shaped, dichotomously much-branched stalks, the branches dilated above into \pm imbricate squamules, the tips becoming irregularly crenate or with incised margin, the whole plant resembling a minute Umbilicaria; sometimes crowded into an irregular crust; fragile; surface ashy brown to blackish or dark chocolate brown; cortex plectenchymatous; medullary hyphae loosely interwoven. Algae in thallus 6-12 μ m diam. Perithecia 0.15-0.3 mm across, immersed; ostiole closed, surrounded by a depressed, sometimes lighter colored area, the wall complete, hyaline to slightly tinged with brown; asci clavate to inflated-clavate; hymenial algae oblong, 10-24 x 3-4 μ m; spores 1-2(-4), brown, broadly ellipsoid, 7-11-septate transversely and 2-5-septate longitudinally, 26-52 x (14-)18-24 μ m. On rocks (\pm calcareous according to Poelt) (or moss according to Fink), "probably arctic-alpine" (according to Poelt). Washington, California.

[Descriptions given by Herre for this species and by Fink for it synonyms in "Pyrenothamnia"] E. pulvinatum Th. Fr.

4. Spores pale, only finally brown, 45-60 x 18-27 μ m.

Squamules tortuous and nodulose, more or less stipitate, erect, ashy brown to dark, almost purplish brown. Hymenial gelatin blue to red-brown in iodine. On rocks on trickle surfaces, arctic to temperate, known from scattered localities (Baffin Island, Alberta, Montana, Nevada, and Michigan). E. tortuosum Herre

ADD:

1. On mortar between bricks (Hcl+); thallus brown, relatively undivided; ascospores 23-31 x 11-16 μ m. Upper cortex composed of relatively thin walled hyphae. Florida. E. sp. (Harris 1995)

1. On Hcl- rock along river; thallus light gray, becoming lobate; ascospores 29-41 x 11-16 μ m. Upper cortex composed of relatively thin walled hyphae. Florida. E. sp. (Harris 1995)

**II. Growing on soil or moss
(sometimes over rock, but not directly attached to the rock).
Thallus squamulose.**

1. Spores not more than 13-septate transversely. Thallus of small, \pm lobed squamules. 2

1. Spores often more than 13-septate transversely, soon brown. 4

2. Thallus pale reddish brown or gray-brownish; squamules ascending, sometimes imbricate, pale or dark below, without rhizoidal hyphae. Spores (28-)32-47(-50) x 14-18 μ m, elongate-ellipsoid, 1/ascus. Pycnidia ca. 100 μ m diam., frequent; pycnospores 4-6 x 0.8 μ m. Thallus nodulose-squamulose to almost foliose, the squamules overlapping, with \pm radiating marginal lobes, forming a \pm compact mat; squamules 1.5 x 0.7 mm (1.5-7 x 1-2 mm according to Poelt), 0.20-0.26 mm thick when wet, often \pm convex, not pruinose, the margins entire or \pm indented-crenulate; upper surface fawn to light brown, dull greenish when wet, matt; lower surface black, with a broad, pale marginal zone. Perithecia 0.2-0.4 mm diam., 1-2 per squamules; upper part brown-black, conspicuous, \pm elevated around the ostiole; ostiole depressed; nucleus globose; wall brown-black above, pale below; \pm discrete crystal clusters few to frequent within perithecium. Hymenial algae 3.5-4.5 μ m, spherical or shortly ellipsoid. Spores soon brown. Rhizine strands absent. On periodically inundated rocks (e.g., granite, mica-schist, porphyry and sandstone), at the margins of rivers and lakes, often encrusting mosses (on mosses over limestone soils according to Poelt). E. adscendens (Anzi) Müll. Arg.

