

**Pertusaria** DC. in Lam. & DC.  
(PERTUSARIACEAE)

After Dibben (1980), and Harris (1990)

Rev. 5/94

Thallus crustose, uniform to dwarf fruticose,  $\pm$  immersed to superficial, thin to moderately or very thick, smooth to tuberculate, wrinkled-plicate, continuous to rimose, rimose-areolate, or verrucose, mainly gray but also white, yellow, green or rarely blue-black, ecorticate or corticate with a thin, cartilaginous, paraplectenchymatous cortex of anticlinal thick-walled, septate, agglutinated hyphae, often becoming abraded or disoriented; attached to substrate by medullary or prothallial hyphae; soralia or isidia frequent.

Apothecia, when present, immersed in a wart (or pseudostromata), generally elevated above thallus, often perithecium-like in appearance, sometimes several hymenia in a wart, each ascocarp opening by a pore, or  $\pm$  sessile with an expanded, open disk, the disk sometimes occluded with granular soralia and appearing soralia-like or pruinose; true exciple weakly developed,  $\pm$  pale, never carbonized; hymenium  $\pm$  globose or disk-like, with profuse colorless to yellow-brown or red gelatin; hypothecium reduced, hyaline or pale, never K+ violet; paraphyses (paraphysoids according to Galloway) septate, lax, branched from the base, variously spaced, becoming strongly reticulate; epihymenium prominent, hyaline to dark, sometimes K+ violet; asci broadly cylindrical to clavate, unitunicate (but with layers), thick walled, I+ blue; tholus I+ blue, the exoascus bursting in layers at maturity; apex with a broad ocular chamber, outer sheath K/I+ blue, otherwise K/I-, with an inner extensile layer, Pertusaria-type. Spores 1-8, ellipsoid or oblong-ellipsoid, simple, usually hyaline, multinucleate, commonly very large (to more than 250  $\mu$ m long); walls single or double, often heavily thickened, uniform or at times with radiating canals to the surface, or appearing ridged (layered), or ornamented.

Pycnidia rare, immersed in warts, globose or racemose, ostiolate or erumpent; fulcrum exobasidial; pycnosporos straight, bacilliform to cylindrical, acicular, or filiform. Chemistry very diverse (xanthonones, fatty acids, depsides or depsidones). Photobiont trebouxoid. On wood, bark, soil, or lime-poor rocks, tropical to arctic-alpine.

Recognition of the types of verrucae is an essential prerequisite of species identification in this genus (see Dibben, or Galloway). Thickness of the spore wall given in species descriptions is at the sides, not at trimmed ends.

Although many of the species are distinctive and well-delimited, they may be difficult to get to wading through the keys. I would like eventually to try to

revise this to make it a bit easier to use in the field, or perhaps make some alternative keys that would be more field-oriented. Although I've tried to provide geographic distribution data for most species, it might be helpful to re-arrange the keys more by geographical distribution (e.g., putting all the southeastern species together).

**I. Subg. Pionospora**  
**Apothecia disciform, verrucae lecanorate or sorediate;**  
**spore wall single**

[If photobiont is Trentepohlia or chemistry is not one of those below, see key to sterile sorediate crusts]

**I-A. With Isidia**  
**(also see subg. Pertusaria)**

**1. Isidia small (always less than 1 mm tall). Thallus C+ orange or red, UV+ dark red (xanthones, with or without gyrophoric acid).**

..... 2

**1. Isidia large (generally more than 1 mm tall. Thallus C- or C+ red (gyrophoric acid), UV-, without xanthones.** Isidia frequent, columnar or coralloid, but never sorediate, predominantly associated with fruit bodies. .... 2b

**2. Thallus K-, P-, C+ orange, UV+ dark red, containing only xanthones (arthothelin and granulysin, in N. American material; thiophanic acid in British material).** Isidia pale yellow, with a soft surface, to 0.6 mm tall; Apothecia unknown. On bark (Alnus and Populus), near seal level to 30 m, in Alaska (on tops of calcareous, schistose boulders in Britain). .... P. flavocorallina Coppins & Muhr

**2. Medulla K± yellow, P+ yellow becoming orange (stictic acid), C and KC± red (gyrophoric acid). Cortex C+ orange, UV+ dark red, containing thiophanic acid.** Isidia infrequent, papillate to coralloid, becoming sorediate, never associated with fruit bodies; thallus yellow-white or sordid; verrucae large (1.3 (±0.6) mm wide). Apothecia [sometimes] present; discs epruinose and dominantly yellow-brown; Epihymenium K+ violet; spores 1, 60 (±13) x 163 (±32) um. .... P. bryontha (Ach.) Nyl.

**2b. Isidia mainly coralloid, fruit bodies absent or present, borne laterally on isidia or on nonisidial portions of the thallus; thallus gray, verrucae large (1.4(±0.6) mm wide), discs epruinose and dominantly black; epihymenium K+ violet; spores 8, 11(±2) x 22(±4) um, uni- or biseriate.** medulla K+ yellow becoming red-brown, P+ yellow becoming orange-red (fumarprotocetraric acid), and KC± red (gyrophoric acid); .... P. oculata (Dickson) Th. Fr.

**2b Isidia mainly columnar, fruit bodies always present, rarely borne other than terminally on isidia; thallus gray-white; verrucae small, discs pruinose, 0.6(±0.2) mm in diameter. Epihymenium K-; spores 1/ascus.**

..... 3

**3. Thallus and disc pruina gray; medulla with all chemical tests negative; verrucae at times lateral on isidia; spores  $1.53(\pm 14) \times 148(\pm 33)$   $\mu\text{m}$ . ..... P. panyrga (Ach.) Massal.**

**3. Thallus and disc pruina white; medulla with at least one spot test positive; verrucae always terminal on isidia. ....4**

**4. Medulla P+ yellow becoming orange-red, K+ yellow becoming red-brown (fumarprotocetraric acid). Spores  $1.64(\pm 19) \times 168(\pm 40)$   $\mu\text{m}$ . ..... P. dactylina (Ach.) Nyl.**

**4. Medulla P-, but K+ yellow becoming finally violet, KC+ rose becoming finally violet (hypothamnolic acid). Spores  $1.52(\pm 14) \times 158(\pm 34)$   $\mu\text{m}$ . ..... P. subdactylina Nyl.**

**I-B Without Isidia; With Soredia (or apparently so)  
Medulla never C+ red or KC+ red (if so, see I-C).**

**I-B-1 On bark or wood**

**1. Medulla with at least one spot test positive; thallus variously colored. .... 2**

**1. Medulla with all chemical tests negative (or spot tests uncertain); thallus always gray. .... 12**

**2. Thallus yellow-green or sulfur-yellow; soralia concolorous; cortex UV+ orange or orange-red, K $\pm$  yellow, C+ deep yellow, KC+ yellow-orange (thiophaninic acid); medulla K+ yellow, P+ yellow becoming orange (stictic acid); restricted to California; infrequently found in this sterile form. .... (*P. flavicunda*)**

**2. Thallus grayish to yellowish but not distinctly yellow; soralia white. Thallus C-, UV+ yellow (lichexanthone) or UV+ pink (coronatone), or UV-. .... 3**

**3. Medulla C- but KC+ rose-violet, K+ or K-, P+ or P-. .... 4**

**3. Medulla C-, KC- (or + yellow-red), K+, P+. .... 6**

**4. Medulla K $\pm$  yellow becoming lavender, C- (?), KC+ reddish or finally violet, P-, containing hypothamnolic acid. Cortex UV+ yellow (lichexanthone). Sometimes fertile; epihymenium K-; spores 1 (rarely sterile), 53( $\pm$ 16) x 163( $\pm$ 24)  $\mu$ m. On hardwoods (less often conifers); widespread throughout the eastern U.S.A. .... *P. hypothamnolica* Dibben**

