

**Umbilicaria Hoffm.**  
(LECANORALES: UMBILICARIACEAE)

After various authors

June 1995

Thallus foliose, umbilicate, single- or multiple-lobed, dorsiventral, soft, pliable and somewhat leathery when wet, brittle when dry; upper surface pale gray-brown to black, smooth to warted-areolate, sometimes folded or reticulate-ridged with a raised central area; isidia or soredia occasionally present; margins sinuous, entire or incised to often markedly lacerate; both surfaces corticate; cortex paraplectenchymatous; lower surface black to brown, tan or pale brown-pink, smooth or warted-areolate, sometimes pitted, bullate, or wrinkled, attached by a central or excentric umbilicus although non-functional rhizinomorphs may also be present on lower surface; plate-like structures (trabeculae) also present on lower surface of some species. Upper cortex at times overlain by an amorphous zone. Medulla white, loose or compact, not always clearly differentiated from lower cortex.

Apothecia sessile, laminal, sometimes immersed in depressions or almost stipitate, black; disc flat or  $\pm$  convex, often  $\pm$  irregular, often gyrose, occasionally smooth with a central protruding button of sterile tissue; thalline margin absent; exciple proper; hypothecium brown; paraphyses unbranched; asci elongate-clavate, unitunicate, I+ blue; ascogelatin I+ violet; apical dome I+ blue; spores 1-8, ellipsoid to oblong ellipsoid, simple and colorless or muriform, becoming brown.

Pycnidia wart-like, uni- or multi-loculate; conidiogenous cells in chains, enteroblastic, acrogenous or pleurogenous (endobasidial according to Rogers); pycnosporangia bacilliform, shortly cylindrical. Thallus present in non-isidiate, non-sorediate, rarely fruiting species, originating from lower cortex or on rhizinomorphs, single-celled or of several cells, appearing as very minute black granules. Gyrophoric acid frequent, umbilicatic, lecanoric, stictic, or norstictic occasional. Photobiont Trebouxia. On rocks, [usually?] siliceous. Arctic-alpine to boreal or temperate.

Lasallia differs in the pustulate thallus, 2-spored asci, and larger ascospores.

There are still some problematic taxa in western North America. More info. could be added from McCune & Goward (1995) and Poelt & Vezda.

After Brodo, Poelt, Llano, and Thomson

June 1995

### **I. Apothecia present.**

Note: immature apothecia of the the Umbilicaria-type and Omphalodiscus-type are often difficult to distinguish from each other and from those of the Agyrophora-type.

**1. Apothecial disks plane, the whole surface smooth and with a continuous proper margin (Agyrophora). .....2**

**1. Apothecial disks plane or convex, the surface with a central button and/or fissures or furrows. ....6**

**2. Lower surface with rhizinomorphs, trabeculae, or lamellae.**

.....3

**2. Lower surface without rhizinomorphs, trabeculae, or lamellae.**

.....4

**3. Thallus crustose-areolate, forming large (to at least 10 cm across) patches or cushions (to 2-3 mm thick in center); lower surface with trabeculae or lamellae. Medulla C-. Upper surface brown to almost black, subnitidous, uneven, undulating, marked with an irregular network of indented, wavy, black lines, becoming rimose with irregular areoles at intervals of ca. 5 mm.; marginally  $\pm$  lobulate; occasional areoles in middle of crust lift above neighboring areoles, continue growth and become lobulate as at the margin. Lower surface of free lobes black, coarsely papillate with branching structures extending ray-like towards periphery and becoming fibrillose. Thallus raised above substratum by the irregular mass of branching structures which develop from the hypothallus. Hypothallus black, composed of closely adherent, radiating, branching strands ca. 0.15 mm wide. Lobes ca. 185  $\mu$ m thick (wet). Apothecia common, to 0.7 mm across, very irregular (elongate, crenate, or deeply lobed); discs plane (leiodiscs); margins thin. Rather rare, on vertical rock faces, in exposed inland alpine localities, British Columbia; Cascade and Olympic mountains of Washington; northern Rocky Mountains (Bow Range). I have collected a peculiar thallus from the Washington Cascades that seems to key out here, but consists of a single very convex, irregular mound ca. 2 cm across and close to 1 cm thick in the center. .... U. lambii Imsh.**

**3. Thallus foliose, not forming cushions, lower surface without trabeculae or lamellae, but with flat or rounded rhizinomorphs, which are attenuate. Medulla C+ red (gyrophoric acid). Thallus small, 1-2 cm diam., mono- or poly-phyllous, the margins thin, slightly incised, the umbo raised; lower surface dark brown to black, verrucose with paler area around umbilicus. Upper surface smooth to minutely papillate except for slight reticulation and pruinosity near the umbo, dark brown to black. Apothecia few to numerous, adnate, to 1 mm broad; flat, the margin irregular; spores simple, hyaline. On acid rocks. Rare. Alaska and Washington; Greenland. .... U. scholanderi**

**4. Upper surface with a fine reticulation of white (pruinose) sharp ridges fading (becoming vermiform) peripherally; thallus leathery, 2-5(-8) cm diam.; lower surface**

uniformly sooty black, smooth. Apothecia rare, stipitate, to 2 mm broad, flat; spores simple, hyaline. Medulla C-. Arctic and Pacific Northwest. .... (see U. lyngei)

