

On rock:

Verrucaria maura

Rhizocarpon bolanderi

Thallus C+ red.

Thallus brown, verrucose. Medulla I+ blue. Rhizocarpon grande

Thallus gray to ashy, areolate to verrucose. Medulla I. Rhizocarpon intermedium

Thallus white to very pale gray or ashy, smooth to areolate. Prothallus black, often conspicuous. Norstictic acid present. Pycnospores short, straight, baciliiform, 46 x ca. 1 um. On exposed boulders. Buellia stigmaea

Pertusaria flavicans

Candelariella rosulans

Thallus small, scattered, areolate to subsquamulose, deep yellow. Candelariella vitellina

Thallus papillate, isidiate, or sorediate. On rock or crustose lichens over rock.

1. On various crustose lichens (but this is not always recognizable in the herbarium) on exposed siliceous rocks.

Medulla P+ yellow, K+ yellow to red, C, or P, K, C+ rose, with gyrophoric acid and varying proportions of norstictic acid; other reported substances are probably contaminants from host lichens. Areoles rough granuloseisidiatefurfuraceous to sorediate. Thallus rimoseareolate or irregularly areolate, to 0.8 mm thick, dark olivebrown to dark brown or blackish; areoles irregular in outline, flat to slightly convex, 0.40.5 mm across; surface minutely isidioid or granular, the granules (20)30(50) um diam. Hypothallus not visible. Photobiont cells 612 um diam. Nova Scotia. "Rimularia" furvella

1. Directly on rock. Thallus C+ red (gyrophoric acid major), usually K, P. 2

2. Thallus thickish (0.10.4 mm), ± bullateareolate, light brown to beige, or gray brown to dark brown, sterile with elongated papillae (isidialike outgrowths), or becoming sorediate; or richly fruiting and then mostly with few or no soralia. Thallus bullateareolate; areoles irregularly angular, 0.30.7 mm broad, mostly scattered on a black hypothallus (occasionally visible between areoles), seldom flat, mostly convex to nearly spherical; upper surface rough or smooth; papillae 0.150.25 mm broad, 0.5 mm high, the tips finally convex, mostly with somewhat paler outgrowths, slightly erose, occasionally breaking into whitish (or yellowish) soralia 0.20.5 mm wide, or the soralia replacing the papillae. Thallus K, P, with gyrophoric acid only. Rimularia (Mosigia) gibbosa

2. Thallus thin (to 0.2 mm), crackedareolate to dispersed areolate, graybrown to dark brown or light brown, or occasionally yellowish to pinkish brown (paler brownish when wet), without papillae or soralia, or papillatesorediate to finely isidiate. Areoles 0.20.7(1.2) mm wide, ± flat, swollen but not bullate, irregularly angular to at margin sublobulate; surface smooth to rough; black hypothallus present, visible at margin, not conspicuous between the areoles. Soralia 0.1 mm broad; isidia (0.05)0.1(0.15) mmbroad, to 0.2 mm high, cylindrical or spherical; prothallus dark brown to black. Medulla usually K, P, but rarely K+ red, P+ orange (norstictic). Rimularia badioatra

1. **Thallus C+ orange or red.** Sorediate to scurfyblastidiate.
Hypothecium yellowbrown to redbrown. 2

1. **Thallus C (may actually be C+ orangeAnderson's C may not have been working).** Thallus verrucose, uneven, grayish. Soralia pale greenish, to 1 mm diam., composed of a roundish, irregularly convex mass of soredia; verrucae to ca. 0.25 mm diam. Thallus and soredia K+ yellow, P+ weak yellow. Black hypothallus not evident. On streamside rock wall in subalpine, Colorado. (Roger told me this is Lecidella scabra, but I that species is supposed to be C+ orange)

..... Lecidella sp. ("Lecidea sp. 13" of Anderson)

2. **Thallus thin, granular. Apothecia sessile. Soralia distinct.** On siliceous or slightly basic rocks, occasionally on dry and often dustimpregnated wood. Lecidella scabra

2. **Thallus thick, composed of blastidia. Apothecia + immersed. Not sorediate.** On noncalcareous maritime rocks, rarely on decorticated wood or decaying vegetation.
Lecidella prasinula [auct. non (Wedd.) Hertel?]

Thallus sorediate.

1. Medulla and soredia C+ orange to red. Thallus deeply and regularly cracked, thick; areoles to 0.4 mm diam., contiguous to discrete, flat to mostly warty convex, pale grey to dark brown, often turning reddish in herbarium, delimited by black prothallus, rounded, tuberculate. Soralia 0.20.5 mm diam., at first punctiform and rounded, pale greenish or ochre or creamcolored to greyyellowish, soon becoming brownish, and + confluent, when old often craterform sunken. Soralia P+ yellow, KC+ red, UV+ faintly yellowish, with alectorialic acid. On + vertical, shaded, siliceous rocks, often under overhangs. Fuscidea praeruptarum

1. Medulla and soredia C. 2

2. Soralia P+ red. Soralia occasional, discrete, pale yellow brown to pale greenish, at most under favorable conditions becoming corticate and then darker; very irregularly distributed, rounded to oval or irregular in outline, 0.51.5(2) mm wide, convex. Fuscidea cyathoides v. sorediata

2. Thallus and soralia P. Thallus areolate or wartyareolate, whitish to grey or brownish gray; areoles 0.10.5 mm diam., usually contiguous, discrete, rounded and unevenconvex or tuberculate. Soralia 0.20.7 mm diam., at first whitish, soon becoming brownish and confluent, uneven, sometimes convex. Prothallus dark brown, thin, + visible between areoles and delimiting the thallus. Medulla and soralia UV+ white, with divaricatic and + nordivaricatic acids. On hard, often + vertical, siliceous rocks. Fuscidea recens

