

LICHENICOLOUS FUNGI AND LICHENS

KEY TO GENERA

Rev. 3/94

Note: the genera listed as "not yet reported from N. America" may well have other, nonlichenicolous species reported from this continent. A few nonlichenized, nonlichenicolous fungi are also included here at present.

IA. SPORES PRODUCED ON CONIDIOGENOUS CELLS: HYPHOMYCETES

After Hawksworth

Conidia hyaline or pinkish at maturity

1. Conidiogenous cells annellidic; conidiophores mononematous; conidia 03 septate, ellipsoid, with a highly refractive basal hilum.Refractohilum

1. Conidiogenous cells monoblastic or polyblastic; conidiophores indistinct, forming flesh colored, orange or reddish compact convex sporodochia; conidia nonseptate, globose or angular, without a refractive hilum.Illosporium

ADD:

Fusarium

**IB. SPORES PRODUCED ON CONIDIOGENOUS CELLS:
COELOMYCETES**

After Hawksworth

1. Conidiomata acervular or superficial and helmetshaped. Not yet reported for N. America. (Pyrenotrichum and Psammnia)
1. Conidiomata pycnidial. 2

2. Conidia shades of brown, arising singly, unicellular.
Lichenoonium
2. Conidia hyaline. 3

3. Conidia distinctly truncated at base. Conidogenous cells holoblastic. Conidia obpyriform. Pycnidial wall pseudoparenchymatous. Vouauxiomyces
3. Conidia with a rounded base. Conidogenous cells arising singly, enteroblastic (phialidic), subcylindrical or elongateampulliform; pycnidia brown or black, the wall entire, cells around the ostiole not separating. Conidia unbranched, unicellular, acrogenous (borne only at the apex). 4

4. Pycnidial wall + smooth; conidia subglobose or narrowly ellipsoid. Microcalicium (anamorphs)
4. Pycnidial wall with pointed cells projecting from it; conidia bacilliform. Conidiomata pycnidial, arising singly, uniloculate, scattered or loosely aggregated, globose, superficial or halfimmersed, dark brown to black, ostiolate; walls composed of radially oriented elongated dark brown pseudoparenchymatous cells becoming attenuated and projecting slightly at the exterior to give the whole a starlike appearance. Conidiophores absent. Conidogenous cells enteroblastic, interdigitated with the inner wall cells and lining the pycnidial cavity, acrogenous, narrowly ampulliform to broadly subcylindrical, phialidic, occasionally biphalidic, not proliferating, hyaline. Conidia subcylindrical, hyaline, simple, smooth-walled, minute, aggregated into a slimy mass which is extruded through the ostiole as a whitish drop. Asterophoma

ADD:

Conidia multicellular, composed of discrete subglobose cells, brown, arising in closed pycnidia. Phaeosporobolus

II. SPORES PRODUCED ON BASIDIA

Basidiocarp agaricoid. Fayodia

III. SPORES PRODUCED IN ASCI

After Hawksworth, Hafellner, Dennis, and others

IIIA1 Ascocarps Perithecioid or Thyriothecioid

After Dennis

1. Asci unitunicate. 2
1. Asci bitunicate. 7
2. Perithecia bright colored (red, yellow, purple, green), soft, fleshy to leathery. NECTRIACEAE
2. Perithecia dark, mostly black, carbonaceous to membranaceous. VERRUCARIACEAE. 3
3. Asci more than 8spored. 4
3. Asci 8spored. 5
4. Ascospores 1septate. Tichothecium
4. Ascospores nonseptate, small. Muellerella
5. Ascospores 1septate, brown. Discothecium
5. Ascospores multiseptate or hyaline. 6
6. Ascospores hyaline. Pharcidia
6. Ascospores brown. Phaeospora
7. Pseudoparaphyses absent; asci arising in a tuft at the base of the locule. DOTHIDEACEAE
7. Pseudoparaphyses present; asci arising from a broad area at the base and sides of the locule. 8
8. Ascospores 1celled. BOTRYOSPHAERIACEAE
8. Ascospores 2 or morecelled. PLEOSPORACEAE

IIIA2 Ascocarps Perithecioid or Thyriothecioid.

