

## II-A. TERRICOLOUS/MUSCICOLOUS.

Thallus without soredia or cephalodia.

Hypothecium hyaline or pale.

1. **Thallus squamulose.** ("Lecidea" caulophylla, a poorly known taxon which is actually a Lecanora, also keys out here, as does Gypsoplaca macrophylla) ..... 2
1. **Thallus crustose.** ..... 5
  2. **Thallus ± forming rosettes.** Asci Trapelia-type. .... (see Trapelia and Trapeliopsis s. lato [including "Lecidea glaucopholis")]
  2. **Thallus of adpressed or ascending, individual squamules, overlapping or ± dispersed, not forming radiating marginal lobes.** ..... 3
3. **Thallus pulvinate, of thickly crowded but non-imbricate areoles or squamules with appressed margins.** Asci with well developed, K/I+ pale blue apical dome and K/I+ dark blue tubular structure, Porpidia-like. [If asci Schaereria-type, not thickened apically, the tholus more or less non-amyloid and reduced, see Schaeria]. ..... (Lecidoma demissum)
3. **Thallus not pulvinate; squamules scattered to imbricate, often with ascending or raised margins.** ..... 4
  4. **Hymenium I+ blue. Hymenium and epihymenium without anthraquinones. Pycnidia immersed when young, soon sessile and marginal or on undersurface near margin of squamules; pycnospores bacilliform, 4-6 x ca. 2 µm. Upper cortex without algal remains. Calcium oxalate lacking under hypothecium.** Squamules olive-, pale to dark-brown (greenish when wet), mostly ± flat, crowded or imbricate. Apothecia black, flat to slightly convex, marginate to soon immarginate, to 1.5 mm. Epihymenium brown. Hypothecium pale. Spores 12-16 x 5-7 µm. Sterile thalli similar to Catapyrenium lachneum. On calcareous soil. .... L. lurida
  4. **Hymenium I-. Hymenium and epihymenium with anthraquinones. Pycnidia immersed; pycnospores elongate-bacilliform, ca. 1 µm wide. Upper cortex with algal remains. Calcium oxalate often present under hypothecium.** ..... Psora
5. **Spores globose, 8-10 µm diameter. Discs ± black. Asci Schaereria-type, without tholus.** ..... Schaereria cinereorufa (syn. L. magnussonii)
5. **Spores ellipsoid to oblong.** ..... 6
  6. **Spores often over 8 µm wide.** ..... 7
  6. **Spores mostly under 8 µm wide, thin-walled.** ..... 8
7. **Spores 15-23 x 8-13 µm, thick-walled. Discs red-brown to black.** ..... (Japewia tornoensis)
7. **Spores 18-31 x 7-9 µm, thin-walled. Disks black.** ..... ("L. sublimosa"; probably = Catillaria jemtlandica)
  8. **Discs ± pale, at least in part.** ..... 9
  8. **Discs ± black.** ..... 12
9. **Asci Trapelia-type, thin-walled, 8-spored; apical dome I- or + weakly blue. Thallus or at least exciple often C+ reddish. Apothecia sometimes with pale, pseudothalline margin.** ..... (see Trapelia and Trapeliopsis)
9. **Asci not Trapelia-type. Apothecia without pseudothalline margin.** ..... 10
10. **Spores 8.5-11 x 2.5 µm. Discs pale to dark olive. (If spores 4-5 µm long and ± tear-**

