

Studies in the Stromatic Sphaeriales of Indiana¹

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This paper is the first in a series of taxonomic reports covering the stromatic members of the order Sphaeriales. An attempt is made here to organize and to complete, where possible, the scattered and often unrelated or incomplete data concerning the Indiana species of the family Xylariaceae, and to present it in such a manner that it will form a workable basis for future taxonomic investigation or for classroom determination of collections.

During the preparation of this study specimens were available from the following institutions: DePauw University (DPU)²; Indiana University (IU); Miami University (MU); Division of Mycology and Disease Survey of the Bureau of Plant Industry, U. S. Department of Agriculture (BPI); and Wabash College (WAB).

Sincere appreciation is acknowledged to the following persons who assisted the author in locating either herbarium material or literature: Doctor A. R. Bechtel, Wabash College; Doctors R. E. Cleland and Paul Weatherwax, Indiana University; Doctor C. L. Porter, Purdue University; Howard Youse, DePauw University; Miss Nellie M. Coats, Librarian of the Indiana Academy of Science Library; and various staff members of the Lloyd Library and Museum and of the libraries of the Farlow Herbarium at Harvard University, the Philadelphia Academy of Sciences, Indiana University, University of Illinois, and Purdue University.

Particular indebtedness is acknowledged to Doctor Truman G. Yuncker and to Doctor Winona H. Welch of the Botany Department of DePauw University whose resources of information, advice, and friendly encouragement were made freely available to the author throughout the course of his work.

XYLARIACEAE

Xylarieae Winter, in Rabenhorst, *Kryptogamen-Flora*. 1 (Div. II): 842. 1887.

Xylariaceae Lindau, in Engler and Prantl, *Die Natürlichen Pflanzenfamilien*. 1 (Div. I): 480. 1897.

¹ A portion of a major thesis (A Monographic Study of the Indiana Species of the Stromatic Sphaeriales) presented to the Faculty of the Department of Botany, DePauw University, in partial fulfillment of the requirements for the degree Master of Arts, June 1946.

² These abbreviations are used in locating specimens referred to in the citations following each species description throughout this paper.

Stromata quite variable in form and size, mostly free, but often more or less sunken in the matrix; either upright and often branched or horizontal, effused, crustaceous, pulvinate, globose, or hemispherical, mostly black or becoming black, of woody, carbonaceous or suberose-carnose consistence. In *Rosellinia* the stroma exists as a thin sterile wall of dark fungal tissue surrounding each separate perithecium. Young stromata clothed with a conidial layer. Perithecia membranaceous, seated under a more or less well-developed ectostroma, with the bases in entostromatic tissue. A subiculum often present. Asci long cylindrical; stalks long and filiform, or short with asci almost sessile. Asci lining the bases and sides of the perithecia. Paraphyses thread-like, branched, completely filling the perithecial cavity at an early period and more or less gelatinizing at maturity. Ascospores unicellular, light brown to black, inequilaterally elliptical, fusoid, or globose, uniseriate in the ascus. Conidiophores hyphomycetous, covering the exposed ectostroma, branched. Conidia single or in clusters, minute, borne apically and becoming lateral by the continued growth of the conidiophore.

KEY TO THE GENERA

1. Perithecia single to aggregate, superficial.....*Rosellinia*
Perithecia several to many in a stroma..... 2
2. Stroma stalked, simple to branched, base sterile..... *Xylaria*
Stroma effuse, pulvinate to globose, sessile..... 3
3. Entostromatic zonation prominent..... *Daldinia*
Entostromatic zonation lacking or inconspicuous..... 4
4. Stroma becoming more or less hollow at maturity..... *Ustulina*
Stroma mostly entirely persistent..... 5
5. Stroma orbicular, cup-shaped, or discoid..... *Nummularia*
Stroma otherwise (globose, pulvinate, or effused).... *Hypoxylon*

DALDINIA Cesati & DeNotaris

Daldinia Cesati & DeNotaris, Schema Sfer. Ital. 4:197. 1863.

Stromata superficial, hemispherical, subglobose, globose, or turbinate; sessile, substipitate, or stipitate. Ectostroma carbonaceous, at first pruinose, later dull black, shining, or laccate. Entostroma dense or lacunate, white, gray, or brown; conspicuously concentrically zonate. Perithecia claviform to subglobose, immersed in the stroma; ostiola obsolete to protruding. Asci cylindrical, soon disappearing, 8-spored, the spores obliquely uniseriate. Ascospores simple, ellipsoid to navicular, light to dark brown.

KEY TO THE SPECIES

- Entostroma persistent.....1. *D. concentrica*
Entostroma collapsing, loculate..... 2. *D. vernicosa*

1. *Daldinia concentrica* (Bolton) Cesati & DeNotaris

- Valsa tuberosa* Scopoli, Fl. Carniolica, ed. 2, 2:399. 1722.
Lycoperdon fraxineum Hudson, Fl. Angl. 2:641. 1778.
Sphaeria concentrica Bolton, Hist. Fung. Halifax, 3:180. 1789.
Sphaeria tunicata Tode, Fungi Meckl. Sel. 2:59, pl. 17, fig. 130. 1791.
Lycoperdon atrum Schaeffer, Icon. Fung. Bav. et Pal. 4:131, pl. 329. 1800.
Sphaeria fraxinea Withering, Arrang. Brit. Pl., ed. 5, 4:429. 1812.
Sphaeria hemisphaericae Nees, Syst. d. Pilze, 1:291. 1817.
Sphaeria concentrica Bolton, in Fries, Syst. Mycol. 2:331. 1823.
Stromatosphaeria concentrica Greville, Fl. Edinensis, 355. 1824.
Sphaeria placenta Link, Linnaea, 5:539-540. 1830.
Hemisphaeria concentrica Klotzsch, Acad. Caes. Leop. Nova Acta, 19:241. 1843.
Daldinia concentrica (Bolton) Cesati & DeNotaris, Schema Sfer. Ital. 4:197. 1863.

Stromata hemispherical to globose, sessile to stipitate, single or coalescing, 1-10 cm. long x 1-7 cm. wide x 1-7 cm. tall, rubiginous when young, erumpent from the bark or superficial on decorticated wood. Ectostroma moderately thin, dark brown, later becoming black and either dull or shiny. Entostroma densely fibrous, persistent, conspicuously concentrically zoned, the lighter zones up to three times wider than the darker zones. Perithecia usually monostichous, rarely polystichous, claviform to subclaviform. Ostiola punctiform to somewhat prominent. Ascospores inequilaterally ellipsoid, brown, the ends sometimes of a lighter color and more refractive, mostly 12-14 x 5-7 microns. Specimens examined:

- Clark Co.: on mulberry, Borden, Nov. 2, 1908, *J. M. Van Hook 2435* (IU).
 Jasper Co.: on decaying stump, Fountain Park woods, one mile north of Remington, July 11, 1935, *Winona H. Welch* (DPU).
 Knox Co.: on slabs of bark from lumber yard, in an apple orchard, near Vincennes, Oct. 20, 1934, *M. A. Byers* (DPU).
 Monroe Co.: Bloomington, Nov. 12, 1908, *J. M. Van Hook 2468* (IU).
 Montgomery Co.: on old log, in woods near Crawfordsville, Aug. 24, 1917, *Bruce Fink 175* (MU); near crinoid beds, Crawfordsville, March 18, 1910, *J. Schraum* and *H. W. Anderson* (WAB).
 Putnam Co.: on decaying log, along Mill Creek, Hoosier Highlands, June 3, 1936, *Winona H. Welch 2249* (DPU); Greencastle, 1932-1933, *F. Shuttleworth* (DPU); on dead wood, in cleared woods south of Greencastle, Oct. 9, 1935, *H. Youse 23* (DPU); on decaying log, DePauw Arboretum, Oct. 25, 1945, *Simmons 1130* (DPU); on decaying branches, DePauw Arboretum, Oct. 25, 1945, *Simmons 1131* (DPU); on fallen beech log, Fern, Oct. 12, 1945, *Simmons 1132* (DPU); on fallen log of *Ulmus* sp., Fern, Oct. 12,

1945, *Simmons 1133* (DPU); on fallen log, Hoosier Highlands, Sept. 16, 1941, *Simmons 1134* (DPU).

Scott Co.: Scottsburg, 1907, *J. R. Weir 8964* (BPI); on *Hicoria ovata*, May 1901, *J. R. Weir 2751* (BPI); on *Hicoria ovata*, June 1912, *J. R. Weir 7433* (BPI).

The macroscopic appearance of the fruiting structures of this species is fairly constant except that when it is found growing on very porous or decaying wood the fruiting structures often attain an abnormally greater size. *D. concentrica* (Bolt.) Ces. & DeN. is of common occurrence in Indiana and is readily identified by means of its fibrous, persistent, concentrically zoned entostroma.

2. *Daldinia vernicosa* (Schweinitz) Cesati & DeNotaris .

Hypoxyylon concentricum (Bolton) Fries var. *obovatum* Fries, Syst. Mycol. 2:331. 1823.

Sphaeria vernicosa Schweinitz, Journ. Acad. Sci. Phil. 5:9. 1825.

Sphaeria cingulata Lévillé, Ann Sci. Nat. Bot. 3:47. 1845.

Daldinia vernicosa (Schweinitz) Cesati & DeNotaris, Comm. della Soc. Critt. Ital. 1:198. 1863.

Hypoxyylon vernicosum (Fries) Berkeley & Curtis, Journ. Linn. Soc. Bot. 10:384. 1867.

Daldinia cingulata (Lévillé) Saccardo, Syll. fung. 1:395. 1882.

Daldinia fissa Lloyd, Mycol. Writings, 7:1313. 1924.

Stromata subturbinate to turbinate, contracted below into a distinct rugose stipe with annular zones externally visible, stromata usually single, occasionally confluent, fragile, 0.6-3.5 cm. long x 0.5-2.5 cm. wide x 0.8-2.5 cm. tall. Entostroma conspicuously zonate, the lighter zones usually gray-white or yellowish-gray, fibrous, collapsing and loculate, 2-4 times broader than the darker and more persistent brown to black zones. Ectostroma thin and carbonaceous, brittle, at first brown, finally shiny or laccate and black. Perithecia monostichous or polystichous, ovoid-oblong to subglobose. Ostiola punctiform to somewhat prominent. Ascospores usually brown to dark brown, the ends obtusely rounded, mostly 11-13 x 5-7 microns. Conidia single or in whorls, subglobose to ovoid, hyaline, 2.5-3 x 2.5-3 microns.