2. Thallus light brown to olive- or dusky-brown, squamulose-areolate; squamules closely appressed to at most weakly ascending at margin, tightly or loosely attached; Spores (24-)45-55(-58) x (12-)14-19(-28) μ m, (1-)2 per ascus, uniseriate, transversely 6-9(-13)-septate and longitudinally (1-)2(-4)-septate. Thallus of scattered or \pm contiguous squamules; squamules 0.8-3.5 mm, ca. 0.18 mm thick, the margins crenate; upper surface pale to dark reddish brown, deep green when wet, matt; lower surface pale or black, with a few wart-like hairs (rhizoidal strands). Perithecia 0.25-0.4 mm diam., globose, 1-2(-10) per squamule; exciple dimidiate. Hymenial algae 3-7 x 2-4 μ m. On soil over calcareous substrates and on old walls (lime plaster). 3

3. Underside of squamules pale; upper side pale reddish brown or paler. Thallus thin; squamules scattered to crowded or imbricate and forming terraced crust, loosely attached; perithecia 1-5(-10) per squamule; ostiole papillate, protruding; spores transversely 7-13

and longitudinally 1-2-septate (according to ?; 3-7-septate longitudinally according to Fink), (32-)38-52(-57) x (14-)18-25(-28) μ m. Squamules ca. 1-2 mm across, crowded or imbricate or overlapping to form terraced crust, flexuous, \pm marginally upturned; lobes rounded with \pm crenate margin; not rosette-forming; upper surface pale reddish or darker; lower surface black; hypothallus absent. Spores 2, uniseriate, brown. Thallus K-, C-. Perithecia immersed; ostiole brown-black, sometimes becoming enlarged; excipulum dark brown, entire; spores 2, hyaline to light brown. Margins of squamules not distinctly paler than rest. Thallus [sometimes?] appearing sorediate. On \pm calcareous rocks (soil according to Fink and according to Poelt). New England; British Columbia; California. Not in Egan?, but E. pallidum was reported by Fink. E. pusillum Hedw. var. pallidum (Ach.) Körber

3. Underside of squamules black; upper side light brown to olive-or dusky-brown. Thallus rather thick; squamules scattered or crowded to imbricate, closely adnate, the smaller ones round, the larger irregular; perithecia 1-2 per squamule; ostiole with black, prominent area around it, protruding slightly; spores transversely 6-9 and longitudinally 2-4-septate, (24-)29-45 x 12-20 μ m. Throughout the U.S. east of Rocky Mountains, and in Nevada and California. ... E. pusillum Hedw. var. pusillum

4. Spores (32-)46-70(-80) x (14-)18-24 μ m, uniseriately arranged, 2/ascus, hyaline (to very pale brown), oblong, 17-23-septate transversely and 3-7-septate longitudinally. Thallus reddish brown, thin (thick according to Poelt), composed of small, lobulate squamules. Perithecia 0.14-0.2 mm across, immersed, often several per squamule, indicated by a minute darker depression; wall dimidiate. Hymenial gel I+ pale "claret". Squamules ascending, not rarely imbricate. Rhizine strands absent. On soil (calcareous according to Poelt). Southern California. E. subnitescens (Nyl.) Nyl.

4. Spores 28-40 x 14-18 μ m, irregularly arranged, 2/ascus, hyaline to pale brown, oblong to ovoid-ellipsoid, 11-17-septate transversely and 5-7-septate longitudinally (7-septate transversely and 2-3-septate according to Hasse). Thallus whitish to light gray, thin, composed of small, round to wavy and lobulate squamules, the margin often ascending or recurved (when dry) and granular-blackened. Perithecia 0.08-0.1 mm diam., immersed, 1-12 or more per squamule, indicated by the minute, protruding gray apices. Ostiole scarcely discernible. Perithecial wall dimidiate, dark, brown-black, 52-56 μ m thick. Hymenial cavity 140-160 μ m diam. Asci 60 x 20 μ m, the apical "perforation" vertical, widening upward, funnel-shaped, the ascus wall quite thick but gelatinous and almost invisible. Spore cells cubic. Hymenial gel I+ wine red, the ascus wall faintly so and its

contents rich yellow to orange. Squamules 0.25-2 mm wide. Lower surface of thallus ecorticate. Upper cortex with horizontally flattened cells "immediately beneath" forming the algal layer. Sterigma indistinctly articulate, somewhat curved; pycnospores minute, barely 1 μ m long. On soil, southern California. E. lepidallum Nyl. in Hasse

ADD:

Endocarpon adsurgens Vainio

Squamules \pm ascending; upper surface pale ochre-brown to dark brown; lower surface blackish, anchored by sparse brown to black. Spores remaining pale. On mossy soil. Montana.

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