1. **Thallus isidiatefurfuraceous**, areolate, dark olivebrown to black, I, P+ yellow, C+ red. Parasitic. ...(Rimularia furvella)
1. **Thallus sorediate. Thallus gray, white, or yellowish, I.**
..... 2
2. **Thallus yellowish. C**, with ± confluent soralia, pale yellowish, uneven or smooth. On steep siliceous rocks. Lecidea orosthea
2. **Thallus gray or graywhite.** 3
3. **Thallus or at least exciple C+ red (gyrophoric acid).**
..... 4
3. **Thallus and exciple C.**
4. Trapelia placodioides and T. obtegens
4. Rimularia gibbosa and R. badioatra
5. **Thallus (medulla) K+ red.** Thallus effuse, moderately thick, areolate; areoles ± convex, 0.20.5 mm wide, contiguous and angular to here and there subdiscrete and rounded; surface matt, gray to bluegray; soralia conspicuous, numerous, 0.40.5(0.8) mm across, becoming confluent; soredia white, granular. Hypothallus indistinct. Usually with apothecia but spores often not developed. Westcentral Canada. Lecidea petsamoensis
5. **Thallus K or + yellow.** 6
6. **Thallus K**, poorly developed, membranaceous or verrucose, dirty gray, with inconspicuous indistinct whitepunctate soralia. New York.Lecidea sorediifera
6. **Thallus K+ yellow.** Thallus indistinctly rimoseareolate, with soralia, patchy? ("maculatim dissolutus"), the patches ± linearly arranged and radiating toward periphery of thallus, thin. Medulla I+ blue. On shaded rock, Smoky Mts.Lecidea degelii

1. Thallus yellow or greenish
yellow.2
1. Thallus gray, white, or brown. 4
2. Thallus thick, \pm lobed at margin, greenish yellow, C+ orange (xanthones); Coast of S. California. Lecanora xanthosora
Thallus thin or thick, C (no xanthones). Mostly inland. 3
3. Thallus greenish yellow, yellow green or sometimes blackish green; effuse, thickish, of crowded or scattered verrucose or coarse subsquamulose granules, or forming a \pm continuous, areolate crust; areoles strongly warted and convex; prothallus when visible blackish. Soralia arising on the upper surface of the areoles, 0.20.5 mm diam., but often coalescing to form an almost continuous sorediate crust; soredia dull yellow to citrine yellow, usually paler but sometimes concolorous with thallus. Thallus and soredia P or occasionally P+ yellow or orange, K, C(Ch: epanorin, rhizocarpic acid, zeorin). On ironrich siliceous rocks in shaded overhangs and dry crevices.Lecanora epanora
3. Thallus strongly yellow, lobate; lobes mostly very short, definitely lifted from substrate, high convex, crowded, each soon breaking up into a wide, deeply hollowed out thalluscolored soraliium; old lobes finally almost hollow; K+ redbrownish. Very loosely attached to noncalcareous, overhanging rocks. Arcticalpine.
(Lecanora reagens)
4. Thallus brown.(Miriquidica intrudens)
4. Thallus gray or white, K+ yellow (atranorin). 5
5. Thallus greywhite, of contiguous, convex to subglobose verrucae. Chem.: sometimes Lgr1 and Lgr2 or fatty acids. Washington, Ontario.L. umbrosa
5. Soralia punctiform. Chem.: zeorin. Arizona.L. sp. 10 sensu Brodo (1984)

Thallus mostly over 4 cm across; cortex K; medulla sometimes K+.
Medulla C. Thallus composed of chestnut brown areoles on a black prothallus, which at the thallus margin forms minute, radiating lobes; prothallus and margins of areoles sootyblack in places due to 2celled to submuriform, coarsely warted, greenblack thalloconidia 914(20) x 712 um. Pycnidia immersed; conidia curved, 1214 x 0.81 um. Medulla P+ orange, K+ yellow, KC. C, UV (stictic acid). On siliceous rock underhangs. Southwest?; probably also elsewhere. Protoparmelia nephaea

6. Squamules mostly paleedged (never strongly blackened and granular), convex towards thallus center on fertile thalli, thinner, plane and imbricate on sterile thalli; lower cortex poorly developed; upper cortex thin; Mostly in the Rocky Mountains, eastward to Ontario. Lecanora weberi Ryan s. l.

6. Squamules mostly blackedged (sometimes strongly so, and granular, with thallospores), plane to concave throughout on both fertile and sterile thalli; lower cortex often well developed; upper cortex thicker. Mostly in the Pacific Northwest (material from the central Rockies that may belong here is especially problematic). Medulla P+ yellow or
P. 7

7. Thallus usually distinctly substipitatesquamulose, the squamules tiny to large, often with ascending and crenateincised margins, and always with a well developed lower cortex, usually forming pulvinate clumps, or if scattered or forming extensive patches then squamules usually very thin, with narrow, smooth blackend edges; edges granular with thallospores, or not. Squamules usually flat to concave. Cortex without pseudoplacodiolic or placodiolic acids. Upper surface usually fairly deep grayish yellowish green, but occasionally more whitish or yellowish. Medulla very often (but by no means always) P+ yellow (psoromic acid). Very widespread and common throughout the arctic and especially western temperate N. America. Rhizoplaca melanophthalma s. lato

7. Thallus (in the holotype) of contiguous, coarse, thick, areoles with + entire, appressed, margins and poorly developed lower cortex (only near the edge), forming + extensive flattened patches, but other specimens from near the type locality, and elsewhere, show transitions towards being more scattered and distinctly squamulose and corticate below); edges (at least at or near the type locality) very thick and densely granular with thallospores. Apothecia rare, often absent, never abundant, large, with thick, raised margins and blueblack (to somewhat paler and pruinose). Known with certainty only from the upper Naches River valley on the east side of the Cascades in Washington State; most material previously called by this name is R. melanophthalma, and I'm not terribly convinced there's a real difference. Lecanora nigromarginata

Thallus (usually) with isidioid soralia towards center, brown or graybrown; lobes very narrow (under 0.5 mm wide), thin (ca. 100-200 um), plane and closely appressed, appearing cellular throughout inside; hyphae thinwalled (walls thinner than lumina). Apothecia unknown. Spermatia bacilliform, 57 um long. Chem.: no substances, or traces of unknown substances. On dry, steep or overhanging silicates at low to moderate elevations. [Note: various Hyperphyscia spp. (Physciaceae) will also key out here; they generally have a prosoplectenchymatous medulla and some lack soredia, but some are extremely difficult to separate from true L. demissa] INCERTAE SEDIS: "Lecanora" demissa

1. Thallus without isidia or soredia, or if soralia present then thallus distinctly yellowish (Lecanora subg. Placodium sect. Endochloris Poelt), very thick and inflated squamulose (Lecanora cavicola) or otherwise different (various taxa not known from North America); lobes broader and thicker; thallus not appearing cellular inside; hyphae thick or thinwalled. Apothecia often present. Spermatia filiform to bacilliform. Chem.: usnic acid present or not. Mostly on exposed rocks, sometimes on soil, mosses, or rarely wood, low to high elevations. 2