Alternate Key

After Hawksworth, 1983

1. Ascospores brown. 2
1. Ascospores hyaline. 11
2. Ascospores septate or muriform. 3
2. Ascospores nonseptate. 10
3. Ascospores transversely septate. 4
3. Ascospores muriform, with 35 transverse septa, broadly ellipsoid, over 7 um wide. On Solorina, Leptogium, or crustose lichens. Dacampia hookeri
4. Ascospores 1septate. 5
4. Ascospores 3 or moreseptate. 8
5. Asci multispored. Muelerella
5. Asci 28spored. 6
6. Interascal tissue (hamathecium) of branched and anastomosing paraphyses (paraphysoids or pseudoparaphyses). 7
6. Interascal tissue absent or gelatinized (periphyses sometimes present). Ascospores lacking conspicuous guttules, reddish brown to dark brown prior to release from the asci.
Endococcus
7. Perithecia arising singly; walls consisting of angular pseudoparenchymatous cells. Polycoccus
7. Perithecia arising in groups united by a dark clypeus; walls consisting of compacted interwoven hyphae. Clypeococcus
8. Asci 24spored. Interthelial tissue (hamathecium) of branched and anastomosing pseudoparaphyses or paraphysoids. Ascospores (17)1930(34) x (7)811(12) um. Pyrenidium (actinellum)
8. Asci 8spored. Perithecia arising singly or in small groups, not aggregated into a stroma. 9
9. Ascospores exceeding 23 um in length, finally 7septate. On Normandina pulchella. (see "Sphaerulina" chlorococca)
9. Ascospores between 12 and 22 um long. VERRUCARIACEAE. Pseudothecia scattered, minute, immersed; asci thickwalled, 48spored; ascospores 3 or moreseptate, brown.
Phaeospora

10. **Asci multispored.** Muelerella
10. **Asci 48spored.** Spores over 15 um long. Adelococcus
11. **Ascospores nonseptate and not vermiform,** with rounded ends, under 15 um long. 12
11. **Ascospores transversely septate or muriform, or vermiform.** 13
12. **Asci multispored.** Thelocarpon
12. **Asci 48spored.** Interascal tissue (hamathecium) present. Thamnogalla (crombei)
13. **Ascomata pink, orange, red, rose or + hyaline;** interascal tissues absent. Perithecia not developed on a stroma. Spores 1septate. Perithecia subglobose, smooth, brightly colored, erumpent; otherwise like those of Nectria. Nectriella
13. **Ascomata greenish, brown or black;** interascal tissues absent. Ascomata perithecioid, flaskshaped. Spores over 4 um wide. Perithecia ostiolate; wall cells without Munk pores. 14
14. **Interascal tissues present.** Ascomata perithecioid, sunken in the thallus or ascocarps of the host, with "prformiertem" ostiole, without papilla, under the lens the exposed part appearing black. Excipulum at base pale bluish, brownish to hyaline, in the ostiole region intensely pigmented, blueblack, blueviolet, bluegreen, or other colors, small celled, not distinctly paraplectenchymatous, composed of a kind of shortseptate "textura intricata". Asci fissitunicate, cylindrical, 1; endoascus somewhat thickened apically and in the center of the thickening with a small invagination. Paraphysoids filiform, anastomosed. Spores 48, often with aborted spores present, hyaline, with 1 or several cross septa, the lower cell(s) often distinctly narrower; perispore very thin, disappearing. Cercidiospora
14. **Interascal tissues absent or gelatinized.** 15
15. **Ascospores 1septate.** Perithecia lacking setae. Stigmidium
15. **Ascospores 3 or moreseptate,** over 15 um long. On Normandia pulchella. "Sphaerulina" chlorococca