Specimens examined:

Decatur Co.: on hardwood trunk, Sandusky, Aug. 17, 1912, *M. C. Jensen* (BPI).

Scott Co.: on dead *Quercus alba*, Scottsburg, 1908, *J. R. Weir 21070* (BPI).

This species is easily distinguished from *D. concentrica* (Bolt.) Ces. & DeN. by reason of the more distinctly stipitate nature of the fruiting body and the loculate, collapsing appearance of the entostroma.

HYPOXYLON Fries

- Hypoxyton* Fries, Summa Veg. Scand. 383. 1849.
Penzigia Saccardo, Mycol. Malac. 20. 1888.
Alboffia Spegazzini, An. Mus. Nac. 1:295. 1899.
Squamotubera Hennings, Hedwigia, 42:(308). 1903.
Spirogramma Ferd. & Wing., Vid. Med. For. Kjob. 142. 1909.
Theissenia Maublanc, Bull. Soc. Mycol. Fr. 30:52. 1914.
Pyrenopolyporus Lloyd, Mycol. Notes, 50:76. 1917.
Entoleuca Sydow, Ann. Mycol. 20:186. 1922.

Stromata globose to pulvinate to effused, erumpent, leathery, woody, or carbonaceous when mature. Perithecia several to many in a stroma. Asci cylindrical, arranged on sides and bottom of perithecia, 8-spored. Paraphyses numerous, thread-like. Ascospores brown to black, with an elongate, hyaline depression, uniseriate in the ascus. Conidial layer formed first on an exposed ectostroma, later developing on old stromata in favorable weather. Conidiophores branched, hyphomycetous, hyaline to greenish-brown; conidia minute, borne apically, becoming lateral by the sympodial growth of the hypha.

KEY TO THE SPECIES

1. Ostiola umbilicate or punctiform; stroma usually woody with red to purple ectostroma and dark-colored entostroma 2
 - Ostiola annulate; stroma carbonaceous, black 6
 - Ostiola papillate; entostroma thick, carbonaceous or fibrous to thin, almost lacking 9
2. Stroma globose, subglobose, or hemispherical 3
 - Stroma effused 5
3. Ascospores 8 microns long or less 8. *H. Howeianum*
 - Ascospores more than 8 microns long 4
4. Stroma subglobose to globose; asci (sp. p.)³ 55-75 microns long 3. *H. coccineum*
 - Stroma hemispherical to depressed-pulvinate; asci (sp. p.) 75-90 microns long 7. *H. fuscum*
5. Ostiola prominently white-margined; ectostroma rusty purple 14. *H. perforatum*
 - Ostiola margins not differing in color from other stromatic material; ectostroma bright red to reddish-brown 16. *H. rubiginosum*
6. Stroma semipulvinate to hemispherical 7
 - Stroma effused 8

³ sp. p. is used here to indicate measurements of the spore-containing portion of the ascus.

7. Perithecia small (0.5 mm.), deeply and evenly sunken in the substance of the stroma 11. *H. marginatum*
 Perithecia larger (0.7-1 mm.), prominent, many projecting half their length beyond the surface of the stroma 1. *H. annulatum*
8. Asci (sp. p.) 50-60 microns long 5. *H. effusum*
 Asci (sp. p.) 60-70 microns long 1. *H. annulatum*
9. Perithecia sunken in the substratum 12. *H. Morsei*
 Perithecia not sunken in the substratum 10
10. Stroma large (3-4 x 2.5-3 cm.), centrally attached, surface in folds or ridges 15. *H. Petersii*
 Stroma not entirely as above; may be globose, hemispherical, turbinate, or variously effused 11
11. Stroma globose, hemispherical, turbinate or pulvinate 12
 Stroma variously effused 14
12. Ascospores 9 microns or less in length 17. *H. Sassafras*
 Ascospores more than 9 microns in length 13
13. Stroma hemispherical, globose, or turbinate 4. *H. cohaerens*
 Stroma usually elliptical and depressed-pulvinate 13. *H. multiforme*
14. Stroma broadly effused 15
 Stroma in small effused patches, rarely exceeding 2 cm. in any dimension except by confluence 18
15. Ectostroma white 2. *H. atropunctatum*
 Ectostroma black or becoming black at maturity 16
16. Ascospores 20-28 microns long 19. *H. stigmatum*
 Ascospores less than 20 microns long 17
17. Perithecia regularly oblong, densely crowded 10. *H. investiens*
 Perithecia globose, prominent 13. *H. multiforme*
18. Ascospores mostly 8 microns long 9. *H. insidens*
 Ascospores more than 9 microns long 19
19. Ascospores mostly 9 x 3.5 microns 6. *H. epirrhodium*
 Ascospores 12-16 x 5-6 microns 18. *H. serpens*

1. *Hypoxylon annulatum*¹ (Schweinitz) Montagne

Sphaeria annulata Schweinitz, in Fries, Elench. Fung. 2:64. 1828.

Hypoxylon annulatum (Schweinitz) Montagne, Syll. Crypt. 213. 1856.

Stromata hemispherical (when growing from bark) or indeterminately effused (when on decorticated wood). Young stromata dark brown, at maturity black, hard, carbonaceous. Ectostroma loose and subiculum-like (on wood), formed by coalescence of the mycelium arising from ascospores. Perithecia large, nearly globose, about 1 mm. in diameter. Apices of perithecia flattened into a truncate disk with the papillate ostiolar necks in the center. Asci cylindrical, 95-110 microns long, sp. p. 60-70 microns long. Ascospores uniseriate in asci, inequi-

laterally elliptical, 7-9 x 3-4 microns, dark brown at maturity. Conidial layer arising from ectostroma as a thick, brown subiculum. Conidiophores much branched.

Specimens examined:

Monroe Co.: on ash, Bloomington, Jan. 17, 1914, *Ramsey* (IU); on oak, Unionville, Nov. 12, 1910, *Owens* (IU).

Putnam Co.: on dead poplar, Greencastle, Oct. 12, 1907, *Banker* (DPU); Fern, April 1893, *L. H. Underwood* (DPU); on rotten beech stump, Greencastle, Jan. 22, 1908, *Daisy G. Lewis* (DPU); on dead log, Limesdale, March 26, 1933, *Ray Dawson 76* (DPU).

Wabash Co.: on elm stump, Roann, March 23, 1908, *Daisy G. Lewis* (DPU).

H. annulatum (Schw.) Mont. is a fairly common Indiana species. The annulate-truncate nature of the perithecia is usually well-defined although the stromata may vary in form from hemispherical to effused. The perithecia of this species, in contrast to the small, evenly immersed perithecia of *H. marginatum* (Schw.) Berk., are noticeably large and prominent. Comparison of specimens of *H. annulatum* and of *H. effusum* Nke. reveals that the former has more prominent annular disks and longer asci, for the most part, than does the latter.

2. *Hypoxylon atropunctatum* (Schweinitz) Cooke

Sphaeria atropunctata Schweinitz, Syn. fung. Car. 5. 1822.

Anthostoma atropunctatum Saccardo, Syll. fung. 1:295. 1882.

Hypoxylon atropunctatum (Schweinitz) Cooke, Grevillea, 13:15. 1884.

Stromata white, punctate with black ostiolar papillae, widely effused, circumscribed by a black line. Ectostroma white, hard, carbonaceous. In old stromata the white layer peels off entirely or in patches leaving a black entostroma exposed. Entostroma very thin, black, leaving perithecia almost in contact with the wood. Perithecia globose to flask-shaped, 200-300 microns in diameter, in a single layer, not crowded. Ostiolar papillate. Asci 150-160 x 12-14 microns with very short stalks. Ascospores uniseriate, 25-30 x 11-14 microns, black at maturity, elliptical with pointed ends. Paraphyses filiform. Conidiophores very long and branched, producing masses of globose conidia 5-6 microns in diameter.

Specimens examined:

Monroe Co.: on oak, Unionville, Nov. 12, 1910, *Owens* (IU); on beech, *J. M. Van Hook 2438* (IU).

Montgomery Co.: on oak stump, in open wood near Crawfordsville, July 27, 1917, *Fuson 100* (MU).

Orange Co.: on beech, March 26, 1910, *Owens* (IU).

The white ectostroma of specimens of *H. atropunctatum* (Schw.) Cke. is a prominent and constant character which readily distinguishes it from mature specimens of other Indiana members of the genus.

3. *Hypoxyylon coccineum* Bulliard

Hypoxyylon coccineum Bulliard, Hist. Champ. Fr. 174. 1791.

Stromata erumpent-superficial, subglobose, generally 0.25-0.75 cm. in diameter, deep brick-red when mature, often paler when young, solitary or subconfluent. Perithecia peripheral in a single layer, small, subglobose, slightly prominent. Ostiola umbilicate or punctiform. Asci cylindrical, sp. p. 55-75 x 6-7 microns. Ascospores uniseriate, opaque, inequilaterally elliptical, 9-12 x 4-5 microns. Paraphyses abundant, simple.

Specimens examined:

Brown Co.: on beech, Trevlac, Oct. 13, 1908, *Burger* (IU).

Monroe Co.: on beech, Unionville, Nov. 7, 1910, *Owens* (IU); on beech, Bloomington, Fall 1907, *J. M. Van Hook* (IU).

Montgomery Co.: on *Fagus sp.*, Summer 1928, *A. R. Bechtel* (IU); on beech bark, Crawfordsville, Spring 1929, *A. R. Bechtel 832* (WAB); at Shades Park, Oct. 2, 1910, *M. B. Thomas* (WAB); Turner's Woods, near Crawfordsville, May 21, 1941, *Simmons 1102* (DPU); on fallen branches, Offield Creek, S. W. Crawfordsville, Nov. 25, 1940, *D. Yoder* (DPU).

Owen Co.: on maple, State Park, December 1930, *Martens* (IU).