**4. Medulla K- or K+ yellow becoming red-brown, C-, P-, KC+ violet (picrolichenic acid). .... 5**

**5. Cortex UV+ yellow (lichexanthone). Sterile. Florida. Not mentioned by Esslinger. .... *P. ventosa***

**5. Cortex UV-. Medulla K- or K+ yellow becoming red-brown, P- or P+ yellow becoming orange-red ( $\pm$  protocetraric acid), C-, but always KC+ instantly rose-violet fading to wine red (picrolichenic acid); sometimes fertile; epihymenium K-; spores 1, 48( $\pm$ 7) x 8( $\pm$ 16)  $\mu$ m. Corticolous on hardwoods (less often conifers). Widespread throughout eastern and western temperate North America. .... *P. amara* (Ach.) Nyl.**

**6. Thallus UV+ pinkish (coronatone). Medulla K+ yellow, C-, KC-, P+ pink-orange (stictic acid agg.). Sterile. Thallus pale green-gray, whitish at margins, with a very smooth, shiny, "greasy" cortex which frequently cracks and pulls away from the medulla. Soralia mostly forming from breaks in cortex, often irregular and pustular but**

sometimes orbicular and weakly capitate; soredia coarse and irregular.  
Florida. .... P. expolita R. C. Harris

**6. Thallus UV+ yellow (lichexanthone) or UV- (no xanthones).**  
..... 7

**7. Medulla K- (or K+ yellow becoming red-brown?), P+ orange-red (fumarprotocetraric acid);** soralia initially pruinose but later high-arched. .... 8

**7. Medulla or K+ yellow, becoming deep yellow or finally brown, P+ yellow or orange (baeomycesic, thamnolic, or haemathamnolic acids);** discs heavily pruinose rather than truly sorediate. .... 10

**8. Thallus margin characteristically zoned; medulla contains fumarprotocetraric and succinprotocetraric acids; usually fertile;** spores 1 (rarely sterile),  $46(\pm 12) \times 134(\pm 32)$   $\mu\text{m}$ . Corticolous on hardwoods (less often conifers); widespread throughout eastern temperate North America. .... P. multipunctoides Dibben

**8. Thallus margin never zoned; without succinprotocetraric acid; fertile or not.** .... 9

**9.** Medulla contains fumarprotocetraric and protocetraric acids; known only sterile. Corticolous on hardwoods (only); restricted to the western arctoboreal coast. .... P. borealis Erichsen

**9.** Thallus immersed to  $\pm$  superficial and very thin; prothallus not distinct; upper surface gray, matt; soralia to 0.5 mm diam., punctiform, flat, pale grayish white or yellowish white, often evenly scattered, with coarse granular soredia. Fertile warts rather rare, 0.5-1 mm diam., prominent, scattered. Apothecia 1 per wart; disc red-black; thalline exciple at first surrounding the disc, thick, wavy and later becoming  $\pm$  excluded; epithecium olive-green, K+ violet. Asci 8-spored; spores 10-14  $\times$  7-11  $\mu\text{m}$ ,  $\pm$  globose to broadly ellipsoid, wall ca. 1  $\mu\text{m}$  thick, smooth. Thallus P+ orange-red to rust-red, K+ dirty reddish, KC+ yellow-red, C- (fumarprotocetraric acid). On smooth-barked hardwood trees and on pine wood, in sheltered, often ancient woodlands. .... P. pupillaris (Nyl.) Th. Fr.

**10. Thallus usually UV+ yellow (lichexanthone).** (If containing thamnolic acid or stictic acid and growing in Florida, see P. spp. of Harris, 1990). .... 11

**10. Thallus UV-.** Medulla K+ yellow becoming deep yellow, P+ yellow or yellow-orange (thamnolic acid), C-, KC-; verrucae well elevated (often 2 or more mm high), usually fertile; discs pink; epihymenium K-; sterile or spores 2,  $36(\pm 10) \times 94(\pm 31)$   $\mu\text{m}$ . Corticolous on hardwoods or conifers; widespread throughout eastern temperate North America. .... P. trachythallina Erichsen

**11. Medulla K+ yellow then brownish, P+ orange, containing haemathamnolic acid. Rarely fertile. Discs yellow-brown or pink;** epihymenium K-; spores 1, 36(±8) x 124(±30) um. Widespread throughout the coastal plain. .... P. copiosa Erichsen

**11. Medulla K-, C-, KC-, P+ yellow, containing baeomycesic acid, unknowns, and trace of squamatic acid; often fertile; discs dark brown or black;** spores 1 (never sterile), 42(±9) x 128(±30) um. Known primarily from the Florida peninsula. .... P. floridana Dibben

**12. Cortex often UV+ yellow or yellow-orange (lichexanthone);** medulla containing hypothamnolic acid; epihymenium K-; spores 1 (rarely sterile), 53 (±16) x 163(±24) um. On hardwoods (less often conifers), widespread throughout the eastern U.S. .... (see P. hypothamnolica)

**12. Cortex always UV- (xanthonenes absent).** .... 13

**13. Medulla KC+ red-violet, containing picrolichenic acid (rarely KC-, P+ red-orange, with protocetraric acid);** on hardwoods (less often conifers); epihymenium K-; sterile or spores 1, 48(±7) x 8(±16) um. Widespread throughout eastern temperate North America. .... (P. amara)

**13. Medulla K-, C-, KC-, P-, without lichen substances.** Epihymenium K-. .... 14

**14. Verrucae small (to 1.2 mm broad) and never scutellate; black disc commonly present beneath young soralium; sterile or spores 1, 49(±13) x 139(±38) um.** On conifers or hardwoods, panboreal. .... P. ophthalmiza (Nyl.) Nyl.

**14 Verrucae large (up to 4.6 mm broad) and often scutellate; black disc rarely present beneath young soralium; spores 1 (but rarely fertile), 56(±16) x 270(±54) um.**--known only as sterile in North America. Restricted to the Southwest on hardwoods (less often conifers). .... P. albescens (Hudson) M. Choisy & Werner in Werner

## **I-B-2 Sorediate. On soil, moss, or rock**

**1. Medulla with at least one spot test positive;** thallus variously colored. .... 2

**1. Medulla with all chemical tests negative (or spot tests uncertain);** thallus always gray (?). .... 4

**2a. Medulla C+ red, KC+ red (alecotrialic and barbatolic acids, + xanthones).** Thallus grayish or yellowish white, of thickly crowded, ± rounded granules 0.1-0.2 mm wide, which at times become ± papillate, apices bursting and sorediate; soralia 0.5-1.5 mm diam., contorted, coarsely granular becoming efflorescent. Apothecia rare, to 2.5 mm diam.; disk dark red to purplish black; thalline exciple thick, wavy, or ± crenulate; epithecium red-brown, K± paler, dissolving. Asci 2-spored; spores 22-40 x 15-20 µm, walls 2-zoned. Thallus P+ yellow-orange, K+ yellow. Herbarium specimens turn red-brown in time and also stain packets pink-brown. On exposed mountain summit heaths, mossy boulders. Arctic-alpine. .... P. geminipara (Th. Fr.) Knight

**2a. Medulla C-, KC+ rose or violet or KC-.** .... 2b

**2b. Medulla K+ yellow becoming red, P+ yellow becoming yellow-orange (norstictic acid), C-, KC-;** saxicolous; disjunct between the Appalachian Mountains and the northwestern arctic coast; known only sterile. .... P. excludens Nyl.

**2b. Medulla K- or K+ yellowish then red-brown or violet, without norstictic acid, KC+ or KC-.** .... 3

**3. Medulla KC-.** Thallus margin characteristically zoned; medulla K-, C-, P+ orange-red, contains fumarprotocetraric and succinprotocetraric acids; spores 1 (rarely sterile), 46(±12) x 134(±32) µm. Saxicolous; widespread throughout eastern temperate North America. .... P. multipunctoides Dibben

**3. Medulla KC+ rose or violet.** Epihymenium K-. .... 4

**4. Medulla K± yellow becoming finally violet, KC+ rose becoming finally violet (hypothamnolic acid). Soralia erumpent; thallus white or yellow-white; humicolous or muscicolous over soil (rarely rocks);** restricted to the western arctic; infrequently found in this sterile form. .... P. subdactylina Nyl.