2. Thallus gray to yellow or redbrown (Chem., in N. American species: without usnic acids; usually with norstictic acid), thick, lobate to fruticose; medullary hyphae thinwalled; spermatia short, bacilliform, under 10 um long. [Note: fruticose, terricolous taxa in Aspicilia Massal. s. l. (including "Agrestia Thoms."), not treated further in this document, will also key out here see key to Aspicilia and similar genera] "ASPICILIACEAE": Lobothallia

2. Thallus usually greenyellow (often whitened by pruina) or occasionally brown or orangebrown (Chem.: often with usnic acids; with or without norstictic acid); thallus thin to thick, areolate to rosulate, lobate or dwarf fruticose; medullary hyphae usually thickwalled (walls thicker than lumina); spermatia usually filiform and over 10 um long (except in Solenopsora, Omphalora, and some species of Rhizoplaca s. l. and Lecanora subg. Placodium sect. Dactylon Poelt). 3

3. Layers of thallus well delimited, evenly thickened; upper cortex false (but sometimes with few dead algal cells). On soil or rock. "SQUAMARINACEAE". 4

3. Layers of thallus well delimited or not, evenly or unevenly thickened; cortex true (without dead algal cells) or false (with

dead algal cells). 5

4. Thalli thick, moderately rigid, squamulose to lobate, brownish, greenish or whitish (Chem.: without usnic acid; usually with various other lichen substances in cortex); upper cortex thin (mostly to ca. 30 um), false but with few or no empty algal cells, with calcium oxalate or not; medulla relatively thin and loose, composed of rather thinwalled but sometimes swollen hyphae; spermatophores endobasidial; spermatia bacilliform, under 10 um long. Often in coastal areas with Mediterranean climates (California and Baja California). [Note: some species of Lecania will also key out here; they differ primarily in having exobasidial spermatophores and can often be distinguished from Solenopsora only with artificial keys treating both genera together]. Solenopsora s. lato

4. Thalli thin or thick, very rigid, rosulate or squamulose, yellowish (Chem: usually usnic acids in cortex); upper cortex usually very thick (30-100 um or more), false, with empty algal cells (often difficult to see because of large amounts of calcium oxalate crystals); medulla thick, dense and chalky, composed of thickwalled, often gelatinized and agglutinated hyphae; spermatophores exobasidial; spermatia filiform, over 10 um long. Generally in inland areas, desert to arctic or alpine. Squamarina s. str.

5. Thallus bullate-areolate to dwarf fruticose (an artificial grouping; several rare taxa of very uncertain affinities ("Biatora" caulophylla from California, and several rare undescribed species from Colorado) will also key out here; I do not have an adequate key for them at present). 6

5. Thallus areolate to lobate or umbilicate
. . . 8

6. Thallus papillate to dwarf fruticose, not differentiated into layers; inside composed throughout of areas of dense, strongly conglutinated hyphae and hyphal bundles, alternating with areas of looser tissue containing algae; surface strongly palespotted, brownish (Chem.: usually usnic acids, with or without unknowns). On rocks at the coast. INCERTAE SEDIS: Cladidium bolanderi

6. Thallus clearly differentiated into cortex, algal layer and medulla, without dense areas inside (except occasionally narrow cords of hyphae); surface at most weakly palespotted, distinctly yellowish (Chem.: usually usnic acids or xanthones). On rock or soil, inland or

coastal. 7

7. Thallus usually yellowbrown to greenblack (Chem.: without cortical substances, or with atranorin; medulla without triterpenes, usually with psoromic acid, alectorialic acid, or both; hyphal walls (at least in L. pringlei (Tuck.) Lamb) containing lichenan; lobes often inflated and strongly plicatefoveolate and rugose towards tips. Growing firmly attached to noncalcareous rock, in alpine (to high montane) habitats. Lecanora cavicola Crevelde (with soredia; not yet reported from N. America but known from a tiny fragment mixed with "Lecideabrandegei" from Colorado) also keys out here. I have not yet decided if "Lecidea brandegei" (which occurs in the Rockies and tends to be ± squamulose) is distinct from L. pringlei, (which occurs mainly in the Sierras and Cascades and tends to be distinctly subfruticose) at the species level. "Lecanora pringlei group" sensu lato

7. Thallus usually greenyellow (Chem.: cortex containing usnic acid or related substances; medullary chemistry various, but lacking alectorialic acid; hyphal walls, so far as known, lacking lichenan); lobes sometimes enlarged and plicate or rugose, but tips not inflated or foveolate. Growing on rock or soil, in various habitats, often at lower elevations. 8

8. Thallus UV+ orange, C+ orange (xanthonenes), growing on rock or rarely on soil, in coastal areas.
. . . (see Lecanora subg. Placodium sect. Endochloris: L. phryganitis Tuck.)

8. Thallus UV, usually C (always without xanthonenes; rarely C+ yellow or red), growing on soil or rock, mostly in inland areas. various subfruticose taxa or modifications of various saxicolous members of Lecanora (especially the L. crustacea/L. opiniconensis group in subg. Placodium) and Rhizoplaca; they can be identified using couplets below starting with 9).

9. Thallus usually umbilicate; underside attached only in a relatively narrow central area; margins of thallus not distinctly radiating; both cortices usually welldefined and with lower one often thicker than upper one; medulla usually loose.
Rhizoplaca

9. Thallus not clearly umbilicate; underside of at least central areoles firmly attached to substrate (usually rock) over a broad area (or sometimes on one side or at several small areas); margins of thallus usually radiating (at most somewhat ascending) and lower (and sometimes upper) cortex thin or absent; medulla

dense or loose. 10

10. Thallus brown (chem: acetoneinsoluble brown pigment), crustose to more or less effigurate, the areoles often subpeltate; cortex false. Spermatia sometimes pleurogenously formed, bacilliiform to filiform. On rock. Protoparmelia (nephaea)

10. Thallus greenish, yellowish, or whitish (chem: usually various yellow pigments), or if brown then clearly rosulate or lobate. Spermatia always acrogenously formed. On rock or sometimes other substrates. Thallus dull greenyellow to graygreen or bluish green (sometimes whitened by pruina), or various shades of brown (Chem.: usually usnic acids or xanthones; without epanorin; rarely if ever with atranorin; with or without zeorin). Thallus squamulose to lobate or fruticose; cortex true or false; medulla solid or loose, with or without hyphal bundles.
. . . 11

