

**VIIID Thallus without Fumarprotocetraric Acid;  
Openings in axils clearly and regularly present  
Sect. Perviae**

Western species after Hammer (1993); others after Thomson

Podetia arising from upper side of squamulose primary thallus, tubular to inflated, corticate to ecorticate-sorediate; axillary and apical openings punctate to gaping, sometimes apparently lacking; branches from margins of axillary openings and lateral positions; podetial squamules minute (< 1 mm long) to large (> 5 mm long), sparse and simple to abundant and luxuriant. Apothecia brown. Barbatic, squamatic, and thamnolic acids, with accessory baeomycesic acid.

**VIID1  
Sorediate**

**1. Podetia coarsely granulose sorediate, K+ yellow; P+ yellow to orange; containing thamnolic acid plus accessory F and G.** Podetia very little branched, mainly simple; Podetia very little branched, mainly simple; K+ yellow; P+ deep yellow to red; containing thamnolic acid plus accessory F and G. Podetia very short (13 mm), tipped with brown apothecia. Surface greenish mineral gray, covered with fine isidioid squamules. Primary squamules finely incised, forming a dense mat, the margins becoming isidioid. Common on rotten logs and stumps (especially on cut top surfaces). Eastern (Great Lakes area to New England, south to Georgia and SW to Arkansas. Eastern..... C. parasitica

**1. Podetia finely to coarsely sorediate, K, P, containing only squamatic acid (UV+ ice blue). .... 2**

**2. Podetia forming narrow cups with inrolled edges, 1365(80) mm tall, irregularly tubular, sparingly to muchbranched from margins of scyphoid openings, bright glaucescentgreen to whitish, ecorticate, sorediate throughout; soredia granular to farinose; elongate squamules towards base. Podetia with regular, triangular scyphoid openings, usually giving rise to one or more proliferations from margins; proliferations reiterating. Primary thallus evanescent; basal squamules 110 mm long, 12 mm wide, palmatelobate, strongly laciniate, sinuate to crenulateedged, with accessory isidioid lobules, becoming granular sorediate beneath margins. Northern (Alaska to Greenland), S in west to Mexico, south in east to Appalachians. .... C. cenotea**

(Ach.) Schaerer

**2. Podetia lacking cups or forming cups with margins of cups not inrolled.** Decorticate areas extending to base of podetia; finely or coarsely sorediate. Thallus P; containing only squamatic acid; decorticate areas extending to base of podetia; finely or coarsely sorediate. Primary squamules persistent or disappearing, small to large, 15 mm long and 1 mm broad, irregularly or subdigitately lobed or partly incised, the lobes crenate-incised, ascending, flat or involute, sparse or tufted; upper side glaucescent or pale greenish white; underside white; esorediate or underside sparsely sorediate. Podetia sometimes in small tufted groups, the base persistent or dying; 2580(100) mm tall, to 2.5 mm diam., cylindrical, cupless or rarely with minute cups up to 3 mm broad at the apices, usually simple, the rare branches suberect, the apices attenuate or blunt, the axils perforated or closed; entirely decorticate and farinose sorediate, or rarely with small corticate are at base, opaque, whitish or ashy glaucescent or rarely ashy brown or variegated; lacking squamules or with a few at base. Apothecia small, sometimes aggregated at tips of podetia, commonly peltate and perforate, brown or yellowish brown. K, KC, P, with squamatic acid. Resembling C. subulata but that species is P+ red and contains fumarprotocetraric acid; apothecia swell beyond the podetium, unlike those of C. subulata). On soils rich in humus, in bogs and heaths. Apparently rare. Boreal (south to Connecticut in the east; to Arizona in the west?but not mentioned by Hammer, 1993). .....C. glauca

## VIID2. Esorediate

**1. Podetia cylindrical, slender, more or less branched, the branches frequently elongate and intertwined and forming complex branch systems, usually cupless; apices acute, obtuse, or attenuate; axils usually perforate and occasionally dilated.**

Podetia K+ yellow, changing to pinkish or wine red (40methylcryptochlorophaeic, merochlorophaeic), P or in acetone extract P+ yellow (lacking fumarprotocetraric and protocetraric acids; with psoromic acid according to Thomson). Podetial squamules rare. Areoles of cortex continuous, becoming separated and exposing translucent inner layers. Acidophilous, in subalpine and maritime bogs and heaths, or in old sandy lichen woodlands in middle and boreal zones. Alaska to Newfoundland, S to New England and northern Great Lakes area. BorealArctic. Not mentioned by Hammer, 1993. ....

