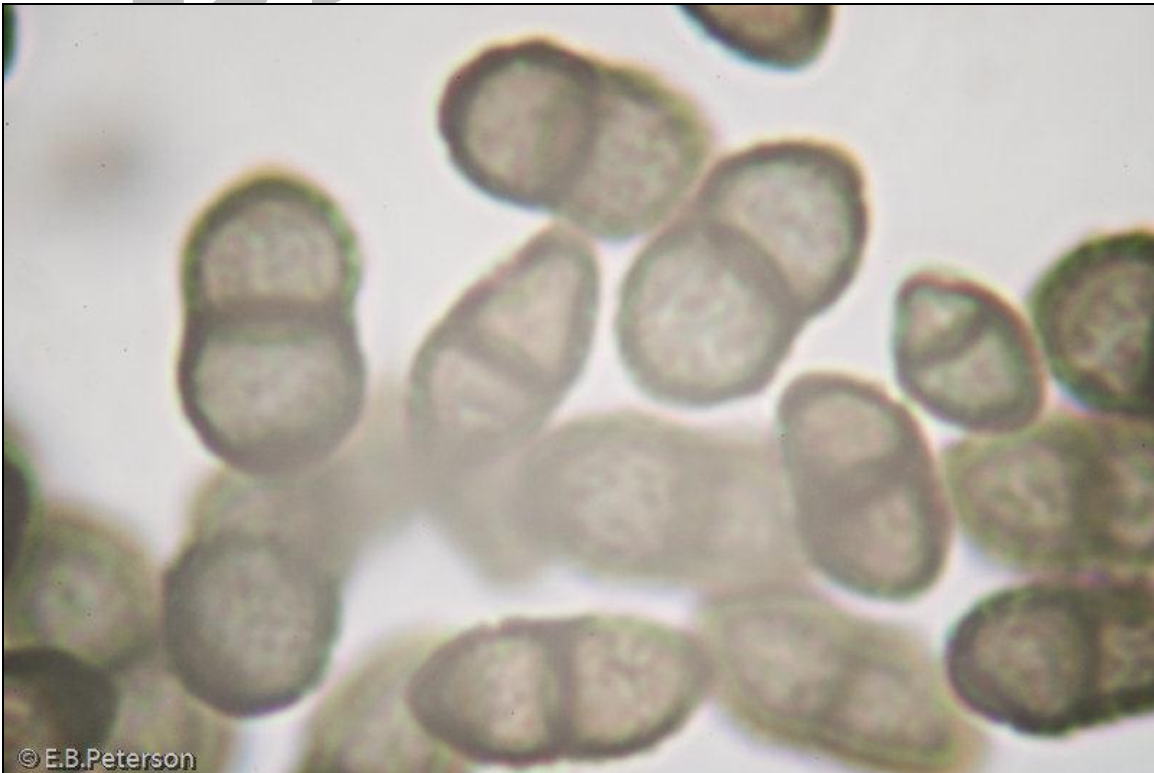

KEY OF CALICIOID LICHENS AND FUNGI
FOR GENERA WITH MEMBERS IN
TEMPERATE WESTERN NORTH AMERICA
DRAFT: 2012-03-11

by E. B. Peterson



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Calicium abietinum, EBP#4640, 1000x

Version Note:

I wrote much of these keys in the late 1990s and continued to make some updates into 2003. Yet even by '03, I was starting to miss some of the newly described species. Life took me to the Great Basin, with many wonderful and remote areas, but rather sparse for Calicioids. The UNR library lacked many mycological resources and my work took my focus away from Calicioids further. Now, having moved back to northern California with its rich Calicioid flora, and with kids becoming more independent, I am reviving my work on calicioids. Work still keeps me distracted with other topics, but work isn't everything.

This draft version of my keys is just the barest beginning toward catching up. It should be used in conjunction with my checklist, which indicates names that are not yet included in the keys (preceded with *). Many things are yet lacking, with numerous newly described species from around the world (particularly Asia), which may eventually turn up in the Pacific Northwest. But I have added at least the few that are known to be relevant to this region, such as *Calicium sequoiae* and *Chaenotheca nitidula*.

Introduction

The following keys have been written or modified by Eric B. Peterson. Their purpose is to include all taxa that are in use in contemporary literature (roughly since the mid 1960's). This is an on-going project; the keys are not meant to serve as final word on the determination of a specimen or to be considered formal publication. I recommend that all determinations be followed up by consulting published taxonomic works or verification by an expert in Caliciales taxonomy.

In most sections, species occurring in the 6th checklist for North America are underlined. Species verified by Peterson or Rikkinen for the Pacific Northwest (Oregon, Washington, + the Klamath region of Northern California) are double underlined.

Although the old Caliciales is an invalid phylogenetic group, most taxa that formed the group important characters that unite them ecologically. Most have stalked ascomata with loose spores remaining at the top (either a mazaedium or spores piling up after active, but weak discharge). This structure suggests similar spore dispersal mechanisms. Also most taxa from the Caliciales occur in one of two specific types of habitats: (A) on twigs, usually with very strong host specificity, and (B) in sheltered sites on old wood or bark. Some of the remaining genera utilize both habitats. For example in the lichenized genus *Calicium*, *C. adaequatum* inhabits twigs of a selection of hardwood trees and shrubs, while other species in the genus inhabit sheltered sites, particularly on old wood or bark; similarly in the Mycocaliciaceae, *Stenocybe pulatula* inhabits twigs of the hardwood genus *Alnus*, while *Stenocybe clavata* inhabits old bark on conifers. Thus the old group may be retained by ecologists as a functional group, the 'calicioids'.

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1. Key to Genera

- 1a. Ascomata with a distinct stalk...
- 2a. Spore mass brown, orange, or pale and often yellowish...
- 3a. Spore mass brown or pale and often yellowish
- 4a. Saprophytic on resin, non-lichenized... *Brucae castoris*
- 4b. Lichenized, spore mass distinctly brown... *Chaenotheca*
- 4c. Lichenized, spore mass distinctly pale, often combined with a white or yellow pruina... *Sclerophora*
- 3b. Spore mass orange, stalk and excipulum with hyaline hairs, up to 0.3 mm tall, with a greenish reaction in KOH... "*Cryptocalicium*" gen. nov.
- 2b. Spore mass black or dark greenish, sometimes dusted with pruina...
- 5a. Stalks very thick, generally thicker than the capitulum (head), whitish, up to 1 cm tall... *Tholurna dissimilis*
- 5b. Stalks narrower than the capitulum, not very thick, generally shorter and not so pale...
- 6a. Forming a true mazaedium of loose spores from the premature disintegration of asci..
- 7a. Spore mass with a peculiar greenish color, spores narrow with parallel sides, abruptly rounded, with a strong spiral ornamentation...
Microcalicium
- 7b. Spore mass without a peculiar greenish color, or if so, then spore sides not parallel
- 8a. Excipulum with a tightly constricted margin, spores non-septate or if septate then with a thin wall and lacking clear ornamentation...
Sphinctrina
- 8b. Excipulum generally not with a tightly constricted margin, spores always septate and with a thick wall that usually shows distinct ornamentation at maturity... *Calicium*
- 6b. Non-mazaediate (spores remaining in the asci until mature)...
- 9a. Spores regularly multiseptate and capitulum not flattened... *Stenocybe*
[this is an older concept of *Stenocybe*, several *Phaeocalicium* key here, but are distinguished in the genus key]
- 9b. Spores non-septate, or with a single septum (occasionally more in some *Phaeocalicium*), or regularly multiseptate and with a flattened capitulum...
- 10a. Mature spores more or less pale as seen in a compound microscope... *Chaenothecopsis*
- 10b. Mature spores with a heavy brown pigmentation as seen in a compound microscope...
- 11a. Mature spores with rounded ends, typically > 10 micrometers long, growing mainly on branches... *Phaeocalicium*
- 11b. Mature spores allantoid (with pointed ends), typically < 10 micrometers long, growing mainly on tree trunks...

- 12a. Ascus tip lacking an apical canal (try a cytoplasmic stain, such as cotton blue)... *Mycocalicium*
- 12b. Ascus tip with an apical canal... *Chaenothecopsis*
- 1b. Ascomata sessile to immersed...
 - 13 . Spore mass with a peculiar greenish color...
 - 14a. On bark or wood... *Microcalicium*
 - 14b. On soil... *Texosporium sancti-jacobii*
 - 13b. Spore mass without a peculiar greenish color...
 - 15a. Rim of excipulum tightly constricted... *Sphinctrina*
 - 15b. Rim of excipulum not tightly constricted...
 - 16a. Thallus dactyliform with a yellow to orange medulla... *Acroscyphus sphaerophoroides*
 - 16b. Thallus crustose, medulla not yellow to orange...
 - 17a. Rim of ascomata (excipulum) clearly visible above the thallus surface... *Cyphelium*
 - 17b. Rim of ascomata (excipulum) sunken deeply into the thallus, not visible above the surface or barely visible...
 - 18a. Thallus intensely yellow... *Cyphelium*
 - 18b. Thallus not intensely yellow... *Thelomma*

2. *Acroscyphus*

Monotypic: *Acroscyphus sphaerophoroides*

3. *Brucea*

Monotypic: *Brucea castoris*

4. *Calicium*

Key to all species with descriptions readily available in the literature. \$ indicates species possessing spores with a spiral ornamentation, # indicates some other ornamentation or smooth.

Written by Eric B. Peterson, last updated 3/23/99.

- 1a. Found growing on rock..... *corynellum* \$
 1b. Found on woody plant...
- 2a. Stalks not or hardly visible in dissecting scope (<0.3mm tall), making apothecium appear essentially sessile...
- 3a. Spores with spirally arranged cracks...
- 4a. Spores 11-14 μm long, apothecia lacking pruina..... *adaequatum* \$
 4b. Spores 6-9 μm long, often with a greenish yellow pruina on young apothecia..... *diploellum* \$
- 3b. Spores smooth or with ornamentation of warts, irregular cracks, or polygonal areas...
- 5a. Thallus superficial, well developed, granular to verrucose, pale grey to greenish..... *montanum* #
 5b. Thallus immersed...
- 6a. Spores 10-12.5 X 5-7.5 μm , ornamentation of coarse irregular cracks..... *victorianum* ssp. *victorianum* #
 6b. Spores 13.5-17.5 X 7-8.5 μm , ornamentation of small warts or polygonal areas..... *victorianum* ssp. *desidiosum* #
- 2b. Stalks greater...
- 7a. Stalk with a yellow pruina...
- 8a. Thallus K-..... *trabinellum* #
 8b. Thallus K+Y to R...

- 9a. Thallus superficial and pale yellowish green.....chlorosporum \$
 9b. Thallus superficial or immersed, but gray...
- 10a. Thallus thick, apothecia short-stout, spores
 12-14.5 X 5.5-6.5 μmadpersum ssp. adpersum \$
 10b. Thallus thin to immersed, apothecia tall, sp.
 9.5-11.5 X 4-5 μmadpersum ssp. australe \$
- 7b. Stalk with a white pruina, or pruina lacking (excipulum may
 have a brown color)...
- 11a. Underside of capitulum brown...
- 12a. Spores spirally ornamented, thallus superficial or immersed,
 straw yellow to beige when visible...
- 13a. Thallus immersed, wood often colored
 grayish green, gen K+Y to R
 (may be weak), UV-.....salicinum (=lichenoides) \$#
 13b. Thallus superficial (weak to thick),
 pale yellowish, K+ or -, UV+...
- 14a. Thallus C+Orange, UV+ orange, pale straw yellow,
 spores 11-14 X 6-7 μmleucochlorum \$
 14b. Thallus C-, UV+ yellow, pale brownish yellow to
 beige, mazaedium often with a yellow pruina,
 spores 10.5-12.5 X 5-6 μmchlorosporum \$
- 12b. Spores without a spiral or striate ornamentation.
- 15a. Thallus distinctly yellowish green (rhizocarpic acid).
 Thallus granular to nearly immersed, UV-, spores not
 spirally ornamented (except rarely seen in immature
 spores), Sp. is more common on E side of Cascades.....viride #
 15b. Thallus white to pale gray-green.
- 16a. Thallus white, stalk I-...
 Xa. On hardwood lignum.....C. salicinum \$#
 Xb. On conifer bark.....C. salicinum ssp. "mccunei" \$#
 16b. Thallus generally pale gray-green,
 stalk I+ blue.....lenticulare #
- 11b. Stalk with white pruina or pruina lacking...
- 17a. Stalk I+ Blue...
- 18a. Stalk pale at base, gen. very short (<<0.6 mm),
 stalk nearly as thick as capitulum, spores spirally
 ornamented.....adaequatum \$
 18b. Stalk evenly black, head much broader than stalk
 (2X or more), gen > 0.6 mm tall, spores ornamented with
 Warts or irregularly cracked.....lenticulare #
 18c. Stalk evenly black, head much broader than stalk
 (2x or more), gen > 0.5 mm tall, spores spirally
 ornamented.....sequoiae \$
- 17b. Stalk I-...