**4. Upper surface chinky-areolate, not reticulately ridged except in center near umbo; thallus 5-10(-15) cm. diam. ....5**

**5. Lower surface smooth to dimpled and finely areolate, or papillose-areolate to verrucose, with a pattern of brown and black patches (usually darker peripherally). Apothecia abundant,** stipitate, marginal to laminal, 1-2 mm diam., flat, the margins slightly shiny; spores simple, hyaline. Thallus rigid, fragile and crisp or somewhat leathery. Upper surface with a fine network around umbo, lightly pruinose, matt, buff to dark brown or black-brown; margins incised, jagged and frequently perforate. Thallus mono- or poly-phyllous, to ca. 5 cm broad, folded, the umbo becoming chinky-areolate or dissected and with a frosty bloom. Medulla (usually?) C-. On acid rocks, often on bird perches, in exposed boreal-alpine areas, mainly Arctic-alpine (Alaska to Iceland, with disjuncts in Alberta, British Columbia, and Washington). .... U. rigida

**5. Lower surface smooth to subpapillose but not papillose-areolate, sooty furfuraceous with paler margins. Apothecia rare,** stipitate, to 2 mm broad, flat, margin even, dark; spores simple, hyaline, the middle dark stained. Thallus leathery. Upper surface with white-pruinose umbo, obscurely ridged marginally, strongly fissured. Chemistry unknown. Arctic and Pacific NW. .... (see U. leiocarpa)

**6. Apothecial disks plane with sterile central button, or fissures, and/or secondary fissures (Omphalodiscus). .... 7**

**6. Apothecial disks convex, furrowed, with or without a margin.  
..... 11**

**7. Upper surface smooth or coarsely wrinkled; rhizinomorphs abundant. Apothecia common. .... 8**

**7. Upper surface reticulate rugose; rhizinomorphs usually absent but occasionally sparsely present. ....9**

**8. Upper surface smooth, light gray to light brown; lower surface light colored, gray reddish; rhizinomorphs cylindrical or flat, rarely plumose.** Apothecia occasionally somewhat gyrodiscoid. Rare, northeastern U.S. and Newfoundland. .... U. crustulosa

**8. Upper surface often wrinkled with coarse, weak, reticulating ridges which fade marginally (immature specimens rarely smooth), subpruinose, dark or deep olive-buff to yellow brown or sometimes darker brown (or often pale and grayish or greenish in very shaded habitats); lower surface pink or salmon to orange-buff or partly brown, generally pale; rhizinomorphs cylindrical or flat, simple or  $\pm$  branched, pale (but often darker than lower surface), thicker toward the margin.** Thallus to 5-10 cm broad, monophyllous, leathery, ca. 260-270  $\mu$ m thick; umbo not elevated; margins irregular, sinuate to crenate to incised or torn. Apothecia to 4.5 mm broad, sessile, round and flat, becoming convex and irregular, central sterile button and fissures often absent and only seen in sections. Spores simple, hyaline. Medulla C+ red. On acid rocks. Common, on vertical surfaces or on or under overhanging faces of large

rocks (often very shaded and sheltered) in inland sites, Arctic-alpine, Alaska to Greenland, south to northeasternmost U.S. and common in the west south to California, Colorado and Mexico. .... U. virginis

**9. Lower surface sooty black with a paler peripheral zone, smooth, rarely pruinose; upper surface rugose with strongly formed rugi in a reticulating pattern decreasing in size toward periphery; margins often laciniate or perforate. Apothecia rare,** to 3 mm broad, adnate, with sterile central button and fissures or covered with fissures, round, with proper margin, becoming convex; spores simple, hyaline. Scattered, arctic and western; also Virginia. .... (see U. decussata)

**9. Lower surface mostly light colored, avellaneous (dove gray) or paler towards periphery, with varying dark area around umbilicus, white pruinose throughout, smooth to finely chinky or obscurely granulose; upper surface with elevated, coarsely granulose umbo from which radiate sharp edged granulose rugi or ridges, which run to the margins but weaken; margins entire. Apothecia common,** to 3 mm diam., sessile to substipitate, flat, with central sterile button and many secondary fissures (smooth to at most buttoned according to Goward, et al.); spores simple, hyaline. Thallus 1-2(-5) cm broad, monophyllous, rigid, 200-500 um thick. Position of the umbilicus usually readily discernable from above. On acid rocks, usually in exposed areas, common, arctic-alpine and western N. America, south to Arizona and California. ....10

**10. Upper surface dull, pruinose, dark ashy to dark brown, becoming areolate granulose.** Arctic-boreal, Alaska to Greenland, S to Maine in the east, S to California and Colorado in the west. ....

