

Peltigera Willd.
(PELTIGERACEAE)

After Goward, et al. (1995) and various other authors

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Thallus foliose, heteromerous, dorsiventral, spreading or somewhat ascending, forming compact to very wide-spreading rosettes; lobes rounded or \pm elongate, discrete, contiguous or overlapping; upper side green (bright green when wet), blue-gray, gray-brown or brown to red-brown, flat, wavy or bullate, matt or shiny, smooth, \pm scabrid, tomentose, or pruinose; margins entire or \pm lobulate, or with folioles, schizidia or soralia; upper surface with a paraplectenchymatous cortex; lower surface ecorticate (corticate according to Rogers), whitish to brown-black, arachnoid-tomentose or with anastomosing pale or dark veins, attached to substrate by conspicuous, often bushy, rhizines arising from the veins; rhizines short or long, simple to fasciculate, often with an anchoring squarrose tuft. Cephalodia, when present, external on either upper or lower surface of species with green photobiont. Medulla white, of \pm loosely interwoven hyphae.

Apothecia immersed on upper surface of horizontal or \pm vertical, ascending specialized marginal lobules, saddle-shaped, flattened or oval, red-brown to black, often with reflexed or crenulate, sometimes areolate-tomentose margins, or \pm emarginate, sometimes with a veil of cortical remains; development hemiangiocarpic; hypothecium hyaline to brown; hymenium colorless to pale brownish; epihymenium red-brown; paraphyses unbranched; asci cylindrical-clavate, fissitunicate (unitunicate according to Rogers), Peltigera-type, I+ blue; tholus I+ blue; apex of the endoascus with a K/I+ blue annulus; spores 8, oblong-ellipsoid to narrowly fusiform or acicular, transversely 3-7-septate, hyaline to pale brown, thin walled. Pycnidia immersed; fulcrum filiform; pycnospores filiform. Hopane triterpenoids, less often phenolic substances (tridepsides). Photobiont Coccomyxa or Nostoc (Nostoc often in cephalodia). On soil, moss, or mossy bark or rock, mostly in humid areas, mostly temperate to arctic-alpine.

Identification of species depends on well developed material in good condition, and careful study of the underside after cautiously removing the substrate.

Descriptions of most species in this key at present do not include anatomical details, which should be put in some time. Additional information from Goffinet, Goffinet & Hastings, Holtan-Hartwig, and Vitikainen needs to be added to the descriptions. The information on geographical distribution in this key is presently very incomplete; need to check McCune & Geiser, McCune & Goward, etc. The info. on ecology in the key is from Goward et al. 1997; information in the descriptions is from other sources. Other sources need to be re-consulted to clarify some apparent contradictions. Notes on similar species need to be added (partly from Goward et al.)

For TLC, Goward et al. used solvent systems G (toluene-ethyl acetate-formic acid = 139:83:8) and (or) EHF (diethyl ether-hexane-formic acid = 300:100:3).

For thallus thickness, membranous = < 200 μ m, thin = 200-400 μ m, thick = 400-1000 μ m, and very thick = > 1000 μ m; measurements should be taken on thalli in a moist condition.

Characteristics of veins and interstices are most satisfactorily assessed on the basis of sterile lobes. Rhizines can be simple (unbranched), fasciculate (bundles of simple rhizines), penicillate (flaring out and fraying towards the tips into mostly downward pointed threads, becoming confluent), or flocculent (as in penicillate but with the threads often going in various directions, giving a cottony appearance). Simple rhizines can be erect-tomentose (shortly squarrose).

1. Algal layer containing green algae (Coccomyxa). Thallus bright green, especially when wet. Nostoc-bearing cephalodia present as nodules on upper or lower side of thallus.

Chem: zeorin, tenuiorin, aphthosin, etc. GROUP I (aphthosa-venosa group)

1. Algal layer containing blue-green algae (Nostoc). Thallus gray-brown to dark green when wet. Cephalodia absent. 2

2. Attached to or associated with lobes containing a green alga and (or) upper surface distinctly maculate (best seen when wet), or thallus homoimerous; restricted to humid localities. 3

2. Not attached to or associated with lobes containig a green alga; upper surface not maculate; ecology various. 4

3. Heteromerous, \pm with veins. Upper surface often maculate. Attached to upper surface or margins of the green lobes. (blue-green phototype of) P. aphthosa, P. britannica, or P. leucophlebia)

3. Thallus homoimerous, resembling a small Leptogium; veins always absent. Upper surface not maculate. Attached to or associated with the green phototype of P. venosa, originating from the underside of the green lobes. blue-green phototype of P. venosa

4. Thallus bearing soredia. 5

4. Thallus lacking soredia. 6

5. Soralia primarily marginal; apothecial disk black, on short extensions of vegetative lobes. Tenuiorin, methyl gyrophorate; \pm dolichorizin, zeorin, and \pm one unidentified triterpenoid. Infrequent over mossy rocks and conifers in sheltered forests at lower elevations in humid regions throughout; hygrophytic; incompletely circumpolar. British Columbia, Washington; California, Arizona, Sonora. P. collina

5. Soralia entirely laminal; apothecial disk usually brownish, on rather elongate extensions of the vegetative lobes. 6

6. Rhizines white-flocculent in central portions of thallus, sparse and simple toward margins. Mature thallus often deeply concave, consisting of a single lobe (occasionally several-lobed), averaging < 1 cm diam. Upper surface brownish-dark gray; veins whitish to brownish towards center; older thalli abundantly fertile with apothecia on erect elongated lobes; medulla KC-; methyl gyrophorate absent. No substances or occasionally traces of a few unidentified substances. Frequent over soil and moss in open sites throughout, except rare in coastal regions; xerophytic; circumpolar. British Columbia to California; Arizona, Baja California. P. didactyla var. didactyla

6. Rhizines white-flocculent throughout, or sparse or lacking towards thallus center. Mature thallus typically flat to at most weakly concave, multilobate, averaging > 1 cm diam. Upper surface light gray; lower surface with whitish veins; apothecia extremely rare; medulla KC+ red (fleeting, best seen when soredia are removed from young soralia); methyl gyrophorate present. Methyl gyrophorate and \pm gyrophoric acid (often in trace amounts). Frequent over moss or soil in open inland localities; mesophytic; incompletely circumpolar. British Columbia to California; Arizona,

- Baja California. P. didactyla var. extenuata
7. **Laminal isidia and (or) lobules present.** 8
7. **Laminal isidia and lobules absent (note: marginal lobules may, however, be present along laminal stress cracks in some species).** 9
8. **Isidia dorsiventral, \pm appressed; mature lobes usually < 0.8 cm wide; lobe tips upturned; usually over soil. Thallus concave, often unilobate. Upper surface tomentose. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; two to four unidentified triterpenoids.** Frequent over (calcium-rich) soil, moss, and mossy rocks and logs in open forests throughout; weakly xerophytic to mesophytic. British Columbia; Arizona. P. lepidophora
8. **Isidia cylindrical to globular or rarely dorsiventral, predominantly erect; mature lobes > 1 cm wide; lobe tips often downturned; over moss in sheltered sites. Isidia diffuse, becoming dense toward lobe apices and mostly lacking toward center, short, constricted at the base, occasionally somewhat squamule-like toward center of lobe; thallus flat, multi-lobed, light gray when dry. Upper surface not tomentose. No substances.** Rare over mosses in sheltered inland forests, especially in boreal regions; mesophytic. North America, especially in eastern temperate regions; also in British Columbia. P. evansiana
9. **Upper surface without greenish lobules; ecology various.** 10
9. **Upper surface bearing scattered greenish lobules, these laminally tomentose, containing a green algal; humid localities.** 11
10. **Upper surface tomentose, the hairs either closely appressed or erect and felt-like (note: the tomentum is sometimes obscured by heavy pruina; in P. malacea and P. kristinsonii, the hairs are often confined to the immediate vicinity of the lobe tips and may be difficult to observe). Mostly without lichen substances.** GROUP II (canina group s. lato)
10. **Upper surface scabrid or pruinose in some specimens, but never tomentose. Often with lichen substances.** GROUP III (polydactyla group s. lato)
11. **Marginal lobules (containing Nostoc) present. Upper surface glabrous, or erect-tomentose near tip. Green lobes typically dominant.** Tenuoirin, methyl gyrophorate, \pm gyrophoric acid; phlebic acid B, dolichorrhizin, zeorin or phlebic acid B and an unidentified triterpenoid. Infrequent over moss and mossy logs in humid coast forests at lower elevations, also rare in humid inland forests; hygrophytic. Western North America. British Columbia. (blue-green phototype of) P. britannica
11. **Marginal lobules absent. Upper surface erect-tomentose near tip. Green lobes typically subordinate.** 12
12. **Rhizines irregular.** Tenuoirin, methyl gyrophorate, \pm gyrophoric acid (traces); phlebic acids \pm A and B, zeorin, unidentified triterpenoids. Rare over moss and mossy logs in open, humid inland forests at lower elevations; hygrophytic. Western North America. British Columbia. (blue-green phototype of) P. aphthosa
12. **Rhizines simple.** Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; two unknown triterpenoids. Frequent over (calcium-rich) soil, moss, and mossy rocks in open forests throughout; weakly xerophytic to mesophytic. (blue-green phototype of) P. leucophlebia

GROUP I

Primary Photobiont Green

1. Thallus small, orbicular to shell-shaped or fan-shaped, averaging < 2 cm across; upper side glabrous, shiny, and without cephalodia. Cephalodia located ventrally on the dark rhizineless veins. Apothecia flat, dark-colored. Thallus attached to the substrate at a single point along the margin. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid, phlebic acid B, and three to five unidentified triterpenoids. Frequent over calcium-rich soil, especially cut banks, in open or somewhat sheltered sites throughout; mesophytic to hygrophytic. Found mostly on bare earth from the arctic southward, eastern and western. British Columbia; Washington;

Arizona. P. venosa

1. Thallus large, averaging > 3 cm across, \pm lobate, with lobes to 5 cm across; upper side decked with nodular cephalodia; tomentum present, especially along margins. Lower surface with rhizines. Apothecia erect. Thallus broadly attached. Widely distributed in mountains and in low-lying areas in the north. (P. apthosa complex) 2

2. Lower surface darkening abruptly inward of lobe tips; undersides of apothecia green-corticate throughout; generally not veined, or with a few broad to indistinct veins. Cephalodia sometimes peltate and detaching. 3

2. Lower surface darkening only gradually inward of lobe tips, and/or undersides of apothecia patchy-corticate, noncorticate areas appearing whitish; veins broad, sometimes well developed. Cephalodia small and numerous, at least toward lobe margins, adpressed, convex and wart-like, never detaching. 4

3. Mature cephalodia small and many, peltate (check sheltered lobes) usually flat or slightly concave, with free margins, frequently detaching and leaving white scars, occasionally giving rise to a few olive-brown lobes. Humid localities at lower elevations.

Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; phlebic acid B, dolichorrhizin, zeorin, or phlebic acid B and an unidentified triterpenoid. Frequent over moss and mossy logs and rocks in sheltered to shaded coastal localities at lower elevations; also infrequent in similar habitats in humid inland forest; hygrophytic; probably incompletely circumpolar. P. britannica

3. Mature cephalodia rather large and not conspicuously abundant, adpressed throughout, convex, somewhat corrugate, not readily detached from the surface. Widespread.

Tenuiorin, methyl gyrophorate, \pm gyrophoric acid (traces); phlebic acids \pm A and B, zeorin and \pm unidentified triterpenoids; or two unidentified triterpenoids as in P. leucophlebia. Found especially in boreal and subalpine zones with continental climates, often on mosses in "sterile" sites, often over bare ground. Common over soil, moss, duff, logs, and rock in open to somewhat shady inland localities, also rare in coastal localities; xerophytic to hygrophytic; circumpolar. P. apthosa

4. Lower surface of apothecia continuously corticate. Lobes rather few; margins even or weakly crisped. Underside with pale broad veins extending toward center. Cephalodia in central portions of thallus up to 2 mm diam. Apothecia rare.

Restricted to snowy districts, usually at higher elevations (but also along the coast), frequent but rare. Tenuiorin, methyl gyrophorate, phlebic acid B, and unidentified triterpenoids. Over moss and mossy rocks and logs in sheltered forests, hygrophytic. Western (British Columbia) and eastern North America. P. sp. 1 of Goward et al. [P. chionophila Goward ined.] (snow-form of P. apthosa) (note: P. sp. 1 of Holtan-Hartwig, reported from Alaska, differs in having patch-corticate undersides of the

apothecia and in having hairs over the inner portions of the upper surface of the thallus).

4. Lower surfaces of apothecia patchy-corticate to non-corticate. Lobes many; margins strongly undulating and crisped. Underside with clearly differentiated veins, brown-black towards the center, towards the margins paler with whitish elongate interstices. Cephalodia seldom > 1 mm diam. Apothecia frequent.

Widespread. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; two to four unidentified triterpenoids. Frequent over (calcium-rich) soil, moss, and mossy rocks and logs in open forests throughout; weakly xerophytic to mesophytic. Often on mineral soil (in "rich" sites, often over moss, according to Goward; often on mossy rocks in somewhat calcareous habitats according to Purvis & James, 1992). Arctic, southward in mountains. British Columbia; Arizona P. leucophlebia

GROUP II

Photobiont Blue-green; Upper Surface Tomentose

1. Upper surface (check sheltered lobes) dark greenish when wet, usually thinly scabrid-tomentose with erect feltlike tomentum hairs toward margins. Lower surface veinless or with sparse, broad and indistinct veins (as in P. apthosa) with few if any interstices. Medulla thick. Chem.: tenuiorin, methyl gyrophorate, \pm gyrophoric acid, two to three unidentified terpenoids. Frequent over (acid, oligotrophic) soil and moss, or on sand, in open, usually dryish inland forests and alpine ridges; xerophytic to weakly mesophytic; boreal and montane, probably circumpolar. British Columbia; Washington; Arizona.

P. malacea

1. Upper surface bluish or grayish when wet. Lower surface with distinct veins. Marginal tomentum on upperside mostly appressed (except for P. kristinssonii). Medulla thin or thick. Chem: none or rare (non-uniform). (If veins indistinct, upper surface grayish blue and maculate, lichen substances present, see blue-green phototypes of P. apthosa, P. brittanica and P. leucophlebia). 2

2. Veins low, very dark brown towards thallus center, strikingly contrastive with the interstices. Upper surface in part lightly scabrid at least near the edge, bearing erect tomentum (best seen near margin on sheltered lobe tips), but becoming glabrous toward center; lobe tips mostly downturned. No constant lichen substances. Infrequent over soil and moss in sheltered inland forests, usually at lower elevations; mesophytic; incompletely circumpolar. Boreal-alpine, on bare mineral soil or over mosses, preferring meso-eutrophic and often somewhat calciferous substrates. P. kristinssonii

2. Veins low or raised, pale throughout or dark toward thallus center, moderately to occasionally strikingly contrastive with the interstices; upper surface rarely scabrid; upper surface at least towards margins with tomentum of appressed, branched hairs; lobe tips upturned or downturned. 3

3. Lobes < 1.5 cm wide at maturity; lobe margins in large part crisped and apically upturned, or at least not obviously downturned or deflexed (check sterile lobes); thallus brittle, the lobes more narrow, mostly less than 1(-1.5) cm across, veins without tomentum; upper cortex generally tomentose to some considerable distance inward of lobe margins. 4

3. Lobes > 1.5 cm wide at maturity; lobe margins in large part downturned (check sterile lobes). Ambiguous specimens exhibiting one or more of the following characters belong here: erect tomentum on the veins (at least in part); an upper surface which soon becomes glabrous inward of the lobe margins; mature lobes generally more than 1.5 cm wide 7

4. Mature apothecia averaging 3-5(-6) mm long; most lobes fertile; soralia scars often present on sterile portion of thallus. No substances or occasionally traces of a few unidentified substances. Frequent over soil and moss in open sites throughout, except rare in coastal regions; xerophytic; circumpolar. British Columbia to California; Arizona, Baja California. P. didactyla v. didactyla

4. Mature apothecia >4-8(-12) mm long; thallus often entirely sterile; upper surface lacking scars. 5

5. Rhizines becoming confluent toward thallus center, usually arranged in dense rows, clustered and fused at the base, often anastomosing, forming a continuous black mat which

conceals the veins (if rhizines simple then mostly blackish), dark, mostly short, densely branched toward apices, Veins rather felt-like, uniformly (and often abruptly) darkening toward thallus center, mostly forming a netlike pattern. Upper side with thick, appressed tomentum especially towards the margins, strongly (to patchily) pruinose especially inwards with crust-forming calcium oxalate crystals. Apothecia usually saddle-shaped. No substances. Frquent over soil (especially calcium-rich soil), moss or mossy rock in open, often somewhat exposed sites throughout; xerophytic; circumpolar. British Columbia to California; Arizona, Chihuahua, Sinaloa.P. rufescens

5. Rhizines mostly discrete, white to brown. Veins with a compact appearance, not felt-like, pale throughout or darkening only more often irregularly and gradually toward center, scattered, or if anastomosing then rhizines fibrillose. Upper surface with thin tomentum gradually disappearing toward center, never encrusted or pruinose. Apothecia fingernail-shaped or horizontal. 6

6. Lobe margins and (or) margins of stress cracks usually lobulate (check mature lobes); upper surface often somewhat broadly billowed. Veins and rhizines at least partly dark, flat to somewhat raised (on sterile lobes), seldom cordlike, apparently never "overlapping" one another; rhizines \pm branched. Apothecia, if present, saddle-shaped or finger nail-shaped, revolute, on slightly ascending lobes. Chem.: no lichen substances. Infrequent over soil, moss, and mossy rocks and logs in open or sheltered forests in humid regions at lower elevations throughout; mesophytic; circumpolar. British Columbia to California; Arizona; Chihuahua, Sonora. P. praetextata

6. Lobe margin and margins of stress cracks lacking lobules; upper surface plane or at least not broadly billowed. Veins, rhizines and entire underside whitish, or veins pinkish, often turning dirty brown toward thallus center; raised and \pm cordlike (especially toward the lobe margins), evidently in part "overlapping" one another; interstices generally pinkish and \pm rounded; rhizines numerous, mostly long and slender, almost unbranched, remaining discrete. Apothecia, if present, plane. No substances. Frequent over soil or moss in open inland localities, especially in dry to semi-arid regions, also infrequent in exposed coastal sites in mediterranean climates; xerophytic to weakly mesophytic; circumpolar. British Columbia; Arizona.P. ponojensis

7. Veins lacking erect tomentum. 8

7. Veins densely and usually conspicuously covered in minute, erect tomentum. 10

8. Rhizines tufted or richly penicillately branched and flocculent-wooly-fleecy (as in a shag-pile carpet), conspicuously flaring downwards, often becoming confluent at the base or at the tips, at least patchily anastomosing and mat-forming (especially toward thallus center), threadlike near margin. Upper surface remaining tomentose for some No substances. Common over soil, moss, duff and logs in open to somewhat sheltered inland localities; weakly xerophytic to mesophytic; circumpolar. British Columbia to California; Arizona; Baja California; Chihuahua. P. canina

8. Rhizines generally simple and discrete (except flaring toward the tips in some specimens). Upper surface usually abruptly glabrous toward thallus center. 9

9. Veins distinctly rusty cinnamon-colored toward thallus center; lobe margins \pm even

(plane); lobe margins and margins of stress cracks lacking lobules. No substances, or traces of unknowns. Frequent over moss and mossy rocks and logs in open to somewhat sheltered inland forests at all forested elevations; mesophytic to hygrophytic; tolerant of prolonged snow cover; western North America. British Columbia. P. cinnamomea