ADD:

Ascomata at first immersed, subglobose and perithecioid, later

becoming erumpent and opening to become apothecioid, either by radial splits in the exciple or not, arising singly or loosely aggregated, black; exciple massively developed, dark brown to black, brittle, composed of thickwalled interwoven short celled hyphae (textura intricata), pale brown inside and to almost black at outer margin, the margin lacking external marginal hairs, with small periphysoids in lower parts; hamathecium of persistent delicate filiform paraphyses, septate, unbranched, not or slightly swollen at apex; centrum I; asci narrowly cylindrical, with a single functional wall alayer, short stalked, the apex abruptly thickened and with an internal apical beak sometimes evident when young; discharge by apical rupture; outer membrane I or slightly bluish, other tissues I; 8spored. Spores irregularly overlapping monostichously, ellipsoid, rounded at apices, colorless, smooth walled, lacking gelatinous sheath, 3septate to submuriform. Anamorph unknown. Lethariicola

VERRUCARIACEAE. Asci with more than 8 spores; spores small and nonseptate (or 1septate?). Muellerella

VERRUCARIACEAE. Pseudothecia small, immersed in lichen thalli or apothecia; asci thickwalled, 4 or 8spored; ascospores hyaline, 13septate. "Pharcidia"

PYRENOXYCETES. Ascocarps extremely small (4080 um diam.). Spores 13septate. Pseudothecia without hairlike protrusions. Growing obligately within the epinecral layer of crustose lichens, forming a characteristic net of dark brown, thickwalled hyphae. Sphaerellothecium

IIIB Ascocarps Stalked and/or Mazaedioid

After Hawksworth, 1983

1. Ascospores hyaline or greenish, ornamented with spiral bands.
..... Microcalicium

1. Ascospores pale brown to dark brown; ornamentation
various. 2

2. Ascospores 1septate. 3

2. Ascospores nonseptate. Sphinctrina

3. Ascospores coarsely ornamented, over 5 μ m wide. 4

3. Ascospores smoothwalled, under 5 μ m wide.

Chaenothecopsis

4. Ascomata stalked or \pm sessile, on a yellowish green soresdiate
crust. Ascospores(9)1115(18) x 58 μ m, irregularly coarsely
verrucose. Calicium (corynellum)

4. Apothecia all sessile, on Pertusaria. Ascospores 1115 x 68
 μ m, coarsely spirally striate at first but developing irregular
ridges and cracks with age. Cyphelium (sessile)

Cyphelium

IIIC Ascocarps Lirelliform

1. **Ascomata in the form of starshaped clusters.** Not yet reported for N. America. Hemigrapha (astericus)

1. **Ascomata ± elongate.** 2

2. **Ascospores 1septate, brown.** No lichenicolous species yet reported for N. America. Melaspilea (including Mycomelaspilea)

2. **Ascospores 3 or more septate, hyaline or brown.** Opegrapha (including Opegraphoidea)

