IV-A. On rock.
Thallus Orbicular, Delimited, K+ red,
Zonate to Radiate or Lobate

1. Thallus usually very thick; lobes usually very distinct and mostly elongated. Discs red-brown to brown-black; epihymenium N-. Mainly in deserts or temperate arid areas. ....(see Lobothallia)

1. Thallus usually thinner; lobes mostly less distinct, less elongated. Discs mostly green-black; epihymenium usually N+ green. Mainly in the Arctic. 2

2. Thallus brownish gray; lobes discrete, narrow. Spores 14-16 x 8.5 um. Apothecia 0.2-0.4(-0.5) mm. Hymenium 85 um. Hypothallus lacking. Pycnospores unknown. Paraphyses non-monilliform. Thallus thin; lobes convex, composed of narrow, elongated, angular, convex areolae, more grouped centrally in the thallus. Cortex transparent, the upper part olive brown. Medulla K+ red, C-, P-, I-. Apothecia in dense numbers in the center of the thallus, 1/verrucule; thalline margin thick, dark brown, the outer part paler; disc concave, black, epruinose. "Hypothecium" darkened (“unclear”), I+ blue-green; epithecium dark olive brown. Hymenium I+ orange-brown. Paraphyses coherent, simple or rarely branched, not moniliform. Spores 8, ellipsoid. On calcareous or siliceous rocks. Alaska. .....A. fimbriata

2. Thallus olive black, blackish gray or black, or sometimes mingled with whitish gray; lobes ± indistinct; spores (13-)17-25 x (7-)10-15 um. Apothecia 0.2-0.7 mm. Hymenium (85-)100-120(-150) um. Hypothallus ± distinct or not, black. (The smaller spores were reported by Magnusson under "Lecanora subradiascens", the larger ones were reported by Nylander under that name, and by various authors under "Lecanora stygioplaca"). Apothecia sparse to very dense in thallus center, solitary or 2-3 ± confluent; margin ± obtuse, pale or black, shining, prominent; disc concave, black, impressed, becoming irregular and uneven. Pycnospores 14-25 um long. Thallus shiny to matt; central part verrucose-areolate or areolate; areoles convex or flat, 0.5-1 mm diam., 0.4-0.6 mm thick, very irregular in shape, towards the center with deep cracks, the sides perpendicular; marginal part not radiate or only indistinctly so; lobes 1-2 mm long, 0.3-0.4 mm broad, widened towards the margin. Cortex 25-30(-40) um thick, transparent, the upper part dark. Epithecium dark olive brown or dark green, N+ green; "hypothecium" 35-50 um, pale; Paraphyses ± distinct, the upper 5-6 cells globose and moniliform, 3-4 um diam., or not moniliform, sparsely branched and anastomosing, the cells elongate and constricted between. Spores 8/ascus. 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 pre-treatment with HCl. On granitic rocks. Alaska and NW Territories. Apparently a quite variable species; the descriptions of its two synonyms (Lecanora subradiascens and L. stygioplaca differ considerably from each other). ..... A. subradians s. lato

Description of A. subradians after Thomson 1997:

Thallus olive-black to black, shining, only indistinctly radiate at margin, mostly not; areolate, the areolae very convex or flat; cortex of + perpendicular cell rows, paraplectenchymatous; over a black hypothallus.

Apothecia sparse, margin thick, of same color as thallus, I-; usually shining; disk black, bare, concave to flat, rough-appearing; hypothecium pale, I+ blue; epihymenium dark olive-green or brown, N+ green; hymenium 100-150 um, pale, I+ blue; paraphyses distinct, not moniliform, sparsely branched, anastomosing with the cells elongated and constricted between; spores 8, ellipsoid, 17-25 x 10-15 um. Conidia 13-24 um. Medulla K+ yellow then red, I-. On granitic rocks. Arctic.