**4. Medulla K- or K+ yellow becoming red-brown, P- or P+ yellow becoming orange-red (± protocetraric acid), C-, but always KC+ instantly rose-violet fading to wine red (picrolichenic acid), UV-; spores 1, 48(±7) x 8(±16) µm. Corticolous on hardwoods (less often conifers) or muscicolous over rock;** widespread throughout eastern and western temperate



North America. .... (P. amara)

**5. Thallus generally over mosses on rock; medulla producing picrolichenic acid;** epihymenium K-; sterile or spores 1, 48( $\pm$ 7) x 8( $\pm$ 16) um. Infrequent throughout temperate North America. ....(P. amara)

**5. Thallus strictly epilithic; producing no lichen substances;** restricted to the (eastern) arctic; epihymenium K-; known only sterile. .... P. pruinifera Erichsen

**I-C: Not isidiate or sorediate; On Rock**

**1. Cortex UV+ strongly orange or orange-red, K<sub>+</sub> yellow, C+ deep yellow, KC+ yellow-orange (thiophaninic acid), P+ yellow becoming orange (stictic acid).** Thallus yellow-green or sulfur yellow. Spores 2 (rarely sterile), 43(±10) x 75(±12) µm. Restricted to (southern) California, very common there. .... P. flavicunda Tuck.

**1. Cortex UV- or UV+ yellow, yellow-orange or yellow-pink, K, C, and KC- or K and KC+ weakly yellow (xanthone absent, thiophaninic acid in low concentration, or lichexanthone or 2,7-dichlornorlichexanthone present).** .... 2

**2. Medulla with at least one spot test positive.** .... 3

**2. Medulla with all chemical tests negative (or spot tests uncertain).** Discs dark, epruinose, or with infrequent concolorous or (±) gray pruina. Spores K-. Spores 8, 17(±3) x 32(±7) µm, uni- or bi-seriate. Discs ± pruinose. Medulla containing stictic acid. Restricted to southern and central California ..... P. chiodectonoides Bagl. ex Massal.

**3. Medulla always C- and KC-.** .... 4

**3. Medulla C and/or KC+ red (gyrophoric and/or lecanoric acid), K-, P-.** .... (P. velata)

**4. Medulla K+ yellow becoming deep yellow or finally brown (never red).** .... P. chiodectonoides Bagl. ex Massal.

**4. Medulla K+ yellow becoming red-brown, P+ yellow becoming orange-red (fumarprotocetraric with succinprotocetraric acid);** epihymenium K-; discs black, but usually heavily white pruinose or (±) sorediate; thallus margin characteristically broadly zoned; verrucal borders generally eroded and double in appearance. Widespread throughout eastern temperate N. America. .... (P. multipunctoides)

**I-D Not sorediate or isidiate. Terricolous/Muscicolous**

**1. Medulla usually C and/or KC+ red (gyrophoric and/or lecanoric acids), K+ yellow becoming red-brown, P+ yellow becoming orange-red (fumarprotocetraric and protocetraric acids). Spores 8, uni- or bi-seriate, 12(+2) x 25(+3)  $\mu$ m.** Epihymenium K+ violet. Discs black (rarely pink), matt. Alpine; restricted to the northern Pacific coast. .... (*P. suboculata*)

**1. Medulla always C and KC-; K+ yellow, P+ yellow becoming orange (stictic acid). Spores 2, 54(+6) x 117(+25)  $\mu$ m.** Thallus ash-gray or yellow-white; discs frequently shiny black; cortex containing thiophaninic acid; epihymenium K+ violet. Humicolous or muscicolous over soil; restricted to the eastern arctic. .... *P. atra* Lynge

**I-E Not soresiate or isidiate. Corticolous/Lignicolous**

**I-E-1 At Least One Spot Test Positive**

- 1. Cortex UV+ orange or orange-red, K<sub>+</sub> yellow, C+ deep yellow, KC+ yellow-orange (thiophaninic acid); medulla K- or K<sub>+</sub> yellow becoming (±) red, P- or P<sub>+</sub> yellow becoming (±) yellow-orange (norstictic acid);** epihymenium K-; spores 2, 53(±12) x 122(±22) um. Corticolous, at times almost hypophloedal. Restricted to coastal California. .... P. lecanina Tuck.
- 1. Cortex UV- or UV+ yellow, yellow-orange, or yellow-pink, K, C and KC- or K and KC+ weakly yellow (xanthone absent, thiophaninic acid in low concentration, or lichexanthone or 2,7-dichlornorlichexanthone present).** ..... 2
- 2. Medulla C+, KC+, or both.** ..... 3
- 2. Medulla always C and KC-.** ..... 9
- 3. Medulla C-, but KC+ rose becoming finally violet (hypothamnolic acid); cortex often UV+ yellow or yellow-orange (lichexanthone);** epihymenium K-; spores 1 (rarely sterile), 53(±16) x 163(±24) um. Corticolous on hardwoods (less often conifers); widespread throughout the eastern U.S. .... P. hypothamnolica Dibben
- 3. Medulla C and/or KC+ red (gyrophoric and/or lecanoric acids).** ..... 5
- 4. Medulla K+ yellow becoming red-brown, P+ yellow becoming orange-red (fumarprotocetraric and protocetraric acids);** epihymenium K+ violet; spores 8, uni- or biseriate, 12(±2) x 25(±3) um. Corticolous on conifers or hardwoods (± hypophloedal); restricted to the northern Pacific coast. .... P. suboculata Brodo & Dibben
- 4. Medulla K and P-.** ..... 5
- 5. Thallus UV+ yellow (lichexanthone). Growing in Florida.** Usually sterile. .... P. pulchella Malme
- 5. Thallus UV-, without xanthonenes (except P. santamonicae).** Growing in western or northern areas (except P. velata) ..... 6
- 6. Epihymenium K-; spores 1;** medulla containing only lecanoric acid. .... 7
- 6. Epihymenium K+ violet; spores 2 or 8.** ..... 8
- 7. Spores 8 (always uniseriate), 11(±2) x 18(±3) um, the wall thin, smooth, and untrimmed;** epihymenium strongly K+ violet; verrucal

borders circular, smooth, and ( $\pm$ ) crenulate; cortex UV- (xanthone absent); medulla producing both gyrophoric and ( $\pm$ ) lecanoric acids. Corticolous on conifers and generally hypophloedal; restricted to the central and northern Pacific coast. .... P. glaucomela (Tuck.) Nyl.

**7. Spores 2, 51( $\pm$ 10) x 100( $\pm$ 25)  $\mu$ m, the wall thick, characteristically corrugate on the inner face, and well trimmed.**

Corticolous on conifers (including lignum) but infrequently hypophloedal; restricted to New England. .... P. sulcata Dibben

**8. Cortex UV+ yellow, containing lichexanthone; fruit center pink or red; spores 40( $\pm$ 12) x 168( $\pm$ 25)  $\mu$ m, the wall thin (4( $\pm$ 1)  $\mu$ m), concentrically laminated only at ends, and lightly trimmed (15( $\pm$ 6)  $\mu$ m).** Corticolous on hardwoods (less often conifers); restricted to coastal California. .... P. santamonicae Dibben

**8. Cortex UV-, lacking a xanthone; fruit center yellow-brown; spores 64( $\pm$ 17) x 225( $\pm$ 49)  $\mu$ m, the wall thick (11( $\pm$ 4)  $\mu$ m), concentrically laminated throughout, and well trimmed (24( $\pm$ 8)  $\mu$ m).** Thallus UV-, C+ red (lecanoric acid). Corticolous on hardwoods (infrequently conifers); widespread throughout eastern temperate N. America. .... P. velata (Turner) Nyl.