IIID Ascocarps Apothecioid

IIID1 Key to and by Families, after Dennis

1. Asci bitunicate. Hymenium often I+ blue.

PATELLARIACEAE

1. Asci unitunicate. 2

2. Asci less than 50 um long. Ascospores minute. Apothecia translucent, waxy when fresh. ORBILIACEAE

2. Asci more than 50 um long. 3

3. Excipulum composed of large subglobose to polyhedral cells. DERMATEACEAE

3. Excipulum composed of elongated cells or hyphae. HELOTIACEAE

IIID2. Artificial Key to Genera, after Hawksworth

1. Ascospores brown. 2
1. Ascospores hyaline. 11
2. Ascomata arthonioid, without excipulum, often irregular or branched. Arthonia
2. Ascomata lecideoid, often with excipulum, usually rounded, and never branched. 3
3. Apothecia marginate, often concave; excipular tissues distinct; asci I+ blue at least in parts. 4
3. Apothecia emarginate, strongly convex, lacking distinct excipular tissues even when young; asci I. Ascospores 1septate. Ascocarps immersed then sessile, round, flat then convex, the margin thin, disappearing, the disc black, almost waxy. Asci clavate, rounded and often thickened above, 48spored. Paraphyses branched, septate. Hypothecium brown. All species lichenicolous. Abrothallus
4. Interthecial tissues of branched and anastomosing netlike paraphysoids. Apical apparatus not Physciatype. Paraphyses strongly anastomosing. 5
4. Interthecial tissues of simple or sparsely branched paraphyses. 6
5. Spores without gelatinous halo, 2celled, with torus. Uppermost part of tholus I+ intense blue. Apothecia erumpent from areoles. On Baemocyces. Epilichen
5. Spores with gelatinous halo, 2celled, several celled transversely, or muriform, persistently hyaline to brownblack. Apical apparatus of asci variable. Apothecia (in lichenized species) between the areoles, often on the prothallus. Rhizocarpon
6. Ascospores with 13 transverse septa, muriform or not. 7
6. Ascospores with 4 or more transverse septa, usually muriform. 10
7. Ascus without a distinct I+ blue cap, with an I+ blue internal apical tholus. Apical apparatus of Physciatype. Paraphyses mostly only branched above. 8
7. Ascus with a distinct I+ blue gelatinous cap or sheath, the internal parts I. Asci without apical apparatus, the ascus tip always with an I+ intense blue gelatinous cap, but many species

have a central I pore. Spores 2celled, parallel severalcelled or weakly muriform. Lichenicolous, saprophytic or on other cryptogams..... Dactylospora

8. Spores 1septate. 9

8. Spores 3septate to submuriform. Diploetomma

9. Spores without wall thickenings, even in K. Apothecialmargin of most species lecideine to biatorine. Spores 2celled, several celled transversely, or muriform. Buellia

9. Spores at least in K with characteristic wall thickenings. Apothecial margin of most species entirely or partly lecanorine. Spores usually 2celled. Rinodina

10. Apothecia with proper margin only. Spores 1523(27?) x 46 um. Dactylospora urceolata

10. Apothecia with thalline and proper margins. Spores over 8 um wide. Diploschistes (muscorum)

11. Ascomata arthonioid, effuse. 12

11. Ascomata lecideoid, discrete. 13

12. Spores nonseptate. Phacopsis

12. Spores 13septate. Ascomata with a continuous hymenium, unilocular. Arthonia

13. Ascospores mainly over 20 um long. 14

13. Ascospores mainly under 20 um long. 15

14. Spores 815 septate. Arthrorhaphis

14. Spores 07septate, between 2 and 5 um wide, 03septate. Asci odontotrmoid, I. Exciple with hairs. Skyttea

15. Spores 1septate, over 8 um long. 16

15. Spores nonseptate, ellispoid to subcylindrical or fusiform. 18

16. Apothecial discs urceolate, with a porelike opening; exciple extending into pale haris around the pore. Skyttea

16. Apothecial discs exposed; exciple not extending into hairs. 17

17. Apothecia immersed, colorless to pale brown. Corticifraga

17. Apothecia superficial, dark reddish brown to black.

Catillaria spp. may also key out here. "Scutula"

18. **Ascospores over 4 um wide.** Apothecia disc lacking a sterile central umbo. 19
18. **Ascospores under 4 um wide.** Apothecia black. 22
19. **Lichenicolous lichens forming an independent thallus.** [Some Lecidea spp. may also key out here]. Rimularia
19. **Lichenicolous fungi not forming an independent lichenized thallus.** 20
20. **Apothecia reddish brown, dark brown or black.** 21
20. **Apothecia colorless to pale brown, immersed.** Corticifraga
21. **Epithecium reddish brown.** Apothecia sessile, erumpent, black, subgelatinous; asci 8spored; ascospores hyaline, nonseptate; paraphyses forked; hymenium I+ blue. Nesolechia (oxyspora)
21. **Epithecium bluish or greenish blue.** [Some Lecidea spp. may lso kye out here]..... Carbonea (vitellinaria)
22. **Apothecia disc urceolate, opening porelike or cruciate, the recurved exciple margin extending into hairs.** Skyttea
22. **Apothecial disc lecideine, exposed from an early stage; exciple margin not extending into hairs.** Lecidea (pr. p.)