Variations in A. subradians sensu lato

1. Paraphyses distinctly moniliform above. Apothecial margin black. Exciple indistinct. Hymenium 85-100 um. Epithecium dark green. Hypothallus absent or indistinct. Lobes ± distinct. Medulla producing only a few norstictic acid crystals in K. Cortex 25-30(-40) um. Spores 17-25 x 8-14 um (13-16 x 7-8.5 um according to Magnusson). Hypothecium 35-50 um. Pycnospores 16-25 um long. ..... A. subradiascens

1. Paraphyses scarcely moniliform above. Apothecial margin pale. Exciple widened at surface, 35-50(-80) um, prominent, ± dark brown. Hymenium 100-120(-150) um. Epithecium ± olive brown. Hypothallus ± distinct. Lobes indistinct. Thallus producing numerous norstictic acid crystals in K. Cortex 25-35 um. Spores 16-20 x 10-15 um (17-25 x 10-14 um according to Magnusson). Hypothecium 40-50 um, yellowish gray, opaque. Pycnospores 13-24 um long. ..... A. stygioplaca

IV-B On rock.
Thallus Orbicular, Delimited, K+ Yellow,
Zonate to Radiate or Lobate

1. Th. sterile, with scattered, ± sorediate verrucae, distinctly radiate, thin. Cortex 15(-20) um thick. Thallus gray to ashy or brownish gray, crustose, closely attached to the rock, with thin, slightly zonate thallus and the areolae radiate to the margins, the angular areolae tiny, to 0.3 mm broad, more elongate in the radiate direction, centrally with round soralia, 0.2-0.3 mm broad with bluish gray soredia, sometimes heaped, sometimes eroded out; cortex thin, not inspersed. Apothecia unknown. Conidia 20-25 um long. Medulla K+ yellow. On siliceous rock. Arctic. ..... (A. mashinginensis)

1. Th. fertile, or at least non-sorediate. 2

> **2. Th. distinctly radiate. Only the exciple surface K+ yellow.** Thallus grayish to white. .....(see A. candida and A. lesleyana)
>
> **2. Th. zonate, radiate or not. Thallus itself K+ yellow (if K+ only after pre-treatment with HCl, see A. contigua and A. polychroma v. ochracea).** 3

3. Lobes separate, narrow, radiate; exciple I+ blue; spores 12-17 x 7-8.5 um, ellipsoid, 8/ascus. Hymenium 70-85 um. Apothecia 0.3-0.5 mm, innate; disc concave, black; margin thick, prominent, concolorous with thallus or dark, I-. Epithecium dark olive brown, HCl+ yellowish mist. "Hypothecium" dense, darkened, I+ blue. Paraphyses coherent, branched, submoniliform, the uppermost cell globular. Hypothallus lacking or indistinct. Lobes composed of serially formed, convex, chinkily separated or contiguous areoles. Surface dark gray to olive or dark brown; central areoles more contiguous. Cortex transparent but upper part dark brown. Conidia 8-22 x 0.6-0.7 um. Medulla K+ yellowish. On non-calcareous rocks. Arctic (Alaska to Greenland). .....A. rosulata

3. Lobes contiguous or not developed. Thallus radiate. 4

> **4. Th. yellow-ochraceous.** Spores (10-)15-17 x 10-12 um. Hymenium 100-115 um. Thallus suborbicular, ca. 3 cm diam., moderately thin, soft, well covering the substrate; areoles separated by deep cracks, subplane to depressed convex, not radiating, toward periphery rather regularly tessellate, towards center coverd by apothecia; surface yellow-ochre; abuptly limited; hypothallus not visible. Apothecia numerous to crowded, often several per areole and becoming confluent, 0.5-1.0 mm diam., round to often angular from mutual pressure, immersed, then ± elevated; disc rather open, black, epruinose, subplane; margin thick, persisent, entire. "Hypothecium"

hyaline. Epithecium brown, inpsersed. Paraphyses coherent, the tips scarcely to slightly thickened, distinctly septate (submoniliform in K). Asci saccate to pyriform; spores often not developed, broadly ovoid to subglobose, 15-17 x 10-12 um. Pycnidia unknown. Medulla K+ yellow. Hymenium I+ blue then sordid red and asci dirty bluish brown. On basalt. Greenland. .....A. narssaquensis.