.....U. krascheninnikovi var. krascheninnikovii

**10. Upper surface shiny, light brown to buff; rugi becoming coarsely areolate.** Southwestern U.S. (Arizona and California). .... U. krascheninnikovii var. darrowii

**11. Furrows of radial gyri without any margin (Actinogyra)**

.....12

**11. Furrow of concentric gyri contained within a continuous proper margin (Umbilicaria sens. str.)** ..... Key I-A

**12. Lower surface with dense nap of black, apically-forked, cylindric, ball-tipped rhizinomorphs, frequently curling over margins or protruding dorsally through thallus apertures as black "warts", without lamellae or trabeculae; apothecia not common.** Medulla C+ red. Western N. Am. and Minnesota. .... (see U. polyrrhiza)

**12. Lower surface without rhizinomorphs, but with papillate lamellae and/or trabeculae which form plate-like layers over the underside; apothecia common,** adnate, in indentations in the upper side, convex, of free gyri which branch dichotomously, lacking a common exciple around the edge; spores simple, hyaline. Thallus 5-10(-20) cm broad, monophyllous, stiff, 210-280 um thick, with folds or pleats centrally, the edges torn or deeply cut; upper surface smooth, matt, olive-brown. Lower surface olive-brown, darker toward umbilicus, areolate. Medulla C+ red. On acid rocks,

including sandstones. Eastern N. America (Great Lakes region to Newfoundland, S to South Carolina), with possible rare disjunct in NW Territories; also infrequent in open intermontane and especially boreal localities, British Columbia. .... U.  
muhlenbergii

**KEY I-A. Apothecia present, with concentric gyri.  
(Umbilicaria s. str.)**

**1. Upper surface vermiform or reticulate-rugose. ....2**

**1. Upper surface not wrinkled, undulating to soft folded, areolate, rimose, or smooth.  
..... 7**

**2. Lower surface with rhizinomorphs. .... 3**

**2. Lower surface without rhizinomorphs. .... 4**

**3. Rhizinomorphs sparse, short, cylindrical. Lower side entirely pale gray.** (also see U. proboscidea, which has reticulate ridges on the upper side instead of irregular vermiform ridges). Very rare. British Columbia. .... U. hyperborea var. radicula

**3. Rhizinomorphs cylindrical to flattened, coarse, forked, in patches or over much of the lower surface; lower surface sooty black with fuscous, pruinose peripheral zone and scattered gray patches; ..... (U. aprina)**

**4. Upper surface with well developed, appressed to broad vermiform rugi extending to margins, becoming essentially verrucose in places. ....5**

**4. Upper surface reticulate-rugose, the rugi fading marginally; umbo pruinose.  
..... 6**

**5. Thallus 6-15(-20) cm diam., coriaceous (ca. 1100 um thick); lower surface with black area around umbilicus, peripherally pale, avellaneous (dove gray or pinkish brown), or (v. diomedensis) lower surface  $\pm$  entirely black.** Upper side sometimes at least partly rather weakly rugose, the rugi not forming a net,  $\pm$  brain-like convoluted; umbo moderately raised, occasionally with marginal perforations, dull, brown, brown-black or tawny, often somewhat shiny. Thallus monophyllous. Lower surface smooth to slightly papillate-areolate. Apothecia common, to 2.5 mm broad, usually gyrose (occasionally without gyri when young), becoming strongly convex, sometimes irregular in shape (v. diomedensis); spores simple and hyaline. Medulla C+ red. On acid rocks, arctic-alpine, south to California in the west and Minnesota in the east. .... U. arctica

**5. Thallus 2-5(-10) cm diam., rigid to thin and pliable (190-230 um thick); lower surface variable, dark gray to clove brown or black, rarely pruinose marginally, smooth to irregularly and minutely granulose** (graininess difficult or impossible to detect with hand lens). Thallus monophyllous; umbo raised, sometimes with lobed excrescences over it; upper side with raised irregular vermiform ridges or bullations (pustules), matt to slightly shiny, olive-brown to dark brown or gray-brown (usually in part darker between the raised areas), smooth other than the ridges or bullations; area corresponding to the umbilicus not readily discernible from above. Apothecia common, to 2 mm broad, sessile, usually between the ridges, circular or irregular in shape, convex, the gyri numerous, regularly dichotomous. Spores simple, hyaline. Medulla C+ red. Common on exposed acid rocks, arctic-alpine and boreal, Alaska to Greenland, south through most of Canada, to Mexico, California and southern Rockies in the west, to northeastern U.S. in the east. [As presently circumscribed this species is extremely variable, in size and in appearance of the rugae. A very common taxon in the Sierras and Cascades, with small, polyphyllous, weakly rugose thallus, also seems to key out here; it corresponds to "U. intermedia

Llano"]. Shade forms can be pale below, but then the upper surface is also paler. .... U. hyperborea

**6. Thallus 4-8(-10) cm diam.; umbo on upper side peaked (raised), with prominent reticulating or irregular rugi (often arranged circularly around the umbo); margins whole, or occasionally perforate or ragged; lower surface dark (to light) gray or brown, buff, or dove gray, sometimes with a pruinose peripheral zone, smooth to areolate, rarely with simple or branched rhizinomorphs. Apothecia common, sessile to subpedicellate, circular, the gyri regularly dichotomous; spores simple, hyaline. Medulla C+ red.** Thallus monophyllous, 120-230 um, rigid to fragile. On acid rocks, in exposed to somewhat sheltered sites, arctic-alpine to montane, Alaska to Greenland and Iceland, South to New England in the east and to Washington and Oregon in the west. .... U. proboscidea

