

**Lepraria** Ach.  
(DEUTEROMYCOTINA)

After Laundon (1992), Tonsberg (1992), and others

Rev. 6/95;  
need to incorporate more from additional articles

Thallus leprose to granular, usually forming a powdery crust, whitish to dark gray to greenish, thick to thin, margin diffuse to delimited, composed of a mass of powdery or non-powdery spherical granules, covered by entangled hyphae which often project outwards (x 25). Prothallus and hypothallus scarce. Photobiont chlorophyceous. Medulla white, or thallus unstratified. Ascocarps and pycnidia unknown. Chiefly aliphatic acids, benzyl esters, depsides, depsidones, and triterpenoids. On various substrates. Frequently dominant in shaded habitats.

Leproloma, which differs mainly in chemistry (presence of dibenzofurans), is included in this key.

The species of Lepraria s. lato are distinguished mainly by chemistry. Many other chemotypes occur in N. America, that do not fit into the species presently known from the continent (names given in **bold**); I have included descriptions of species not yet reported from N. America in the hopes that some of the unknowns will turn out to be these.

Only a few of the numerous sterile leprose taxa in other genera are cross referenced here in this edition.

The vast majority of specimens of Lepraria s. lato in North America (at least in the West) do not entirely match the chemistry and other characters of any of the "species" presently reported from the continent (ones indicated in **bold**), so I have included whatever species I can find reasonably reliable information on, from anywhere.

FeCl<sub>3</sub> is a 1% solution of ferric chloride in water, which apparently produces a color reaction to all phenolic substances other than atranorin and porphyrillic acid. Phenolic substances are visible in UV before spraying with acid and heating, whereas aliphatic (fatty acids) and triterpenoids are not.

# Diagnostic Substances in Lepraria s. lato

SUBSTANCE	SOLVENT SYSTEM		CHARACTERISTICS	
	A	B	C	(* = after charring)
atranorin	7	7	7	y*, K+y, P+p.y, C-, KC-
usnic acid	6	6	6	gray-gr*, K-, C-, KC+y, P-
divaricatic acid	4	6	5-6	y-gr*, K-, C-, KC-, P-
obtusatic acid	4	6	5	y-gr*, K-, C-, KC-, P-
psoromic acid	4	5	5	y-br*, K-, C-, KC-, P+y
alectorialic acid	4	5-6	4	br*, P+y, K+y, C+r, KC+r-o
lepraric acid	3	2	3	pink/p.br*
stictic acid	2	3	3	or-y*, K+y, C-, KC-, P+y-o
barbatolic acid <sup>2</sup>	5-6	3		y*, P+y, K+y, C+, KC+r-o
thamnolic acid <sup>2</sup>	3	2-3		r-br/y-o*, K+y, C-, KC-, P+y-o
pannaric acid 6-methyl ester	2-3	5	2-3	P+ reddish orange
pannaric acid	2	3	2	f. gr-y/purp*, K-, P-, C+gr
vouauxii unk. 1	2	3	2	-
porphyrilic acid	2	2	2	f. gr or -*, K-, P-, C+gr
fumarprotocetraric acid	1	3	2	d. gray*, K-, C-, KC-, P+r-o
protocetraric acid	1	3	2	d. gray*, K-, C-, KC-, P+r-o
oxypannaric acid 7-methyl ester	1-2?	2?	1-2?	P+r-br
vouauxii unk. 2	1	2	1	-*
pulveracic acid				
angardianic acid	4(-5)	5-6	6	-* (fatty acid)
roccellic acid	4	6	5-6	-* fatty acid
nephrosteanic acid	5	5-6	5	-* fatty acid

rangiformic acid	2	5	5	-* fatty acid
norrangiformic acid	2	5	3	-* fatty acid
flavescin				

	fatty acids	depsides/ depsidones	other phenolic triterp- substances	enoids
# = rarely present				
<u>crassissima</u>		divaricatic		zeorin
<u>incana</u>		divaricatic gyrophoric± atranorin# thamnolic±(?)	parietin#(?)	zeorin±
<u>lobificans</u>	roccellic±	stictic agg. atranorin gyrophoric± divaricatic±		zeorin
<u>elobata</u>	rangiformic±	stictic agg. atranorin		zeorin
<u>lesdainii</u>				lesdainin
<u>eburnea</u>		protocetraric atranorin#	alectorialic barbatolic	zeorin#
<u>frigida</u>			alectorialic barbatolic	
<u>nivalis</u>		atranorin gyrophoric#		
strain 1	rangiformic#?	protocetraric agg.		
strain 2	roccellic	protocetraric agg.		
strain 3	roccellic	protocetraric agg.		
strain 4		stictic agg.		
strain 5	roccellic	stictic agg.		
strain 6		psoromic		
<u>obtusatica</u>		obtusatic		
<u>flavescens</u>			sordidone flavescin	
<u>farinosa</u>	roccellic	pulveracic	usnic	
<u>umbricola</u>	roccellic±	thamnolic		
<u>nylanderiana</u>	roccellic	thamnolic		
<u>rigidula</u>	nephrosterinic	atranorin		
<u>jackii</u>	jackinic±	atranorin		zeorin#

roccellic±

sp.