4. Th. ± gray or blackish. [Note: A. uplandica will also key out here; see note on that species under "ADD?"]. 5

5. Exciple I- (at least in "A. subradiascens"). Lobes indistinct, or to 1-2 mm long. Cortex 25-35(40) um. Thallus olive black to blackish gray or black, or mingled with whitish-gray. Medulla containing at least traces of norstictic acid in places (K+ rusty crystals, at least after pre-treatment in HCl). Spores (13-)17-25 x (7-)10-15 um (the smaller spores were reported by Magnusson under "Lecanora subradiascens", the larger ones were reported by Nylander under that name, and by various authors under "Lecanora stygioplaca"). Alaska and NW Territories. ..... A. subradians s. lato ("A. subradiascens")

5. Exciple I+ blue. Lobes 3-5 mm long. Cortex 15-20 um. Thallus ashy gray to dark gray. Medulla (and cortex) without norstictic acid (according to Magnusson, Nylander's report of a K+ reddish reaction is based on another species on the same rock as the type of this species). Spores 15-18 x 8.5-10 um. Thallus ± gray, not blackish. Hypothallus dark. Apothecia solitary or 2-4 confluent, prominent to sessile. Pycnospores 17-21 um. Thallus lobate, zonate toward the margins; lobes contiguous, dense, low, convex, radiate, 0.2-0.4 mm wide, tapering towards the tips, splaying over a black hypothallus, which forms a 1-2 mm wide, distinct border to the thallus; center verrucose-areolate; areoles convex, seprated by broad cracks that narrow towards the base. Cortex 15-20 um thick, transparent, the upper part dark brown, cells irregularly arranged. Thallus K+ yellow. Apothecia to 1.5 mm diam., prominent to almost sessile, 1(-2-4) per areole; discs 0.4-0.6 mm diam., concave or flat, black, sometimes with thin pruina; margin pale gray and prominent, sometimes inflexed. Epithecium greenish to brown. "Hypothecium" pale to slightly darkened, I+ bluish; hymenium 80-100 um, I+ greenish yellow to reddish brown. Paraphyses 1 um thick, indistinct, coherent, submoniliform, the upper cells subglobose, 2-3 um wide. Spores broadly ellipsoid to subglobse, 8/ascus. On siliceous rocks. Arctic (Alaska to Greenland). .....A. perradiata

ADD?:

6. Exciple I-. Cortex 25-35 um thick. Pycnospores 20-25 um long. Apothecia frequent towards center, ± crowded, solitary or 2-4 confluent, prominent to subsessile; disc black, plane, 0.5-1 mm diam., often irregular in shape; margin rather thin, ± flexuous, concolorous with thallus, ± inflexed, abrupt; limit between the disc and margin sharp. Subhymenium 35-50 um. Hymenium (85-)100-125 um high; epithecium 20-25 um, ± pale olive. Paraphyses ± distinct, with oil droplets, 1.7-2 um thick, rarely branched, submoniliform, the apices 3(-4) um, subglobose, the next cells ± broadly ellipsoid. Asci clavate. Excipulum ± distinct. Spores 15-18 x 8.5-10 um, ellipsoid, 8/ascus. Thallus ± broadly expanded, to 6-8 cm or more across, bluish- to lead-gray, towards periphery very thin, with 1-1.5 mm broad, dark, ± distinctly zonate margin, the areoles 0.3-0.5 mm across, irregular, convex, sterile; towards center much thicker (0.6-1 mm), verrucose-areolate; areoles covered by apothecia, or partly loosened; hypothallus dark. Cortex 25-35 um thick, ± transparent or cloudy, the upper part pale yellowish-olive, without epinecral layer; cells ± distinct, 3-3.5(-4.5) um. Algae 7-12 um diam.; algal layer 40-50 um thick, with even surface. Medulla ± transparent to ± opaque. On granite, probably by water. Not in Egan; identification tentative; may not occur in N. America [Need to find where I got the idea that it did; I may be mixed up with A. nordlandica]. ..... A. uplandica

IV-C-1. On rock.
Thallus Orbicular, Delimited, K-,
± Distinctly Radiate or Lobate