- shaped, see Psilolecia clavulifera) .....(L. cellularis; possibly = L. areolata)
- 10. Spores 10-20 x 3-9 um.** ..... 11
- 11. Paraphyses free. Apothecia 0.3-0.7 mm. Discs pale red-brown to brown-black. Hypothecium hyaline to pale yellow. Thallus ± thick. Spores 9-18 x 4-9 um.** Thallus widespread, granulose-verrucose, whitish to brownish; hypothallus whiteish. Apothecia subsessile; disc flat to convex; exciple concolorous with disc, thin, finally disappearing. Spores oblong-ellipsoid. On turfy soil. Colorado. ....(L. rufofusca; related to L. leprosula; possibly = L. porhyroplaca)
- 11. Paraphyses coherent. Apothecia 0.7-1 mm. Discs whitish, yellowish or red-brown. Hypothecium hyaline to yellow-brown. Thallus thin. Spores 10-20 x 3-7 um.** .....(see Biatora vernalis)
- 12. Spores mostly over 16 um long.** .....13
- 12. Spores mostly under 16 um long.** .....15
- 13. Thallus ± thick, verruculose.** ..... 14
- 13. Thallus thin, ± granulose, gray to white.** Apothecia to 0.4 mm, black, epruinose, rugose, the margin concolorous. Hypothecium hyaline. Epihymenium intense emerald green. Spores non-septate, oblong-elongate, (15-)18-31 x 7-9(-10) um. Arctic. See Thomson 1997 for fuller description. .... "L. sublimosa" (probably = Catillaria jemtlandica, according to Printzen)
- 14. Spores 15-25 x 3-4 um, oblong.** Thallus very thick, verruculose to subareolate, whitish to grayish, K-. Apothecia 0.5-1.2(-2) mm diameter, black, epruinose, convex and immarginate from the start. Hypothecium hyaline. Epihymenium blue-green. .... "L. alpestris" (according to Printzen, the three syntypes represent Micarea incrassata, cf. Toninia aromatica, and what is probably Lecidea stenotera)
- 14. Spores (12-)15-19(-24) x 5.5-7(-9) um, ellipsoid.** Hypothecium ± colorless to yellowish or reddish brown or almost violet, K+ reddish orange. .... (Frutidella caesioatra)
- 15. Spores over 5 um wide.** ..... 16
- 15. Spores under 5 um wide.** .....17
- 16. Thallus verrucose, K+ orange-red.** Spores 11-12 x 5-6 um. Thallus moderately thick, whitish or grayish. Apothecia to 0.7 mm, black, depressed to plane, the margin thick and elevated, persistent. Hypothecium hyaline to pale olivaceous. Epihymenium brownish black, granular. New York. ....(Rimularia sphacelata)
- 16. Thallus pulverulent, rimose-areolate, K-, C-.** Spores 10-12 x 6-7 um, ovoid-ellipsoid. Apothecia to 0.5 mm; discs black, flat to slightly convex, the margin thin, finally disappearing. Hypothecium dusky or paler (to hyaline?). Thallus white. On adobe soil and small pebbles on the ground, S. California. ....L. austro-californica Zahlbr. (= L. subplebeia Nyl. non Vainio)
- 17. Spores under 10 um long.** .....18
- 17. Spores 10-16 x 3-5 um.** Apothecia adnate, to 1 mm. Thallus white to olivaceous, K-, membranaceous to verruculose. Spores non-septate, subfusiform to ellipsoid. Hypothecium pale olive or brownish above, ± hyaline below; epihymenium bluish- or greenish-black. On mosses over soil. Boreal-arctic; Colorado. ....(L. limosa; based on ascus type and ± fusiform spores, may have affinities with Lecidoma demissum)

**18. Spores 10-14 x 3-6 um (according to Thomson 1997; 8-10 x 2.5-3.5 um according to ?).** Thallus very thin, arachnoid over moss, white or gray-white. Apothecia adnate, to 0.7 mm broad, black, bare; margin thin, concolorous, disappearing; exciple plectenchymatous, the columnar exterior greenish, interior hyaline; hypothecium hyaline; epihymenium pale bluish or violet-tinged to black, with violet-black granules scattered in it, as in the exciple; hymenium 40-60 um, hyaline to pale violet, with colored grains in stripes through it, I+ blue turning red; paraphyses coherent, only slightly thicker at tips; asci clavate; spores oblong to ellipsoid, simple. Thallus K-, C-, P-, I-. On moss, Arctic. ....L. ementiens (= close to Biatora, but having a different structure of excipulum and hypothecium)

**18. Spores 7-10 x 3-4(4.5) um,** ellipsoid to broadly ellipsoid, often 1-septate. Thallus pale to deep or bluish gray, compacted-verrucose, K-. Apothecia to 1 mm, black, convex and immarginate from the start. Hypothecium hyaline. Epihymenium black or bluish-black. New York. .... L. subramosa (related to Frutidella caesioatra)

ADD:

Spores 16 per ascus. On disturbed soils. .... Steinia

## II-B. TERRICOLOUS/MUSCICOLOUS.

**Thallus without soredia or cephalodia.**

**Hypothecium  $\pm$  dark (at least distinctly colored).**

- 1. Thallus pulverulent, rimose-areolate**, white, K-, C-. Spores 10-12 x 6-7  $\mu$ m, ovoid-ellipsoid. Apothecia to 0.5 mm, discs black, flat to slightly convex, the margin thin, finally disappearing. Hypothecium dusky or paler (to hyaline?). On adobe soil and small pebbles on the ground, S. California. .... L. austro-californica Zahlbr. (= L. subplebeia Nyl. non Vainio)
- 1. Thallus verruculose-granulose or not evident.** ..... 2
- 2. Spores often over 15  $\mu$ m long.** ..... 3
- 2. Spores under 15  $\mu$ m long.** ..... 4
- 3. Thallus P+ yellow, K-**. Spores 10-22 x 3-6  $\mu$ m, non-septate, oblong. Apothecia to 1 mm, discs cinnamon brown to reddish, convex, margin thin, concolorous, disappearing. Thallus verruculose, whitish, Hypothecium pale yellow-brown to red-brown. Epihymenium reddish or yellowish. .... Biatora cuprea
- 3. Thallus P-, K $\pm$  weakly yellowish, C-, KC+ orange (sphaerophorin).** Thallus verruculose, gray-white to gray or olive-gray, rather thick, of dense, subglobose,  $\pm$  isidioid granules 0.1-0.2 mm diam., gray to dark gray or almost black, whitish when eroded; prothallus absent. Photobiont cells 6-12  $\mu$ m. Apothecia sessile or partly hidden by thallus granules, to 0.5-1(-1.2) mm, strongly convex, sometimes tuberculate, bluish black with blue gray bloom especially when wet; exciple reflexed, hyaline to pale dull yellowish, of radiating conglutinated hyphae (in K) 1.5-2  $\mu$ m wide. Epithecium and upper hymenium bright blue-green, K-. Hymenium 50-65(-75)  $\mu$ m; hypothecium  $\pm$  colorless to yellowish or reddish brown or almost violet, K+ reddish orange. Paraphyses 1.3-1.8  $\mu$ m wide, simply or sparsely branched; tips not markedly swollen but with individual, colorless gel-coats. Asci  $\pm$  Lecanora-type with a broad apical cushion. Spores (12-)15-19(-24) x 5.5-7(-9)  $\mu$ m, ellipsoid. On mosses. Often mistaken for Micarea spp., which have smaller photobiont cells. .... Frutidella caesia
- 4. Thallus dark, brown-black.** Spores 10-14 x 5-7  $\mu$ m. Discs red-brown to  $\pm$  black. Hypothecium pale brown to brown black. .... (see Placynthiella uliginosa)
- 4. Thallus  $\pm$  pale.** ..... 5
- 5. Thallus thick, well-developed, verrucose.** ..... 5
- 5. Thallus thin.** Spores 10-14 x 3-5  $\mu$ m. Discs pale red-brown to black. .... 13
- 6. Discs red-brown to dark brown or black.** Hypothecium red-brown to black. Spores oblong to ellipsoid, 7-12 x 2.5-4.5  $\mu$ m, non-septate. Thallus composed of often clustered verrucules, grayish brown to greenish white or grayish white, K-, C-, P-, I-, sometimes sorediate; verrucules to 0.3 mm wide, compact or scattered. Apothecia solitary or often clustered, 0.2-0.4 mm across, adnate to sessile; margin thin, paler than disk; exciple dark brown or yellow-brown externally, paler brown internally, radiate. Hymenium 50-65  $\mu$ m, pale below epihymenium, I+ blue; paraphyses 1.5-2.5  $\mu$ m, coherent, tips not thickened; asci clavate. Epihymenium  $\pm$  brown above. Asci similar to Micarea-type. On rotting wood and charred wood. Arctic-boreal. .... L. botryosa (may be congeneric with "Toninia" cumulata)
- 6. Discs black.** ..... 7
- 7. Paraphyses free.** ..... Lecidella wulfenii
- 7. Paraphyses coherent.** ..... 8