Parke Co.: on dead branch, Turkey Run State Park, Nov. 22, 1940, *L. Lee* (DPU).

Putnam Co.: Fern, November 1892, *L. M. Underwood* (DPU); on decaying tree branch, in ravine over stream 1-2 miles N. W. Greencastle, April 8, 1943, *Winona H. Welch 9004* (DPU); on fallen beech log, Fern, Oct. 12, 1945, *Simmons 1181* (DPU); on bark of fallen log, shaded ravine, Hoosier Highlands, Sept. 16, 1941, *Simmons 1187* (DPU); on fallen beech limb, in valley E. Bainbridge, Oct. 17, 1941, *Simmons 1210* (DPU); on bark of dead limb, ravine near Depauw Arboretum, Oct. 14, 1941, *Simmons* (DPU); on rotting bark, in ravine, Hoosier Highlands, Sept. 16, 1941, *Simmons 1192* (DPU).

Ripley Co.: on *Quercus sp.*, April 5, 1931, *Busteed* (IU).

Wabash Co.: on dead beech log, Roann, March 20, 1908, *Daisy G. Lewis* (DPU).

H. coccineum Bull. is one of the most commonly collected species of *Hypoxyylon*. The bright brick-red color of the ectostroma sets it off from other subglobose members of the genus except *H. Howeianum* Peck. The entostromatic tissue of *H. coccineum* is homogeneous in structure and of a gray-black color. That of *H. Howeianum* is radiate-fibrous in structure with faint concentric rings and blue-black in color. The length of ascospores of *H. Howeianum* (6-8 microns) is measurably less than that of *H. coccineum*.

4. *Hypoxyylon cohaerens* (Persoon) Fries

Sphaeria cohaerens Persoon, Syn. meth. fung. 11. 1801.

Sphaeria turbinulata Schweinitz, Syn. fung. N. Am. 192. 1831.

Hypoxyylon cohaerens (Persoon) Fries, Summa Veg. Scand. 42. 1849.

Hypoxyylon turbinulatum (Schweinitz) Ellis & Everhart, N. Am. Pyr. 636. 1892.

Stromata erumpent-superficial, 2-4 mm. in diameter, gregarious or crowded and often confluent, hemispherical or globose, mostly flattened above, at first dirty-brown, becoming nearly black. Perithecia in a single layer, 6-10 in a stroma, rather large and distinctly prominent with papilliform ostiola. Asci cylindrical, 8-spored, sp. p. 40-68 x 5-6 microns. Ascospores uniseriate, ovate, inequilateral, brown, 10-12 x 4-6 microns. Conidial hymenium clothing the young stromata, of a pale clay color, becoming cinereous. Conidia obovate-subglobose, very small.

Specimens examined:

Brown Co.: on beech, Oct. 22, 1908, *J. M. Van Hook* (IU); on American beech in brushpile, on earthen dam of Ogle Lake, Brown County State Park, Oct. 21, 1945, *Winona H. Welch 9003* (DPU).

Clark Co.: on beech, Borden, Nov. 2, 1908, *J. M. Van Hook 2410* (IU).

Monroe Co.: on beech, Unionville, Nov. 12, 1910, *Owens* (IU); on beech, S. E. Bloomington, March 4, 1911, *Owens* (IU).

Montgomery Co.: on bark, Crawfordsville, *Hudersons* (MU); on dead, decaying limb of *Fagus sp.*, Camp Rotary, October 1945, *A. R. Bechtel* (DPU).

Parke Co.: on old log, Turkey Run State Park, Oct. 27, 1945, *T. G. Yuncker 11920* (DPU); on dead beech wood, Turkey Run State Park, Nov. 21, 1940, *L. Lee* (DPU); on dead wood, Turkey Run State Park, Sept. 17, 1940, *L. Lee* (DPU); on fallen beech log, Turkey Run State Park, Nov. 2, 1940, *L. Lee* (DPU).

Putnam Co.: on dead decorticated wood, in ravine, Hoosier Highlands, Sept. 16, 1941, *Simmons 1189* (DPU); on cork of dead log, Hoosier Highlands, Sept. 16, 1941, *Simmons 1202* (DPU); on rotting beech log, Fern, Oct. 12, 1945, *Simmons 1217* (DPU); on beech log, Greencastle, May 27, 1908, *Daisy G. Lewis* (DPU), originally determined as *H. Ravenelii* Rehm; on beech log, 3 mi. W. Greencastle, May 14, 1946, *Winona H. Welch 9016* (DPU); on beech log, 3 mi. W. Greencastle, May 14, 1946, *Winona H. Welch 9015* (DPU).

Miss Lewis determined her above-cited collection as *H. Ravenelii* Rehm, but this specimen agrees both in macroscopic appearance and in spore measurements with our descriptions of *H. cohaerens* (Pers.) Fr. The fruiting structures of *H. cohaerens* may vary in shape from sessile, hemispherical to turbinate. This species may be distinguished from *H. Sassafra* (Schw.) Berk. by reason of its longer ascospores (10-12

microns in contrast to 7-9 microns for *H. Sassafras*). Schweinitz recognized the turbinate forms of this species as *Sphaeria turbinulata*⁴ and Ellis and Everhart continue this separation with their *H. turbinulata* (Schw.) E. & E.⁵ *H. turbinulata*, as described by Ellis and Everhart, differs from *H. cohaerens* only in the substipitate appearance of the stroma and can be only an accentuated growth form of the latter. The two are considered as synonyms by C. L. Shear.⁶ The present writer concurs in this opinion.

5. *Hypoxylon effusum* Nitschke

Hypoxylon effusum Nitschke, Pyr. Germ. 48. 1867.

Stromata indefinitely effused, convex, carbonaceous, black at maturity, dotted by the exposed annular disks surrounding the ostiola. In old stromata the ectostroma wears off leaving the perithecia exposed. Entostroma scarcely developed. Asci cylindrical, attenuated into a stalk, 80-100 microns long, sp. p. 50-60 microns long. Ascospores uniseriate, 5-8 x 3-3.5 microns, pale brown at maturity.

Specimens examined:

Monroe Co.: on rotten *Quercus* sp., Nov. 20, 1913, Ramsey (IU); on elm, Bloomington, Jan. 7, 1911, Owens (IU).

Putnam Co.: on dead log, near Big-Four Springs, Greencastle, April 13, 1908, Daisy G. Lewis (DPU).

This species, because of the annular stromatic disks around the ostiola and the effused habit of the stroma, generally is not confused with other species of *Hypoxylon* except *H. annulatum* (Schw.) Mont. In this case, however, the annular disks of *H. effusum* are seen to be less pronounced than in specimens of *H. annulatum* and the average ascus length is less (sp. p. 50-60 microns against 60-70 microns for *H. annulatum*).

6. *Hypoxylon epirrhodium* Berkeley & Ravenel

Hypoxylon epirrhodium Berkeley & Ravenel, Grevillea, 4:51. 1875.

Stromata black, effused, thin, forming dark patches about 4 mm. across, papillose from the slightly prominent ostiola. Asci linear. Ascospores uniseriate, elliptical, 9 x 3.5 microns.

Specimens examined:

Putnam Co.: on dead wood, near Big-Four Springs, Greencastle, May 27, 1908, Daisy G. Lewis (DPU).

⁴ Lewis David von Schweinitz, "Synopsis fungorum in America Borealis media degentium," *Trans. Amer. Phil. Soc.* 4:192, 1831.

⁵ J. B. Ellis and B. H. Everhart, *The North American Pyrenomycetes*. New-Jersey, New Jersey: Ellis and Everhart, 1892, p. 636.

⁶ Cornelius L. Shear, *Mycologia*, 20:84. 1928.

Conclusive identification of *H. epirrhodium* Berk. & Rav. depends largely on spore measurements. It is classed among those species which produce small, effused patches of stromatic tissue, as do *H. insidens* (Schw.) E. & E. and *H. serpens* (Pers.) Fr. As is indicated in the key to Hypoxylon, separation of these three very similar species is possible by means of observations of variation in spore characters.

7. *Hypoxylon fuscum* (Persoon) Fries

Sphaeria fragiformis Hoffmann, Veg. Crypt. 1:20. 1787.

Sphaeria confluens Willdenow, Flora Berol. 416. 1787.

Sphaeria tuberculosa Bolton, Fungi Hal. 3:123. 1789.

Sphaeria castorea Tode, Fungi Meckl. 2:28. 1791.

Sphaeria fusca Persoon, Syn. meth. fung. 12. 1801.

Sphaeria Coryli DeCandolle, Flora Franc. 2:287. 1805.

Sphaeria glomerata DeCandolle, Flora Franc. 2:287. 1805.

Hypoxylon fuscum (Persoon) Fries, Summa Veg. Scand. 384. 1849.

Stromata erumpent-superficial, solitary or subconnate, depressed-pulvinate or hemispherical, generally 1-3 mm. in diameter, dark purplish-red, finally black, somewhat uneven from the slightly projecting perithecia. Perithecia small, closely packed, slightly projecting, irregularly monostichous, subglobose, with minute, mammilliform ostiola. Asci cylindrical, on long pedicels, sp. p. 75-90 x 5-6 microns. Paraphyses filiform. Ascospores uniseriate, subinequilaterally elliptical, opaque, 11-14 x 5-6 microns. Conidia very minute, borne singly at the extremities of short, sparingly branched sterigmata.

Specimens examined:

Monroe Co.: on *Ostrya* sp., Bloomington, 1911, *Martin* (IU); on elm, Bloomington, 1911, *Owens* (IU); on water beech, Unionville, Nov. 12, 1910, *Owens* (IU).

Montgomery Co.: on bark, at the Shades, Sept. 6, 1913, *H. W. Anderson* (MU, WAB); on beech stump, Durhams' Wood, July 22, 1917, *Sylvia Fuson 99* (MU).

Morgan Co.: on dead limb, ravine N. E. Martinsville, Sept. 20, 1941, *Simmons 1212* (DPU).

Parke Co.: on dead bark, Turkey Run State Park, Nov. 22, 1940, *L. Lee* (DPU).

