

SECTION 4--ON BARK OR WOOD

Rev. Jan. 1994

1. Thallus isidiate or sorediate. Apothecia (if present) yellow, orange, red, or rusty, K+ red or purple. 2

1. Thallus not isidiate or sorediate, but sometimes granular, of various colors or thallus not apparent. Apothecia usually present, variously colored, K+ or K-. 3

2. Thallus (at least the soredia or isidia) yellow to orange or reddish, K+ reddish to purple. KEY 4-A (*C. citrina* group)

2. Thallus entirely whitish to blackish, K-. KEY 4-B (*C. herbidella*/*C. chlorina* group)

3. Thallus at least partly \pm distinctly yellowish to orangish (sometimes pale or spotty), K+ reddish to purple. [If thallus distinctly lobed, see rare lignicolous forms of *C. saxicola*]. KEY 4-C (*C. aurantiaca* group)

3. Thallus immersed, or \pm grayish (whitish to blackish or tinged with other colors but not yellowish or orangish), K-. 4

4. Apothecia brown, K-. KEY 4-D (*C. camptidia* group)

4. Apothecia yellow, orange, red, or black, or \pm brown, but always with at least the disc K+ reddish or purplish. 5

5. Apothecia \pm rusty colored to brown, or black (variously tinged). 6

5. Apothecia (at least the discs) yellow, orange, red, sometimes brownish but not rusty nor blackening. 7

6. Apothecia \pm black (variously tinged). KEY 4-E (*C. pollinii* group)

6. Apothecia \pm rusty colored (with yellowish to orangish or reddish tinges, but often brownish or blackening). Key 4-F (*C. ferruginea* group)

7. Apothecial margin (at least outer part) some shade of white, gray, brown, or black, K-. KEY 4-G (*C. cerina* group)

7. Apothecial margin concolorous with disk or somewhat lighter or darker, but K+ reddish to purple and not gray to black. Key 4-H (*C. pyracea* group)

3a. Thallus rosulate, with distinct lobes. Usually on rock, occasionally on wood. (see *C. saxicola*)

3a. Thallus not lobed. 3b

**4-A. On bark or wood;
Thallus isidiate or sorediate,
at least the isidia or soredia yellow, orange or red, K+ purple;
Apothecia, if present, yellow, orange, or red, K+ purple.
(C. citrina group)**

1. Thallus completely of sorediate or isidiate granules. 2

1. Thallus areolate to verrucose or lobate, or thin and continuous. Apothecia, if present, small, mostly 0.2-0.7 mm diam. 3

2. Thallus immersed or areolate, with soralia. Thallus to 5 mm diam., endoxylic or as scattered, thin, 0.2 mm large, orange yellow areoles, which soon erupt and are transformed into bright golden yellow, irregular, to 0.4 mm wide soralia; single scattered soralia may occur on the substrate; soredia 25-35 µm diam. Apothecia very scarce, to 0.6 mm diam., few, sessile among the soralia; disc orange yellow, more orange than thallus, plane to slightly convex; margin thin (60 µm), regular, slightly prominent or more often level with disc, soon depressed, concolorous with areoles. Spores 10-12 x 7-8 µm; septum ca. 3 µm thick. C. citrina

2. Thallus completely leprose-granulose, citrine yellow to yellow-orange, similar to that of Candelariella xanthostigma but K+ violet. Apothecia unknown. On trunks of Betula, Abies and Thuja, New Brunswick. C. xanthostigmoidea

3. Thallus not marginally lobate; soralia greenish yellow to gold or rusty yellow. Apothecia without thalloid margin. 4

3. Thallus marginally lobate. 5

4. Soralia discrete, distinctly delimited, usually round; dull pale orange to pinkish (or greenish yellow or greenish, to golden or bright orange yellow?). Spores (10-)13-15(-20) x (5.6-)6.5-8.5(-10) µm, ellipsoid; septum (2.8-)3.5-5(-7) µm wide, ca. 1/4 length of spore. Thallus immersed, inconspicuous, or a thin smooth film, or definite, gray or whitish, sometimes tinged with yellow or green; prothallus indistinct. Soredia crowded, flat to ± convex, ± rounded, erose to superficial; soredia farinose to minutely granular. Apothecia rare but sometimes present, to 1 mm diam., scattered, ± elevated, orbicular, concave then flat; disc orange to brownish orange; thalline margin sometimes present, pale yellowish, thick or thin, sorediate; proper margin well developed. Paraphyses 2 µm thick, simple; tips to 3 µm. Containing emodin, parietin, and fragilin. On various types of nutrient enriched tree bark in open situations, Arizona, California, Texas, to eastern U.S. C. chrysophthalma

4. Soralia not delimited, forming scattered strings and patches of soredia, pale rusty yellow or light orange, granular to somewhat isidiate. Spores (11-)12-15(-18) x (7-)8-11 µm; isthmus (2.8-)3.5-7 µm. Thallus very thin and scarce to irregular and verrucose, ± scattered, whitish to yellowish white or pale to bright yellow, bursting into soredia. Soralia round to irregular, scattered to grouped on the upper surface, thin. Thallus sections with a necrotic upper layer over a cortex which is irregularly K+ purple but which may not show the K+ reaction on gross thallus application. Soredia K+ deep purple; other color reactions negative. Apothecia very uncommon, 0.2-1 mm diam.,

adnate to sessile; disc flat to convex, rusty red to reddish brown; margin concolorous with disc (pale orange according to Thomson 1997), evanescent. Exciple hyaline and partly radiate and covered by a thalloid margin which is \pm paraplectenchymatous, and with the algae \pm glomerulate and mainly below the apothecium, so that the margin may appear biatorine, the outer layer K+ purple as in the cortex. Hypothecium hyaline, interspersed with oil droplets, slowly I+ blue; hymenium 85-90 μ m, hyaline, with upper c. 25 μ m dark with yellow granules. Spores 8, ellipsoid, broad and thick walled. Containing emodin, parietin, 2-chloroemodin, and fragilin. On trees. Northeastern U.S. (New England and New York); Black Hills; Alaska.C. discolor

5. Thallus not rosetiform; lobes to about 1 mm long and wide, closely appressed, centrally areolate; areoles small, usually subsquamulose, effigurate, yellow orange to orange; soralia punctiform, red-orange to orange or dark orange (sometimes lacking). Apothecia uncommon; disks orange; paraphyses branched above; end cell somewhat enlarged, ca. 4 μ m across; spores 9-12.6(-14) x (4-)5.6-7 μ m, the septum (2.8-)4.2(-5.6) μ m thick. Tissues in margin and under hypothecium clearly cellular. Usually on wood (rarely bark). Frequent on desert shrubs to oak woodlands in the Southwest, California, Texas; also in S. Dakota, Michigan and Ontario (throughout northern U.S. according to Fink).C. microphyllina

5. Thallus rosetted; lobes to 5 mm long, high-convex; soralia capitate on the ends of short secondary lobes in the interior of the thallus. Usually on rock but occasionally on wood. (C. decipiens)

ADD: Thallus lobed, rosetted, with globular isidia. On wood on the seashore. (C. verruculifera)

Key 4-B. On bark or wood.

**Thallus isidiate or sorediate, whitish to blackish,
K- (or sometimes blue-violet or partly faint purple);**

Apothecia orange-red, rusty, K+ red or purple

(*C. herbidella*/*C. chlorina* group)

1. Thallus isidiate. 1a

1. Thallus lacking isidia, with soredia. 2

1a. Spores with two locules. Thallus isidiate, gray to greenish gray or whitish to yellowish, K- (or tips of isidia K+ faint purple), widespreading, thin and continuous. Isidia numerous, crowded, usually \pm obscuring thallus, simple or branched, elongate, warted-papillate, granular, nodulose, or coralloid, whitish gray, sometimes with a yellow tinge or suffused brownish at tips. Apothecia occasional to common, to 1.3 mm diam., scattered, rounded to flexuose; true margin concolorous, persistent, smooth; disc flat to slightly convex, rough, deep orange-red to rusty orange. Paraphyses simple or forked, septate, broadening towards the apices. Spores (10-)13-15 x (6-)7.5-8.5 μ m; septum 3-4(-5) μ m, 13=12 length of spores. Common on bark and wood (especially *Quercus*), Colorado. *C. herbidella*

1a. Spores with three locules. Thallus whitish gray, continuous, thin (50-80 μ m), with abundant simple to branched or coralloid isidia 200-500 μ m long, 55-90 μ m diam., without prothallus. Thallus cortex paraplectenchymatous, 10-15 μ m thick, with granules insoluble in K or cN, algal layer continuous, medulla very thin. Apothecia scattered, round, flat, sessile, disk dull orange to brownish orange, thalline margin whitish gray, usually isidiate, thin inner proper margin sometimes present and same color as disk. Epihymenium dark golden, amphitheciium with algae, proper exciple with irregular radiating hyphae, hypothecium with small irregular cells, hymenium 85-110 μ m, asci with 8 spores (occasionally less when mature). Tips of paraphyses not swollen, frequently branched. Spores with three equal locules, 18-22 x 10.0-12.5 μ m. Pycnidia not found. Thallus K-, cN-, C-, UV+ yellow, epihymenium K+ red-brown, C-, cN-. On trunks of oaks at high elevations (1400-1700 m) in open oak woodland, Baja California Sur. *C. lagunensis* Wetmore

