

III-a. Thallus \pm brown. On soil.

1. Spores 10-13 μ m diameter, globose. (A. thelococcoides)
1. Spores ellipsoid, or if globose, to 7 μ m.2
 2. Spores \pm globose, 3 or more μ m wide.3
 2. Spores ellipsoid, to 2 μ m wide. Thallus non-pruinose, K-.4
3. Spores 4-7 x 3-6 μ m. Thallus densely white pruinose. K+ red (A. reagens) or K- (A. nodulosa).
3. Spores 3-3.5 μ m diam., ca. 100/ascus. Thallus K-, areolate-verrucose or squamulose-verrucose; verrucae 0.7-1.5(-2) mm across, red-brown, smooth, then scabrid and greenish pruinose when old; convex, partly irregular, always broadly affixed; underside brown; older ones contiguous or approaching, younger ones dispersed. Cortex 10-20 μ m thick; cells 2-3 μ m diam. Algal layer 50-70 μ m. Apothecia often 1 per areole, brown-black, concave, 0.5-1 mm, the margin thick and prominent. Hypothecium 20-25 μ m. Paraphyses 1.7 μ m thick; tips brown, 3.5 μ m in K. Hymenium 85-90 μ m. California; eastern Washington.A. geogena
4. Spores 7-11 x 3-6 μ m.(A. macrospora subsp. murorum)
4. Spores under 7 x 3 μ m.5
5. Thallus C+ red (according to whom?--C- according to Zahlbruckner 1902). Squamules shining, light chestnut to chestnut, discrete, crowded or scattered, somewhat wrinkled and pitted, convex and rounded, 1-1.5 mm wide, 0.2-0.3 mm thick, brown below, attached by a short and wide gomphus; upper cortex pseudoparenchymatous, c. twice as thick (as lower one?), covered by epinecral layer; algal layer continuous, algae 10-18 μ m diam.; medulla white, loose, hyphae 3.5-4 μ m thick, branched, thinly septate, thin-walled, I-. Apothecia 0.4-0.6 mm across, partly immersed, 1(to several) per squamule, the disc concave to flat, papillate, reddish brown and sometimes obscurely glaucous-pruinose, the thalloid margin prominent, moderately thick, crenulate. Amphithecium pale, of densely interwoven longitudinal hyphae; hypothecium pale, subindistinct and rather coarsely pseudoparenchymatous; hymenium pale, 160-180 μ m, I+blue then wine red; epihymenium granulate; paraphyses tightly conglutinate, filiform, simple, euseptate, tips capitate, dark brown, K+ paler; asci saccate-clavate, tip rounded, subequal to hymenium. Spores ovoid to oblong or oblong-baciliform, 3-7 x 1.5-2 μ m. Thallus K-. S. California.A. obpallens
5. Thallus C-. Thallus non-pruinose.6
 6. Hymenium 200-300 μ m high. Areoles \pm dark brown, pale below, subconvex, 0.3-0.5 mm across, 0.4-0.6 mm thick; upper cortex 25-40 μ m thick; cells 3-8 μ m; algal layer continuous, 50-100(-200) μ m, with even surface. Apothecia numerous, 1 to few per areole, immersed, punctiform, brown-black, 0.1-0.3 mm; excipulum very distinct, 18-22 μ m thick, at the surface widened to 50-70 μ m; hypothecium 30-40 μ m; paraphyses 1-1.5 μ m; spores \pm ellipsoid to cylindrical, several hundred per ascus, 4-5.5 x 1.7 μ m, narrowly ellipsoid or subcylindric. Thallus areolate to squamulose-areolate, contiguous or \pm

dispersed, strongly affixed. Thallus indeterminate; areoles paler at the edges, towards the center round. On clayey soil, California (to Washington?)A. terricola

6. Hymenium under 200 μ m. (Usually on rock).7

7. Squamules \pm dispersed.8

7. Squamules grouped in an areolate-squamulose thallus, generally poorly delimited.A. smaragdula v. benedarensis

8. Discs rugose-scabrid, deeply immersed.(A. scabrida)

8. Discs smooth, only slightly immersed. ...(A. veronensis)

III-b. Thallus \pm brown. On wood.

1. Thallus C+ red, K-2

1. Thallus C-, K-3

2. Apothecial disc 0.1-0.2 mm diameter; areoles contiguous, subplane, dark below.
Spores ellipsoid. Hymenium 80-90 μ m.A. saepincola

2. Apothecial disc 0.2-0.4 mm diameter. ...(see A. fuscata)

**3. Thallus reduced to a thin band around the apothecia. Epihymenium and cortex of
apothecial margin carbonaceous black.**(Polysporina lapponica)

**3. Thallus \pm well developed; epihymenium and cortex brown, not black. Discs
smooth4**

4. Squamules very dispersed.(A. veronensis)

**4. Squamules grouped into a poorly delimited areolate-squamulose crust, dark
brown, sometimes almost black; apothecia of very variable outline even on the same
squamule, most often irregular. Paraphyses 2-3 μ m thick at base.**
(A. impressula)

III-C. Thallus brown, lobed at margin (sect. Trochia)

1. Cortex C+, KC+ red.2

1. Cortex C-, KC-. Spores 1.5-2 μ m wide, to 4.5 μ m long; hymenium to 100 μ m high. Thallus \pm definitely lobed, dark (when dry); areoles often convex.3

2. Thallus pulvinate, not radiating, various shades of brown, often (?) gray or blue-gray pruinose, often blackened by fungal parasite, developed from stems which branch from rootlike, finally flattened stipes, black below; forming small irregular clumps 8-15(-25) mm or more across, to 10-15 mm tall when well developed, with dome-like 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-)1-1.5 mm broad, 0.4-0.6 mm thick not including the stipe, very irregular in shape and size, with rounded edges, often with a \pm deep partly furrow-like cut into the areole, therefore sublobate or intestiniform, on the whole plane, smooth. Apothecia rare, 1 per areole, to 0.8 mm diam., immersed, scabrid, marginate; paraphyses 1-2.7 μ m broad; hymenium ca. 60 μ m; spores 3.3-4.5 x 0.75-1.25 μ m. Upper cortex (30-)50-65(-80) μ m thick; cells 1.7-2(-2.5) μ m. Algal layer continuous, 100(-150) μ m thick. Pycnospores 2-2.5 x 1-1.5 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; Magnusson treated it as a synonym of this species)(A. thamnina)

2. Thallus horizontally expanded, \pm radiating.4

3. Lobes indistinct. Thallus blackish to brown-black, shiny, determinate; mostly of discrete, \pm scattered, semi-globose verrucae, strongly adnate, pale below. Upper cortex 35-45(-50) μ m thick; cells 1.5-3 μ m.; algal layer 50-675 μ m thick, continuous, with even surface. Apothecia 0.1-0.4 mm diameter, 1-5 per areole, to 0.4 mm diam., immersed, finally somewhat prominent; disc rough; hypothecium 20-30 μ m thick; hymenium 85-110 μ m; paraphyses 2-3 μ m thick at base; apices dark brown, 3-4 μ m wide; spores ca. 100, 3-4.5 x 1.7(-20 μ m, somewhat broadly ellipsoid, especially when young. On non-calcareous mica-schist, Alpine, California, and arctic, Greenland.A. nitida

3. Lobes \pm distinct; Thallus dark red-brown, paler when wet, placodioid; lobes convex, contiguous, 1 mm wide, to 4 mm long, sometimes branched with short branches, widened toward tips; areoles often very large, pale below. Thallus center verrucose with globulose verrucae; upper surface shiny; underside pale with dark edge. Apothecia 0.2-0.5-1.0 mm diameter, abundant, usually solitary in central convex areoles, immersed; disc concave or flat, brown-black, darker than thallus; margin persistent and proper exciple sometimes also showing; hypothecium grayish; epihymenium yellowish brown; hymenium 90-185 μ m, I+ blue; paraphyses 0.5-1 μ m thick at base (2 μ m according to Thomson 1997), tips to 3 μ m. Spores very numerous, ellipsoid-cylindrical, 3-4 x 1.5 μ m. Algal layer dissected by thick hyphal strands. Thallus K-, C-, P- (according to Thomson 1997; need to check other sources, since somewhere I got the idea that the species was C+ red). On steep granitic rocks mostly near the tops of hills, usually in sunny exposures, on seashores, Arctic, south to New Brunswick and Maine, and to Colorado.A. molybdina

4. Apothecia 0.3-1.8 mm diameter. Hymenium 100-120 um. Thallus determinate, 1-2 cm diam., pale olive brown to intensely red-brown; lobes 1-2 mm long, 1 mm broad, contiguous to overlapping, somewhat convex or rarely flat; lobe ends rounded or slightly incised; thallus center areolate-verrucose; areoles 0.6-1(-1.5) mm wide, 0.3-0.7 mm thick, angular, smooth, pale below. Upper cortex 40-65 um thick. Algal layer (50-)70-120 um thick, continuous with even upper surface. Apothecia common, 1 to several per areole, disc umbonate-rugose; margin turgid, prominent; spores 3-4 x 1.5-2 um. Medulla milk-white from granules.A. bullata

4. Apothecia 0.1-0.2 mm. Hymenium 70-80 um. Thallus continuous, to 6.5 cm or more across, invading and destroying other lichens, 0.4-0.6 mm thick, areolate, quite smooth; dark red-brown, somewhat shiny towards margins, with indistinct, thinner marginal lobes; marginal areoles ca. 1 mm broad and to 2 mm long, partly concave; central areoles 0.5-0.8 mm diam., of uniform size and separated by thin, distinct, regular cracks, plane, broadly attached to substrate. Upper cortex 30-50 um thick; algal layer 120-170 um thick, continuous with even surface. Apothecia partly abundant but very inconspicuous and small, 0.1-0.2 mm diam., punctiform, immersed, blackish, plane, in the level of the thallus. Hypothecium 35-100 um; paraphyses 1.7-2 um thick, not capitate. Spores ca. 100, narrowly ellipsoid, 4-5 x 1.5-2 um. Mexico, Arizona.A. complanata

III-D Thallus brown, at least partly K+ red

1. **On soil.**(see A. terricola & A. nodulosa v. reagens)

1. **On rock.**2

2. **Thallus C+ red**, rimose-areolate, mostly covered by apothecia, very pale yellowish or brownish gray, epruinose. Apothecia 0.2-0.5 mm diameter, 1-5 per areole, immersed then \pm prominent, rounded to slightly angular or elongated, sometimes confluent, concave, smooth or slightly rugose, matt, the margin entire, prominent, paler than disc, sometimes concolorous with thallus. Hymenium 60-120 μ m; paraphyses 1.5-2.5 μ m, the tips 3-5 μ m. Spores 3-6 x 1-2 μ m, ellipsoid or subcylindrical, 100-200 per ascus. On non-calcareous rocks. New Mexico.(A. tongletii var. variegata)

