

KEY 9

**With neither Isidia nor Soredia,
Saxicolous**

1. Thallus entirely papillate, pinkishgray. On coastal rocks. Lecania aipopsila

1. Thallus pulvinate, C+ red, not radiating, various shades of brown, often (?) gray or bluegray pruinose, often blackened by fungal parasite, developed from stems which branch from rootlike, finally flattened stipes, black below; forming small irregular clumps 815(25) mm or more across, to 1015 mm tall when well developed, with domelike or irregularly rounded surface, or \pm flattened; on closer examination the surface is seen to be made up of a great number of small to minute, closely appressed, and highly irregular, plicate, or even imbricate, lobulate squamules. Thallus continuous, probably determinate, sublobate to subareolate, at the margin thin, 0.5 mm, thicker toward center; areoles (0.5)11.5 mm broad, 0.40.6 mm thick not including the stipe, very irregular in shape and size, with rounded edges, often with a \pm deep partly furrowlike cut into the areole, therefore sublobate or intestiniform, on the whole plane, smooth. Upper cortex (30)5065(80) μ m thick; cells 1.72(2.5) μ m. Algal layer continuous, 100(150) μ m thick. Pycnospores 22.5 x 11.5 μ m, broadly ellipsoid. California. (*A. thermophila*, which is pale and color and composed of short, branched stipes would also key out here, if it is C+ red)

Acarospora thamnina

1. Thallus not pulvinate. Squamules scattered to contiguous, not stipitate, lobulate or imbricate. 2

2. Thallus K+ red. Spores not developed. Thallus 310 mm wide; areoles 11.5 mm wide, plane, irregular, black below, C. Apothecia \pm abundant, 316 per areole, 0.2 mm diameter. Cortex 2530 μ m, the cells 34 μ m diameter.

Mexico. *Acarospora cratericola*

2. Thallus K. 3

3. Cortex C+ red. Parasitic on other lichens. Areoles plane, dark below, dark brown above, thin, partly dispersed, 0.50.8 mm across, 0.30.4 mm thick, variable in shape, mostly angular, plane, distinctly and rather narrowly peltate. Cortex thin, 1522 μ m; cells 23 μ m. On lichens (*Dimelaena*) on siliceous rock. New Mexico. *Acarospora succedens*

3. Thallus C. Cortical cells 34.5 μ m. Thallus delimited, the areoles plane, castaneous brown. Thallus forming continuous, \pm distinctly limited areas to at least 4 cm broad, or groups only a few mm wide, or areoles \pm scattered among and upon other lichens, 0.50.7 mm across, 0.30.5 mm thick, dark (or in shade very pale), in open situations \pm shiny, smooth, plane, angular, separated by very thin cracks, closely adnate, nongomphate, pale below. On sandstone, New Mexico. *Acarospora applanata*

1. Thallus C (but apothecia in section and pycnidia C+ red, with gyrophoric acid), beige (pale fawn), yellowgray, pale yellowish or ochre, granularverrucose, sometimes secondarily cracked, Pycnidia ca. 5080 um diam., often numerous, immersed in thalline warts; conidia 56 x 0.7 um, bacilliform. On sheltered, ± metalrich, siliceous rocks, especially basalts and pebbles in moorlands. Trapelia mooreana

1. Thallus usually C+ red (gyrophoric acid).2

4. Thallus areolate, effigurate or subsquamulose, marginally crenate to lobed, often lumpysquamulose, smooth or minutely rugose, mostly beige, gray or brownish whitish; areoles ± convex, often ± overlapping; marginal squamules 0.20.4 mm wide and 0.040.15(0.12) mm thick, contorted, sometimes in irregular, knotted clusters. On siliceous rocks. Trapelia involuta

4. Thallus effuse and continuous to cracked or areolate, never distinctly effigurate at edge; areoles mostly contiguous but sometimes dispersed and ± squamulose at margins, smooth to ± rugose, thin, not marginally crenate to lobed, whitish to gray, greenwhite or brownish often tinged pinkish, K, P; prothallus ± present, white. On siliceous rocks and stones, brickwork, occasionally on consolidated caly soil. Very variable; distinguished by the even, smooth to areolate, noneffiugrate thallus. Immature apothecia may appear as scattered, starkly white, punctiform dots.
Trapelia coarctata

2. Thallus cortex or medulla K+ yellow, P+ orange (stictic acid) and either C+ red (gyrophoric acid) or C; cephalodia usually with Stigonema.Amygdalaria subdissentiens

2. Thallus cortex and sometimes medulla K, P, C+ red (gyrophoric acid), or C and KC+ pinkorange (confluent acid).
.....3

3. Thallus bullate areolate, eroding into granular soredia at least in part; cephalodia large, hemispherical, pink, containing Gloeocapsa; medulla C+ red, or rarely C.Amygdalaria panaeola

3. Thallus esorediate, usually with flat areoles, becoming rimoseareolate, but sometimes with rounded areoles; cephalodia brown, disklike to rounded, containing Stigonema; medulla C+ red.
.....Amygdalaria pelobotryon

2. Thallus verrucose, pustulate; pustules often forming erect plates or columns by the disintegration of the pustule summits, leaving the vertical portions of the walls intact, but sometimes breaking down into coarse granular soredia. With elatinic acid as a rare accessory. Primarily in the eastern United States.