2. Thallus episubstratal, with a distinct bluish gray overall color, K+ blue-violet, N+ violet or \pm brown with violet tinge, indeterminate, forming irregular patches to 10 cm or more diam., areolate or sometimes leprose throughout; areoles distinct to indistinct, bluish gray, sometimes grayish to greenish gray, discrete to contiguous, sometimes confluent, convex and rounded at first, later usually becoming flattened, \pm irregular in outline, \pm incised, sometimes with marginal tuberculae, to 0.2(-1) mm diam.; soralia (present when thallus areolate) concolorous with areoles or darker, often marginal on the areoles, sometimes \pm punctiform where the areoles have been completely dissolved into soredia, usually \pm discrete and up to 0.2 mm diam., sometimes becoming confluent forming a leprose sorediate crust. Soredia fine, (15-)20-30(-40) μ m diam., sometimes forming subcylindrical (to 90 μ m long), globose to irregular consoredia, with a distinct, continuous cortex (wall) of globular cells. Prothallus sometimes distinct, brownish to brownish violet. Medulla indistinct or absent. Photobiont to 20 μ m diam. Apothecia sometimes often present, sometimes richly so, to 0.6(-0.8) mm diam.; thalline margin

distinct, grayish blue, prominent at first, later often becoming eroded and flush with level of disc, often sorediate; disc usually orange and K⁺ purple, sometimes faintly white pruinose. On eutrophicated bark of Betula and on Populus and Ulmus americana; also to be expected on rock. British Columbia; Quebec. C. chlorina (Flotow) Sandst.

2. Thallus immersed, or variously colored but not bluish overall, usually K- or K⁺ brown, N⁺ reddish brown or N-. 3

3. Soredia usually K-, N- (rarely K⁺ and N⁺ violet). Lichen substances absent; soredia not shiny in polarized light. Thallus smooth to weakly areolate or scaly or not apparent, initially thin, continuous, pale to dark gray, vivid green when wet, with soralia scattered to contiguous, minute, rounded, erose, 0.1-0.3 mm diam., becoming uneven-scurfy, whitish to pale yellow-green or bluish gray, concave to flat, derived from the rupture of convex, pimple-like vesicles; prothallus \pm present, gray or bluish black. Apothecia to 0.8 mm diam., usually rather rare, small, inconspicuous, scattered, rounded, flat or slightly swollen; disks brown to pale reddish or pale grayish brown. Spores 9-12(-13) x 5-7(-8) μ m, septum 4.5-7(-8) μ m; thalline and proper margins at first both distinct but soon excluded, whitish to tan or usually dull to dark brown, pellucid when wet; algae present in the base of the apothecium but sometimes absent in the margin. Epihymenium lacking the colored crystals present in most other species of the genus.

Paraphyses lax, simple to forked, septate, with dark globose apical cells 3-6 μ m wide. Spores ellipsoid; septum ca. 1/2 (or more) length of spore. Thallus and apothecia K-. On \pm nutrient-rich bark of broadleaved trees (e.g., Aesculus, Acer, Ulmus) in damp situations, sea level to ca. 100 m. British Columbia, Washington and Oregon; Nova Scotia. C. obscurella (synonym: C. sarcopisoides)

3. Soredia K⁺ fuscous brown, N⁺ reddish brown; roccellic acid (a fatty acid) present; soredia shining in polarized light. Thallus gray, endo- to episubstratal, indeterminate, often forming small, inconspicuous patches between other lichens, sometimes spreading irregularly and discontinuously to 10 cm or more across, areolate; prothallus, when visible, dark; areoles grayish brown to brown or whitish green, discrete or becoming \pm contiguous, flattened to weakly convex, irregularly rounded to somewhat elongate, to 0.2 mm diam.; soralia distinct and roundish, brownish or greenish, or whitish where soredia have been shed, usually discrete, sometimes becoming contiguous or crowded but never confluent, 1(-3) per areole, distinctly delimited, circular, flush with thallus or more usually raised, sometimes doliiform, surrounded laterally by a corticate sheet which in upper part forms a white circular rim, to 0.3(-0.5) mm diam.; soredia fine, the outer ones brown, to 20(-30) μ m diam. Apothecia very infrequent, to 0.3(-0.5) mm wide, the disk rust red (to sometimes yellow brown or red brown), plane, rough, densely beset with K⁺ purple crystals; margin indistinct, grayish, eroding. Spores 8-11 x 4-5 μ m. Containing roccellic acid. On bark (e.g., Populus and Betula, Alnus, Salix, Sorbus), 300-1500 m, Colorado, Alaska, Washington. C. sorocarpa

**4-C. On bark or wood;
Thallus \pm yellow to orange, K+ reddish to purple;
not sorediate or isidiate
Discs \pm orange
(C. aurantiaca Group)**

1. Apothecia stipitate. Epithecium K+ weakly red to red-brown. Thallus yellow orange to whitish yellow, continuous to areolate at margin, vertically expanding and bullate areoles in center; dark prothallus often visible. Thallus cortex 30 μ m thick, without crystals, without epinecral layer, with indefinite cells. Apothecia stipitate, abundant to clumped, 0.5-2 mm diam., round to irregular, concave at first then flat; disks orange; margin same color as thallus, often becoming crenulate, flush to slightly raised, smooth to lumpy, occasionally with inner proper margin same color as disk. Epihymenium golden; hymenium 70-95(-100) μ m, hypothecium hyaline, without distinct cells; parathecium with irregular hyphae; algae in upper amphithecium; apothecial cortex thin at top (30 μ m) but expanding toward base to 90-95 μ m, often with crystals insoluble in K. Paraphyses with one slightly swollen tip cell and with few branches. Spores 12.5-14 x 5.5-7.0 μ m, isthmus 4.0-5.5 μ m. Pycnidia immersed, ostioles orange, conidia bacilliform, 3.6 x 1.2 μ m. Thallus weakly K+ red, epihymenium weakly K+ red to red-brown. Thalline parts often developing yellow crystals (insoluble in water and K) on the surface after 8-10 years in the herbarium. On bark of shrubs and trees in desert areas, California and Baja California. C. stipitata Wetmore

1. Apothecia not stipitate. Epithecium K+ strong red or purple. 2

2. Discs \pm rusty colored or dark red-orange. (see C. arizonica Magn., C. fraxinea, and C. ferruginea v. subflavens)

2. Discs orange. 3

3. Thallus orange (\pm pale), of small squamules or spherical granules. Disc orange to dark orange. Apothecia 0.3-0.7 mm diam. Spores (9.8-)11.2-14(-15) x 5.2-6.1(-7) μ m; septum (1.5-)2.8-4.2(-5.6) μ m. Thallus mostly immersed, sometimes small, pale orange verrucae visible between apothecia (probably apothecial initials). On pine bark or wood, northern Arizona, Colorado, Texas. (C. durietzii)

3. Thallus yellow to yellow-green or yellow-orange or grayish. Apothecial sessile or adnate. Epithecial granules dissolving in K. 4

4. Spores 14-18 x 6-10 μ m, ellipsoid; septum 5-9 μ m wide (to 1/2 length of spores).

Thallus pale yellowish to whitish with yellow spots, or yellowish green, sometimes diffused gray, continuous, smooth and even to areolate or coarsely convex-granular-papillate, often delimited by a \pm conspicuous, smooth, white-gray to blue-gray prothallus. Apothecia sessile, to 3.0 mm diam., scattered to crowded, flat to often slightly convex, becoming irregular and distorted when old; thalline margin thin, gray-yellow, crenulate, soon excluded but retained on underside of apothecia; proper margin prominent, somewhat elevated, smooth, orange; disk orange to deep orange, \pm flat. Cortex uniformly thin. Lower part of hymenium and hypothecium with numerous oil droplets. Paraphyses mainly forked towards tips, apices often broader, to 4 μ m. Typically on broadleaved plants, especially wayside and parkland trees (particularly Fraxinus). "Throughout the

United States" according to Fink.C. flavorubescens (syn. C. aurantiaca)

4. Spores 12-13(-14) x (4.5-)5-5.5(-6) um, oblong; septum 3-3.5 um (ca. 1/4 length of spores). Spore isthmus distinct; apical wall thin but double. Thallus effuse, thin, pale citrine yellow, verrucose, soon covered by apothecia. Apothecia 0.7-1.5(-2) mm, sessile, becoming very crowded upon large areas; disc orange, plane or slightly convex, often irregular by pressure; margin thick, slightly paler than disc, at first prominent, somewhat crenulate, then \pm depressed below the \pm distinct proper margin. Apothecia 0.4-0.5 mm thick, the pale part about 250 um deep; algal layer 70-100 um, horizontal, partly not continuous, the surface very undulating; medulla below it lax, easily bursting. Cortex only at base, 40-60 um thick; in K the hyphae \pm parallel, 3-3.5 um; I+ pale grayish violet blue. Exciple laterally 35 um with dense hyphae, at base diffuse with intricate, gelatinous hyphae, at edge widened to 100(-150) um, refracting; exterior 35 um sordid dark yellow, hyphae there rarely branched, lumina ca. 1 um; whole exciple I-. Hypothecium 70-100 um, pale gray, I+ pale blue; hyphae densely intricate, 2.5(-3) um. Hymenium 70 um; upper 20 um greenish yellow. Paraphyses discrete in K, 1.5 um thick; tips colorless, 3-3.5 um, irregularly clavate and \pm constrictedly septate. Spores 8 per ascus. On bark. Coastal California.C. californica

ADD:

Thallus to 3 cm, lacking or mostly present but poorly developed, as elongate patches, consisting of scattered to contiguous, convex or occasionally uneven areoles 0.05-0.2 mm wide, to 0.1 mm thick, with smooth surface; margin indistinct, consisting of scattered areoles; surface mostly bright yellow, occasionally with orange tinge or fading toward grayish yellow; prothallus occasionally present, very thin and yellow. Apothecia always present and often rather abundant, mostly scattered or occasionally more crowded, zeorine, initiating in strongly convex to subglobular areoles, initially sessile but soon raised, 0.3-1.1 mm, round to somewhat irregular; disk slightly concave to somewhat convex, bright yellow to orange-yellow; proper margin fairly thin, 25-75(-100) um, slightly raised or not, concolorous with or slightly lighter than disk. Spores narrowly to broadly ellipsoid, (9.6-)10.2-13.6(-14.0) x (3.2-)3.7-7.2(-7.8) um; septum (2.5-)3.0-4.7(-5.1) um. On wood, coastal. California to British Columbia. (C. inconspicua Arup)

ADD?:

Thallus to several cm across (when on wood, elongated in direction of the wood fibers, few mm broad, epixylic, staining the wood light gray); sometimes with scattered, orange-yellow, to 0.2 mm across squamules, which can become rather effigurate. Apothecia zeorine, numerous, dispersed or very crowded, sometimes forming raised conglomerates, 0.5(-0.9) mm diam.; disc flat to slightly convex, orange; margin prominent, rather thick (60 um), persistent; proper margin slightly paler than disc; thalline margin somewhat paler than proper margin, irregular and in epixylic specimens confluent with the squamules. Spores 12-13 x 5.5-8.5 um; septum 3.5-5 um thick. On strongly eutrophic substrates (usually rock, occasionally wood), not far from the sea. (C. alcarum)

4-D. On bark or wood.
Thallus (usually?) ± grayish, K-, or immersed.
Apothecia brown or ± black, K+ red or purple or K-
(*C. pollinii*/*C. camptidia* Group)

After Wetmore (1994)

- 1. Epihymenium blue or bluish purple. 2**
- 1. Epihymenium gray, brown, or golden. 3**

2. Epihymenium producing abundant purplish-blue solution in K; spore isthmus 4-7 um; apothecia brown to dark brown with rusty red tinge. Thallus thin, scattered, smooth or minutely granulose, becoming chinky, whitish to pale greenish gray or ashy; no prothallus. Apothecia 0.5-1(-1.25) mm across, sessile, rounded or lobed, sometimes connate or composite, often proliferous; disk flat then convex, matt or shining, dark brown to blackish with slight reddish brown tinge, epruinose; proper margin very thin, dark brown to blackish, flush to at most slightly elevated, persistent or disappearing, becoming irregularly and wavy; no thalloid margin. Hypothecium hyaline to tinged reddish, without paraplectenchymatous cells or small hyphal cells; thick walled cells in proper exciple; enlarged thick walled hyphal cells in parathecium; hymenium 87-116 um; asci ventricose; paraphyses distinct, slender, coherent, with two to three slightly swollen cells, somewhat to frequently branched, the tips dark or reddish black; epihymenium with dark aeruginose or dark blackish purple granules; epihymenium and margin, K+ strong reddish then purple turning blue, with bluish solution; spores ellipsoid (to somewhat ovoid or oblong), with acute ends, 12.5-18 x 5.5-10(-11) um, becoming polarilocular; isthmus 4-7 um; end walls thin. Thallus K-. No substances. On trunks of conifers, and of willows, alders and birches, coastal. British Columbia to California, with disjuncts in Massachusetts and central Mexico. *C. atrosanguinea* (G. K. Merr.) Lamb

2. Epihymenium K-; isthmus 1.5 um, barely more than a septum; apothecial disks black; margin thin. Thallus dark gray, thin, continuous to areolate at margins, cyanotrophic; no prothallus. Apothecia very small (0.1-0.2 mm), sessile, flat; margin thin to disappearing, black; no outer thalloid margin. Hymenium 42-72 um; no araplectenchymatous cells in hypothecium or proper exciple; few large paraplectenchymatous cells in parathecium; few algae in upper amphithecium; paraphyses with one to two swollen cells, no branching; spores 10-12.5 x 4-5.5 um; isthmus 1.5 um. All tissues and thallus K-. No substances. On hardwood bark, rare, Northern Minnesota and Michigan. *C. parvula* Wetm.

- 3. Epihymenium K+ purple or K+ brown turning purple. 4**
- 3. Epihymenium completely K- or K+ yellow. 6**

4. Thallus with pseudocyphellae or isidia or both; radiating hyphae in parathecium; spores with thickened end walls. Thallus gray green, verruculose-areolate, on surface of substrate, with small pseudocyphellae and isidia (58-72 um diam., to 150 um long); no prothallus. Apothecia sessile, round, flat to convex, 0.3-1.0 mm diam.; disk dark brown to red-brown or black; thalloid margin often excluded; proper margin red brown to dark

brown. Epihymenium dark golden brown; hymenium 72-87 μm ; paraphyses not swollen, abundantly branched; hypothecium without paraplectenchymatous cells; proper exciple with irregular cells or thick walled hyphae; parathecium with radiating hyphae; amphithecium without algae. Asci with 8 spores; spores 1-septate, end walls thickened, 14-15.5(-17) x 7-8.5 μm , isthmus 4-5.5 μm . Epihymenium K+ brown (or occasionally red brown) becoming purple without abundant solution; thallus K-. One identified substance (7-8 A, pale orange, UV+ light yellow after charring). On bark. Louisiana, Texas, Baja California. C. neotropica Wetm.

4. Thallus without pseudocyphellae and isidia.5

5. Epihymenium brown, K+ strong red turning purple with colored solution; prothallus absent; apothecia 0.3-1.0 mm; spores with thick end walls.

Thallus scanty, inconspicuous, wide-spreading, immersed to superficial, continuous, smooth to uneven or warted, \pm rimose-cracked, becoming areolate at margin; areoles low, with amorphous necral layer on upper surface, gray-green or pale (to dark) gray; prothallus absent (or pale or inconspicuous). Apothecia 0.3-1 mm wide, scattered to crowded-contiguous, rounded or \pm flexuose, sessile; discs black, with a dirty red-brown to olive-brown tinge, \pm concolorous, the pigmentation variable, often darker towards the center of the discs and sometimes with a reddish tinge, especially towards the exciple, dirty red-brown to olive-brown or black, flat, becoming convex when mature; proper margin concolorous with disk or slightly orange, at first thick, flush to slightly raised, then excluded; thin thalline margin present on juvenile apothecia but soon disappearing. Epihymenium patchily yellowish brown to brown. Epihymenium and outer margin K+ red-violet turning purple with abundant colored solution. Usually no algae in amphithecium. Hymenium 58-90 μm ; hypothecium with indefinite or no paraplectenchymatous cells; exciple with thick walled hyphae; parathecium with radiating thick walled hyphae. Paraphyses abundantly branching at tips, thickened to 3 μm toward tips. Spores ellipsoid, with thickened end walls, (9-)12.5-17 x (5-)7-10 μm , sometimes non-septate; septum (3-)4-7 μm , 1/5-1/3 length of spore. Thallus K-. Parietin, emodin, fallacinol, fallacinal. On acidic wood and bark (conifers and hardwoods), widely distributed in eastern U.S. except SE coastal plain; Mexico; report from Washington state is presumably erroneous. Common. C. pollinii (Massal.) Jatta

5. Epihymenium gray, K+ weak purple with no solution; black prothallus present; apothecia 0.2-0.4 mm; spores with thin end walls. Thallus thin, continuous, smooth (rough and becoming chinky, according to Fink), greenish gray to ashy, limited and often intersected \pm by black hypothallus. Apothecia 0.15-0.45 mm across, adnate; disc flat, dark brown to black; proper exciple thick, entire, slightly raised, gray to dark gray; no thalline margin. Epihymenium without granules, occasionally brown. Hymenium 58-87 μm ; no pseudoparenchymatous cells in hypothecium; thick walled cells in proper exciple; indefinite cells in parathecium; algae in lower amphithecium and sometimes in upper amphithecium. Paraphyses with (0-)1-2 swollen cells, few to some branching. Spores ellipsoid, 10-14(-16) x (5-)5.5-7(-7.5) μm ; isthmus (4-)5.5-7(-8.5) μm , with thin end walls. Outer margin K+ weak purple (without solution). Thallus K-. No substances. On bark or wood, Florida to Texas. C. floridana (Tuck.) Tucker

6. Epihymenium K+ yellow (rarely becoming K+ fleeting red-violet); apothecia similar to those of Lecanora subfusca group. Thallus thin, continuous, smooth to verruculose-areolate, cracked, greenish gray (to ashy white according to Fink); cortex

with small granules that persist in K. Apothecia 0.2-1.2 mm diam., sessile; disc flat to convex, brown (reddish brown and blackening according to Fink), sometimes slightly yellowish pruinose; thalline exciple thin, flus (sometimes raised according to Fink), gray like thallus or slightly yellowish (orange according to Fink), entire to crenulate; no inner proper margin. Epihymenium dark golden brown; hymenium 58-72 μm ; paraphyses not swollen or with 1-2 slightly swollen cells, with few branches; hypothecium without paraplectenchymatous cells; proper exciple with thick walled hyphae; parathecium with small oval paraplectenchymatous cells or elongated hyphal cells; algae present in amphithecium. Spores ellipsoid, (10-)14-18(-9.5) x 7-10(-11) μm , with thin end walls; isthmus 4-7 μm . Thallus K-. One unknown (7-8 A, pale orange, UV+ light yellow after charring) and occasionally parietin complex. On bark, Mexico and Texas (to Florida according to Fink). C. diphasia (Tuck.) Wetm.