2. **Thallus C-.** 3

3. **Spores usually developed.** 4

3. **Spores not developed.** Thallus 3-10 mm wide; areoles 1-1.5 mm wide, plane, irregular, black below, C-. Apothecia \pm abundant, 3-16 per areole, 0.2 mm diameter. Cortex 25-30 μ m, the cells 3-4 μ m diameter. Mexico.(A. cratericola)

2. **Upper surface pale to rather dark yellowish brown or grayish, rarely rust-brown.**

Thallus areolate, the areolae dispersed or in small groups. Squamules well developed, very variable, not entirely occupied by the apothecia, to 2(-5) mm across, to 1 mm thick, rounded to crenulate, rarely angular, plane or uneven, matt or sometimes shining, underside pale, upper side epruinose, not lobed or verruciform, C-. Apothecia immersed, 0.1-0.4(-0.7) mm diam., (1-)3-7(-15) per areole, discs dark brown or black, even, slightly roughened, often rugose or umbonate, \pm concave, sunken or level with thallus; proper margin concolorous with disc, well developed, 10-20 μ m below, widening to 50 μ m above, hyaline or pale yellow. Hypothecium dense, I+ blue; epihymenium brownish or yellowish brown. Paraphyses to 1-1.5 μ m thick at the base, mostly non-anastomosing, the upper cells appearing submoniliiform; the tips under 3 μ m thick. Algal layer regular or irregular, continuous or discontinuous. Spores 200(-300) per ascus, elongate or cylindrical, (2-)3-5 x 1-1.5(-2) μ m. Cortex K+ red, C-, P-, I-. On acid rocks, on cliffs, boulders, and especially on rocks manured by birds. Subarctic and alpine, south to Arizona and Texas in the west, south to Kentucky in the east.A. smaragdula

2. **Upper surface black.** Thallus of dispersed areoles. Areoles rounded, 0.8-1.3 mm across, matt, \pm rough. Apothecia usually 1 per areole, 0.5-0.7 mm wide, the margin in young apothecia very thick, turgid, uneven, slightly more prominent. Spores broadly ellipsoid or partly subglobose, 3-4 x (1.7-)2 μ m. Hymenium 120-150 μ m; paraphyses indistinct, 2 μ m (in KOH), tips 3-4 μ m. Thallus P+ orange. On sandstone, Utah.A. desolata

III-E. Thallus brown; cortex C+ red

The C+ red reaction is often difficult to see, especially on dark thalli. Noble recommends either looking for it in sections under the compound scope, in the cortical tissues surrounding the apothecia, or squashing a squamule on a piece of filter paper pre-dotted with C while looking at it through the dissecting scope. I find that it is also useful to test a thick section, with the surface of the squamule perpendicular to the field of view, under the dissecting scope, such that you are looking through the very narrow translucent surface layer of red, without the brown color of the thallus obscuring the color. And of course, there's always TLC, but that's a pain when you've got scattered squamules mixed with other lichens.

1. Thallus lobed at margin.(see A. bullata, A. complanata and A. thamnina in Key III-C)

1. Thallus not lobed at margin.2

2. On wood.(see A. saepincola)

2. On rock or soil.3

3. Thallus of small, closely aggregated, branched stipes, expanding into small, often lobulate and even imbricate, areole-like areas. Mountains of California, eastward to Montana and Nevada. (A. thamnina)

3. Squamules scattered to contiguous, not stipitate, lobulate or imbricate.
.....4

4. On soil or crumbling sandstone. Thallus of shining, light chestnut, crowded or scattered, somewhat wrinkled and pitted, convex and rounded squamules. Apothecia 0.4-0.6 mm across, partly immersed, 1-several per squamule, the disc concave to flat, papillate, reddish brown and sometimes obscurely pruinose, the thalloid margin prominent, moderately thick, crenulate. Spores oblong-ellipsoid, 3-6 x 1.5-2 um. S. California.A. obpallens

4. On solid rock, or parasitic on other lichens.5

5. Parasitic on other lichens.6

5. Not parasitic.7

6. Hymenium 60-80 um; areoles plane, dark below, dark brown above, thin, partly dispersed, 0.5-0.8 mm across, 0.3-0.4 mm thick, variable in shape, mostly angular, plane, distinctly and rather narrowly peltate. Apothecia rare, few, 1/areole, 0.2-0.3 mm; disc impressed, dark brown, plane, \pm punctiform. Cortex thin, 15-22 um; cells 2-3 um. Spores ca. 100 per ascus, not fully developed. On lichens (Dimelaena) on siliceous rock. New Mexico.A. succedens

6. Hymenium 80-100 um; areoles convex, pale below, pale red-brown above.
.....(see A. interspersa)

7. Thallus densely pruinose.8
(also see A. nicolai from Mexico)

7. **Thallus epruinose or at most weakly pruinose.**10

8. Disc pale red-brown, thinly pruinose. Spores \pm narrowly ellipsoid, 5-6 x 1.8-2 μ m. Thallus densely blue-green pruinose above. Areoles 0.5-0.7 mm across, contiguous. Apothecia 0.1-0.4 mm diam. Hymenium 80-100 μ m. Cortex 35-50 μ m. On non-calcareous sandstone, Texas.A. caesiofusca

8. Discs blackish. 9

9. Spores subglobose, 3-4.5 x 2.5-3 μ m. Areoles 0.5-1.5 mm broad, 0.5-0.9 mm thick, irregularly convex, \pm umbilicated, crowded, pale reddish, white-pruinose, the surface slightly sulcate. Apothecia 0.2-0.4 mm diameter, 1 per areole, immersed, plane, impressed, Discs epruinose. Hymenium 85-110 μ m; paraphyses 1.7 μ m, tips only slightly swollen. On granitic rock, Nevada.A. nevadensis

9. Spores 3-4 x 1.5-2 μ m. Areoles always very convex, sparse, often pale brown, in general pruinose. Discs often blackish brown, sometimes pruinose, very rugose due to presence of numerous umbos. Apothecia 0.3-1.8 mm diameter. Hymenium 100-120 μ m. Thallus determinate, 1-2 cm diam., pale olive brown to intensely red-brown; lobes 1-2 mm long, 1 mm broad, contiguous to overlapping, somewhat convex or rarely flat; lobe ends rounded or slightly incised; thallus center areolate-verrucose; areoles 0.6-1(-1.5) mm wide, 0.3-0.7 mm thick, angular, smooth, pale below. Upper cortex 40-65 μ m thick. Algal layer (50-)70-120 μ m thick, continuous with even upper surface. Apothecia common, 1 to several per areole, disc umbonate-rugose, margin turgid, prominent; Medulla milk-white from granules. (A. bullata)

10. Discs 0.8-1 mm across, densely pruinose, flat to \pm convex, \pm crowded, 1-3 in each squamule. Hymenium 125-135 μ m. Thallus of small, angular or rounded, clustered or more or less scattered, reddish brown and darkening, epruinose squamules. Areoles dark below. Apothecia immersed, 0.4-0.7 mm across, Spores oblong, 3.5-6 x 1.5-2.5 μ m. On siliceous rocks, Arizona, California.A. carnegiei

10. Discs under 0.5 mm across, epruinose, or at most weakly (?) pruinose in A. instrata. 11

11. Discs rugose and often with one or more umbos. Paraphyses 1.5-2 μ m below; apothecia at least partly 3-8 per areole, Upper side of areoles usually dark. Discs rough. Areoles convex. Santesson (1984) and Egan accept the next two taxa as distinct, but the descriptions below need to be checked--the one of A. rugulosa is based only on the one for A. montana (listed by Egan as a synonym of A. rugulosa, but included under A. peliscypha by Clauzade & Roux), and the one for A. peliscypha is based on one that included A. rugulosa as a synonym. 12

11. Discs smooth or slightly rugose to scabrid or papillate, without unbos. 13

12. Underside pale; disc umbonate; apothecial margin less developed; hymenium 110-170 μ m; spores 3-5 x 1.8-2 μ m. A. rugulosa

12. Underside black; disc not umbonate; apothecial margin well developed; hymenium 100-130 μ m; spores 3-5.5 x 1.2-2 μ m. A. peliscypha

13. Upper side of areoles \pm dark, red-brown. 14

13. Upper side of areoles ± pale, often yellowish tinged. 18

14. Areoles ± impressed (forming shallow pits) in the rock; disks often thinly pruinose. Cortex 35-40 µm, cells 2 µm. Apothecia 1 per areole, 0.1-0.2 mm diam., punctiform, disc plane, red-brown. Hymenium 100-125 µm; cortical cells 2 µm. Thallus indeterminate; areoles 0.5-0.8(-1) mm diameter, 0.2-0.3 mm thick, ± dark red-brown, often thinly pruinose, subplane, irregularly angular, contiguous to somewhat dispersed. Hymenium 100-125 µm; paraphyses 1.8-2 µm, the tips slightly swollen, 3 µm. New Mexico. A. instrata

14. Areoles not impressed; disks epruinose. 15

15. Lower side black. Apothecia 0.2-0.4 mm diameter, 1-3(-5)/areole, the discs round or irregular concave, deeply impressed, dark brown, ± shiny; thalline margin not very prominent; spores 4-5 µm long, ± cylindrical, often not developed; areoles 0.5-0.7 mm across, 0.3-0.4 mm thick, round or sublobate, subconvex, ± dispersed, upper side epruinose, pale to dark castaneous brown, often shiny. Cortex 50-55 µm; cortical cells 1-2 µm. On granitic rock, S. California. A. interposita v. nitidella

15. Lower side pale. 16

16. Hymenium 110-130 µm; spores 4.5-5.5 x 2-2.5 µm, somewhat broadly ellipsoid. Apothecial margin elevated. Cortex 35-40 µm, cortical cells 2.5-3 µm. Apothecia 0.15-0.3 mm diameter, 1/areole, the disc concave, dark brown. Thallus indeterminate, squamulose; squamules dispersed to a few contiguous, round, 0.3-0.4 mm across, thin, epruinose, red-brown, subplane, pale below. Paraphyses 1.5-1.7 µm thick below; tips 4-5 µm thick. On siliceous rock. Arizona, New Mexico. A. tucsonensis

16. Hymenium under 100 µm. Spores under 2 µm wide. 17

17. Cortical cells 3-5(-6) µm. Hymenium 65-80(-100) µm. Lower side pale. Apothecia 0.1-0.5 mm diameter, 1(-8)/ areole, deeply immersed, the discs concave but slightly projecting, ± craterform, red-brown or blackening, the margin usually indistinct, entire or irregularly granulose, ± concolorous with thallus; spores 3-5 x 1.7-1.9 µm; areoles 0.2-1.4 mm across, ± dispersed or grouped, ± round, plane or usually convex, smooth, dark red-brown, rarely pale or black, usually C-. Upper cortex (10-)15-25(-35) µm; Paraphyses 1.6-1.9 µm thick. (A. veronensis)

17. Cortical cells 2.5-3 µm. Hymenium 90-100 µm; spores 4-5 x 1.7 µm, ± cylindric. Apothecial margin indistinct, sloping. Areoles dark red-brown, epruinose, smooth. Apothecia 0.2-0.4 mm diameter, 1-3 per areole, the disc deeply depressed with sloping sides, ± round to irregular, blackish, plane, Areoles 0.4-1.3 mm across, usually dispersed, irregular, convex; paraphyses 1.5-1.7 µm thick below; tips 3-4 µm. On non-calcareous sandstone. New Mexico. A. sparsa

Upper side pale.