- 19a. Thallus superficial, granular, to nearly immersed, distinctly yellowish green (rhizocarpic acid), more common E side of Cascades. See lead ___.....viride #
- 19b. Thallus otherwise...
- 20a. Thallus gen. immersed, gen. growing on lignum...
- 21a. Most capitula with white pruina on rim of exciple, sp. 9-13 μm long (occasional longer spores), ornamentation of irregular cracks.....glaucellum #
- 21b. Stalks and capitula lacking pruina...
- 22a. Ascomata 0.3-0.4 mm tall.....pinastri #
- 22b. Ascomata gen 0.6 mm or taller...
- 23a. Stalk black, long (0.7-1.3 mm), spores with a slightly cracked surface.....denigratum #
- 23b. Stalk black or dark brown, medium (0.6-0.9 mm), spores 11-15 μm . with a warty surface to minutely cracked areolate.....abietinum #
- 20b. Thallus superficial (may be thin), substrate variable...
- 24a. Thallus superficial, thin and bumpy (verrucose), pale green, gen. with numerous small pale-brown stalks (anamorph?). -----> double check IKI test, make sure reagent is good.
If I+, then.....lenticulare #
- 24b. Thallus and spores otherwise...
- 25a. Thallus C+Orange...
- 26a. Pruina PD+Orange.....tricolor #
- 26b. Pruina PD-...
- 27a. Stalk 0.4-0.9 mm tall, often white pruina on exciple rim, spores 10.5-14 μm , ornamentation of minute cracks.....hyperelloides #
- 27b. Stalk 0.35-0.6 mm tall, epruinose, spores 12.5-15.5 μm , ornamentation of minute warts.robustellum #
- 25b. Thallus C-...
- 28a. Thallus K-
- 29a Spores 5.5-8 X 2.0-3.5.....constrictum #
- 29b Spores 11-15 X 5-9.....isabellinum #
- 28b. Thallus K+Y or R...
- 30a. Asci cylindrical.....quercinum \$
- 30b. Asci obovate to clavate...
- 31a. Spores 13-16 μm long, pruina yellow or lacking.....adpersum ssp. adpersum \$

- 31b. Spores 8–11.5 μm long, pruina yellow, white, or lacking...
- 32a. Thallus thin to immersed, pruina yellow or lacking.....adpersum ssp. **australe** \$
- 32b. Thallus gen. thick, pruina gen. present, white.....parvum #

abietinum: see Tibell 1987. Spore mass in squash dark blue

Calicium adaequatum Pers.

Common Synonyms:

Identification: Lichenized, thallus usually immersed but sometimes very thin verrucose to _____. Ascomata stalked, ___ to ___ mm tall. Excipulum _____. Spores with a distinct spiral ornamentation; ___ X ___ μm ; 2-celled; constricted at the septum.

Substrate and Habitat: Branches and occasionally trunks of various hardwood trees and shrubs (very rarely conifers) where rain is received directly. Hardwoods are generally, but not limited to, the genera Acer, Alnus, Ceanothus, Fraxinus, Populus, Prunus, Quercus, and Rhamnus.

Distribution:

Notes: This is the only species in *Calicium* that grows on twigs where it regularly receives direct rain. This ecology, along with the spore and excipulum structure, and the occasionally pale stalks, suggests that it might be more properly placed in the genus *Tholurna*.

adpersum ssp. adpersum: see Purvis 1992 (I think this subspp.)

adpersum ssp. australe: see Tibell 1987

chlorosporum: see Tibell 1987. UV+ yellow (xanthones)

constrictum: see Tibell 1996

corynellum: see Purvis 1992

denigratum

diploellum: see Purvis 1992

glaucellum: see Tibell 1987, Purvis 1992. Spore mass in squash dark blue

hyperelloides: see Tibell 1987

isabellinum Tibell (1998). Thallus superficial, verrucose, to immersed, ‘fawn to tawny yellow’, K-, C-, KC+pale orange, Pd-, UV-, isousnic acid; stalks .6-.9 mm tall, epruinose or with a faint white pruina, with a hyaline sheath, I-; Asci cylindrical; spores broadly ellipsoidal, 11.5-14.7 X 5.8-8.5, minute polygonal areas, coarse irregular cracks with age; anamorph coelomycetous; pycnidia “0.08 - 0.12 mm” diam. spherical, ostiolate, dark brown; conidia cylindrical, 3 X 1 μm ; on lignum, Chile.

lenticulare: see Tibell 1987

lentigerellum???

leucochlorum

“**mccuneii**”: close to *C. viride* (but lacking pigment and with a different thallus form) and close to *lenticulare* (but I- and thallus distinctly white). May actually be *C. salicinum* on conifers with well developed thallus.

montanum Tibell (1999). Thallus superficial, well developed, granular to verrucose, pale gray to greenish; Apothecia short-stalked (0.32-0.41 mm); excipulum white pruinose; I-; surface of stalk with a hyalin coat; asci cylindrical; spores smooth, becoming irregularly cracked, 9.6-11.4 X 4.8-6.1; thallus K-, C-, KC-, Pd-, divaricatic and 2-O-methyldivaricatic acid; on *Castanea* in ancient woodlands and by fields in mediterranean area, or on lignum of *Quercus* & conifers in open situations, Europe.

parvum Tibell (1975). See also Purvis 1992.

pinastri Tibell (1999). Thallus very thin to immersed, grey or greenish; Apothecia small, 0.33-0.50 mm; epruinose; I-; capitulum obconical to lenticular; 0.14-0.20 mm diam; asci cylindrical, 30-35um; spores smooth becoming irregular cracked, 9.5-13.5 X 5.1-6.4; thallus K-, C-, KC-, Pd-, minute amounts of several unidentified compounds; on flaking bark of *Pinus* and *Picea*, Finland to Germany

quercinum: see Purvis 1992

robustellum: see Tibell 1987

salicinum: see Tibell 1987

subquercinum = *lenticulare* (above)

trabinellum: : see Tibell 1987. Spore mass in squash dark blue???

tricolor: see Tibell 1987

victorianum ssp. victorianum: see Tibell 1987

victorianum ssp. desidiosum: see Tibell 1987

viride: see Tibell 1975, Purvis 1992. Capitulum or brown pruina K+purple on McCune #22546. For an excelent example of stalks with and without the brown pruina, see McCune #21160. Apparently ascie do not fully break down, or mature simultaneously (similar in sp. 1)

[following notes not yet added]

+ preceding citation indicates the paper where the species was described.

- preceding citation indicates a good description but lacking pictures, but many of these descriptions include citations for illustrations.

5. *Chaenotheca*

Key to all species with descriptions readily available in the literature. Many species include references to complete descriptions. A rough key to algal genera is included after the Caliciales keys. Begun with key from Tibell 1984 (*Chaenotheca*) and Middelborg & Mattsson 1987 (*Sclerophora*), otherwise written by Eric B. Peterson, last updated 3/23/99. Still missing: *Coniocybe gracilescens* (a name that may only represent a typo).

Groups

- 1a. Pruina yellowish and/or spore-mass whitish...
 2a. Mature spores ellipsoidal, spore-mass not white.....**Group 1**
 2b. Mature spores spherical, spore-mass either color...
 3a. Spore-mass brown, photobiont various.....**Group 2**
 3b. Spore-mass pale yellow to white, photobiont *Trentepohlia*
 ...*Sclerophora*
- 1b. Pruina white, red, or absent...
 3a. Photobiont Chlorococcales.....**Group 3**
 3b. Photobiont *Stichococcus*.....**Group 4**

Group 1: Pruina yellow, spores ellipsoidal

- 1a. Thallus granular, intensely yellow; spores
 (5.4)-(12.5) X*C. chrysocephala*
- 1b. Thallus not as above...
 2a. Photobiont *Stichococcus* (in southern hemisphere,
 evidently associated with Chlorococcales), thallus
 greenish grey, gen. verrucose;
 spores (4.3) 4.8-7.7 (14.1) X (2.2)-(4.4).*C. chlorella*
- 2b. Photobiont not *Stichococcus*; thallus immersed or superficial,
 olivaceous green, or greyish green...
 3a. Thallus immersed, spores smooth, 5.7-6.9 X 3-4 µm.
*C. citriocephala*
 (see also *olivaceorufa*)
- 3b. Thallus immersed or well developed, olivaceous green or
 grayish green, spores coarsely ornamented, variable in size,
 often septate.....*C. laevigata*

Group 2: Pruina yellow, spores spherical, spore-mass brown

- 1a. Thallus immersed, photobiont *Trentepohlia*.
 2a. Mature spores 5.0-7.6 µm diameter. Spores irregularly
 fissured and with a reddish color.....*C. hispidula*
 2b. Mature spores 2.9-3.5 µm diameter.....*C. olivaceorufa*
- 1b. Thallus immersed or covering the surface of the substrate,
 photobiont not *Trentepohlia*
 3a. Thallus intensely yellow-green and leprose, capitulum and
 oft. stalk covered with yellow-green pruina, photobiont
Stichococcus.

- 4a. apothecia 0.4-1.4 mm tall,
thallus immersed or thin and
inconspicuous.....*C. brachypoda*
- 4b. apothecia 1.6-2.7 mm tall,
thallus visible and obvious...
- Xa. Spores with a minute ornamentation of tiny warts,
difficult to see in a light microscope.....*C. furfuracea*
- Xb. Spores with an irregular, cracked ornamentation.....*C. confusa*
- 3b. Thallus not intensely yellow-green, photobiont various.
- 5a. Photobiont *Stichococcus*, thallus immersed or not, stalk
long and slender.
- 6a. Pruina yellowish green (vulpinic acid), covering the whole
apothecium, spores 2.3-3.7 μm*C. brachypoda*
- 6b. Capitulum with a well developed excipulum, thallus
immersed to very thin. Thallus immersed or very
thin, pruina reddish-yellow to yellow, K-?
(thallus at least), spores 3.8-4.2 μm in
diameter, known only from Slovakia.....*C. servitii*
- 5b. Photobiont Chlorococcales, thallus superficial
- 7a. Thallus usually thick and well developed, olivaceous-
grayish green, apothecia with a stout-middle-sized stalk.
.....*C. phaeocephala*
- 7b. Thallus thin: farinose, leprose, or granular...
- 8a. Spores 5.4-8.7 μm diam. Thallus whitish grey,
covered by minute granules; ascomata with middle-sized
to long stalks; thallus with pseudoplacodiolic
acid.....*C. subroscida*
- 8b. Spores 4.3-5.6 μm diam. Thallus whitish gray or
yellowish or greenish gray, stalk with whitish
protruding tangled hyphae in lower part.....*C. australis*
- Group 3:** pruina lacking or not yellow, photobiont chlorococcales
- 1a. Thallus white to greyish white, often with yellow-red spots
reacting K+ purple red, Capitulum obconical, spores
(4.3)5.6-7.7(9.2) μm , with coarse, irregular fissures at
maturity.....*C. ferruginea*
- 1b. Not as above... (*C. brunneola* group)
- 2a. Asci catenulate...
- 3a. Ascomata tall & slender; excipulum very well developed;
on hardwood lignum, in PNW especially *Acer macrophyllum*;
hyphae at top of stalk distinctly yellow and perfectly
parallel; in PNW typically associated with a hyphomycetous
anamorph.....*C. nitidula*
- 3b. Not as above (may still include many species).....*C. brunneola*

2a. Asci single...