6. Epihymenium completely K-. 7

7. Parathecium with radiating hyphae. 8

7. Parathecium with large oval cells. 9

8. Disks thinly white-pruinose, tan to brown or black (reddish brown to dark chestnut-brown); apothecia 0.3-1.5 mm. Thallus not sorediate. Thallus thin, continuous, to partly areolate, (smooth to chinky and wrinkled or verrucose according to Fink), green-gray (pale to sordid whitish, ashy, or brownish gray according to Fink); cortex amorphous; prothallus only present when thallus meets another lichen. Apothecia (0.2-)0.6-1.5 mm diam., generally scattered, sessile; disc flat to slightly convex or uneven; margin usually lighter than disk (concolorous with or slightly darker than thallus), entire or often flexuous, prominent, sometimes becoming excluded; usually no "extra" thalloid margin. Epihymenium light brown to brown. Hymenium 50-80(-85) μm . Hypothecium with irregular cells or no paraplectenchymatous cells; proper exciple with thick walled hyphae; parathecium with radiating hyphae, often with large lumina (but not with oval cells); sometimes with granules (insoluble in K); algae extending high up into upper amphithecium. Paraphyses contiguous, 1.5 μm , wide, slowly thickened to 2.5-3.5 μm at tips, with one to three enlarged cells, usually brown capitate (also in K), somewhat to frequently branched. Spores ellipsoid, 10-14(-16) x (4-)5.5-7(-8) μm ; isthmus (3.5-)4-5.5(-7.5) μm ; locules with thin walls (but apical wall distinctly double, according to ?). Pycnidia uncommon, with dark ostiole; pycnosporos short rods 3 x 0.5 μm . Apothecial tissues and thallus K-. One unknown substance (3A, UV+, light brown). On bark, usually hardwood, sometimes conifers or wood, throughout SE U.S. N to southern New England, Illinois, and Ohio; west of Texas and Oklahoma. The report from Oregon is presumably erroneous. C. camptidia (Tuck.) Zahlbr.

8. Disks epruinose, dark brown to black; apothecia 0.2-0.6 mm. Thallus gray green, thin areolate at margins to more continuous in center, often uneven and thicker in center; no prothallus. Apothecia sessile; only proper margin present, flush or slightly raised, often notched and indented, tan to brown or mottled black. Epihymenium light brown; hymenium 50-60 μm ; hypothecium with irregular paraplectenchymatous cells; thick walled hyphae in proper exciple; parathecium with radiating thick walled hyphae; some algae in upper amphithecium but more abundant below. Paraphyses with 1-2 swollen cells, brown tipped, frequently branched. Spores 10-12.5(-14) x 4-5.5(-7) μm , isthmus

(3-)4-5.5 um. Apothecial tissues and thallus K-. No substances. On conifer and hardwood bark, Minnesota, Missouri, Oklahoma, and Wisconsin. C. brunneola Wetm.

9. Soredia absent; thallus subsquamulose-areolate. Thallus gray brown, the margins of the areoles often slightly uplifted and lobed; no prothallus. Apothecia sessile, flat, 0.5-0.8 mm diam.; disk brown; thalloid margin concolorous with thallus, flush with disk; no proper margin evident. Epihymenium brown; hymenium 60-77 um; indefinite paraplectenchymatous cells in hypothecium; thick walled cells in proper exciple; oval paraplectenchymatous cells in parathecium; few algae in upper amphithecium but more below. Paraphyses with one to two large brown capitate cells, few to many branches. Spores 10-12.5 x 5.5-7 um, isthmus (3.5-)4-5.5 um. Apothecial tissues and thallus K-. No substances. On conifer bark, N & S Dakota, Arizona, Texas, Kentucky. C. dakotensis Wetm.

9. Soredia present; thallus of thin dispersed areoles. Thallus dark gray or dark gray-green, occasionally almost absent; soralia round to slightly irregular, usually crateriform, occasionally all soredia gone leaving open craters; soredia dark gray-green. Apothecia 0.2-0.5(-0.8) mm diam.; disks flat, brown to dark brown; margin same color as disk; rarely with some thalloid margin. Epihymenium brown; hymenium 58-72 um; indefinite paraplectenchymatous cells in hypothecium; thick walled paraplectenchymatous cells in proper exciple; usually oval or elongated paraplectenchymatous cells (to 5.6 um) in parathecium; algae in lower amphithecium and rarely into upper amphithecium. Paraphyses with one to three large tip cells, some tips brown, few to some branching at tips. Spores (9-)10-14 x (5.5-)5.5-7(-8) um, isthmus 4-5.5(-8) um. No pycnidia seen. Apothecial tissues and thallus K-. No substances. On hardwood bark, rarely on conifers or wood; often on dirty or dusty substrates. Widely scattered in temperate N. America, from British Columbia to Oregon and Colorado, east to Missouri, Minnesota, New York, and SE Canada. C. obscurella (J. Lahm ex Körber) Th. Fr.

ADD?:

Thallus ± yellow, K+. Apothecia stipitate; epithecium K- or weakly K+ violet, granules not dissolving; crystals outside apothecial margin; apothecia with thick cortex; spores 11.2-14 x 5.6(-7) um; isthmus (3.5-)4.2-5.6 um. On bark or wood. Baja California. C. sp. 162 (Wetmore preliminary key--this may be C. neotropica, but that species is described as having pseudocyphellae and isidia and sessile apothecia)

Disks black with a citrine yellow tinge, flat; margin thick (ca. 50 um), prominent, black and somewhat shining. Apothecia biatorine to lecideine, scattered, 0.3 mm diam., broadly sessile. Spores 13-18 x 6.5-7 um; septum 2-3 um thick. Thallus endoxyllic, giving a dark gray tinge on wood. Usually on rock. [If apothecia lecanorine and spore septum 3-5.5 um thick, see C. tirolensis and C. cerina, which usually have yellowish discs but may turn almost black in very exposed situations]. (C. exsecuta; Wetmore excludes this species from this group, saying that the disks are apparently orange and K+ red)

Disks initially black with a tinge of yellow, later turning more reddish orange. (see C. phaeocarpella)

Discs black with yellow tinge. Epithecium K+ red. Apothecial margin dark gray like thallus, thick, raised, with some algae; epithecium blue-green; paraphyses brown capitate; spores 12.6-15.4 x 7-8.4 um; isthmus 5.6-7 um. California. C. sp. 127 (Wetmore preliminary key; this would key out near C. atosanguinea, but that species is described as having reddish tinged disks and only a dark brown to blackish, at most scarcely raised proper margin, not a gray thalloid raised one one)

Thallus medium-thick, granular, densely sprinkled over with white granules or coralloid branchlets. Discs dark red to reddish brown. Epihymenium K+ purple or violet. Spores 12-18 x 6-8.5 um. Thallus light greenish gray to whitish, with a dark gray hypothalline border. Apothecia 0.3-1 mm diam., adnate; disk flat to convex; margin moderately thick, concolorous with disk or paler, becoming flexuous, sometimes bordered \pm by a thin thalline margin. Spores ellipsoid. On trees, Texas and New Mexico. (C. wrightii)

**4-F. On bark or wood;
Thallus \pm grayish, K-, or immersed
Apothecia \pm rusty colored, K+ red or purple
(C. ferruginea Group)**

1. Thallus isidiate or sorediate. 2

1. Thallus verrucose-granular or \pm smooth, or immersed. 3

2. Thallus isidiate, without soredia. (see C. herbidella)

2. Thallus isidiate-sorediate. (see C. discolor)

**3. Thallus at least in thicker parts pale yellow or dirty tan-orange, K+ purple or K-.
Hymenium at least in lower part conspicuously inspersed with oil droplets. 4**

3. Thallus usually \pm grayish and K- or immersed, or if yellowish and K+ purple (e.g., C. ferruginea v. subflavens) then hymenium not inspersed.. 5

4. Apothecia becoming convex, margin disappearing. Spore septum 1.2-2.8(-3.5) μ m thick. Thallus effuse, thin, uneven, subareolate to subgranular yellowish to dirty tan-orange (but K- according to Magnusson), spreading on whitish hypothallus. Apothecia frequent, sessile, 0.5-1 mm diam.; discs plane then soon convex, dark red-orange; thalline margin \pm thick then soon depressed or disappearing. Hypothecium to 50 μ m, dark gray from oil drops; Epihymenium C+ dark violet red. Hymenium 70 μ m, inspersed. Paraphyses conglutinate, tips gradually clavate to 2.5-3.5 μ m thick. Spores (11.2-)12.6-14(-17) x (5.6-)6.5-7.5 μ m, the apical wall distinctly double. On bark of hardwoods and conifers, typically at moderate to high elevations, southwestern U.S.; S. Dakota, Utah, New Mexico, Arizona. C. arizonica Magnusson non Rud.