18. Paraphyses tips clavate. Spores ellipsoid, ca. 3-6 x 1-2 μ m. Apothecia not clearly marginate, brown or deep brown. Squamules never very convex. 19

18. Paraphyses tips capitate, 3-5 μ m. 20

19. Areoles 0.3-1.4 x 0.3-1 mm across, sometimes composite, united in small groups less than 3 cm across, not loboate nor imbricate, pale below. Apothecia (1-)3-7(-12) per areole. Spores ellipsoid, 3.5-5 x 1.5-2 μ m. Areoles plane, 0.3-1 mm across, often angular, non-imbricate, brown-yellow, pale, whitish edged. Apothecia 0.1-0.8 mm diameter, the discs epruinose, dark brown, \pm smooth, sunken, round to elongated or irregular; margin little projecting, smooth and regular, concolorous with thallus; spores 3.5-5 x 1.5-2 μ m. Paraphyses 1.5-1.7 μ m at base, tips 2-2.5 μ m. New Mexico (v. devastata (Eitn.) Magn., with thallus reduced to a margin around the apothecia). **A. gallica**

19. Areoles 0.5-3 mm across, simple, grouped into a \pm extensive and rather poorly delimited areolate-squamulose thallus (or scattered and squamule-like?), sometimes sublobulate or slightly imbricate; underside black. Apothecia 1(-5) per areole. Spores narrowly ellipsoid to subcylindrical, 4-6 x 1-1.5 μ m. Apothecial discs smooth to uneven or rough and papillose, concave to convex, reddish to dark brown, the thalloid margin thin, disappearing. Spores subspherical to oblong, 3-5 x 1.8-2.7 μ m. Thallus clustered and areolate or often scattered and often lobulate squamules; squamules 1-1.5 mm, plane, often angular; upper surface relatively pale chamois brown. Apothecia abundant, 0.2-0.9 mm across, immersed to superficial, 1-several per areole. Cortex 25-35 μ m. Paraphyses 1.5-2 μ m at base; tips 2-3 μ m; hymenium 80-120 μ m; cortical cells 3-4 μ m. Common and widespread, usually on non-calcareous rocks. Common and widespread, arctic to temperate, eastern and western. Usually on non-calcareous rocks, in fairly exposed sites, maritime to inland. This is a trashbag for most C+ red species, but it does seem to be the most frequently encountered one. **A. fuscata**

20. Hymenium ca. 150 μ m. Spores broadly ellipsoid to subglobose, 3-4 x 2-2.5 μ m. Paraphyses 2-2.5 μ m below; apothecia 1 per areole. Upper side pale of areoles pale brown, matt, rather smooth. Lower side pale. Apothecia 0.5-0.6 mm diameter, immersed, black, plane, depressed, scabrid, round to irregular, thalline margin turgid, thick, often fissured. Areoles dispersed to grouped, round to irregular, 0.6-1 mm diameter, 0.5-0.6 mm thick. Paraphyses tips 4(-5) μ m (in KOH). Cortical cells 3.5-4 μ m. Algal layer 100-150 μ m thick. On sandstone, Utah. **A. fuscescens**

20. Hymenium to 125 μ m. Spores ellipsoid to subcylindrical, under 2 μ m wide. 21

21. Hymenium (60-)100-125 μ m. Cortical cells 1.5-2 μ m. Areoles on surface, dispersed, convex; discs bare. Cortex 15-25 μ m. Thallus K+ red, rimose-areolate, mostly covered by apothecia, very pale yellowish or brownish gray, epruinose. Apothecia 0.2-0.5 mm diameter, 1-5 per areole, immersed then \pm prominent, rounded to slightly angular or elongated, sometimes confluent, concave, smooth or slightly rugose, matt, the margin entire, prominent, paler than disc, sometimes concolorous with thallus. Paraphyses 1.5-2.5 μ m, the tips 3-5 μ m. Spores 3-6 x 1-2 μ m, ellipsoid or subcylindrical, 100-200 per ascus. On non-calcareous rocks. New

Mexico.(*A. tongletii* var. *variegata*)

21. Hymenium 80-110 μ m. Cortical cells 3-3.5 μ m. Upper side of areoles pale red-brown.

Apothecia 0.5 mm diam., 1 per areole, only slightly immersed, the disc black, scabrid, the margin \pm distinct and prominent in older apothecia; spores ellipsoid 3-4(-5) x 1.5-1.7 μ m.

Areoles 0.5-1.3 mm across, 0.3-0.4(0.6) mm thick, matt, convex, dispersed to grouped.

Paraphyses 1.7-2 μ m, tips 3.5-4 μ m; cortex 30-40 μ m. On granitic rock, New

Mexico.*A. interspersa*

ADD:

Thallus areolate; areoles 0.3-2 mm wide, markedly contiguous, often \pm in lines, edges rounded or \pm irregular by compression, swollen, convex, faintly pale striate, pale to deep reddish brown.

Apothecia numerous, 1(-3) per areole, dark gray-red-brown, darker than thallus; thalline exciple somewhat prominent, \pm swollen, striate; disc 0.1-0.3 mm diam., rounded, oblong, kidney-shape, rarely \pm contorted; hymenium 80-100 μ m tall. Paraphyses 1.5-2 μ m wide at base, 2-4 μ m at apex.

Spores 4-6 x 1-2.5 μ m. Thallus P+ yellow-orange, K+ red, KC+ red, C-. Norstictic acid. On siliceous coastal rocks, Oregon. *A. subrufula* (Nyl.) H. Oliv.

A. peliscypha s. lato

Apothecia dark brown. Thalline margin distinct and \pm projecting. Squamules often convex or lobulate. Spores 3-5 x 1-2 μ m, ellipsoid, very numerous. Squamules 0.5-3 mm across, very variable in color and form, often even on the same individual, pale to \pm dark chestnut brown, often hemispherical, at other times with surface \pm uneven and contour slightly lobulate. Apothecia 0.3-1 mm diam., numerous but unevenly distributed, completely covering some squamules, absent from others, isolate or grouped, to as many as 10 per squamule, at first sunken and punctiform, then \pm prominent, plane or convex; disc rugose. Hymenium 100-170 μ m.

1. Areoles pale below. Apothecia umbonate. Hymenium (110-)125-140(-170) μ m. Apothecial margin little developed. Areoles matt. Spores 3-4(-5) x 1.8(-2) μ m, Thallus indeterminate, squamulose, dark chestnut brown or rarely pale red-brown; squamules scattered or in small groups, 0.5-1(-1.5) mm wide, 0.2-0.4(-0.6) mm thick, \pm rounded, irregular or rarely becoming lobed, matt, broadly attached, K-. Upper cortex 30-45(-60) μ m thick, mostly gray-white; C+ red; cells 4-5 μ m. Apothecia partly numerous and 3-8 per areole, partly sparse, solitary, immersed; disc long remaining punctiform, 0.15-0.3(-0.45) mm diam., brown-black, concave or flat, rough or wrinkled. Paraphyses 1.5-1.8 μ m; tips 4-5 μ m. Spores to several hundred, somewhat broadly ellipsoid. Pycnospores 2-2.5 x 1 μ m. On gneiss or mica-schist, mostly on iron-rich rocks. A. montana (= A. rugulosa)

1. Areoles black below. Apothecia not umbonate. According to Magnusson in Rabenhorst, the apothecial margin is better developed, the hymenium is mostly lower, 100-120(-170) μ m, the areoles are \pm shiny, and the spores shorter [need next page of Rabenhorst to see what the dimensions are]. A. peliocypha (= A. peliscypha)

According to Magnusson in Rabenhorst, specimens of "A. rugulosa" in Koerber's herbarium are a mixture of A. montana and A. peliocypha, but in that same work Magnusson lists A. rugulosa as a synonym of A. peliocypha

ADD:

Thallus areolate; areolae dispersed or contiguous, irregularly shaped but not lobate, the margins closely appressed, convex, shining, pale or dark chestnut brown; underside dark brown. Apothecia solitary or several per areole, starting as a depression in the areole, then rising above the surface or filling the areole, to 1 mm broad, round; margin smooth and shiny; exciple 15-30 μ m, yellowish white; disc reddish or blackish brown, rough, in old apothecia nearly rugose; hypothecium yellowish; epihymenium yellowish brown or brown; hymenium 100-130 μ m, hyaline, I+ blue or wine red; paraphyses 1.5-2 μ m, not capitate; spores nearly cylindrical, 3-5.5 x 1.2-2 μ m, with oil drops within. Thallus K-, C+ red, P-. On acid rocks, nitrophilous, arctic-alpine. A. peliscypha sensu Thomson 1997

Thallus areolate, the areolae to 1.5 mm broad, round or indistinctly lobate, convex, dark brown or reddish brown, dull; cortex 30-60 μ m; underside pale. Apothecia solitary or 3-8 per areola, immersed, to 0.5 mm broad; margin often prominent; exciple 10-120 μ m, I-; disc concave or flat,

rough or umbonate, dark black-brown; hymenium 110-170 μm , I+ red or sometimes blue; paraphyses 1.5-1.8 μm , tips dark brown capitate and 4-5 μm ; spores very numerous, broadly ellipsoid, 3-5 x 1.8-2 μm . Thallus K-, cortex C+ red, P-. On a variety of acid rocks, usually those containing iron. Arctic.

Paraphyses tips 3 μm . Hymenium 100-120(-170) μm . Spores 3-4(-5) x 1.8(-2) μm . Apothecia 0.15-0.3(-0.45) mm across, the disc umbonate, rough, impressed, concave or plane, brown-black; margin often raised; Cortical cells 4-5 μm . Thallus indeterminate, squamulose or areolate-squamulose; areoles 0.5-1(-1.5) mm across, \pm dispersed, convex, dark castaneous to rarely pale red-brown. Montane. A. peliscypha sensu ?

III-F. Thallus brown, C-, K-; spores over 7 x 3 um.