Putnam Co.: on rotting beech log, Fern, Oct. 12, 1945, *Simmons 1244* (DPU); on dead bark of *Carpinus* sp., E. Bainbridge, Nov. 14, 1945, *Simmons 1205* (DPU); on bark of *Quercus* sp., E. Bainbridge, Nov. 14, 1945, *Simmons 1206* (DPU); on dead *Fagus* sp., DePauw Arboretum, Oct. 25, 1945, *Simmons 1245* (DPU); on cork of dead log, Hoosier Highlands, Sept. 16, 1941, *Simmons 1201* (DPU); on bark of dead limb, DePauw Arboretum, Nov. 18, 1941, *Simmons 1229* (DPU).

Scott Co.: on *Alnus glutinosa*, Weirtown, 1904, *J. R. Weir 20054* (MU).

This common species usually is determined readily by reason of its pulvinate to hemispherical and dark purplish-red stromata. It rarely will be confused with hemispherical specimens of *H. Howeianum* Peck which often become nearly black at maturity. A comparison of ascospore measurements (*H. fuscum* 11-14 x 5-6 microns; *H. Howeianum* 6-8 x 3-3.5 microns) will facilitate making a distinction between the two species.

8. *Hypoxyylon Howeianum* Peck

Hypoxyylon Howeianum Peck, 24th Rep. N. Y. St. Mus. 98. 1871.

Stromata globose to hemispherical and symmetrical except when compressed by adjacent ones; never effused or pulvinate. Most stromata 3-12 mm. in diameter and 3-8 mm. thick, fleshy to woody, not carbonaceous. Ectostroma bright brick-red which darkens to almost black in very old specimens. Perithecia monostichous, borne in the periphery of the stroma, not erumpent through the stroma. Ostiola umbilicate, the ectostroma being slightly raised over each perithecium. Periphyses delicate, lining the ostiola. Asci thin, hyaline, 80-100 microns long, sp. p. 50-60 microns long. Paraphyses very delicate and branched, completely filling the centrum. Ascospores 6-9 microns long, light brown, uniseriate in the ascus. Conidia minute, 4-6 microns in diameter, globose to oblong, hyaline, borne in clusters of one to several on lateral branches.

Specimens examined:

Monroe Co.: on beech, Bloomington, 1908, *J. M. Van Hook 2245* (IU).

Putnam Co.: on dead limb, near Fern, April 17, 1908, *Daisy G. Lewis* (DPU); on bark of dead *Platanus* sp., E. Bainbridge, Nov. 14, 1945, *Simmons 1203* (DPU).

The radiate-fibrous and faintly concentrically zonate entostroma and the shorter ascospores of *H. Howeianum* Peck serve to distinguish it from *H. coccineum* Bull., which usually produces an homogeneous, gray-black entostroma. Distinctions between *H. Howeianum* and *H. coccineum* often are difficult to make out, and for this reason some mycologists consider the two species as being identical.

9. *Hypoxyylon insidens* (Schweinitz) Ellis & Everhart

Sphaeria insidens Schweinitz, Syn. fung. Car. 13. 1822.

Fuckelia insidens (Schweinitz) Cooke, Grevillea, 12:52. 1884.

Hypoxyylon insidens (Schweinitz) Ellis & Everhart, N. Am. Pyr. 653. 1892.

Stromata innate, effused, nearly round, brown-black, partly sterile, apparently superficial but the base immersed in the matrix and surrounded by a faint circumscribing line. Perithecia more or less prominent, subpapillate. Asci cylindrical. Ascospores uniseriate, elliptical, pale brown, 8 x 4 microns.

Collection of this species in Indiana (Montgomery County) is reported by Fink & Fuson,⁷ but their specimen is not found among others of their collections deposited in the herbarium of Miami University. *H. insidens* (Schw.) E. & E. is included in this study on the basis of the report of Fink and Fuson. This is one of the *Hypoxylon* species which produces small, effused patches of stromatic tissue. According to its description, it may be distinguished from similar species by reason of its small (usually 8 x 4 microns) ascospores.

10. *Hypoxylon investiens* (Schweinitz) Berkeley

Sphaeria investiens Schweinitz, Syn. fung. N. Am. 193. 1831.

Hypoxylon investiens (Schweinitz) Berkeley, Journ. Linn. Soc. 10:385. 1869.

Stromatic material very scanty, covering the perithecia with a thin, black stratum, mammillose above from the slightly projecting perithecia. Perithecial layer seated on a thick sterile crust of entostroma that spreads over and blackens the wood following all the inequalities of the surface. Surface of the stroma with a distinct purplish tinge. Perithecia densely crowded in a single series, the regularly oblong perithecia forming a continuous layer about 0.75 mm. thick and 4-9 cm. long and wide. Ostiola papilliform, deciduous. Ascospores oblong, pale brown, 6-10 (mostly 6-8) x 3-4 microns.

Specimens examined:

Putnam Co.: on rotten stump, N. E. Greencastle, March 25, 1908, *Daisy G. Lewis* (DPU).

H. investiens (Schw.) Berk. closely resembles the effused forms of *H. multiforme* Fr. However, the perithecia of *H. investiens* are compressed-oblong and slightly projecting above while those of *H. multiforme* are globose and distinctly prominent.

11. *Hypoxylon marginatum* (Schweinitz) Berkeley

Sphaeria durissima Schweinitz, Syn. fung. Car. 6. 1822.

Sphaeria truncata Schweinitz, Syn. fung. Car. 18. 1822.

Sphaeria marginata Schweinitz, Syn. fung. N. Am. 190. 1831.

Hypoxylon marginatum (Schweinitz) Berkeley, Grevillea, 4:49. 1875.

Hypoxylon durissimum (Schweinitz) Cooke, Grevillea, 11:131. 1883.

Stromata at maturity black, semipulvinate to hemispherical, variable in form, 1-4 cm. in diameter and 2-10 mm. thick; never flat and effused. Young stromata olivaceous-green inside and darker on the outside with a green tint, nearly globose, with an even surface, perithecia breaking through the ectostroma late in its development. Entostroma

⁷ Bruce Fink and Sylvia Fuson, "An Arrangement of the Ascomycetes of Indiana," *Proc. Ind. Acad. Sci.* 28:127, 1919.

always well developed. Ectostroma slightly roughened by the annular depressions around the ostiola. Asci cylindrical, 105-125 microns long, sp. p. 65-75 microns long. Ascospores uniseriate, slightly inequilaterally elliptical, 7-9 x 3-4 microns, opaque at maturity. Conidia hyaline to greenish-hyaline, 3 x 4 microns. Conidial layer greenish.

Specimens examined:

Clark Co.: on oak, Borden, Nov. 2, 1908, *J. M. Van Hook 2412* (IU).

Monroe Co.: on oak, Bloomington, Feb. 4, 1911, *Owens* (IU).

Parke Co.: on beech, Turkey Run State Park, May 19, 1932, *Martens* (IU); on bark, Turkey Run State Park, Nov. 15, 1940, *L. Lee* (DPU).

Ripley Co.: on *Quercus* sp., April 5, 1931, *Busteed* (IU).

H. marginatum (Schw.) Berk. is a fairly common Indiana species which often resembles the effused forms of *H. annulatum* (Schw.) Mont. The perithecia of *H. marginatum* are small (0.5 mm. in diameter) and evenly sunken in the stromatic tissue while those of *H. annulatum* are larger (0.7-1 mm. in diameter) and projecting above the surface of the stroma.

12. *Hypoxyylon Morsei* Berkeley & Curtis

Hypoxyylon Morsei Berkeley & Curtis, *Grevillea*, 4:51. 1875.

Hypoxyylon Blakei Berkeley & Curtis, *Grevillea*, 4:52. 1875.

Hypoxyylon pauperatum Karsten, *Enum. Fungi Lapp.* 8:211. 1882.

Sphaeria mammata Nylander, *Not. pro Fauna et Flora Fenn.* 88. 1923.

Stromata erumpent, orbicular, 3-5 mm. in diameter, flattened above, brownish-black, composed of 5-10 perithecia. Ectostroma thin, covering the perithecia. Entostroma lacking or nearly so. Perithecia large (about 1 mm. in diameter), globose, flattened on top, sunken in the wood substratum. Ostiola papillate. Asci cylindrical, 160-200 microns long, sp. p. 120-140 microns long. Ascospores uniseriate, elliptical, with rounded to acute ends, 17-22 x 8-10 microns, brown.

Specimens examined:

Montgomery Co.: on *Rhus vernix*, Elmdale, April 15, 1929, *A. R. Bechtel* (IU); on *Rhus vernix*, Cranberry Bog near Elmdale, Spring 1929, *A. R. Bechtel 830* (WAB).

This species is the only papillate *Hypoxyylon* reported for Indiana which typically has its perithecia sunken in the wood. Entostromatic tissue is lacking, or nearly so, in this species thus allowing the perithecia to come in close contact with the tissues of the substratum.

13. *Hypoxyylon multiforme* Fries

Hypoxyylon granulolum Bulliard, *Hist. Champ. Franc.* 176. 1791.

Sphaeria rubiformis Persoon, *Syn. meth. fung.* 9. 1801.

Sphaeria peltata DeCandolle, Flora Franc. 2:287. 1805.

Sphaeria multiformis Fries, Syst. Mycol. 2:334. 1823.

Sphaeria atropurpurea Fries, Syst. Mycol. 2:340. 1823.

Hypoxyton multiforme Fries, Summa Veg. Scand. 384. 1849.

Hypoxyton atropurpureum Fries, Summa Veg. Scand. 384. 1849.

Stromata erumpent and often margined by the ruptured bark, of various shapes but usually transversely elongated, oblong or elliptical, somewhat flattened above, 1-1.5 cm. long by 0.5-0.75 cm. wide or, by confluence, broadly effused, dull rusty-red at first, finally black and smooth. Perithecia irregularly monostrichous, rather large, globose, distinctly prominent, with papilliform ostiola. Asci cylindrical, on long stalks, sp. p. 60-90 x 6-8 microns. Paraphyses simple, slender, longer than asci. Ascospores uniseriate, inequilateral-oblong, pale brown, 9-14 x 3.5-6 microns. Conidial layer dirty-yellowish, becoming darker. Conidia very small, obovate.

Specimens examined:

Brown Co.: on beech, no date, *Owens* (IU).