- 3a. Barbatic and obtusic acids in thallus; thallus thin and minutely granular.....*C. sphaerocephala*
[probably in our area; I haven't reviewed my specimens yet]
- 3b. Chemistry otherwise.....*C. hygrophila*

Thallus immersed or, when covering the surface of the substrate, greyish green, without yellow-red spots. Capitulum spherical to lenticular, spores (2.2)3.4-4.6(5.4) μm , smooth to irregularly fissured at maturity.....*C. brunneola*
.....**See conspectus to group variants following key**

Group 4: pruina lacking or not yellow, photobiont *Stichococcus*

1a. Thallus immersed, stalk black throughout

- 2a. Lower side of capitulum and upper part of the stalk covered by a dense, white pruina.....*C. xyloxena*

2b. Pruina, if present, reddish brown or reddish-yellow.

- 3a. Thallus immersed or very thin, pruina reddish-yellow to yellow, K-? (thallus at least), spores 3.8-4.2 μm in diameter, known only from Slovakia.....*C. servitii*

- 3b. Thallus immersed, pruina reddish brown, K+ violet, spores 2.6-3.2.....*C. gracillima*

1b. Thallus thick to thin or minutely granular, but rarely immersed, stalk variable, lower side of capitulum with or without a white pruina

- 4a. Stalk pale at base and rather stout, 6-10 times as high as the diameter of the stalk, stalk and capitulum with a dense white pruina.....*C. cinerea*

4b. Stalk dark and slender, 13-24 times as high as the diameter of the stalk...

- 5a. Thallus thin or usually rather thick, verrucose to squamulose, greenish grey. Lower side of capitulum usually with a faint, white pruina, excipulum well developed; spores 3.8-6.5 μm , smooth to ornamented with narrow irregular cracks.....*C. trichialis*

5b. Thallus thin, farinose.

- 6a. Pruina reddish brown or lacking. Capitulum lacking an excipulum, thallus minutely granular to farinaceous, rarely immersed, greenish-grey, spores spherical to somewhat square, algae often a mix of *Stichococcus* and chlorococcales.....*C. deludens*
[few possible specimens for PNW found by Eric & Jouko]

6b. Pruina present, white to pale brown.

- 7a. Thallus thin, farinose, light greenish to bluish green. Lower side of capitulum with a whitish hyphal web, which often has a brownish tinge, excipulum well developed. Mazaedium brown; spores 3.3-6.5 μm , smooth to irregularly cracked.....*C. stemonea*
- 7b. Thallus farinaceous, greyish green, pruina white (often dirty-white), faint and clumpy, K-, excipulum weakly developed, Mazaedium pale brown.....*C. gracilenta*

Taxa included:

***C. australis* Tibell** (1998). Thallus superficial, whitish grey to pale yellowish or greenish gray, minutely granular (0.02-0.04 mm diam), thin to slightly thicker and leprose, often covered with tiny colorless crystals protruding from the surface; photobiont Trebouxioid; apothecia variable in size, gen 0.9 - 1.3 mm high; stalk 0.06-0.10 mm diam, black, with tangles of hyaline hyphae protruding above the surface with a dense greenish yellow crystalline pruina in the upper part (oft white in the lower part from the protruding hyphae); capitulum lenticular 0.17-0.26 mm diam with well developed excipulum, yellow pruinose; asci single, cylindrical, with well developed stalks; spores globose 4.3-5.6 μm in diam, orn of irregular, polygonal areas delineated by irregular cracks; thallus K-, C-, KC+ yellow, Pd-, with bourgeanic and usnic acids; pruina with vulpinic acid; on bark and decorticated stump, *Nothofagus*, Argentina & Chile.

***C. brachypoda* (Ach.) Tibell**: see T87, M&M 1987 (*C. sulphurea*) imm-leprose, yellowish green, Stichococcus, yellowish green (whole apoth.), sp. spherical, 2.3-3.7

***C. brunneola* (Ach.) Müll. Arg.**

C. carthusiae = *C. chlorella*

***C. chlorella* (Ach.) Müll. Arg.:** see T87, T96

***C. chrysocephala* (Turner ex Ach.) Th. Fr.**

***C. cinerea* (Pers.) Tibell**

***C. citrocephala* (F. Wilson) Tibell**: see T96 immersed, Trentepohlia, yellow excipulum, sp. ellipsoid, smooth, 5.7-6.9X3-4

C. coniophaea = *Sclerophora coniophaea*

C. degelii = *C. olivaceorufa*

***C. deludens* Tibell**: in T87 epi, granular, green-grey, Stichococcus, red-brown on upper stalk, stalk & hypoth. K+Y, sp. spherical-square, smooth-cracked, 2.8-4.4

***C. ferruginea* (Turner ex Ach.) Mig.**

***C. furfuracea* (L.) Tibell**

***C. gracillima* (Vainio) Tibell**

C. hispidula (Ach.) Zahlbr.

C. hygrophila Tibell (1984): currently synonymized with *C. brunneola*, but we are considering reviving this taxon. See notes in key.

C. laevigata Nádv.

C. olivaceorufa Vainio: see T96, T87(degelii) immersed, Trentepohlia, yellow turning reddish brown excipulum, sp. spherical (occ. ellipsoid), smooth-cracked, 2.9-3.5

C. phaeocephala (Turner) Th. Fr.

C. servitii Nádv. known only from Slovakia

Ch. sphaerocephala Nádv.

C. stemonea (Ach.) Müll. Arg.

C. subroscida (Eitner) Zahlbr.

C. sulphurea = *C. brachypoda*

C. trichialis (Ach.) Th. Fr.

C. xyloxena Nádv.

Coniocybe gracilescens Willey --- no sources of information have been found on this name. It may be a typo that has carried through the literature.

Cybebe gracilentata (Ach.) Tibell

S. amabilis

S. coniophaea

S. farinacea

S. nivea

S. peronella

S. sanguinea

6. *Chaenothecopsis*

Key to all species with descriptions readily available in the literature, plus a few undescribed species. Many of my specimens do not key out properly; this may be due to the narrow definitions given for species in the literature, or it may indicate that there are numerous undescribed taxa in the Pacific Northwest beyond those already added to this key. Most species descriptions (at end of key) include references to complete descriptions. Chemical reactions can be difficult to observe and may require testing multiple apothecia. Written by Eric B. Peterson, last updated 24 March, 1999.

WARNING: this key currently contains a few trichotomies.

Key to groups:

- 1a. Growing on resin, or resin soaked bark; often under flaking bark and associated with a thick mat of hyphae.....**Group 1**
- 1b. Growing elsewhere (may be in deep cracks of bark)...
- 2a. Spores septate.....**Group 2**
- 2b. Spores non-septate...
- 3a. Spores rounded at ends, generally (but not always) pale....**Group 3**
- 3b. Spores allantoid (foot-ball shaped with pointed ends), generally pigmented (usually brown).....**Group 4**

Group 1: Resinicolous

[re-arrange this around spore septae]

- 1a. Ascomata not entirely black...
 - 2a. Ascomata covered with a yellow or green pruina...
 - 3b. Spores non-septate.....*Mycocalicium sequoiae*
 - 3a. Spores septate
 - Xa. Spores _____.....*edbergii*
 - Xb. Spores 6 - 9 um.....*eugenia*
 - 2b. Ascomata not covered with a yellow pruina...
 - 4a. Ascomata with a brownish spore mass...
 - 5a.*Brucea castoris*
 - 5b.*Mycocalicium chaudhari*
 - 4b. Ascomata not with a brownish spore mass...
 - 6a. Stalk black, capitulum white pruinose with black spots from spores collecting on the surface.....*nigropunctata*
 - 6b. Stalk pruinose, capitulum not as above...
 - 7a. Ascomata generally > 1.5 mm tall; on *Tsuga*, *Abies*, or *Picea*. Stalk with a pale greenish or bluish hue.....*tsugae*
 - 7b. Ascomata < 1.5 mm tall...
 - 8a. Spores septate, ascomata more than 0.6 mm tall...

- 9a. Spores 5-7 um long.....***asperopoda***
 9b. Spores 8-11 um long.....***golubkovae***
- 8b. Spores non-septate, ascomata less than 0.6 mm tall...
- 10a. Spores 3.5-5.3 um long.....***resinicola***
 10b. Spores 6.0-8.5 um long.....***shefflerae***
- 1b. Ascomata entirely black...
- 11a. Ascomata not reacting with KOH...
- 12a. Stalks up to 1 cm tall; spores septate; on Picea.....***sitchensis***
 12b. Stalks 0.5 - 1.5 mm tall; spores non-septate, elipsoidal,
 6-8.5 um in length.....***montanum***
 12c. Stalks less than 1 mm tall; spores non-septate,
 allantoid; on Pseudotsuga.....***"pseudonana"***
- 11b. Ascomata reacting with KOH...
- 13a. KOH + G.....[sp nov?]
rumor that this is in pub. by Rikkinen
- 13b. KOH + R to purpleish...
- 14a. Spores non-septate, ca. 5-8 um long.....***oregana***
 14b. Spores septate, 8-12 um long.....***dolichocephala***
- Group 2: Spores septate**
- 1a. Apothecia in tufts.....***caespitosa***
 1b. apothecia not in tufts...
- 2a. Parasitic on Cladonia spp.***parasitaster***
 2b. Not parasitic on Cladonia spp...
- 3a. KOH - (for color; stalk may swell) or pale brownish...
- 23a. Stalks very short (generally less than 0.2 mm), parasitic
 on lichen crust...
- 24a. Stalks extremely short ("0.05-0.11 mm tall" but then see
retinens), in section at least in part with red pigments...
- 25a. Apothecia 0.10-0.18 mm high, occ in groups; spores
 6.5-7.6 X 2.8-3.3, parasitic on *Arthonia* or
Lecanactis.***brevipes***
 25b. Apothecia 0.1-0.25 mm tall; spores 7-11 X 2.5-3.5;
 on *Schismatomma cretaceum*.***retinens***
- 24b. Stalks up to 0.28 mm high, without red pigment...
- 26a. Asci 52-69 um long; ascomata 3-5 times as high as
 width of the stalk; stalk pale brown towards the
 base; parasitic on *Lecanora* spp. (just L.
caesiorubella?).....***kalbii***
 26b. Asci 43-51 um long, on sterile lichen thalli on
 shaded rocks.....***subparoica***
- 23b. Stalks not very short (> 0.2 mm)...
- 27a. Stalks moderately short (<0.5 mm), on *Trentepohlia*-

- containing lichens, spores 6.7-8.3 μm ...
- Xa. Stalk shiny black, excipulum reddish, at least in section, 6-11 μm thick, red pigment intensifying in KOH. Described from *Arthonia* in South America.....***arthoniae***
- Xb. Stalk dull black, excipulum dark to reddish brown, 11 - 14 μm thick, not described as having pigments that intensify in KOH. Described from *Sagenidium* and other *Trentepohlia* containing lichens in Tasmania.....***sagenidii***
- (several specimens clearly one of these 2 species; not reported yet)**
- 27b. Not as above...
- 28a. Spores gen > 7 μm long...
- 29a. Excipulum epruinose...
- Xa. Growing on lecanactis.....***lecanactidis***
- Xb. Growing elsewhere...
- 30a. Stalks flexuous & shiny black, 0.8-1.4 mm tall, spores longitudinally wrinkled, 7.2-10.0 μm , on lignum.....***nigropedata***
(probable specimen for PNW)
- 30b. Spores lacking longitudinal wrinkles...
- 31a. Spores 7-11 μm , on lignum, norstictic acid present.....***norstictica***
(the description of this species seems poor, I'm not sure I believe in it)
- 31b. Spores 6-9 μm , on bark, often forming a tall head (older stalks typically form a whitish pruina mixed with the spore mass.....***cascadensis sp. nov.***
- 29b. Excipulum generally pruinose...
- 30a. On lignum, excipulum often with a blue-grey pruina, spores 7.5-8.7 μm , ornamentation _____?.....***fennica***
- 30b. On bark, especially in cracks, spores 6-9 μm , often forming a tall head; older stalks with a pale whitish pruina mixed with the spore mass.....***cascadensis sp. nov.***
- 30c. On exudate of conifers, excipulum often white pruinose spores (7.0)8.0-10.5(12.0), smooth.....***golubkovae***
(see also ***dolichocephala***)
- 28b. Spores gen < 8 μm long...
- 31a. Excipulum generally with white pruina or hyphae (rarely seen on *debilis*---Keys below)...
- 32a. Stalk with a coarse surface, gen. white pruinose, on resin.....***asperopoda***
(1 potential specimen from PNW)
- 32b. Stalk smooth, on old wood with *Trentepohlia* containing lichens; swelling in KOH.....***sanguinea***
- 31b. Excipulum epruinose...
- 33a. N+ red...