11. Thallus squamulose, typically forming small (to 12 cm diameter) convex mounds; cortex evenly thick, usually inspersed with grayish granules (insoluble in K); containing usnic acid; medulla thick, dense, stiff. On rock. Does not belong in Squamarina, and may be a distinct genus. "Squamarina sect. Petroplaca"

11. Thallus rosulate to lobate or minute fruticose, or if squamulose then usually forming larger, more flattened masses, or cortex either thinner or unevenly thickened; containing usnic acid or related compounds, xanthones, or occasionally no acetonesoluble substances; medulla various, often thin or loose. Lecanora subg. Placodium. 12

12. Cortex C+ orange, UV+ orange, with xanthones, with or without usnic acid or related substances (placodiolic, pseudoplacodiolic, or isousnic acids); cortex not inspersed with gray calcium oxalate granules; on or near the seashore, often very nitrophilous. 13

12. Cortex C, UV, most species with usnic acid (or related substances), without xanthones; cortex with or without oxalate granules; mostly in inland areas and only moderately nitrophilous if at all. 14

13. Thallus yellow or yellowish green, rosulate or dwarf fruticose, usually 12 mm or more thick; cortex with usnic acid in addition to xanthones; surface often roughwartygranular or eroding, sometimes with soredia or blastidia; lobes coarse, ca. 1

mm wide; medulla C+ orange, UV+ orange, with xanthonenes (arthothelin, thiophanic acid and others) and zeorin. Spermatia 1015 m long. Restricted to southwestern N.

America. Group 2. Lecanora sect.

Endochloris

13. Thallus more or less yellowbrown, squamulose to lobate; cortex with xanthonenes, without usnic acid; surface more or less smooth (not eroding, without soredia or blastidia); lobes narrow to broad; medulla C+ orange, UV+ orange (with arthothelin or other xanthonenes) or C, UV (without xanthonenes), without zeorin. Spermatia mostly 2035 m long. Circumborealarctic. Thallus rosulate, 1 to many cm diam.; marginal lobes elongated and usually radiating, thin and small to very thick and large; cortex well developed on thallus, often unevenly thickened, forming bundles dividing the algal layer.

. Group 3. Lecanora sect. Arctoxanthae

14. Medulla solid, dense; cortex usually evenly thickened and lacking distinct hyphal bundles, with or without dead algal cells; thallus areolatesquamulose to rosulate, less often distinctly lobate; lobes concave to plane or convex, usually not sinuous or plicate. Thallus composed of thin or thick, loosely or tightly adnate areoles or squamules, often becoming rosulate or lobate, often forming rosettes to 34 cm. or more diam., usually not moundforming; cortex relatively thin (mostly under 50 m); medulla not chalky (more weakly inspersed).

. . . Lecanora sect. Petrasterion s. l.

14. Medulla mostly loose to almost hollow; cortex usually unevenly thickened with distinct hyphal bundles, with few or no dead algal cells (except in L. laatokkaensis group, which typically has immersed to adnate apothecia borne laminally on central areoles); thallus areolatesquamulose to lobate or subfoliose; lobes flattened to concave or undulate, or convex and often becoming sinuous and more or less plicate. Group

6. Lecanora sect. Placodium

1. Thallus dwarf fruticose (rarely poorly developed and appearing somewhat crustose, but not marginally lobed) L. PHRYGANITIS Tuck.

1. Thallus crustose, marginally lobed. Thallus forming rather thin, more or less flat rosettes, usually grayish yellow or greenish yellow (more strongly yellow in herbarium); hypothallus thin or absent; medulla and lower hypothecium of more or less randomly oriented hyphae; cortex Pd+ yellow; thallus without LPN1 and 2. Thallus usually with pustules or soredialike granules, grayish yellow to slightly brownish (often much paler at margin); Baja California (Norte) to southern California L. XANTHOSORA Ryan & Poelt

Thallus small to medium sized (to 3 cm diam.); lobes very small and narrow (to 23 mm long and 0.5 mm wide), thin (to 0.5 mm); cortex to 50 μ m thick, only moderately uneven; medulla C+, UV+ (xanthonenes); apothecia small (to 1 mm), discs epruinose. Thallus contiguous, rosulate, to 23 cm diam., areolate verrucose in center, with distinctly elongated and radiating marginal lobes; cortex of thallus and apothecia well delimited; Eastern Canada, and Alaska. Rare, possibly extinct. L.
MICROBOLA

1. Thallus distinctly lobate. Apothecia (in N. American species) adnate to sessile even when young. Cortex well developed, without dead algal cells. Chemistry and other characters various. 2

2. Lobes usually \pm elongated and often \pm swollen and sinuous-plicate; margins not raised or thickened; pruina, if present, on upper surface, not primarily on margins. Upper cortex without distinct conical bundles of hyphae. Leucotylin absent. L. garovaglii group. (Note: "L. chiricahuae Ryan & Nash ined.", a rare taxon from SE Arizona, with elongated but flattened lobes, containing zeorin, will also key out here). 3

2. Lobes mostly shorter, not swollen or sinuous-plicate; margins often raised or thickened; pruina, if present, often primarily on the margins. Upper cortex usually with distinct conical bundles of hyphae (giving a jagged appearance to the algal layer, visible in section even under a hand lens). Leucotylin usually present. L. muralis group ("L. muralis sensu [very] lato")

3. Upper surface of thallus greenish yellow (often tinged with olive or gray), often palespotted near lobe tips; lobes usually strongly inflated and sinuous-plicate. Medulla with triterpenes,

usually P, but rarely P+. Western North America, Eurasia, and South America. L. GAROVAGLII S. L. 3. Upper surface of thallus yellow to bluegreen or various shades of brown, often shiny, not palespotted; lobes mostly only weakly inflated and sinuouspllicate. Medulla without triterpenes, often Pd+ orange or yellow (pannarin or psoromic acid). Western North America. 4

4. Thallus surface yellow to bluegreen, shiny; cortex with usnic acid; medulla with rangiformic acid; mostly at high elevations in the Sierra Nevada mountains of California. L. SIERRAE