**9. Medulla K+ yellow becoming red or red-brown. .... 10**

**9. Medulla K+ yellow becoming deep yellow or finally brown (never red);** disks generally heavily white-pruinose; epihymenium K-. .... 13

**10. Medulla K+ yellow becoming red, P+ yellow becoming yellow-orange (norstictic acid);** discs generally black and ( $\pm$ ) gray-white pruinose; verrucae shallow and broad-based, the margin often double in appearance; epihymenium K-; spores 1, 38( $\pm$ 8) x 118( $\pm$ 26)  $\mu$ m. Corticolous on hardwoods; restricted to the Appalachian-Great Lakes region. .... P. waghornei Hulting

**10. Medulla K+ yellow becoming red-brown, P+ yellow becoming orange-red (fumarprotocetraric with protocetraric and/or succinprotocetraric acids).** .... 11

**11. Epihymenium K+ violet; medulla possibly C or KC+ red in places (gyrophoric acid),** succinprotocetraric acid absent; discs black (rarely pink) and nonshiny; spores 8, 12( $\pm$ 2) x 25( $\pm$ 3)  $\mu$ m. Corticolous on conifers or hardwoods ( $\pm$  hypophloedal); restricted to the northern Pacific coast. .... P. suboculata Brodo & Dibben

**11. Epihymenium K-; medulla always C and KC-;** protocetraric acid absent or in low concentrations. .... 12

**12. Discs black, but usually heavily white pruinose or ( $\pm$ )**

**sorediate; thallus margin characteristically broadly zoned; spores 1 (rarely sterile), 46(±12) x 134(±32) um.** Medulla contains fumarprotocetraric and succinprotocetraric acids. Corticolous on hardwoods (less often conifers) or saxicolous; widespread throughout eastern temperate North America. .... P. multipunctoides Dibben

**12. Discs variously colored (white, pink, green or brown-black) on a single thallus, but always lightly pruinose; thallus margin never zoned; spores 8, 10(±3) x 17(±6) um, uni- or biseriate.** verrucal borders never eroded but becoming multiply concentric and tiered (stacked like a pile of plates); Corticolous on conifers (less often on hardwoods); restricted to northern Pacific N. America. .... P. subambigens Dibben

**13. Medulla K+ yellow becoming deep yellow, P+ yellow or yellow-orange (thamnolic acid); cortex UV- (xanthone absent); verrucae well elevated (often 2 or more mm high); disks pink;** sterile or spores 2, 36(±10) x 94(±31) um. Corticolous on hardwoods or conifers; widespread throughout eastern temperate N. America. .... P. trachythallina Erichsen

**13. Medulla K+ yellow becoming finally brown, P+ yellow becoming deep orange; cortex generally UV+ yellow or yellow-orange (lichexanthone); verrucae little elevated (at times around 1 mm high); disc yellow-brown or black.** On hardwoods (less often conifers), restricted to the southeastern coastal plain (primarily the Florida peninsula). .... 14

**14. Medulla P+ yellow, containing baeomycesic acid;** often fertile; discs dark brown or black; spores 1 (never sterile), 42(±9) x 128(±30) um. Florida. .... P. floridana Dibben

**14. Medulla P+ orange or pink-orange, containing other substances.** .... 15

**15. Medulla P+ pink-orange, containing stictic acid.** Florida. .... P. sp. (Harris, 1990)

**15. Medulla P+ orange, containing thamnolic or haemthamnolic acid.** .... 16

**16. Medulla containing haemthamnolic acid;** rarely fertile; discs yellow-brown (pink); spores 1, 36(±8) x 124(±30) um. Widespread throughout the coastal plain. .... P. copiosa Erichsen

**16. Medulla containing thamnolic acid.** Florida. .... P. sp. (Harris, 1990)

## I-E-2 Spot Tests Negative or Uncertain

1. Discs dark, but always white pruinose, at times heavily so (appearing sorediate). ..... 2
1. Discs dark, epruinose, or with infrequent concolorous or (+) gray pruina. .... 4
  2. Cortex generally UV+ yellow or yellow-orange (lichexanthone); medulla containing hypothamnolic acid; spores 1 (rarely sterile), 53(±16 x 163(±24) um. Corticolous on hardwoods (less often conifers); widespread throughout the eastern U.S. .... P. hypothamnolica Dibben
  2. Cortex UV- (xanthones absent); medulla containing no lichen substances; thalli at times hypophloedal. .... 3
3. Thallus dark gray, shiny, and (+) marginally zoned; verrucae never embedded; epihymenium and spore wall and lumen K-; sterile or spores 1, 49(±13) x 139(±38) um. Corticolous on hardwoods or conifers; panboreal in distribution. .... P. ophthalmiza (Nyl.) Nyl.
3. Thallus light gray, ± pruinose, and marginally unzoned; verrucae characteristically embedded; epihymenium and spore wall and lumen K+ violet; spores 2, 48(±10) x 95(±28) um. Corticolous on hardwoods (rarely conifers); restricted to northeastern temperate N. America. .... P. rhexostoma Nyl.
  4. Epihymenium and spore wall and lumen K+ violet; thallus shiny, often green or brown-gray; containing several unknown orcinol derivative; verrucal margins frequently eroded (exposing the medulla); spores 2, 42(±10) x 81(±24) um; corticolous on conifers (including lignum); restricted to the northern Rocky Mountains. .... P. saximontana Wetmore
  4. Spores K-; epihymenium K+ violet (at times weak). Spores 2; thallus ash gray to green-gray. .... 5
5. On conifers (including lignum) but rarely hypophloedal; restricted to New England; thallus containing 2,7-dichlorolichexanthone, gyrophoric acid, and perlatolic acid derivatives; verrucal margins contorted and lacerate (exposing the medulla); epihymenium K+ weakly and slowly violet; spores 51(±10) x 100(±25) um, the inside spore wall surface characteristically corrugate. Discs ± pruinose. .... P. sulcata Dibben
5. On conifers or (less often) hardwoods and predominantly hypophloedal; restricted to central and western boreal-temperate N. America; thallus containing no lichen substances; verrucal margins intact, but characteristically blackened around the often shiny disc; epihymenium K+ strongly violet; spores 47(±11) x 96(±20) um, the

**inside spore wall surface always smooth. .... P. stenhammari**  
Hellb.



**II. Subgenus Pertusaria**  
**Apothecia pertusariate, opening by one or more pores;**  
**Soredia absent; isidia sometimes present**

**II-A On rock.**

**1. Medulla with all chemical tests negative (or spot tests uncertain). .....2**

**1. Medulla with at least one spot test positive. ....3**

**2. Cortex UV+ orange or orange-red, K $\pm$  yellow, C+ deep yellow, KC+ yellow-orange (thiophaninic acid or related xanthone);** thallus generally yellow-green or sulfur-yellow.

Epithymenium K-. Spores 4 (but variable), 44( $\pm$ 7) x 81( $\pm$ 16)  $\mu$ m, uni- or bi-seriate. Verrucae dominantly pertusariate; ostioles ( $\pm$ ) white-pruinose, at times dilating and fusing as black, pseudolecanorate discs, bordered by intact (but rarely crenulate) margins; medulla containing planic and 2-O-methylconfluent acid.

Southwest. .... P. arizonica Dibben

**2. Cortex UV- or UV+ yellow, yellow-orange or yellow-pink, K, C, and KC- or K and KC+ weakly yellow (xanthone absent, or lichexanthone or 2,7-dichloronorlichexanthone present);** thalli variously colored. Epithymenium K-. Spores 2, 45( $\pm$ 12) x 149( $\pm$ 42)  $\mu$ m, the inner spore wall rough and radially grooved or channeled outside. Thallus gray, containing norstictic and perlatolic acids and their derivatives in the medulla; verrucae generally flat-topped and multiperforate; ostioles ( $\pm$ ) dark and often surrounded by a whitened border; epithymenium at times K+ weakly violet or wine-red.