9. Veins pale to dark brown, but not distinctly cinnamon-colored; lobe margins \pm crisped; lobe margins and margins of stress cracks usually lobulate (check mature lobes). Chem.: no lichen substances. Infrequent over soil, moss, and mossy rocks and logs in open or sheltered forests in humid regions at lower elevations throughout; mesophytic; circumpolar. British Columbia to California; Arizona; Chihuahua, Sonora. Temperate-boreal, eastern and western. P. praetextata

10. Veins numerous, almost as broad as the interstices, strongly raised, apparently overlapping, partly with erect tomentum, flat, soft; interstices few and oval (to rounded or lens-shaped), very deep-set (appearing as pits). Rhizines stout (ca. 7 mm), densely squarrosely short-branched/erect tomentose. Thallus thick (0.4-1.5 mm), coriaceous. Primarily boreal. Chem.: tenuiorin, methyl gyrophorate (traces), zeorin, dolichorrhizin, peltidactylin, sometimes accompanied by gyrophoric acid and traces of an unknown triterpenoid. Infrequent over thick moss in somewhat sheltered inland forests, especially in boreal regions at lower elevations; incompletely circumpolar. British Columbia. P. retifoveata

10. Veins somewhat rounded, compact, much narrower than interstices, low to strongly raised, generally fusing; interstices polygonal to diamond-shaped or more often lenticular, shallow; rhizines stout or elongated, simple (if erect-tomentose then thallus thin and membranaceous). Distribution various. No substances. 11

11. Lobe margins and margins of stress cracks usually lobulate (check mature lobes); interstices mostly lenticular; veins raised or more often rather low; rhizines generally lacking erect tomentum. Chem.: no lichen substances. Infrequent over soil, moss, and mossy rocks and logs in open or sheltered forests in humid regions at lower elevations throughout; mesophytic; circumpolar. British Columbia to California; Arizona; Chihuahua, Sonora. Temperate-boreal, eastern and western. P. praetextata

11. Lobe margins and margins of stress cracks lacking lobules; interstices lenticular to polygonal; veins strongly raised; rhizines bearing erect tomentum. No substances. Frequent over soil, moss, and mossy rocks and logs in humid forested localities throughout, except essentially absent from semi-arid and boreal regions; weakly mesophytic to hygrophytic; probably incompletely circumpolar. British Columbia to California; Arizona. P. membranacea

Group III.
Photobiont Blue-green; Upper Surface Without Tomentum.

1. Upper surface conspicuously scabrid (at least toward lobe tip), never pruinose. 2
1. Upper surface smooth and occasionally pruinose near lobe tip. 5
 2. Veins dark toward thallus center, strikingly contrastive with the interstices; upper surface apparently glabrous but actually bearing minute erect tomentum near lobe tips (check sheltered lobes). No constant lichen substances. Infrequent over soil and moss in sheltered inland forests, usually at lower elevations; mesophytic; incompletely circumpolar. British Columbia. P. kristinsonii
 2. Veins dark or pale, not strikingly contrastive with the interstices; upper surface glabrous throughout. With constant lichen substances. 3
3. Rhizines simple, elongate; upper cortex indistinctly scabrid or scabrid in places; widespread in humid coastal localities. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; \pm peltidactylin, \pm dolichorrhizin, \pm zeorin, and various unidentified triterpenoids. Over soil, moss, mossy rocks, and mossy logs in humid localities; mesophytic to hygrophytic; probably circumpolar. British Columbia. (scabrid form of) P. neopolydactyla
3. Rhizines fasciculate, proportionally short; upper surface distinctly and uniformly scabrid; inland. 4
 4. Lower surface dark toward thallus center; rhizines dark throughout. Lobe margins even. Upper surface \pm billowed. Veins moderately contrastive with interstices. Rhizines fasciculate. Tenuiorin, methyl gyrophate, \pm gyrophoric acid, peltidactylin, and two unidentified triterpenoids. Infrequent over moss, mossy logs, and mossy rock in somewhat open inland localities at lower elevations; mesophytic; circumpolar. British Columbia; Arizona. P. scabrosa
 4. Lower surface pale toward thallus center; rhizines pale when young (check toward lobe tips). Lobe margins crisped. Upper surface \pm plane. Veins weakly contrastive with interstices. Rhizines \pm simple. Tenuiorin, methyl gyrophorate, gyrophoric acid, dolichorrhizin, zeorin, and two unidentified triterpenoids. Yukon. P. scabrosella
5. Apothecial disk distinctly black. 6
5. Apothecial disk brownish, or apothecia absent. 7
 6. Thallus with phyllidia. Without soredia. Otherwise like P. collina. Southern Appalachians. P. phyllidiosa
 6. Thallus without phyllidia. Distribution various. 6a
 - 6a. Upper surface distinctly shiny; veins usually broad, indistinct; outermost rhizines typically dark; generally over (mossy) ground; inland. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; dolichorrhizin, zeorin, and three or more unidentified triterpenoids. Infrequent over soil, mossy rocks and decaying logs in inland localities at lower elevations, especially in humid forest sites, but also rare in steppe communities; mesophytic; probably incompletely circumpolar. British Columbia; New England; Arizona. P. neckeri
 - 6a. Upper surface usually rather matt; veins rather narrow and distinct (check fertile lobes); outermost rhizines typically pale; often over (mossy) trees; widespread

- in humid localities.** Tenuiorin, methyl gyrophorate; \pm dolichorhizin, zeorin, and \pm one unidentified triterpenoid. Infrequent over mossy rocks and conifers in sheltered forests at lower elevations in humid regions throughout; hygrophytic; incompletely circumpolar. British Columbia, Washington; California, Arizona, Sonora. (P. collina)
- 7. Lobe margins and (or) margins of stress cracks lobulate or phyllidiate.** 8
- 7. Lobe margins and margins of stress cracks crisped in some specimens but never distinctly lobulate or phyllidiate.** 11
- 8. Veins low, abruptly darkening toward thallus center in some specimens, interstices absent or sparse, oval.** 9
- 8. Veins \pm raised, darkening only gradually (if at all) toward thallus center; interstices mostly numerous, lenticular.** 10
- 9. Outermost rhizines generally aligned in one or more concentric rows; thallus thick; upper surface dimpled, pruinose near lobe tips, with \pm numerous stress cracks; veins darkening abruptly toward center; apothecia horizontal, plane; inland. Frequent over soil and mossy (calcium-rich) rock in open inland forests, especially at lower elevations; weakly xerophytic to mesophytic.** Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; zeorin and several unidentified triterpenoids. Circumpolar. British Columbia; New England; Arizona; P. elisabethae
- 9. Outermost rhizines unaligned; thallus thin; upper surface plane, epruinose, with sparse stress cracks; veins darkening gradually toward center; apothecia erect, folded; coastal. Infrequent over exposed mossy outcrops in hypermaritime localities at lower elevations; hygrophytic.** Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; peltidactylin, dolichorhizin, zeorin, and traces of unidentified triterpenoids. British Columbia. P. hymenina
- 10. Southern Appalachians.** Tenuiorin, methyl gyrophorate and gyrophoric acid, zeorin, and unknown; without peltidactylin and dolichorhizin. P. phyllidiosa
- 10. Western.** 10a
- 10a. Marginal lobules well developed; rhizines darkening abruptly toward thallus center; margin upturned, crisped to lobulate; chemical substances present (TLC).** Tenuiorin, methyl gyrophorate, gyrophoric acid; peltidactylin, dolichorhizin, and zeorin. Infrequent over soil, moss, and mossy logs in sheltered to shady forests in coastal localities at lower elevations, also rare in humid old-growth inland forests; hygrophytic; western North America. British Columbia; Washington. P. pacifica
- 10a. Marginal lobules poorly developed, hardly recognizable as such; rhizines darkening only gradually toward thallus center; margin downturned, even; chemical substances absent (TLC).** Rare over moss and mossy logs in humid coastal localities at lower elevations; also rare in sheltered, humid inland forests; hygrophytic; probably incompletely circumpolar. British Columbia. P. degenii
- 11. Outermost rhizines fasciulate, generally aligned in one or more concentric rows; mature apothecia horizontally oriented, the disk \pm plane.** 12
- 11. Outermost rhizines simple, penicillate or flocculent, not aligned in concentric rows; mature apothecia vertically oriented, the disc vertically folded.** 13
- 12. Upper surface typically with numerous stress cracks; veins dark brown to almost black, indistinct or apparently absent; interstices sparse.** Frequent over soil and mossy (calcium-rich) rock in open inland forests, especially at lower elevations; weakly xerophytic to mesophytic. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid;

- zeorin and several unidentified triterpenoids. circumpolar. British Columbia; New England; Arizona. P. elisabethae
- 12. Upper surface typically lacking stress cracks; veins medium brown, broad to occasionally indistinct; interstices \pm numerous.** Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; zeorin and several unidentified triterpenoids. Frequent over soil and moss in sheltered inland forests, usually at lower elevations; mesophytic to weakly hygrophytic; incompletely circumpolar. British Columbia; Arizona. P. horizontalis
- 13. Veins narrow, \pm distinctly raised, (apparently overlapping in P. ponojensis); veins and rhizines erect-tomentose or not.** 14
- 13. Veins broad, low, apparently never overlapping; veins and rhizines never erect-tomentose.** 16
- 14. Veins and rhizines at least in part erect-tomentose.** No substances. Over soil, moss, and mossy rocks and logs in humid forested localities throughout, except essentially absent from semi-arid and boreal regions; weakly mesophytic to hygrophytic; probably incompletely circumpolar. British Columbia to California; Arizona. (glabrous form of) P. membranacea
- 14. Veins and rhizines not erect-tomentose.** 15
- 15. Upper surface dull; lobe tips upturned; veins in part apparently overlapping; frequent in xeric and mesic sites in inland localities (infrequent in coastal localities).** No substances. Frequent over soil or moss in open inland localities, especially in dry to semi-arid regions, also infrequent in exposed coastal sites in mediterranean climates; xerophytic to weakly mesophytic; circumpolar. British Columbia. (glabrous form of) P. ponojensis
- 15. Upper surface distinctly shiny; lobe tips downturned; veins not apparently overlapping; rare in hygric sites in coastal and in inland localities.** No substances. Rare over moss and mossy logs in humid coastal localities at lower elevations; also rare in sheltered, humid inland forests; hygrophytic; probably incompletely circumpolar. British Columbia. P. degenii
- 16. Veins very dark toward thallus center, strikingly contrastive with interstices; upper surface apparently glabrous, but actually bearing erect tomentum near lobe tips (check sheltered lobes); inland. No constant lichen substances.** Infrequent over soil and moss in sheltered inland forests, usually at lower elevations; mesophytic; incompletely circumpolar. British Columbia. P. kristinsonii
- 16. Veins pale or dark, not strikingly contrastive with interstices; upper surface glabrous throughout; distribution various. With constant lichen substances.** 17
- 17. Lobes thick; upper surface pruinose or not.** 18
- 17. Lobes thin; upper surface lacking pruina.** 19
- 18. Stress cracks frequent; veins abruptly darkening toward center; apothecial disk black. Upper surface pruinose near lobe tips.** Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; dolichorrhizin, zeorin, and three or more unidentified triterpenoids. Infrequent over soil, mossy rocks and decaying logs in inland localities at lower elevations, especially in humid forest sites, but also rare in steppe communities; mesophytic; probably incompletely circumpolar. British Columbia; New England; Arizona. P. neckeri
- 18. Stress cracks sparse; veins gradually darkening toward center; apothecial disk**