4. Thallus surface various shades of brown (usually orangish or reddish, but yellowish in shade), shiny or matt; cortex without usnic acid; medulla with fatty acids of the protolichesterinic group; mostly at low to moderate elevations, especially in the Columbia Plateau of the Pacific Northwest. L. PSEUDOMELLEAE

1. Cortex strongly differentiated from medulla, evenly to unevenly thickened, usually with few or no dead algal cells; hyphae densely packed, with large (ca. 3 um diam.), rounded lumina. Medulla with fatty acids, plus or minus psoromic acid; without triterpenes. Thallus rosulate to areolatesquamulose, the lobes often short and flat, frequently with thickened edges; medulla with fatty acids of murolic group and often psoromic acid; excipular cell lumina (tangential section) often large (35 um) and rounded. Lowland to montane, hot deserts to semidesert scrub. Lecanora sect. Petrasterion subsect. Deserticola. 2

1. Cortex more or less weakly differentiated from medulla, evenly thickened and usually with numerous dead algal cells; hyphae usually loosely packed, with narrow (12 um) lumina; cortex with usnic, placodiolic, or isousnic acids, or no substances; medulla with or without fatty acids or psoromic acid; often with triterpenes. Thallus areolate to squamulose, rosulate or lobate. Lecanora sect. Petrasterion subsect. Pseudocorticatae.

2. Upper surface usually yellowish to slightly orangish or brownish, either with at most a thin line of pruina inside the often blackened margin of the lobes, or densely pruinose throughout. Thallus areolatesquamulose, scattered or rosetteforming, at most rather shortly and weakly lobed at margin; lobes \pm concave to plane, with \pm thickened, usually strongly blackened and often granular margins. Primarily in the

Chihuahuan Desert or at higher elevations in the Sonoran Desert or southward; absent from coastal areas. Thallus surface epruinose or with thin line of pruina next to margin; scattered to rosetteforming, with marginal lobes often poorly developed, often with black, sometimes granular, margins. Areoles relatively large and thick, often contiguous and rosetteforming, and often ± distinctly lobed, usually with thick, granular black margins. SW Colorado south to Texas, New Mexico and Arizona, Chihuahua and Sonora. L. "nashii" Ryan ined.

2. Upper surface usually with greenish or grayish overall color (when fresh), with ± dense but spotty pruina scattered on the surface, or if yellowish and epruinose then growing on the seashore in Baja California. Thallus areolate incenter, usually with distinct, short to long but usually distinctly radiating, marginal lobes; lobes or areoles often partly somewhat convex; margins plane to thickened and raised, sometimes weakly blackened especially towards lobe tips, but never strongly blackened and granular. Primarily in the Sonoran Desert or at ± low elevations southward. 4

4. Thallus surface grayish or greenish tinged when fresh, ± densely but spottily pruinose; marginal lobes usually distinct, often ± elongated, often with raised margins. A very problematic taxon, probably needing to be further divided. Typically with coarse, elongated lobes, but extremely variable, with some forms approaching all of the other species in the section. Arizona to southern California, south to Baja California and central Mexico. L. bipruinosa ± s. str.

4. Thallus surface often pale yellowish green when fresh, epruinose; marginal lobes short and indistinct, without raised margins. Baja California. L. "bajacalifornicae" Ryan & Nash ined.

1. Thallus areolatesquamulose, usually scattered on other lichens; areoles small, thin, often blackedged; apothecial margins often thick and black. Common but inconspicuous, mainly in the Sierras and Cascades, with a few outliers in the central to northern Rockies that may not belong here. L. semitensis group

1. Thallus areolatesquamulose to rosulate to lobulate; areoles usually larger, thicker, blackedged or not; apothecial margins usually thin and pale (except in L. nigromarginata). Common and conspicuous, mainly in the Rockies, with outliers in alpine areas of the Sierras and Cascades. L. novomexicana/L. weberi group. 2

2. Thallus areolatesquamulose to rosulate or lobate, usually greenish yellow except in shade; cortex more or less thick (3070 m). Medulla often with psoromic and/or lecanoric acids; cold desert to montane or alpine; widely distributed in mountains of western North America L. NOVOMEXICANA

MAGNUSSON (COMPLEX, including L. nigromarginata Magn., with short, broad, flat to concave lobes and strongly thickened, raised, black and granular margins, known with certainty only from central Cascades of Washington)

2. Thallus more or less squamulose lobate, composed of densely imbricate, flat to more or less concave squamules, more or less grayish tinged; cortex very thin (1015 m). Medulla with fatty acids only, or also with psoromic acid. Montane; widely distributed, eastern and

western. L.

WEBERI RYAN s. lato (including some undescribed taxa of uncertain status)

4. Thallus when fresh distinctly yellowish, orangish, reddish, or brownish, or grayish green, without usnic acid, usually with isousnic acid or no acetone-soluble pigments, sometimes with placodiolic acid, usually with fatty acids, sometimes with phenolic medullary substances, never with terpenoids or psoromic or lecanoric acids. Thallus forming rosettes, with distinct, elongated marginal lobes. Endemic to California west of the Sierras (except for populations in the Tehachapi mountains). L. mellea group

4. Thallus when fresh usually pale to moderate greenish yellow, sometimes yellowish or orangish towards the lobe tips, with usnic or placodiolic acid, usually without isousnic acid, often with fatty acids, sometimes with phenolic medullary substances (including psoromic or lecanoric acids), sometimes with terpenoids. Widespread, always east of the Sierras or outside of California (if growing in California west of the Sierras, and thallus areolatesquamulose, see the L. semitensis complex). 5

5. Thallus scattered and areolatesquamulose to subfruticose, or forming large, often thick and convex, ± loosely attached mounds or rosettes, often with somewhat broad and short marginal lobes; surface often shiny waxy, always epruinose, often turning orangish towards lobe tips. Eastern N. America, Arctic, or mostly ± sheltered, shaded or moist sites in the mountains of the West. L. crustacea complex

5. Thallus contiguous, forming forming ± flat and closely appressed rosettes, with ± narrow and elongated marginal lobes,

or sometimes small (under 1 cm across) mounds; surface matt,
often \pm pruinose, never turning orangish towards lobe tips. On
exposed surfaces in arid areas of the temperate intermontane
West, from SW Canada to SW United States. L.
phaedrophthalma complex

Sorediate, Isidiate, or Papillate

1. **Medulla I+ blue, K+ red. Thallus with discrete soralia.**
Alpine. (Bellemeria subsorediza)