Widespread throughout eastern U.S. .... P. plittiana Erichsen

**3. Medulla always K- and P-, C+ red and KC+ red (gyrophoric acid,  $\pm$  lecanoric acid);** spore walls always very thin, smooth and unzoned. Thallus generally off-white,  $\pm$  endolithic; verrucae always pertusariate, frequently fertile, more yellow than the thallus, isolated or grouped and fused, at times forming distinct rosette-like fruit bodies; epithymenium K-; spores 8, 28( $\pm$ 9) x 46( $\pm$ 15)  $\mu$ m, always biserial. Coastal arctic. .... Ochrolechia subplicans

**3. Medulla K and P+, C and KC- (or KC+ yellow-red);** spore walls various. ....4

**4. Cortex UV+ orange or orange-red, K $\pm$  yellow or red, C+ deep yellow, KC+ yellow-orange (xanthone);** thalli generally yellow-green or sulfur yellow. .... (see P. texana and P. wulfenoides in Key II-B)

**4. Cortex UV- or UV+ yellow to pink-brown, K, C, and KC- or weak (xanthones absent or in low concentration) .....5**

**5a. Thallus P+ yellow, K+ yellow-red, KC+ yellow-red, C-, UV-(norstictic acid).** Thallus rather thick, grayish white with a brownish tinge, when fertile, coarsely warted, irregularly granular, often appearing eroded, with few or no isidia. Fertile warts rather rare, scattered or  $\pm$  crowded, 1-3 mm diam., irregularly semi-globose, with 2-7 apothecia; discs punctiform, gray-black. Asci 2-spored. Spores 120-200 x 50-80  $\mu$ m, wall 5-6  $\mu$ m thick, uniform. On dry, well-lit, siliceous rocks in both coastal and upland areas. .... P. pseudocorallina (Liljeblad) Arnold

**5a. Thallus without norstictic acid.** ..... 5b

**5b. Epithymenium K+ strongly violet.** .....6

**5b. Epithymenium K- (or infrequently K+ weakly violet).** Thallus gray. ....7

**6. Spores 8.** ..... (see P. propinqua in Key II-B)

**6. Spores 4 (or thallus sterile).** Thallus ash-gray or yellow-white; stictic acid absent; mature verrucae large (1.7( $\pm$ 0.6) mm broad); ostioles typically dilating and fusiform to form black, pseudolecanorate discs; spores 53( $\pm$ 13) x 130( $\pm$ 38)  $\mu$ m, uni- or bi-seriate. Northwestern arctic. .... P. alaskensis Erichsen

**7. Thallus sterile, containing gyrophoric acid; margin broadly zoned and more yellow than the thallus; mature verrucae small (0.4( $\pm$ 0.2) mm broad) and 1-ostiolate.** Shenandoah National Park. ....  
P. shenandoahensis Dibben

**7. Thallus fertile; gyrophoric acid absent; margin at times ( $\pm$ ) narrowly zoned; mature verrucae large (1.3( $\pm$ 0.5) mm broad) and multiostiolate;** ostioles frequently surrounded by a whitened border; spores 2 and thick walled. .... 8

**8. Verrucae dominantly pertusariate and hemispherical; ostioles generally papillate; spores rarely aborted, 64( $\pm$ 12) x 191( $\pm$ 37)  $\mu$ m, the inner wall smooth and unzoned. Producing no additional lichen acids. Restricted to (central) coastal California.** .... P. californica Dibben

**8. Verrucae  $\pm$  ampliariate and flat-topped; ostioles generally level or sunken; spores not infrequently aborted, 45( $\pm$ 12) x 149( $\pm$ 42)  $\mu$ m, the inner wall externally roughened (radially grooved or channelled). Also producing perlatolic acid derivatives. Widespread throughout the eastern U.S.**  
..... P. plittiana Erichsen

## II-B. On bark.

### II-B-1. Medulla with at least one spot test positive.

**1. Medulla always K and P-, C- or C+ red and/or KC+ red or wine-red;** spore walls always very thin, smooth and unzoned. .... 2

**1. Medulla K+ and/or P+, C and KC-;** spore walls various. .... 3

**2. Medulla always C-, KC± wine-red (alectoronic acid); thallus ash-gray to yellow-white; verrucae concolorous with (or more white than) the thallus, characteristically possessing a pink to red-brown ostiole border;** spores 4 (but variable), 32(±5) x 79(±19) µm, uni- or biseriate. Corticolous on hardwoods and conifers (± hypophloedal), restricted to the western arctic. ....  
Ochrolechia xanthostoma

**2. Medulla C and KC+ red (gyrophoric acid, ± lecanoric acid). Thallus generally yellow-green; verrucae always ampliariate with the apex rufescent;** epihymenium K-; corticolous on hardwoods (± hypophloedal); restricted to New England. .... P. papillata (Ach.) Tuck.

**3. Cortex UV+ orange or orange-red, K± yellow, C+ deep yellow, KC+ yellow-orange (thiophaninic acid or related xanthone);** thalli generally yellow-green or sulfur yellow. .... 4

**3. Cortex UV- or UV+ yellow, yellow-orange, orange-pink, or pink-brown, K, C and KC- or K and KC+ weakly yellow (xanthonenes absent, thiophaninic acid or related xanthone in low concentration, or lichexanthone or 2,7-dichlorolichexanthone present);** thalli variously colored. .... 9

**4. Medulla containing virensic acid (P+ orange) and unknown (P-, possibly related to perlatolic acid); cortex with thiophaninic acid.** Ostioles not yellow and raised. Spores 8/ascus, 60-70 x 28-35 µm, uniseriate to basally subbiserial, smooth. Thallus pale yellow-gray, slightly shiny, continuous, smooth to rugose. Apothecial wart ampliariate to weakly pertusariate. Epihymenium K-. Florida. .... P. virensica R. C. Harris

**4. Without virensic acid; with stictic or norstictic acids.** [Need more info.] .... 5

**5. Medulla K+ yellow, P+ yellow becoming orange (stictic acid); verrucae mainly ampliariate; ostioles epruinose and variously colored, either non-dilating or forming pseudolecanorate discs with ruptured and lacerate borders.** [If growing in Florida, with xanthone X-1,

spores 4/ascus, smooth, 90-105 x 30-35 um, see *P.* sp. of Harris, 1990). ..... 6

**5. Medulla K+ yellow becoming red, P+ yellow becoming yellow-orange (norstictic acid); verrucae mainly pertusariate, the ostioles pruinose and black, generally dilating and fusing to form pseudolecanorate discs with intact and (+) crenulate borders.**

..... 8

**6. Spores 8, 27(+6) x 59(+14) um, usually basally biseriate; ostioles characteristically borne on prominent yellow papillae and non-dilating; epihymenium K-. Corticolous on hardwoods (rarely conifers), restricted primarily to the southeastern coastal plain (Texas to Florida). .... *P. texana* Müll. Arg.**

**6. Spores 2; ostioles level or sunken. .... 7**

**7. Ostioles always black beneath, often fusing to form epruinose pseudolecanorate discs, bordered by torn verrucal margins; epihymenium occasionally K+ weakly violet or wine-red; spores 34(+7) x 98(+35) um, the inner spore wall essentially smooth and unzoned. Cortex with xanthone X-1. Corticolous on hardwoods or less frequently conifers (at times ± hypophloedal); widespread throughout eastern temperate North America with a disjunct representation in California. .... *P. pustulata* (Ach.) Duby**

**7. Ostioles yellow to brown beneath, only rarely dilating, the verrucal margins intact; epihymenium always K-; spores 36(+8) x 92(+35) um, the inner spore wall rough (grooved or channelled) outside. Cortex with thiophaninic acid. Corticolous on hardwoods (rarely hypophloedal); restricted to the southeastern coastal plain in the East and coastal California in the West. .... *P. xanthodes* Müll. Arg.**

**8. Spores 8, 39(+8) x 81(+18) um, dominantly biseriate; epihymenium K+ violet; corticolous on hardwoods (rarely conifers); restricted to the Appalachian-Great Lakes region in the East and coastal California in the West. .... *P. rubefacta* Erichsen**

**8. Spores 4 (but variable), 46(+7) x 86(+15) um, dominantly uniseriate; epihymenium K-; corticolous on conifers; restricted to the southern Rocky Mountains. .... *P. wulfenioides* de Lesd.**