brown. Upper surface epruinose. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; \pm peltidactylin, dolichorrizin, zeorin, and one or two unidentified triterpenoids. Infrequent over moss in bogs and at margins of alpine tarns; mesophytic. British Columbia. P. occidentalis

19. Rhizines proportionally short, either fasciculate or poorly developed; veins indistinct; interstices sparse; restricted to well illuminated sites. 20

19. Rhizines short to more often elongate, simple, well developed; veins broad; interstices \pm numerous; usually restricted to sheltered sites.21

20. Upper surface smooth; outermost rhizines pale, usually tapering to a point; maritime; mostly over mossy outcrops in lowlands. Lobe margins \pm crisped. Infrequent over exposed mossy outcrops in hypermaritime localities at lower elevations; hygrophytic. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; peltidactylin, dolichorrizin, zeorin, and traces of unidentified triterpenoids. British Columbia. P. hymenina

20. Upper surface in part minutely corrugate; outermost rhizines dark, usually fasciculate; primarily inland (absent along the outer coast); mostly in bogs and at the mossy edges of ponds at all elevations. Lobe margins \pm even. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; \pm peltidactylin, dolichorrizin, zeorin, and one or two unidentified triterpenoids. Infrequent over moss in bogs and at margins of alpine tarns; mesophytic. British Columbia. P. occidentalis

21. Lobe margins lobulate or at least very strongly crisped; mature lobes <10(-15) mm wide; upper surface plane or variously wrinkled but never billowed. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; peltidactylin, dolichorrizin, and zeorin. Infrequent over soil, moss, and mossy rocks and logs in open but humid inland forests; mesophytic to weakly hygrophytic; circumpolar. British Columbia to California; Arizona. P. polydactylon

21. Lobe margins neither lobulate nor strongly crisped; mature lobes > 20 mm wide; upper surface plane or somewhat broadly billowed. Tenuiorin, methyl gyrophorate, \pm gyrophoric acid; \pm peltidactylin, \pm dolichorrizin, \pm zeorin, and various unidentified triterpenoids. Frequent over soil, moss, mossy rocks, and mossy logs in humid localities throughout; mesophytic to hygrophytic; probably circumpolar. British Columbia. P. neopolydactyla

(Old versions)

GROUP III-A

**Photobiont Blue-green; Upper Surface Non-Tomentose;
With Isidia, Soredia, or Lobules**

1. Upper side with laminal, scattered to clustered, cylindrical-clavate, sometimes branched, dark brown isidia, otherwise pale gray to brown, scabrid, matt. Lower side pale brownish white to brown, with a network of light brown to brown veins which are narrow and strongly raised (caniniform); interstices large; rhizines simple, to 4 mm long. Thallus to 10 cm diam., thin (under 0.5 mm); lobes to 3 cm broad. Apothecia unknown. On soil, mossy rocks, and bases of trees. Northeastern N. America. (Specimens of P. lepidophora without distinct tomentum have peltate, cephalodia-like isidia and pale, rather low and indistinct veins). P. evansiana

1. Upper side without cylindrical-clavate isidia, but in some species isidio-soralia, scale-like to granular schizidia, or squamule-like lobules occur, especially along margins or cracks.

Apothecia present or not. Other characters various. 2

2. Thallus with a well developed border of isidio-soralia. Thallus over 2 cm diam.; lobes mostly ca. 1 cm broad, radiating; margins irregular-wavy, crisped and curled upwards; upper surface more or less scabrose toward margins, without tomentum, lead gray to chestnut brown. Lower side with low, brownish to brown-black veins, or almost uniformly tomentose; interstices yellowish white. Rhizines short, fasciculate or fibrillose, sometimes forming a dense mass toward the center. Apothecia rather rare, to 3 mm across, dark, borne on the tips of short lobes, horizontal or erect and saddle-shaped, chestnut brown to black; spores often degenerate, 4-8-celled, acicular, to 60-70 um long. Chem.: tenuorin, methyl gyrophorate, and various terpenoids. On moss over bark or rock, in damp habitats, common and widespread in the West. (if soralia laminal, see P. didactyla, in Group II). P. collina

2. Thallus without soredia, but some species often with other vegetative propagules (isidia, schizidia, phyllidia, folioles or lobules); mostly not scabrous (except in P. scabrosa). 3

3. Veins low, often abruptly darkening inward of lobe tips; interstices absent or at most sparse and oval. 4

3. Veins somewhat raised, darkening only gradually (if at all) inward of lobe tips; interspaces mostly numerous and lens-shaped. 5

4. Outermost rhizines generally aligned in concentric rows; inland. P. elisabethae

4. Outermost rhizines unaligned; coastal. P. hymenina

5. Marginal lobules well developed; rhizines darkening abruptly inward of lobe tips; veins rather broad, thick. P. pacifica

5. Marginal lobules poorly developed, indistinct; rhizines darkening only gradually inward of lobe tips; veins narrow-linear, rather thin. (P. degeni)

III-B.

**Photobiont blue-green; upper surface glabrous;
without vegetative propagules; with apothecia**

1. Apothecia horizontally inclined and with a flat disk; spores 4-celled, 25-45 um long. Rhizines fasciculate (clustered), mostly dark, the outermost ones often arranged in concentric rows. (*P. horizontalis* group). 2

1. Apothecia on narrow, often erect lobes, often saddle shaped and with down-turned margins; spores 4 to many celled, more than 45 um long, narrow, spindle-shaped to acicular. Rhizines various, sometimes pale, the outermost ones usually not in concentric rows. (Mostly *P. polydactyla* complex, sensu lato). 3

2. Lower side with veins conspicuous, anastomosing, whitish to dark near margins, becoming dark brown-black towards center; interstices numerous, starkly white, elongate, deep-set. Rhizines more or less smooth (without perpendicular branches or hypahe), to 2 mm long, the outermost ones generally strongly tufted. Thallus thin, pliant, not at all leathery, to 10 cm or more diam. Upper surface characteristically "dimpled" in \pm concentric rows of small depressions, bluish gray, often browned, \pm glossy, seldom cracked or exfoliating. Lobes to 2 cm wide; margins \pm entire or indented, rarely sublobulate and crisped. Apothecia generally present. Chem.: tenuiorin, methyl gyrophorate, \pm gyrophoric acid, various terpenoids. On mosses over tree bases, wood, or rocks, often in sheltered valleys in old growth forests, especially in the northeast. *P. horizontalis*

2. Lower side dark brown to black, felted, veinless, but often with small, rounded, white interstices towards the center. Rhizines dark, rather thick. Thallus thickish and stiff, forming multilobate patches to 10 cm diam. or more. Upper surface gray-brown (at least in exposed situations), grayish when wet, metallic-shiny, peeling (irregularly exfoliating) near margins, and often with slash-like cracks. Lobes 0.5-1 cm wide; margins crisped, often forming flattened, nodular or curled schizidia-like scales, often with isidia or lobules. Apothecia generally absent. Chem.: tenuiorin, methyl gyrophorate, gyrophoric acid, various terpenoids On soil or moss over rock, often on somewhat calcareous substrates. (Mostly?) Eastern North America. [Specimens of *P. malacea* without distinct tomentum on upper surface might also key out here; in that species the upper surface usually turns green when wet, and vegetative propagules are absent] *P. elisabethae*

3. Apothecia black. 4

3. Apothecia brown. 5

4. Upper surface distinctly shiny; veins usually indistinct; outermost rhizines typically dark; generally over mossy ground; inland. Apothecia black, on short lobes; lobe margin often pruinose; veins blackish, broad, and often anastomosed. *P. neckeri*

4. Upper surface usually rather matt; veins rather narrow and distinct (check fertile lobes); outermost rhizines typically pale; often over (mossy) trees; widespread in humid localities. (*P. collina*)

5. Upper surface scabrous; veins darkening gradually; rhizines penicillate. Upper side of thallus finely but distinctly scabrid (roughened), especially near lobe margins, matt, without

vegetative propagules, or occasionally with regenerative lobules along the margins. Rhizines short, penicillate (like a brush, with divergent branches). Upper surface greenish gray to yellowish brown or brown, turning bluish green to brownish green when moist. Lower side with distinct (to indistinct) but somewhat broad and flattened veins, which are pale (to dark) grayish brown, seldom contrasting with the interstices; rhizines pale to dark. Thallus wide-spreading, to 2-5(-10) cm diam.; lobes 3-5 cm broad, subcoriaceous; margins \pm erect. Apothecia to 6 mm cross, erect, reddish brown. Chem.: ? On acidic, mossy earth and stones, boreal-arctic. (if veins broad, low, dark chocolate brown, see P. kristinssonii in Group II).
P. scabrosa