1. **Medulla I.** 2

2. **Medulla K+ red. Thallus grayish.** 3

2. **Medulla K+ yellow or K.** 7

3. **Thallus papillate tuberculate, without isidia or soralia (or with simple to branched isidia? according to Ozenda & Clauzade, or with soredia? according to Wetmore).** Thallus ± effigurate at margin, rather thick, somewhat tartareous, uneven, rimose areolate, with wart papillose or branched granular areoles, dark or grayish ashy olive. In f. pseudoradiata, the thallus is regularly orbicular, 12 cm wide, radiating and appearing lobed, somewhat violet grayish. (If thallus effuse, see A. cinerea). Usually at higher elevations. Arctic (Greenland); S. Dakota and Wyoming; very common in California; Washington?; probably elsewhere. Aspicilia mastrucata

3. **Thallus not papillate tuberculate, but isidiate, sorediate, or both.** 4

4. **Isidiate; with or without soredia.** 5

4. **Not isidiate; with soredia.** [Wetmore's "A. mastrucata" will also key out here, but I don't have enough information on it to put it into the key]. 6

5. **Isidia scattered, short, ± dark gray, eventually becoming sorediose at the tips; soredia whitish or yellowwhite. Thallus ± dark gray.** Thallus 0.30.5 mm thick, rimose areolate or irregularly areolate, covering ± large areas; areoles partly smooth, uneven, partly very minutely verruculose (x 20 lens). Upper cortex (15)2535(50) µm thick, the surface hardly darker; epinecral layer sometimes present; cells 35(6) µm diam. Algae 818 µm diam.; algal layer 5070 µm thick, frequently interrupted or broken up. Medulla airfilled. Pycnospores straight, 710 x 1 µm. Thallus K+ rusty crystals (norstictic acid). On somewhat moist rocks. Aspicilia simoensis v. isidiata (typical strain)

5. **Isidia developing on edges of areoles, few to abundant, minute and papillate or larger, flattened coralloid, constricted variously along their length, becoming bent over, ± hollow or opening along one side, white gray to medium gray or often blackening; not becoming sorediose. Thallus ± pale gray.**

Thallus rimose areolate; areoles plane or occasionally somewhat

convex, contiguous, usually with upper surface minutely cracked to give a scurfy appearance. Hypothallus absent or visible only at the margin, narrow, shiny, black. Thallus K⁺ yellow, sometimes turning red with rusty crystals; P⁺ yellow to \pm orange. On sandstone and conglomerate, especially in the supralittoral zone, sometimes inland. British Columbia. Aspicilia leproscenscens sensu Noble

6. Soralia developing from breakup of verrucae, poorly delimited and becoming confluent, yellowish to whitish. Thallus rimoseareolate to rimosegranulate or verrucose, grey to greengray, thick. Verrucae immediately breaking up into soredia, covering the whole surface of the verruca and often forming large areas of confluent, soredia, giving the thallus a variegated color. Alpine or subalpine. California. Aspicilia simoensis v. simoensis

6. Soralia discrete, depressed (very low), not confluent, bluish white to greenish white. Thallus areolate to slightly verrucose. Soralia 0.51 mm diam. Thallus broadly expanded, to 1020 or more cm across, dark gray with a bluish shade; areoles 0.51 mm across, 0.30.4 mm thick, irregular, slightly convex to uneven, separated by broad or narrow cracks and perpetually dividing into smaller prats; surface smooth, matt, for the most part sorediose; soralia round, subcrateriform, limited, efflorescent, often not occupying the whole surface of the areoles, not confluent. Hypothallus pale, indistinct. Cortex 2035(50) μ m thick, hardly darker at the surface, Medulla granular, the granules dissolving in K but not in HCl. Pycnospores 710 μ m long, straight. Aspicilia bahusiensis

7. Thallus K⁺ yellow (often rather indistinct without pretreatment with HCl, due to poor development of cortex; presumably containing stictic acid, but the reaction may at least partly be due to release of algal pigments instead).

..... 8

7. Thallus K, without stictic acid.

..... 11

8. Thallus \pm orbicular, ochraceous. 9

8. Thallus effuse, \pm dark gray. 10

9. Thallus distinctly radiate, very indistinctly sorediate.

Thallus thin, ochraceousgray, with scattered, verrucae; lobes undulating, extending even far towards the center. Cortex 15(20) μ m thick; cortical cells 23 μ m thick. Algae 68 μ m diam. Cortex K⁺ yellow, stronger after pretreatment in HCl. Pycnospores 2025 μ m. On siliceous rock. Arctic.

Aspicilia mashinginensis (typical strain)

9. Thallus radiating only along a very narrow (to 1.5 mm broad) marginal zone; soralia very distinct. Thallus to 2 cm diam., sometimes confluent, areolate; central areoles 0.25-0.35 mm diam., plane, abruptly limited, \pm discrete, becoming sorediate; marginal lobes thin, subplane, contiguous, not apiculate, indistinctly terminate. Soralia often darkened, with a stellate appearance (probably due to parasitic Torula). Thallus (hypothallus?) between the areoles concolorous with them. Medulla strongly granular, the granules soluble in HCl. Cortex better developed on lobes than on areoles, the outer part dark yellowgray; hyphae 56 μ m thick, leptodermatous, constrictedly septate. Cortex rather weakly K⁺ yellow, but K⁺ intense golden yellow after pretreatment with HCl. On dry siliceous rock. Borealarctic (Greenland; NW Territories).Aspicilia sorediza

10. Thallus with isidia, becoming sorediose. [If soredia lacking, see A. leproscenscens sensu Noble]. K⁺ yellow strain of Aspicilia simoensis v. isidiata ("f. inferior")

10. Thallus without isidia, verrucosepapillate, broadly expanded, thick, scarcely rimose, dark grayblack to brownblack, limited by black, radiate hypothallus; verrucae subdiscrete to contiguous, epruinose. Pycnidia rare; pycnospores 15-23 μ m long. On siliceous rock. Arctic (Greenland, and elsewhere). Other nonisidiate, nonsorediate, K⁺ yellow species will probably also key out here. The report by Ryan & Nash, 1990, of a stictic acid strain of A. mastrucata from California, may be based on A. mastoidea instead. Both taxa are very similar; aside from the chemical difference, A. mastrucata has a more olivaceous and somewhat effigurate thallus.
Aspicilia mastoidea