Substrate? Loxospora pustulata

Thallus ± endolithic, on pure limestone or dolomite. Thallus inconspicuous, when partly superficial appearing as a pale orange stain, greenish gray in herbarium, sometimes scurfy, effuse, not delimited. Moist areas, high

elevation. Sagiolechia protuberans

2. Lobes very distinct, elongated, very narrow (mostly to ca. 0.5 mm or less), graybrown; soredia or isidioid granules often present. Thallus with pseudoparenchymatous true cortex. (Hyperphyscia)

2. Lobes indistinct or short; thallus radiateplicate at margin, rimose to areolate in center, greenish yellow, white, or graybrown, without soredia or granules. Usually fertile. Dimelaena

Thallus lobed at margin. Cortical cells very small (1 um), indistinct. Medulla opaque. Upper surface of areoles pale yellow. Lobes 1.0 mm long. Thallus 0.51 cm across. Cortex 3550 um. Lobes contiguous, 1 mm long, 0.50.75 mm wide, plane or slightly convex, matt, smooth, ca. 0.2 mm thick; central areoles contiguous, anuglar, separated by thin cracks, 0.30.4 mm thick, the fertile ones ± slightly verrucose, broadly attached; lower surface pale. Medulla opaque. On granitic rock, Texas. Acarospora texana
Thallus areolatesquamulose, not lobed. 2

2. Cortical cell lumina 34 um diam. Thallus areolate, apparently indeterminate (margin not observed); areoles squamulelike, usually distinctly peltate, contiguous to imbricate, confluent, 13 mm broad, 0.71.5 mm thick, on the whole plane or slightly convex though very uneven and ± verruculose from numerous pycnidia; upper surface somewhat dark greenish yellow, matt; margins often free, especially in the ± panniform areoles; lower surface pale. Upper cortex very uneven in thickness (varying from specimen to specimen). Upper cortex 70100 um thick. Hymenium (110)120135 um. Medulla filled with granules. Pycnospores narrowly ellipsoid, 22.5 x 0.81 um. Upper surface epruinose. On granitic or volcanic rocks. California, Colorado. Acarospora evoluta

2. Not as above. Upper surface of thallus epruinose. 3

3. Areoles peltate, often large, thick or thin. (if thallus pruinose, see A. chrysops). Areoles dispersed, very large, 12(3) mm wide, 0.40.5 mm thick (to 0.7 mm thick at center), very irregular in shape, the fre margin thinner, ± depressed toward the rock; attached by a usually rootlike umbilicus 0.20.3 mm long. Upper side epruinose, with simple or crossing cracks which often do not reach the edge, parly with dense punctiform impressions in connection with the cracks, probably indicating pycnidia or apothecial initials. Thallus K, C, P. Cortex 5070 um; cells ca. 3 um diam. On hard, probably siliceous, rock. Arizona. Acarospora radicata

3. Areoles not peltate, small, mostly thin., dispersed to contiguous, not imbricate. (If thallus pruinose, see A. rimulosa, A. albida and A. subalbida). Areoles contiguous. Upper surface dark greenish yellow, uniformly colored. Areoles 0.40.7(1) mm across, 0.30.6 mm thick, plane or subconcave, broadly attached. Cortex 3550 um thick, with distinct epinecral layer; cells 2.53 um. Upper surface epruinose. Similar to A. chrysops but areoles contiguous, small, thin. Pycnospores ellipsoid, 2 x 0.6 um. On

volcanic rock. Mexico. (including v. invadens Magn., from
Kansas, Texas and Mexico, with areoles thick, intense citrine
yellow, contiguous or often subdispersed, invading other lichens,
surface smooth, subconvex. Acarospora subcontigua

2. Thallus effuse, indeterminate, without any trace of marginal effiguration, thin (up to 0.2 mm thick); areoles contiguous or dispersed; Placopsis effusa

2. Thallus effigurate, lobate, determinate. Soredia often present, scattered over the center and granulose; soralia rounded or radially elongate, eroded or plane, often irregularly confluent. Thallus forming rosettes which become confluent into large patches to 8 cm diam.; marginal lobes closely to \pm loosely attached, contiguous, separated by cracks to 0.1 mm wide, to 2.5 mm long (or extending to center of thallus), 1.6 mm broad; apices uneven, rounded or crenulate, sometimes with a narrow, olivebrownish peripheral zone; thallus center becoming areolate; areoles irregularly angular, 0.62 mm across, \pm swollen or plane; surface cream or ivory colored or glaucous, often olivebrownish tinged, smooth, matt, not pruinose; cephalodia single in center of small thalli, scattered in older thalli, discrete, 13(8) mm diam., orbicular, radiately folded and cracked, yellow brown or reddish brown, matt. Cortex Kor K+ yellowish, C+ rose; medulla K, C+ red, KC+ red, P+ red or P. Thallus containing gyrophoric acid. Pycnidia immersed in slight swellings, ostioles brownblack, 0.1 mm diam; pycnosporos filiform, straight or curved, 1527 x 0.5 mm. Rather variable. On rocks (siliceous), occasionally on mosses or sandy soil, arctic to temperate, south to the White Mountains in the east and to California in the west; very common, at least in montane areas on the west side of the Cascades. Placopsis gelida