rangiformic    atranorin

	fatty acids	depsides/ depsidones	other phenolic substances	triterp- enoids
# = rarely present				
<u>caesioalba</u> strain 1	roccellic±? angardianic± rangiformic±	gyrophoric±? fumarpro.± atranorin±		
strain 2	angardianic± rangiformic#	stictic agg. atranorin		
strain 3	angardianic	psoromic atranorin		
<u>neglecta</u>	angardianic± rangiformic# roccellic±?	alectorialic atranorin±		
<u>cacuminum/ caerulescens</u>	angardianic± roccellic± rangiformic#	atranorin psoromic#?	porphyrylic±	
<u>borealis</u>	rangiformic roccellic#	atranorin		
=====				
<u>diffusum</u>	roccellic#		4?-oxypannaric- 2-methylester	
<u>membranaceum</u>	roccellic	atranorin±	pannaric	zeorin#?
<u>vouauxii</u>	roccellic#	atranorin#	pannaric- 6-methylester	

**I-a. Thallus P+ strong yellow, orange, or red.**

**With phenolic substances other than or in addition to atranorin.**

**Thallus granular, with few if any projecting hyphae, minute, < 1 cm diameter, grayish to blue-gray, usually forming delimited rosettes which may be minutely lobed marginally. In slightly shaded to sun-exposed habitats exposed to rain and wind. Often on mossy, acid rocks or stony ground, usually on horizontal to gently sloping surfaces; less often on bark or wood.**

Note: various other whitish or grayish sterile granular lichens are also common, but are apparently not named at present.

**1. Thallus C+ reddish orange or C-, KC+ reddish orange, P+ yellow, K+ yellow or K-, containing alectorialic acid and minor amounts of related compounds, and angardianic acid (rarely replaced by rangiformic and norrangiformic acids), ± atranorin, rarely with gyrophoric acid as an accessory substances.** Thallus granular, firm, delimited, somewhat effigurate and growing in irregular rosettes, but usually without distinct lobes, usually delimited and minute, under 1 cm diameter, but coalescing with other thalli; granules tightly packed, convex-globular, ca. 0.1 mm (or in consoredia to 0.2 mm diam., or to 0.3 mm near edge of thallus), wall distinct, of globose to somewhat irregular cells, usually without projecting hyphae, ± separated in center but clustered at the margins; dark gray or bluish to whitish gray (turning pinkish in herbarium); medulla grayish white, rarely exposed. Hypothallus sparse, of brown hyphae. Photobiont to 15(-20) µm diam. On moss cushions or acidic rock, and on stony ground, usually in open, sunny locations. Colorado, Georgia, New York, New England states, Newfoundland. A duplicate of my own collection from shaded rocks in Vermont (originally determined by Brodo as L. zonata, and distinctly zonate at least in the specimen in my herbarium) is L. neglecta according to Kümmerling, et al. (1993). ..... **L. neglecta** (Nyl.) Lettau [(Nyl.) Erichsen according to Kümmerling, et al., 1993]

**1. Thallus C-, KC- or ± yellow, without alectorialic acid. .... 2**

**2. With fumarprotocetraric acid, usually + atranorin (and zeorin?--not mentioned by Laundon).** Thallus P+ orange red, K± yellow, KC± yellow. Also with angardianic or rangiformic acid. Thallus a mass of densely packed, round, convex granules to 0.05 diam., simple or in consoredia to 0.2(-0.4) mm diam., with a distinct wall, projecting hyphae sometimes present, short (up to ca. 10 µm) on central soredia, long (to 0.2 mm) on marginal soredia, whitish gray to bluish gray or dark gray, rarely greenish gray, delimited to effuse, the granules often lighter and clustered towards the margin, sometimes giving a zonate appearance, with alternating zones of dark and light greenish or bluish gray, firm (or soft?), usually not clearly lobed but often growing in irregular rosettes to 1 cm diam. or coalescing with other thalli; medulla grayish white, absent or poorly developed and rarely exposed. Colorless anchoring prothallus sometimes present. Photobiont to 20 µm diam. On moss cushions, lichens and cyanobacteria, or directly on rock, often on gently sloping and somewhat sunny habitats; rarely also on bark or wood of hardwood trees or shrubs. Resembles L. neglecta but differs chemically. .... **L. caesiocalba** (B. de Lesd.) Laundon (syn. L. zonata)

**2. Without fumarprotocetraric acid. .... 3**

3. With porphyritic acid. .... 4  
 3. Without porphyritic acid. .... 5

**4. Thallus diffuse, undelimited to delimited, without lobes; yellowish white to gray,** crustose-leprose, forming a thick, non-areolate crust of powdery to non-powdery spherical granules to 0.4 mm diam.; surface not corticate, or eroded to leave a leprose membrane; medulla white; underside with a weft of loosely entangled hyphae forming the early development of a hypothallus, whitish gray. Thallus containing atranorin, porphyritic acid and fatty acids (usually angardianic acid), K+ yellow, P+ pale yellow. FeCl<sub>3</sub>-. On especially acid, mossy rocks, also acid bark, soil, and other lichens.

Temperate-arctic. .... **L. cacuminum** (Massal.) Kümmerling & Leuckert (syn.: Leproloma cacuminum)

**4. Thallus with minute marginal lobes usually consisting of 1-2 consoredia, whitish gray to bluish gray,** forming small rosettes or irregular patches to 4 mm diam., soon becoming fused with adjacent thalli. Hypothallus sparse, of colorless to brownish hyphae. Soredia coarse, to 50(-100) µm diam., simple or in ± rounded consoredia to 125 µm diam., with a distinct wall of mostly globose cells giving the soredia a papillate appearance, occasionally with short hyphal projections. Photobiont chlorococcoid, to 20 µm diam. Thallus K+ yellow, P+ pale yellow, containing atranorin, porphyritic acid, and fatty acids (roccellic acid). On naked bark (juniper or willow shrubs) or corticolous foliose lichens, and on rock or soil. .... **L. caerulescens** (Hue) Botnen & Ovstedal (= L. cacuminum according to Leuckert, et al., 1995)

**5. With squamatic and baeomycesic acids, or thamnolic acid. .... (Leprocaulon subalbicans)**

**5. With stictic or psoromic acid, plus angardianic acid and atranorin. .... L. caesioalba**

ADD? (these are probably both L. caesioalba):

Containing stictic acid. Thallus whitish to grayish or bluish, coarsely granular (granules much coarser than those of L. neglecta). Montane to alpine areas on the west slope of the Cascades in Washington. .... L. sp.