C. pseudorangiformis

**1. Podetia funnel or cupshaped, or cupless, simple or sparingly shortbranched; apices attenuate, truncate, or cupforming; axils dilated, often cupforming. Cups, if present, with interior entirely open to inside of podetium, lacking lacerate or puncture membrane. .... 2**

**2. Thallus UV+ ice blue, P or P+ yellow, K, containing squamatic acid as a major substance. Podetia covered by squamules. .... 3**

**2. Thallus UV or weakly UV (never ice blue), P+, K+ or P, K. .... 10**

**3. Thallus P+ yellow, K, UV+ white, containing baeomycesic acid in addition to squamatic acid. Eastern. .... 4**

**3. Thallus P. Western or Eastern. .... 5**

**4. Podetia not cupshaped but forming pointed or blunt clubs, simple or sparingly branched; cortex continuous or often becoming minutely and densely squamulose. Basal squamules irregular, small. Without accessory substance F. Podetia 0.5-1.5 cm tall, simple or sparingly branched; cortex continuous or often becoming minutely and densely squamulose. Basal squamules well developed, irregular, small to medium-sized, incised. Southeastern coastal plain. (mostly Fla.) Podetia whitish mineral gray. Pycnidia and apothecia rare, brown. On sandy soil, rotten logs, and tree bases, in open areas. Eastern, south to Fla. .... C. beaumontii (Tuck.) Vainio**

**4. Podetia forming distinct cups. Basal squamules small or lacking. Podetia sparsely to moderately squamulose. Cups open**

and gaping. Containing accessory substance F; similar in appearance to C. squamosa forms. Primary squamules persistent or disappearing, 13 x 0.5 mm, irregularly digitate or pinnately divided; tips rounded; upper side glaucescent to olive green; underside white. Podetia 15 mm tall, to 2 mm diam., cylindrical, bearing cups which flare abruptly and have proliferate margins sometimes forming several successive tiers, sometimes with blunt or subulate points or repeatedly branched; cups or apices open or closed; cortex continuous, smooth or with indistinct areoles or slightly verruculose; glaucescent or olivegreen, not pellucid. Apothecia and pycnidia on margins of cups or tips of branches, brown. On soil, sometimes over rocks, and on hummocks in bogs. Eastern U.S., Massachusetts to N. Carolina mainly near the coast, inland in Mississippi valley and N to Alabama, Illinois, and Kentucky. .... C. atlantica

**5. Basal squamules coarse, persistent, imbricate, green above, often weakly pruinose at the tips, strongly white maculate in older parts,** white below, recurved when dry exposing the underside, linear to slightly flabellate; margin often sinuous, irregularly lobed, 35(8) x 12 um, 0.30.4 mm thick; cortex very well developed, very irregular, 50-150 um thick, containing small clumps of colorless crystals; medullary hyphae 7-11 um thick. Podetia to 2 cm tall, repeatedly branching, proliferating, perforate, broadly expanded above, weakly cupforming, squamulose, partially corticate and smooth and continuous; exposed stereome whitish or translucent; axils open; numerous apothecia on ultimate perforations. Apothecia plane, ca. 0.2 mm across; margin pale tan, with radiating lines of small crystals; disk brown; ephymenium with numerous colorless crystals; hypothecium pale brownish; spores fusiform, 10-13 x 2.54 um. Pycnidia laminal on squamules, pyriform, often with short stalk, pale brown to brownblack; pycnosporos curved, thickened in the middle, ca. 8 x 1 um. Containing squamatic acid and a low amount of an unknown substance. On bases of Taxodium just above water, Fla. .... C. buckii R. C. Harris