1. On soil. Spores globose, 10-12 um, about 40 per ascus. Thallus squamulose, pruinose. Hymenium 200-250 um. Apothecia deeply immersed, 0.3-0.5 mm. California.(A. thelococcoides)

1. On rock. Spores subglobose to ellipsoid, 7-13 x 3-6 um.2

2. On calcareous rock. Areoles ± contiguous. Paraphyses 2-3 um wide at base.

Areoles sometimes indistinct or immersed, hardly squamulate, attached by most of the lower surface, 0.5-1.0 mm wide, angular over a 1-2 cm broad area, more leongated near the periphery; upper surace slightly shiny, ± dark brown to whitish, sometimes darker near the margin. Apothecia common, 1-4 per areole, impressed, without margin, often becoming confluent in older areoles, ± round, 0.4-1.0 mm diam.; disc plane, immersed but nearly level with top of areole, darker than thallus, matt. Hymenium 130-150 um high; paraphyses coherent; epithecium somewhat orange-brown. Spores 24-100 per ascus, ellipsoid, 9-11 x 5-6 um. On calcareous sandstone, British Columbia; Greenland.A. macrospora

2. On ± non-calcareous rock. Areoles ± dispersed; paraphyses under 2 um wide at base.3

3. Areoles white to ochraceous white. Apothecia 2-5 per areole, irregular, 0.2-0.4 mm, black, subscabrid; hymenium 100-150 um; cortical cells 2-3 um. Utah. (A. utahensis)

3. Areoles ± dark red-brown to greenish brown, sometimes pruinose, 0.5-1(-1.5) mm across, convex, mostly rounded, dispersed or grouped. Apothecia 1-5 per areole, round, 0.3-0.6(-1) mm diameter, the discs first immersed and concave, then plane or subconvex, red-brown to black, surrounded by thin, darker proper margin and lighter, non-prominent thalline margin. Spores ellipsoid, 9-13 x 5-6 um. Cortex ca. 50 um thick. Hymenium (60-)85-100 um thick; paraphyses 1.5-1.8 um, the tips distinctly widened, brownish. Thallus C-. On non-calcareous rocks near the ground, often in limestone areas. California, Iowa.A. oligospora

**III-G Thallus brown, K-, C-, non-radiating,
on calcareous rocks.**

1. Asci fewer than 100 spored; spores over 7 x 3 um.(see A. macrospora & A. oligospora)

1. Asci 100-200 spored; spores mostly under 6 um long.2

2. Thallus poorly developed, thin, seen only around the apothecia.3

2. Thallus well developed.4

3. Discs grayish pruinose, flat, the margin thin, concolorous with thallus, entire. Thallus smooth to minutely chinky and areolate, dark greenish gray to black. Apothecia 0.1-0.15 mm across, immersed 1 or rarely more in an areole. Spores ellipsoid, 3-4 x 1.5-2 um. On limestone. Ohio.A. immersa

3. Discs epruinose (according to ?; greenish or pale bluish to whitish pruinose according to Thomson 1997), concave, pale red-brown, the margin thicker; exciple yellowish or brownish yellow, 20-30 um, I-; hypothecium pale; epihymenium brownish yellow. Thallus often \pm rosulate; of dispersed or contiguous areoles, hardly noticeable; areoles 0.2-0.5 mm broad, convex or plane, rusty colored to yellowish or pale brown (rarely whitish) above, pale below, K-. Hymenium 100-130(-150) um, I+ blue, but asci reddish brown with I, so reactions appearing variable; paraphyses slender, not capitate, to 1 um thick; spores oblong, 3.5-5.5 x 1.8-2 um, sometimes with 2 oil drops. Apothecia 0.2-0.4 mm diam., usually 1 per areole, immersed. Thallus K-, C-, P-. Principally on calcareous rocks and pebbles in the ground. Indiana (record doubtful according to Fink); California; Minnesota; Manitoba; British Columbia; Alaska.A. heppii

4. Apothecia mainly in the form of short, sunken furrows, or irregularly polyhedral, 0.2-0.4 mm across, plane to concave. Areoles \pm confluent and plane, 0.5-1(-2.5) mm across, epruinose. Spores 3-4 x 2-2.5 um; paraphyses 2-3.5 um below. Growing near the seashore, \pm parasitic on other lichens, over calcareous rocks, Arctic.A. impressula

4. Apothecia \pm round. Growing in inland areas.5

5. Apothecial discs \pm pruinose. Algal layer irregular and discontinuous, dentate in vertical section. Paraphyses 2-3 um thick at base, 4-7 um at tips; spores 4-8 x 1.5-3 um; hymenium 60-110 um tall. Areoles dispersed or grouped, irregular-undulate, non-angular, often imbricate, \pm epruinose, 0.5-4 mm across, \pm pale brown, sometimes greenish or grayish, matt, pale below. Apothecia 0.5-2 mm diam., 1-3 per areole, disc projecting from beginning, red-brown, \pm pruinose, smooth, margin slightly darker than disc, thick and projecting, sometimes flexuous and pruinose. On calcareous rocks. From Vermont to Washington and southward according to Fink (f. depauperata, without a thallus, is reported from Washington and New Mexico; f. verrucosa, with thallus reduced and scattered and discs soon epruinose, is reported from Kansas, Texas and California; f. sarcogynoides, with squamules small, deformed, and disc and margin dark brown, is reported from New Mexico; f. conspersa, with thallus thin, gray, apothecia partly immersed, with partly white margin, is reported from southern California and New Mexico (with question

by Magnusson).A. cervina var. glaucocarpa [Esslinger accepts A. glaucocarpa as a separate species]

5. Apothecia epruinose. Algal layer usually \pm regular and continuous, not dentate in vertical section.6

6. Spores narrowly ellipsoid, 3-5 x 1.7 μ m. Hymenium 65-85 μ m. Thallus red-brown, epruinose, determinate, areolate-squamulose; areoles 0.5-0.8(-1) mm wide, 0.3-0.4 mm thick, scattered or suncontiguous, convex, roundish to subangular, pale below; paraphyses 2-3 μ m thick at the base; algal layer \pm regular and continuous. Cortex 15-20 μ m thick, the cells 1.7-2 μ m. Apothecia common, 1 per areole, filling the whole areole, emergent, 0.3-0.5-0.8 mm, rounded, dark brown, plane, the margin narrow. Hymenium 65-85 μ m; paraphyses 2-2.7 μ m below, the tips 3-4 μ m (in KOH). On calcium-containing sandstone, Ontario.A. canadensis

6. Spores broadly ellipsoid to globose. 7

7. Hymenium 80-90 μ m. Apothecia punctiform, finally to 0.3 mm diameter. Spores subglobose, 3-4 x 2.5-3 μ m. Thallus indeterminate, dark red-brown but densely bluish-white pruinose, squamulose; squamules dispersed to subcontiguous, 0.5-1 mm across, convex, pale below. Apothecia (1-)2-5 per areole, the disc concave. Paraphyses 1.8-2.5 μ m, the tips brown capitate, 4 μ m. Thallus K-, C-. On calcium-containing rock.

Colorado.A. coloradiana

7. Hymenium 100-120 μ m. Apothecia 0.5-0.8 mm or more across. Spores globose to broadly ellipsoid, 2.5-3.5 x 2-2.5 μ m. Thallus gray-brown, not or slightly pruinose. Thallus of rounded or irregular, raised, chunky-areolate squamules; squamules pale below, with deep furrows above, 0.5-0.8 mm thick; groups of squamules 2-4 mm wide. Apothecia small, spreading, immersed 1-3 in each squamule, the disc flat, black. Hymenium I+ dark blue. Cortex 40-50 μ m; epinecral layer 100-120 μ m thick. Medulla opaque from granules, the hyphae not distinctly thin-walled. Pycnidia 200 μ m broad, 150 μ m deep., subcomposite; pycnosporangia narrowly ellipsoid to cylindric, 2.5-3 x 0.6 μ m. Differs from the typical variety in having smaller ascospores in addition to lack of thallus pruinosity. New Mexico. A. peltastica v. subnuda Magn.

ADD:

(A. bullata)

(A. complanata)

**III-H. Thallus ± brown, C-, K-; spores to 7 x 3 um.
Parasitic on other lichens.**

1. Apothecia mainly in the form of short, sunken furrows, or irregularly polyhedral, 0.2-0.4 mm across, plane to concave. Areoles ± confluent and plane, 0.5-1(-2.5) mm across, epruinose. Spores 3-4 x 2-2.5 um; paraphyses 2-3.5 um below. Growing near the seashore, ± parasitic on other lichens, over calcareous rocks, Arctic (but not mentioned by Thomson 1997).A. impressula

1. Apothecia round. On other lichens over siliceous rocks. 2

2. Areoles dark brown or black below. 2a

2. Areoles pale below. Cortical cells over 3 um diam. Areoles 0.5-0.7 mm across, 0.3-0.5 mm thick. 3

2a. Cortical cells 1.5-3 um. Hymenium mostly to 100(-115) um. Thallus squamulose-areolate, with indistinct, thinner marginal lobes; areoles angular, to 0.5 mm across, dispersed to grouped, dark red-brown, black below; apothecia 0.1-0.3 mm across, 1 per areole, the margin prominent. Spores narrowly ellipsoid, 4-5 x 1.7 um. Hymenium 85-115 um. Paraphyses tips not thickened. Parasitic on other lichens. Arizona, Mexico. A. complanata

2a. Thallus squamulose or areolate, dispersed or contiguous, making small areas or lines over or between the areolae of other crustose lichens, the areolae to 1.5 mm broad, reddish brown, dull or slightly shining, nearly convex; lower side dark brown to black. Apothecia usually 2-5 per squamule; exciple 15-20 um; disc to 0.5 mm broad, slightly or deeply impressed, of same color as thallus and with thick thalloid border; hypothecium hyaline; epihymenium red-brown; hymenium 60-90 um, I+ blue; paraphyses 2 um, not capitate; spores numerous, broadly ellipsoid, 3-4 x 2-2.5 um. Thallus K-, C-, P-. On other lichens on either granitic or slightly calciferous rocks, principally along stream margins at the water's edge. Greenland. A. hospitans

3. Spores 3-4 x 2-2.5(-3) um, subglobose to broadly ellipsoid. Hymenium 100-170 um. Cortical cells 3.5-5.5 um. Cortex 35-45 um thick. Thallus squamulose-areolate, the areoles very irregular in shape, with smooth convex surface, often verruciform, separated by thin cracks, contiguous, forming islands among other lichens, dark red-brown, broadly attached, pale below. Apothecia 1 to few per areole, the disc dark, punctiform. Thallus K-, C-. Parasitic on a yellow Acarospora (A. novomexicana) over siliceous rocks, New Mexico. A. interjecta

3. Spores 3-4(-5) x 1.5(-2) um, ellipsoid, perhaps not ripe. Cortical cells 3-4.5 um. Apothecia rare, to 0.2 mm diam., 1 per areole, the disc black, epruinose; thallus delimited, the areoles plane, castaneous brown. Thallus forming continuous, ± distinctly limited areas to at least 4 cm broad, or groups only a few mm wide, or areoles ± scattered among and upon other lichens, dark (or in shade very pale), in open situations ± shiny, smooth, plane, angular, separated by very thin cracks, closely adnate, non-gomphate, pale below. On sandstone, New Mexico. A. applanata