- 34b. Parasite on *Chaenotheca* (*trichialis*),
 hypothecium greenish.....*epithallina*
 (note: N+ rxn may be variable)
- 34a. Saprophyte on decorticate wood,
 hypothecium pale.....*debilis*
- 33b. N-...
- Xa. Growing on *Lecanactis*.....*lecantactidis*
 Xb. Growing elsewhere...
- 35a. Spore septum very dark.*nigra*
 (several potential specimens from PNW,
 however the distinction from *epithallina* is vague)
- 35b. Spore septum much paler than outer wall.
- 36a. Stalk in water mount appearing entirely deep
 green, greenish color often visible under
 dissecting scope, stalk never pale at base;
 on bark, commonly within cracks; not associated
 with algae or lichen thalli.....*viridipes(?) sp. nov.*
- 36b. Stalk often pale at base, in water mount
 greenish to brownish, generally on lignum
 and usually associated with lichen thalli
 or free-living algae.....*pusilla*
- 36c. Stalk white or nearly white in light microscope;
 Capitulum similarly pale; on bark, within cracks, often
 Deeply so and often in tunnels of beetles; not
 Associated with algae or lichen thalli....*lemura sp. nov.*
- 3b. KOH+...
- 36a. KOH + yellowish brown to reddish brown...
- 37a. KOH + yellowish brown, HNO₃ + red.....*vainioana*
 (see also *dolichocephala*, *nigropodata*, *norstictica*)
- 37b. KOH + reddish brown, H -.....*tasmanica*
 (several probable specimens for the PNW)
- 36b. KOH + red or green...
- 38a. KOH + red (may include intensification of some green pigments,
 but red reaction predominates)...
- 39a. Stalk with a coarse surface, oft. white pruinose...*asperopoda*
 (1 potential specimen from PNW)
- 39b. Stalk smooth...
- Xa. Stalk visibly reddish under dissecting scope,
 distinctly reddish under compound scope reacting
 violet red in KOH; hypothecium greenish, green
 intensifying in KOH.....*himalayensis*
- 40a. N+R, K+R mainly as intensification in upper stalk;
 spores 5.5-7.5(-9.8) μ m.....*debilis*
- 40b. N-(?)...
- 41a. Spores gen. 5.4-6.5 μ m, K+R soon fades.....*pusiola*

- 41b. Spores gen. > 7 μm , K+R variable...
- 42a. Norstictic acid not present, on exudate
of conifers.....***dolichocephala***
- 42b. Norstictic acid present, on lignum.....***norstictica***
(species validity uncertain)
- 38b. KOH + green...
- 43a. Obligate parasite on *Chaenotheca chrysocephala*. ...***consociata***
- 43b. Not an obligate paracite on *Chaenotheca chrysocephala*...
- 44a. Stalk in water mount appearing intensely red;
spores narrowly ellipsoidal, 7-8 X 2-2.5 μm***rubina***
(new to North America!)
- 44b. Upper part with +/- reddish tinge; epithecium
and stalk mainly brown or olive-brown but stalk
sometimes reddish in parts; spores ca 5-6 μm
long.....***viridireagens***
- Group 3: Spores non-septate, generally rounded & pale**
- 1a. Found on exudate of Sequoia; apothecia 1-4 mm tall; formed
from black pseudostroma; capitula with a greenish yellow
pruina on the upper surface; asci evidently with a visible
apical canal.
.....***Mycocalicium sequoiae*** Bonar (see Tibell & Titov 1995)
- 1b. Not as above...
- 3a. KOH -....
- 4a. Stalks extremely short, up to 0.1 mm; parasitic on
lichen crust.***pilosa***
- 4b. Stalks moderately short to tall (>0.10 mm)...
- 5a. Found in associated with Trentepohlia containing lichens...
Xa. Found on *Phellodendron amurense*; assoc. with
Trentepohlia; asci 25-30 (-33) μm***amurense***
(potential specimen found in PNW)
- Xb. Found on bark in association with *Trentepohlia*
(or more often on *Lecanactis*.....***australis***
- 5b. Found elsewhere...
- 6a. Stalks pruinose or with coarsely granular surface...
- Xa. Stalks rough but lacking white pruina. Hypothecium
brown, clearly delimited from the pale
central part of the stalk; asci (30)30.8-33.7(36.0)
 μm long (often shorter in PNW); typically found in bark
crevases.....***ussuriensis***
- Xb. Stalks with a thick white pruina...
7a. Asci 32 - 36 μm long; hypothecium greenish.....***cinerea***
7b. Asci (20)23-29(30) μm long; hypothecium pale.....***resinicola***
- 6b. Stalks smooth, epruinose, hyphae not anticlinally arranged...
Xa. Ascomata very tall, 0.8 - 2.0 mm.....***tibellii***
Xb. Ascomata not so tall...

- 8a. Apothecia aggregated.***shefflerae***
 8b. Apothecia not aggregated...
- 9a. Associated with algae or a lichen (other than *Trentepohlia*,
 if so see *C. amurensis*)...
 Xa. Growing on the lichen *Lecanactis*.....***australis***
 Xa. Growing in association with algae...
 Xa. Spores completely nonseptate.....***savonica***
 Xb. Spores generally septate, though septum is pale
 and often difficult to see.....***pusilla***
 9b. Not associated with algae...
10. Compare with *Mycocalicium*.
 10a. Spores allantoid to fusiform, not associated
 with lichens or algae, often associated with
 historic resin flows, stalk not swelling
 significantly in KOH.....***nana***
 10b. Spores ellipsoidal, associated (parasitic?) with
Chaenotheca or free algae; apothecia 0.7-1.0 mm
 high, stalk swelling strongly in KOH.....***pusilla***
- 3b. KOH + ...
- 11a. Reaction of mixed color; apothecia short (0.1-0.5 mm);
 stalk covered with a dense granular pruina; KOH + red
 (fading) excipulum and green in rest of capitulum.***koerberi***
 11b. Reaction of a single color; apothecia gen. taller (?)...
- 12a. KOH + red...
- 13a. Apothecia generally > 0.4 mm tall...
- 14a. Spores smooth, ellipsoid 5.4-6.5 X 2.2-2.7 μ m; K
 reaction in solution, quickly fading.....***pusiola***
 14b. Spores with distinctive, minute areolate
 ornamentation visible in light microscope, allantoid
 to ellipsoid, 6.5-9 X 3-3.5 μ m; K reaction slow, in
 tissues, remaining, oft purplish in color.***rubescens***
- 13b. Apothecia generally < 0.5 mm tall...
- 15a. On *Lecanora* or sterile lichen thalli.***hospitans***
 15b. On *Haematomma ochroleucum*.***ochroleuca***
- 12b. KOH + green (aeruginose)...
- 16a. Asci large, 47-67 μ m; apothecia oft pruinose.***irregularis***
 (1 potential specimen from PNW)
 16b. Asci in normal range?, 22-52 μ m...
- 17a. Stalk pale, with irregular surface, oft appearing
 white-pruinose, actually formed by senescence of
 outer hyphae.***viridialba***
 17b. Stalk darker, not with irregular or pruinose surface...
- 18a. Mature spores gen < 6.0 μ m long.***haemtopus***
 18b. Mature spores gen > 6.5 μ m long...
- 19a. Stalk very narrow 0.02-0.03 mm. Stalk appearing

intensely red in water mount; hyphae periclinal,
not swelling much in K; spores actually have a thin
septum.....**rubina**
(new to North America!)

- 19b. Stalk thicker, spores truly non-septate...
20a. Stalk moderately thick, 0.04-0.06 mm.**nivea**
(see discussion on p. 141 of Tibell 1987
for comparison of these species)
20b. Stalk thick, 0.06 mm or more [other characters?]...**vinosa**

Group 4: Spores non-septate, allantoid, pigmented

- 3a. KOH -...
- 4a. Stalks extremely short, up to 0.1 mm; parasitic on
lichen crust.**pilosa**
4b. Stalks moderately short to tall (>0.10 mm)...
- 5a. Found on *Phellodendron amurense*; assoc. with *Trentepohlia*; asci
25-30 (-33) um.....**amurense**
(potential specimen found in PNW)
5b. Found elsewhere...
- 6a. Stalks with coarsely granular surface...
- 7a. Hypothecium brown, clearly delimited from the pale
central part of the stalk; asci (30)30.8-33.7(36.0)
um long (often shorter in PNW); typically found in bark
crevases.....**ussuriensis**
7b. Hypothecium pale; asci (20)23-29(30) um long.**resinicola**
- 6b. Stalks smooth, epruinose, hyphae not anticlinally arranged...
- 8a. Apothecia aggregated.**shefflerae**
8b. Apothecia not aggregated...
- 9a. Associated with algae (other than *Trentepohlia*,
if so see *C. amurense*).**savonica**
9b. Not associated with algae...
10. Compare with *Mycocalicium*.
- 10a. Spores allantoid to fusiform, not associated
with lichens or algae, often associated with
historic resin flows, stalk not swelling
significantly in KOH.....**nana**
specimen with truly allantoid spores, but stalk
swelling & of irregularly intertwined hyphae SL-00-579A
10b. Spores ellipsoidal, associated (parasitic?) with
Chaenotheca or free algae; apothecia 0.7-1.0 mm
high, stalk swelling strongly in KOH.....**pusilla**
- 3b. KOH +...
- 11a. Reaction of mixed color; apothecia short (0.1-0.5 mm);
stalk covered with a dense granular pruina; KOH + red
(fading) excipulum and green in rest of capitulum.**koerberi**
11b. Reaction of a single color; apothecia gen. taller (?)...

- 12a. KOH + red...
- 13a. Apothecia generally > 0.4 mm tall...
- 14a. Spores smooth, ellipsoid 5.4-6.5 X 2.2-2.7 μm ; K reaction in solution, quickly fading.....*pusiola*
- 14b. Spores with distinctive, minute areolate ornamentation visible in light microscope, allantoid to ellipsoid, 6.5-9 X 3-3.5 μm ; K reaction slow, in tissues, remaining, oft purplish in color.*rubescens*
- 13b. Apothecia generally < 0.5 mm tall...
- 15a. On Lecanora or sterile lichen thalli.*hospitans*
- 15b. On Haematomma ochroleucum.*ochroleuca*
- 12b. KOH + green (aeruginose)...
- 16a. Asci large, 47-67 μm ; apothecia oft pruinose.*irregularis*
.....(1 potential specimen from PNW)
- 16b. Asci in normal range?, 22-52 μm ...
- 17a. Stalk pale, with irregular surface, oft appearing white-pruinose, actually formed by senscence of outer hyphae.*viridialba*
- 17b. Stalk darker, not with irregular or pruinose surface...
- 18a. Mature spores gen < 6.0 μm long.*haemtopus*
- 18b. Mature spores gen > 6.5 μm long...
- 19a. Stalk very narrow 0.02-0.03 mm. Stalk appearing intensely red in water mount; hyphae periclinal, not swelling much in K; spores actually have a thin septum.....*rubina*
(new to North America!)
- 19b. Stalk moderately thick, 0.04-0.06 mm. Stalk appearing intensely red in water mount; spores truly aseptate.....*nivea*
(see discussion on p. 141 of Tibell 1987
for comparison of these species)

Species included:

amurensis Titov: (+Titov & Tibell 1993) Found on *Phellodendron amurensis*; assoc. with *Trentepohlia*; apothecia (0.20)0.23-0.33(0.40) mm tall ; spores (4.5)-5.1-6.7-(8.0) X (1.8)-2.0-2.9-(3.0), smooth or with minute ornamentation, ellipsoidal to allantoid, brown.