**5. Basal squamules smaller, not maculate.** Occurring in northern or western areas (not in Florida). .... 6

**6. Podetia with few squamules, mostly restricted to basal portions.** Cortex persistent. .... 7

**6. Podetia covered by squamules.** .... 9

**7. Podetia not forming cups,** corticate, olivegreen, often with divaricate branchlets. Cracks between pieces of cortex at base black. Primary squamules disappearing, midsized, 15 mm long,

irregularly crenatelobate or laciniate, ascending, flat, tufted, esorediate; upper side glaucescent to olive or pale glaucescent; underside white. Podetia dying at the base, the growth continuing from the apices, 15-110 mm tall, 11.5(2.5) mm diam., subcylindrical and somewhat thickened at the s=axils; cupless; branching in sympodia, dichotomously or trichotomously, the axils perforate or not; branchlets divaricate or ascending, usually short; apices obtuse or shortly attenuate, erect, branching widely or subradiately spinulose around a perforate axil; forming tufts or small mats, esorediate; cortex partly subcontinuous, partly contiguous-areolate, smooth or low rugose; without squamules or with a few at base, dull or shining, not pellucid, pale or olive-glaucous or reddish brown to brown, also variegated at times, the dying parts usually spotted, the decorticated portion black and the spots of cortex pale to olive green. Apothecia small, to 0.7 mm diam., at apices of branchlets; pycnidia containing reddish, K+ violet material. Squamatic acid. On soil rich in humus. Arctic-boreal, Alaska to Greenland, S across Canada. .... C. subfurcata

**7. Podetia forming cups.** Cortex persistent. Podetia with few or no squamules. Podetia 11.5 mm thick. Usually K, P, containing squamatic and consquamatic acids, but several other chemotypes (including ones that are K+ and P+) are known. Often on tree bases, logs, or humus.

Northern. .... 8

**8. Podetia mostly thick,** with the base dying and growth continuing from the apex, the cups (when present) usually narrow, with numerous radial proliferations which bear minute cups, lacking squamules, usually reddish brown. Podetia mostly thick (relative to length), with the base dying and growth continuing from the apex, the cups always present, usually relatively wide, 11.5(2) mm across, abruptly flaring, with numerous and repeated radial proliferations which bear minute cups, lacking squamules or minutely squamulose in places, pale greenish to usually reddish brown or dark brown. Primary squamules persistent, ca. 1 x 1.5 mm. Podetia to 5 cm tall; cups opening to the interior; cup margins dentate with 5-15 teeth, 15 of which grow to form new branches. Apothecia 0.8-1 mm across. On rotting logs, tree trunks, humus, and sometimes bushes, in scannas or scrub areas, sometimes also in disturbed forests. .... C. crispata (Ach.) Flot. in Wendt var. crispata

**8. Podetia very thin,** the cups narrow, the proliferations almost solitary from the margins of the small cups which are on the sides of the podetia, the slender proliferations with obsolete

cups of obtusespinescent, lacking squamules, dark brown or reddish brown. Podetia thinner (taller), the tips usually subulate or bluntish; cups (only occasionally present) narrow, the proliferations almost solitary from the margins of the small cups which are on the sides of the podetia, the slender proliferations with obsolete cups of obtusespinescent, lacking squamules except occasionally near base, pale to dark brown or reddish brown. Primary squamules persistent or evanescent, 0.20.3 mm wide. Podetia to 78 cm tall, irregularly or radiately branched; axils mostly open. On soil, peat, or rock, usually in rather dry habitats, especially in grasslands. Coastal areas of Canada. ....C. crispata var. cetrariiformis

**9. Apices of podetia and lateral branches mostly subulate;** axils closed or open; cortex continuous to densely squamulose; cortex present beneath podetial squamules. Primary thallus evanescent; basal squamules 12 x 24 mm, entire to finely incised, crenatelobate. Podetia 1550 mm tall, simple or branched dichotomously laterally and trichotomously from the axils, greenish to olivaceous or castaneous. Apothecia usually under 1 mm diam. Washington. .... C. singularis Hammer