**9. Cortex UV+ pinkish (coronatone). Medulla P+ pink-orange (stictic acid agg.). Apothecial warts very irregular. Spores 8/ascus, uniseriate, smooth, 50-60 x 27-30 um. Florida. .... *P.* sp. (Harris, 1990).**

**9. Cortex UV+ yellowish or UV-, without coronatone. .... 10**

**10. Medulla K+ yellow, P+ yellow becoming orange (stictic acid); most species containing 2,7-dichlorolichexanthone in the cortex. .... 11**

- 10. Medulla K+ yellow becoming red or red-brown, P+ yellow becoming yellow-orange or orange-red; xanthones generally absent from the cortex. .... 19**
- 11. Epihymenium K+ strongly violet. .... 12**
- 11. Epihymenium K-. .... 15**
- 12. Spores 8, 18(±16) x 28(±8) um, rarely biseriate; verrucae usually prominently blackened towards the apex; corticolous (± hypophloedal) on hardwoods or conifers; boreal-temperate in distribution. .... P. sommerfeltii (Flörke ex Sommerf.) Fr.**
- 12. Spores 2. .... 13**
- 13. Thallus white;** verrucae frequently fused forming a characteristic multi-perforate sheet of fertile tissue; arctic-alpine in distribution. .... (see P. subobducens)
- 13. Thallus gray;** restricted to northeastern temperate North America. .... 14
- 14. Thallus matt and pruinose (with presence of xanthone unconfirmed); light-colored and ± hypophloedal; verrucae flat-topped and often zeorine in appearance (the apothecia breaking free of the amphithecial envelope); spores 33(±5) x 79(±19) um.** Corticolous on hardwoods; restricted to New England. .... P. zeorina Erichsen
- 14. Thallus smooth and shiny, gray or ash-gray but never hypophloedal; verrucae numerous and hemispherical, often fused as a multiperforate fertile sheet; spores 46(±7) x 148(±30) um.** Corticolous on conifers (less often hardwoods); restricted to the northern Appalachian-Great Lakes region. .... P. consocians Dibben
- 15. Spores 2, 52(±12) x 154(±34) um, verrucae dominantly pertusariate;** Spore wall and lumen often K+ violet when immature and the inner spore wall internally (rarely also externally) corrugate at maturity. Thallus ash-gray or green-gray. Ostioles generally arranged in (light bordered) prominent verrucal depressions. Corticolous on hardwoods (rarely conifers); widespread throughout northeastern temperate North America. .... P. macounii (Lamb) Dibben
- 15. Spores 4 or 8 (always uniseriate); verrucae dominantly ampliariate. .... 16**
- 17. Spores 8, 25(±7) x 49(±13) um;** thallus green-gray or yellow-green, epi- or hypophloedal; verrucae at times flattened, ± elongated, and dark-topped; corticolous on hardwoods (less often conifers); panboreal in distribution. .... P. alpina Hepp ex Ahles

**17. Spores often 4 (but ranging 2-5).** Hymenium not  
inspersed. .... 18

**18. Spores frequently other than 4; thallus more often green-gray or yellow-green, epi- or hypophloedal (but a times thick with pertusariate verrucae); ostioles rarely surrounded by a light colored border; spores  $33(\pm 10) \times 76(\pm 24)$   $\mu\text{m}$ , the inner spore wall smooth and unzoned at maturity.** Corticolous on hardwoods (less often conifers); widespread throughout temperate North America, south to Florida. .... P. leioplaca (Bernh.) Massal.

**18. Spores less commonly other than 4; thallus more often yellow-gray or ash-gray, never hypophloedal; verrucae conical or flat-topped, smooth or warted; ostioles generally surrounded by a whitened border; spores  $35(\pm 8) \times 103(\pm 29)$   $\mu\text{m}$ , the inner spore wall rough and radially zoned (outside) at maturity.** Corticolous on hardwoods (rarely conifers); widespread throughout the eastern U.S.A. (particularly abundant in the Southeast). .... P. tetrathalamia (Fée) Nyl.

**19. Medulla K+ yellow becoming red-brown, P+ yellow becoming orange-red (fumarprotocetraric and protocetraric acids); cortex containing an unknown xanthone;** thallus gray; verrucae generally amplariate or erect, flat-topped, and multiostiolate; epihymenium K+ violet; spores 2,  $38(\pm 7) \times 104(\pm 31)$   $\mu\text{m}$ , the inner spore wall rough and radially grooved outside. Corticolous on hardwoods; widespread throughout the southeastern U.S.A. ....  
B. subpertusa Brodo

**19. Medulla K+ yellow becoming red, P+ yellow becoming yellow-orange (norstictic acid); cortices generally lacking a xanthone.** .... 20

**20. Epihymenium K- (or infrequently K+ weakly violet). Spores 2.** Thallus gray (lacking a cortical xanthone); verrucae generally flat-topped, dispersed, and multiostiolate; ostioles black and frequently surrounded by a whitened border; spores  $39(\pm 7) \times 127(\pm 31)$   $\mu\text{m}$ , the inner spore wall finely grooved and channelled. Corticolous on hardwoods (less often conifers); widespread throughout eastern temperate North America. .... P. neoscotica Lamb

**20. Epihymenium K+ strongly violet. Spores 8.** ..... 21

**21. Thallus white or sordid, containing stictic acid; mature verrucae small ( $0.8(\pm 0.3)$  mm broad); ostioles black, nondilated, but often papillate. Spores  $29(\pm 11) \times 63(\pm 18)$   $\mu\text{m}$ , often uniseriate.** Arctic-alpine. .... (see P. octomela)

**21. Thallus gray, lacking stictic acid; mature verrucae large ( $1.6(\pm 0.7)$  mm broad); ostioles typically dilating and fusing to form black, pseudolecenorate discs; spores  $48(\pm 13) \times 93(\pm 20)$**

**umn, generally biseriate.** Corticolous on hardwoods; widespread throughout the eastern U.S.A. .... P. propinqua Müll. Arg.

**II-B-1. Medulla with all chemical tests negative or uncertain  
(but cortex may have positive tests)**

**1. Cortex UV+ orange or orange-red, K $\pm$  yellow, C+ deep yellow, KC+ yellow-orange (thiophaninic acid or related xanthone);** thalli generally yellow-green or sulfur yellow. .... 2

**1. Cortex UV- or UV+ yellow, yellow-orange or yellow-pink, K, C, and KC- or K and KC+ weakly yellow (xanthone absent, or lichexanthone or 2,7-dichlorolichexanthone present);** thalli variously colored. .... 8

**2. Spores 8/ascus.** .... 3

**2. Spores 2/ascus.** Epihymenium usually K-. .... 7

**3. Growing in Florida.** .... 4

**3. Growing in the north or west.** .... 5

**4. Containing variolaric acid and thiophaninic acids (both apparently concentrated around the ostioles). Spores basally biseriate to uniseriate, 65-90 x 30-40  $\mu$ m,** smooth. Apothecial wart pertusariate, usually quite flat-topped; ostiolar area often depressed and yellow. Thallus pale gray to yellowish, continuous, shiny. Florida. .... *P. epixantha* R. C. Harris

**4. Containing unknown substance (perlatolic/confluent acid group). Spores uniseriate, 55-60 x 25-28  $\mu$ m.** Florida. .... *P.* sp. (Harris, 1990)

**5. Epihymenium K+ violet.** Spores 8 per ascus. Verrucae dominantly pertusariate; ostioles ( $\pm$ ) white-pruinose, frequently dilating at maturity to form black, pseudolecanorate discs, bordered by intact, ( $\pm$ ) crenulate margins. .... 6

**5. Epihymenium K-.** Spores 8, 34( $\pm$ 8) x 86( $\pm$ 22)  $\mu$ m, rarely apically uniseriate. Thallus gray or ash-gray; verrucae generally less than 1 mm broad, amplariate or pertusariate, but often fused forming multiperforate fertile sheets; ostioles infrequently surrounded by a yellow-pink border; epihymenium at times K+ weakly wine-red; thallus containing only an unknown xanthone. Appalachian-Ozark region. .... *P. ostiolata* Dibben