Containing psoromic and 2'O-demethylpsoromic acids, roccellic acids, and atranorin. Morphologically similar to L. neglecta. On mossy rocks. Norway. .... L. sp.



**I-b. Thallus P+ strong yellow, orange or red,  
With phenolic substances other than or in addition to atranorin,  
FeCl<sub>3</sub>+ pinkish, brownish, grayish, or violet.  
Thallus powdery, usually with projecting hyphae,  
Often extensive, delimited to diffuse.  
Usually growing in shade, often on steep or overhanging surfaces  
(protected from sun and precipitation); on various substrates.**

**1. Thallus C- to orange-pink, KC+ orange-pink to red, K- to K+ yellow (the KC reaction is different from that obtained by K alone), P+ yellow to orange, containing alecatorialic acid (R<sub>F</sub> 4 in C) and related substances; turning herbarium packets pink after a few years. (If thallus granular, without projecting hyphae, in exposed habitats, see L. neglecta). ..... 2**  
**1. Thallus C- to yellow to orange-brown, KC- to orange-brown, K- to + yellow to yellow-brown or orange (if there is a KC reaction it is not pinkish and is similar to that obtained by K alone), without alecatorialic acid, not turning packets pink. ....3**

**2. Thallus P+ yellow, without protocetraric acid. Thallus whitish, often with a yellowish tinge, ± lobed.** Thallus byssoid, leprose, consisting of a mass of loosely packed, powdery convex granules, to 0.6 mm diam., with projecting hyphae, often eroded to leave a leprose membrane, forming an irregularly shaped patch or sometimes delimited by an obscurely lobed margin, thick, whitish, often with a yellow tinge; medulla white. Alecatorialic acid only. Over mosses in damp crevices on limestone cliffs. Resembles L. eburnea and Leproloma vouaxii but differs chemically. .... **L. frigida**  
**Laundon** (L. sp. #2 in Brodo, Ottawa, also keys out here)

**2. Thallus P+ orange, with protocetraric acid (in variable amounts). Thallus bright whitish gray with a greenish or yellowish tinge, diffuse, without marginal lobes.** Thallus byssoid, composed of a mass of ± scattered, loosely packed groups of powdery spherical granules, with short projecting hyphae, when well developed forming a thick powdery crust, bright whitish gray with a greenish or yellowish tinge, diffuse, without marginal lobes, irregularly spreading, mostly non-stratified, or, when well developed, forming a thick, continuous, stratified, ± delimited crust up to 10 cm or more across; medulla white, distinct in thickish specimens. Hypothecallus not distinct. Soredia fine to coarse, to 40 µm diam., often in lax consoredia to 120(-200) µm diam., wall distinct to indistinct. Soredia and consoredia ± embedded in a hyphal matrix. Medulla thick and white. Photobiont to 20 µm diam. With alecatorialic and barbatolic acids. On bricks, mortar and mosses of brick walls in slight shade, rock crevices and tree trunks. Some material collected on Thuja plicata on the west side of the Cascades in Washington state may belong here, if its unknown substance is alecatorialic acid. .... **L. eburnea**  
**Laundon**

**3. Thallus FeCl<sub>3</sub>+ grayish, P+ orange, with pannaric acid or its derivatives, yellowish gray or yellowish white. .... 4**  
**3. Thallus FeCl<sub>3</sub>+ pink to gray-brown or violet, without pannaric acid and its derivatives (except in Leproloma diffusum), greenish gray to whitish gray or bluish. .... 5**

**4. Lobes indistinct (absent according to Tonsberg). Containing pannaric acid 6-methyl ester, 4?-oxypannaric acid-6-methyl ester, and pannaric acid; without roccellic acid and usually without atranorin. Thallus P+ reddish orange, K-, C-.**

Thallus forming irregular rosettes to 4(-6) cm diam., and obscurely lobed, or irregularly delimited small crusts, powdery, whitish to pale yellowish or greenish gray; surface not corticate, a mass of powdery, convex granules, which are sometimes eroded to leave a leprose margin; medulla white, exposed in places on most specimens; underside a weft of loosely entangled hyphae forming the early development of a hypothallus, whitish gray to brownish, distinct in well developed specimens. Soredia usually coarse, up to 100 um diam., often in consoredia to 150(-200) um diam., with or without projecting hyphae; wall usually poorly developed. Photobiont to 16 um. FeCl<sub>3</sub>+ gray. On calciferous stone and bark, in shaded situations, especially on nutrient-rich Fraxinus and Ulmus in sheltered parks and woodlands, on bare surfaces, and bryophytes, also commonly on soil. Resembling a poorly developed morph of Leproloma membranaceum, but lobes indistinct and differing chemically. .... **Leproloma vouauxii (Hue) Laundon**