Key to Genera of "Karschia" s. lato

After Hafellner

1. Asci unitunicate, without stainable apical apparatus. Spores walls with pale outer and brown inner wall layers. Type species is lichenicolous. (Stratisporella)
1. Characteristics not in the above combination. 2
2. Asci with apical apparatus enclosed in the tips or with gelatinous cap, which is I+ intense blue. 3
2. Asci bitunicate, with "Jackinthebox" type dehiscence, I or at most the hymenial gelatin I+ slightly bluish. 7
3. Asci without apical apparatus, the ascus tip always with an I+ intense blue gelatinous cap, but many species have a central I pore. Spores 2celled, parallel severalcelled or weakly muriform. Lichenicolous, saprophytic or on other cryptogams. Dactylospora
3. Asci with internal apical apparatus. Species lichenized or lichenicolous. 4
4. Apical apparatus of Physciatype. Paraphyses mostly only branched above. 5
4. Apical apparatus not Physciatype. Paraphyses strongly anastomosing. 6
5. Spores without wall thickenings, even in K. Apothecial margin of most species lecideine to biatorine. Spores 2celled, several celled transversely, or muriform. Buellia
5. Spores at least in K with characteristic wall thickenings. Apothecial margin of most species entirely or partly lecanorine. Spores usually 2celled. Rinodina
6. Spores without gelatinous halo, 2celled, with torus. Uppermost part of tholus I+ intense blue. Apothecia erumpent from areoles. On Baemocyces. Epilichen
6. Spores with gelatinous halo, 2celled, several celled transversely, or muriform, persistently hyaline to brownblack. Apical apparatus of asci variable. Apothecia (in lichenized species) between the areoles, often on the prothallus. Rhizocarpon
7. Pseudothecia fragile, shortstalked, sessile on a subiculum. Spores hyaline. Type species on Cupressaceae. (Pseudodiscus)

7. Characters not in the above combination. 8
8. Spores with distinct terminal germination pores. Excipulum at least partly of textura intricata. Asci firmwalled. Saprophytic or parasitic on higher plants. (Eutrybliidiella)
8. Spores without noticeable germination pores. Excipulum pseudoparenchymatous. 9
9. Pseudothecia from the beginning apothecioid. Excipulum cells at least in the margin distinctly radiating. 10
9. Pseudothecia at first closed, later opening above or the covering layer breaking up. Excipulum cells in the margin at most indistinctly radiating. 11
10. Spores with strong tendency to break at the septa. Asci narrowly cylindrical. Type species saprophytic. (Colensoniella)
10. Spores not breaking at the septa. Asci broadly clavate to ventricose. Type species saprophytic. (Schrakia)
11. Covering layer breaking early, but often a small piece remaining over the hymenium. At least two species are lichenicolous. Karschia
11. Covering layer opening with pore and/or stellately splitting. 12
12. Pseudothecia with persistent margin partly covering the hymenium. Type species saprophytic. (Heteropshaeriopsis)
12. Covering layer, after stellately splitting, broadly exposing the hymenium. 13
13. Pseudothecia growing not only centrally, but also with free hyphae from the flanks of the exciple, which penetrate the substrate. Ascus wall layers difficult to distinguish. Type species saprophytic. (Rhizodiscina)
13. Pseudothecia growing only centrally or with the entire base of the substrate, or breaking through this. Asc wall layers slightly distinguishable. 14
14. Ripe spores deep honeybrown, with somewhat broken wall. Saprophytic. (Poetschia)
14. Ripe spores pale brown, with continuous wall. Lichenicolous. Ascocarps scarcely to 0.5 mm diam. Buelliella.