5. Upper surface smooth, sometimes pruinose near margin; veins and rhizines various; if upper surface scabrous then rhizines thread-like and/or veins soon becoming dark brown to almost black. Upper side smooth, often shiny; not scabrid, but some species often with schizidia or lobules, which occur mainly on or near the margins or long cracks. Rhizines mostly not penicillate, often long. Lobes mostly narrower. Other characteristics various. 6

6. Lower surface pale throughout or only darkening gradually toward center; veins strongly raised. P. ponojensis s. lato (P. sp. 1 of Goffinet & Hastings); P. membranacea and P. degenii

6. Lower surface mostly dark throughout (except near margin), if gradually darkening toward center, then veins only somewhat raised but more often flat. 7

7. Upper surface dull, scabrous, and with sparse erect tomentum near margin (look at sheltered tips); lower surface with a distinct network of dark brown, tomentose veins; rhizines fasciculate to abundantly branched. No constant lichen substances. Infrequent over soil and moss in sheltered inland forests, usually at lower elevations; mesophytic; incompletely circumpolar. British Columbia. P. kristinsonii

7. Upper surface shiny, smooth and glabrous, but sometimes pruinose; veins distinct or not, never highly contrastive, never tomentose; rhizines thread-like to penicillate, never abundantly branched. 8

8. Rhizines short, stout, sparse, poorly developed; veins indistinct, interspaces sparse; restricted to open sites. 9

8. Rhizines short to more often elongate, slender, abundant, well developed; veins usually (but not always) distinct; interspaces more or less numerous; usually restricted to sheltered sites. 10

9. Upper surface smooth; outermost rhizines usually tapering to point, pale; maritime, mostly over sheltered mossy outcrops along coast. P. hymenina

9. Upper surface in part minutely wrinkled; outermost rhizines usually tufted, dark; primarily inland (absent along outer coast); usually in open istes, in bogs and at mossy edges of ponds and alpine tarns. P. occidentalis

10. Thallus large, to 15 cm across; main lobes averaging to more than 12 mm wide (to 3 cm wide); upper surface typically matt, even or somewhat broadly blistered/pustulate; rhizines thread-like, 7-10 mm long, especially near the center. Lobe margins not lacerate or strongly crisped. P. neopolydactyla

10. Thallus medium-sized, to 10 cm across; main lobes less than 2 cm wide (averaging to 5-10(-12) mm wide; upper surface typically very shiny, plane or variously wrinkled, but never broadly blistered/pustulate; rhizines short, to 5 mm long. Lobe margins tattered/lacerate or at least very strongly crisped. Apothecia

brown, on elongate and somewhat canaliculate lobes; lobe margin not pruinose; veins brownish, remaining distinct almost to center. P. polydactylon

III-C

Photobiont blue-green; upper surface glabrous;
Vegetative propagules absent; apothecia absent

1. Upper surface at least partly textured/scabrid, apparently never white pruinose.

..... 2

1. Upper surface smooth, glabrous or at most white-pruinose (check lobe tips); veins indistinct, glabrous, if contrastive with interstices then veins brown but not dark brown or black. 5

2. Upper surface bearing erect hairs (check sheltered lobes); veins dark brown to almost black, tomentose, distinct, highly contrastive with pale interstices.

(*P. kristinsonii*)

2. Upper surface without erect hairs; veins pale (to dark) grayish brown, distinct (to indistinct), seldom contrasting with the interstices. 3

3. Rhizines elongate and slender; upper surface irregularly and often indistinctly textured/scabrid; widespread in humid localities. (*P. neopolydactyla*)

3. Rhizines short and stout; upper surface uniformly and distinctly textured/scabrid; inland. 4

4. Lower surface dark toward thallus center; rhizines dark, even when young. (*P. scabrosa*)

4. Lower surface pale toward thallus center; rhizines pale at least when young (check lobe tips). (*P. scabrosella*)

5. Rhizines near margin stout, fasciculate and arranged in concentric lines; upper surface often characteristically "dimpled" in \pm concentric rows of small depressions; schizidia present or absent. (see *P. elisabethae* and *P. horizontalis*, above)

5. Rhizines near margin stout or slender, fasciculate or not, not arranged in concentric lines; upper surface not "dimpled" (but "blistered/pustulate" in *P. neopolydactyla*); schizidia always absent. 6

6. Outermost rhizines often arranged in concentric rows. (see *P. horizontalis*, above)

6. Upper surface smooth or bullate, but seldom distinctly "dimpled". Outermost rhizines apparently never concentrically arranged. 7

7. Veins narrow and more or less distinctly raised (occasionally also "overlapping" in *P. ponojensis*); veins and rhizines with or without erect hairs. 8

7. Veins broad, low, never overlapping; veins and rhizines never erect-tomentose. 10

8. Veins and rhizines partly with distinct erect hairs. (Group II: *P. membranacea*)

8. Veins and rhizines lacking erect hairs. 9

9. Upper surface matt; lobe tips upturned; veins often partly "overlapping"; restricted to dry sites; frequent in inland localities, infrequent in coastal localities. (Group II: *P. ponojensis* s.l. [*P. sp.* 1 of Goffinet & Hastings])

9. Upper surface distinctly shiny; lobe tips downturned; veins not at all "overlapping"; restricted to humid sites; rare (at least in British Columbia) both in coastal and inland localities. *P. degenii*

10. Upper surface dark greenish when wet, bearing minute, erect, feltlike hairs,

- especially near lobe tips; lower surface lacking veins or with few and very broad veins; medulla thick. (P. malacea)
10. Upper surface bluish or grayish when wet, bearing appressed or erect hairs near lobe tips; lower surface more or less veined; medulla thin or at least not distinctly thick. 11
11. Veins very dark at maturity (check thallus center), highly contrastive with interspaces; upper surface apparently hairless/glabrous, but actually bearing minute hairs near lobe tips (check sheltered lobes); inland. (P. kristinsonii)
11. Veins pale or dark, never highly contrastive with interspaces; upper surface hairless/glabrous throughout; distribution various. 12
12. Lobes distinctly thick; upper surface often partly white pruinose (check lobe tips); stress cracks frequent; interstices usually sparse; inland. (P. neckeri)
12. Lobes thin or at least not distinctly thick; upper surface not at all white-pruinose; stress cracks uncommon; interspaces numerous or sparse; widespread in humid climates. 13
13. Rhizines short, stout, sparse, poorly developed; veins indistinct; interstices sparse; restricted to open sites. 14
13. Rhizines short to more often elongate, slender, abundant, well developed; veins usually (but not always) distinct; interstices more or less numerous; usually restricted to sheltered sites. 15
14. Upper surface smooth; outermost rhizines usually tapering to point, pale; maritime, mostly over sheltered mossy outcrops along coast. P. hymenina
14. Upper surface in part minutely wrinkled; outermost rhizines usually tufted, dark; primarily inland (absent along outer coast); usually in open sites, in bogs and at mossy edges of ponds and alpine tarns. P. occidentalis
15. Lobe margins tattered/lacerate or at least very strongly crisped; main lobes averaging to 5-10(-12) mm wide; upper surface very shiny, plane or variously wrinkled, but never broadly blistered/pustulate, very shiny; rhizines short, to 5 mm long, thread-like, fasciculate, or somewhat branched. P. polydactylon
15. Lobes margins not lacerate or strongly crisped; lobes averaging to more than 12 mm wide (typically to 3 cm wide); upper surface matt, even or somewhat broadly blistered/pustulate, surface matt; rhizines to 7 mm long, thread-like. P. neopolydactyla

DESCRIPTIONS OF SPECIES

P. aphthosa (L.) Willd

(green phototype): Thallus (thin to) very thick and rather stiff. Lobes 2-4 cm across, margins \pm even, not crisped. Cephalodia rather large and not conspicuously abundant, adpressed, convex, somewhat corrugate, not readily detached from the surface. Lower surface light colored toward margins, abruptly darkening (blackish) inward, wooly but without rhizines; veins indistinct; interstices pale ochraceous near margins.

Apothecia frequent; underside uniformly corticate.

Tenuoiorin, methyl gyrophorate, \pm gyrophoric acid (traces); phlebic acids \pm A and B; zeorin and unidentified triterpenoids; or two unidentified triterpenoids as in P. leucophlebia.

Found especially in boreal and subalpine zones with continental climates, often on mosses in "sterile" sites, often over bare ground.

(blue-green phototype): Lobes 1-1.5(-2) cm across, thin; upper surface grayish blue, smooth, conspicuously maculate; erect tomentum present near lobe tips; marginal lobules absent; veins indistinct, weakly contrastive, smooth; interstices lenticular, moderately depressed; rhizines irregular. Green lobes typically subordinate. Rare over moss and mossy logs in open, humid inland forests at lower elevations; hygrophytic. Western North America.

P. britannica (Gyelnik) Holtan-Hartwig & Tonsberg

(green phototype): Lobes 2-3 cm wide, (thin to) very thick; margins even to crisp. Cephalodia small and many, peltate, with free margins, flat or slightly concave, frequently detaching and leaving white scars, occasionally giving rise to a few olive-brown lobes. Veins abruptly darkening inward. Rhizines present but often few, in scattered groups, bottle-brush-like.

Apothecia rare, underside continuously corticate.

Tenuoiorin, methyl gyrophorate, \pm gyrophoric acid; phlebic acid B; dolichorrhizin, and zeorin, an unidentified triterpenoid.

(blue-green phototype): Thallus to 3 cm across; lobes 0.5-1.0 cm wide, thin; margins crenate or dentate, with erect hairs; upper surface blue-gray, smooth, with a characteristic network of pale interconnected spots (maculae); erect-tomentose near lobe tip or glabrous; lower surface blackish, densely felted, with scattered bundles of irregular rhizines; veins indistinct, weakly contrastive, smooth; interstices lenticular, moderately depressed; secondary attached lobules of the green morphotype are usually present and typically dominant. Infrequent over moss and mossy logs in humid coast forests at lower elevations; also rare in humid inland forests; hygrophytic. Western North America.