**6. Thallus 10-13 cm diam., friable, with occasional erect dorsal fibrils; umbo depressed to eroded, obscurely wrinkled-reticulate, granulose; margins perforate, fenestrate, incised; lower surface sooty black with rare sooty fibrils. Apothecia rare. Medulla C-.** Apothecia to 2 mm broad, sessile to subpedicellate; disk at first flat then becoming strongly gyrose; spores hyaline, simple. Arctic and northwestern. .... (U. havasii)

**7. Lower surface without rhizinomorphs, trabeculae or lamellae. .... 8**

**7. Lower surface with rhizinomorphs; with or without trabeculae or lamellae.** [Note: a rare form of U. phaea, with sparse, short rhizinomorphs in patches, may key out here]. ....10

**8. Thallus monophyllous (but sometimes appearing polyphyllous); upper surface light to medium or somewhat dark brown or sometimes grayish (or rarely deep red), not blackish, without isidia; Apothecia common,** immersed to adnate, to 2.2 mm broad, round to irregular, convex, with thin exciple, the gyri regular or irregular; spores simple, hyaline. Upper surface smooth or chinky, with occasional soft folds, smooth, or rimose between the apothecia and marginally; margins entire, torn or perforated; lower surface avellaneous (dove gray) or darker, sometimes blotched, coarsely papillate to verrucose, with discoidal scoring below the apothecia, sometimes pruinose peripherally. Thallus 1-3(-6) cm broad, 150-200 um thick, rigid with thinner margins; umbo raised, sometimes pruinose. Medulla C+ red. On exposed, semi-arid to dry, often hot, rocks, in open sites at low to moderate elevations, mainly in dry intermontane localities. Very common, western N. America (Alaska and NW Territories south to California and Mexico); var. coccinea, with a crimson (deep red) upper surface, occurs rarely, in northern California to north-central Washington. .... U. phaea

**8. Thallus polyphyllous; upper surface dark, blackish, never red; with or without isidia. Apothecia rare. ....9**

**9. Upper surface covered with papillate, cylindrical or leaf-like isidia; lower surface dark.** Apothecia to 1.5 mm broad, adnate to partly depressed, flat to convex, gyrose; spores simple, hyaline. Arctic and boreal. .... (see U. deusta)

**9. Upper surface smooth, without isidia, dull to subshiny, blackish brown; thallus**

membranous; lower surface black to black-brown, smooth; margins whole, slightly thickened. Apothecia sessile, to 1.5 mm broad, convex, with few gyri and thick margin; spores simple, hyaline, ellipsoid. Western North America (and New England?). ..... (see U. polyphylla)

**10. Lower surface without trabeculae or lamellae.** (Also see forms of U. torrefacta, e.g., from British Columbia). .....11

**10. Lower surface with trabeculae or lamellae.** .....12

**11. Upper surface pitted, sometimes obscurely vermiform or areolate-pruinose, matt to shiny, gray to light brown; lower surface light brown or tan to pink, sometimes darker towards umbilicus, sometimes with a gray pruinose marginal zone, smooth or bullate, or finely granular; rhizinomorphs marginal and/or ventral, well-developed, long, cylindrical or flat, branched; apothecia common, markedly stipitate,** to 4 mm broad, the stipe and underside the same color as thallus; disc convex with few, deep gyri; spores simple, hyaline. Thallus 2-10(-26) cm broad, polyphyllous, raised and curved, rigid,  $\pm$  perforated, 450  $\mu$ m thick. Medulla C-. On acid rocks, arctic-alpine (to subalpine), south to new England in the east, to Oregon and Colorado in the west. .... U. cylindrica

**11. Upper surface not pitted, smooth, plane to undulating; brown with strong olive cast, smooth to slimy; thallus membranous to fragile; lower surface black to rufous-black, lacunose, verrucose; rhizinomorphs scattered, black, shreddy; apothecia infrequent, sessile to subpedicellate.** Alaska and N. Carolina. .... (see U. caroliniana)

**12. Trabeculae or lamellae covering the whole lower surface.** ..... 13

**12. Trabeculae or lamellae mainly around umbilicus, fading marginally.**  
..... 14

**13. Thallus 2-6 cm diam., rarely plane, usually crumpled, thin (250-400  $\mu$ m), the margins finely perforate to fenestrate; lower surface dark brown or occasionally buff, smooth to finely granulose-papillose, the lamellae or trabeculae usually well developed over the entire surface, sometimes becoming fimbriate, occasionally poorly developed or absent; rhizinomorphs absent; apothecia common,** adnate to subimmersed in depressions, to 2 mm diam., round or irregular, convex; margins soon disappearing; spores simple, hyaline. Thallus monophyllous, rigid or membranaceous and fragile; umbo not much developed; center of upper side folded or puckered; upper surface matt or shining, dark brown to olive-brown. Medulla C+ red, K- (gyrophoric acid,  $\pm$  umbilcaric acid), P- or C-, K+ yellow, P+ orange (stictic acid). On acid or base-rich rocks in open areas. Arctic-alpine and boreal, Alaska to Greenland, S to New England and Great Lakes area in the east, to California, Colorado, and Mexico in the west. .... U. torrefacta