**4. Lobes distinct. Without pannaric acid 6-methyl ester; With pannaric and roccellic acids and often atranorin, P+ reddish orange, K+ yellow (atranorin) or K-, C-.** Thallus soft, well delimited, forming irregular rosettes, usually rather distinctly lobed at the margin, forming small, shelf-like membranous outgrowths, yellowish white; apices of lobes rounded, ± flat; surface not corticate, of numerous powdery convex granules, the margin either flat or raised, 1-17 mm wide, older lobes often disintegrate to powdery convex granules to 0.5 mm diam., especially at the center of the thallus, or eroded to leave a leprose membrane; medulla whitish, well developed; underside a continuous, well-developed weft of branched hyphae forming a hypothallus, whitish gray to brownish. Young specimens with rounded powdery squamules with a rolled edge at the margin, recalling Normandina. Soredia fine to coarse, to 60 um diam., with or without shortly projecting hyphae, often in consoredia to 125(-200) um diam.; wall indistinct to distinct. Photobiont to 15 um. Apothecia very rare, to 2 mm diam., the sorediate thalline exciple 0.5 mm thick. FeCl<sub>3</sub>+ gray. Usually on shaded, steep, mossy, acidic rock faces or walls, on the surface and over mosses, occasionally on mosses on shaded tree trunks, especially Quercus. A major part of the reports from N. America are misidentifications; however, I have seen material from Ohio and Arizona that seems to match European material quite well. .... **Leproloma membranaceum (Dickson) Vainio**

**5. K+ violet-red (parietin); thallus often tinged dull orange.** ..... (unusual strain of L. incana reported from Britain)

**5. K- to + yellow or orange; thallus not orangish.** .....6

**6. Thallus delimited.** Thallus whitish, K- or + yellow, P+ orange; on calcareous rock. .... (L. nivalis)

**6. Thallus not delimited.** ..... 7

**7. Thallus K+ bright yellow, P+ orange, FeCl<sub>3</sub>+ dull violet to dull pinkish violet, in Ba(OH)<sub>2</sub> producing clusters of boat-shaped crystals. Containing thamnolic acid.** ..... 8

**7. Thallus K+ less vivid yellow, color with FeCl<sub>3</sub> not violet; without thamnolic acid.** ..... 9

**8. Soredia fine, simple or in rounded consoredia to 40(-60)  $\mu$ m diam.,** sometimes with shortly projecting hyphae; wall indistinct to distinct. Thallus gray green to green, diffuse, forming a thin to thick, irregularly spreading crust to 10 cm or more across, unlobed, usually unstratified, sometimes with a white medulla. Photobiont chlorococcoid, to 15  $\mu$ m diam. Thallus K+ yellow, P+ yellow-orange. FeCl<sub>3</sub>+ dull pinkish-violet to dull violet. Also containing atranorin. On shaded bark of various trees, in cavities formed by roots and tree bases and on trunks of phorophytes growing under overhanging rocks. ....  
L. umbricola Tonsb.

**8. Soredia coarse, up to 0.3 mm.** Thallus whitish to pale gray, delimited, thick; medulla whitish; well developed specimens with sublobes and conspicuous grayish hypothallus. Hyphae of thallus 2-5  $\mu$ m, surface rough. Photobiont protococcoid, 7-15  $\mu$ m. Thallus K+ and P+ distinctly yellow. Containing roccellic acid. On soil, mosses and siliceous rocks in the Mediterranean area and in warmer sites of central Europe, frequently accompanied by Leprocaulon microscopicum. .... L. nylanderiana Kümmerling & Leuckert

**9. Containing psoromic acid (R<sub>F</sub> 5 in solvent C, P+ bright yellow) and atranorin. ....**  
(strain of L. nivalis)

**9. Without psoromic acid. .... 10**

**10. Thallus containing obtusatic acid (R<sub>F</sub> 5 in solvent C),  $\pm$  an unidentified yellow pigment and sometimes traces of other substances.** Thallus leprose throughout, or composed of soredia mixed with some colorless medullary hyphae, episubstratal, pale green with a gray-yellow tinge, becoming more distinctly gray-yellow in the herbarium, diffuse, unlobed, discontinuous to partly continuous, forming irregular patches to several cm across, usually unstratified. Soredia fine, to 25(-35)  $\mu$ m diam., sometimes in loosely packed,  $\pm$  irregular consoredia to 50  $\mu$ m diam., very fragile; wall poorly developed. Photobiont chlorococcoid, to 10  $\mu$ m diam. Thallus UV+ dull pink, P+ yellow [presumably due to the unknown substance(s)]. On shaded tree trunks, often adjacent to overhanging rock. .... L. obtusatica Tonsb.

**10. Without obtusatic acid; with substances having R<sub>F</sub> values of 4 or less in solvent C. .... 11**

**11. Thallus P+ orange, orange-red, or red-brown, without porphyric acid. Containing either stictic acid agg. or fumarprotocetraric/protocetraric acid. .... 12**

**11. Thallus P+ pale yellow, containing porphyric acid and fatty acids. ....**  
(see L. cacuminum and L. caerulescens)

**12. Thallus greenish white or greenish yellow, K+ yellow or K-, C+ yellow (var. diffusum) or K+ slowly orange, C- (var. chrysodetoides Laundon), always P+ brownish red (4-Oxypannaric acid-2 methylester, pannaric acid-2-methylester, pannaric acid). FeCl<sub>3</sub>+ dull gray-brown with pinkish tinge.** Thallus crustose-leprose, forming a thick, non-areolate crust of powdery granules, either greenish white (var. diffusum) or greenish yellow, becoming orange-yellow in places (var. chrysodetoides), surface not corticate; a mass granules powdery, spherical, to 0.3 mm diam., not marginate, diffuse, usually undelimited but occasionally delimited, without lobes; medulla

white, sometimes exposed in places; underside with a weft of loosely entangled hyphae forming the early development of a hypothallus, whitish gray to brownish. 4-Oxypannaric acid-2-methylester,  $\pm$  atranorin. On mosses over calcareous and acidic stone in shaded to moderately illuminated situations. Western N. America. ....