P. canina (L.) Willd.

Thallus thin but not papery or membranaceous. Lobes 1.5-2(-3) cm wide, tips downturned; marginal lobules absent. Upper surface remaining tomentose for some considerable distance inward of lobe margins; tomentum appressed. Veins narrow, low to raised, pale or becoming dark brown toward center of thallus, forming a rather neat, dense network, towards the center rather flattened and smooth, never strongly raised on sterile lobes, rarely covered by erect hair and, if so, only near margin; interstices lenticular, moderately impressed. Rhizines generally short (1-2 mm), coarse, tufted or densely penicillately branched and flocculent-wooly-fleecy (as in a shag-pile carpet), conspicuously flaring downwards, often becoming confluent at the base or at the tips, at least patchily anastomosing and mat-forming (especially toward thallus center),

threadlike near margin, never squarrosely branched.

Apothecia robust; spores less than 60 μm long.

On various substrates, mostly acidic (Goward & Vitikainen?) or basic or calcareous (Purvis & James), often on sandy soils in oligotrophic habitats, widely distributed, especially in somewhat arid sites.

P. chionophila Goward ined. (*P.* sp. 1 of Goward, et al.)

Lobes rather few, 3-4(-5.5) cm across, thin; margins even or weakly crisped. Upper surface without hairs over the inner portions. Cephalodia appressed. Underside with pale broad veins extending toward center, darkening only gradually toward center.

Apothecia rare, underside continuously corticate.

Tolerant of prolonged snow cover; in inland regions essentially restricted to localities in which snow persists for more than half the year, though along the coast it may also occur in districts that receive very little snow. Frequent over moss and mossy rocks and logs in sheltered forests, usually at higher elevations, but also rarely in seaside forests; hygrophytic. Western North America (British Columbia); eastern North America.

P. cinnamomea Goward

Thallus foliose, loosely appressed, large, 10-30 cm across; lobes somewhat leathery, stiff, averaging to (1-)1.5-3 cm wide, elongate, loosely overlapping, irregularly branching; lobe tips rounded, plane to downturned; lobe margins essentially even; upper surface pale bluish gray to pale brownish gray or infused in part with cinnamon brownish, dull, often somewhat broadly billowed, tomentose, the tomentum appressed, usually disappearing abruptly towards thallus center; soredia absent; isidia and marginal lobules absent; lower surface veined; veins pale tan, grading inward to rusty brown, distinct, narrow, in part raised, glabrous; interstices whitish, lenticular, moderately deep; rhizines concolorous with veins, abundant, simple to becoming penicillate, discrete. Cortex 50-80 μm thick; photobiont layer 20-80 μm thick, containing *Nostoc*; medulla white, 70-180 μm thick.

Apothecia common, marginal, located on narrow, elongate lobes; disc medium brown, longitudinally folded, averaging to 6-10 mm long, erect; spores hyaline, 8 per ascus, (38-)40-49(-55) \times 3-5 μm , 3-septate.

Trace amounts of unidentified substances.

Frequent over moss and mossy rocks and logs in open to somewhat sheltered inland forests at all forested elevations; mesophytic to hygrophytic; tolerant of prolonged snow cover. British Columbia, Alberta, Washington, Montana.

P. collina (Ach.) Schrader

Thallus over 2 cm diam.; lobes 0.7-1.5(-2) cm wide, radiating; margins even (according to Goward et al.; in my experience and according to ?, often irregular-wavy, crisped and curled upwards); upper surface plane, \pm scabrose toward margins, without tomentum, lead gray to chestnut brown, pruinose near lobe tips or not. Thallus with a well developed border of isidio-soralia. Lower side with low, \pm broad, brownish to brown-black veins, moderately contrastive, smooth (or, according to ?, underside almost uniformly tomentose); interstices yellowish white. Rhizines pale to brown, simple to flocculent (according to Goward et al.; according to ?, fasciculate or fibrillose, sometimes forming a dense mass toward the center, short).

Apothecia very frequent (according to Goward et al.; according to ? and in my experience

rather rare), to 3 mm across, borne on the tips of short lobes, horizontal or erect and saddle-shaped, black (to chestnut brown according to ?); spores often degenerate, 4-8-celled, acicular, to 60-70 μ m long.

Chem.: tenuorin, methyl gyrophorate, and various terpenoids.

On moss over bark or rock, in damp habitats, common and widespread in the West.

P. degenii Gyelnik

Lobes 0.7-1.5(-2) cm across, thin; margins even (according to Goward et al; according to ?, often somewhat irregularly wavy and bordered with lobules); lobe tips downturned. Upper surface shiny, when dry slate-colored to more or less browned. Veins whitish to pale yellowish brown at center, narrow and distinctly raised and more or less cordlike, hardly less so toward thallus center, smooth; interstices lenticular to \pm polygonal. Lower surface creamy white. Rhizines simple (or weakly squarrose according to ?), discrete, pale cream or grayish brown, smooth (to occasionally slightly pubescent).

Apothecia erect, saddle-shaped, brown to dark reddish brown.

Chem.: no lichen substances.

On soil or among mosses over rock; northeastern.

P. didactyla (With.) Laundon v. didactyla (syn. P. erumpens)

Thallus small (mostly to 3 cm diam.), roundish-shell-shaped; when young with soralia toward center, later not, and instead consisting predominantly of erect lobes bearing apothecia. Lobes 0.7-1 cm wide, membranous (very thin), ear-shaped when young with ascending margins, later lobe tips downturned. Upper surface finely tomentose near lobe tips. Thallus sorediate; soralia roundish, ulcerose, whitish, with pale blue-gray to brownish granular soredia. Rhizines sparse, generally difficult to locate, pale to brown, discrete, \pm simple to flocculent, smooth (according to Goward et al.; according to ?, downy, occasionally \pm bottle-brush-like, the tips often somewhat penicillate); veins pale cream to pinkish-ochraceous, narrow, low (according to Goward et al.; according to ?, raised and \pm cordlike (especially toward the lobe margins)), anastomosing, evidently in part "overlapping" one another, either darkening to dark brown only gradually inward, or not at all darkening; interstices well developed, lenticular, moderately impressed.

Apothecia very frequent, under 5 mm in length, \pm oblong, generally saddle-shaped (folded lengthwise), red-brown or brown, delicately crenulate and denticulate at the margins.

Chem.: no substances or occasionally a few unidentified substances present in trace amounts.

Present especially in burns and similar disturbed habitats with sparse vegetation; fast-growing, and often only an ephemeral stage.

1. Thallus small, brownish-dark gray, when young usually a single deeply concave lobe; veins whitish to brownish towards center; rhizines mostly simple; older thalli abundantly fertile with apothecia on erect elongated lobes; medulla KC-. P. didactyla var. didactyla

1. Thallus broad, light gray, flat; lower surface with whitish veins; apothecia extremely rare; medulla KC+ red (fleeting, best seen when soredia are removed from young soralia). P. didactyla var. extenuata

P. didactyla (With.) Laundon v. extenuata (Nyl. ex Vainio) Goffinet & Hastings

P. elisabethae Gyelnik

Thallus thick and stiff, forming multilobate patches to 10 cm diam. or more. Lobes (0.5-)1-2(-3) cm wide; margins crisped, often forming flattened, nodular or curled schizidia-like scales or sometimes isidia or lobules. Upper surface gray-brown (at least in exposed situations), rarely deep slate-blue, grayish when wet, invariably somewhat uneven, dimpled, metallic-shiny, peeling (irregularly exfoliating) near margins, and with \pm numerous slash-like stress cracks; pruina present near lobe tips (according to Goward et al.; absent according to ?). Lower side dark brown to black, felted, veins indistinct, lwo, abruptly darkening to blackish toward center; interstices often numerous small, oval, white, towards the center. Rhizines 1-3(-5) mm long, dark, rather thick, fasciculate; outermost ones often disposed in one or two concentric rows.

Apothecia rare, horizontal, rounded, discs brown to black.

Chem.: tenuiorin, methyl gyrophorate, gyrophoric acid, various terpenoids.

On soil or moss over rock, often on somewhat calcareous substrates. (Mostly?) Eastern North America.

[Specimens of P. malacea without distinct tomentum on upper surface might also key out here; in that species the upper surface usually turns green when wet, and vegetative propagules are absent]

P. evansiana Gyelnik

Thallus to 10 cm diam., thin (under 0.5 mm); lobes to 3 cm broad. Upper side with laminal, scattered to clustered, cylindrical-clavate, sometimes branched, dark brown isidia, otherwise pale gray to brown, scabrid, matt. Lower side pale brownish white to brown, with a network of light brown to brown veins which are narrow and strongly raised (caniniform); interstices large; rhizines simple, to 4 mm long.

Apothecia unknown. On soil, mossy rocks, and bases of trees.

Northeastern N. America; British Columbia.

(Specimens of P. lepidophora without distinct tomentum have peltate, cephalodia-like isidia and pale, rather low and indistinct veins).

P. horizontalis (Huds.) Baumg.

Thallus thin, pliant, not at all leathery, to 10 cm or more diam. Lobes 1-2(-3) cm wide; margins \pm entire or indented, rarely sublobulate and crisped. Upper surface characteristically "dimpled" in \pm concentric rows of small depressions, bluish gray, often browned, \pm glossy, seldom cracked or exfoliating; pruina absent. Lower side with veins conspicuous, broad (to distinct), low, anastomosing, whitish to dark near margins, abruptly becoming dark brown (to brown-black) towards center; interstices numerous, starkly white, oval (elongate according to ?), deep-set. Rhizines \pm smooth (without perpendicular branches or hypahe), 2-4(-5) mm long, the outermost ones generally strongly tufted (fasciculate) and concentric.

Apothecia generally present, horizontal, plane, brown.

Chem.: tenuiorin, methyl gyrophorate, \pm gyrophoric acid, various terpenoids.