Monroe Co.: on white walnut, University Dam, Feb. 4, 1911, *Owens* (IU); on walnut, Bloomington, Nov. 25, 1910, *Owens* (IU); on beech, Unionville, Nov. 7, 1910, *Owens* (IU); on black walnut, Bloomington, Nov. 25, 1910, *Owens* (IU); on hickory E. Bloomington, March 4, 1911, *Owens* (IU); on beech, Nov. 12, 1910, *Owens* (IU).

Montgomery Co.: on dead wood, Pine Hills, Sept. 1, 1940, *Simmons 1236* (DPU).

Parke Co.: on old log, Turkey Run State Park, Oct. 27, 1945, *T. G. Yunker 11921* (DPU); on dead wood, Turkey Run State Park, Oct. 26, 1940, *L. Lee* (DPU); on decaying wood, Fallen Rock, Oct. 16, 1941, *Simmons 1216* (DPU).

Putnam Co.: on rotting limb of *Salix sp.*, DePauw Arboretum, Oct. 10, 1941, *Simmons 1231* (DPU); on rotting stump, field S. W. Blackstock Stadium, Greencastle, Oct. 10, 1941, *Simmons 1232* (DPU); on dead, rotting stump, DePauw Arboretum, Nov. 13, 1941, *Simmons 1233* (DPU); on dead wood, in ravine, DePauw Arboretum, Sept. 12, 1941, *Simmons 1234* (DPU); on rotting log, DePauw Arboretum, Oct. 25, 1945, *Simmons 1228* (DPU); on beech bark, Fern, Oct. 12, 1945, *Simmons 1227* (DPU); on fallen log of *Ulmus sp.*, Fern, Oct. 12, 1945, *Simmons 1239* (DPU); on rotting log, DePauw Arboretum, Sept. 12, 1941, *Simmons 1198* (DPU); on rotting, decorticated wood, DePauw Arboretum, Oct. 25, 1945, *Simmons 1246* (DPU).

Stromata of *H. multiforme* Fr. vary from small, elliptical, depressed-pulvinate patches to broadly effused forms. The globose, distinctly projecting perithecia of this species readily are contrasted to the oblong, densely crowded perithecia of *H. investiens* (Schw.) Berk.

Until comparatively recent times *Hypoxyylon atropurpureum* Fries has been considered a distinct species. C. L. Shear, after examination of authentic specimens of Fries, states that "this is only an effuse condition of *multiforme*, it having all the other stromatic and spore characters."⁸ *H. atropurpureum* Fr. and *H. multiforme* Fr. are considered as synonyms in the present study.

14. *Hypoxyylon perforatum* (Schweinitz) Saccardo

Sphaeria perforata Schweinitz, Syn. fung. Car. 5. 1822.

Hypoxyylon perforatum (Schweinitz) Saccardo, Syll. fung. 1:375. 1882.

Stromata superficial, effused or tubercular-convex, often interruptedly confluent for several centimeters, dark or purplish rust-color, dotted with minute, white-margined, punctiform ostiola. Perithecia submonostichous, globose, small (0.25-0.35 mm. in diameter), lying near the surface of the stroma, crowded, mostly not distinctly prominent. Asci cylindrical, sp. p. 60-90 x 7-9 microns, with the ends mostly obtuse, nearly straight or subinequilateral, dark brown, 10-14 x 5-7 microns. Conidial layer cinereous-white, pulveraceous. Conidia minute, ovoid or subglobose on short, simple or branching hyphae.

Specimens examined:

Clark Co.: on *Ostrya sp.*, Borden, Nov. 2, 1908, *J. M. Van Hook 2443* (IU).

Monroe Co.: on *Sassafras sp.*, Unionville, Nov. 12, 1910, *Owens* (IU); on *Juglans nigra*, Bloomington, Jan. 17, 1914, *Ramsey* (IU); on elm, Unionville, Nov. 12, 1910, *Owens* (IU); on sumach, Bloomington, Nov. 25, 1910, *Owens* (IU); on ash, Bloomington, Jan. 28, 1911, *Owens* (IU).

Montgomery Co.: on dead wood, Crawfords' Woods, near Crawfordsville, Oct. 16, 1940, *L. Lee* (DPU).

Morgan Co.: on dead, decorticated wood, ravine near Martinsville, Sept. 20, 1941, *Simmons 1230* (DPU).

Owen Co.: on dead wood of *Ulmus sp.*, McCormick State Park, December 1930, *J. M. Van Hook 5371* (IU).

Putnam Co.: on dead, decaying, decorticated wood, DePauw Arboretum, *Simmons 1213* (DPU); on dead, decaying branch, E. Bainbridge, Nov. 14, 1945, *Simmons 1215* (DPU); on trunk of ironwood, DePauw Arboretum, Nov. 18, 1941, *Simmons 1220* (DPU); on dead, decaying limbs, DePauw Arboretum, Oct. 25, 1945, *Simmons 1221* (DPU); on decorticated wood of beech stump, DePauw Arboretum, Nov. 18, 1941, *Simmons 1222* (DPU); on decorticated wood of dead branch, DePauw Arboretum, Nov. 13, 1941, *Simmons 1238* (DPU); on decorticated wood of fallen limb, DePauw Arboretum, Nov. 13, 1941, *Simmons 1223* (DPU).

⁸ Cornelius L. Shear, *Mycologia*, 20:85-86. 1928.

The minute, white-margined ostiola dotting the dark or purplish rust-colored stromata of this species are a unique and striking characteristic. *H. perforatum* (Schw.) Sacc. rarely would be confused with any other Indiana species of *Hypoxylon*.

15. *Hypoxylon Petersii* Berkeley & Curtis

Hypoxylon Petersii Berkeley & Curtis, Journ. Linn. Soc. 10:384. 1869.

Stromata pulvinate, depressed-conical, centrally attached with a spreading margin, 3-4 x 2.5-3 cm. across, covered at first by a thick coriaceous-membranaceous veil which soon disappears except around the margin; substance corky-fibrous, hard, dull, umber-colored, becoming darker outside. Perithecia crowded in several layers, subglobose or subelongated, 0.5-0.75 mm. in diameter, with slender necks ending in distinctly prominent, papilliform ostiola. Asci cylindrical, about 60 microns long, sp. p. 40 x 5 microns. Ascospores uniseriate or subbiseriate above, narrowly elliptical, brown, 6-8 x 3.5-4 microns.

Specimens examined:

Monroe Co. (?): on oak, "Huckleberry Ravine," Aug. 7, 1908, *J. M. Van Hook 2147* (IU).

H. Petersii Berk. & Curt., in its gross aspect, is distinguished by its large, irregular, fibrous stromata which bear perithecia crowded in several layers. Among the Indiana species it is unique in its twisted and ridged stromatic tissue.

16. *Hypoxylon rubiginosum* (Persoon) Fries

Sphaeria rubiginosa Persoon, Syn. meth. fung. 11. 1801.

Sphaeria fuscopurpurea Schweinitz, Syn. fung. N. Am. 192. 1831.

Hypoxylon rubiginosum (Persoon) Fries, Summa Veg. Scand. 384. 1849.

Hypoxylon fuscopurpureum (Schweinitz) Berkeley, Journ. Linn. Soc. 10:385. 1869.

Stromata pulvinate or effused, indefinite in extent, quite variable under different environmental conditions. Young stromata variable in color from bright brick-red to purplish-red to reddish-brown. Black in old age. Ectostroma always colored in interior; entostroma always dark. Entostroma may be highly developed (in thick bark) or nearly lacking. Ostiolar necks umbilicate; those of old stromata often stuffed with white mycelial growth from germinating ascospores. Asci 135-160 microns long, sp. p. 70-80 microns long. Stalks long and filiform. Ascospores 9-12 x 4-6 microns.

Specimens examined:

Brown Co.: April 26, 1935, *Witmer* (IU), originally determined as *H. fuscopurpureum* (Schw.) Berk.

- Clark Co.: on tulip tree, Borden, Nov. 2, 1908, *J. M. Van Hook 2424* (IU).
- Monroe Co.: on elm, Bloomington, *Owens* (IU); on Liriodendron, Bloomington, Fall 1908, *Peck* (IU), originally determined as *H. fuscopurpureum* (Schw.) Berk.
- Montgomery Co.: on decorticated log, Crawfords' Wood, near Crawfordsville, Aug. 27, 1917, *Fink & Fuson 288* (MU); on old log, in exposed field, Crawfordsville, Aug. 24, 1917, *Bruce Fink 179* (MU); Pine Hills, Fall 1942, *J. Crowder* (WAB); on dead wood, Crawfordsville, Aug. 4, 1940, *L. Lee* (DPU).
- Putnam Co.: Greencastle, April 22, 1908, *Daisy G. Lewis* (DPU); on rotting, decorticated wood, Fern, Oct. 12, 1945, *Simmons 1240* (DPU); on rotting, decorticated log, E. Bainbridge, Nov. 14, 1945, *Simmons 1235* (DPU); on decaying, decorticated limb, W. Greencastle, Nov. 5, 1945, *Simmons 1209* (DPU).

The general stromatic configuration of this species is similar to that of *H. perforatum* (Schw.) Sacc. However, the ostiolar margins of *H. rubiginosum* (Pers.) Fr. do not differ in color from other stromatic material while those of *H. perforatum* are distinctly white against an otherwise rusty purple stroma. *Hypoxylon fuscopurpureum* (Schw.) Berk. now is considered to be merely a purple-red form of *H. rubiginosum*. This relationship is pointed out by J. H. Miller in a discussion on the variability of stromatic form of *H. rubiginosum* under various environmental conditions.⁹

17. *Hypoxylon Sassafras* (Schweinitz) Berkeley

Sphaeria Sassafras Schweinitz, Syn. fung. Car. 10. 1822.

Hypoxylon Sassafras (Schweinitz) Berkeley, Grevillea, 4:54. 1875.

Stromata thin, dirty brownish-black outside, rusty-yellow inside. Perithecia large (1.5 mm. in diameter), the internal cavity nearly 1 mm. in diameter, occurring either singly and quite evenly scattered over the surface of the matrix or loosely aggregated in clusters or groups of 3-8 perithecia standing side by side, their bases united in the thin stroma, with one-third to one-half their upper part free, subtruncate above, with minute, papilliform ostiola. Asci, including the slender base, 110-120 x 4 microns. Ascospores uniseriate, oblong, pale brown, 7-9 x 3 microns. Paraphyses filiform, abundant.