Thallus with cephalodia. Thallus with pink to brown tones (reddish brown, light orange, grayish reddish orange or yellowish pink to dark reddish gray), rimoseareolate, continuous, sometimes smooth at edges; prothallus absent or black and conspicuous. Cephalodia cushion or diskshaped, greenish brown when wet and black or dark brown when dry, containing Stigonema. Medulla K+ yellow, P+ orange, C, I, containing stictic acid and almost always menegazzic acid in varying concentrations. On siliceous rocks, close to shore on bluffs, and in alpine zone, British Columbia; Alaska. Rhizocarpon hensseniae

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. Pycnosporos short, straight, baciliform, 46 x ca. 1 um. On exposed boulders. Buellia stigmaea

Pertusaria flavicans

Candelariella rosulans

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

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

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

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.

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 pale spotted, 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 plicatelloate and rugose towards tips. Growing firmly attached to noncalcareous rock, in alpine (to high montane) habitats. Lecanora cavicola Crevel'd (with soredia; not yet reported from N. America but known from a tiny fragment mixed with "Lecidea brandegei" from Colorado) also keys out here. I have not yet decided if "Lecidea brandegei" (which occurs in the Rockies and tends to be \pm 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

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 xanthonenes; 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 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, xanthonenes, or occasionally no acetonesoluble substances; medulla various, often thin or loose. Lecanora subg. Placodium. 12

12. Cortex C+ orange, UV+ orange, with xanthonenes, with or without usnic acid or related substances (placodiolic, pseudoplacodiolic, or isousnic acids); cortex not interspersed 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 xanthonenes; cortex with or without oxalate granules; mostly in inland areas and only moderately nitrophilous if at all. 14

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 interspersed).

. . . Lecanora sect. Petrasterion s. l.: L. mellea

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: L. pseudomellea

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+ (xanthones); 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 yellow to bluegreen or various shades of brown, often shiny, not palespotted; lobes mostly only weakly inflated and sinuous plicate. Medulla without triterpenes, often Pd+ orange or yellow (pannarin or psoromic acid). Western North America. 4

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.

PSEUDOMELLEA

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 μ m 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 semidesertscrub. 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 \pm distinctly lobed, usually with thick, granular black margins. SW Colorado south to Texas, New Mexico and Arizona, Chihuahua and Sonora. L. "nashii" Ryan ined.

4. Thallus when fresh distinctly yellowish, orangish, reddish, or brownish, or grayish green, without usnic acid, usually with isousnic acid or no acetonesoluble 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

3. Thallus papillatetuberculate, 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, rimoseareolate, with wartypapillose or branchedgranular areoles, dark or grayish ashy olive. In f. pseudoradiata, the thallus isirregularly orbicular, 12 cm wide, radiating and appearing lobed, somewhat violetgrayish. (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 papillatetuberculate, but isidiate, sorediate, or both. 4

9. Thallus distinctly radiate, very indistinctly sorediate.

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

10. Thallus without isidia, verrucosepapillate, broadly expanded, thick, scarecely rimose, dark grayblack to brownblack, limited by black, radiate hypothallus; verrucae subdiscrete to contiguous, epruinose. Pycnidia rare; pycnospores 1523 um 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

13. Thallus (at least towards center) of easily detached flattenedglebulose (subsquamulose) to ± papillate granules, at times later becoming ± 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 \pm verruciform, dark bluish gray, with irregularly scattered, 0.5-1.5 mm across, low heaps of densely clustered isidia. Pycnidia numerous, at least partly composite, up to 250 μ m broad; pycnospores 78 μ m 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, \pm orbicular but not distinctly radiate; soralia distinct. Cortical cells 56 μ m thick.
..... (see Aspicilia sorediza)

14. Thallus dark gray, distinctly radiate; soralia \pm indistinct. Cortical cells 23 μ m thick. Thallus soft, orbicular, 1.5 cm diam., towards center effuse, areolate, towards margin narrowly radiate; areoles 0.3-0.55 mm wide, separated by deep and somewhat wide cracks, subcolumnar, rounded to subangular, distinctly and densely sorediate. Marginal strings of areoles branched, often \pm discrete, convex, narrow, 0.1-0.3 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 μ m thick, the outer part dark gray; hyphae strongly leptodermatous, 5 μ m 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.

lecodeoides

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, \pm 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