On mosses over tree bases, wood, or rocks, often in sheltered valleys in old growth forests, especially in the northeast.

P. hymenina (Ach.) Del. (syn. P. lactucifolia)

Lobes 0.4-0.8(-2) cm across, thin; margins \pm crisped, without folioles, but small regenerative lobules occasionally present. Upper surface plane, matt to partly glossy, with few if any slash-like cracks, light brown, little changed when wet, epruinose. Veins pale to deep ochre-colored in older parts of thallus, indistinct (\pm well-defined according to ?), extending towards the margins, there pale, flattened, low, wide, with frequent to scattered, broad, oval to lenticular, pale interstices. Rhizines pale (to darkened by substrate), 1-2(-3), slender, (simple to) flocculent, occasionally splitting towards ends, unaligned.

Apothecia to 5 x 3 mm, pale brown or red-brown, \pm on short extensions from the lobes, erect, folded.

Chem.: tenuorin, methyl gyrophorate, \pm gyrophoric acid, peltidactylin, dolichorrhizin, zeorin, and other terpenoids.

On soil, mosses and rocks in damp situations.

P. kristinssonii Vitik.

Thallus rather thin and pliant, to thick. Lobes 1-1.5(-2) cm across. Upper side with erect tomentum (best seen near margin on sheltered lobe tips) and partly lightly scabrid, at least near the edge, but becoming glabrous toward center, browned or yellowish tan; maculae absent. Marginal lobules absent. Rhizines brown, dark toward center of thallus, paler outward, to 3-4 mm long, solitary, \pm fasciculate, tufted, squarrosely branched. Veins brown, low to raised, broad, conspicuously erect-tomentose, strikingly contrasting with the numerous low, whitish, lenticular (to rounded) interstices.

Apothecia infrequent, brown.

Without lichen substances.

Boreal-alpine, on bare mineral soil or over mosses, preferring meso-eutrophic and often somewhat calciferous substrates.

P. lepidophora (Nyl. ex Vainio) Bitter

Thallus small (mostly less than 1.5 cm across); lobes to 1 cm wide, concave to ear-shaped with \pm ascending, entire or \pm eroded, sometimes inrolled margins; upper side smooth, naked in part or \pm thinly tomentose, With distinct, cephalodia-like, scutiform (peltate) isidia. Lower surface with often rather indistinct, whitish to pale gray, anastomosing veins and discrete unbranched pale rhizines.

Apothecia very rare.

Chem.: no lichen substances.

On flat, mossy rock ledges, often hidden by other plants or sunken into substratum, overlooked. Rather similar to young stages of P. didactyla, which is sorediate. (P. evansiana, in Group III, has isidia that are more granular-cylindrical, not peltate, and the veins are darker, distinct and raised).

P. leucophlebia (Nyl.) Gyelnik

(green phototype): Thallus thin in the center, to thick elsewhere, rather pliant. Lobes many, 2-3.5 cm across; margins strongly undulating and crisped. Cephalodia appressed. Underside with clearly differentiated veins, gradually brown-black towards the center, towards the margins paler with whitish elongate interstices. Rhizines present.

Apothecia frequent, underside discontinuously corticate.

Widespread. Arctic, southward in mountains. Often on mineral soil (in "rich" sites, often

over moss, according to Goward; often on mossy rocks in somewhat calcareous habitats according to Purvis & James, 1992).

(blue-green phototype): Lobes 1-1.5(-2) cm across, thin; upper surface grayish blue, smooth, conspicuously maculate; erect tomentum present near lobe tips; marginal lobules absent; veins indistinct, weakly contrastive, smooth; interstices lenticular, moderately depressed; rhizines simple. Green lobes typically subordinate.

P. malacea (Ach.) Funck

Thallus to 10 cm diam., thick to very thick; lobes 1-3 cm across, rounded; margins raised, undulate. Upper side usually thinly tomentose with erect hairs toward margins (look for sheltered lobe tips), \pm even, brownish with blue-green tinge, usually deep olive green when moist, downy or greasy-looking, smooth, maculae absent. Lower surface veinless or with sparse, broad to indistinct veins (as in *P. aphthosa*) with few if any interstices, pale at margins, gray-brown, soon becoming brown-black, \pm uniformly tomentose; interstices lenticular, moderately depressed; rhizines irregular, mostly absent.

Apothecia orbicular, adpressed, brown-red, \pm crenulate at margin.

Chem.: tenuiorin, methyl gyrophorate, \pm gyrophoric acid, unidentified terpenoids. [According to text of Goward et al.; the statement in Table 2 that chemistry is absent is incorrect].

On acid, oligotrophic soils among mosses, or on sand, boreal and montane.

P. membranacea (Ach.) Nyl.

Thallus often forming broadly radiating patches to 30 cm or more diam., thin, membranous (with the algal layer visible on the lower surface, according to Olech & Alstrup, 1987); lobes 1.5-3 cm broad, usually \pm contiguous, elongate or rounded; margins uneven, undulating, turned downwards, entire, \pm indented or \pm lacerate and radiating. Upper surface gray or often brownish gray, \pm thinly to thickly white-gray tomentose, at least towards and at the margins, but often glabrous and shiny toward center, rarely flat, frequently \pm markedly bullate-ridged, without folioles but occasionally with swollen regenerative secondary lobules. Lower surface often uniformly whitish (rarely becoming dark brown). Veins pale to dark brown, widely separated and rather sparse, much narrower than the interstices, sharp and strongly raised, at least patchily covered with erect tomentum, loosely reticulate; interstices rather many, lenticular to diamond-shaped or often polygonal and isodiametric, shallow to at most moderately deep-set. Rhizines well developed, dispersed, rather slender, moderately narrow and long (to 3 mm or more), simple and discrete but strongly covered with squarrose hyphae (downy to bottle-brush-like), pale to brown.

Apothecia often present, proportionally small, to 5-7 mm in length, roundish, becoming saddle-shaped, red-brown to brown; spores to 75 μ m long.

Chem.: no lichen substances.

Among mosses over soil, rock, or bark or wood. Common, in humid boreal and temperate forests.

P. neckeri Hepp ex Mull. Arg.

Lobes 1-1.5(-2) cm wide, (thin to) thick. Upper surface plane, deep slate-blue to green, turning black when wet, generally strongly glossy, but not infrequently pruinose toward lobe margins, usually smooth and even, but with \pm elongate, slash-like cracks \pm numerous, with \pm

raised edges exposing medulla; margins even, schizidia and isidia absent, but margins occasionally with small regenerative lobules. Veins abruptly darkening toward center, there blackish, sparse, indistinct (to broad), low, mostly diffuse or nearly absent; interstices very few. Rhizines mostly few, diffuse, confluent, not at all in concentric rows, 2-3(-5) mm long, simple to fasciculate or flocculent.

Apothecia common (but occasionally absent), erect and folded lengthwise, robust, black (to dark brown according to ?), positioned on rather short stalks.

Chem.: tenuoirin, methyl gyrophorate, \pm gyrophoric acid, dolichorrhizin, zeorin, and other terpenoids.

On soil, mosses, or rocks.

P. neopolydactyla (Gyelnik) Gyelnik (syn. P. polydactylon v. dolichorhiza Nyl. sensu Thomson)

Thallus large, to 15 cm across; main lobes averaging 2-3(-4) cm wide, thin (to thick); Lobe margins even, not lacerate or strongly crisped. Upper surface epruinose, typically matt, plane to somewhat broadly blistered/pustulate (billowed); stress cracks sparse. Veins broad (to narrow), low, gradually darkening to brown towards center, interstices lenticular to oval. Rhizines thread-like, 4-7(-10) mm long, especially near the center, \pm simple, unaligned.

Apothecia erect, folded, brown.

P. occidentalis (E. Dahl) H. Krist.

Lobes 1-1.5(-2) cm wide, (thin to) thick. Upper surface plane to finely corrugate (minutely wrinkled), epruinose or pruinose towards lobe tips, stress cracks sparse; margins \pm even. Veins \pm indistinct, low, gradually darkening to brown toward center, interstices oval to lenticular; rhizines 2-3(-5) mm long, \pm flocculent, unaligned, outermost rhizines usually tufted, dark.

Apothecia erect, folded, brown.

Primarily inland (absent along outer coast); usually in open istes, in bogs and at mossy edges of ponds and alpine tarns.

P. pacifica Vitik.

Thallus membranous (200-400 μ m, not including veins) to somewhat thickened, Lobes 0.7-1(-1.5) cm across; margins of ascending ones often markedly and irregularly wavy (crisped-contorted), becoming cracked and lobulate to squamulose. Upper surface plane to occasionally "dimpled" but apparently never bullate, smooth and somewhat glossy, epruinose, bluish gray or sometimes brownish when dry; stress cracks sparse. Margins crisped to lobulate. Margins with isidioid squamules and lobules usually well developed; laminal isidioid propagules and phyllidia also present. Veins distinct throughout, but \pm flat, broad to \pm narrow, low (to somewhat raised), dirty brown, pale, ochraceous near margins but gradually (to abruptly according to ?) darkening to blackish inward, distinct or sometimes indistinct, but never totally wanting; interstices numerous both marginally and inward, oval (elongated according to ?). Rhizines simple to fasciculate (but with the clusters discrete), 2-4 mm long, dark nearly to thallus margins, often becoming slender-elongate inward of lobe margins, unaligned.

Apothecia on elongated, erect lobes, erect, revolute, folded, ca. 6 mm long, brown.

Chem.: tenuiorin, methyl gyrophorate, zeorin, polydactylin and dolichorrhizin.

Restricted to very humid localities in the boreal and temperate zones.

P. phyllidiosa Goffinet & Miadlikowska

Thallus 5-8 cm diam.; lobes 0.5-2.0 cm broad, plane to concave with reflexed or rarely plane or erect margins; phyllidia present along margins or laminal cracks, branched, becoming dorsiventral, spreading laterally, forming small 'cushions' of squamules; soredia absent; upper surface gray to grayish brown when dry; lower surface reticulate, veins distinct, flat to bulging, slightly raised above the interstices, dark brown to pale toward margin; interstices elliptic, white; rhizines simple, rarely fasciculate, to 45 μ m thick; photobiontic layer containing cyanobacteria (*Nostoc*), to 75 μ m thick; medulla to 120 μ m thick, veins to 150 μ m thick.