arthoniae Tibell: (Tibell 1998) Apothecia 0.32 – 0.43 mm high. Stalk shinny black, greenish brown in section, and not swelling in KOH. Capitulum black, obconical to lenticular. Epitecium intensely reddish brown. Ecipulum reddish, 6-11 μm thick. Reddish pigments in capitulum intensifying in KOH. Asci 37-46 μm X 2.5 – 3.5 μm . Ascospores 1-septate, medium brown, ellipsoidal, smooth, 6.3 – 7.8 X 2.0 – 3.0 μm , septum distinct and pigmented similarly to the spore wall. Growing on *Arthonia* with *Trentepohlia*. Known only from Argentina and Chile.

asperopoda Titov: (Titov & Tibell 1993) Stalk with a coarse surface, oft. white pruinose. On exudate of conifers; algae gen. not present; stalk tall (.6-1.5mm), with coarse surface with cracks toward top, gen white pruinose; often with red crystals, especially in the lower part of stalk which are K+red then aeruginose, other parts K-; asci 38-45; spores narrowly ellipsoidal, pale brown, (5.6)-5.9-6.8-(7.2) X (1.8)-2.2-2.4-(2.5), smooth in compound scope. (1 potential specimen for PNW)

australis Tibell: (Tibell 1998) Apothecia 0.37 – 0.49 mm high. Stalk shinny black, hyphae pale greenish and irregular to periclinally arranged in the center, dark brown toward the exterior and not swelling in KOH. Capitulum black and lenticular. Epithecium greenish. Excipulum 7-16 um thick, greenish brown, composed of 3-9 layers of periclinal, short cylindrical cells. Asci 34 – 40 um X 3.3 – 3.7 um. Ascospores non-septate, ellipsoidal, smooth, greenish brown, 5.3-6.7 X 2.1 – 2.9 um.

brevipes : Apothecia 0.10-0.18 mm high, occ in groups; stalk black, in squash reddish brown to red at the base, cells isodiametric; asci 41-50 um long; spores ellipsoidal, septum distinct, medium brown, 6.5-7.6 X 2.8-3.3, smooth in compound scope; K- except excipulum + pale brownish parasitic on Arthonia or Lecanactis.

caespitosa (Phillips) D. Hawksw. (1980): Apothecia in tufts, 2-4 mm tall; spores 9-14 X 3-4.5; not associated with algae, found on decaying polypores and rotten Taxus bark; possibly Endemic to British Isles.

cascadensis E. B. Peterson (future): Apothecia ca. 0.5-1.2 mm tall; spores 7-9 um long, septate; not associated with algae; K-; stalk with dark greenish brown pigments, capitulum with dark redish brown pigments, in water mount; spore-mass frequently tall, with a whitish pruina; species was previously refered to as “fennica-like”; growing on bark, frequently in cracks.

cinerea Tibell: (Tibell 1998) Ascomata stalked, 0.4 – 0.7 mm tall. Stalks densely white pruinose, formed from dead hyphae; stalk surface with +/- isodiametric cells, with a brown pigment toward the exterior; central hyphae intertwined and hyaline; not swelling in KOH. Capitulum sub-spherical, black. Excipulum poorly developed. Epithecium reddish brown; hypothecium greenish brown. All parts KOH-. Asci 32 – 36 X 3.3 – 4.1 um. Spores non-septate pale brown, roundly ellipsoidal, 5.4 – 6.3 X 3.1 – 3.8 um, with a minute but rough ornamentation.

consociata : Obligate parasite on *Chaenotheca chrysocephala*; epithecium, hypothecium, and surface of the stalk reddish brown.

debilis* : (-Titov & Tibell 1993)N+ red. Stalk black, in water mount pale, wine-red, rarely with a white pruina, hyphae arranged longitudinally; hypothecium K-, stalk K+ grayish red or K-, N+ red; epithecium and exciple reddish brown; hypothecium greenish, N+ intensifying; spores 5.5-7.5 (9.8) X 2-2.3 (3.3), septum pigmented and distinct, surface smooth or minutely cracked; asci 40-54 um; “exclusively” on lignum.

dolichocephala Titov: (+Tibell & Tittov 1995) Spores gen > 8 um. Capitula K+ red but stalk K+ yellow-brown, soon fading, not observed in specimens more than 2-3 years old; asci 50-70 um; apothecia 0.8-1.2 mm tall; spores 8-12 X 2.5-4.0 um with minute ornamentation visible in light microscope, narrowly ellipsoidal to cylindric, pale brown; on exudate of conifers.

edbergii

epithallina Tibell (1975 append. 2): Parasitic on *Chaenotheca* spp. Stalk black?, reddish brown in squash, internally brown or reddish brown, K- (“or K+ brownish”-Brit Fl.); hypothecium greenish; apothecium black or brown below; (all parts N-?)---Tibell 1975 states N+ (p. 115); spores 4.8-6.7 (7.6) X (1.5) 1.9-2.3, septum darker than outer wall, parasitic on thallus of *Chaenotheca trichialis* which contains *Stichococcus*.

- eugenia Titov:** (Titov 2001) Ascomata stalked, 0.4 – 1.5 mm tall. Stalk generally flexuose, covered with a granular greenish pruina; stalk green from pruina, otherwise pale to black; hyphae pale and loosely interwoven toward the center; brown, periclinal, and often cracked toward the exterior; swelling strongly in KOH. Capitulum lenticular to hemispherical, black. Excipulum poorly developed, a continuation of the outer stalk. Epithecium greenish brown; hypothecium pale with colorless oil droplets. KOH- except greenish pigments turning brown. Asci 42 – 50 μm X 2.8 – 4.0 μm . Ascospores septate, narrowly ellipsoidal, pale, 6.0 – 9.0 X 2.0 – 3.0 μm , smooth. On resin of Abies.
- fennica** (M. Laurila) Tibell: (Tibell 1978) On dry lignum. Apo. 0.9-1.6 mm tall. Epithecium with faint blue-gray pruina, otherwise stalk black, of interwoven hyphae. K-, H+Reddish-brown. Asci 50-60 μm . Spores 7.5-8.7 X 2.6-3.1, septate.
- golubkovae** Tibell & Titov: (+Titov & Tibell 1993) On exudate of conifers; K+ pale brown; excipulum & stalk often white-pruinose; asci 50-70; spores smooth, pale brown, narrowly ellipsoidal, (7.0)8.0-10.5(12) X (2.5) 2.7-3.3(3.5) μm .
- haemtopus** Tibell (1987): Mature spores gen < 6.0 μm long. Stalk red or grayish, 0.03-0.10 mm thick; red pigment crystals, turn aeruginose in K; N-; asci 29-35 μm , spores ellipsoidal with rounded ends, pale brown, 3.5-6 X 2-3.5. (potential specimen from California)
- hospitans** (Th. Fr.) Tibell: (Tibell & Ryman 1995) On Lecanora or sterile lichen thalli, apothecia 0.15-0.31 mm, often agglomerated into groups of 3-8, especially when on apothecia; stalk black or pale in lowermost part; spores 8-9.5 X 4-5.
- irregularis** Titov (1991): Asci large, 47-67 μm ; apothecia oft pruinose; spores non-septate or with a very thin and unpigmented septum, narrowly ellipsoidal, pale brown, smooth or with a very weak ornamentation, (6.0)6.7-9.0(12) X (3.5)3.8-4.4(4.5) μm . (potential specimen for PNW) (see also note in Titov 2000: larger apothecia and pale stalks, but otherwise matching irregularis).
- himalayensis (Räsänen) Tibell & Titov:** (see Titov 2000) Ascomata 0.4 – 0.6 mm tall. Stalk reddish especially toward the base with hyphae pale, loosely interwoven to periclinal towards center, reddish-brown, thick walled, and periclinal toward exterior; strongly swelling in KOH. Capitulum obconical to subspherical or lenticular, black, sometimes reddish on lower parts. Epithecium reddish brown; hypothecium greenish. Red pigments KOH+violet-red; Green pigments intensifying in KOH. Asci 40 – 45 μm X 3 – 4 μm . Ascospores septate (difficult to see), narrowly ellipsoidal, pale brown, 7-9 X 2 – 2.5 μm , with an irregular ornamentation.
- kalbii** : Asci 52-69 μm long; ascomata 3-5 times as high as width of the stalk; stalk pale brown towards the base; parasitic on Lecanora spp. (just *L. caesiorubella*?).
- koerberi** (Nadv.) Tibell: (-Titov & Tibell 1993) Reaction of mixed color; apothecia short (0.1-0.5 mm); stalk covered with a dense granular pruina; KOH + red (fading) excipulum and green in rest of capitulum; stalk 0.04-0.05 mm thick; asci 25-40, spores uni or biseriata, fusiform, dark brown, 6-8 X 2.5-4, with a smooth surface.
- lignicola = pusiola*
- lecanactidis** Tibell: (Tibell 1998) Ascomata stalked, 0.3 – 0.6 mm tall. Stalk pale brown, especially toward base, hyphae irregularly interwoven, pale through most, thick and darkly sclerotized on the exterior; strongly swelling in KOH. Capitulum lenticular, black. Excipulum sclerotized, reddish brown. Epithecium dark brown; hypothecium greenish brown. Asci 39 – 43 X 2.4 – 3.3 μm . Spores septate (septum distinct), ellipsoidal, brown, 6.6 – 7.6 X 2.2 – 2.7 μm , smooth.

- nana*** Tibell (1979): (-Titov & Tibell 1993) Spores allantoid to fusiform with minute but distinctive areolate ornamentation; apothecia 0.37-0.63 mm high. Central part of stalk pale, outer part brown to greenish brown; asci 26-33; spores (4.9) 5.4-6.8 (8.7) X (2.2) 2.8-3.4 (3.8) μm , rather dark brown; on old resin flows of conifers; HNO_3 -. Note: compare with *Mycocalicium subtile*, sp. 6-13 μm , asci 45-65 μm .
- nigra*** Tibell (1987): Spore septum very dark. Stalk black? greenish in squash; epithecium and hymenium brown; hypothecium and stalk greenish; K- (or slightly redish), N-; spores 4.8 - 7 X 1.5 - 2.2 (-2.5), septum much darker than outer wall; usually with *Stichococcus* on wood. (probable specimens from PNW) (note this species appears to differ from *epithallina* only in habitat and distribution).
- nigropedata*** Tibell (1987): On lignum. Stalk black, shiny, +/- flexuous, of periclinal hyphae. Epithecium reddish brown, Hypothecium greenish brown. K- (or yellowish, dissolving), not swelling. H-. Asci 42-49 μm . Spores 1-septate, 7.2-10.0 X 2.2-2.8, ellipsoidal, longitudinally wrinkled. Septum thin, of less contrast than wall. (potential specimen for PNW)
- nivea*** (F. Wilson) Tibell: Stalk moderately thick, 0.04-0.06 mm. Stalk of conglutinated, irregularly interwoven hyphae; asci 35-40 μm ; ascomata with reddish pigment that reacts KOH+ green; spores ellipsoid to fusiform, 6.5-8.1 X 2.2-3.3, with minute, irregular ornamentation.
- norstictica*** R. C. Harris (1995): On lignum, not associated with algae, apothecia dark brown, ca. 0.9 mm, stalk dark brown, hyphae +/- periclinal?, Capitulum obconical, 0.3-0.4 mm diameter, exciple & upper stalk bleeding yellow in KOH & forming substantial quantity of norstictic acid crystals, spores pale brown, +/- cylindrical with rounded ends, septate, 7-11 X 3-3.5 μm , septum dark.
- ochroleuca*** Tibell & K. Ryman (1995): (+Tibell & Ryman 1995) On *Haematomma ochroleucum*, apothecia with distinct stalk (0.30-0.46 mm tall, stalk pale throughout, spores 7-8 X 4-5.
- parasitaster*** (Bagl. & Car.) D. Hawksw. (1978): Parasitic on *Cladonia* spp. Stalk in water mount? greenish; all parts K-, N-; epithecium and hymenium reddish brown, spores (5-) 6-9.5(-14) X 2.3-3(-3.5), septum brown but thinner than outer wall, = or paler than outer wall; parasitic on *Cladonia* spp., gen on dry sides of large stumps and peaty overhangs.
- pilosa*** : (see Tibell & Kalb 1994) Stalks extremely short, up to 0.1 mm; parasite or parasymbiont on crustose lichens (only *Tylophoron?*); apothecium margin with minute hairs; stalks up to 0.1 mm.
- pusilla*** (Ach.) A. Schmidt (1970): (-Titov & Tibell 1993) Spores ellipsoidal, smooth; apothecia 0.7-1.0 mm high. Stalk in water mount? gen greenish or gray-brown, internally dull greenish or brownish (without a reddish pigment), 0.04-0.08 mm, K-, N-; asci 29-36; spores medium brown, 5-7(-8.5) X 2-2.5(-3), septum only tardily colored, much paler than outer wall, surface +/- smooth; parasitic on algae (globose though some collections are assoc. with *Stichococcus*) or on lichens, sometimes on *Calicium glaucellum*. Note: 1) = subpusilla. 2) EBP#2441 has spore length 4.6-6.2 μm and asci 36-44 μm .
- pusiola*** (Ach.) Vain.: (-Titov & Tibell 1993) (=lignicola, (Tibell 1987)) Septum thin, with less contrast than the wall; asci 21-36 μm [note a specimen I keyed fit best here except the asci were c. 40-50 μm]; hypothecium K+red. Spores smooth 5.4-6.5 X 2.2-2.7 μm ; apothecium 0.4-0.9 mm tall. K+ red reaction quickly fading; parasitic on *Chaenotheca* spp (*trichialis* & *brunneola*).
- resinicola*** Tibell & Titov: (+Tibell & Titov 1995) Hypothecium pale; asci (20)23-29(30) μm long. On exudate of *Pinus* (*koraiensis*); apothecia (0.20)0.26-0.52(0.60) mm high, black with a coarse surface, covered by greenish or whitish crystalline pruina.
- retinens*** (Nyl.) Tibell: (Tibell & Ryman 1995) Apothecia 0.1-0.25 mm tall; spores 7-11 X 2.5-3.5; on *Schismatomma cretaceum*.