1. Thallus sorediate. Thallus K+ yellow after pre-treatment with HCl. Thallus dark gray, distinctly radiate; soralia ± indistinct. Cortical cells 2-3 um thick. ..... (A. mashinginensis)
1. Thallus not sorediate. 3

2. Thallus darker or paler gray, or brown-gray. 3
2. Thallus grayish white to white. 6

3. Apothecia at least 0.5 mm diameter when mature. Thallus brown to brownish gray or lead gray, sometimes olive. Hymenium ca. 100-110 um, I+ blue (according to Thomson), non inspersed. Paraphyses coherent, at most submoniliform. Epithecium olive blackish. Subhymenium pale, I+ blue. Exciple I+ dark blue, K-. Medulla opaque. Apothecia 1 per areole, immersed (projecting to sessile according to Thomson); disk impressed, black; margin thick, obtuse. Pycnospores 25-35 um. Thallus expanded; margins distinctly radiating; lobes 2-3 mm long, to 0.5 mm broad, convex, contiguous, separated by cracks; center areolate; areoles separated by cracks. Cortex 30-50 um thick, transparent; cells oriented perpendicularly. Spores 8, oval, 14-26 x 8-10 um. On siliceous rock. Arctic (Alaska to Greenland), S to Maine, Alberta, and Colorado. .....A. sublapponica
3. Apothecia rarely larger than 0.5 mm diameter. Medulla granular. Exciple K-, I-. 4

4. Apothecial margin ± darkened toward disc. Cortical hyphae perpendicular. Apothecia 1(-2) per verruca, 0.2-0.4 mm diam., impressed, often irregular; disc black. Epithecium dark greenish brown. Subhymenium dense, I+ blue. Hymenium 70-100 um, I+ blue (according to Thomson). Paraphyses coherent, moniliform with globose cells. Pycnospores 25-30 um. Spores broadly ellipsoid, 10-15 x 5-8 um. Thallus ± ochraceous gray, or gray with very yellowish or orangish cast, very continuous and thin with slightly raised radiating marginal lobe-like ridges giving a plicate appearance, the lobes not separated by cracks but by thallus portions; central parts appearing more areolate. Cortex 30-40 um thick. Medulla opaque. Pycnospores 25-30 um. On shaly or slaty, non-calcareous rock. Alaska. .....A. plicigera
4. Apothecial margin ± pale. 5

5. Hymenium 100-110 um. Thallus K+ yellow only after treatment with HCl. Thallus small, orbicular, radiate-areolate, ashy gray, thin, smooth, epruinose, minutely verrucose-areolate in center, radiate and ± distinctly zonate at margin, the lobes contiguous, convex; hypothallus dark. Areoles

convex, narrow, to 0.2 mm broad, branching, and toward the periphery, over a dark, ashy hypothallus, the sides of the radiating lobes darker than the centers. Apothecia numerous, 0.3-0.4 mm, 1 per areole, raised above thallus; disc black, epruinose, to 0.2 mm, thalloid margin entire, elevated and prominent. Thalloid exciple I+ blue turning reddish. Hypothecium cloudy; epihymenium brownish, HCl+ green; hymenium 100-110 um, inspersed, I+ blue; paraphyses slender, tips slightly monilifrom, to 2.5 um thick. Spores 8, often poorly developed, 12-16(-18) x 70-10 um. Margin of fertile verrucae with K+ pale yellow diffusion, I+ blue turning red. On non-calcareous rocks. Arctic (Greenland; NW Territories). .....A. contigua