**6. Medulla containing only gyrophoric acid; spores 36( $\pm$ 8) x 88( $\pm$ 20)  $\mu$ m, always biseriate.** Corticolous on hardwoods, restricted to (central) coastal California. .... *P. hymenea* (Ach.) Schaerer

**6. Medulla containing gyrophoric, norstictic and connorstictic acids; spores 39( $\pm$ 8) x 81( $\pm$ 18)  $\mu$ m, mainly biseriate.** Corticolous on hardwoods (rarely conifers); restricted to the



Applachacian-Great Lakes region. .... P. rubefacta Erichsen

**7. Cortex containing an unknown xanthone; verrucae ampliariate or pertusariate; ostioles always black beneath, often fusing to form epruinose, pseudolecanorate discs, bordered by regularly lacerate margins; epihymenium at times K+ weakly violet or wine-red; spores 34(±7) x 98(±35) um, the inner spore wall essentially smooth and unzoned.** Corticolous on hardwoods or less often conifers (at times hypophloedal); widespread throughout eastern temperate North America with a disjunct representation in California. .... (P. pustulata)

**7. Cortex containing thiophaninic acid; verrucae dominantly ampliariate; ostioles yellow to brown beneath, rarely dilating, the verrucal margins intact; epihymenium always K-; spores 36(±8) x 92(±35) um, the inner spore wall externally rough (grooved or channelled).** Corticolous on hardwoods (rarely hypophloedal); restricted to the southeastern coastal plain in the East and coastal California in the West. .... (P. xanthodes)

**8. Spores 2/ascus. Cortex generally UV- (lacking xanthoness-- but need to check P. zeorina again).** .... 9

**8. Spores 4 or 8/ ascus. Cortices generally UV+ yellow (lichexanthone or 2,7-dichlornorlichexanthone).** .... 10

**9. Medulla containing variolaric acid; cortex UV- (no xanthoness).** **Spores 30-40 x 100-120 um,** weakly radially ridged. Apothecia mostly immersed, rarely ampliariate. Thallus pale green-gray, shiny, continuous, somewhat rugose. Florida. .... P. obruta R. C. Harris

**9. Medulla without variolaric acid. Spores 2, 33(±5) x 79(±19) um;** epihymenium K+ violet. Thallus light colored, pruinose, containing stictic acid and a structurally uncertain xanthone; verrucae flat-topped and often zeorine in appearance (the apothecia breaking free of the amphithecial envelope), corticolous (± hypophloedal) on hardwoods; restricted to New England. .... P. zeorina Erichsen

**10. Spores often 4 (but variable).** .... 11

**10. Spores 8.** .... 13

**11. Epihymenium K+ violet.** Spores 4, 37(±8) x 81(±18) um, always uniseriate; hymenium densely inspersed; thallus gray and shiny, producing perlatolic acid derivatives in the medulla; verrucae similar to thallus, characteristically possessing prominent radiating marginal fissures. Corticolous on hardwoods; restricted to the southeastern coastal plain. .... P. sinusmexicani Dibben

**11. Epihymenium K-.** .... 12

**12. Thallus yellow-gray, green-gray, or yellow-green; verrucae dominantly ampliariate; ostioles infrequently papillate, rarely surrounded by a light colored border; medulla containing stictic acid; spores 33(±10) x 76(±24) um, always uniseriate and smooth-walled, frequently ranging 2-5;** corticolous (epi- or hypophloedal) on hardwoods (less often conifers); widespread throughout temperate North America. .... P. leioplaca DC. in Lam. & DC.

**12. Thallus ashy gray or gray; verrucae dominantly pertusariate; ostioles usually (±) papillate, at times surrounded by a white border; medulla containing no lichen substances; spores 38(±17) x 104(±21) um, uniseriate, at times ranging 2-5, the inner spore wall rough and radially grooved inside;** corticolous (always epiphloedal) on hardwoods (less often conifers); endemic to the Appalachian-Ozark region. .... P. valliculata Dibben

**13. Epihymenium K+ lavender to violet.** ..... 14

**13. Epihymenium K-.** ..... 15

**14. Spores 28(±8) x 18(±6) um, rarely biseriate; thallus light colored and often matt, producing stictic acid in the medulla; verrucae usually prominently blackened towards the apex.**

Epihymenium K+ violet. Corticolous (± hypophloedal) on hardwoods or conifers; boreal-temperate in distribution. .... P. sommerfeltii Hellb.

**14. Spores 70-95 x 30-40 um, uniseriate, roughened with radial edges. Medulla containing unknown substance (just above norstictic acid in TKC), K-, C-, P-. Cortex UV- (no xanthones).** Epihymenium often K+ lavender. Thallus gray, continuous or cracked, sometimes white maculate, whitish at the margins. Apothecial warts mostly pertusariate but rarely ampliariate or even immersed. Florida. .... P. iners R. C. Harris

**15. Thallus green-gray or yellow-green;** verrucae ampliariate, but a times flattened, ± elongate, and dark-topped; medulla containing stictic acid; spores 49(±13) x 25(±7) um. Epihymenium K-. Corticolous (epi- or hypophloedal) on hardwoods (less often conifers); panboreal in distribution. .... P. alpina Hepp ex Ahles

**15. Thallus gray or ash-gray (at times yellow-gray),** never hypophloedal; epihymenium at times K+ weakly wine-red. Corticolous on hardwoods (occasionally on conifers). .... 16

**16. Verrucae generally less than 1 mm broad, ampliariate or pertusariate, but often fused forming multiperforate fertile sheets; ostioles infrequently surrounded by a yellow-pink border; thallus containing only an unknown xanthone; spores**

**86(±22) x 34(±8) um, rarely apically uniseriate;** endemic to the Appalachian-Ozark region. .... P. ostiolata Dibben

**16. Verrucae generally more than 1 mm broad, amplariate to erect (infrequently pertusariate) and never fused in sheets; ostioles often surrounded by a whitened border; medulla K-, P-containing 2-O-methylperlatolic acid (4-O- according to Harris, 1990); cortex UV+ yellow (lichexanthone); spores uniseriate, 76(±23) x 34(±6) um, rarely basally biserial;** restricted to the eastern deciduous forest, south to Florida. .... P. paratuberculifera Dibben

## II-C. On soil or moss.

**1. Isidia present** (always less than 1 mm tall), papillate to coralloid, becoming sorediate, never associated with fruit bodies; thallus gray (cortex containing 2,7-dichloronolichexanthone); verrucae dominantly pertusariate; ostioles dark and generally sunken, surrounded by a pink-white border; medulla all chemical tests negative (producing 2;-O-methylperlatoric acid). Epihymenium K-; spores 4(or 2), 41 ( $\pm 9$ ) x 92( $\pm 21$ ), always uniseriate. Muscicolous over rock, soil, or tree boles (mainly hardwoods); endemic to the Appalachians. .... P. globularis

**1. Isidia absent.** .....2

**2. Medulla with all chemical tests negative.** .....3

**2. Medulla with at least one spot test positive.** Humicolous or muscicolous over soil or rock, arctic or alpine .....5

**3. Epihymenium K+ violet.** Cortices generally containing xanthones. Spores 4, 35( $\pm 7$ ) x 68( $\pm 14$ )  $\mu$ m, uni- or biseriate; thallus white and matt; producing stictic acid in the medulla; verrucae similarly  $\pm$  pruinose. Humicolous or muscicolous over soil, western arctic. .... P. trochiscea Norman

**3. Epihymenium K-.** Temperate eastern U.S. ....4

**4. Spores 4 (sometimes 2), 41( $\pm 9$ ) x 92( $\pm 21$ )  $\mu$ m. Ostioles generally sunken and surrounded by a pink-white border; medulla containing 2-O-methylperlatic acid.** Spores uniseriate, the inner spore wall always smooth and unzoned. Muscicolous over rock, soil, or tree boles (mainly hardwoods), Appalachians. .... (see P. globularis)