rubescens Vain.: (-Titov & Tibell 1993) Spores with distinctive, minute areolate ornamentation visible in light microscope, 6.5-9 X 3-3.5 μm ; K+ red reaction persistent; apothecia 0.4-0.7 mm tall.

rubina Tibell (1982): Stalk very narrow 0.02-0.03 mm. Stalk dark, dull brown to dark red in incident light, in water mount appearing intensely red, of periclinally arranged hyphae, with minute granules of red pigment reacting K+green; spores narrowly ellipsoidal, 7-8.5 X 2-2.5, uniseriate, minute irregular ornamentation; septum thin and hyaline; parasitic on lichens (*Pyrgidium* in Costa Rica).

sagenidii Tibell (1987): On *Sagenidium molle* or *Trentepohlia* containing lichens. 0.28-0.48 mm tall. Epruinose and black, stalk of irregularly interwoven hyphae. K-, H-. Asci 38-43. Spores med. brown, ellipsoidal, smooth, 6.7-8.3 X 2.2-3.3 μm , Septum equal to wall. Endemic to Australia.

sanguinea Tibell (1987): On old wood, oft. with *Trentepohlia* (free or lichenized), esp. with *Arthonia* spp.. 0.4-0.7mm tall. Excipulum with white, cottony hyphae, otherwise stalk black, of periclinally arranged hyphae, swelling in KOH. Stalk in mount yellowish red, intensified by K. Otherwise K-, H-. Asci 34-42 μm . Spores med. brown, ellipsoidal, smooth, 6.1-7.8 X 2.2-3.3 μm , septum thin and of less contrast than outer wall. Endemic to New Zealand.

savonica (Ras.) Tibell: (-Titov & Tibell 1993) Associated with algae (other than *Trentepohlia*, if so see *C. amurensis*), spores pale, ends typically rounded, surface minutely warted; stalk internally dull or reddish brown, epruinose, slender (0.03-0.07mm), K-, N-; spores pale greenish brown, ellipsoid with rounded ends, smooth under compound scope, 4.5-6.5 X 2-3.

shefflerae (Samuels & D.E. Buchanan) Tibell: (-Tibell & Titov 1995) Apothecia aggregated; known only from one collection on exudate of *Schefflera digitata* in New Zealand.

subparvica : Asci 43-51 μm long, on sterile lichen thalli on shaded rocks. See Tibell 1973. [new to North America!]

tasmanica Tibell: (Tibell 1987) On *Chaenotheca* or free living algae. 0.5-0.7 mm tall. Epruinose, black. Stalk color in mount variable, hyphae irregularly interwoven. K+Y to reddish brown, H-. Stalk swelling strongly in K. Asci 35-42 μm . Spores med. brown, ellipsoidal, 6.0-7.6 X 2.2-2.7 μm , 1-septate, strongly pigmented. (probable specimens from PNW)

tibellii Titov: (Titov 2000) Ascumata 0.8 – 2 mm tall. Stalk straight or flexuous, shiny black, hyphae pale greenish, loosely interwoven to periclinally toward center; swollen, periclinally green toward exterior, swelling in KOH. Capitulum subspherical to lenticular, black. Excipulum thin, continuation of stalk, greenish. Epithecium pale; hypothecium pale, lightly greenish. KOH- or yellowish-brown. Asci 38 – 50 μm X 3.0 – 4.5 μm . Ascospores non-septate, narrowly ellipsoidal, pale, 8.0 – 12.0 X 2.4 – 3.2 μm , smooth under light microscope (SEM reveals longitudinal ridges). On lignum.

Not entered in key yet:

trassii Titov: (??? – mentioned in Titov 2000) Ascumata [short]. Stalk not like in *C. nivea*. Red pigments in hymenium KOH+ green. Ascospores non-septate, ellipsoidal.

ussuriensis Titov: (+Titov & Tibell 1993) Hypothecium brown, clearly delimited from the pale central part of the stalk; asci (30)30.8-33.7(36.0) μm long. w/ anticlinally arranged hyphae in outer part of stalk, often white pruinose otherwise shiny black, stalk pale inside, outer part brown, anticlinally arranged hyphae; spores ellipsoidal, ends typically rounded; hypothecium brown; excipulum poorly developed, consisting of 2-3 layers of dk brown, thick walled cells; spores brown, uniseriate, obliquely to anticlinally arranged, ellipsoid with rounded ends, ornamentation of irregular cracks, (3.9)4.0-4.8(5.2) X (1.8)2.2-3.0(3.9); on lignum and bark, mainly *Pinus*, but sometimes others. [(0.05)0.06-0.08(0.09) mm... refers to?]

vainioana: KOH + yellowish brown, HNO₃ + red; spores ellipsoid (ends bluntly rounded), uniseriate, parallel w/ascus wall (sometimes overlapping in middle), (6.5) 7.3-9.3 (11.9) X (2.2) 2.6-3.3 (3.8); parasitic on algae or lichens (*Trebouxia* or *Trentepohlia*).

***vinosa* Titov**: (Titov 2000) Ascomata stalked, 0.65 – 1.8 mm tall, associated with chlorococcalean algae. Stalk generally flexuose, occasionally branched, surface rough, bright red to black (especially toward the base); hyphae pale, thin, and loosely interwoven toward the center; red, thick, and periclinal toward the exterior. Capitulum subspherical to hemispherical, black. Excipulum poorly developed and not differentiated from the exterior stalk hyphae, red in color. Epithecium red; hypothecium reddish. Granular reddish pigments throughout the capitulum. KOH+Green (red pigments). Asci 40 – 52 X 3.0 – 5.0 um. Ascospores non-septate, ellipsoidal, pale greenish 6.0 – 10.0 X 2.6 – 3.5 um, irregular ornamentation.

viridialba (Krempel.) A. Schmidt (1970): Stalk pale, with irregular surface, oft appearing white-pruinose, actually formed by senescence of outer hyphae, tall 1.0-2.1 mm, 0.2-0.3 mm thick; red pigment crystals, turn aeruginose in K; N-; hypothecium and stalk reddish brown; spores 6-8-(11) X (2)-3-3.5, medium to dark brown, with a distinctive minute ornamentation visible at high magnification; apparently not associated with algae.

viridipes E. B. Peterson (future): Similar to *pusilla* except: Stalk intensely deep green; never pale at base; occurring only on bark, and not associated with algae. This species may fall within the borders of *pusilla*, but just barely. There seems to be a general consensus that *pusilla* is an aggregate of species; what I am seeing seems to be relatively uniform from site to site and cleanly distinguishable from more classical *pusilla* specimens. See discussion in Tibell 1987.

viridireagens : Upper part with +/- reddish tinge; epithecium and stalk mainly brown or olive-brown but stalk sometimes reddish in parts; KOH reaction persistent; spores (5) 6-7 X 2-2.7; septum paler than outer wall; (gen?) parasitic on *Chaenotheca stemonea* and *C. trichialis* or algal crusts.

* The British Lichen Flora mentions a similar, undescribed species.

+ preceding citation indicates the paper where the species was described.

- preceding citation indicates a good description but lacking pictures, but many of these descriptions include citations for illustrations.

7. *Cryptocalicium*

monotypic, undescribed

8. *Cyphelium*

Key modified from Tibell (1969, 1975, 1976) and Weber (1969). Last modified by E. B. Peterson on 11/14/97.

- 1a. Excipulum well developed laterally, so as to be clearly visible above the thallus, gen. on wood or bark. (most of genus *Cyphelium*)...
- 2a. Apothecia immersed. Excipulum thin, rim like...
- 3a. Thallus gray.....*Cy. trachylioides*
- 3b. Thallus intensely yellowish green...
- 4a. Spores submuriform.....*Cy. notarisi*
- 4b. Spores 1-septate...
- 5a. Spores 17-21 μm in length.*Cy. tigillare*
- 5b. Spores 11-13 μm in length.*Cy. brachysporum*
[may be synonymous with *Cy. tigillare* (Webber 1967)]
- 2b. Apothecia sessile. Excipulum thickened at the base...
- 6a. Parasymbiont or parasite on *Pertusaria* species.....*Cy. sessile*
- 6b. Autonomous lichens, own thallus +/- well developed...
- 7a. Thallus gray or faintly greenish gray...
- 8a. Spores small, 7-12 μm in length, possibly with a slight yellow pruina, evidently known only from *Quercus* in California.....*Cy. chloroconium*
- 8b. Spores larger, 12-19 μm in length, pruina white or epruinose...
- 9a. Thallus faintly greenish gray, apothecia up to 0.5 mm diam., spores not striated, **very** roughly cracked areolate (reminiscent of a tank track).....*Cy. karelicum*
- 9b. Thallus gray, apothecia 1.5-2.5 mm, spores finely striated, minutely cracked.....*Cy. inquinans*
- 7b. Thallus intensely yellowish green...
- 10a. Apothecia epruinose, spores 13-17 μm in length. ...*Cy. pinicola*

10b. Apothecia yellow-pruinose, spores 17-22 μm in length.....*Cy. lucidum*

1b. Excipulum reduced laterally, not visible without sectioning an apothecium, thallus never *intensely* yellow (though sometimes yellow-tinged), gen. on wood or rock. (go to key for *Thelomma*; contains one *Cyphelium*)...

DRAFT

9. *Microcalicium*

Key taken directly from Tibell (1978. The genus *Microcalicium*. Bot. Notiser 131: 229-246) except for updated nomenclature and reformatting.