ADD (mostly to key IIID2):

Ripe spores pale brown, with continuous wall. Lichenicolous. Ascocarps scarcely to 0.5 mm diam. Ascocarps sessile on the host thallus, first erupting and punctiform, later opening up. Excipulum uniformly thin, pseudoparenchymatous. Spores thinwalled. All parts I. Buelliella

Thallus immersed within substrate but surface often paler. Photobiont absent. Ascomata apothecia. Thalline exciple absent; true exciple poorly developed. Epithecium redbrown, nongranular, K+ dissolving. Hymenium I+ blue. Hypothecium colorless to pale straw. Paraphyses branched and entangled, especially towards apices, slender, slightly swollen at apices. Asci 8spored, Trapelialike. Ascospores colorless, nonseptate. No substances. On bark or wood. Agyrium

LECANORALES. On crustose lichens on rock, forming cecidia (galls). Apothecia black, to 0.6 mm diam., umbonate, the excipulum well developed, carbonaceous to dark pigmented. Hymenium to 110 um high, hylaine, I+ blue, I(conc.)+ blue to intense red. Paraphyses not moniliform. Asci 8spored; tholus Lecideatype; spores hyaline, simple. Pycnospores bacilliform. On Lecidea or Porpidia spp, forming galls. Cecidonia

Ascocarp sessile to stipitate, globose to urnshaped or cupshaped, mostly flat, thin margined. Exciple pseudoparenchymatous. Paraphyses furcate above, septate, thin, the tips swollen, forming a thick, pigmented epithecium. Asci clavate, stalked, mostly 8spored. Spores hyaline, acicular to threadlike, straight or curved, many septate. Lahmia

Apothecia sessile, eruptent, black, subgelatinous; asci 8spored; spores becoming brown, 27(?)septate; paraphyses forked; hymenium I+ blue. Leciographa

Ascomata at first immersed, subglobose and perithecioid, later becoming eruptent and opening to become apothecioid, either by radial splits in the exciple or not, arising singly or loosely aggregated, black; exciple massively developed, dark brown to black, brittle, composed of thickwalled interwoven short celled hyphae (textura intricata), pale brown inside and to almost black at outer margin, the margin lacking external marginal hairs, with small periphysoids in lower parts; hamathecium of persistent delicate filiform paraphyses, septate, unbranched, not or slightly swollen at apex; centrum I; asci narrowly cylindrical,

with a single functional wall layer, short stalked, the apex abruptly thickened and with an internal apical beak sometimes evident when young; discharge by apical rupture; outer membrane I or slightly bluish, other tissues I; 8-spored. Spores irregularly overlapping monostichously, ellipsoid, rounded at apices, colorless, smooth walled, lacking gelatinous sheath, 3-septate to submuriform. Anamorph unknown. Lethariicola
Pseudothecia gregarious, superficial, at least at maturity, black. Asci cylindrical. Ascospores uniseriate or biseriate, brownish, with more than one septum. Melanomma

Apothecia completely immersed, flask-shaped, having their long axis parallel with that of the twig, ending in a curved neck which opens by a pore. Asci cylindrical; ascospores threadlike. Robergea

Ascocarps sessile, eruptive, black, subgelatinous, globose then round and cup-shaped, flat and thin-margined, then convex and immarginate. Asci ovoid or clavate, thick walled especially above, 8-spored. Spores ovoid, clavate or ellipsoid, 1-septate, hyaline, often with oil drops, biseriately arranged. Paraphyses filiform or branched, septate, the tips enlarged and colored. Hypothecium thick, mostly colored. Hymenium I+ blue then red or violet. Scutula

HELOTIALES. Skytella

ONDONTREMIDS. Apothecial disc urceolate, the opening pore-like or cruciate, the recurved exciple margin extending into hairs. Spores under 10 µm long. Skyttea