5. Hymenium 85 um. Cortex paraplectenchymatous. Spores 8, ellipsoid, 12-15 x 8-9 um. Discs impressed, 0.2 mm. Thallus "delicate". Pycnospores unknown. Thallus orbicular, radiate, 1-1.5 cm diam., pale to dark gray, towards margin thinner, pale, continuous, smooth; towards center gradually lobate; lobes 2-3 mm long, 0.2-0.3 mm wide, sometimes branched, thin, convex, slightly darker, with indistinct cracks in the interior part; central part verrucose-areolate, rimulose. Hypothallus indistinct. Cortex ca. 35 um thick. Algae 7-10 um; algal layer ca. 50 um. Medulla granular. Fertile areoles 0.2-0.3 mm thick, prominent. Apothecia frequent towards center, 1 per areole, immersed; disc 0.2(-0.3) mm diam., deeply impressed; thalline margin obtuse, usually not obscured, regular. Exciple I-. "Hypothecium" ca. 30 um, cloudy, I+ faintly blue. Hymenium ca. 85 um, I+ yellowish brown. Epihymenium ± brown. Paraphyses indistinct, branched, seprating in K, 1.5 um wide; apices ca. 3 um, moniliform; cells subglobose. Asci broadly clavate. Thallus K-, C-, P-, I-. On slaty rock. Arctic (NW Territories). ..... A. subplicigera

6. Surface of exciple K+ brownish-yellow mist. Apothecial margin thick. 7

6. Surface of exciple K-. 9

7. Apothecia pruinose. Thallus ± expanded. 8

7. Apothecia epruinose. Thallus small (to 2 cm broad), forming rosettes, chalky white with a bluish tinge; outer areoles lobate and radiate; lobes short (ca. 1.5 mm long and 0.5 mm broad), rather distinct, convex, separated by cracks; central areoles angular. Hypothallus blackish and ± visible. Cortex and medulla filled with crystals. Apothecia in prominent verrucules, 1-3 per areole; disc to 0.3 mm diam., concave, black; margin thick, black next to disc, K+ yellow, I+ blue. Exciple I+ blue. Spores 8, ellipsoid, 9-16 x 7-10 um. Hymenium 75-120 um, I+ greenish yellow. Epithecium olive brown. "Hypothecium" hyaline, I+ pale blue. Paraphyses coherent, in much gelatin, containing oil drops, unbranched or sparingly branched, submoniliform, the tips ellipsoid. Asci clavate. Pycnospores unknown. Thallus K- but apothecial margin K+ yellow. On calcareous rock. Arctic (Alaska to Greenland; Utah; Colorado. .....A. lesleyana

8. Apothecial discs 0.15-0.35 mm diam., ± pruinose, irregular, immersed in ± flat verrucae; thalline margin slightly raised, black, sometimes K+ brownish yellow. Hymenium 110-170 um; subhymneium 50-100 um; hypothecium not visible; epithecium N± green. Paraphyses submoniliform, branched and anastomosed. Asci 6-8-spored. Spores (14-)18-21(-24) um x (10-)11.5-14(-16) um, ellipsoid, biseriately arranged. Pycnospores 15-28 um, sometimes very flexuous. Areoles 0.3-1 mm diam., 0.4-0.7 mm thick. Cortex 20-50 um. Algal layer continuous and irregular, 20-60 um. Lobes ± indistinct, subplane. Exciple I-. Thallus chalky blue-white or grayish to yellowish, pruinose, rimose-areolate to verrucose-areolate in center, well delimited and usually somewhat radiate or even vaguely lobate at margins. Medulla K+ yellow, with stictic and cryptostictic acids. Usually on calcareous rock, sometimes on siliceous rock. Alaska to Ellesmere Island; common in western Canada; south to Alberta and Colorado. .....A. candida (stictic acid strain; according to Thomson the species is K-)

8. Apothecial discs 0.5-1 mm, white pruinose, the margin thick, concolorous with thallus. Spores mostly 16-24 x 10-16 um. Thallus not radiate. .....(A. nikrapensis)

9. Apothecial margin indistinct. Cortex 30-35 um. Thallus white, forming distinctly radiate-fimbriate rosettes; lobes divergent; hypothallus pale. Apothecia numerous, 0.2-0.3(-0.5) mm, black, epruinose, margin not prominent. Proper exciple 35 um, dark olive brown, I+ blue. Hypothecium 35-45 um, indistinct. Epihymenium dark olive, K+ yellowish brown. Spores 8, broadly ellipsoid, 17-19 x 7.5-10 um, or subglobose, 10-12 x 8-10 um. Hymenium 70-90(-100) um, I+ greenish yellow or reddish brown. Paraphyses 2-2.5 um, not moniliform. Asci clavate. Pycnospores unknown. Thallus K-, C-, P-. On calcareous and non-calcareous rock.
Arctic. .....A. alboradiata