- 1a. Apothecia with long stalks (3-14 times the diameter of the capitulum), mature spores ellipsoidal, one-septate, 5.5-8 μm long...
- 2a. Apothecia 0.6-1.8 mm high, hyphae of the stalk distinct, mazaedium without sclerotized hyphae.....*M. arenarium*
- 2b. Apothecia 0.5-1.1 mm high, hyphae of the stalk strongly arched and forming an almost paraplectencymatous tissue, mazaedium with sclerotized hyphae.....*M. ahlneri*
- 1b. Apothecia sessile or subsessile, mature spores cylindrical, 1-3(-7) septate, 9-15 μm long...
- 3a. Excipulum reddish brown, mature spores 1-septate, pycnidial wall reddish brown-dark brown, pycnospores narrowly ellipsoidal.....[*M. conversum*]
- 3b. Excipulum very dark green, mature spores 3(-7) septate, pycnidial wall very dark green, pycnospores broadly ellipsoidal.....*M. disseminatum*

[note: I have a specimen with a reddish brown excipulum and 3-septate spores (combining characters of *conversum* and *disseminatum*)]

10. *Mycocalicium*

Key to all species with descriptions readily available in the literature. Most species descriptions (at end of key) include references to complete descriptions. Underlining indicates species in the North American checklist. An * marks species which have not been addressed by Tibell or any other workers since the 1940's. Taken partly from Tibell 1987, otherwise written by Eric B. Peterson, last updated 3/24/99.

viscinicola?

|||||

- 1a. Capitulum with a brownish color...
- 2a. Mazaedium itself brown, K+green, on exudate.....chaudhari
 2b. Mazaedium black, but excipulum brown, on lignum...
- 3a. Excipulum with brown pruina, K+R, spore wall exceptionally thick.....fulvofuscum
 3b. Excipulum brownish black (pruina?), K ?, spore wall probably not as above.....rappii*
- 1b. Capitulum black, epruinose or with a white or yellowish green pruina, never brown...
- 4a. Capitulum with a yellowish green pruina...
- 5a. Stalks growing from a black pseudostroma over exudate on scarred trees of *Sequoiadendron* or *Sequoia*.....sequoiae
 5b. Growing on lignum.....calicioides
- 4b. Capitulum with a white pruina or epruinose...
- 6a. Excipulum with a strongly incurved margin...
- 7a. Thallus present, granulose, greenish-grey.....ravenelii*
 7b. Thallus absent...
- 8a. Margin of excipulum strongly thickened.....americanum
 8b. Margin of excipulum not strongly thickened.....subtile
- 6b. Excipulum without a strongly incurved margin...
- 10a. Spores often exceeding 10 µm in length...
- 11a. Excipulum white pruinose, apothecia small, thallus not visible.....fuscipes*
 11b. Excipulum epruinose, thallus granulose, greenish grey.....ravenelii*
- 10b. Spores not exceeding 10 µm in length...
- 12a. Central part of stalk hyaline...

- 13a. Spores 8-9 μm , K+ intensified reddish.....***victoriae***
 13b. Spores 6-7 μm , K-.....***anomalum***
- 12b. Central part of stalk dark greenish to dark brownish, though possibly more pale than outer part of stalk, spores 5.5-10 μm ...
- 14a. Excipulum at the base with large (8-13 μm), thin-walled +/- isodiametric cells.
- 15a. Cells isodiametric, 8-13 μm in diameter.....***albonigrum***
 15b. Cells isodiametric to slightly elongate, 15-20 X 20 μm***reticulatum****
 [probably synonymous with *albonigrum*]
- 14b. Excipulum at the base consisting of periclinally arranged, sclerotized hyphae or a pseudoparenchymatic tissue consisting of rather small (4-6 μm) cylindrical or isodiametric cells with thickened walls...
- 16a. Spores allantoid, 5.5-9 μm long.....***subtile***
 16a. Spores oblong-ellipsoidal, 6.5-10 μm***rappii****
 [probably synonymous with *M. subtile*]

Species included:

albonigrum (Nyl.) Tibell: (see Tibell 1987). K-, H-; spores 6-8 X 3-3.5, dark brown, broadly ellipsoidal to ellipsoidal, slightly fusiform and flattened, with a slightly uneven surface.

americanum (see Tibell 1987) K+violet red, H+intensified reddish; spores dark brown, 9-11 X 4.5-5.5 μm , allantoid to almost ellipsoidal, with a minute ornamentation. On lignum.

anomalum Tibell (1998). K- (swelling), N-; spores dark brown, 6-7 X 2.5-3.5 ellipsoidal to fusiform, smooth, non-septate; stalk with branched strongly swollen hyphae, c. 5-6 μm in diam with small lumina; stalk hyphae brown at the surface, hyalin in the inner part.

calicioides (Nádv.) Tibell: (see Tibell 1996) On lignum, southern US and Kenya. 0.5-0.8 mm tall, stalk pale greyish brown to black, often thickened toward the base, excipulum with a thin yellowish green pruina, often with longitudinal ridges. K+, H+ slightly intensified reddish. Spores fusiform to ellipsoid, surface smooth under the light microscope, 7.5-10 X 4-4.5 μm .

chaudhari Tewari & Pant: (see Tibell & Titov 1995) On exudate of *Mangifera indica*. Apothecia 0.5-0.8 mm tall; mazaedium brown, convex; hypothecium violet-red; upper part of stalk & excipulum with a hyaline envelope; hypothecium and hyalin parts K+green, stalk H+R; spores non-septate, fusiform to subspheric, pale brown, 3.0-6.0 X 2.5-3.5 μm , minute irregular ornamentation under light microscope. On exudate, known only from India.

fuscipes (Tuck.) Fink: (see Fink 1935) Stalk dark brown, shading into white, excipulum white, capitulum lenticulate to top-shaped, spores oblong, ellipsoid, 9-15 μm . On old wood (New Jersey).

fulvofuscum (F. Wilson ex Bailey) Tibell: (see Tibell 1987) K+R (excipulum), H-; spores 6.5-10X5-5.5, dark to medium brown, broadly allantoid, with a distinctive reticulate pattern in the thick outer part of the wall (wall is exceptionally thick in light microscope). On lignum, Southern Hemisphere.

****rappii*** Nádvl.: (+ Nádvlorník 1942) 0.5-0.6 mm tall, stalk black or brownish black, excipulum black, brown in section; spores oblong-ellipsoidal, brown, 6.5-10 X 3-4 μ m. Described from Florida.

****ravenelii*** (Tuck.) Fink: (see Fink 1935) Thallus granulate, greenish grey, stalk brownish black, exciple dark, radiate-striate, incurved, capitulum spherical to top-shaped; spores ellipsoid to fusiform-ellipsoid, brownish, 7-12 X 3-5 μ m. On lignum (South Carolina)

****reticulatum*** Nádvl.: (+ Nádvlorník 1942) 0.8-1.1 mm tall, stalk brownish black (pale inside in mount), excipulum black, with reticulate-patterned pseudoparenchyma, cells 15-20 μ m; spores brown, ellipsoidal, smooth, 5.5-7 X 3-4 μ m, ends angular (allantoid?) [This description seems to me very close to *M. albonigrum*] Described from South Carolina.

sequoiae Bonar: (see Tibell & Titov 1995) On exudate of *Sequoiadendron* and *Sequoia*. Apothecia developing from a dark pseudostroma of intertwined, dark brown hyphae with strongly sclerotized walls and small lumina. 1.5-3.2 mm tall, often branched;

subtile (see Tibell 1987) K- or + slightly reddish brown, H- or slightly intensified reddish brown; spores dark brown, 5.5-9 X 3.5-5 μ m, allantoid to almost ellipsoidal, with a very minute ornamentation.

victoriae (see Tibell 1987) K+ intensified reddish or greyish violet red, dissolving, H- intensified red; spores dark brown, 8-9 X 3.5-4.5 μ m, allantoid to almost ellipsoidal, smooth or with very minute ornamentation..

+ preceding citation indicates the paper where the species was described.

- preceding citation indicates a good description but lacking pictures, but many of these descriptions include citations for illustrations.

11. *Phaeocalicium*

Key to all species with descriptions readily available in the literature. Most species descriptions (at end of key) include references to complete descriptions. Largely taken from Tibell 1996, otherwise written by Eric B. Peterson, last updated 3/24/99.

- 1a. Spores non-septate...
- 2a. Capitula strongly flattened...
- 3a. Excipulum with an outer layer of small, isodiametric cells, spores pale brown, smooth.....***betulinum***
- 3b. Excipulum consisting of periclinally arranged hyphae, without isodiametric cells, spores dark brown, with a minute ornamentation.....***compressulum***
- 2b. Capitula lenticular...
- 4b. Excipulum edge strongly thickened, ascomata 0.3-0.4 mm high on *Fraxinus*, *Populus*, and *Salix*.....***interruptum***
- 4a. Excipulum edge not thickened...
- 5a. On *Populus*, ascomata 0.6-0.9 mm high, often K+G.....***praecedens***
- 5b. On *Fraxinus* (+*Quercus*?), ascomata less than 0.5 mm high, K reaction various - may represent several spp..***"fraxinea"***
- 5c. On *Alnus*, ascomata less than 0.25 mm tall, spores 8-10 mm long, K reaction undetermined, known only from a single small specimens.....***"parvispora"***
- 1b. Spores 1-3 septate...
- 6a. Capitula strongly flattened...
- 7a. Spores 3 septate.....***fuegensis***
- 7b. Spores 1 septate...
- 8a. Stalk in section brown, excipulum 11-13 μm thick, known only from *Betula* in northern Sweden.....***flabelliforme***
- 8b. Stalk in section aeruginose (greenish), excipulum 20-25 μm thick, known only from decaying branches of *Coprosma* in New Zealand.....***asciiforme***
- 6b. Capitula not strongly flattened...
- 9a. On polypore.....***polyporaenum***
(note: *Chaenotheca brunneola* and *Chaenothecopsis caespitosa* have also been found on polypores)
- 9b. On bark of vascular plant...
- 10a. On stems and large branches of *Rhus typhina*.....***curtisii***
- 10b. Phorophyte other than *Rhus*...

- 11a. Ascomata 0.4-0.7 mm high, excipulum consisting of periclinally arranged hyphae, on *Populus*...
 Xa..Ascospores 12 - 21 μm long.....tibeticanicum
 Xb. Ascospores shorter.....populneum
- 11b. Ascomata 0.3-0.4 mm high, excipulum consisting of isodiametric or periclinally arranged cells, on *Alnus*, *Betula*, *Populus*, and *Salix*...
- 12a. Excipulum edge strongly thickened, spores 9-11 X 4-4.5 μminterruptum
 (1 possible specimen from PNW)
- 12b. Excipulum edge not strongly thickened, spores 11-17 X 4-6 μm ...
- 13a. Excipulum and stalk reddish in section, K+ intensified reddish, stalk finally dark reddish grey.....boreale
- 13b. Excipulum and stalk pale, brownish or greenish brown in section, K-...
- 14a. Mature spores often non-septate, on *Fraxinus*...."fraxinea"
 14b. Mature spores always septate...
- 15a. Mature spores with heavily pigmented septa, excipulum consisting of a single layer of isodiametric cells with thick walls 5-6 μm wide.tremulicola
- 15b. Mature spores with poorly pigmented septa, excipulum consisting of 2-3 layers of sclerotized, periclinally arranged hyphae.Stenocybe pullatula

Species included:

asciiforme Tibell (1987): 0.4-0.5 mm tall, olive or lead grey; capitulum strongly flattened; excipulum 20-25 μm thick; K-, H+; spores medium brown to greenish, 1-septate, 12-15 X 5-5.5 μm , smooth. Endemic to New Zealand

betulinum (Nyl.) Tibell: (see Tibell 1996)

boreale Tibell (1996): (see Tibell 1996)

curtisii (Tuck.) Tibell: (see Tibell 1975, Merrill 1909) average 0.5 mm tall, black to dk. brown, stalk lacking a hyaline envelope; spores ellipsoid, brown, 1-septate, 11-14 X 3.5-5.0 μm , smooth. On stems & large branches of *Rhus typhina*.

compressulum (Nyl. ex Szatala) A.F.W. Schmidt: (see Tibell 1996)

flabelliforme Tibell (1996): (see Tibell 1996)

"fraxinea"

fuegensis Tibell (1998). Ascomata flattened; spores 3-septate, brown, 17.5-20.5 μm ; on branches of *Nothofagus*, Argentina.

interruptum (Nyl.) Tibell: (see Tibell 1996)

“parvispora”

polyporaeum (Nyl.) Tibell: (see Hutchison 1987) stalk black; spores light brown, oblong-cylindrical to bacilliform-cylindrical with obtuse ends, (7.8)10.0-15.0(19.5) X (2.0)3.0-4.0 μm , (0-)1(-2) septate.

populneum (Brond. ex Duby) A.F.W. Schmidt: (see Tibell 1996)

praecedens (Nyl.) A.F.W. Schmidt: (see Tibell 1996)

tibeticum **Titov:** (Titov 2000) Ascomata stalked, 0.4 – 0.7 mm tall. Ascospores 1-septate, narrowly ellipsoidal, pale-brown 16.2 – 17.8 X 5.0 – 5.6 μm . KOH-, N-, hymenium I+blue.

tremulicola (Norrl. ex Nyl.) Tibell: (see Tibell 1996 - comb. nov.)

+ preceding citation indicates the paper where the species was described.

- preceding citation indicates a good description but lacking pictures, but many of these descriptions include citations for illustrations.