**9. Apices and lateral branches (if present) blunt, rarely subulate;** axils open, often gaping; cortex missing beneath podetial squamules. Podetia with numerous squamules; cortex strongly tending to disintegrate but leaving the inner medullary layer as a more or less arachnoid opaque surface; cracks at base white. Podetia sometimes forming rather indistinct cups, graygreen. Cracks at base of podetia white. Podetia with numerous squamules; cortex strongly tending to disintegrate but leaving the inner medullary layer as a more or less arachnoid opaque surface. Primary squamules persistent or evanescent, small, ca. 0.51 x 11.5 mm. Podetia 57(9) cm tall, 12(3) mm thick, pale to dark brown; bases and ecorticate patches often white; often forming dense cushions; without cups or more often with narrow, 0.7101(1.5) mm wide cups, opening to the interior of the podetium; branching irregular, radiate or in scyphose podetia by marginal proliferations, often in repeated ranks; scyphal margins dentate, with 35(8) teeth, 23 of which grow to form new branches; tips subulate or bluntish; surface of podetia varying from ecorticate and richly squamulose to corticate and somewhat less densely squamulose. Apothecia ca. 0.7 mm wide. With squamatic and consquamatic acids, and barbatic acid in fertile specimens; occasionally also one unknown. Usually on humus and soil (occasionally sandy), also on rocks with small accumulations of soil, stumps, or sometimes trees, especially in grasslands or scrub areas, usually not in disturbed sites. Arctic (Alaska to

Greenland) S to California and Montana in the west, to Florida in the east. .... C. squamosa Hoffm. var. squamosa

**10. Thallus K+ yellow, P+ yellow, containing thamnolic acid.**

..... 11

**10. Thallus K, containing barbatic acid.** ..... 17

**11. Podetia with three or more narrow (13 mm wide) equal perforations from margins of distinctly scyphoid, open axils; podetia more or less symmetrical, not inflated.** Primary squamules usually disappearing, sometimes buried in substrate, to 7 mm long, to 3 mm wide, ascending, crenatelobate to subpalmately lobate; lobes to 1.3 mm wide, simple or sinuateedged; upper surface olivaceous; lower surface white, smooth or barely subfibrillose, with scattered corticate granules; esorediate. Podetia (6)1428(35) mm tall, 0.52.0 mm wide, wideneing slightly below scyphuslike structures, very sparingly branched laterally by dichotomy, more often with 28 branchlike proliferations from margins of scyphuslike openings; openings sometimes axillary or lateral, usually apical, or arising as regular punctures in between lateral branches, enlarging and deforming slightly, with membranaceous layer overhanging and growing downward into opening, exposing light to dark brown cartilaginous layer; proliferations usually subulate and sterile, sometimes giving rise to further series of proliferations with usually one apothecium at tip; cortex continuous at base, becoming chinky, sometimes rather thick, especially under and around scyphuslike openings and at base of proliferations, sometimes giving rise to squamules; squamules often abundant around openings, esorediate. Apothecia light to dark brown, flat, seldom confluent. On soil over sandstone, 70200 m. California to Washington and British Columbia. .... C. poroscypha Hammer [See Bryologist, 1993, vol. 96: 83]

**11. Podetia with unequal proliferations; axils not scyphoid; podetia symmetrical or asymmetrical, inflated or not inflated.** ..... 12.

**12. Podetia with open, symmetrical, rarely gaping axils; podetia covered with abundant squamules, becoming decorticate; interspaces opaque; pycnidia on podetia; K+ bright yellow, containing thamnolic acid (or also accessory barbatic acid and substances F and G according to Thomson). Podetia relatively tall, often branched. Cortex squamulose. Basal squamules persistent or disappearing, small, ca. 0.51 x 1.5 mm. Podetia 12(2.5) mm thick, pale brownish or greenish, rarely dark brown,**

usually ecorticate, densely squamulose, without cups or with narrow, repeatedly proliferating cups. Usually growing on bases and trunks of trees or rotting stumps, in forests (including disturbed sites). Western California to Washington. .... C. squamosa var. subsquamosa (Leight.) Vainio

**12. Podetia with axils open or closed; axils asymmetrical; squamules few to lacking. .... 13**

**13. Growing in Eastern N. America. Basal squamules irregular, small.** Thallus K+ yellow, P+ yellow to orange (thamnolic acid). persistent, in depressed mats. (also see C. subsubulata). .... 14