Specimens examined:

Monroe Co.: on *Sassafras* sp., Bloomington, Feb. 11, 1911, *Owens* (IU).

Specimens of *H. Sassafras* (Schw.) Berk. often are very similar to those of *H. cohaerens* (Pers.) Fr. The perithecia of *H. Sassafras* typically are scattered or loosely aggregated while those of *H.*

⁹ Julian H. Miller, *Mycologia*, 20:315. 1928.

cohaerens are clustered in distinctly hemispherical or subglobose stromata.

18. *Hypoxylon serpens* (Persoon) Fries

Sphaeria Macula Tode, Fungi Meckl. 2:33. 1791.

Sphaeria serpens Persoon, Syn. meth. fung. 20. 1801.

Sphaeria caries Schweinitz, Syn. fung. N. Am. 194. 1831.

Hypoxylon serpens (Persoon) Fries, Summa Veg. Scand. 284. 1849.

Hypoxylon caries (Schweinitz) Saccardo, Syll. fung. 1:393. 1882.

Stromata effused, thin, applanate, black, variable in form and size, often in narrow, elongated strips 2-3 mm. wide and 3-6 cm. long but also in small subelliptical or irregularly shaped patches 1-2 cm. long by 0.5-1 cm. wide. Perithecia subglobose, crowded, rather large, rounded and prominent above or rarely slightly depressed around the central papilla, then only slightly prominent and the surface of the stroma not so distinctly roughened. Asci cylindrical, long-pedicillate, sp. p. 75-100 x 6-8 microns, with abundant paraphyses. Ascospores obliquely uniseriate, subcylindrical, rounded at the ends, oblong-cylindrical, subinequilateral or almost curved, seldom straight, becoming dark, 12-16 x 5-6 microns.

Specimens examined:

Hamilton Co.: on red oak, Jolietville, Dec. 20, 1913, *Ramsey* (IU).

Monroe Co.: on decaying elm, Bloomington, May 11, 1935, *Witmer* (IU).

Montgomery Co.: on *Ulmus* sp. (drift wood), April 1929, *A. R. Bechtel* (IU); on drift wood, Sugar Creek Dam, Crawfordsville, Spring 1929, *A. R. Bechtel 831* (WAB); on dead, rotting wood, Lybyar farm, 10 miles S. W. Crawfordsville, Nov. 22, 1941, *Simmons 1243* (DPU).

Parke Co.: on dead wood, Turkey Run State Park, Nov. 20, 1940, *L. Lee* (DPU).

Putnam Co.: on elm, May 28, 1908, *Daisy G. Lewis* (DPU), originally determined as *H. caries* (Schw.) Sacc.; on decaying decorticated wood, W. Greencastle, Nov. 6, 1945, *Simmons 1225* (DPU).

H. serpens (Pers.) Fr. can best be separated from similar species (*H. insidens* (Schw.) E. & E. and *H. epirrhodium* Berk & Rav.) by comparison of ascospore measurements. Of these three species *H. serpens* produces the largest ascospores (12-16 x 5-6 microns). Study of the type specimens of *H. serpens* and of *H. caries* (Schw.) Sacc. has led Shear to publish the two names in synonymy.¹⁰ He bases this conclusion upon comparison of spore measurements and of substratum conditions. The present study follows Shear's treatment of these species.

¹⁰ Cornelius L. Shear, *Mycologia*, 20:37. 1928.

19. *Hypoxyton stigmatum* Cooke

Hypoxyton stigmatum Cooke, Grevillea, 7:4. 1879.

Stromata effused, black, crustaceous, thin (0.5-1 mm.), papillose from the prominent ostiola, 3-5 or more centimeters broad, originating beneath the cuticle of the bark which it throws off. Asci linear-cylindrical. Ascospores uniseriate, elliptical, with the ends subacute, sometimes navicular, dark, 20-28 x 8-12 microns.

Specimens examined:

Montgomery Co.: on stump, in woods, July 22, 1917, *Sylvia Fuson* 112 (MU); on dead wood, at the Shades, Sept. 6, 1913, *P. J. Anderson* (MU).

Putnam Co.: on dead limb, near Fern, April 17, 1908, *Daisy G. Lewis* (DPU).

Union Co.: on old log, Sayres' Wood, July 25, 1917, *Bruce Fink* 78 (MU).

H. stigmatum Cooke and effused forms of *H. multiforme* Fr. have a close macroscopic resemblance because of their black stromata and papillate ostiola. Ascospore measurements are helpful in making a distinction between the two species, the spores of *H. stigmatum* being distinctly larger (20-28 x 8-12 microns) than those of *H. multiforme* (9-14 x 3.5-6 microns).

NUMMULARIA Tulasne

Nummularia Tulasne, Sel. fung. carp. 2:42. 1863.

Stromata orbicular, cup-shaped or discoid, becoming black, marginate, the margin more or less distinctly sterile. Perithecia monostichous, peripheral, immersed. Asci cylindrical, 8-spored. Ascospores uniseriate, subelliptical, continuous, dark.

KEY TO THE SPECIES

1. Stroma cup-shaped with perithecia opening on the concave side 2
Stroma convex or plane 3
2. Ostiola punctiform, scarcely visible in mature specimens;
ascospores globose or subglobose 2. *N. discreta*
Ostiola projecting, mammillose; ascospores
subinequilateral 4. *N. repanda*
3. Ascospores 10-20 microns long 4
Ascospores 4.5-5 microns long 3. *N. microplaca*
4. Stroma shiny black; adjacent wood stained bright
orange 5. *N. tinctor*
Stroma dull black; wood not stained 1. *N. Bulliardii*

1. *Nummularia Bulliardii* Tulasne

- Hypoxylon nummularium* Bulliard, Champ. Franc. 1:179. 1791.
Sphaeria nummularia DeCandolle, Flore Franc. 2:290. 1805.
Sphaeria anthracina Schmidt, in Kunze & Schmidt, Mykol. Hefte, 1:55. 1817.
Sphaeria nummularia (Bulliard) Fries, Syst. Mycol. 2:348. 1823.
Nummularia Bulliardii Tulasne, Sel. fung. carp. 2:43. 1863.
Nummularia nummularia (Bulliard) Schroeter, Pilz. Schles. 2:458. 1897.
Nummularia anthracina (Schmidt) Traverso, Fl. Ital. Crypt. Pyr. 1:57. 1906.
Kommamyce Bulliardii (Tulasne) Nieuwland, Am. Mid. Nat. 4:375. 1916.
Numulariola nummularia (Bulliard) House, N. Y. St. Mus. Bull. 266:49. 1925.

Stromata convex, orbicular or oval, sometimes irregular in shape or broadly effused, black inside and out, punctate from the slightly prominent ostiola, at first covered by the epidermis and clothed with a reddish layer of conidia, soon erumpent, almost superficial and free. Perithecia large, ovate, black, loosely included in the packed cells of the stroma. Asci cylindrical with very short stalks, sp. p. 115-140 x 7-10 microns. Paraphyses long and stout. Ascospores eight, uniseriate, elliptical, hyaline, becoming opaque or brown, 10-20 x 5-10 microns.

Specimens examined:

- Hendricks Co.: on old log, open pasture, Aug. 10, 1917, *Fuson 129* (MU).
 Monroe Co.: on *Acer sp.*, Unionville, Nov. 7, 1910, *Owens* (IU); on beech, N. E. Bloomington, March 20, 1931, *Amidei & Marten* (IU); on dogwood, 1916, *J. M. Van Hook 3708* (IU); Unionville, Oct. 21, 1911, *Owens* (IU); on *Fagus sp.*, Bloomington, March 4, 1911, *Owens* (IU); on beech, Unionville, Oct. 21, 1911, *Owens* (IU); on beech, Unionville, Nov. 7, 1910, *Owens* (IU).
 Montgomery Co.: on trunk of dead, fallen tree, ravine in Shades Park, Nov. 9, 1941 *Simmons 1166* (DPU); on beech log, woods on Lybyar farm, S. W. Crawfordsville, Nov. 22, 1941, *Simmons 1168* (DPU).
 Parke Co.: on dead wood, Turkey Run State Park, Nov. 22, 1940, *L. Lee* (DPU); on bark of dead oak stump, Fallen Rock, Oct. 16, 1941, *Simmons 1173* (DPU).
 Putnam Co.: on dead beech log, Greencastle, Jan. 22, 1908, *Daisy G. Lewis* (DPU); on dead beech log, Greencastle, May 27, 1908, *Daisy G. Lewis* (DPU); on small fallen trunk, Fern, Oct. 12, 1945, *Simmons 1161* (DPU); on decaying, fallen branch, Fern, Oct. 12, 1945, *Simmons 1162* (DPU); on fallen beech limb, DePauw Arboretum, Oct. 10, 1941, *Simmons 1164* (DPU); on fallen beech log, valley E. Bainbridge, Oct. 17, 1941, *Simmons 1170* (DPU); on rotting oak limb, valley E. Bainbridge, Oct. 17,

1941, *Simmons 1171* (DPU); on dead, decaying limb, W. Greencastle, Nov. 6, 1945, *Simmons 1172* (DPU); on beech log, 3 mi. W. Greencastle, May 14, 1946, *Winona H. Welch 9017* (DPU).

N. Bulliardii Tul. is common in Indiana on the trunks and branches of various deciduous trees. Its stromata often closely resemble those of *N. microplaca* (Berk. & Curt.) Cke. and of *N. tinctor* (Berk.) E. & E., but its ascospores (12-20 microns long) are much longer than those of *N. microplaca* (4.5-5 microns long) and its stromata do not stain the substratum as do those of *N. tinctor*.

2. *Nummularia discreta* (Schweinitz) Tulasne

Sphaeria discincola Schweinitz, Syn. fung. Car. 8. 1822.

Sphaeria discreta Schweinitz, Syn. fung. N. Am. 195. 1831.

Sphaeria excavata Schweinitz, Syn. fung. N. Am. 195. 1831.