**Leproloma diffusum Laundon**

**12. Thallus whitish, grayish, or yellowish white.  $\text{FeCl}_3$ + grayish or pinkish, without pannaric acid and its derivatives. .... 13**

**13. Containing fumarprotocetraric or protocetraric acids, + atranorin, + or - roccellic acid. Thallus  $\pm$  lobed. .... 14**

**13. Containing stictic acid. .... 15**

**14. Thallus usually thick; on rock or moss.** With rangiformic or roccellic acids as uncommon accessories. Thallus forming an uneven non-corticate membrane on which occur powdery convex granules to 0.4 mm diam., with projecting hyphae, when well developed producing an extensive, thickish, powdery, folded crust, delimited, with the margins almost lobe-like; color white to pale gray, sometimes with a bluish gray tinge. On bare rock and over mosses and lichens on shaded limestone, often dominant, also on siliceous coastal rocks. I have collected material in Ohio and Vermont that seems to correspond to this species. .... **L. nivalis Laundon** (syn. L. crassissima auct. p. p., non (Hue) Lettau)

**14. Thallus thin; on bark or wood.** Thallus distinctly bluish tinged. West side of the Cascades in Washington state. .... L. sp.

**15. With zeorin.** Without roccellic acid, but sometimes with an unidentified fatty acid. Containing stictic acid and related substances, and atranorin. .... 16

**15. Without zeorin.** Containing stictic and constictic acid (norstictic in traces  $\pm$ , cryptostictic acid in traces  $\pm$ ), and atranorin, + or - roccellic acid. Thallus  $\pm$  lobed. .... (**L. nivalis**)

**16. Thallus distinctly stratified (with definite medulla), with filamentous "airy" soredia, with long, projecting hyphae which sometimes form a weft on the surface, or the granules becoming eroded to leave a leprose membrane, marginally lobate (according to Tonsberg and most other authors, but according to Laundon, thallus is usually diffuse, without marginal lobes but in eroded specimens the medulla often develops into delimited sublobes).** Thallus byssoid, composed of a mass of loosely packed powdery convex granules of variable shape and size, to 0.5 mm diam.; usually forming a thick, irregular crust, bright greenish gray, light green, bluish gray-tinged, or whitish gray, the latter color especially when eroded; medulla white. Thallus K+ yellow, P+ orange, containing atranorin, stictic acid, and  $\pm$  constictic acid and zeorin, and sometimes an unidentified fatty acid. On shaded bark and on shaded acidic and calcareous rock, directly on the surface and especially over mosses; also on shaded earth. I have collected material from soil and rock in montane to alpine inland sites in California and the Pacific Northwest that seems to fit well here, but according to Tonsberg in Norway the species is mostly restricted to lowland coastal sites. I have also collected a specimen from Ohio that seems to fit, but has very small, discrete thalli. .... **L. lobificans Nyl.** (syn. L. finkii)

**16. Thallus unstratified (without a medulla), with compact soredia, without projecting hyphae, non-lobate,** entirely episubstratal or, rarely,  $\pm$  endosubstratal in young parts, gray, bluish gray or greenish gray, leprose throughout, mostly diffuse, forming a thin cover of discrete to  $\pm$  contiguous soredia, or a  $\pm$  continuous, thick crust, rarely forming discrete, well-defined, flattened aggregations to 1 mm diam of densely packed soredia, usually irregularly spreading to 10 cm or more across. Soredia mostly fine, to 30-45  $\mu$ m, often in globose to ellipsoidal consoredia to 100  $\mu$ m diam.; wall usually not complete. Photobiont chlorococcoid, to 18  $\mu$ m diam. Thallus K+ yellow, P+ orange, with stictic acid as the major substance; and cryptostictic, norstictic and constictic acids as minor constituents. Differs from lobificans in lacking a distinct medulla and in having rather compact soredia that lack protruding hyphae. On wide range of bark types, especially on naked bark at the base of trunks; rarely on rock or soil. Found both in coastal and inland sites, low to rather high elevations, Norway, British Columbia. I have collected material on live oak bark in Florida that appears to correspond to this species, but I am skeptical because of the rather different distribution. .... L. elobata Tonsb. (= L. lobificans according to Leuckert, et al., 1995)

ADD:

**Thallus small, discrete, non-lobed, powdery, slightly yellowish, K+ yellow, P+ red-orange, containing atranorin, protocetraric acid, and three unknown phenolic substances (yellowish after charring, R<sub>F</sub> 6, 5-6, and 3 in solvent C).** On wood, Idaho. .... L. sp.

**Thallus K+ yellow then red (norstictic acid).** Thallus pale green to dingy orange, very thick, soft, fine, on moss. Washington. .... L. sp.

Thallus fragile, stiff, clearly lobed, white, P+ orange-red, K+ yellow, KC-, with atranorin, plus protocetraric or fumarprotocetraric acid. On soil. .... L. lobificans sensu ?