**13. Growing in Western N. America. .... 15**

**14. Pycnidia on primary squamules. Podetia short, 58 mm tall, ca. 0.5 mm diam., sparingly and irregularly branched in upper part; cortex of contiguous to dispersed, coarse globose areoles or low verrucae, appearing to be appressed squamulose, sometimes with distinct squamules similar to primary ones but smaller; interspaces semipellucid, whitish.** Primary squamules to 2 mm long and 0.5 mm wide, irregularly divided; margins crenate to lobulate; apices rounded; upper side glaucescent; underside white; esorediate. Podetia cupless or with rudimentary cups, often remaining sterile and blunt. Apothecia small, dark brown, single or clustered on tips. Containing only thamnolic acid (or also barbatic acid? implied by Harris, 1990). On old lobes and prostrate tree trunks. Rather rare. East Coast, New York to Fla. .... C. santensis Tuck.

**14. Pycnidia on the podetia. Podetia relatively tall, 1030(60) mm tall, to 1.5 mm diam., commonly irregularly and ± abundantly shortbranched from a short distance above base, the branches sometimes forming corymbose clusters; cortex continuous or subcontinuous; minute areoles ± apparent; squamules absent or few; interspaces not pellucid, whitish.** Primary squamules to 810 mm long and 1 mm broad, simple or divided into 24 linear divisions; margins subentire to crenate; apices rounded; upper side grayish green to pale glaucescent; underside white. Podetia cupless, cylindrical, ascendent with pointed or subulate apices; axils closed or open; sometimes the ultimate branches forming whorls around gaping axils and resembling poorly developed cups; esorediate. Containing thamnolic acid plus accessory barbatic acid. On sandy soil rich in humus, and on fallen or prostrate tree trunks and decayed wood. Massachusetts to Fla, east to Ohio and Kentucky. .... C. floridana Vainio

**15. Growing in eastern N. America. Cortex smooth, continuous,**

lacking squamules or with but few; containing thamnolic acid plus accessory F and/or G. Primary squamules usually disappearing, small, 12(3) mm long and broad, crenate or incised crenate to becoming irregularly subdigitate laciniate, ascending, flat, in tufts or sparse; upper side glaucescent or pale or olivaceous glaucescent; underside white; esorediate. Podetia 2089 mm tall, to 2 (3) mm wide; cups abruptly flaring, to 35 mm broad, oblique or partly almost lacking on one edge; interior open; margins entire or dentate to radiate proliferate, sometimes with repeated ranks of proliferations; apices of proliferations usually irregularly subcorymbose or cymose lacerated, in tufted clusters or branchletes; erect or ascending; esorediate; smooth; usually lacking squamules; whitish or ashybrownish variegated, opaque, or the decorticate parts semipellucid. Apothecia to 0.3 mm diam., at apices of branchlets or agglomerated in axils or subsolitary, brown or reddish brown. Pycnidia on apices or on short stipes on margins of cups. On earth rich in humus, sandy soil, or rotting wood. Nova Scotia, Maine, Massachusetts, Connecticut, New York. (Reports of "C. carassensis" from Oregon and California, and Thomson's photograph under that name, are based on C. poroscypha. Egan lists C. carassensis as a synonym of C. subsubulata. However, Hammer, 1993 accepts C. carassensis as a species but excludes it from N. America; he mentions examining the type of C. subsubulata, but does not say anything else about it]. ..... C. subsubulata

#### 15. Growing in western N. America.

..... 16

16. Podetia usually inflated, with or without inconspicuous perforations; open axils punctate to rarely gaping; swollen areas common, typically bearing proliferations. Primary squamules persistent, usually deeply buried within substratum. "Basal squamules" (ones on base of podetia?this is very confusing, because Hammer implies that these squamules are not always persistent, and are ± entiremargined, while the primary squamules are deeply dissected, although with the edges only sinuate], when persistent, ± entiremargined, never luxuriant; [also buried within substratum?]. Thallus K+ bright yellow, KC+ yellow, P+ deep yellow to orange (thamnolic acid). Primary squamules forming extensive mats, 412 mm long, 15 mm wide, irregularly dichotomously branched, deeply laciniate, subcoralloid to irregularly lobate above; edges sinuate; to 3 mm thick; accessory lobules occasionally present; upper surface glaucescent green, sometimes with bluish tinge, subpruinose; lower surface white, subfibrillose, upturned, esorediate or with granular corticate soredia beneath upturned lobes. Podetia 430 mm tall, to 4.5 mm