**III-H. Thallus \pm brown, C-, K-; spores to 7 x 3 μ m.
On siliceous rock.**

Key After Magnusson

1. Epihymenium and apothecial margin carbonaceous black; spores very numerous.(see Polysporina)

1. Epihymenium and apothecial margin not carbonaceous.2

2. Thallus ferruginose red or ochraceous; apothecia punctiform, brown, 2-8 per squamule; spores 3-3.5(-4) x (1)1.2-1.6(-2) μ m. Thallus sometimes in small masses of rounded or angular areolae, and separated by cracks, or dispersed, rust-colored or dark orange-brown to yellowish; underside pale or darkened at edges; cortex 20-35 μ m. Apothecia immersed and with the ostiole appearing as dots or narrow disks; disk 0.1-0.2 mm, rarely to 0.7 mm broad, dark brown or blackish, lacking proper exciple around it, although there is a 15-30 μ m proper exciple within it section view; hypothecium opaque; epihymenium dark rusty; hymenium 120-170 μ m, globular in shape with paraphyses convergent toward disk, I+ yellowish red; paraphyses 1-1.5 μ m, tips not thickened. Spores very numerous, ellipsoid. Thallus K-, C-, P-. On metal-rich siliceous rocks in upland areas. Arctic and \pm northern U.S.A. sinopica

2. Thallus shades of brown or gray.2

3. Thallus pale, greenish, yellowish, or brownish.4

3. Thallus \pm dark, \pm red-brown.8

(However, see A. asahinae, A. peliscypha, A. scabrida, and A. smaragdula, which can be fairly pale)

4. Thallus \pm greenish gray. Apothecia over 0.3 mm diameter, epruinose. Hymenium height and paraphyses width not known.4

4. Thallus brownish, without greenish or gray tone.

.....5

5. Thallus thin, composed of small, flat to slightly convex, rough, greenish gray to brownish, scale-like areoles, sometimes crowded into an uneven, chinky crust. Apothecia 0.3-0.7 mm across, 1 or rarely more partly immersed in an areole, the disc flat to slightly convex, black, the proper exciple thin, black, becoming irregular, surrounded by a very thin, soon disappearing, thalloid one. Hypothecium hyaline to brownish. Spores ellipsoid, 2.5-4 x 1-1.5 μ m. On sandstone, S. California.A. arenosa

5. Thallus thick, of irregular, sometimes lobate, often scattered areoles or squamules, pale greenish gray to dusky yellowish or brown, beneath pale yellowish to brown; apothecia 0.4-0.6 mm across, immersed 1-several in each areole, the disc slightly concave to flat, reddish brown. Spores 3-5 x 1-1.5 μ m. On sandstone, California.A. hassei
(= A. smaragdula v. lesdainii according to Magnusson's monograph; also see A. boulderensis)

6. Apothecia under 0.3 mm. Hymenium over 140 μ m.6

6. Apothecia over 0.3 mm, epruinose. Hymenium 80-100 μ m. Thallus pale chocolate

brown, faintly pruinose; areoles verrucose, 0.5-1 mm across; apothecia punctiform, 0.5-0.6 mm, 1-3 per areole, disc depressed; spores 4-7 x 3 μ m; paraphyses 2-3 μ m thick at base. California.A. californica

7. Hymenium 200 μ m. Spores 3-5 x 1.5 μ m; areoles discrete, convex, alutaceous (leather colored/pale brown) above; apothecia 0.2-0.3 mm across, the disc immersed, the margin usually distinct. Algal layer interrupted. Pennsylvania.A. dispersa

7. Hymenium 140-150 μ m. Apothecia pale greenish or bluish pruinose. Paraphyses ca. 1.5 μ m below, tips not thickened. Thallus of minute, flattened to convex, continuous or scattered squamules. Apothecia immersed 1-3 in each squamule, the disc punctiform to round or irregular, concave to flat. Spores oblong, 3-4 x 1-2 μ m. Thallus C-. On argillaceous shale, S. California.A. aeruginosa

8. Paraphyses 2-3 μ m thick at the base. III-H-1

8. Paraphyses under 2 μ m thick at the base. 9

9. Paraphyses 1.5-2 μ m thick at base. III-H-2

9. Paraphyses under 1.5 μ m thick at base. III-H-3

III-H-1

Paraphyses 2-3 um thick at base.

1. Apothecia often \pm sessile, the disc becoming convex; spores over 200 per ascus, 3-6 x 1.5-2.5 um. Apothecia 0.4-2 mm diam., 1 per areole, the disk \pm circular, smooth then \pm rugose, the margin concolorous with disk, entire, projecting, often rather thin. Thallus poorly delimited, areoles 0.4-3 mm across, to 1 mm thick, round, irregularly convex to \pm plane, smooth or rugose, \pm dark brown, \pm grouped, dark below. Paraphyses 2-3 um thick below; tips 4-5 um; hymenium 60-90 um; cortical cells 3-4 um; algal layer regular, \pm continuous. On schists or granite, alpine, southwestern; Great Lakes area; Arctic. See Thomson 1997 for fuller description.A. badiofusca

1. Apothecia \pm immersed and concave. 2

2. Areoles bordered in black, densely pruinose in center, 0.5 mm across, very thin (0.1-0.2 mm); underside pale. Apothecia punctiform, 0.1 mm diam., concave, black, epruinose. Paraphyses 2-2.5 um thick below; tips apparently capitate but not widened. Spores 3.5-4 x 2.5 um; hymenium 85-100 um. Arizona, Mexico.A. nigromarginata

2. Areole borders pale or concolorous. Undersides of areoles pale.
3

3. Apothecia 1-1.5(-2) mm diameter, partly common, the disc black, scabrid, \pm prominent, plane, the margin thin. Thallus broadly expanded, areolate-squamuliform, uniform, mostly contiguous, partly dissolved into groups of areoles; areoles (0.5-)1-1.5 mm across, often at least 0.7 mm thick, irregular, convex, \pm broadly affixed, red-brown above, pale below, mostly separated by often wide cracks, sometimes with partly raised margin and subimbricate, by cracks gradually dividing into smaller parts. Crust on the whole very uneven, the areoles easily loosening from the substrate. Upper cortex 25-35 um thick; cells 3-4 um diam. Spores 3.5-5 x 1.6 um; hymenium 60-75 um high. Algal layer 100 um thick, with deep pits of perpendicular hyphae; cortical cells 3-4 um. Colorado.A. asperata

3. Apothecia under 1 mm diameter. 4

4. Thallus red-brown, epruinose. 5

4. Thallus pale chocolate brown, faintly pruinose; areoles densely crowded, verrucose, 0.5-1 mm across; apothecia 0.5-0.6 mm, 1-3 per areole, disc depressed; hymenium 80-100 um; cortex 35-40 um. Spores (often not developed) globular to ovoid, 4-7 x 3 um. Paraphyses 2-3 um thick at base. Upper cortex 35-40 um thick; cells 3-5(-6) um. Algal layer 60-80 um thick, with even upper surface but frequently interrupted by distinct strands of hyphae. Apothecia punctiform to elongate-distorted. On granite, southern California.A. californica

5. Hymenium 80-110 um. Cortical cells 2.5-3.5 um. Thallus effuse, contiguous; areoles 0.6-1(-1.5) mm across, 0.5-0.8 mm thick, red-brown; young ones convex, verruciform; older ones slightly convex forming an uneven crust with the medulla sometimes visible in the irregular cracks between the areoles, which are firmly attached and dissolve the surface of the rock. Spores ca. 100, broadly ellipsoid, 4-5 x 2-2.5 um. Cortex 35-40 um thick. Apothecia 0.4-0.5

mm, 1 per areole, disc slightly pruinose, surrounded by the prominent, thick margin of the areole. Paraphyses 2-2.5 um thick at base; tips capitate, 4 um. Arizona.A. obnubila

5. Hymenium 100-170 um. Cortical cells 3.5-5.5 um. Cortex 35-45 um thick. Thallus squamulose-areolate, the areoles 0.5-0.7 mm across, 0.3-0.5 mm thick, very irregular in shape, with smooth convex surface, often berruciform, separated by thin cracks, contiguous, forming islands among other lichens, dark red-brown, broadly attached, pale below. Apothecia 1 to few per areole, the disc dark, punctiform. Paraphyses 2-3 um thick. Spores ca. 100, subglobose to broadly ellipsoid, 3-4 x 2-2.5(-3) um. Thallus K-, C-. Parasitic on a yellow Acarospora (A. novomexicana) over siliceous rocks, New Mexico. (A. interjecta)

III-H-2
Paraphyses 1.5-2 um thick at base.

- 1. Underside of areoles dark.** 2
1. Underside pale. Hymenium under 200 um. 5

- 2. Areole edges concolorous or pale.** 3
2. Areoles black edged. 4

3. Apothecia (0.3-)0.5-1 mm diameter, Hymenium 90-100-120(-170) um. Spores subcylindrical, 4-6 x 1.5-2 um. Thallus indeterminate, squamulose or areolate-squamulose; squamules grouped or contiguous, pale or dark chestnut brown, mostly shiny, epruinose, (0.5-)1-2(-3.5) mm diameter, convex or almost hemispherical or irregular, almost lobed. Underside black. Apothecia mostly several per areoles, soon very roughened, surrounded by a mostly well developed prominent thalline margin. Paraphyses 1.5-2 um thick below; tips 2.5-3-4(-5) um. On non-calcareous rocks, often high in iron or other heavy metals. Nevada. A. peliscypha

3. Apothecia 0.1-0.5 mm, Hymenium to 100 um. Spores 3-5 um long. Apothecial discs concave, smooth or slightly rugulose. Algal layer continuous. Thallus of dispersed, adnate, rounded areoles; areoles plane or slightly convex, smooth, \pm dark brown, 0.2-1.4 mm across; lower side pale or often dark. Apothecia 1(-5) per areole, the disk red-brown or blackish, the margin usually indistinct, entire or irregularly granulate, \pm concolorous with thallus. Spores 100-200 per ascus, 3-5 x 1.5 um; hymenium 60-80 um; paraphyses 1.6-1.9 um below; tips 3-5 um, reflexed. On nutrient-enriched rocks. California; Alaska. See Thomson 1997 for fuller description. A. veronensis

4. Hymenium 70-85 um. Areoles grouped, angular, 0.2-1.2 mm across, dark red-brown. Underside black-brown. Apothecia 0.2-0.8 mm, 1(-3) per areole, filling the areole, the disc \pm immersed, plane or slightly concave, dark (red when wet), the margin concolorous with the disc, distinct but not projecting. Algal layer regular, interrupted. Spores 4-5.5 x 2-2.5 um; Paraphyses ca. 2 um thick, tips 3-6 um thick. A. scotica

4. Hymenium 85-115 um; Thallus squamulose-areolate, with indistinct, thinner marginal lobes; areoles angular, to 0.5 mm across, dispersed to grouped, dark red-brown, black below; apothecia 0.1-0.3 mm across, 1 per areole, the margin prominent. Paraphyses 1.7-2 um thick. Spores narrowly ellipsoid, 4-5 x 1.7 um. cortical cells 1.5-3 um. Paraphyses tips not thickened. Parasitic on other lichens. Arizona, Mexico. (A. complanata)