Thallus thick, poorly delimited, not lobed, pale greenish or yellowish, friable in consistency, K+ yellow, KC+ yellow, P+ pink-orange, UV+ white, with atranorin, usnic acid, and stictic and constictic acids (and UV+ white substance?). On soil or peat over rock, or on tree bases, shaded. .... L. finkii sensu ? (lumped by Laundon under L. lobificans)

Thallus KC± red, with fumarprotocetraric acid and zeorin, + or - alectorialic acid, + or - atranorin, soft and powdery or firm and granular, zonate. Directly on rock, in shaded to somewhat sunny habitats, northeastern. .... L. zonata sensu ? (lumped by Laundon under L. caesiocalba)

**II-a. Thallus P- (at most P+ pale yellowish).  
With phenolic substances other than or in addition to atranorin;  
FeCl<sub>3</sub>+ pinkish, brownish, violet or gray.**

**1. Thallus strongly yellow (an acetone-insoluble pigment).** (also see Chrysothrix if bright greenish yellow K-, Caloplaca if orangish yellow, K+ purple; both have acetone-soluble pigments). ..... Leproloma diffusum v. chrysodetoides

**1. Thallus not bright yellow, at most pale yellow.** .....2

**2. Thallus coarsely granular, often zonate, K± yellow, C-.** With either rangiformic or roccellic acids, ± atranorin [If containing porphyrilic acid, see Leproloma cacuminum]. Often growing on rather sunny, mossy, acidic rocks. .... (see L. caesioalba)

**2. Thallus finely granular or powdery soft or firm, not zonate, growing in shade.** (If containing porphyrilic acid, or pannaric acid or related dibenzofurans, see Leproloma spp.]. ..... 3

**3. Thallus C+ pink to red, KC+ orange pink to red, K-, KC-.** Containing divaricatic and nordivaricatic acid. [Note: material with thallus K-, P-, KC+ yellow; thick, pale green with white prothallus, fine, soft, on dry overhangs, in Western Washington, also keys out here and may be this species] ..... L. crassissima

**3. Thallus C- or C+ yellow, KC-, K+ or K-.** ..... 4

**4a. Thallus ± yellow, C+ or KC+ strong yellow.** ..... 4b

**4a. Thallus ± white, gray, green, bluish, or creamy, without usnic acid, KC-, UV+ white or UV-.** ..... 5

**4b. Thallus ± yellow, C-, KC+ yellow (usnic acid), UV-, without divaricatic acid.** K+ yellow (atranorin). Friable in consistency. With fatty acids (roccellic, hydroxyroccellic) and pulveracic acid. Not treated by Laundon, 1992, nor by Tonsberg, 1992. .... L. farinosa

**4b. Thallus yellow-white, K- or almost, C+ strong yellow. Containing sordidon (in variable amounts) and flavescin (in variable amounts), and atranorin.** Thallus ± distinctly delimited. On ± calcareous rocks. .... L. flavescens Clauzade & Roux

**5. Thallus UV+ white, with divaricatic acid (R<sub>F</sub> 5-6 in C).** ..... 6

**5. Thallus UV- (?), with porphyrilic acid (R<sub>F</sub> 2 in C) or pannaric acid 6-methyl ester (R<sub>F</sub> 2-3 in C).** ..... 7

**6. Thallus poorly delimited, not lobed. Medulla poorly developed or absent.** Thallus UV+ white or bluish, with divaricatic acid, zeorin, and other triterpenoids, K± yellow (atranorin). Thallus forming ± irregular, continuous patches to at least 8 cm diam., or small, poorly developed patches in colonies, leprose, a mass of powdery spherical granules to 0.1 mm diam., with projecting hyphae, when well developed forming a thick (sometimes loosely attached?), frequently areolate, powdery crust, dull greenish gray, usually with a bluish tinge, diffuse, without marginal lobes; medulla ± undifferentiated. Soredia mostly fine, occasionally coarse and up to 45 µm, simple or in consoredia to 70(-110) µm diam., sometimes with some shortly projecting hyphae; wall usually not

complete, of cylindrical cells. Medulla sometimes differentiated. On acid, shaded bark, and on acid, shaded walls and rocks, especially on bare surfaces but also over mosses. I have collected material from California and Washington that seems to correspond well to this species. If zeorin absent and prothallus distinct, blue, N+ violet, see Lecidea nylanderii. ..... **L. incana (L.) Ach.**

**6. Thallus well delimited, ± lobed; lower surface cerebriform. Medulla very thick.** Thallus thick, soft. With divaricatic acid and substantial amounts of nordivaricatic acid. Thallus white to grayish-white with a bluish tinge, cobwebby-membranaceous, with folded-rugose upper surface. On shaded, overhanging surfaces of calcareous substrates. Not treated by either Laundon or Tonsberg. .... **L. crassissima (Hue) Lettau** (including v. isidiata Llimona)

**7. Thallus obscurely lobed, usually K-, containing pannaric acid 6-methyl ester, ± pannaric acid, rarely atranorin. .... (Leproloma vouauxii)**

**7. Thallus with or without lobes, K+ yellow, containing porphyritic acid and fatty acids.**

The differences between these two taxa need to be clarified. Laundon lists Leproloma angardianum as a synonym of L. cacuminum, but according to Tonsberg that species is a synonym of Lepraria caerulescens. According to Kümmerling, et al., angardianic and roccellic acids are virtually indistinguishable by TLC. .... 8

**8. Thallus diffuse, undelimited to delimited, without lobes; yellowish white to gray,** crustose-leprose, forming a thick, non-areolate crust of powdery to non-powdery spherical granules to 0.4 mm diam.; surface not corticate, or eroded to leave a leprose membrane; medulla white; underside with a weft of loosely entangled hyphae forming the early development of a hypothallus, whitish gray. Thallus containing atranorin, porphyritic acid and fatty acids (angardianic acid, according to Kümmerling, et al., 1993), K+ yellow, P+ pale yellow. On especially acid, mossy rocks, also acid bark, soil, and other lichens. Temperate-arctic. .... **Leproloma cacuminum (Massal.) Laundon**