wide, subcylindrical to somewhat inflated, sparingly to moderately branched laterally or from margins of apical openings; cortex continuous or subcontinuous, sometimes disappearing, thick, chinkyareolate to rugose to verruculose; areoles or verrucules elevated and forming closely appressed squamules, or enlarging and imbricating, or upturned, abundant and appearing as corticate granules; apices often abundantly covered with peltate squamules; closed apices enlarging and inflating. Apothecia brown, in clusters around margins of apical openings, to 0.9 mm diam.. On thin soil over sandstone or stabilized sand, near the ocean. California, rare. .... C. thiersii Hammer (also see Mycotaxon, 1989, 34: 115)

**16. Podetia infrequently inflated, with numerous conspicuous perforations; without proliferations or with one (rarely more) wide (to 45 mm) proliferations; open axils asymmetrical, gaping (except in immature podetia, which are unbranched and tubular with a single more or less symmetrical opening surrounded by pycnidia. Primary squamules evanescent or persistent, not buried beneath substratum, deeply dissected, sometimes luxuriant. Thallus K+ bright yellow, P+ deep yelloworange, or K, KC, P (thamnolic acid, barbatic acid, or usually both). Primary squamules to 11 mm long, 13 mm wide, irregularly subdigitately to subpalmately lobed, rarely coralloid; margins sinuate, crenate to crenulate; upper surface pale glaucescent green to olivaceous to chestnut brown, shiny to dull; upturned edges whitish; lower surface white, smooth to minutely fibrillose, darkening at base; esorediate. Podetia irregularly subcylindrical, dilating irregularly, unbranched or sparingly branched from dilated portions or from margins of axillary openings, (5)1275 mm tall, to 6 mm wide; bases persistent or dying; cortex continuous or more frequently thinning and breaking up above base, becoming areolate to dispersed areolate or chinky or verrucose, sometimes imbricating and giving rise to squamules, especially toward apices, esorediate; squamules grayish green to olivaceous to brownish; cartilaginous layer white to tan; perforations apical and lateral, to 10 mm diam., elongating and deforming, splitting longitudinally and bearing a membranaceous flap of cortex downturned into interior, giving rise to blunt proliferations along margins, or bearing pycnidia or apothecia along margins or on proliferations. Apothecia and pycnidia sessile on short, blunt, ecorticate stipes, or stipes giving rise to further series of proliferations; apices of proliferations usually blunt, sometimes abundantly squamulose. Apothecia light to dark brown or blackening, convex to flattened, solitary or clustered and sometimes conglomerating, to 11 mm diam. On soil in exposed localities and under Arctostaphylos shrubs, on lateritic hardpan,**

and over stabilized sand dunes, coastal. California to Washington and British Columbia. .... C. artuata Hammer

**17. Growing in Florida. Primary squamules persistent**, forming depressed mats, 12 mm x 0.150.25 mm, linear, sparingly branched subpinnately; upper side grayish green; underside white; esorediate. Podetia small, to 10 mm tall and less than 1 mm diam., cylindrical, cupless, simple or sparingly branched above; cartilaginous layer of wall exposed and podetia more or less translucent, esorediate but with scattered minute areoles of cortex or scattered to crowded squamules similar to the primary ones. Apothecia dark brown, subspherical, single or clustered to confluent at tips of podetia; pycnidia on podetia. K, KC, P. Containing barbatic acid and accessory substance F. On rotten logs and the trunks and roots of palmetto. .... C. botyrocarpa

**17. Growing in western N. America. Primary squamules evanescent (but "basal squamules" sometimes persistent)**, not buried beneath substratum, deeply dissected, sometimes luxuriant. Podetia infrequently inflated, without proliferations or with one (rarely more) wide (to 45 mm) proliferations; open axils asymmetrical, gaping, except in immature podetia, which are unbranched and tubular with a single more or less symmetrical opening surrounded by pycnidia; K (barbatic acid only). .... (thamnolic acid deficient strain of C. artuata)

ADD:

K+ bright yellow, P+ yellow to red, containing thamnolic acid. Podetia rather branched; cups/axils open; nonsorediate. Cortex rather thick. Apothecia brown. .... C. pseudohondoensis Asah.