5. Hymenium 140-180 um. Paraphyses tips 6 um. Apothecia 0.3-1.4 mm diam., 1-6 per areole, at first dot-like and immersed, surrounded by a thick thalloid margin, becoming superficial, flat, and with a thin proper exciple of same color as disc, the disc umbonate, \pm projecting and rapidly convex, dark reddish brown, scabrid, finely rugose, sometimes several confluent; margin concolorous with thallus, thin, indistinct. Areoles dispersed or grouped, variable in shape, round or lobate, with uneven, rough, bullate surface, matt, (0.6-)1.5-5 mm across, 0.4 mm thick, \pm pale brown or yellowish brown; cortex 30-60 um. Underside pale to

brownish. Algal layer very irregular and discontinuous, dentate in vertical section. Exciple 20-30 um, dark brown. Hypothecium yellowish, I+ blue; epihymenium yellowish brown; hymenium 120-170 um, hyaline, reaction with I variable, blue, greenish blue or dark wine-red. Paraphyses 1.5 um thick, not capitate. Spores ellipsoid, sometimes appearing 1-septate, 3.5-5.5 x 1.8-2 um. Thallus K-, C-, P-. On rocks. Arctic.A. scabrida

5. Hymenium lower. Paraphyses tips mostly narrower. 6

6. Hymenium over 100 um. 7

6. Hymenium under 100 um. 8

7. Spores subglobose to broadly ellipsoid, 3.5-5 x 3-3.5 um. Upper side of areoles ± dark red-brown. Thallus squamulose; squamules dispersed, matt, epruinose, 1-2 mm diameter, ca. 0.5 mm thick, subverrucose, roundish, pale below. Apothecia 1(-3) per areole, impressed-sessile, 0-3-0.7 mm diameter, black, plane, surrounded by prominent dark proper margin. Hymenium 100-110 um; paraphyses 2 um thick below, the tips 3-3.5 um. Thallus K-, C-. On volcanic rock. Washington.A. washingtonensis

7. Spores narrowly ellipsoid, 3.5-4 x 1.7 um. Upper side of areoles pale brown-olive; hymenium 100-120 um; apothecia 0.5-1 mm diam., the disc brown-red, level with thallus, often irregular in shape, epruinose. Thallus determinate, to at least 2-3 cm across; areoles ca. 1 mm wide and convex, with slightly raised edge, partly incised and lobe-like, sterile; central areoles more undulating or appressed with often subimbricate margins or separated by ± wide fissures; areoles 0.5-0.7 mm thick (1 mm thick at edge), contiguous, with narrow affixing point, with free, ± ascending margins, convex, epruinose. Lower side pale. Upper cortex 25-35 um thick. Algal layer ca. 100 um thick, continuous. Paraphyses 1.7-2 um thick, the tips not thickened. Spores probably under 100/ascus. On arkosic rock, 6000 ft. Colorado.A. boulderensis

8. Hymenium 85-100 um.9

8. Hymenium under 85 um. 10

9. Cortical cells 3-4.5 um. Apothecia rare, to 0.2 mm diam., 1 per areole, the disc black, epruinose; thallus delimited, the areoles plane, castaneous brown. Thallus forming continuous, ± distinctly limited areas to at least 4 cm broad, or groups only a few mm wide, or areoles ± scattered among and upon other lichens, 0.5-0.7 mm across, 0.3-0.5 mm thick, dark (or in shade very pale), in open situations ± shiny, smooth, plane, angular, separated by very thin cracks, closely adnate, non-gomphate, pale below. Paraphyses 1.8-2 um thick at base, the tips 3.5-4.5 um. Spores ca. 100, 3-4(-5) x 1.5(-2) um, perhaps not ripe. On sandstone, New Mexico.A. applanata

9. Cortical cells 2-3 um. Apothecia 0.1-0.3 mm diam., 1-3 per areole, the discs concave, the margin indistinct. Thallus effuse, ± contiguous; areoles 0.4-0.7 mm, dark red-brown. Paraphyses 1.7-2 um. Southwest to Midwest.A. americana

10. Areoles 0.2-0.5 mm, dark red-brown to brown-glack, contiguous, plane. Spores 3-4.4 x 1.7 um, 100-200 per ascus; paraphyses 1.7 um below, tips 3-3.5 um, brown. Cortical cells 3-5 um. Apothecia numerous, 1-2 per areole, 0.1-0.3 mm, subimpressed, the margin prominent. Hymenium 68-75(-85) um. Thallus areolate, indeterminate, at

least 2-3 cm across; areoles contiguous, separated by thin cracks, angular, matt. Upper cortex 10-20 μm . Algal layer continuous with even upper surface, 40-55 μm . On sandstone, western Texas.A. tenebrica

10. Areoles 0.5-0.7(-1) mm. 11

11. Cortical cells 5-10 μm . Apothecia 1 per areole, occupying the whole areole, the disc 0.4-0.6(-1) mm diam., plane, dark red-brown to brown, the margin very thin, slightly prominent. Thallus indeterminate, areolate; areoles \pm dispersed, verruciform, irregular, dark red-brown to brown, pale below. Upper cortex consisting only of the dark reddish brown ends of the hyphae, which are 4-6 μm broad, or sometimes with an additional row of colorless, indistinct cells below; epinecral layer absent. Algal layer occupying most of the thallus. No lower cortex. Hypothecium ca. 50 μm . Hymenium 75-85 μm high. Paraphyses 1.7 μm thick, the tips swollen to 3-4 μm . Spores ca. 100, narrowly ellipsoid, 4-5 x 1.7 μm . On sandstone, southern California, New Mexico.A. particularis

11. Cortical cells 2-3 μm . Apothecia often 1 per areole, immersed, punctiform, the disc finally dilated at top of areole to 0.3-0.5 mm diam., black, plane, round, rather smooth, the margin prominent. Thallus squamulose; squamules dispersed to a few grouped, 0.5-0.7(-1) mm across, 0.4-0.5 mm thick, dark red-brown, smooth, very convex, almost verruciform, \pm regularly rounded, \pm broadly peltate, pale below. Upper cortex ca. 25 μm thick; cells 2-3 μm diam.; algal layer continuous, ca. 50 μm thick, the surface even. Medulla transparent. Lower cortex distinct. Hypothecium 35-50 μm . Hymenium 65-75 μm . Paraphyses \pm discrete, 2 μm thick, the tips capitate. Spores scarcely 100, broadly ellipsoid, 3-4 x 2 μm . On sandstone, southern California.A. elevata

III-H-3

Paraphyses under 1.5 um thick at base

1. Areoles dark below. Edges pale or concolorous. 2

1. Areoles pale below. 4

2. Algal layer frequently interrupted. Hymenium 200 um. Spores 3-5 x 1.5 um. Areoles discrete, convex, alutaceous (leather colored/pale brown) above; underside dark. Apothecia often 2-3 per areole, 0.2-0.3 mm across, the disc immersed, brown-black, the margin usually distinct, dark, elevated. Algal layer interrupted. Thallus squamulose; squamules evenly dispersed to a few contiguous, round, matt, dark below, 0.4-0.6(-1) mm diam., 0.3-0.5 mm thick, narrowly attached. Upper cortex 30-40 um thick; cells 2.5-4 um. Algal layer 100-135 um thick. Paraphyses 1-1.5 um thick, the tips 3 um.

Pennsylvania. A. dispersa

2. Algal layer continuous. 3

3. Areoles 1-1.5(-2.5) mm across, 0.5-0.7 mm thick, blackish, ± convex to nearly globulose.

Hymenium 135-170 um. Spores very numerous, narrowly ellipsoid, 4-5 x 1.5 um. Apothecia punctiform, 0.15-0.3 mm across, 2-8 per areole, deeply immersed, the disk round, dark brown, the margin swollen, elevated; areoles ± dispersed to grouped. Cortex very thin, 8-15 um thick. Underside dark. Algal layer continuous. Proper exciple distinct, 15-20 um. Epihymenium dark brown; hymenium 135-170 um, I+ blue or reddish. Paraphyses 1.3-1.7 um thick at base, tips to 3 um. Thallus K-, C-, P-. On granitic rocks, sometimes over other lichens.

Arctic. A. pyrenopsoides

3. Areoles 0.5-1 mm across, 0.2-0.4 mm thick, pale yellow-brown to red-brown, plane, matt.

Spores ellipsoid, 3.5-6 x 1.5-1.7 um. Areoles dispersed to contiguous, irregular, angular, smooth. Apothecia 0.2 mm across, the disc red-brown, the margin slightly prominent, blackish. Algal layer continuous. Hymenium 120-200 um. Paraphyses 1-1.5 um thick. British Columbia (as "cf.") A. asahinae

4. Areole borders white. Areoles 0.1-0.3 mm diam., ± circular and rather thick but flattened, rather thinly scattered or occasionally in small clusters; upper surface dark chestnut brown. Apothecia 1/areole, punctiform. Asci flask-shaped. Paraphyses free, thread-like, ± twining, not septate, rarely forked near apex; hymenium I+ blue; spores very numerous, ellipsoid, 2.5-4 x 1-1.5 um. On loose rocks on soil, 2400 ft, central coast of California. A. albomarginata (Herre) Salisb. non (Magn.) Clauz. & Roux (was Thelocarpon; see Lichenologist 3: 191 (1966); paraphyses width not given by that article)

4. Areole borders ± concolorous. Areoles to 5 mm across, to 1 mm thick. Hymenium 125-140(-200) um. Spores 2-5 x 1-2 um, 200(-300) per ascus. Areoles well developed, very variable, not entirely occupied by the apothecia, under side pale, upper side pale to rather dark yellowish brown or grayish, epruinose, not lobed or verruciform. Apothecia 0.1-0.7 mm diam., 1-5(-15) per areole, discs often rugose or umbonate, ± concave, margin concolorous with disc. Paraphyses to 1-1.5 um thick at the base, mostly non-anastomosing, the tips under 3 um thick. Algal layer regular or irregular, continuous or discontinuous. Northern. (A. smaragdula v. lesdainii)

Description of A. albomarginata from Salisbury:

Verrucae broadly hemispherical, 0.25-0.5(-0.6) mm diam., chestnut brown, margined with white crystals at the base. Upper cortex c. 20 µm thick, cellular, walls of outermost cells brown. Lower cortex absent

Apothecia 1-3 per wart. Discs punctiform; thalline exciple c. 60 µm thick, tapering to apex of apothecium. Apothecia sublobose, 200-250 µm across; excipulum c. 9 µm thick all around, colorless; hymenium 100-150 µm, I+ blue. Paraphyses equal in length with the apices pressed together to form the disc, simple. Asci pyriform, walls at apices 3-6 µm thick. Spores oblong, 3-5(-6) x 1.5 µm.