- 8. Thallus blue-gray**, quite thick, of high verrucules and torulose, isidioid structures, K-; hypothallus indistinct, whitish. Apothecia dispersed or grouped, base constricted, becoming immarginate; disc flat to convex, black, the margin thin, concolorous, disappearing. Exciple radiate, outer part bluish brown to olivaceous, inner part pale. Hypothecium brownish to reddish brown, lower part paler. Epihymenium brownish to reddish brown. Hymenium 50-60  $\mu$ m, brownish to reddish brown, I+ blue. Paraphyses confluent, not branched, tips not thickened; asci clavate. Spores biserial, non-septate, oblong-elongate, 9-18 x 3-6  $\mu$ m. On soil, Arctic. .... L. ramulosa (Biatoraceae: incertae sedis)
- 8. Thallus white (to olivaceous in L. limosa)**. .... 9
- 9. Thallus K+ orange-red**, moderately thick, verrucose, whitish or grayish. Apothecia to 0.7 mm, black, depressed to plane, the margin thick and elevated, persistent. Hypothecium hyaline to pale olivaceous. Epihymenium brownish black, granular. Spores non-septate, ellipsoid to broadly ellipsoid, 11-12 x 5-6  $\mu$ m. New York. .... Rimularia sphacelata
- 9. Thallus K- or yellowish.** (if thallus squamulose, see Toninia tristis). .... 10
- 10. Thallus snow white**, granulose, K-, P-, C-, I-; granules to 0.5 mm, convex, dull. Apothecia to 0.4-0.6 mm, adnate, convex to hemispherical, blackish brown, bare or slightly pruinose, immarginate from the first. Spores simple, ellipsoid, 8-12 x 3.5  $\mu$ m. Hypothecium blackish brown, upper side wavy. Epihymenium pale brownish. Hymenium 50-60  $\mu$ m, hyaline, I+ blue; paraphyses gelatinized, 1-1.5  $\mu$ m; asci gelatinized; spores 8, ellipsoid, 8-12 x 3-5  $\mu$ m. On calcareous sandy soil. Alaska and NW Territories. .... L. subcandida (systematic position unclear)
- 10. Thallus white, green, or brown.** (If thallus with cephalodia, see Pilophorus pallida). Apothecia convex and immarginate,  $\pm$  black. .... 11
- 11. Paraphyses branched.** Apothecia not constricted, to 0.8 mm diameter. Thallus white, ashy, or ashy brown, verrucose, K-. Spores 8-19 x 3-6  $\mu$ m. Hypothecium reddish brown or brown (or purplish in f. irubata); epihymenium hyaline or brownish above. Arctic, S to Washington and Colorado. .... Micarea assimilata
- 11. Paraphyses not branched.** .... 12
- 12. Apothecia strongly constricted at base, with short stipe between granules of thallus**, to 1 mm diam. Thallus white or greenish-white, granular to subcoralloid, K-. Spores 10-13(-16) x 3-5(5.5)  $\mu$ m. Hypothecium green-black to brown-black above, purple-black below; epihymenium olive-brown. New York. .... (Helocarpon crassipes)
- 12. Apothecia adnate (adpressed sessile)**, to 0.5-0.8(-1) mm, black, strongly convex; exciple not apparent, reflexed. Thallus white to olivaceous, K-, C-, KC-, P+ orange-red (often patchily), containing pannarin and unidentified triterpenoids, membranaceous to verruculose, of convex granular areoles (0.1-)0.2-0.6(-1) mm diam.; prothallus white or absent. Spores 10-16 x 3-5  $\mu$ m, non-septate, subfusiform to ellipsoid. Exciple  $\pm$  hyaline, of branched, radiating hyphae 1-2  $\mu$ m wide. Hypothecium pale olive or brownish to reddish brown (K+ orange) above,  $\pm$  hyaline below; epihymenium and hymenium bluish-green or greenish-black, K-. Hymenium 45-65  $\mu$ m. Paraphyses 1.3-2  $\mu$ m wide, sparsely branched and anastomosed, sparsely septate, the tips not swollen or pigmented. Asci Catillaria-type but sometimes with an indistinct ocular chamber. Pycnosporangia 6-7 x 1.5  $\mu$ m. On soil or mosses over humus. Boreal-arctic; Colorado. .... L. limosa (may be related to Lecidoma demissum)