**13. Thallus 20-30 cm. diam., usually plane, medium to coarse, the margins not perforate; upper surface black, smooth; lower surface black, coarsely trabeculate or lamellate, rarely fimbriate; apothecia not known.** ..... (U. mammulata v. magnaeva)

**14. Margins sorediate;** lower surface brown, areolate; lamellae fibrillose; rhizinomorphs numerous, light colored; upper surface ashy to ashy brown. Apothecia rare, adnate and slightly immersed to sessile, to 2 mm broad; disc black, convex with



narrow gyri; spores simple, hyaline. Arctic, western U.S., New England. .... (see U. hirsuta)

**14. Margins not sorediate. .... 15**

**15. Rhizinomorphs not ball-tipped. Apothecia common,** immersed to adnate, angular, with few gyri; margin thick; gyri sometimes becoming beaded; surface dull or shiny. Thallus to 9 cm across, monophyllous, thick, rigid, round to irregular, often divided into overlapping lobes, the umbo puckered in between creases and folds. Spores simple and hyaline then finally brown and muriform. Rhizinomorphs intricately branched, forming a tangled mat, attenuate, cylindrical or flattened granulate (with thallospores); lower surface black, coarsely papillate-verrucose, with lamellae and trabeculae near the umbilicus. Upper surface smooth to obscurely wrinkled and rimose, brown to dark brown with a thin purple pruina towards the margins, sometimes blotched with grayish olive; with occasional coarse black cracks, matt or subshiny. Medulla C+ red. On very exposed, dry rocks. Western N. America (S. Calif. to Alaska). .... U. angulata

**15. Rhizinomorphs (at least some) ball-tipped. Apothecia rare. ....16**

**16. Rhizinomorphs infrequent to poorly developed, short, frequently ball-tipped.**

**Spores brown and muriform.** Thallus mono-polyphyllous, dark gray, reddish or violet-gray, rigid; lower surface black, strongly verrucose. Arctic and Arizona. .... (see U. cinereorufescens)

**16. Rhizinomorphs better developed; long, cylindric, attenuate ones interspersed with shorter, ball-tipped ones. Spores hyaline and simple.** Thallus monophyllous; ...28

**17. Thallus thick, rigid; upper surface rarely smooth, white to violet brown or stained brown or red (white-pruinose?); apothecia infrequently occurring (but occasionally numerous), regularly gyrose.** Widespread. .... (see U. vellea; U. americana may also key out here--see key to sterile thalli)

**17. Thallus thin, membranous, smooth, rarely light colored, olive brown to warm sepia or darker; apothecia irregular in shape and gyri, 3-4 mm across.** In shaded habitats. Eastern N. America. .... 18

**18. Lower surface black, usually densely rhizinate, with few trabeculae; upper surface matt.** Apothecia rare, to 4 mm broad, sessile to stipitate, becoming convex, irregular, the gyri becoming separate, common margin persistent or broken. Spores simple, hyaline. .... (see U. mammulata)

**18. Lower surface devoid of rhizinomorphs; trabeculae very conspicuous; upper surface shiny.** ....(young specimens of U. muhlenbergii)

## II. Apothecia absent.

### II-a. Lower surface without rhizinomorphs, trabeculae or lamellae.

**1. Upper surface covered with  $\pm$  abundant phyllidia (isidia-like structures).** Isidia papillate, cylindrical or leaf-like or lobed or tiny squamulose, fine to coarse. Lower surface black, smooth to areolate-papillate, often weakly pitted, weakly or strongly veined with papules; rhizinomorphs absent. Thallus mono- or polyphyllous, 1-4 cm wide, usually occurring in dense colonies, paper thin (200-300  $\mu$ m) and fragile when dry, somewhat gelatinous when moist, undulating, the margins lobed and crenate, the edges often perforate; upper surface dull, brownish black or dark brown, more brown when moist. Medulla C+ red. On acid rocks, particularly in rills or water channels on the rock face, in the open or in partial shade, predominantly on sloping surfaces that are snow-covered in winter. Arctic and boreal, Alaska to Washington and Arizona in the west, and Great Lakes area to New England and the Adirondacks in the east. .... U. deusta (L.) Baumg.

**1. Upper surface without isidia.** .....2

**2. Upper surface smooth and continuous, or occasionally roughened to weakly ridged or squamulose, but not at all reticulate-rugose; thallus to 6 cm broad. Lower side smooth to finely areolate, sooty black or blotched with dark brown. Thallus crisp, fragile, usually polyphyllous (or sometimes monophyllous according to Thomson),** thin (155-350  $\mu$ m), very irregular in shape; lobes rounded and overlapping, partly lacerated and perforated, reflexed; upper side matt or shiny, shades of dark brown. Thallus incised from the edge into many small leaves, usually 1-2(-5 or 7) cm broad. Production of 3-6-celled thallospores begins spottily on the underside, later covering the greatest part of the lower surface. Medulla C+ red (gyrophoric and umbilicatic acid). On acid rocks, preferably along rills, usually in sunny sites, mostly arctic-alpine, Alaska to Greenland, S to Great Lakes area and New England in the east and to California and Colorado in the west; widely distributed in British Columbia. Material from British Columbia tentatively identified as U. nylanderiana (Zahlbr.) Magnusson may also belong here; its thallus is usually few-lobed, with the upper surface  $\pm$  pustulate-ridged, not at all lobulate; such material, which seems to be common down into California, may be "U. intermedia" (see above, under U. hyperborea). .... U. polyphylla (L.) Baumg.