Pycnidia immersed, conical, c. 100 µm diam., 200 µm high, wall very thin, colorless. Conidiophores 14 µm long, simple; microconidia produced apically, oblong, simple, 4 x 0.7 µm. On rock.

ADD:

A. cervina

Thallus consisting of scattered, or ± continuous, almost squamulose, rather thin areoles, which are gray-brown, usually with a white margin, often pruinose, 0.5-1.8 mm wide, usually incised or slightly lobed.

Apothecia not crowded, 0.3-1 mm wide, immersed, dark brown-red, pruinose; hymenium 0.3% and 1% I+ blue; spores 5-6 x 3-4 µm.

A. glaucocarpa

Thallus areolate, usually continuous, areoles 0.5-3.2 mm wide, thick, not incised or squamulose, often pruinose at margin, sometimes completely pruinose, grayish to greenish brown or light brown.

Apothecia often crowded, 0.6-3 mm wide, sometimes cracked, with elevated rim and red-brown epruinose disc, hymenium I+ blue; spores > 100, 2.5-4.5 µm.

ALTERNATIVE KEYS TO K-, C-, BROWN, NON-LOBATE SPECIES

Rev. 3/94

This is a preliminary attempt to group species by obvious, mostly external, features, saving features such as paraphyses width till later within the keys.

ALT-1. Thallus pale, greenish, yellowish, or brownish.

1. **Growing in California or Nevada.** [More info. needed]. 2

1. **Growing in more northern or eastern areas.** 6

2. **Apothecia pale greenish or bluish pruinose.** Spores oblong, 3-4 x 1-2 um. Hymenium 140-150 um. Paraphyses ca. 1.5 um below, tips not thickened. Thallus of minute, flattened to convex, continuous or scattered squamules. Apothecia immersed 1-3 in each squamule, the disc punctiform to round or irregular, concave to flat. Thallus C-. On argillaceous shale, S. California. A. aeruginosa

2. **Apothecia epruinose.** 3

3. **Thallus pale chocolate brown or chestnut brown.** 4

3. **Thallus greenish gray to yellowish or brownish, not reddish brown.** 5

4. **Spores (often not developed) globular to ovoid, 4-7 x 3 um. Paraphyses 2-3 um thick at base. Thallus pale chocolate brown, faintly pruinose; areoles 0.5-1 mm across,** closely congregated, verrucose. Upper cortex 35-40 um thick; cells 3-5(-6) um. Algal layer 60-80 um thick, with even upper surface but frequently interrupted by distinct strands of hyphae. Apothecia punctiform to elongate-distorted, to 0.5-0.6 mm, 1-3 per areole, disc depressed. Hymenium 80-100 um. California. A. californica

4. **Spores subcylindrical, 4-6 x 1.5-2 um. Paraphyses 1.5-2 um thick at base. Thallus pale or dark chestnut brown, mostly shiny, epruinose; areoles (0.5-)1-2(-3.5) mm diam.** Hymenium 90-100-120(-170) um. Thallus indeterminate, squamulose or areolate-squamulose; squamules grouped or contiguous, convex or almost hemispherical or irregular, almost lobed. Underside dark. Apothecia mostly several per areole, (0.3-)0.5-1 mm diam., soon very roughened, surrounded by a mostly well developed prominent thalline margin. Paraphyses tips 2.5-3-4(-5) um. On non-calcareous rocks, often high in iron or other heavy metals. Nevada. A. peliscypha

5. **Thallus thin, composed of small, flat to slightly convex, rough, greenish gray to brownish, scale-like areoles, sometimes crowded into an uneven, chinky crust.** Apothecia 0.3-0.7 mm across, 1 or rarely more partly immersed in an areole, the disc flat to slightly convex, black, the proper exciple thin, black, becoming irregular, surrounded by a very thin, soon disappearing, thalloid one. Hypothecium hyaline to brownish. Spores ellipsoid, 2.5-4 x 1-1.5 um. On sandstone, S. California. A. arenosa

5. **Thallus thick, of irregular, sometimes lobate, often scattered areoles or squamules, pale greenish gray to dusky yellowish or brown, beneath pale yellowish to brown.** Apothecia 0.4-

0.6 mm across, immersed 1-several in each areole, the disc slightly concave to flat, reddish brown. Spores 3-5 x 1-1.5 μ m. On sandstone, California. A. hassei (= ? A. smaragdula v. lesdainii; also see A. boulderensis)

6. Apothecial disc \pm expanded, mostly over 0.5 mm diam. 7

6. Apothecia punctiform, to 0.2-0.3 mm diam. 9

7. Discs smooth, subplane. Areoles to 1 mm across. Upper side of areoles pale brown-olive; hymenium 100-120 μ m; apothecia 0.5-1 mm diam., the disc brown-red, level with thallus, often irregular in shape, epruinose. Thallus determinate; areoles 0.5-0.7 mm thick (1 mm thick at edge), contiguous, with free, \pm ascending margins, convex, epruinose; underside pale.

Paraphyses under 1.5 μ m thick at the base. Colorado. A. boulderensis

7. Discs often umbonate, rugose, or scabrid. Areoles to 5 mm across. 8

8. Paraphyses tips under 3 μ m thick. Apothecia 0.1-0.7 mm diam., 1-5(-15) per areole. Spores 2-5 x 1-2 μ m, 200(-300) per ascus. Areoles well developed, very variable, not entirely occupied by the apothecia, to 5 mm across, to 1 mm thick, lower side pale, upper side pale to rather dark yellowish brown or grayish, epruinose, not lobed or verruciform. discs often rugose or umbonate, \pm concave, margin concolorous with disc. Paraphyses to 1 μ m thick at the base, mostly non-anastomosing. Algal layer regular or irregular, continuous or discontinuous. Northern. (A. smaragdula v. lesdainii)

8. Paraphyses tips 6 μ m. Apothecia 0.3-1.4 mm diam., 1(-6) per areole. Spores 3.5-5.5 x 1.8-2 μ m. Disc umbonate, \pm projecting and rapidly convex, brown, finely rugose, the margin concolorous with thallus, thin, indistinct. Areoles dispersed or grouped, variable in shape, uneven, rough, 0.6-5 mm across, 0.4 mm thick, \pm pale brown. Underside pale. Algal layer very irregular and discontinuous, dentate in vertical section; hymenium 140-180 μ m. Paraphyses 1.5 μ m thick at base. Arctic. A. scabrida

9. Discs red-brwon. Areoles angular, plane. Spores 3.5-6 x 1.5-1.7 μ m. Areoles dispersed to contiguous, irregular, 0.5-1 mm across, 0.2-0.4 mm thick, dull, pale yellow-brown to red-brown, smooth. Apothecia 0.2 mm across, the margin slightly prominent, blackish. Algal layer continuous (dissected by thick hyphal strands according to Noble). Hymenium 120-200 μ m. British Columbia (as "cf."). A. asahinae

9. Discs brown-black. Areoles rounded, convex. Areoles 0.4-0.6(-1) mm across, 0.3-0.5 mm thick, Hymenium 200 μ m. Spores 3-5 x 1.5 μ m. Areoles discrete, alutaceous (leather colored/pale brown) above. Apothecia 0.2-0.3 mm across, the disc immersed, the margin usually distinct. Algal layer interrupted. Underside of areoles dark.

Pennsylvania. A. dispersa

**ALT-2. Thallus \pm dark, \pm red-brown.
Areoles bordered in black;**

1. Paraphyses 2-3 μ m thick at the base. Upper surface of areoles densely pruinose.

Underside pale. Areoles bordered in black, 0.5 mm across, very thin (0.1-0.2 mm). Apothecia punctiform, 0.1 mm diam., concave, black, epruinose. Spores 3.5-4 x 2.5 μ m; hymenium 85-100 μ m. Arizona, Mexico.A. nigromarginata

1. Paraphyses under 1.5 μ m thick at base. Upper surface of areoles epruinose or at least not densely pruinose. Underside dark. 2

2. Apothecia 0.2-0.8 mm, Hymenium 70-85 μ m. Paraphyses tips 3-6 μ m thick.

Areoles grouped, angular, 0.2-1.2 mm across, dark red-brown. Apothecia 1(-3) per areole, filling the areole, the disc \pm immersed, plane or slightly concave, dark (red when wet), the margin concolorous with the disc, distinct but not projecting. Algal layer regular, interrupted. Spores 4-5.5 x 2-2.5 μ m; Paraphyses under 1.5 μ m thick at the base.A. scotica

2. Apothecia 0.1-0.3 mm across, Hymenium 85-115 μ m; Paraphyses tips not thickened.

Thallus squamulose-areolate, with indistinct, thinner marginal lobes; areoles angular, to 0.5 mm across, dispersed to grouped, dark red-brown, black below; apothecia 1 per areole, the margin prominent. Spores narrowly ellipsoid, 4-5 x 1.7 μ m. Cortical cells 1.5-3 μ m. Paraphyses under 1.5 μ m thick at the base. Parasitic on other lichens. Arizona, Mexico.(A. complanata)

**ALT-3. Upper side of areoles ± dark;
Areole borders pale or concolorous.**

1. Areole borders white. Paraphyses under 1.5 µm thick at base. Areoles 0.1-0.3 mm diam., ± circular and rather thick but flattened, rather thinly scattered or occasionally in small clusters; upper surface dark chestnut brown. Apothecia 1/areole, punctiform. Asci flask-shaped.

Paraphyses free, thread-like, ± twining, not septate, rarely forked near apex; hymenium I+ blue; spores very numerous, ellipsoid, 2.5-4 x 1-1.5 µm. On loose rocks on soil, 2400 ft, central coast of California. A. albomarginata (Herre) Salisb. non (Magn.) Clauz. & Roux

1. Areole borders ± concolorous, or at least not white. 2

2. Discs expanded, often over 0.5 mm wide. 3

2. Discs punctiform, to 0.3 mm wide, or apothecia absent. ALT 3-a

3. Apothecia often ± sessile, the disc becoming convex. 4

3. Apothecia ± immersed and concave. 5

4. Hymenium 60-90 µm. Algal layer regular, ± continuous. Spores over 200 per ascus, 3-6 x 1.5-2.5 µm. Apothecia 0.4-2 mm diam., 1 per areole, the disc ± circular, smooth then ± rugose, the margin concolorous with disk, entire, projecting, often rather thin.