- 13. Thallus ± distinct**, whitish to grayish or greenish-gray, K-. Asci Porpidia-type. Thallus P-, K-, C-, KC- (no substances). ..... 14
- 13. Thallus indistinct or not evident.** ..... 16
- 14. Thallus white, tartareous (mostly ca. 200 µm thick). Apices of paraphyses clavate to capitate, ± brown-walled, under 6 µm wide.** Widespread, arctic-alpine. .... "Mycobilimbia" berengeriana
- 14. Thallus gray or tinged brown or dull green, thin and membranous. Apices of paraphyses colorless, under 3 µm wide.** ..... 15
- 15. Apothecia dark brown to black, often persistently marginate; spores 4.5-6(-7) µm wide, often thinly 1(-3)-septate and finely warted.** On moss or sandy soil. Widespread arctic-alpine. .... "Mycobilimbia" hypnorum
- 15. Apothecia pale to dark brown, usually soon immarginate; spores 3-4.5(-4.8) µm, always simple, smooth.** (treated as a synonym of Mycobilimbia hypnorum by Egan, but accepted as distinct by Hawksworth & Coppins). On dead moss, or on soil. .... L. sanguineoatra auct. (= Mycobilimbia?)
- 16. Spores oblong to oblong-ellipsoid, 11-16(-19) x 3.5-5 µm**, partly 1-septate. On Diapensia or sometimes peaty soil. Thallus scant, varnish-like or very thin, white. Apothecia 0.4-0.8(-1.5) mm, broadly adnate, epruinose, usually concave to plane, or becoming convex, olivaceous- to reddish- brown or black, epruinose, slightly shiny, the margin thin, rather conspicuous, persistent or becoming excluded. Exciple radiate, narrow exterior pale, interior purplish brown. Hypothecium , olivaceous- or reddish-brown to blackish (violet brown or with upper part bluish, lower paler, according to Thomson 1997). Epihymenium brown or reddish brown. Hymenium 60-80 µm, not granulose, upper part reddish, lower part pale or with a narrow violet-blue base, I+ blue but epihymenium remaining red; paraphyses coherent, sometimes branching, tips slightly thicker; asci clavate; spores biserial. Arctic-alpine.. .... L. diapensiae (systematic position unclear)
- 16. Spores ellipsoid, 9-11 x 5-5.5 µm.** On bare clayey soil, Arctic. Apothecia to 0.3-0.5 mm, sessile, base slightly constricted, disc black, subconvex (quite convex according to Thomson 1997), immarginate; exciple dark violet-brown. Thallus poorly developed, very thin, minutely granulose, gray-white, K-. Hypothecium violet brown, K+ violet. Epihymenium violaceous.. Hymenium 45-50 µm, violet; paraphyses coherent, tips only slightly broadened; asci clavate. Thallus K-, C-, P-, I-; hymenium I+ wine-red. On bare soil, high in clay, as in frost boils. Arctic. .... L. tenuissima (systematic position unclear)

ADD:

Spores 16 per ascus. On disturbed soils. .... Steinia

## II-D. TERRICOLOUS/MUSCICOLOUS.

### Thallus with soredia or cephalodia.

1. **Thallus with cephalodia. Hypothecium brown. Discs black.** Spores 16-22 x 6-9 um. ....(*Pilophorus pallidus*)
1. **Thallus with soredia. Hypothecium hyaline. Discs  $\pm$  pale, at least in part.** Spores under 8 um wide, thin-walled. .... 2
  2. **Thallus C-, without lichen substances.** On moss over bark or rarely wood. ....(*Mycobilimbia*: "*Biatora*" *epixanthoides*)
  2. **Thallus C+ red, with gyrophoric acid.** .... 3
3. **Areoles usually distinct, markedly convex throughout, or when scattered or at the edge of thallus sometimes incised, usually over 0.1 mm diam.** Asci *Trapelia*-type. ....(see *Trapeliopsis* spp.)
3. **Areoles usually indistinct, minute, under 0.1 mm diam., never incised.** On mosses over bark. [If thallus C-, P+ red or orange, see *Biatora efflorescens*]. .... (*Biatora chrysantha* [syn. *L. gyrophorica*])

ADD:

Thallus effuse, thin, minutely granulose-verrucose, granules to 0.2 mm, occasionally larger and papilliform, pale brown, shining, esorediate. Apothecia minute, 0.2-0.3 mm, adnate; margin concolorous with disk; exciple brown or reddish brown; disk shining black, epuriose, soon slightly convex; hypothecium brown or reddish brown; epihymenium blue, bluish brown or pale blue; hymenium 88-100 um; upper part blue or blue-brown; paraphyses easily separated, tips not thickened; asci subcylindrical; spores uniseriate, broadly ellipsoid to subglobose, thick-walled, 9-15 x 8-11 um. Thallus K+ brown, C-, P-, I-. On moss. Alaska. .... *Hafellnera parasemella* (Nyl.) Houmeau & Roux

Thallus thin, of minute convex verrucules, bluish-ashy or ashy white, esorediate. Apothecia small, base narrowed, flat to soon convex, brick-red or brownish red; margin of the same color and soon disappearing; exciple radiate, pale; hypothecium pale to hyaline; epihymenium pale; hymenium 80-90 um, hyaline, I+ blue turning reddish; paraphyses slender, tips slightly thicker; asci clavate; spores simple or usually partly 1-septate, oblong, 14-20 x 5-7 um. On humus and rotting wood. Greenland. .... *L. subduplex* (Nyl.) Nyl.