Apothecia on short elongate lobes; disc black, scabrose, with either strongly recurved margins or saddle-shaped, to 7 mm long; paraphyses linear, simple, with swollen apical cells; asci clavate, 8-spored; spores acicular, 3-septate, 40-71 x 2.0-3.5 μ m.

Pycnidia not seen.

Tenuiorin, gyrophorate and gyrophoric acid (both often in trace amounts), zeorin, and one unidentified compound turning yellow after charring, R_F classes 5A, 5B', 5-6C.

On mosses at base of deciduous trees or on boulders, in mesophytic forests from upper montane to Piedmont, North Carolina to northern Georgia and Alabama and Missouri

Very similar to *P. collina* but with phyllidia rather than soredia; chemically different from other non-tomentose, phyllidiate species.

P. polydactylon (Necker) Hoffm.

Thallus thin to thick. Lobes 0.7-1(-1.5) cm across; margins of ascending ones often markedly and irregularly wavy (crisp-contorted), becoming cracked and lobulate to squamulose. Upper surface plane or occasionally "dimpled" but apparently never bullate, entirely glossy, epruinose, greenish, often browned, little changed when wet; stress cracks sparse. Lobe margins often irregularly wavy and cracked and crisp-contorted, sometimes becoming squamulose; laminal propagules usually absent. Veins broad, \pm flat, low, and dirty brown, pale near margins but often abruptly darkening inward, mostly dark brown to blackish, usually very distinct throughout; interstices numerous, oval, rather broad. Rhizines 2-4 mm long, simple to fasciculate, unaligned, often confluent when young, pale to dark brown.

Apothecia on elongated, erect lobes, erect, folded, brown.

Chem.: tenuiorin, methyl gyrophorate, dolichorrhizin, zeorin, \pm gyrophoric acid. On soil and mosses over rocks and tree bases.

P. ponojoensis Gyelnik

Thallus obviously consisting of at least some sterile, prostrate lobes. Lobes 0.5-1.5 cm wide, thin (to thick). Upper side generally tomentose even toward center (sometimes glabrous in old specimens), with appressed (erect according to ?) tomentum, lobe tips upturned; marginal lobules absent. Veins, rhizines and entire underside whitish, or veins pinkish, often turning dirty brown toward thallus center; raised and \pm cordlike (especially toward the lobe margins), evidently in part "overlapping" one another; veins narrow, raised to ropy, pale to dark brown, smooth, interstices generally pinkish, lenticular (to \pm rounded), deeply impressed; rhizines numerous, mostly long and slender, almost unbranched, remaining discrete, pale to brown, smooth.

Apothecia frequent, plane, often large (over 6 mm long and ca. 1 cm across).

Chem.: no substances.

On soil, calcareous or siliceous, in dry, open sites.

P. praetextata (Florke ex Sommerf.) Zopf

Thallus (membranous to) thin, lobes 1-1.5(-2) cm wide, generally (but not always) with, erect, flattened, \pm divided schizidia or phyllidia along the margins, cracks and often also laminally, on mature lobes, scattered or in dense, overlapping clusters. Upper side often glabrescent and strongly browned toward center, dirty-looking near margins, with appressed tomentum near lobe tip. Margins of lobes wavy, plane to often upturned, not downturned; marginal lobules often present. Veins and rhizines pale to dark brown but never cinnamon-colored. Veins low, slender, smooth or with erect hairs especially near margin; interstices many and mostly narrowly lens-shaped, moderately impressed. Rhizines threadlike (to rather sparsely branched), smooth (mostly downy according to?), discrete, pale to brown.

Apothecia frequent, rounded, \pm elongate or saddle-shaped.

Found especially in shady, damp localities on mossy surfaces on the forest floor. Temperate-boreal, eastern and western.

P. retifoveata Vitik.

Thallus thick to very thick (0.4-1.5 mm), coriaceous. Lobes 1.5-2(-3) cm wide, margins almost entire, downturned (elevated or flat according to ?), without schizidia (nevertheless occasionally with flattish marginal regeneration lobules). Upper side whitened and appressed-tomentose toward margins, but often glabrous and shiny toward center. Veins numerous, broad, almost as broad as the interstices, partly with erect tomentum, strongly raised, pale to dark brown, flat, soft; interstices few and oval or lens-shaped, very deep-set (appearing as pits). Rhizines stout (ca. 7 mm), simple, discrete, densely erect tomentose, brown.

Apothecia infrequent, proportionally small, to 5-7 mm in length. Spores to 47(-57) μ m long.

Chem.: tenuiorin, methyl gyrophorate (traces), zeorin, dolichorrhizin, sometimes accompanied by gyrophoric acid and traces of an unknown triterpenoid.

On soil or moss, in moderately acidic habitats, usually in humid boreal forests, rather uncommon.

P. rufescens (Wies) Humb.

Thallus rosette-forming or \pm fragmented, to 20 cm diam.; lobes to 0.5-1 cm wide, thin to thick, \pm radiating, contiguous or somewhat overlapping; margins even, crinkled or crisped, \pm elevated (upturned), \pm swollen; center adpressed, often with adventitious lobules and small adpressed lobes, but marginal lobules absent. Upper side with thick, appressed tomentum especially towards the margins but often also well inward, strongly (to patchily) pruinose especially inwards with crust-forming calcium oxalate crystals, under tomentum or crystals brownish, flat or wavy, rarely somewhat bullate. Veins numerous, usually darkening (dark brown to uniformly blackish toward thallus center), narrow, smooth, not conspicuously tomentose, flattened and low (or somewhat raised); interstices whitish or gray and mostly narrowly lens-shaped, moderately impressed. Rhizines brown to black, mostly short, densely branched toward apices, usually arranged in dense rows, clustered and fused at the base, often anastomosing (confluent), forming a continuous black mat which conceals the veins (if rhizines simple then mostly blackish).

Apothecia frequent, usually saddle-shaped, often large and conspicuous, elevated and

recurved, on lateral ends of main lobes, with an inrolled, coarsely crenulate or denticulate, uneven thalline margin. On soil, mostly in dry and open localities, often over rocks; often in somewhat calcareous sites.

P. scabrosa Th. Fr.

Thallus wide-spreading, to 2-5(-10) cm diam.; lobes 2-3(-4) cm broad, subcoriaceous; margins \pm erect, even. Upper surface \pm billowed, without tomentum, epruinose, surface greenish gray to yellowish brown or brown, turning bluish green to brownish green when moist, finely but distinctly scabrid (roughened), especially near lobe margins, matt, without vegetative propagules, or occasionally with regenerative lobules along the margins. Lower side with indistinct to somewhat broad and flattened, low to raised, smooth veins, which are pale (to dark) grayish brown, moderately contrasting with the interstices; darkening gradually towards center; Rhizines short, penicillate (like a brush, with divergent branches), fasciculate, dark throughout.

Apothecia frequent, to 6 mm cross, erect, reddish brown.

On acidic, mossy earth and stones, boreal-arctic.

P. scabrosella Holt.-Harw.

Lobes 1.5-2.5 cm wide, margins criped; upper surface \pm plane, tomentum absent, pruina absent; veins indistinct, low, weak, smooth; rhizines \pm simple, pale to brown.

Apothecia frequent, brown.

Lichen substances present.

Yukon.

P. venosa (L.) Hoffm.

(green phototype): Thallus small, orbicular to shell-shaped or fan-shaped, to 2 cm across; upper side glabrous, shiny, and without cephalodia. Cephalodia located ventrally on the dark rhizineless veins. Apothecia flat, dark-colored. Found mostly on bare earth from the arctic southward, eastern and western.

(blue-green phototype): Thallus consisting of small, \pm ascending, overlapping, brown-black squamules, up to 1 mm long, semi-circular or ligulate. Photobiont evenly distributed throughout inner part of the lobe. Resembling a small Leptogium. No lichen substances.

ADD TO GROUP III? (species treated briefly in preliminary key for B.C., but not in published version. Need to check original key, and probably also need more info. directly from Goward, et al.)

1. Veins darkening to black inward of lobe margins. Upper surface with a bluish or brownish cast, never greenish. Lobes with or without marginal lobules (?). Thallus thickened, more or less leathery, seldom bullate; rhizines generally mostly tufted, sparse; veins flattened. 2

1. Veins darkening only to pale ochraceous inward of lobe margins. Upper surface with a distinct olive-greenish cast. Lobes without marginal lobules. Thallus thickened, more or less leathery, seldom bullate; rhizines generally mostly tufted, sparse; veins flattened. [This species should perhaps be keyed out earlier, closer to *P. lactucifolia*]. *P. viride* Goward & Vitik., ined.

2. Upper cortex matt and pale milky blue in color; interstices highly contrastive against the crisp-edged veins; restricted to highly oceanic localities. Thallus thickened, more or less leathery, seldom bullate; rhizines generally mostly tufted, sparse; veins flattened. *P. glauca* Goward & Vitik., ined.

2. Upper cortex generally \pm glossy and medium blue or brown in color; interstices often rather vague, not particularly contrasting with the dull-edged veins. Widespread. *P. coriacea* Goward & Vitik., ined.

Thallus membranous to somewhat thickened, often bullate; rhizines often becoming slender-elongate inward of lobe margins; veins somewhat ridged (at least in part) or, if low throughout, then margins generally crisped-lobulate. Veins at least in part low-ridged, especially in the submarginal region, most often darkening only inward. Upper surface often strongly bullate; lobes broad, often more than 1.5 cm across; margins apparently never crisped-lobulate. Apothecia supported on a rather short stalk. Veins ridged nearly throughout. Upper cortex with a distinct olive-greenish cast. Restricted to highly oceanic localities. *P. sitchensis* Goward & Vitik. ined.

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etc. (very incomplete)