11. Thallus C⁺ red. (see "Mosigia gibosa")

11. Thallus C. 11

12. Thallus \pm effuse (sometimes delimited, but not at all radiate), \pm papillate or isidiate, becoming sorediate. 13

12. Thallus \pm orbicular, weakly to strongly radiate, not papillate or isidiate; distinctly to indistinctly sorediate. 14

13. Thallus (at least towards center) of easily detached flattenedglebulose (subsquamulose) to \pm papillate granules, at times later becoming \pm granularsorediate, pale to dark bluish gray, rimoseareolate, smooth to scurfy or scabridtartareous; prothallus sometimes evident, conspicuous, dark greengray,

delimiting. Thallus P, K, containing aspicilin. Pycnidia unknown. Usually on nutrientenriched siliceous rocks on or near the seashore. The report of this species from N. America (British Columbia) is based on K+ yellow to red, isidiate material that is probably a separate taxon.Aspicilia leproscens s. str.

13. Thallus partly with narrow, verruciform isidia soon dissolving into grayish white soredia. Areoles ± verruciform, dark bluish gray, with irregularly scattered, 0.51.5 mm across, low heaps of densely clustered isidia. Pycnidia numerous, at least partly composite, up to 250 µm broad; pycnosporos 78 µm long. On siliceous rocks. "Probably an accidental form, found only once" [in Norway] according to Magnusson; not definitely known from N. America.Aspicilia caesiocinerea v. isidiata

14. Thallus pale ochraceous, ± orbicular but not distinctly radiate; soralia distinct. Cortical cells 56 µm thick. (see Aspicilia sorediza)

14. Thallus dark gray, distinctly radiate; soralia ± indistinct. Cortical cells 23 µm thick. Thallus soft, orbicular, 1.5 cm diam., towards center effuse, areolate, towards margin narrowly radiate; areoles 0.350.55 mm wide, separated by deep and somewhat wide cracks, subcolumnar, rounded to subangular, distinctly and densely sorediate. Marginal strings of areoles branched, often ± discrete, convex, narrow, 0.150.3 mm wide, apiculate, often longitudinally striate and here and there nodulose, under 0.15 mm thick. Surface deep gray or (when cortex destroyed) partly graywhite. Cortex variable, to 25 µm thick, the outer part dark gray; hyphae strongly leptodermatous, 5 µm thick, constriated septate. Medulla somewhat granular, the granules dissolving in HCl. Algae bright orange in K after HCl; cortex unchanged. Pycnidia unknown. On basalt, Greenland. [If not pretreated with HCl, the typical strain will also key out here; it differs in having a larger, ochraceousgray thallus, with the lobes undulating and extending even far towards the center, and the verrucae only indistinctly sorediate].Aspicilia mashinginensis K strain ("A. bennettii")

V. Thallus effuse.

VA1. On calcareous (HCl+) rock.

Thallus effuse, K+ red (at least after pretreatment in HCl)

1. Thallus radiate, ashy brown. Medulla K+

red.(see A. fimbriata in Key IVA)

1. Thallus not radiate, white or various shades of gray, but not brownish. 2

2. Thallus continuous to rimose. Pycnospores 4.57 um. Thallus extensive, white, farinose, 0.52.5 mm thick, well delimited, the margins fringed to lobulate. Pycnospores immersed, punctiform, simple. Cortex 2050 um, scarcely cellular, opaque from pruina; algal layer continuous, 4080 um, extended under the apothecia.

Thallus K+ red, with norstictic and connorstictic acid. On calcareous rocks, in fissures or northfacing surfaces. [Need to check Esnault again; some parts of this description are based on someone else's quite different concept.] [Note: an apparently rare strain of A. calcarea will also key out here; it has a continuous to rimoseareolate white thallus]. A. farinosa sensu Esnault v. reagens

2. Thallus areolateverrucose. 3

3. Thallus chalkwhite to bluegray, rarely yellowgray, continous, areolateverrucose, with a dark gray prothallus. Medulla K; cortex K+ red. Frequent, Alberta, Ontario, Yukon. "A. [cinerea] sp. 2" sensu Brodo

3. Thallus pale to dark yellowish to greenish or bluish gray, continuous to discontinuous, on a blackish hypothallus; areolateverrucose, areoles 0.61 mm, having sloping sides, like volcanos; Medulla densely granular. Thallus K+ red only after pretreatment in HCl. Frequent, western. A. gibbosa

VA2. On noncalcareous (HCl) rock.

Thallus effuse, K+ red (without pretreatment with HCl)

2. Thallus dark, mostly brownish gray to oliveblack. 3

2. Thallus ± pale, mostly whitish to pale grayish or tinged with other colors. 5

3. Thallus orbicular, delimited, ± distinctly radiate. 4

3. Thallus effuse, indeterminate, uniform almost to the margin. Thallus broadly expanded, dark to brownish gray, rimoseareolate, 0.20.3(0.4) mm thick; areoles ca. 0.5 mm broad (though dividing through new cracks), angular with perpendicular edges, plane; hypothallus not distinct. Cortex and medulla ± opaque. Cortex (15)2530 um, the exterior 45 um brownish olive; epinecral layer 812 um. Algae 612 um; algal layer 3570 um, with rather even surface. Apothecia often absent. Pycnospores 1520 um. On siliceous rock. Alpine, Washington. A. nordlandica

4. Thallus papillatetuberculate; apothecia usually absent. Alpine. Common, California to Washington; S. Dakota; Greenland. (A. mastrucata)

4. Thallus not papillatetuberculate; apothecia often present at least in many of the species. [If thallus ± dark bluish gray, see A. caesiocinerea an apparently rare strain; most authors consider that species to be always K]. (see A. fimbriata and A. subradians s. lato, in Key IVA)

5. Thallus rimoseareolate. 6

5. Thallus verrucose or verrucoseareolate, or if rimoseareolate then spores (sometimes poorly developed) under 15 um wide. 7

6. Spermatia 2432 um long, straight, acicular. Thallus rimoseareolate, thick, whitish to light gray; areoles angular, plane or slightly concave, smoothish. On granite, southern California. A. cinerea sensu Hasse non (L.) Koerber