Thallus poorly delimited, areoles 0.4-3 mm across, to 1 mm thick, round, irregularly convex to ± plane, smooth or rugose, ± dark brown, ± grouped, dark below. Paraphyses 2-3 µm thick at the base, tips 4-5 µm; cortical cells 3-4 µm; On schists or granite, alpine, southwestern. A. badiofusca

4. Hymenium 140-180 µm. Algal layer very irregular and discontinuous, dentate in vertical section; Paraphyses tips 6 µm. Apothecia 0.3-1.4 mm diam., 1(-6) per areole, the disc umbonate, ± projecting and rapidly convex, brown, finely rugose, the margin concolorous with thallus, thin, indistinct. Areoles dispersed or grouped, variable in shape, uneven, rough, 0.6-5 mm across, 0.4 mm thick, ± pale brown. Paraphyses 1.5-2 µm thick at the base. Arctic. (A. scabrida)

5. Apothecia 1-2 mm diameter, common, the disc black, scabrid, ± prominent, plane, the margin thin. Thallus squamuliform, with cracks; areoles 1-1.5 mm across, 0.7 mm thick, red-brown above; Paraphyses 2-3 µm thick at the base. spores 3.5-5 x 1.6 µm; hymenium 60-75 µm high; algal layer 100 µm thick, with deep pits of perpendicular hyphae; cortical cells 3-4 µm. Colorado. A. asperata

5. Apothecia under 1 mm diameter. 6

6. Upper side of thallus pale to rather dark yellowish brown or grayish, Spores 2-5 x 1-2 µm, 200(-300) per ascus. Areoles well developed, very variable, not entirely occupied by the apothecia, to 5 mm across, to 1 mm thick, lower side pale, epruinose, not lobed or verruciform. Apothecia 0.1-0.7 mm diam., 1-5(-15) per areole, discs often rugose or umbonate, ± concave, margin concolorous with disc. Paraphyses to 1 µm thick at the base, mostly non-anastomosing, the tips under 3 µm thick. Algal layer regular or irregular, continuous or discontinuous. Northern. (A. smaragdula v. lesdainii)

6. Upper surface dark red-brown or dark brown, without yellowish or grayish tinges. 7
7. Thallus \pm contiguous. 8
7. Thallus \pm dispersed. 9
8. Hymenium 80-110 μ m. Paraphyses 2-3 μ m thick at the base. Areoles 0.6-1(-1.5) mm across. Apothecia 0.4-0.5 mm, 1 per areole; disc slightly pruinose. Cortical cells 2.5-3.5 μ m. Thallus effuse, contiguous; areoles 0.5-0.8 mm thick, red-brown, epruinose; spores 4-5 x 2-2.5 μ m. Cortex 35-40 μ m thick. Arizona. A. obnubila
8. Hymenium 90-100-120(-170) μ m. Paraphyses 1.5-2 μ m thick at the base. Areoles (0.5-)1-2(-3.5) mm across. Apothecia (0.3-)0.5-1 mm diam., mostly several per areole, soon very roughened, surrounded by a mostly well developed prominent thalline margin. Cortical cells 3(-5) μ m diam. Spores subcylindrical, 4-6 x 1.5-2 μ m. Thallus indeterminate, squamulose or areolate-squamulose; squamules grouped or contiguous, pale or dark chestnut brown, mostly shiny, epruinose, convex or almost hemispherical or irregular, almost lobed. Paraphyses tips 2.5-3-4(-5) μ m. On non-calcareous rocks, often high in iron or other heavy metals. Nevada. A. peliscypha
9. Underside of areoles dark. Areoles verruciform, irregular. Cortical cells 5-10 μ m. Apothecia 1 per areole, the disc plane, dark red-brown to brown, the margin prominent. Areoles \pm dispersed, dark red-brown to brown; spores narrowly ellipsoid, 4-5 μ m long. Paraphyses under 1.5 μ m thick at base. On sandstone, California, New Mexico. A. particularis
9. Underside of areoles pale. 10
10. Apothecia with prominent, dark proper margin. Hymenium 100-110 μ m; paraphyses 2 μ m thick below, Spores subglobose to broadly ellipsoid, 3.5-5 x 3-3.5 μ m. Thallus squamulose; squamules dispersed, \pm dark red-brown, matt, epruinose, 1-2 mm diameter, ca. 0.5 mm thick, subverrucose, roundish, pale below. Apothecia 1(-3) per areole, impressed-sessile, 0.3-0.7 mm diameter, black, plane, Paraphyses tips 3-3.5 μ m. Thallus K-, C-. On volcanic rock. Washington. A. washingtonensis
10. Margin of apothecia usually indistinct, \pm concolorous with thallus. Hymenium 60-80 μ m. 11
11. Paraphyses under 1.5 μ m thick at the base. Spores rather narrowly ellipsoid, 3-5 x 1.5 μ m. Areoles \pm dark brown, plane or slightly convex, rounded. Apothecial discs concave, smooth or slightly rugulose. Algal layer continuous. On nutrient-enriched rocks. Thallus of dispersed, adnate, areoles; smooth, 0.2-1.4 mm across. Apothecia 0.1-0.5 mm, 1(-5) per areole, the disk red-brown or blackish, the margin entire or irregularly granulose, Spores 100-200 per ascus; paraphyses tips 3-5 μ m, reflexed. California. (A. veronensis)
11. Paraphyses 2 μ m thick at the base. Spores broadly ellipsoid, 3-4 x 2-2.2 μ m. Cortical cells 2-3 μ m. Apothecia often 1 per areole, immersed, punctiform, the disc finally dilated at top of areole to 0.3-0.5 mm diam., black, plane, round, rather smooth, the margin prominent. Thallus squamulose; squamules dispersed to a few grouped, 0.5-0.7(-1) mm across, 0.4-0.5 mm thick, dark red-brown, smooth, very convex, almost verruciform, \pm regularly rounded, \pm broadly

peltate, pale below. Upper cortex ca. 25 μ m thick; cells 2-3 μ m diam.; algal layer continuous, ca. 50 μ m thick, the surface even. Medulla transparent. Lower cortex distinct. Hypothecium 35-50 μ m. Hymenium 65-75 μ m. Paraphyses \pm discrete, 2 μ m thick, the tips capitate. Spores scarcely 100/ascus. On sandstone, southern California.A. elevata

**ALT-3-A. Upper side \pm dark; borders \pm concolorous;
Apothecia punctiform (under 0.3 mm diam.) or absent**

1. Areoles dark below. Thallus \pm dispersed. 2

1. Areoles pale below. Thallus often \pm contiguous. 3

2. Hymenium 135-170 μ m. Apothecial margin swollen, elevated. Areoles 1-1.5(-2.5) mm across. Spores 4-5 x 1.5 μ m. Apothecia punctiform, 0.15-0.3 mm across, 2-8 per areole, the disk dark brown, Areoles \pm dispersed to grouped, \pm convex, 0.5-0.7 mm thick, blackish. Algal layer continuous. Paraphyses under 1.5 μ m thick at the base.

Arctic. A. pyrenopsoides

2. Hymenium to 100 μ m. Apothecial margin usually indistinct. Areoles 0.2-1.4 mm across. Spores 3-5 μ m long. Apothecial discs concave, smooth or slightly rugulose. Algal layer continuous. On nutrient-enriched rocks. Thallus of dispersed, adnate, rounded areoles; areoles plane or slightly convex, smooth, \pm dark brown, Apothecia 0.1-0.5 mm, 1(-5) per areole, the disk red-brown or blackish; margin entire or irregularly granulose, \pm concolorous with thallus. Spores 100-200 per ascus, 3-5 x 1.5 μ m; hymenium 60-80 μ m; Paraphyses under 1.5 μ m thick at the base. paraphyses tips 3-5 μ m, reflexed. California. (A. veronensis)

4. Areoles rounded, convex, dispersed. Cortical cells 2-3 μ m. Apothecia 1 per areole, the disc finally dilated at top of areole, plane, smooth, the margin prominent. Areoles convex, rounded. Paraphyses under 1.5 μ m thick at base. Spores 3-4 x 2 μ m. California. (A. elevata)

4. Areoles angular, plane, \pm contiguous. 5

5. Areoles 0.5-1 mm across, Hymenium 120-200 μ m. Spores 3.5-6 x 1.5-1.7 μ m. Areoles dispersed to contiguous, irregular, angular, 0.2-0.4 mm thick, dull, pale yellow-brown to red-brown, plane, smooth. Apothecia 0.2 mm across, the disc red-brown, the margin slightly prominent, blackish. Algal layer continuous. Paraphyses 1.5-2 μ m thick at the base. (A. asahinae)

5. Areoles mostly to 0.5(-0.7) mm across. Hymenium under 100 μ m. 6

6. Hymenium 68-75(-85) μ m. Areoles contiguous, 0.2-0.3(-0.5) mm across, Upper cortex 10-20 μ m thick, the cells 3-5 μ m. Areoles dark red-brown to brown-black, plane, pale below. Spores 3-4.4 x 1.7 μ m, 100-200 per ascus; paraphyses 1.7 μ m below, tips 3-3.5 μ m, brown. Apothecia 1 per areole, 0.1-0.3 mm, almost concolorous with thallus, subimpressed, the margin prominent. Algal layer 40-55 μ m, continuous, with even surface.

Texas. A. tenebrica

6. Hymenium over 85 μ m. Areoles partly \pm dispersed, mostly over 0.5 mm across. Upper cortex mostly over 20 μ m thick. 7

7. Cortical cells 3-4.5 μ m. Paraphyses under 1.5 μ m thick at base. Apothecia 1 per areole, rare, to 0.2 mm diam., the disc black, epruinose; 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, 0.5-0.7 mm across, 0.3-0.5 mm thick, dark (or in shade very pale), in open situations \pm shiny, smooth, plane, angular, separated by very thin cracks, closely adnate, non-gomphate, pale below. Hymenium 85-100 μ m. Spores ca. 100, 3-4(-5) x 1.5(-2) μ m, perhaps not ripe. Upper cortex (25-)30-40(-50) μ m thick. On sandstone, New Mexico.A. applanata

7. Cortical cells 2-3 μ m. Paraphyses 1.7-2 μ m thick at base. Apothecia 1-3 per areole, 0.1-0.3 mm diam., the discs concave, punctiform to dilated, impressed, dark brown; margin indistinct. Thallus effuse, \pm contiguous to subdispersed; areoles 0.4-0.7 mm across, 0.2-0.5 mm thick, dark red-brown, plane to subconvex, irregularly round, non-lobate, usually matt; pale below. Upper cortex (15-)20-35 μ m thick; cells 2-3(-4) μ m. Algal layer 50-110 μ m, continuous with even surface. Hymenium (70-)85-100 μ m. Paraphyses tips capitate, 3-4 μ m. Spores narrowly ellipsoid, 100-200/ascus, 3.5-4.5 x 1.5-1.7 μ m. On granite, apparently nitrophilous. Southwest to Midwest.A. americana

ADD (not necessarily brown species):

A. clauzadeana (Llimona) Casares & Hafellner in Hafellner & Casares (See Hafellner & Casares-Porcel, 1992)

A. amphibola Wedd. (possibly a synonym of A. smaragdula)

Squamules pale to dark chestnut brown, red-brown, or gray-brown, often partly whitish pruinose, with white margin, \pm flat, usually contiguous. Algal layer mostly \pm continuous. Apothecia 1-4 per areole, mostly sparse, sunken; discs epruinose. Spores 3-6 x 1-3 μ m, more than 100 per ascus. A. cervina Massal. [both Wirth and Purvis & James treat this under A. glaucocarpa s. lato]