**8. Thallus with minute marginal lobes usually consisting of 1-2 consoredia, whitish gray to bluish gray,** forming small rosettes or irregular patches to 4 mm diam., soon becoming fused with adjacent thalli. Hypothallus sparse, of colorless to brownish hyphae. Soredia coarse, to 50(-100) µm diam., simple or in ± rounded consoredia to 125 µm diam., with a distinct wall of mostly globose cells giving the soredia a papillate appearance, occasionally with short hyphal projections. Photobiont chlorococcoid, to 20 µm diam. Thallus K+ yellow, P+ pale yellow, containing atranorin, porphyritic acid, and fatty acids (roccellic acid). On naked bark (juniper or willow shrubs) or corticolous foliose lichens, and on rock or soil. .... **L. caerulescens (Hue) Botnen & Ovstedal**

ADD:

Containing only an unknown substance (R<sub>F</sub> 6 in C), dirty greenish or yellowish gray, effuse, rather thin. On rock, California. .... L. sp.

Containing atranorin and unknown substances (in the vicinity of R<sub>F</sub> 5-6 in C), grayish with a bluish tinge, effuse. On rock, very common, California, Oregon. .... L. sp.



**II-b. Thallus P- or + pale yellow.**  
**Without phenolic substances, or with atranorin as the only one.**  
**FeCl<sub>3</sub>- (at most faintly brownish). K+ yellow**

**1. With the triterpene lesdainin (= 6 $\alpha$ -acetoxyhopan-22-ol) only, without atranorin or other substances, K-, C-, KC-, P-.** Thallus leprose, of a mass of powdery irregular granules, to 0.1 mm diam., but often much smaller, with numerous projecting, septate hyphae which tend to form a weft over the surface, when well developed forming a thick powdery crust, dark verdigris green, but becoming dull greenish gray in herbarium; forming  $\pm$  irregularly orbicular patches in the early stages, without marginal lobes. Thallus UV-. FeCl<sub>3</sub>-. In GE forming moss-like branching patterns of minute crystals. On rock and over mosses in limestone caves and clefts, and on limestone cliffs shaded by trees, confined to damp, heavily shaded habitats, in deeper shade than *Leproplaca chrysodeta* with which it often grows. .... ***Botryolepraira lesdainii* (Hue) Canals, Hernández-Mariné, Gómez-Bolea & Llimona** (syn.: *L. lesdainii* (Hue) R. C. Harris)

**1. Without triterpenes, with atranorin and usually fatty acids.** (I have a number of specimens that appear to contain atranorin only, and a few that apparently lack substances completely, but these need to be re-TLC's). .... 2

**2. Thallus minute, < 1 cm diam., grayish to blue-gray, usually forming delimited rosettes which may be minutely lobed marginally. In slightly shaded to sun-exposed habitats exposed to rain.** .... 3

**2. Thallus to several cm or dm in diameter, variously colored, delimited to diffuse. Often in dry, deeply to semi-shaded habitats.** .... 4

**3. Roccellic or angardianic acid present; rangiformic acid absent.** .... (see *L. caerulescens* and *Leproloma cacuminum*)

**3. Rangiformic acid present; roccellic acid sometimes also present.** Thallus grayish white, forming minute rosettes to 2 mm diam. which may fuse to form patches up to 2-3 cm in diam., occasionally with minute, obscure marginal lobes, unstratified or with a whitish medulla or (in saxicolous specimens) a layer or whitish soredia beneath, sorediate. Hypothallus sparse, of colorless hyphae. Soredia fine to coarse, to 75  $\mu$ m diam., simple, or in consoredia up to 100  $\mu$ m (-0.16 mm) diam., sometimes with shortly projecting hyphae; wall indistinct to distinct. Photobiont green, coccoid, to 15(-20)  $\mu$ m diam. Ch.: atranorin, rangiformic,  $\pm$  norrangiformic acid, sometimes also roccellic acid. Thallus UV+ dull pink. Apparently mainly on mossy rocks, less often on shaded hardwood and softwood bark, British Columbia and Washington. I have collected material on rock and moss over rock on the west side of the Cascades in Washington state, that has a thin, bluish-greenish thallus and the same chemistry as this species. ....

..... *Lepraria borealis* Lohtander & Tonsberg (Syn. *Lepraria* sp. A of Tonsberg, 1992; = acid-deficient material of *L. caesioalba* or *L. cacuminum*, according to Leuckert, et al., 1995)

**4. Containing the fatty acid nephrosteranic acid ("rigidula unknown"). Soredia with very long, projecting filaments (easily seen with a dissecting scope).** Thallus episubstratal, leprose, white, whitish gray or bluish gray, diffuse, soft, usually forming a thick, soft,  $\pm$  continuous, irregularly spreading crust, to several dm across, unlobed, or in

young specimens, sometimes with obscure lobes, usually unstratified, occasionally with a distinct white medulla forming a lax, felty mat. Soredia very loosely packed, fine to coarse, to 60 µm diam., simple or, more often, in consoredia to 300 µm diam., with up to 120 µm long, projecting, simple hyphae; wall usually distinct, of globose to cylindrical cells. Photobiont chlorococoid, to 20 µm diam. Thallus UV- (or UV+ dull pink). FeCl<sub>3</sub>-. Also containing atranorin. Usually on mossy rocks, only rarely on bark (usually naked, mainly of deciduous trees, on the shaded side high up on the trunks, or underside of leaning trunks). ..... **L. rigidula (B. de Lesd.) Tonsb.**