Nummularia discreta (Schweinitz) Tulasne, Sel. fung. carp. 2:45. 1863.

Stromata erumpent, concave, with a thick raised margin, circular, definite in outline, 3-5 mm. in diameter, gray or yellow-gray, becoming black; the concave side at first white-punctate from the minute ostioli which are scarcely visible when mature. Bark and wood beneath the stromata marked by black, circumscribing lines. Perithecia monostichous, oval or ovate-cylindrical, about 1 mm. long, contracted above into ostiolar necks varying in length, extending to the base of the stroma. Asci cylindrical, short-stalked, 140-200 x 12-15 microns. Paraphyses long, filiform. Ascospores globose, black at maturity, 10-14 microns in diameter, uniseriate in the ascus. Conidia continuous and hyaline, borne above the ectostroma.

Specimens examined:

Monroe Co.: on *Amelanchier sp.*, near Bloomington, April 15, 1911, *J. M. Van Hook 3187* (IU).

County unrecorded: on dead limb of apple, May 9, 1901, *A. G. Wood* (IU).

N. discreta (Schw.) Tul. and *N. repanda* (Fr.) Nke. are very similar Indiana species. The punctiform ostioli of *N. discreta*, however, are scarcely visible in mature specimens while ostioli of *N. repanda* are distinctly prominent giving the surface of the stroma a mammillose appearance.

3. *Nummularia microplaca* (Berkeley & Curtis) Cooke

Diatrype microplaca Berkeley & Curtis, Journ. Linn. Soc. 10:385. 1869.

Anthostoma microplacum Saccardo, Syll. fung. 1:298. 1882.

Nummularia microplaca (Berkeley & Curtis) Cooke, Grevillea, 12:8. 1883.

Stromata orbicular to subelliptical, 0.5-1 cm. across, or elongated 1-4 x 0.5-1 cm., or extending by confluence for long distances in the

grooves of the bark, forming a thin carbonaceous crust, black, arising beneath the epidermis but soon becoming bare, surface even, faintly punctate from the minute ostiola. Perithecia ovate-globose, small (less than 0.5 mm. across), monostichous. Ostiola minute, not prominent but slightly depressed, the opening at first filled with a white farinaceous matter. Asci 60-80 x 3-5 microns, sp. p. 40-50 microns long. Ascospores uniseriate, ends mostly slightly overlapping, elliptical, inequilateral, pale brown, 5-7.5 x 2.5-3 microns.

Specimens examined:

Monroe Co.: on *Sassafras* sp., Bloomington, March 4, 1911, *Owens* (IU);
on *Sassafras* sp., W. Bloomington, May 18, 1935, *Witmer* (IU).

Superficially similar to this species are *N. Bulliardii* Tul. and *N. tinctor* (Berk.) E. & E. However, the ascospores of *N. microplaca* are very short (4.5-5 microns long) in comparison with those of the other two species (10-20 microns long).

4. *Nummularia repanda* (Fries) Nitschke

Sphaeria repanda Fries, Syst. Mycol. 2:346. 1823.

Hypoxylon repandum Fries, Summa Veg. Scand. 383. 1849.

Nummularia repanda (Fries) Nitschke, Pyr. Germ. 57. 1867.

Nummularia pezizoides Ellis & Everhart, Bull. Torr. Bot. Club, 11:74. 1884.

Stromata erumpent-superficial, orbicular or subelliptical, 0.5-1 cm. in diameter, concave and often with a thin, erect, rather broad margin, reddish-gray at first, finally black, mammillose from the projecting ostiola. Perithecia monostichous, immersed, ovate-oblong, 0.5-0.75 mm. long, crowded, often subangular from mutual pressure. Asci cylindrical, sessile, 8-spored, 110-120 x 8 microns. Ascospores obliquely uniseriate, narrow ovate, obtuse, subinequilateral, dark brown, 8.5-14 x 4-7.5 microns.

Specimens examined:

Clark Co.: on decorticated hickory, Borden, Nov. 2, 1908, *J. M. Van Hook* 2420 (IU).

Monroe Co.: on elm, near Bloomington, Nov. 25, 1910, *Owens* (IU).

Putnam Co.: on dry dead branch, DePauw Arboretum, Oct. 25, 1945, *Simmons* 1174 (DPU).

The stromatic disk of *N. repanda* (Fr.) Nke. is mammillose-roughened due to the prominent ostiola; the disk of *N. discreta* (Schw.) Tul., in contrast, is comparatively smooth, the minute ostiola being scarcely visible in mature specimens.

5. *Nummularia tinctor* (Berkeley) Ellis & Everhart

Sphaeria tinctor Berkeley, Hook. London Journ. Bot. 4:311. 1845.

Hypoxylon tinctor (Berkeley) Cooke, Grevillea, 13:16. 1884.

Nummularia tinctor (Berkeley) Ellis & Everhart, N. Am. Pyr. 627. 1892.

Stromata much effused showing irregularities of surface upon which it grows, very hard and brittle, 1 mm. thick, black, with surface almost smooth but distinctly papillose from projecting ostiola (as seen under the handlens); wood beneath the stromata stained definitely reddish-orange and rendered very hard. Perithecia monostichous, crowded, elongate (0.75 mm. long), covered above with the ectostromatic layer. Asci 100-140 x 6-10 microns, sp. p. 75-120 microns long. Paraphyses filiform, abundant. Ascospores uniseriate, pale brown, conspicuously uniguttulate, oblong navicular, 13-20 x 5-8 microns.

Specimens examined:

Monroe Co.: on *Acer* sp., E. Bloomington, Oct. 13, 1911, *Owens* (IU).

Montgomery Co.: on bark of fallen limb, in ravine, Shades Park, Nov. 9, 1941, *Simmons 1165* (DPU).

Orange Co.: on sycamore, Paoli, March 25, 1910, *Owens* (IU).

Owen Co.: on *Acer* sp., State Park, Dec. 11, 1934, *Martens* (IU).

Parke Co.: on bark, Turkey Run State Park, Nov. 22, 1940, *L. Lee* (DPU).

Putnam Co.: on living limb of *Betula* sp., Theta lawn, Greencastle, Nov. 14, 1945, *Simmons 1157* (DPU); on dead limb of *Quercus* sp., E. Bainbridge, Nov. 14, 1945, *Simmons 1158* (DPU); on dead, decaying limb, E. Bainbridge, Nov. 14, 1945, *Simmons 1159* (DPU).

N. tinctor (Berk.) E. & E. is distinct among the Indiana species of the genus by reason of the bright red-orange color it imparts to its substratum. The coloring of the wood by the fungus is accompanied by hardening of the substratum tissues immediately adjacent to the stroma.

ROSELLINIA Cesati & DeNotaris

Rosellinia Cesati & DeNotaris, Giorn. Bot. Ital. 2:334. 1847.

Pleosporopsis Oersted, Nat. For. Vid. Medd. 128. 1865.

Stromatic layer thin, each mature perithecium being tightly enclosed within an ectostromatic layer. Perithecia nearly superficial, globose, papillate, subcarbonaceous, black, smooth to rough, often associated with a subiculum. Asci cylindrical-clavate, paraphysate, 8-spored. Ascospores globose-ovoid to navicular, dark, ends obtuse to appendiculate.

KEY TO THE SPECIES

- | | |
|---|---------------------------|
| 1. Perithecia small (0.33-0.5 mm. in diameter)..... | 2 |
| Perithecia large (0.75-1.5 mm. in diameter)..... | 3 |
| 2. Perithecia gregarious, not bristly..... | 7. <i>R. pulveracea</i> |
| Perithecia usually scattered, bristly..... | 3. <i>R. ligniaria</i> |
| 3. Subiculum usually prominent..... | 4 |
| Subiculum scanty..... | 6 |
| Subiculum wanting..... | 7 |
| 4. Subiculum brown or purplish-brown, persistent..... | 5 |
| Subiculum sulphur-yellow, evanescent..... | 8. <i>R. subiculata</i> |
| 5. Ectostromatic tissue thick, carbonaceous; asci (sp. p.) more
than 130 microns long..... | 1. <i>R. aquila</i> |
| Ectostromatic tissue thin, very brittle; asci (sp. p.) less
than 130 microns long..... | 9. <i>R. thelena</i> |
| 6. Subiculum dark brown; asci 7-8 microns wide..... | 5. <i>R. medullaris</i> |
| Subiculum black; asci 8-10 microns wide..... | 4. <i>R. mammiformis</i> |
| 7. Bases of perithecia glandular-roughened..... | 2. <i>R. glandiformis</i> |
| Bases of perithecia not glandular-roughened..... | 8 |
| 8. Asci (sp. p.) less than 95 microns long..... | 6. <i>R. mutans</i> |
| Asci (sp. p.) more than 95 microns long..... | 9 |
| 9. Ectostroma sooty, powdered-roughened..... | 5. <i>R. medullaris</i> |
| Ectostroma bare..... | 4. <i>R. mammiformis</i> |

1. *Rosellinia aquilla* (Fries) Cesati & DeNotaris

Sphaeria byssiseda Tode, Fungi Meckl. 2:10. 1791.

Sphaeria papillosa Sowerby, Engl. Fungi, Vol. 2, pl. 236. 1799.

Sphaeria aquila Fries, Vet. Akad. Hand. 1817:251. 1817.

Sphaeria aquila Fries, Syst. Mycol. 2:442. 1823.

Sphaeria mammosa Withering, Bot. Arr. 4:360. 1830.

Rosellinia aquila (Fries) Cesati & DeNotaris, Schema Sfer. Ital. 21, 1863.

Hypoxyton aquila (Fries) Brefeld, Unters. Gesamt. Mykol. 10:259.
1891.

Rosellinia byssiseda (Tode) Schroeter, Krypt.-Flora Schles. 3:299. 1894.

Subiculum rather thick and prominent, dark to purplish-brown, nearly enveloping the perithecia at first but finally more or less disappearing. Perithecia large, globose, 1-1.25 mm. in diameter, gregarious, crowded or sometimes confluent, with distinct, black, conic-papilliform ostiola, dark brown at first with a thin tomentose coating, finally becoming bare. Ectostroma thick, carbonaceous. Perithecial wall coriaceous. Asci long, cylindrical, sp. p. 165-190 x 10-12.5 microns. Ascospores uniseriate, oblong, brown, 16-27.5 x 8-11 microns, with or without a short, obtuse, hyaline appendage 2-2.5 microns long at each end.