**2. Upper surface areolate and/or ribbed to thickened, or reticulately ridged, flat toward the edge.**

**3. Entire upper surface is covered by a dense, irregular pattern of small (to ca. 1 mm across), very peculiar-looking, irregular, wrinkle-like to pustular or almost squamule-like thickenings strongly raised above the main surface, and large parts of the thallus curl strongly downward, making the thallus irregularly tubular to corniculate in places.** Upper surface grayish brown, with black rimmed margins; lower surface tan to black, smooth. Thallus monophyllous, 1-2 across. Sierra Nevada Mountains, California. .... U. sp. (possibly U. nylanderiana, reacting to damage or parasitism)

**3. Upper surface not as above; thallus not curling strongly downward.** ..... 4

**4. Upper surface very coarsely ribbed and chunky-areolate in center near umbo;**

**toward the edge producing a hump-back, which is largely coordinated with the indefinite ribs.** Thallus (3-)5-10(-15) cm. diam. Lower surface smooth to subpapillose but not papillose-areolate, blackened around the umbilicus by 1-2(-3)-celled thallospores, sooty furfuraceous-roughened with paler, minutely areolate marginal areas. Thallus leathery (except for the marginal regions which are fragile and slightly perforate), usually monophyllous but usually deeply incised and folded, sometimes at least apparently polyphyllous. Upper surface pruinose over the umbo, matt, dark brown to brown-black. Thallus ca. 250 µm thick. Chemistry unknown. Rare, usually on steep surfaces in the alpine zone and the eastern Arctic (Greenland and NW Territories), and also reported from the Pacific NW. .... U. leiocarpa DC. in Lam. & DC.

**4. Thallus thickened to reticulate ribbed in the center, flat toward the edge.** ..... 5

**5. Upper side with smooth cortex, covered with narrow, closely crowded, greenish-gray to brown thickenings (pustulate-ridged).** Thallus ca. 1-3 cm wide. Underside blackened by mostly 2-celled thallospores. Medulla C+ red (gyrophoric acid). Somewhat nitrophilous, on summits of boulders and rocks, in boreal alpine localities, Alaska to California, and eastward in the boreal zone. Rare. Must be carefully distinguished from abnormally thickened thalli of U. polyphylla. .... U. nylanderiana (Zahlbr.) Magnusson

**5. Upper side ± cracked-areolate, with ± strongly developed reticulate ribs, which are most definite in the center.** ..... 6

**6. Lower surface whitish rose around the umbilicus, gray at the edge, blackened between by thallospore complexes, which occur on short papillae or delicate rhizinomorphs.** Upper surface with occasional erect fibrils; lower surface sooty black with rare sooty fibrils. Thallus monophyllous, to 5-8 cm wide, thin (120-225 µm), often radially perforate at edge. Upper surface matt, gray, dark mouse-gray, strongly pruinose-white over the umbo; margins weakly vermiform, wrinkled, irregular. On acid rocks. Arctic (Alaska to Greenland) and Pacific NW (Washington). .... U. havaasii Llano

**6. Lower surface not whitish rose anywhere, especially blackened in the center, toward the exterior somewhat fading. Upper surface without erect fibrils.** Thallospores 1-2(-3)-celled. .... 7

**7. Lower surface sooty black with a paler gray or light brown peripheral zone, occasionally blotched, smooth; upper surface rugose with strongly formed rugi in a reticulating pattern decreasing in size toward the periphery, becoming lower and vermiform; often with small epithalline buds. Medulla C+ red (gyrophoric acid) or C-.** Thallus usually only 1-2 cm, commonly up to 5(-8) cm broad, monophyllous, rigid, 300-600 µm thick, the umbo raised, coarsely granulose, pruinose; upper surface matt, light brown or buff to dark brownish black, occasionally with small lobules from the ridges or margins. On rocks, especially vertical to overhanging surfaces, somewhat nitrophilous, arctic-alpine, Alaska to Greenland, S to Mexico, California and Colorado and the west, with disjunct in Virginia in the east. .... U. decussata (Vill.) Zahlbr.

**7. Upper surface with a fine reticulation of white (pruinose) ridges gradually fading peripherally; lower surface uniformly dark, sooty black or with paler patches, marginally with a pruinose-granular band, otherwise smooth, but with radial folds around the**

**umbilicus. Medulla (usually?) C+ red (gyrophoric acid, sometimes also with small amounts of norstictic acid), or sometimes C-.** Thallus leathery, 300 um thick, 2-5(-8) cm. diam, monophyllous, the margins thin, torn or incised; upper surface matt, dark brown to brown. On steep surfaces, not nitrophilous, in exposed, inland, arctic-alpine sites, Alaska to Greenland, with disjuncts in British Columbia, Washington and Oregon, and SE Canada. .... U. lyngei Schol.