**4. Containing rangiformic acid or jackinic acid. Soredia without or with shortly projecting hyphae. .... 5**

**5. Containing the fatty acids jackinic acid and roccellic acid.** Soredia greenish without or with shortly projecting filaments. Thallus episubstratal, leprose, pale green, grayish green, yellowish green, straw-colored or, rarely, bluish green, diffuse, forming a thin to usually thick, ± continuous, irregularly spreading crust to several dm across, unlobed, unstratified, or in thick specimens, with a white medulla. Soredia loosely packed, fine to coarse, to 50 µm, simple or in consoredia to 80 µm diam., often with some shortly (mostly ca. 10 µm long) projecting hyphae; wall distinct, of globose to ± cylindrical cells. Photobiont chlorococcoid, to 15 µm diam. Containing atranorin. The report of rangiformic acid is based on misidentification of jackinic acid, which has the same R<sub>F</sub> values. FeCl<sub>3</sub>-. On acidic bark (usually naked, at or near base of trunks), rarely on rocks. .... **L. jackii Tonsb.**

**5. Without roccellic acid. .... (see L. borealis)**

"Atranorin only". Thallus pale greenish, diffuse, extensive; soredia with long hyphal projections (as in L. rigidula). On bald cypress, Florida. .... **L. sp.**

"Atranorin only". Thallus whitish, with a slight bluish or greenish tinge, thin to thick, mostly extensive, diffuse; soredia with some short hyphal projections. On soil or moss over rock, very common in montane inland areas of California. This may be L. caeruleascens. .... **L. sp.**

ADD:

L. glauccella

Lepraria "muscicola" Ryan in herb.--Thin, greenish, powdery, containing atranorin, zeorin, and unknown phenolic substance (pale,  $R_F$  3 in solvent C); on moss.

Lepraria "mysteria" Ryan in herb.--Thin, greenish, powdery, containing only an unknown phenolic substance (pale,  $R_F$  3 in solvent C); on wood.

Lepraria "problematica" Ryan in herb.--Thin, greenish, powdery, containing only an unknown phenolic substance (orange after charring,  $R_F$  5-6 in solvent C); on wood.

Lepraria "luteola" Ryan in herb.--Thin, pale yellowish, powdery, on bark. I do not have a record of the chemistry.

Lepraria "mollis" Ryan in herb.--Rather thick and soft, pure pale green, powdery, on bark. I do not have a record of the chemistry.

"No substances". Thallus thick, white, powdery, extensive. On moss. Colorado and British Columbia. .... L. sp.

## Literature

- Aptroot, A., P. Diederich, E. Serusiaux and H. J. M. Sipman. 1997. Lichens and lichenicolous fungi from New Guinea. *Bibl. Lichenol.* 64.
- Botnen, A. & D. Ovstedal. 1988. Muscicolous Lepraria species and other leprarioid lichens in the Antarctic. *Polar Research* 6: 129-133. [Not seen]
- Brodo, I. M. 19 . Lichens of Long Island.
- Brodo, I. M. 19 . Lichens of the Ottawa Region.
- Clauzade, G. & C. Roux. 19 . [Esperanto book]
- Harris, R. C. 19 . Lichens of the Straits Counties, Michigan.
- Kümmerling, H. 1991. Zur Kenntnis der Flechtenflora am Hoher Meissner und in seinem Vorland (Hessen) unter besonderer Berücksichtigung chemischer Merkmale. *Bibl. Lichenol.* 41: 1-315.
- Kümmerling, H., C. Leuckert & V. Wirth. 1991. Chemische Flechtenanalysen. VI. Lepraria incana (L.) Ach. *Nova Hedwigia* 53: 507-517.
- Kümmerling, H., D. Triebel & G. Rambold. 1993. Lepraria neglecta and its lichenicolous fungi. *Biblioth. Lich.* 53: 147-160.
- Laundon, J. R. 1989. The species of Leproloma -- the name for the Lepraria membranacea group. *Lichenologist* 21: 1-22.
- Laundon, J. R. 1992. Lepraria in the British Isles. *Lichenologist* 24: 315-350.
- Laundon, J. R. 1992. Lepraria. In: Purvis, et al., Lichen Flora of Great Britain and Ireland.
- Leuckert, C. & H. Kümmerling. 1991. Chemotaxonomische Studien in der Gattung Leproloma Nyl. ex Crombie (Lichenes). *Nova Hedwigia* 52: 17-32.
- Leuckert, C., H. Kümmerling and V. Wirth. 1995. Chemotaxonomy of Lepraria Ach. and Leproloma Nyl. ex Crombie, with particular reference to Central Europe. *Bibl. Lichenol.* 58: 245-259.
- Lohtander, K. 1994. The genus Lepraria in Finland. *Ann. Bot. Fennici* 31: 223-231.
- Orange, A. 1995. The British species of Lepraria and Leproloma: chemistry and identification. *British Lichen Society Bulletin* : 1-9
- Ovstedal, D. O. 1983. Some lichens from H. U. Sverdrum mountains, Dronning Maud Land,

Antarctis. Nova Hedwigia 37: 683-690.

Ozenda, P. & G. Clauzade. 1970. Les Lichens.

Poelt, J. 1969. Bestimmungsschlüssel europäischer Flechten. Cramer, Vaduz.

Tonsberg, T. 1992. The soresiate and isidaite, corticolous crustose lichens in Norway. Sommerfeltia 14.

Wirth, V. 1980. Flechtenflora. Ulmer, Stuttgart.