**4. Spores 8, 34( $\pm 8$ ) x 86( $\pm 22$ )  $\mu$ m, ostioles infrequently surrounded by a yellow-pink border; thallus containing only an unknown xanthone.** Spores rarely apically uniseriate. Thallus gray or ash-gray; verrucae generally less than 1 mm broad, ampliariate or pertusariate, but often fused forming multiperforate fertile sheets; epihymenium at times K+ weakly wine-red; Appalachian-Ozark region. .... P. ostiolata Dibben

**5. Medulla always K and P-;** spore walls always very thin, smooth and unzoned. ....6

**5. Medulla K+ and P+, C- and KC-;** spore walls various. ....7

**6. Medulla always C-, KC $\pm$  wine-red (alectoronic acid); thallus ash-gray to yellow-white.** .... (see P. xanthostoma)

**6. Medulla C and KC+ red (gyrophoric acid,  $\pm$  lecanoric acid). Thallus generally off-white;** verrucae always pertusariate, rarely

fertile, always isolated, and often apically rufescent; epihymenium K-; sterile or spores 4, 35(±9) x 63(±14) um, usually bisertiate. Arctic-alpine. .... Ochrolechia bryophaga

**7. Medulla K+ yellow, P+ yellow becoming orange (stictic acid), usually with xanthones in cortex.** Epihymenium K+ violet; spores 2, 56(±14) x 143(±41) um. Thallus white; verrucae frequently fused forming a characteristic multiperforate sheet of fertile tissue. Arctic-alpine. .... P. subobducens Nyl.

**7. Medulla K+ yellow becoming red or red-brown, P+ yellow becoming yellow-orange or orange-red; usually without xanthones.** .....8

**8. Epihymenium K+ strongly violet.** .....9

**8. Epihymenium K- (or infrequently K+ weakly violet).** Thallus white or sordid; containing thiophaninic acid; verrucae generally hemispherical, but often fused in multiperforate fertile sheets; spores 2, 54(±7) x 163(±40) um, the inner wall smooth and unzoned. Widespread throughout the arctic. .... P. coriacea (Th. Fr.) Th. Fr.

**9. Spores 8,** 29(±11) x 63(±18) um, often uniseriate. Thallus white or sordid; mature verrucae small (0.8(±0.3) mm broad); ostioles black, nondilated, but often papillate. Arctic-alpine. .... P. octomela (Norman) Erichsen

**9. Spores 4 (or thallus sterile).** .....10

**10. Thallus ash-gray or yellow-white; stictic acid absent.** ..... (see P. alaskensis in Key II-A)

**10. Thallus white or sordid; containing stictic acid;** mature verrucae small (1.0(±0.5) mm broad); ostioles little dilated, often prominently papillate and black rimmed; spores 36(±10) x 95(±34) um, generally uniseriate. Widespread throughout the arctic; Queen Charlotte Islands. .... P. glomerata (Ach.) Schaerer

ADD:

Thallus in small patches or sometimes wide-spreading, thin to moderately thick, margin ± entire, not zoned; upper surface dark gray, blue- or brown-gray, smooth or roughened, distinctly cracked-areolate; areoles (0.2-)0.6(-1.5) mm diam., ± flat. Fertile warts (0.2-)0.7(-1.5) mm diam., ± numerous and well dispersed, rarely confluent, flat. Apothecia 1-3\*-8 per wart; discs (0.1-)0.3(-0.6) mm diam. black or dark gray, immersed, ± widened when mature, often roughened and gray-white pruinose and appearing irregular or ± stellate with a ± paler, irregular, not or slightly raised, common margin; epithecium dark brown-black, K± deep violet. Spores (20-)25-42 x 11-24

um; wall 3-4(-5) um, even, smooth. Coniida 7-10 x 0.5-1 um. Thallus P+ orange-red, K+ yellow, KC+ yellow, C-, UV0 (stictic,  $\pm$  norstictic and  $\pm$  constictic acids). California material is identical to typical material of the species except that the spores are K+ violet. On siliceous rocks in exposed, sunny and dry situations, often in sites with Peltula, but mostly on non-vertical surface. Channel Islands of S. California. Recently discovered, not yet reported from N. America. .... P. aff. chiodectinoides Massal.

P. subcorallina (Liljeblad) Arnold [I have not yet found a description of this species; it isn't in any of the sources given below]

### III. Apothecia absent; Isidia present

**1. Thallus C-, UV- (without xanthoness).** Thallus rather thick, grayish white with a brownish tinge,  $\pm$  smooth, wrinkled to coarsely warted; isidia usually present, scattered to crowded, rounded, 0.5-1 mm diam., constricted at base, apices brown-pigmented, rounded, often breaking off at the base leaving non-sorediate, crater-like depressions. Thallus P+ yellow, K+ yellow-red, KC+ yellow-red, C-, UV- (norstictic acid). On dry, well-lit, siliceous rocks in both coastal and upland areas. .... P. pseudocorallina (Liljeblad) Arnold

**1. Thallus C+ orange, UV+ red or orange (xanthoness).** .... 2

**2. Thallus K-, P-, C+ orange, UV+ dark red, containing only xanthoness (arthothelin and granulysin, in N. American material; thiophanic acid in British material).** Isidia pale yellow, with a soft surface, to 0.6 mm tall. On bark (Alnus and Populus), near sea level to 30 m, in Alaska (on tops of calcareous, schistose boulders in Britain). .... P. flavocorallina Coppins & Muhr

**2. Medulla K $\pm$  yellow, P+ yellow becoming orange (stictic acid), C and KC $\pm$  red (gyrophoric acid). Cortex C+ orange, UV+ dark red, containing thiophanic acid.** Isidia infrequent, papillate to coralloid, becoming sorediate, never associated with fruit bodies; thallus yellow-white or sordid; verrucae large (1.3 ( $\pm$ 0.6) mm wide). .... P. bryontha (Ach.) Nyl.

ADD:

Thallus clearly delimited, mostly or entirely "ensela" (Esperanto), smooth or "fajne" (Esperanto) granular, here and there slightly cracked, whitish or yellowish white, very thin, K- or K+ yellow. Apothecia 0.4-0.7 mm diam., Lecanora-like, with thalline margin irregular and disk even, reddish yellow or rufous brown, pruinose at first, finally brown and epuriose. Spores 8/ascus, 20-30 x 12-16 um (v. protuberans) or 28-42 x 15-24 um (v. macrospora). Thallus and apothecia P-. On bark. See the chemical study of European spp. for more info. .... P. carneopallida (Nyl.) Anzi in Nyl. (Syn.: P. protuberans)

P. disticha Erichsen

Similar to P. sommerfeltii but Containing 2,7-dichlorolichexanthone; lacking stictic acid; spores 35-55 um long; apothecia more ampliariate, with a single ostiole per verruca, yellower; spores biseriate. On Alnus rubra, Queen Charlotte Islands, British Columbia. See Oshio, 1968 for more info. .... P. hakkodensis Yasuda ex Räsänen

P. subamplicata Nyl.

### Literature

Brodo, I. M. 1995. Lichens and lichenicolous fungi of the Queen Charlotte Islands. ....

Dibben, M. J. 1980. Chemosystematics of the Lichen Genus Pertusaria in North America North of Mexico. Publications in Biology and Geology No. 5, Milwaukee Public Museum. 162 pages.

Galloway, D. 1985. Flora of New Zealand Lichens.

Harris, R. C. 1990. Some Florida Lichens. Published by the author.

Oshio, M. 1968. Taxonomical studies on the family Pertusariaceae of Japan. J. Sci. Hiroshima Univ., Ser. B., Div. 2, Bot. 12: 81-163.

Purvis, O. W. and P. W. James. 1992. Pertusaria. In: Purvis, et al., Lichen Flora of Great Britain and Ireland.

Rogers, 19 . Genera of Australian Lichens.