## II-b. Apothecia absent.

### Lower surface with rhizinomorphs, trabeculae and/or lamellae.

1. Lower surface without trabeculae or lamellae. .... 2

1. Lower surface with trabeculae or lamellae. .... 4

**2. Lower surface with dense nap of black, apically-forked, cylindric, ball-tipped rhizinomorphs, frequently curling over margins or protruding dorsally through thallus apertures as black "warts", without lamellae or trabeculae.** Apothecia not common, to 5 mm broad, adnate, convex, the gyri free, without common exciple; spores simple, hyaline. Medulla C+ red. Western N. Am. (British Columbia to California), in British Columbia it occurs in open coastal localities at lower elevations, but material from California that I have identified as this species occurs in inland, high mountain areas (according to Hale & Cole the species occurs in both coastal and montane parts of the state). Also reported from Minnesota. .... U. polyrrhiza (L.) Fr.

**2. Lower surface with scattered to numerous but irregularly distributed rhizinomorphs, which are simple to cribose or split, or cylindrical to flattened and forked, not ball-tipped, and not projecting through upper surface.** .... 3

**4. Upper surface smooth, plane to undulating. Rhizinomorphs scattered, black, simple to cribose or split.** Upper surface not pitted, brown with strong olive cast, matt or shining, smooth to slimy; consistency membranous to fragile. Lower surface black to rufous-black, lacunose, verrucose or granular. Thallus to 6 cm broad, mono- or poly-phyllous, 250-350 µm, irregular; margins curled. Apothecia rare, sessile to subpedicellate, with few gyri and thick margin, convex; spores brown, many-celled muriform. Medulla C+ red. On exposed, vertical, acidic rocks. Alaska, and Tennessee and N. Carolina. .... U. caroliniana Tuck.

**4. Upper surface obscurely vermiform-ridged to chinky-areolate. Rhizinomorphs few to many but irregularly distributed, cylindrical or flattened, forked.** Lower surface sooty black with fuscous, pruinose peripheral zone. Thallus to 3 cm broad, monophyllous, rigid, 275-325 µm thick, deeply incised; umbo slightly raised, smooth to slightly vermiform or areolate-chinky, partly coarsely granulose; upper side dull, powdery, dark gray to pale olive-buff. Apothecia rare, to 1.5 mm broad, with 1-2 fissures, occasionally omphalodisc, but with no central column. Medulla C+ red. On exposed rocks (e.g., gneiss) in open boulderbeds. Boreal-Arctic (Baffin Island, NW Territories), and alpine, rare. Material from British Columbia belongs to v. halei Llano, which bears a narrow band of sparse rhizines near the thallus margin. .... U. aprina Nyl.

**5. Margins powdery soresediate;** lower surface brown, smooth to finely warty, not warty-areolate; lamellae fibrillose, usually clearly developed around the umbilicus in older thalli, extending toward edges or sometimes absent; rhizinomorphs sparse to usually numerous, poorly developed, cylindrical, short, simple or branched, light colored, or darker brown to dove-gray or black. Thallus usually to 3(-8) cm across, monophyllous or polyphyllous, thin (140-225 µm), paper-like to leathery; umbo only slightly elevated; upper surface with fine network of fissures, often "bran-like" in texture, matt, light to dark brown; margins torn-lacerate, often reflexed upwards. Medulla C+ red. [Note: v. pyrenaica Frey differs in being larger, to 12-14 cm across, ± rigid, with upper side almost

smooth, underside strongly areolate, often almost without rhizinomorphs]. On acid rocks in open areas, but predominantly in protected cracks on steep surfaces or under small overhangs, strongly nitrophilous. Arctic (Alaska to Greenland), southern Canada, south to California and Colorado in the west, and to New England in the east, rather infrequent. .... U. hirsuta (Swartz ex Westr.) Hoffm.

**5. Margins not soredate;** rhizinomorphs (at least some) ball-tipped. Lower side light initially, becoming dark, finally  $\pm$  areolate; rhizinomorphs varied but only exceptionally strongly branched and covered at tips by groups of thallospores; thalli mostly over 2 cm diam. (often much larger). On various types of rock. .... U. vellea group s. lato (see separate key)

## U. vellea group sensu lato

After Poelt & Nash, 1993

**1. Lower cortex remaining light for a long time but finally becoming blackish to deep black; possessing two clearly different types of rhizinomorphs (in varied amounts) arranged in two layers: the longer, attenuate rhizinomorphs are forked to strongly branched and pale to grayish in upper half (contrasting with the rest of the lower surface) but black in basal portions due to thallospores, and the smaller ones are short, simple, completely covered by thallospores, and eventually have knoblike tips.** Lower cortex at most light brown as seen in cross section. Thalli thick, rigid, often large; upper surface grayish to dark or also whitish, rarely smooth, white to violet brown or stained brown or red (white pruinose?). Arctic, with scattered occurrences southward in the northern Rockies. .... U. vellea (L.) Ach.