4. Apothecia persistently plane and marginate. Spore septum 5-8 μ m thick. Thallus effuse, widespread, very thin, \pm membranaceous, smooth, continuous or in places interrupted or \pm evanescent, in thicker parts pale yellow, K+ purple; thinner part whitish; matt; without soredia or isidia; hypothallus indistinct. Apothecia numerous, usually scattered, 0.5-0.8(-1) mm diam., rusty red, round or sometimes slightly irregular; margin persistent, thin or moderately thick, entire or occasionally subflexuose, concolorous with disk or slightly paler, with few or no algae; disc plane or finally slightly convex, matt, smooth, epruinose; hypothecium colorless, 90-110 μ m; hymenium 75-85 μ m; epihymenium granular; paraphyses discrete, 1.5-2.5 μ m thick, simple or occasionally branched, not articulated, only slightly swollen (to 3 μ m) at tips; asci clavate, 55-70 x 13 μ m, thick-walled at top; spores 4-8, subbiserial, ellipsoid to broadly ellipsoid, 15-18 x 8-9(-10) μ m; apical wall very thin. On bark of Fraxinus, Nova Scotia. C. fraxinea

5. Thallus of constricted granules. Thallus distinct, pale to white, effuse, thin, minutely granular. Apothecia sessile, \pm frequent, minute; disc rusty red, plane to slightly convex; margin thin, concolorous, faintly prominent, lacking algae; hypothecium pale brownish orange, 20-25 μ m thick; hymenium 50-55 μ m, pale brownish orange; paraphyses conglutinate, scarcely thickened at tips; spores not developed. On oak, N. Carolina. C. quercicola

5. Thallus [mostly?] thin, smooth, or immersed. 6

6. Septum < 3.5 um thick. 7
 6. Septum > 3.5 um thick. 8

7. Apothecia rather bright ferrugineous red. Spores 13-17 x 4-6 um; septum 2.5-3 um (to 5 um according to Ozenda & Clauzade). Exciple I+ bluish. Apothecia numerous to crowded, rounded or angular from mutual pressure, 0.7-0.8(-1.5) mm diam.; disc slightly convex, epruinose, matt, rusty to rusty brown; proper margin thick then thin, shiny, yellow-rusty, entire then crenate; hypothecium hyaline, not plectenchymatous; hymenium 75-80 um; epihymenium granulose; paraphyses coherent, septate, slender, not or slightly thickened at tips; epihymenium K+ rosy; asci narrow, 10-12 um wide, thick-walled at top; spores straight to slightly curved, narrowly oblong, (11-)14-16 x (4-)4.5-5.5(-6) um; isthmus 2.5-3 um; walls thin at tips. Thallus thin and ashy or obsolete. On drift wood, sometimes parasitic on a lecideoid lichen.

Arctic. C. discoidalis

7. Apothecia dark brownish orange. Disk flat, margin persistent; hypothecium 85-100 um, pale. Spores 14.5-16 x 5-6 um; septum 2.5-3 um. Thallus effuse, several cm diam., endoxyllic or with dark gray areoles. Apothecia lecanorine, sessile, numerous, generally scattered, but crowded in central parts of thallus, to 1.2 mm diam.; disc flat to slightly convex; margin thick (to 100 um), initially regular, later carved or folded, initially very prominent, later more level with disc, bright orange, eventually more brownish, always contrasting to the more brown color of the disc, ± shining; lower surface always more yellowish. Usually on rock, occasional on wood.

Arctic. [May not belong in ferruginea group, but was included in the group by Magnusson]. (C. fraudans)

8. Apothecia with few or no algae. Usually on bark; C. ferruginea occasionally on wood. [This is not a great choice, but it's been used by several authors, and I can't think of anything else to use at present]. "Blastenia rubrofusca" may also key out here, if the spore septum is wide. 9

8. Apothecia ± with algae. Usually on wood; some species occasionally on bark. 12

9. Apothecia to 0.4 mm. Hymenium 50-65 um. Paraphyses tips 1.7 um, discrete in K. Spores 12-14 x 6 um; septum 4-5 um. Santa Catalina Island, California. C. catalinae

9. Apothecia 0.5-0.8(-1) mm. Hymenium mostly over 65 um. Spores often over 14 um long; septum often over 5 um. 10

10. Thallus medium-thick, granular, densely sprinkled over with white granules or coralloid branchlets. Discs dark red to reddish brown. Spores 12-18 x 6-8.5 um. Thallus light greenish gray to whitish, with a dark gray hypothalline border. Apothecia 0.3-1 mm diam., adnate; disk flat to convex; margin moderately thick, concolorous with disk or paler, becoming flexuous, sometimes bordered ± by a thin thalline margin. Spores ellipsoid. On trees, Texas and New Mexico. May not belong in ferruginea group. (C. wrightii)

10. Thallus thin or immersed, without white granules or coralloid branchlets. Discs ferrugineous. 11

11. Proper margin thick, raised, often flexuous. Disc dirty orange to red-orange or red-black, ± smooth. Spore septum (4.2-)5.6-7(-8.5) um. Pycnidia present, red. Thallus scarce or gray, chinky areolate to verruculose; spores 15-17 x 8-8.5 um; septum 7-8.5 um; apothecia to 1 mm, often crowded and with thin, protruding, angular margins; paraphyses tips not thickened. Hymenium 65-75 um. A few algae usually present in apothecial margin. Epithecium K+ red. With radiating hyphae in margin, usually with oil. On hardwoods and conifers. Similar to C. crenularia but differing in the entire or ± immersed, usually smooth, whitish gray, rarely darker, thallus. Apothecia 1.0-2.0 mm diam., often with a markedly unevenly flexuose margin. Chem.: emodin, parietin, xanthorin, fallacinal, chloremodin, fragilin. On smooth, well-illuminated bark of often young trees, less common on wood.C. ferruginea

11. Proper margin thin, not raised or flexuous. Disc dirty orange (not reddish or blackening), veru roughened-granular. Spore septum (4-)6(-7.5) um. Pycnidia absent. Thallus whitish gray, thin, scant, ± smooth, sometimes rimose, often containing hyaline, irregularly squarish crystals; hypothallus commonly present, black, marginal and often visible scattered through thallus. Apothecia abundant, ± scattered, adnate, moderately constricted, 0.4-0.7(-0.8) mm wide; disc ± round, plane to slightly convex, matt, quite roughened, dirty orange, brown-orange, ferrugineous, appearing granular orange pruinose; proper margin initially thick and raised but quickly thin, smooth, even, ± shiny, persistent, usually concolorous with disc, sometimes initially partially blackened; without algae (at most a few clumps below hypothecium). Hypothecium hyaline to pale fulvous, inspersed with oil; epithecium orange-brown, granular; paraphyses thin, branched towards tips; hymenium hyaline, 70-80(-95) um; spores 8, ellipsoid, (12-)16-18 x 5.5-7.5(-10) um; isthmus distinct, 4-6 um thick. On bark of deciduous trees and shrubs, especially common on Alnus, Vancouver Island, British Columbia.C. vicaria

12. Apothecia to 0.5 mm diam.; disc brick red to blackish brown (not rusty); margin concolorous or blackish. Spores 5-7(-8.5) um wide; septum 4-6(-8) um. Thallus immersed. 13

12. Apothecia larger, at least the disc rust-red. [Note: C. discoidalis may also key out here; it was not mentioned by Hansen, et al., 1987, in their treatment of Caloplaca in Greenland; need to see if it is mentioned by Sochting, 1989]. 15

13. Apothecia dark ferrugineous when young, usually soon dark brown, soon immarginate. Thallus almost invisible. Apothecia sometimes dense, 0.2-0.4 mm, when young dark rusty with thin concolorous margin, soon brown and slightly convex with excluded margin, or mainly rusty; 0.2 mm thick; exciple indistinct; hypothecium 25-35 um; hymenium 65-70 um; epithecium granular; paraphyses contiguous, upper part gradually widened to 3-3.5 um at tips, sometimes furcate or much branched; asci 40-50 x 12-14 um; spores 8, easily escaping, 12-14 x 6-7 um; septum 5 um; apical wall double. Margin and cortex I+ blue. On old wood or twigs, Arctic (Alaska to Greenland). [Hansen, et al., 1987 suggest this probably belongs under C. phaeocarpella, but they do not formally list it as a synonym]. C. ferrugineofusca

13. Apothecia persistently not very dark reddish brown, or black then reddish orange, long remaining marginate. [Note: C. crenularia, which usually grows on rocks, may occasionally occur on wood, and seems to key out here]. 14

14. Margin of apothecia concolorous with disc or paler. Exciple I+ bluish. Thallus endoxylic, to 1 cm across. Apothecia numerous, scattered to centrally crowded, sessile, to 0.5 mm diam.; disc flat, eventually slightly convex, reddish brown; margin thin (ca. 25 µm), regular or in crowded apothecia irregular from mutual pressure, initially slightly prominent, later \pm excluded and level with disc, concolorous with disc. Spores 12-13(-14.5) x 5-6(-8.5) µm; septum 4-5(-6.5) µm. On various substrates, particularly wood, arctic-boreal. C. caesiorufella (= C. phaeocarpella according to Hansen, et al., 1987, but accepted as distinct by Sochting, 1989)

14. Margin of apothecia darker or more grayish than disc. Exciple I-. Thallus endoxylic, to 5 mm across. Apothecia rarely more than 15 together, rather crowded or scattered, sessile, to 0.5 mm diam.; disc initially slightly concave, later slightly convex, black with an initial tinge of yellow, later turning more reddish orange; margin regular, moderately thick (to 40 µm), initially prominent, later almost level with disc, black, \pm shining. Spores 15.5-17 x 7-8.5 µm; septum 3-8 µm, mostly about 4 µm thick. On wood, bark, and dead leaves, often in somewhat eutrophicated sites. C. phaeocarpella