9. Apothecial margin prominent. 10

10. Thallus bluish white. 11

10. Thallus grayish with distinctly cream-yellow tinge; Thallus thin, somewhat distinctly radiate, 2-3 cm broad, areolate, circumference thin, limited by a very thin black hypothallus, radiate-areolate; the areolate lines ("lobes") contiguous or discrete over a thiner thallus, the marginal sterile lobes elongate and slightly convex, the central areoles angular and convex, contiguous, the fertile areoles verruciform. Cortex indistinct, irregular; medullary layer dense, clearing in HCl. Apothecia numerous, 1(-2-3) per areole, depressed in the top of the areolae; disc to 0.5 mm, concave, matt, roughened, sometimes umbonate, black, often pruinose; thalloid margin thick, darker next to disc. Thalloid exciple c. 135 um thick, the outer 20-30 um brown, I-, K-; proper exciple I+ blue turning violet. Hymenium ca. 135 um,

I+ brown-yellow. "Hypothecium" pale. Epithecium olive brown, HCl+ green. Paraphyses thin-walled, 1-2 um, not moniliform; tips thickening to 2.5 um. Asci clavate. Spores 8, ellipsoid, 18-23 x 10-12..5 um. Medulla K-, C-, P-, I-. Pycnospores unknown. On siliceous rock. Alaska. Originally abundant at the type locality, but not found since and now possibly extinct. ..... A. concinna

11. Thallus large (ca. 5 cm or more), somewhat thick (ca. 0.6 mm in center), the center areolate (not lobate); areoles separated by broad cracks; areoles angular, 1-1.5 mm wide, rugose, becoming convex, minutely verrucose, minutely and irregularly cracked; texture soft; surface white, subnitid towards periphery; marginal lobes ± contiguous, distinctly radiating, convex, 0.2-0.35 mm wide, apiculate; hypothallus black, distinct, radiating, surrounding the thallus. Cortex 30 um, indistinct. Medulla transparent. Apothecia sparse but occasionally congested, 0.7-1 mm, immersed then distinctly elevated, simple or subcomposite; discs concave to plane, black; margin white to ashy white, entire to slightly sinuate. Spores 20-25 x 10-15 um. Pycnospores unknown. Hymenium ca. 125 um. Paraphyses coherent, thickened above to 3-4 um, indistinctly septate. On siliceous rock, semi-aquatic. Arctic (Greenland; NW Territories).. .....A. humboldtii

11. Thallus small, thin, composed throughout of distinctly radiate discrete lobes, rarely contiguous, the lobes forking and chinkily divided into sections transversely, the center of thallus still radiate but of more convex areoles; surface bluish white to bluish gray, darkening at lobe tips; lobes convex, narrow; hypothallus not visible between the lobes. Cortex 20-25 um, opaque. Medulla granular, lax. Apothecia immersed, 1 per areole; disc flat or concave, black, rough, epruinose; margin thick and prominent, concolorous with thallus. Epithecium olive brown. "Hypothecium" pale. Paraphyses branched towards tips, moniliform, the upper cells globose. Spores 8, ellipsoid, 16-18 x 8.5-10 um. Hymenium 80-90 um. Pycnospores 15-17 um. On calcareous or acid rocks. Arctic (Alaska to Greenland). (A. contigua is similar but has a darker, thinner thallus, less discrete lobes and better developed hypothallus)
.....A. disserpens

ADD:

Thallus pale ashy, thin at circumference, there smooth and continuous, with black hypothallus line delineating it; toward the center, radiate-areolate, areolae convex, elongate radially, and with transverse cracks; cortex paraplectenchymatous, not vertically arranged. Apothecia quite sessile, in raised areolae with a thick, thalloid margin; thalloid margin I+ blue; proper exciple indistinct; hypothecium cellular, I+ greenish yellow, of vertical hyphae; epihymenium dark olive-greeen, K+ reddish brown; hymenium 110-130 um; paraphyses 2 um, tips to 304 um, moniliform; spores 8 per ascus,