**1. Lower cortex soon at least partially black, possessing one variable type of black rhizomorphs (very inconspicuous in L. havaasii); thallus size various.** ..... 2

**2. Thallus seemingly without rhizinomorphs, but mostly with some groups of very small inconspicuous ones that soon become covered by thallospores; lower side outwardly grayish, with black flecks of thallospore-producing areas.** Upper surface strongly pruinose in the area over the umbilicus, otherwise dark gray to dark brown. On vertical surfaces in exposed areas, mainly Arctic-alpine, S to Washington in the west. .... U. havaasii Llano

**2. Rhizinomorphs well developed and easily recognized (except in senescent thalli); lower side mostly soon black.** ..... 3

**3. Thallospores  $\pm$  spherical, consisting of many cells densely packed at ends of or along sides of rhizinomorphs.** Attenuate cylindrical rhizinomorphs intergrading with shorter, ball-tipped rhizinomorphs. Thallus somewhat thin (300-600  $\mu$ m), membranous, mostly very large, to 30(-63) cm, monophyllous; upper surface smooth, shiny, rarely light colored, olive brown to warm sepia or darker. Spores 16-26  $\times$  8-15  $\mu$ m, simple, hyaline. Medulla C+ red. In shaded habitats, mostly in forests. On shaded sandstones, granites, slates, etc. Infrequent in arctic-boreal areas, but very common southward in SE Canada and eastern U.S. .... U. mammulata (Ach.) Tuck.

**3. Thallospores not spherical and compacted, easily fragmenting into small, one- or two- (to a few-)-celled parts.** ..... 4

**4. Rhizinomorphs mostly densely crowded, long and gradually tapered (when well developed), covered with thallospores from basal portions to tips, but in old thalli often reduced to stumps, sometimes knoblike; thalli to 27 cm diam.** Thallus thick and rigid. Lower cortex dark brown as seen in cross section. Frequent and widely distributed in drier inland mountains of the West (Baja California and Arizona, north to British Columbia), eastward in the North to New England. .... U. americana Poelt & Nash

**4. Rhizinomorphs not densely crowded, not long and pointed, often very irregular; thalli mostly only 1-5 cm diam.** Rhizinomorphs coarse, simple or branched near tips or, more rarely, irregularly branched, rarely completely disintegrating in very old

**thalli.** Apothecia rare. .... 5

- 5. Rhizinomorphs very short, ball-tipped short, very irregular, often strongly laterally flattened, never filiform, often developing (in older thalli) from trabeculae, sometimes rather infrequent or almost absent.** Thallus mono-polyphyllous, 2-6(-12) cm diam., 200-300 um thick, rigid, irregular in shape; umbo with folds or fading rugi; upper surface strongly undulating, rarely smooth, matt, mouse gray, dark gray, reddish or violet-gray, or blotched with cinnamon brown; margins wavy, often reflexed. Lower surface black, marginally slightly paler, strongly verrucose (more so marginally), the umbilicus with ray-like coarse lamellae becoming fibrillose. Apothecia adnate to partly immersed, irregular, convex, the margin becoming cracked; spores brown, muriform. Medulla C+ red. On acid rocks, especially sandstone, Arctic (Alaska, Yukon and Greenland), and alpine in inland areas, S to British Columbia, and in high mountains of Arizona. .... U. cinereorufescens (Schaerer) Frey
- 5. Rhizinomorphs filiform when well developed, but often with knoblike thickenings at ends (ball-tipped), not developing from trabeculae.** .... 6

**6. Upper surface dark brown, often somewhat shiny. Lower surface with somewhat dense nap of papillate to cylindrical rhizinomorphs, which are simple to apically forked or rather richly branched, frequently bent to the outside along rim or upwards or protrude dorsally through thallus as black "warts", and covered on the tips with thallospores. Apothecia actinogyric.** Thallus to 10 cm broad, ca. 420 um thick, mono- or poly-phyllous, with folds in center; upper surface smooth, dark brown, matt or shining. Lower surface dark brown to black, areolate, with coarse black verrucae. Medulla C+ red. Rare in the arctic (NW and NE Canada) and Minnesota, common in the Pacific NW (SW British Columbia, south in the western U.S. to California). .... U. polyrhiza (L.) Fr.

**6. Upper surface gray to blackish gray, not shiny; rhizinomorphs typically short, irregular and often knoblike (ball-tipped), more rarely elongated, very variable; not bent as above. Apothecia gyrose.** Western N. America. .... U. trabeculata Frey & Poelt s. l.

### **U. trabeculata Frey & Poelt**

Thallus usually monophyllous, rarely weakly polyphyllous, to 6 cm or more across, thickish, plane to slightly undulate; margins rounded to irregularly crenate; upper surface smoothish to verrucose-subareolate (finely rimose)-uneven, ochre-white to dirty brown, epruinose; lower surface black to the margin, matt, rimulose-verrucose, towards the umbilicus coarsely areolate; rhizinomorphs rarely elongate and distinctly applanate, usually short, dilated (with truncate to capitate ends) and often distorted, to 0.5-1 mm wide, partly densely congregated, black, black thallospores developing on the margins of the expanded part ("± radiately dehiscent"); umbilicus sometimes excentric, divided into rugose, applanate trabeculae; upper cortex paraplectenchymatous; medulla thick, strongly scleroplectenchymatous.

Apothecia aborted, without distinct structure.

Cortex and medulla C+ red.



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