15. Spores 6.5-8.5(-9) µm wide. Apothecia to 1(-1.5) mm diam., \pm brownish red, ferruginous brown-red to black, concave to plane with coarse surface; margin regular or irregular due to pressure, sometimes flexuous or carved, thick (to 80 µm), persistently prominent; proper margin concolorous with disc or slightly lighter; thalline margin more yellowish, sometimes eventually gray; spores (14.5-)16-17.5 x 6.5-8.5(-9) µm; septum (3.5-)4-6.5 µm; paraphyses \pm free in water, with ends thickened to 3.5 µm. Thallus to 2 cm across, endoxylic or with poorly developed pale gray granules. Apothecia numerous, \pm crowded, broadly sessile. Arctic-alpine, especially on bird-manured wood; also on moss, etc. California; Northwest Territories. C. amniospila (syn.: C. cinnammomea)

15. Spores 5.5-6 µm wide. Apothecia 0.5(-0.7) mm diam. (0.7-1 mm according to Thomson 1997), dark reddish brown, convex. Exciple I-. Thallus scarcely visible, patchy, dark gray, granular. Apothecia often congested or confluent, rusty red then dark reddish brown, plane; margin thin, subconcolorous; disc soon slightly convex and margin depressed, with a few algae. Hypothecium sordid gray, 25-35(-50) µm; hymenium 75-85(-100) µm; paraphyses dense, 1.5-1.7 µm wide, scarcely thickened above; asci narrow; spores 8, oblong, 13-15(-17) x 5.5-6 µm; septum 3.5-4 µm thick. On wood, Arctic. C. spitsbergensis (included under C. amniospila by Sochting, 1989)

ADD:

Apothecia without algae. Thallus K-, glaucous-ashy, matt, areolate; areoles 0.2-0.3 mm wide, thin, variously angular, plane, contiguous, forming irregular crust; hypothecium indistinct. Apothecia red-brown, K+ rosy, sessile, numerous, at first concave then plane, with margin thin, entire, concolorous with disc, then convex and immarginate; hypothecium hyaline; paraphyses free, articulate, rather thick, simple or furcate towards tips, slightly inflated at tips; asci clavate, ca. 70 µm long; spores 9, ellipsoid, 1-septate to polarilocular, 18-20(-23) x 7-11(-13) µm. On bark. New Mexico. [Type probably lost]. "Blastenia rubrofusca B. de Lesd."

Apothecia with algae. Thallus olive-gray, K-, thin, shiny; hypothallus thin, black; forming

patches ca. 1 cm wide. Apothecia red-brown, K+ intense red, numerous, dispersed, 0.2-0.3 mm wide, concave then plane; thalline margin thin, entire; epithecium granular; hypothecium hyaline; paraphyses free, slender, simple or occasionally furcate towards tips, articulate towards tops; asci clavate, ca. 37 μ m long; spores 8, ellipsoid, polarilocular, 14-17 x 7-9 μ m. On bark, Louisiana. [Type probably lost]. C. neonii B. de Lesd.

Apothecia \pm dark, coppery orange to orange-brown; paraphyses branched above; end cells slightly enlarged, 3-5 μ m. spores 13-15 x 7.5-9 μ m. Margin of apo. yellow or orange, contrasting with thallus. Thallus gray or absent, non-sorediate. On conifers, Michigan. [May not belong in C. ferruginea group] C. sp. 5 (Harris)

ADD? (May belong in obscurella group rather than ferruginea group):

Thallus thin, smooth to granulate-areolate, greenish gray to ashy white. Apothecia 0.2-0.8 mm diam., sessile; disc flat to convex, reddish brown and blackening, sometimes greenish pruinose; exciple sometimes raised, orange, entire to crenulate; spores ellipsoid, 10-16 x 8-11 μ m. On trees, Florida to Texas. Blastenia diphasia

**4-G On bark or wood;
Thallus whitish, grayish, blackish, K-, or immersed
Amphithecium whitish to blackish;
discs yellow to orange;
(C. cerina Group)**

1. Spore isthmus very narrow (1.4 um), barely more than a septum. Thallus of dispersed lumps on twigs. Spores 12.6-14 x 4.2-5.6 um. Discs epruinose. On bark, Baja California. C. sp. 137 (Wetmore)

1. Spore isthmus over 2 um. 2

2. Amphithecium dull black; spore septum 2-3 um. Spores 8, ellipsoid, 13-15 x 7-8 um. Thallus a thin dark film or indistinct. Apothecia 0.5-0.6 mm broad; margin thin, entire; disc waxy yellowish to darkening olivaceous yellowish; epithecium yellow, K+ red-purple; hypothecium 30-35 um, grayish; hymenium 70 um, hyaline; paraphyses coherent, septate, the tips capitate to 4-6 um. On conifers; also on humus and Salix in the Arctic. C. pinicola

2. Amphithecium grayish or whitish; spore septum over 4 um. Thallus granular, areolate, or indistinct. 3

3. Apothecial disks with whitish pruina, appearing tan, orange, dirty orange, or pinkish orange. 4

3. Apothecial disks not pruinose (or only slightly, or, in C. ulmorum, and with a waxy yellow appearance). Apothecia with inner margin (or color) like disk and at least some apothecia without outer margin or color like thallus. 5

4. Discs heavily white pruinose, appearing tan. Apothecia densely arranged. Thallus rough, white or light gray. Spores 12.6-14 x 7 um; isthmus 4.2-5.6 um. On bark. Baja California. C. sp. 139 (Wetmore)

4. Discs somewhat pruinose, appearing orange or pinkish orange. 5

5. Apothecia scattered. Thallus indistinct or dark. Spores 12.6-14 x 5.6 um; isthmus 4.2 um. On bark. Baja California. C. sp. 138 (Wetmore)

5. Apothecia dense. Thallus distinct, pale. Spores 15-17 x 8.5 um, isthmus 6-7 um. On bark. California. C. stanfordensis

6. Thallus granular (almost isidiate); gray apothecial margin also lumpy, occasionally disappearing; inner and outer apothecial margins distinctly separate. Spores 11.2-14 x 5.6-7 um; isthmus (2.8-)-4.2-6(-7) um. On wood. Colorado. C. sp. 147 (Wetmore)

6. Thallus not obviously granular, or indistinct. Apothecial disks yellow orange or orange or dirty orange. Indefinite cells under hymenium and in margin (sometimes irregular cells one place but not both). Spores smaller. Apothecial margin thicker, orange or thick and gray. 7

7. Most obvious apothecial margin orange or yellowish like disk. Spore septum mostly under

5.5 um thick. 8

7. Most obvious apothecial margin gray like thallus. Spore septum mostly over 5.5 um thick. Apothecia (mostly?) 0.5-1 mm or more diam. 11

8. Growing in northern or high elevation areas. Apothecia under 0.5 mm diam. Thallus K-. 9

8. Growing in Baja California at low to moderate elevations. Thallus dark and indistinct. Apothecial margin with indistinct cells or elongate radiating hyphae. 10

9. Hymenium ca. 60 um. Discs not becoming olive-blackish. Thallus whitish, thin, smooth to wrinkled, K-. Apothecia dispersed, base narrowed, adnate, 0.2-0.4 mm broad; margin thin, at least at the beginning and towards the inside yellowish, frequently becoming secondarily yellowish gray to grayish olive or dark gray towards the outside; exciple markedly radiate; disk flat to slightly convex, waxy or ochre-yellow or yellow-orange, epruinose; hymenium 60 um; paraphyses with tips not thickened; spores 8 or fewer, broadly ellipsoid, the center often broadened, 11-14 x 6.5-8 um, septum 3.5-5 um. On smooth bark of Alnus, Salix, and Sorbus. Greenland; NW Territories. (C. borealis)

9. Hymenium 30 um. Discs becoming olive-blackish. Apothecial margin usually distinctly yellow, but sometimes much darker than disc, to black; exterior part most often olive. Usually on soil or moss, but occasionally on wood or old antlers. (C. tirolensis)

10. Elongate radiating hyphae in apothecial margin; apothecia slightly pruinose; spores 12.6-14 x 4.2-5.6 um; isthmus 4.2 um. On bark. (see C. sp. 138 of Wetmore, above)

10. Indefinite cells in apothecial margin; apothecia not pruinose; spores 12.6-14 x 4.2-5.6 um; isthmus 4.2-5.6 um. On bark. C. sp. 145 (Wetmore)

11. Discs lightly to heavily pruinose, sometimes (C. ulmorum) giving a waxy yellow appearance. 12

11. Discs epruinose to sometimes strongly white pruinose particularly on young apothecia, but never becoming waxy yellow with pruina. Thallus immersed or thin and dull. Spores 14.5-16(-18) x (5-)6.5-8 um; septum 5.5-6.5 um thick. Apothecia orange to yellow, Thallus sometimes staining substrate light gray, occasionally developing dispersed, bluish gray indistinct areoles. Apothecia lecanorine, scattered, often in elongated groups of about 10, sessile to subsessile, to 0.5(-1.3) mm diam.; disc slightly concave to flat; discs eventually turning dark to almost black when strongly exposed; margin moderately thick, initially prominent, later often excluded, thin and level with disc, light gray to black, depending on a varying degree of pruinosity. On wood or bark of hardwoods and conifers. C. cerina s. lato. 13