DRAFT

12. *Sclerophora*

Group 3: spores spherical, spore-mass pale, photobiont *Trentepohlia*
(genus *Sclerophora*)

1a. Spores 3-5 μm diameter.

2a. Apothecia small (0.5-0.8 mm). Capitulum pale brown with
reddish brown, K+ violet, pruina; spores 3.0-3.6 μm ...*S. peronella*

2b. Apothecia tall (1.1-3.0), excipulum forming a collar.

3a. Apothecia pale pink to pale ochraceous, stalks
reddish brown to brown, excipulum forming a distinct, white
collar paraphyses covered by yellowish red, granular
crystals, K+ dark red in ascomata, spores 3.4-4.5 μm ,
dark and humid situations in Southern Hemisphere
and Central America.....*S. sanguinea*

3b. Pruina on young apothecia violet red, older apothecia
with yellow to brown stalks and a white pruina on the
excipulum.*S. amabilis*

1b. Spores 4.5-8.5 μm diameter.

4a. Pruina yellow, K-. Apothecia white, Spores 7.2-8.4 μm .
.....*S. nivea*
(possible specimens in PNW, not yet verified)

4b. Pruina a darker color.

5a. Pruina on capitulum, violet, K-. Spores 6.6-7.8 μm .
.....*S. farinacea*
(1 probable specimen for PNW)

5b. Pruina on the whole apothecium, reddish-brown, K+ violet.
Spores 4.7-6.3 μm*S. coniophaea*
(1 probable specimen for PNW)

13. *Sphinctrina*

anglica

leucopoda

porrectula

turbinata

DRAFT

14. *Stenocybe*

Key to the species of *Stenocybe* found in contemporary literature. Taken from Peterson & Rikkinen (manuscript in progress, 11/13/97).

1a. Spores < 30 μm ...

2a. Spores 5-7 septate. ***S. fragmenta* Peterson & Rikkinen**

2b. Spores (1-)3 septate...

3a. Spores generally > 20 μm long...

4a. On conifers (*Abies* spp.). Ascomata 0.8-1.5 mm tall, black[?]; spores 20-30 X 7-10 μm , 3 septate, dark brown, ___ some description? ___. On trunks of *Abies* spp, northern hemisphere. See Tibell (1975) or Schmidt (1970).....

***S. major* (Nyl.) Körber**

4b. On hardwoods...

5a. Spores not constricted at the septa. spores 20-26 μm , not constricted at the septa. Ascomata 0.5-0.8 mm tall, black to brown and pale; spores 20-26 X 6-8 μm , 3 septate, dark brown, wall with an ornamentation of irregular cracks. On twigs of *Lonicera* sp., known only from Asia.

***Phaeocalicium ahtii* (Titov & Baibul.) Titov**

5b. Spores not constricted at the septa. Spores ca. 20-30 μm . Ascomata mostly less than 0.5 mm tall. 0-3 septate, with pale apical cells when 3 septae are well developed. On old *Cercocarpus* (*ledifolius*) trunks (on or under flaking bark) in the arid western North America (California and Nevada).

Phaeocalicium cercocarpicola

5c. Spores slightly constricted at the septa. Spores 14-30 μm , constricted at the septa. Ascomata generally less than 0.5 mm tall, blackish; spores 14-30 X 4-7 μm , (1-) 3 septate, brownish, slightly constricted at the septa. On smooth bark of young *Quercus*, known only from eastern North America. See Merrill (1909).....

***Phaeocalicium minutissima* (G. Merr.) Selva**

3b. Spores < 20 μm long...

- 6a. Stalk black, remaining opaque when moist; on *Alnus*.
Ascomata 0.5-0.8 mm tall, black; spores 10-20 X 4-5 μm , becoming 1-3 septate, uniformly pale gray brown. On twigs of *Alnus*, especially dead twigs overhanging water, northern hemisphere. See Purvis et al. (1992). ***S. pullatula* (Ach.) Stein**
- 6b. Stalk brownish, becoming pale and transparent when moist; on *Populus*. Ascomata up to 0.6 mm tall, brownish black, semi-transparent, pale brown when moist; spores 13-20 X 4-6 μm , simple or 1-3 septate, often slightly constricted at the septa, uniformly grey-brown or brown. On twigs of *Populus*, endemic to Europe. See Tibell (1996).
..... ***Phaeocalicium tremulicola* (Norrlin ex Nyl) Tibell**
- 1b. Spores > 30 μm ...
- 7a. Septa strongly but unevenly thickened to form an hour-glass shape. Ascomata 0.9-1.3 mm tall, pale to dark olivaceous or greyish; spores 35-43 X 11-14 μm , 3 septate, dark brown, thick-walled, end lumina very small and pale, wall smooth. On trunks of hardwoods, especially *Weinmannia*, endemic to New Zealand. See Tibell (1987). ***S. bartlettii* Tibell**
- 7b. Septa more or less evenly thickened, not at all forming an hour glass shape...
- 8a. On bryophytes (leafy liverworts). Ascomata 1-1.5 mm tall, black; spores 30-40 X 12-15 μm , 3 septate, central cells large, dark red-brown, with rounded oil droplets, and end cells much smaller and paler. Endemic to Europe. See Purvis et al. (1992). ***S. bryophila* W. Watson**
- 8b. On vascular plants...
- 9a. On conifers. Ascomata 1.1-2.1 mm tall, black; spores 42-55 X 10-15 μm , 5-7 septate, dark brown, walls and septa evenly thickened, pale at the apices, developing an ornamentation of minute warts. On trunks of old conifers, endemic to western North America. See Tibell (1991). ***S. clavata* Tibell**

9b. On hardwoods... Septa evenly thickened. Ascomata up to 1.8 mm tall, black; spores 35-90 X 11-20 μm , variably (1-) 3 (-6) septate, red-brown, with a small, paler, sometimes extended nipple at the apices. Endemic to Europe, mainly on trunks of *Ilex* and other hardwoods. See Purvis et al. (1992).***S. septata* (Leighton) Massal.**

ahtii Titov & Baibul.: (+Titov 1994) 0.5-0.8 mm tall, black to brown and pale; spores 3 septate, ellipsoidal, dark brown, 20-26 X 6-8 μm . The surface of the mature spores with an ornamentation consisting of irregular cracks, visible in the light microscope. On twigs of *Lonicera* sp..

bartlettii Tibell (1987): 0.9-1.3 mm tall, pale to dark olivaceous or greyish; spores 35-43 X 11-14 μm , dark brown, thick-walled and with strongly and unevenly thickened septa, 3 septate with very tiny and pale end lumina, central lumina rhomboid, end lumina conical, wall smooth.

byrophila W. Watson: (see Purvis 1992) 1-1.5 mm tall, black; Spores 30-40 X 12-15 μm , 3 septate, ellipsoid, wall thin or slightly thickened, comprising 2 large, dark red-brown, median cells, with large, rounded oil droplets and 2, much smaller, paler end cells. Partly buried in old tufts of leafy liverworts (e.g. *Scapania punctata*, *Plagiochila tridenticulata*, and *Microlejeunea ulicina*), especially on old trees and rocks in damp, humid situations.

cercocarpicola E.B.Peterson & Titov. (See Titov 2003). On *Cercocarpus ledifolius* in arid climates of western North America (known from California and Nevada), typically on and under flaking bark at the base of mature, tree-like plants. spores ca. 20-30 μm , dark brown, with 3 septae when well developed but frequently fewer or even 0 septae; when well developed apical cells are more pale than central cells. Although not yet formally described, this species was included in Titov 2003 which may be considered an invalid publication of this name, so final description may need to use a different name.

clavata Tibell (1991): 1.1-2.1 mm tall, black; spores 42-55 X 10-15 μm , dark brown, ellipsoidal to slightly fusiform, moderately and evenly thickened walls and septa; spores (3)5-7 septate, pale at a small area just at apices, old spores with very minute warts. On bark of *Pseudotsuga menziesii*.

fragmenta Peterson & Rikkinen (1998?): small, up to 0.5 mm tall, capitulum black, stalk brownish, spores 15-30 μm , ellipsoidal to fusiform, 5-7 septate, splitting at the septum after ejection from asci, eventually fragmenting into part-spores. On twigs of *Cercocarpus*, only one specimen known, from New Mexico.

major (Nyl.) Körber: (Tibell 1975) 0.8-1.5 mm tall; spores 3 septate, 20-30 X 7-10 μm , dark brown. On trunks of *Abies* spp. (North America: *balsamea*-Tibell 1975, Selva 1988; *lasiocarpa*-Tibell 1975. Europe: *alba*-Tibell 1975)

minutissima (G. Merr.) Zahlbr.: (Merrill 1909) Gen. less than 0.5 mm tall, blackish; spores (1-)3 septate, slightly constricted at the septa, brownish or livid(bluish?)-brownish, 14-30 X 4-7 μm . On smooth bark of young oaks, eastern North America.

pullatula (Ach.) Stein: (see Purvis 1992) 0.5-0.8 mm tall, slender, black; spores (10)13-18(20) X 4-5(6) μm , at first simple, becoming 1-3 septate, uniformly pale grey-brown. Twigs of *Alnus*, especially dead twigs overhanging water.

septata (Leighton) Massal.: (see Purvis 1992) up to 1.8 mm tall, black, sometimes branched at base; spores (35)45-60(90) X (11)15-20 μm , variable (1)-3-(6) septate, ellipsoid or elongate-ellipsoid, red-brown, the outer cells and septa +/- uniformly thickened, 2-2.5 μm , except for a small, paler, sometimes shortly extended nipple at one or both ends of these cells. Mainly on bark of *Ilex* trunks, rarely also on *Betula*, *Quercus*, *Sorbus* and *Corylus*.

Phaeocalicium tremulicola (Norrlin ex Nyl) Tibell: (see Purvis 1992, Tibell 1996) up to 0.6 mm tall, brownish black, semi-transparent, pale brown when moist; spores 13-20 X 4-6 μm ellipsoid, often slightly waisted, simple or 1-sometimes thinly 3 septate, uniformly grey-brown or brown, not thickened. Twigs of *Populus*.

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15. *Texosporium*

monotypic: *Texosporium sancti-jacobi* (Tuck.) Nád.

16. *Thelloma*

- 11a. Thallus with black, well-delimited groups of minute isidia or isidioid soredia, medula I+ dark blue.....*T. ocellatum*
- 11b. Thallus without isidia or soralia...
- 12a. Spores non-septate...
- 13b. Thallus with a yellow to olivaceous tinge, KC-....*T. santessonii*
- 13a. Thallus grayish, KC+ rose red...
- 14a. Spores with a very coarse ornamentation, fertile verrucae irregular in shape (see fig.s in Tibell 1976).....*T. siliceum*
- 14b. Spores with a less coarse and irregular ornamentation, fertile verrucae smooth and regular in shape (see figures in Tibell 1976).....*T. mammosum*
- 12b. Spores septate...
- 15a. Thallus placodiform, KC+ rose red.....*T. californicum*
- 15b. Thallus verrucose or rimose, KC-...
- 16b. Mature spores 22-28 X 14-15 μm , thallus thick, verrucose, PD-, on wood.....*T. occidentale*
- 16a. Mature spores 13-17 X 8-9 μm ...
- 17a. Thallus PD+ red.....*T. carolinianum*
- 17b. Thallus PD-.....*Cy. brunneum*
[probably belongs in *Thellomma*]

17. *Tholurna*

monotypic: *Tholurna dissimilis*

[in my opinion, *Calicium adaequatum* belongs here]

18. Algae

Written by Eric B. Peterson, last updated 2/10/98.

- 1a. Cells small, elongate (like beans, or short sausages), clustered or in chains, internal structure generally not visible.....**Stichococcus**
- 1b. Cells more or less round, clustered or not, internal structure generally visible...
 - 2a. Cells with carotinoid pigments occasionally to commonly visible, generally > 10 µm diameter and with a thick wall (do not confuse with a coating of hyphae).....**Trentepohlia**
 - 2b. Cells always entirely green or transparent (sometimes with a single amber colored body, possibly the pyrenoid), variable in size and wall thickness... (**Chlorococcales**)
- 3a. Cells gen. greater than 10 µm.....**Dictyochloropsis**
- 3b. Cells gen. ≤ 10 µm.....**Trebouxia** or **Trebouxioid**

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