12-17 x 10-12 um. Conidia 16-17.5 um long. Thallus K-, C, P-, I-; cortex of margin I+ blue. On acid rocks. Greenland. ..... A. circularis (H. Magn.) Oxner

IV-C-2. On rock.
Thallus Orbicular, Delimited, K-,
often Zonate but not Radiate or Lobate

1. Thallus sorediate. Thallus K+ yellow after pre-treatment with HCl. Thallus pale ochraceous, not distinctly radiate; soralia distinct. Cortical cells 5-6 um thick. Thallus areolate; marginala lobes thin, contiguous. Apothecia unknown. On dry siliceous rock. Arctic. ..... (A. sorediza)
1. Thallus not sorediate. [also see A. limitata and several other species in Key V which need to be incorporated here; perhaps this group should simply be incorporated into Key V]. 2

> **2. Medulla filled with granules (dissolving in HCl).** 3
> **2. Medulla transparent.** Spores 8, broadly ellipsoid to subglobose, 13-17 x 8-10 um. Thallus gray to yellowish clay-colored, thin, orbicular, zonate; areoles also ± radiate but contiguous, thinning down toward the periphery; center chinky-areolate; areoles angular; hypothallus indistinct, grading into thallus, concolorous with thallus. Cortex olivaceous, opaque, rather indistinct. Apothecia abundant centrally, immersed, usually 2-3(-5) per areola; discs to 0.5 mm diam., concave to flat, black, epruinose; margin not prominent, not darkened, exterior brown, I-; proper exciple not distinct. Epihymenium olive brown. "Hypothecium" pale, cloudy, I+ bluish. Paraphyses coherent, in much gelatin, at most indistinctly moniliform. Hymenium 85-110 um, I+ bluish or brownish yellow. Paraphyses slender, tips only slightly moniliform, 2-3 um thick. Asci clavate. Pycnospores cylindrical, straight or curved 13-17 x 1 um. On non-calcareous rocks. Alaska. Pictures of this species make the thallus appear rather radiate. .....A. cingulata

3. Spores mostly over 15 um long and 8 um wide. 4
3. Spores (10-)13-14 x (5-)7-8 um. Thallus ashy to yellowish-ashy, thin and zonate marginally, very closely attached to the substratum, and with a slight upward rasing in radiating lines dimly showing; centrally the thallus areolate with angular or rounded areolae to 1 mm broad; cortex unclear and inspersed; medulla filled with granular inclusions and thus opaque. Apothecia innate, rounded or angular; margin thick, entire, of same color as thallus, I-; hypothecium hyaline, I+ blue; epihymenium dark brown, N+ green; hymenium 90-100 um, hyaline, I+ greenish yellow; paraphyses slender, 1.5-2 um, tips only slightly enlarged to 2 um and the whole not moniliform; asci clavate; spores 8, ellipsoid, 10-14 x 5-8 um, often with oil droplets. Conidia 27-30 um long. Thallus K-, C-, P-, I-. Hymenium (90-)140-150 um; Epihymenium olive-brown. Areoles mostly 0.7-1 mm across. Fertile verrucae low, very dense; discs usually 0.5-0.7 diam. Exciple ± indistinct. Paraphyses non-moniliform, upper 1-2 cells globose. On rocks. Arctic. Very similar to A. cingulata. ..... A. novaesemliae (Zahlbr.) Oxner

4. Thallus brownish gray, pale yellow-brown to light olive-gray (never ashy- or blue-gray?; sometimes with violet tint), continuous, smooth or indistinctly rimose-areolate, zonate to radiate at times, determinate, limited by a distinct blackish hypothallus; cortex granular inspersed; medulla filled with granules. Epithecium olive brownish, HCl+ green. "Hypothecium" cloudy and inspersed with oil. Hymenium 90-135 um. Paraphyses coherent, ± branched and anastomosing, the tips globular, the cells below the tip submoniliform. Spores 8, ellipsoid, (15-)17-22(-25) x 10-12(-14) um. Apothecia toward the center, innate; disc 0.3-0.5(-1.0) mm diam., concave, black; margins absent or indistinct, slightly prominent, smooth and even, concolorous with thallus. Pycnospores 22-40 um. On acid rocks. Arctic-alpine. Alaska to Greenland; infrequent in British Columbia. .....A. supertegens