12. Paraphyses tips not capitate. Spores 13-15(-18) x (5-)7.5-8.5(-10) um. Thallus rather thick, areolate to granulate- verrucose or squamulose, blue-gray to greenish gray or ashy, shiny, K+ weakly purple. Spores ellipsoid; septum (4.2-)5-7 um; Thallus irregularly spread in small patches. Apothecia 0.2-1.3 mm diam.; sessile; disc concave to flat, roughened; margin ashy whitish (white on top, gray outside), prominent, entire to

subcrenulate or radiately striate. On elms, and rarely on oaks, cedars and other trees. Ohio, Minnesota, Iowa, Kansas. C. ulmorum

12. Paraphyses tips capitate, 4-5 μ m. Spores 15-17 x 8.5 μ m, with a thick apical wall and rounded cells. Thallus thin, rimose-subareolate, subcontinuous; areoles granule-like, 0.1-0.2 mm diam., very irregular, or \pm flattened and uneven; glaucous to pale ashy, forming \pm limited small areas or effuse and wide-spreading; hypothallus pale, indistinct; Apothecia dense, sessile, constricted at base, 0.5-0.7(-1) mm wide, sometimes 2-4 grouped, mostly circular; disc plane, pale dirty orange, slightly white pruinose; margin regular, usually persistent, sometimes partly disappearing in age, thin, pale to whitish. Hymenium 75-85 μ m. Hypothecium 25-35 μ m, grayish. Paraphyses 1.7 μ m, thin-walled; rarely with one short branch near tip. Spore septum 6-7 μ m. On smooth bark of Aesculus, and on Quercus, California. (C. stanfordensis)

13. Thallus granulose to warty, or immersed. Spores oblong-ellipsoid, 5-7 μ m wide.

Apothecia 0.2-0.6 mm diam.; disc orange to brownish orange. Thallus often scattered, becoming inconspicuous or disappearing, thin, ashy gray to yellowish. Apothecia becoming sessile; disc slightly concave to convex; proper margin thin to moderately thick, yellow to light orange; thalline margin thin, finally disappearing. Spores 12-17 x 5-7 μ m. On trees, Massachusetts, Illinois, N.Dakota, Washington, California. C. cerina f. gilva

13. Thallus smooth and chinky to subareolate, or immersed. Spores ellipsoid, 5-10 μ m wide. Apothecia to 1.3 mm diam. (but often much less); disc lemon yellow (to reddish, greenish, or brownish, or blackening). Thallus thin, ashy to lead gray, brownish or whitish, becoming irregular and widespread, rarely disappearing. Apothecia 0.2-1.3 mm diam.; margin concolorous with disc or thallus, sometimes raised, entire or becoming wavy. Spores 8-18 x 5-10 μ m. On rocks, trees, and rarely old wood [also on soil or moss if C. stillicidiorum is included; that taxon differs in having pruinose discs]. "Throughout the United States." C. cerina f. cerina

ADD (somewhere under couplet 12):

Inner part of apothecial margin yellowish orange like disk. Thallus cortex K-; spores 12.6-14 x 5.6-7 μ m; isthmus 4.2-7 μ m. On bark, western U.S. C. sp. 133 (cf. cerina) (Wetmore)

No yellowish inner apothecial margin. Thallus cortex K+ purple. Spores (11.2-)12.6-14 x 5.6-7 μ m; isthmus (4.2-)5.6-7 μ m. On bark. C. sp. 132 (cf. cerina) (Wetmore)

**4-H. On bark or wood;
Thallus poorly developed, ± grayish, K-, or immersed
Apothecia Yellow to Orange or Red
(C. pyracea Group)**

1. Spores 16-22 x 9-12 um. Disk orange. Spore septum over 4 um. Thallus present only in spots, thin, effuse, whitish, smooth. Apothecia dispersed, to 0.7-1 mm diam. when mature; disc orange, plane to slightly convex; margin ± citrine yellow, then pale reddish yellow, paler laterally and below, thin; proper and thalline margins both distinct. Hymenium 85 um. Paraphyses rather distinct in water, 1.5-1.7 um; tips scarcely widened, to 2.5-3 um. On bark. Coastal California to British Columbia, inland to Idaho. C. oregona

1. Spores under 17(-18) um long. 2

2. Spore septum under 3.5 um. 3

2. Spore septum over 3.5 um. [If apothecia orange, algae abundant in margin, spores 9.8-11.2(14) x 5.6-7 um, isthmus 3.5-5.6 um, on bark and wood, see C. sp. 153 of Wetmore, which he tentatively identifies as either C. holocarpa or C. luteoalba). 7

3. Spore septum ca. 1 um thick, ca. 1/8 length of spore. Thallus crustose, wide-spreading, gray-white, thin, continuous, uneven, ecorticate, developing a characteristic waxy pruinose "tomentum" of crystals in the herbarium; prothallus pale or absent. Apothecia 0.3-0.5(-0.8) mm diam., numerous, crowded, often ± contiguous, rounded, immersed then ± superficial; thalline margin undeveloped, or sometimes thinly enveloping sides of young apothecia; true margin orange, ± excluded; disc bright orange, deeply concave then flat to ± convex. Paraphyses lax; apical cell often swollen, to 5 um. Spores 8-12 x 3-6 um, ellipsoid; Pycnidia orange-red, ± emergent; conidia 3-4 x 1 um, straight. Thallus K-. On bark (usually Ulmus, rarely Acer), especially in wound tracks of injured, old trunks in parklands. [If disks red-orange, thallus obvious and gray, and growing on wood in California, see C. sp. 152 of Wetmore) C. luteoalba [sensu Laundon, 1992]

3. Spore septum 1.5 um or more. 4

4. Apothecia 0.7-1.5(-2) mm. Thallus pale citrine yellow, effuse, thin, verrucose, soon covered by apothecia. Spores 12-13(-14) x (4.5-)5-5.5(-6) um, oblong; septum 3-3.5 um (ca. 1/4 length of spores). Spore isthmus distinct; apical wall thin but double. Apothecia becoming crowded upon large areas; disc orange, plane or slightly convex, often irregular by pressure; margin thick, slightly paler than disc, at first prominent, somewhat crenulate, then ± depressed below the ± distinct proper margin. Apothecia 0.4-0.5 mm thick, the pale part about 250 um deep; algal layer 70-100 um, horizontal, partly not continuous, the surface very undulating; medulla below it lax, easily bursting. Cortex only at base, 40-60 um thick; in K the hyphae ± parallel, 3-3.5 um; I+ pale grayish violet blue. Exciple laterally 35 um with dense hyphae, at base diffuse with intricate, gelatinous hyphae, at edge widened to 100(-150) um, refracting; exterior 35 um sordid dark yellow, hyphae there rarely branched, lumina ca. 1 um; whole exciple I-. Hypothecium 70-100 um, pale gray, I+ pale blue; hyphae densely intricate, 2.5(-3) um. Hymenium 70 um; upper 20 um greenish yellow. Paraphyses discrete in K, 1.5 um thick; tips colorless, 3-3.5 um, irregularly clavate and ± constrictedly septate. Spores 8 per ascus. On bark. Coastal

California. [also see C. arizonica Magnusson].C. californica

4. Apothecia mostly under 1 mm diam. Thallus grayish or immersed. [If disks light orange, thallus absent, apothecia to 1 mm diam., spores 9.8-11.2 x 5.6-7 um, isthmus 1.4-2.8 um, and growing on bark, see C. sp. 154 ("C. luteoalba", pr. p.), of Wetmore] 5

5. Spores 14.5-16 x 5-6 um; septum 2.5-3 um. On wood. Discs dark brownish orange. Thallus effuse, several cm diam., endoxylic or with dark gray areoles. Apothecia to 1.2 mm diam.

Usually on rock, occasional on wood. Arctic. (C. fraudans)

5. Spores mostly under 13 um long. Apothecia smaller. 6

6. Discs pale or dirty orange. Apothecia 0.2-0.4 mm diam., Spore septum 2.5-3.5(-6?) um. Spores 8-9.5(-13?) x 5.5-7(-8?) um. Thallus immersed. Apothecia single or in small groups, distinctly constricted sessile; margin level with disc, distinct, later indistinct, containing algae; disc pale or dirty orange. Hymenium ca. 60 um. Paraphyses tips clavate-capitate, to ca. 5 um wide; epihymenium moderately granular. Spores to 8 or fewer, broadly ellipsoid. On bark or wood of conifers and hardwoods, especially common on Populus tremuloides in the northern states and provinces. C. pyracea coll.