6. Spermatia 69(12) um long. Thallus continuous, rimoseareolate, well delimited, light grayish yellow brown, pale gray to almost white; areoles plane or convex, smooth or granulose, 0.41.2 mm diam. Cortex variable, 2060 um thick, ± cellular; algal layer regular or (in more verrucose thalli) irregular. Pycnidia immersed or projecting, with elongated

ostiole. Thallus K+ red, with norstictic and connorstictic acid. Very polymorphous. On siliceous rock. Rare, Black Hills. A. intermutans

7. Thallus rimoseareolate, the areoles contiguous (but separated by deep, sometimes wide, cracks). 8

7. Thallus verrucose or verrucoseareolate, the verrucae contiguous or dispersed. 10

8. Edges of areoles often becoming papillate to flattenedcoralloid isidiate. Surface of areoles minutely cracked, giving a scurfy appearance. Usually fertile. On sandstone. British Columbia. (A. leproscens sensu Noble)

8. Thallus without papillae or isidia. 9

9. Thallus dull gray to graybrown, whitish gray, yellowish gray, yellowish white, grayish yellow or olive gray, at times rustcolored or greenish, smooth or rough, forming continuous patches 12 cm or more across, rimoseareolate to areolate, or + verrucoseareolate to papillate in nutrientrich environments; areoles plane to convex, angular, 12 mm wide, separated by deep gaping cracks, superficially graypruinose or frosted; prothallus, if visible, sometimes dark gray, delimiting. Cortex and medulla K+ red, P+ orange, C, with norstictic acid. Pycnospores 1116(25?) x 1 um. On exposed siliceous rocks. Common from Nova Scotia to BC in boreal (or arctic) regions; California (Herre's rather skimpy description of material from the Santa Cruz Peninsula, fits here); probably elsewhere in the west. A. cinerea + s. str.

9. Thallus deeply cracked, ashy white, rimoseareolate. Hypothallus indistinct. Thallus broadly expanded, ashy white, moderately thick; areoles flattish to convex, 0.61 mm across, 0.51.2 mm thick, irregular in shape, generally roundedangular, the perpendicular sides separated by ± broad (0.10.5 mm), deep cracks; surface smooth, matt. [Fertile?] verrucae often 0.91.1 mm high, ca. 1 mm broad at surface, ± podicellate, with about 0.3 mm thick margin; "foot" 0.7 mm thick. Cortex 4050 um, dark gray. Algae 1015 um diam.; algal layer 50100 um, dense, continuous. Medulla dense, but with airfilled spaces. Apothecia sparse. Cortex K+ red. Medulla also K+ red? On granitic rock, Maine. A. monticola (Degel.) ined.

10. Thallus discontinuous, on a conspicuous black prothallus.

Thallus verrucoseareolate, chalky white to bluegray or rarely yellowgray, A. cf.

leciodeoides

10. Thallus ± continuous (or often dispersed in A. sipeana, but then without visible hypothallus). 11

11. Areoles or verrucae 12 mm wide, graywhite or often tinged yellowish, greenish, brownish, or rusty. Pycnospores 1116(25?) x 1 um. (forms of A. cinerea ± s. str. from nutrientenriched sites)

11. Verrucae (at least the sterile ones) 0.40.7(1) mm diam., ashy white (medium gray with slightly scabridpruinose appearance, according to Noble). Pycnospores ("not free", possibly immature) 57 um long. Thallus effuse, probably extensive, verrucose; sterile verrucae 0.30.4 mm thick, irregular in shape, usually separated, rarely 23 contiguous. Fertile verrucae ± scattered, at length ± prominent and 0.59.8mm high with narrower, partly footlike base. Hypothallus apparently absent. Cortex (25)3045 um thick, the lower portion partly granular, the outer 1215(20) um transparent with distinct 34.5 um diam cells. Algae 712 um diam.; algal layer 50100 um. Medulla ± transparent or with patches of air and granules. On siliceous rocks, apparently in moist sites, Oregon; on noncalcareous sandstone, rare, British Columbia ("cf.", but Noble's description differs only in minor ways). A. sipeana (Magn.) ined.

Thallus areolate; areoles completely crackedseparate, contiguous, distinct, angular, straightedged, moderately thick, ± flat, smooth, almost shiny, brownish gray to white, whiter around apothecia and slightly whiter around edge of some areoles. Hypothallus absent. Medulla K+ red. On noncalcareous sandstone, rare. British Columbia. A. cinerea sensu Noble

Medulla and cortex both K+ red. Thallus medium gray. Thallus rough, continuous, verrucose. Rare, northwestern Canada.A. [cinerea] sp. 1 sensu Brodo

Medulla K? (check Brodo's manuscript again); cortex K+ red. Thallus areolateverrucose. Hypothallus dark gray. Thallus continuous, chalky white to bluegray or rarely yellowgray. Pycnospores 1625 um long (?need to check Brodo's key again). Frequent, Alberta, Ontario, Yukon. "A. [cinerea] sp. 2" sensu Brodo

VA3. On rock.

Thallus effuse, containing norstictic or salazinic acid,
but K⁺ red only after pretreatment in HCl.

1. **Thallus effuse, ± yellowish or bluegray**, pale to dark yellowish to greenish or bluish gray, continuous to discontinuous, on a blackish hypothallus; areolateverrucose, areoles 0.61 mm, having sloping sides, like volcanos. Medulla densely granular. Thallus K⁺ only after pretreatment in HCl. Frequent, western. This name has been almost indiscriminately applied to almost any grayish, ± verrucose, effuse, apparently K Aspicilia on siliceous rocks, and I do not understand it at present except by its cryptic K⁺ red reaction.A. gibbosa

1. **Thallus orbicular, olive black, blackish gray or black, or sometimes mingled with whitish gray**; lobes ± indistinct. Hypothallus ± distinct or not, black. Pycnospores 1425 um long. Thallus shiny to matt; central part verrucoseareolate or areolate; areoles convex or flat, 0.51 mm diam., 0.40.6 mm thick, very irregular in shape, towards the center with deep cracks, the sides perpendicular; marginal part not radiate or only indistinctly so; lobes 12 mm long, 0.30.4 mm broad, widened towards the margin. Cortex 2530(40) um thick, transparent, the upper part dark. Thallus containing salazinic acid and/or norstictic acid; medulla K⁺ yellow; small parts of thicker thalli K⁺ yellow with few to numerous rusty crystals, at least after pretreatment with HCl. On granitic rocks. Alaska and NW Territories. A. subadians s. lato