4. Thallus whitish or grayish, sometimes with slight yellowish or reddish tint, but not brownish or olivaceous. 5

5. Thallus pale rosaceous (grayish on reddish substrate?), soft, ± distinctly orbicular and abruptly delimited but not zonate or radiate, thickish, areolate to verrucose. Apothecia numerous, sometimes confluent, 0.5-0.7 mm, elevated on subcolumnar verrucae; disk black, epruinose, margin entire, tumid, gray. Hymenium 75 um; paraphyses distinctly moniliform; spores 14-20(-22) x 8-13 um. Pycnospores unknown. On somewhat calcareous siliceous rock. Arctic (Greenland; NW Territories). .....A. nathorstii

5. Thallus not rosaceous. 6

6. On siliceous rock. 7

6. On calcareous rock. 8

7. Spores 18-23 x 10-12.5 um. Paraphyses scarcely moniliform. ..... (A. concinna)

7. Spores 12-17 x 8-13 um. Paraphyses monilliform. Thallus indistinctly lobate. Apothecial verrucae prominent. Pycnospores 17-24 um long. Exciple I-. Thallus 3-4 cm across; margin distinctly radiate; lobes 5-6 mm long, contiguous, inwards somewhat convex, ends plane, thin; thallus towards center rimose-areolate with dense, fertile, prominent verrucae; color in herbarium sordid yellowish white, hardly ochraceous. Apothecia solitary, sometimes 2-3 confluent, occasionally circular, generally ovoid or oblong; disc black, somewhat pruinose; margin thick. Cortex 35 um thick. Cortex K+ yellow after pre-treatment with HCl. Apotheica 300 um deep, conical. Hymenium 120-150 um high. On HCl- rock. .....A. polychroma v. ochracea

8. Paraphyses not moniliform. Thallus pruinose, chalky white, verrucose-areolate, thicker in center, irregular, orbicular (but

apparently not zonate or radiate). Apothecia 1-2 mm, numerous and crowded, becoming adnate, disc blackish, bluish pruinose, margin slightly pruinose. Spores 16-22 x 9-10 um. Hymenium ca. 100 um. Pycnospores 22-25 um. Exciple K+ yellow. .....A. caesiopruinosa

8. Paraphyses distinctly moniliform with globose end cells and those below swollen ellipsoid. Thallus thickish, at most partly indistinctly radiate. Spores 13-20 x 8-13 um. Hymenium 85-110 um. Paraphyses unbranched, with oil drops, Hypothallus not visible. Thallus verruculose-areolate, thin at the edges and partly indistinctly radiate; areoles flat or slightly convex; fertile areoles verruciform; surface pale gray or whitish gray with a yellowish tinge. Cortex opaque. Apothecia to 0.8 mm broad, 1(-2-3) per verruca; margin prominent, not darkened; disc concave, black, ± pruinose. Epithecium olive brown. "Hypothecium" pale. Spores 8, ellipsoid. On calcareous rocks. Arctic (Alaska to Ellesmere Island). .....A. polychroma v. polychroma

ADD:

Thallus gray, the center of broad areolae with deep fissures, soft, angular (not lobate), the areolae to 1.5 mm broad, rough-surfaced, becoming convex, and with minutely chinky surface; the margins with the areolae lobate and radiate in a narrow zone, the areolae elongate, convex, and with a distinct black hypothallus around the edge. Apothecia at first immeersed, later elevated on the thallus, simple or composite; margin entire or wavy, white or ashy, I-; thalloid margin ± paraplectenchymatous, its cortex indistinct; disk black, concave or flat; hypothecium unclear; epihymenium brownish; hymenium 125 um, inspersed, I+ wine-red; paraphyses coherent, not moniliform; spores 8, ellipsoid, 20-25 x 10-15 um. Conidia not known. Thallus K-, C-, P-, I-. On acid rocks. Greenland. ..... A. humboldtii (Lynge) J. W. Thomson