6. Disc dark orange. Apothecia 0.3-0.7 mm diam. Spore septum 1.5-3.0 um. Thallus mostly immersed, sometimes small, pale orange verrucae visible between apothecia (probably apothecial initials). Apothecia dense, sessile; disc plane to slightly convex, dark orange; margin concolorous with disc, persistent, often slightly crenulate. Cortex 25-30 um thick, almost to the edge, \pm sordid yellow, cells rounded, 2-4 um wide or \pm lengthened. Exciple 8-10 um broad laterally, or \pm indistinct. Epithecium orange-granular; hymenium ca. 60-70 um high; hypothecium hyaline, ca. 30-40 um (100 um according to Rudolph); algal layer below, continuous, ca. 50 um thick, up into the margin; paraphyses discrete in K, ca. 1.5 um diam., branching above asci, tips twice clavate or the uppermost cell globose, 4-5 um, encrusted. Asci clavate-cylindrical, 41.8-45.2 x 10.4-11.3 um. Spores 8, biseriate, narrowly ellipsoid, 11.3-13.1(-15) x 5.2-6.1 um; On pine bark, northern Arizona.C. durietzii

7. On bark. 8

7. On wood. 12

8. Apothecia margin pale to whitish. Spores 15-17 x 8.5 um, septum 6-7 um.

Thallus glaucous to pale ashy, rimose-subareolate, thin, subcontinuous, uneven, forming \pm limited small areas or effuse and wide-spreading; hypothallus pale, indistinct; areoles granule-like, 0.1-0.2 mm diam., very irregular, or \pm flattened and uneven. Apothecia dense, sessile, constricted at base, 0.5-0.7(-1) mm wide, sometimes 2-4 grouped, mostly circular; disc plane, pale dirty orange, slightly white pruinose; margin regular, usually persistent, sometimes partly disappearing in age, thin, pale to whitish. Hymenium 75-85 um. Hypothecium 25-35 um, grayish. Paraphyses 1.7 um, thin-walled; rarely with one short branch near tip; tips capitate, 4-5 um. On smooth bark of Aesculus, and on Quercus, California. May not belong in C. pyracea group [if the margin is never orange or yellow]. (C. stanfordensis)

8. Apothecia margin yellow or orange, at most slightly grayish towards

outside. 9

9. Spores 14-18 x 6-10 um, ellipsoid; septum 5-9 um wide (to 1/2 length of spores). Thallus pale yellowish to whitish with yellow spots, or yellowish green, Apothecia to 3.0 mm diam.

On bark. (*C. flavorubescens*)

9. Spores smaller, septum thinner. Thallus grayish and immersed. Apothecia smaller. 10

10. Spores 11-14 x 6.5-8 um; septum 3.5-5 um. Thallus scarcely epiphyloidal, smooth to rugose-warty, whitish, K-. Apothecia 0.2-0.4 mm diam.; Apothecia constricted but closely and broadly sessile, numerous but mostly scattered, discs plane to slightly convex, waxy- to ochre yellow or yellow-orange, epruinose; margin thin, at least at the beginning prominent, concolorous or frequently becoming secondarily yellowish gray to grayish olive or dark gray towards the outside. Apothecia at the base lecanorine; parathecium strongly confluent, on the margin strongly "fächerig verbreitert" (translates as "loculate-broadened", which doesn't make sense to me). Hymenium ca. 60 um. Paraphyses coarse, towards the end uniformly but slightly widened, often indistinct. Spores to 8 or fewer, broadly ellipsoid, often swollen in the middle. On smooth bark of *Alnus*, *Salix*, and *Sorbus*. Greenland. *C. borealis*

10. Spores 8-9.5(-13?) x 5.5-7(-8?) um, septum 2.5-3.5(-6?) um. Thallus immersed. Apothecia single or in small groups, 0.2-0.4 mm diam., distinctly constricted sessile; margin level with disc, distinct, later indistinct, containing algae; disc pale or dirty orange. Hymenium ca. 60 um. Paraphyses tips clavate-capitate, to ca. 5 um wide; epihymenium moderately granular. Spores to 8 or fewer, broadly ellipsoid. On bark or wood of conifers and hardwoods, especially common on *Populus tremuloides* in the northern states and provinces. *C. pyracea* coll. [Most recent authors lump the next two taxa, but one recent report suggests they are separate; I need to see that to find out what the differences are supposed to be. 11

11. *C. pyracea*

11. *C. holocarpa*

12. Disc yellow with a ± olive tinge, which intensifies with age and exposure, sometimes very dark to almost black. Thallus immersed. Spores 13-18 x 8-9 um; septum 3-5.5 um thick. Usually on soil or moss, occasionally on wood or old antlers. (*C. tirolensis*)

12. Disc orange, without olive tinge, never dark. 13

13. Thallus epixylic. Spores 12-13 um long; septum 3.5-5 um thick. On strongly eutrophicated substrates (usually on rock, occasionally on wood), not far from the sea. (*C. alcarum*)

13. Thallus immersed. Spores often under 10 um long; septum often under 3.5 um thick. On wood of conifers and hardwoods; also on rock. (*C. pyracea* coll.)

ADD?:

Apothecia light orange. Thallus ashy gray to brownish ashy or darker, K-. On bark. C. atrosanguinea v. armeniaca Rud. ined.

Apothecia \pm dark, coppery orange to orange-brown; paraphyses branched above; end cells slightly enlarged, 3-5 μ m. spores 13-15 x 7.5-9 μ m. Margin of apo. yellow or orange, contrasting with thallus. Thallus gray or absent, non-sorediate. On conifers, Michigan. [May not belong in C. pyracea group]. C. sp. 5 (Harris)

ADD:

Caloplaca xanthostigmoidea (Rasanen) Zahlbr.

[Description below will need to be copied also into the saxicolous and terricolous keys, and adjusted accordingly]

THALLUS crustose, effuse, forming \pm circular patches up to a few cm in diam., typically areolate and episubstratal, but corticolous specimens sometimes with a non-pigmented, endosubstratal thallus between the areoles. A bluish black hypothallus sometimes present.

Areoles in corticolous specimens initiated below the uppermost cell-layers of the bark surface. They are initially flat and pale yellowish, later becoming convex and orange and with irregular, subcoralloid, conspicuous protuberances that are mostly \pm fastened and isidioid or sometimes becoming \pm loose. On bark the areoles have protuberances up to c. 1 mm diam., discrete or sometimes confluent, but rarely covering major parts of thallus surface.

On detritus and rock the thallus is more confluent and irregular, mostly pale gray or yellow, and the protuberances tend to be less prominent and formed in irregular, eroded areas on the central part of the thallus. The eroded areas are almost invariably speckled by dispersed greenish olive spots.

Areoles with isidioid protuberances up to 360 μ m high; protuberances irregular, composed mostly of aggregations of spherical, soredia-like elements, the latter 15-40 μ m diam. with an outer wall one cell-layer thick surrounding algal cells up to 20 μ m diam., and some hyphae; wall heavily incrustated with yellow to orange anthraquinone crystals, or in the olive parts with an olive green pigment in the fungal walls, that reacts K-. The aggregations are very similar to consoredia, being composed of globose, soredia-like elements, except that they seem to be fastened at the base. In squash preparations the protuberances may easily disintegrate forming consoredia-like or soredia-like elements.

APOTHECIA sometimes present on corticolous and lignicolous specimens, biatorine or lecanorine, dispersed, 0.5-1 mm diam.; disc plane to slightly convex, deep orange; excipulum thick, to 140 μ m, initially very prominent and often remaining so, concolorous or sometimes lighter orange than disc, somewhat shining; **excipulum** with few or no algae, consisting of prosoplectenchymatous tissue of interwoven hyphae that become radiating and perpendicular towards the surface, with plenty of oil droplets; no delimited cortex, but in the outer c. 30 μ m the hyphal tips are interspersed with fine anthraquinone granules. On top of this is located a transparent matrix that becomes thicker towards the lower side of the excipulum. **Hymenium** 60-110 μ m, with many oil droplets; paraphyses 1.5 μ m thick, slightly branched and with only slightly inflated apices; **asci** normally with < 8 spores; spore size variable depending on number in asci, 16-20 x 10-13 μ m, often poorly developed or deformed; septum 7-10 μ m thick.

PYCNIDIA occasionally present, 0.1 mm diam., deep orange; conidia bacilliform, 3-4 x c. 1.3 μ m.

CHEMISTRY: Anthraquinones: emodin, 7-chloroemodin, parietin, fragilin.

ECOLOGY AND DISTRIBUTION: On bark in cool, usually humid, forests in Canada (British Columbia, New Brunswick), and on driftwood in northern Alaska. Material on calcareous rocks and dead mosses or soil in crevices of such rocks is known from Eurasia.

NOTES:

Detailed Descriptions

Caloplaca fraudans (Th. Fr.) Olivier

Thallus to 3 cm broad, various shades of gray, matt, K-, poorly developed or verrucose, uneven to rugulose, mostly discontinuous, to 1.0 mm thick, sometimes as small cushions covered with aggregate apothecia; prothallus absent; cortex poorly developed, consisting of rather loosely arranged \pm isodiametric cells, covered by a 25-50 μ m thick, amorphous epinecral layer.

Apothecia 0.4-2.0 mm diam., round to irregular, sessile to raised, zeorine, always present and numerous, separate to frequently strongly aggregate and crowded; disks \pm plane to strongly convex, sienna to rusty or dark brownish red, often umbonate (central formation of sterile hyphae through the hymenium, seen as a wart on the disk); proper margin initially thick, raised above disk, bright yellow to reddish orange, clearly lighter than disk, with age thinner, more level, and concolorous with disk, 25-125 μ m thick, matt to shiny, consisting of radiating, thick-walled, tightly packed hyphae; thalline margin mostly excluded, sometimes present and to 50 μ m thick, gray; hymenium 60-100 μ m high, hyaline or pale ferruginous; hypothecium 75-130 μ m, hyaline; paraphyses simple or occasionally branched twice, the tips to 3 μ m broad; asci cylindrical, 35-45 x 10-14 μ m; spores 8, polaribilocular, 9.5-13.5 x 4.0-6.5 μ m; septum 2.5-4.5 μ m.

Pycnidia not seen.

Parietin and parietinic acid as major pigment, and small amounts of emodin and teloschistin.

On wood, or on spruce twigs, on or near the seashore, Maine, Newfoundland, Nova Scotia.