Specimens examined:

- Clark Co.: on chestnut, Borden, Nov. 2, 1908, *J. M. Van Hook 2417* (IU).
 Monroe Co.: on *Juglans sp.*, E. Bloomington, March 22, 1931, *Martens* (IU); on oak, Unionville, Nov. 12, 1911, *Ramsey* (IU).
 Montgomery Co.: April 1929, *A. R. Bechtel* (IU); Turners' Woods, near Crawfordsville, May 21, 1941, *Simmons 1104* (DPU).
 Owens Co.: on *Prunus sp.*, McCormick's Creek State Park, June 1938, *Banta* (IU).
 Putnam Co.: on dead beech log, Greencastle, Jan. 22, 1908, *Daisy G. Lewis* (DPU); on dead limbs in brush pile, DePauw Arboretum, Oct. 25, 1945, *Simmons 1226* (DPU).

Of the Indiana species of *Rosellinia R. thelena* (Fr.) Rab. is most nearly similar to *R. aquila* (Fr.) Ces. & DeNot. The ectostroma of *R. aquila*, however, is carbonaceous and relatively thick in contrast to the very brittle, thin ectostromatic layer of *R. thelena*.

2. *Rosellinia glandiformis* Ellis & Everhart

Rosellinia glandiformis Ellis & Everhart, Proc. Acad. Nat. Sci. Phil. 42:227. 1890.

Perithecia scattered, the bases sunken in the wood about one-fourth, ovate-globose, roughened with glands, with reinforcement around the lower half similar to the cupule of an acorn (this thickening sometimes reduced to a thin granular coat). Ostiola papilliform, small, sometimes obsolete, the apices of the perithecia then being evenly rounded. Asci cylindrical, 100-114 x 8-10 microns. Paraphyses abundant. Ascospores uniseriate, acutely elliptical, opaque, 14-17.5 x 7-10 microns.

Specimens examined:

- Monroe Co.: on poplar, Bloomington, 1908, *J. M. Van Hook 3550* (IU); on *Juglans sp.*, Bloomington, Nov. 20, 1913, *Ramsey* (IU); on *Fraxinus sp.*, Bloomington, Jan. 17, 1914, *Ramsey* (IU).
 Putnam Co.: on well-rotted, decorticated wood, E. Bainbridge, Nov. 14, 1945, *Simmons 1194* (DPU).

The bases of the perithecia of *R. glandiformis* E. & E. characteristically are glandular-roughened in contrast to the relatively smooth perithecia of the otherwise macroscopically similar *R. mutans* (Cke. & Pk.) Sacc. The subiculum present in many species of *Rosellinia* is noticeably lacking in specimens of *R. glandiformis*.

3. *Rosellinia ligniaria* (Greville) Saccardo

Sphaeria ligniaria Greville, Scot. Crypt. Flora, 1:82. 1823.

Rosellinia ligniaria (Greville) Saccardo, Syll. fung. 1:269. 1882.

Perithecia scattered, gregarious or crowded, sometimes forming a crust, ovate-conical, very black, superficial, about 0.25 mm. in

diameter, clothed with minute black bristles about 20-30 microns long. Asci cylindrical, sp. p. 65-75 x 8-10 microns. Ascospores obliquely uniseriate, elliptical, brown, 10-14 x 6-8 microns.

Specimens examined:

Hamilton Co.: on *Fraxinus* sp., Jolietville, March 28, 1914, Ramsey (IU).

Putnam Co.: on rotting wood, in ravine, DePauw Arboretum, Oct. 12, 1941, Simmons 1183 (DPU); on rotting wood, E. Bainbridge, Nov. 14, 1945, Simmons 1186 (DPU); on dead, decorticated *Populus nigra* var. *Italica*, Greencastle, Nov. 1, 1945, Simmons 1195 (DPU).

R. ligniaria (Grev.) Sacc., like *R. pulveracea* (Ehrenb.) Fkl., produces very small (0.33-0.5 mm. in diameter) perithecia. The perithecia of *R. ligniaria* usually are well-separated on the substratum and are covered with minute black bristles; those of *R. pulveracea* are gregarious to almost confluent and typically bare.

4. *Rosellinia mammiformis* (Persoon) Saccardo

Sphaeria mammiformis Persoon, Syn. meth. fung. 64. 1801.

Hypoxyylon globulare (Bulliard) Fuckel, Fung. Rehn. No. 1060, (fide Ellis & Everhart, N. Am. Pyr. 166. 1892). 1866.

Hypoxyylon mammaeforme Berkeley, Grevillea, 4:52. 1875.

Rosellinia mammiformis (Persoon) Saccardo, Syll. fung. 1:258. 1882.

Perithecia gregarious, crowded or confluent, (2-3 in one stroma), globose, 1-1.5 mm. in diameter, fragile, black and bare but not polished. Ostiola abruptly papilliform, black and subshining. Asci (sp. p.) 100-115 x 8-10 microns. Paraphyses abundant. Ascospores 19-25 x 7-12 microns, oblong, elliptical, sometimes slightly curved, mostly without any distinct appendage.

Specimens examined:

Monroe Co.: Unionville, Oct. 21, 1913, Peck (IU).

The scanty black subiculum produced by *R. mammiformis* (Pers.) Sacc. usually is absent in mature specimens. Ascus measurements and the bareness of the surface of the ectostroma of this species serve to distinguish it from *R. medullaris* (Wallr.) Ces. & DeN. whose asci are comparatively narrow (asci of *R. medullaris* 7-8 microns wide; *R. mammiformis* 8-10 microns wide) and whose ectostroma characteristically is powdered with a fine, sooty covering.

5. *Rosellinia medullaris* (Wallroth) Cesati & DeNotaris

Sphaeria medullaris Wallroth, Fl. Crypt. Germ. 2:792. 1833.

Rosellinia medullaris (Wallroth) Cesati & DeNotaris, Schema Sfer. Ital. 177. 1863.

Rosellinia Macouniana Ellis & Everhart, Bull. Torr. Bot. Club, 11:74. 1884.

Perithecia gregarious or crowded, superficial, globose or ovate-globose, 0.75-1.5 mm. in diameter, covered at first with a pruinose-pubescent coat of a dull red or brick-red color, becoming bare and black with age, loosely adnate, apices convex to conic-papilliform, surface dirty-roughened with a finely powdered, sooty covering, very fragile, subiculum slight or lacking. Asci (sp. p.) 100-120 x 7-8 microns. Ascospores 19-25 x 6-7 microns, uniseriate, ovoid, only slightly curved, sometimes obscurely appendiculate, brown.

Specimens examined:

Monroe Co.: Bloomington, 1914, *Ramsey* (IU).

This species is very similar to *R. mammiformis* (Pers.) Sacc. but may be distinguished by the sooty roughness of the ectostroma surface and by its comparatively narrow asci.

6. *Rosellinia mutans* (Cooke & Peck) Saccardo

Sphaeria mutans Cooke & Peck, 29th Rep. N. Y. St. Mus. 64. 1876.

Rosellinia mutans (Cooke & Peck) Saccardo, Syll. fung. 1:259. 1882.

Perithecia more or less crowded or gregarious, rather small, about 0.5-0.75 mm. in diameter, at first clothed with a thin, tawny, evanescent tomentum, finally becoming smooth, black, and shining, mostly globose with papillate ostiola. (Region about ostiolum may have tendency to be depressed.) Asci subcylindrical, sp. p. 80-92.5 x 6.5-7.5 microns. Ascospores uniseriate, elliptical, brown, 9-13 x 4-5.5 microns.

Specimens examined:

Monroe Co.: on *Juglans* sp., Bloomington, November 1913, *Ramsey* (IU).

Posey Co.: on decorticated elm, May 12, 1928, *Shaw* (IU).

Warren Co.: Pine Village, April 1940, *Gray* (IU).

R. mutans (Cke. & Pk.) Sacc. is very similar to *R. glandiformis* E. & E. in its perithecial size and lack of a subiculum. Mature stromata of *R. mutans* are black and shining while those of *R. glandiformis* are glandular-roughened.

7. *Rosellinia pulveracea* (Ehrenberg) Fuckel

Sphaeria pulveracea Ehrenberg, in Persoon, Syn. meth. fung. 83. 1801.

Sphaeria millegrana Schweinitz, Syn. fung. N. Am. 213. 1831.

Sphaeria transversalis Schweinitz, Syn. fung. N. Am. 213. 1831.

Sordaria Friesii Niessl, Vorarb. z. Crypt. Fl. von Mähren. 112. 1864.

Rosellinia pulveracea (Ehrenberg) Fuckel, Symb. Mycol. 149. 1869.

Rosellinia Friesii Niessl, Beitr. z. Kenntniss d. Pilze. 34. 1872.

Perithecia densely gregarious, often forming a continuous crustaceous layer but sometimes scattered, ovate-globose, minutely tubercular-roughened, about 0.33 mm. in diameter. Ostiola papilliform, soon perforated. Asci cylindrical, 60-70 x 10-12 microns, with a stipitate base 20-30 microns long. Paraphyses filiform. Ascospores uniseriate, elliptical, brown, 8-15 x 6-9 microns.

Specimens examined:

Hamilton Co.: on *Platanus* sp., Jolietville, Dec. 18, 1913, Ramsey (IU).

Monroe Co.: on *Ostrya* sp., Bloomington, Nov. 20, 1913, Ramsey (IU).

Montgomery Co.: Shades Park, March 12, 1941, Simmons 1122 (DPU).

Putnam Co.: on dead decorticated wood, DePauw Campus, Nov. 13, 1945, Simmons 1184 (DPU); on dead branch of *Platanus* sp., E. Bainbridge, Nov. 14, 1945, Simmons 1185 (DPU).

R. pulveracea (Ehrenberg) Fuckel and *R. ligniaria* (Grev.) Sacc. are alike in their production of very small perithecia (0.35-0.5 mm. in diameter). The perithecia of *R. ligniaria* typically are scattered on the substratum and are covered with short, stiff bristles while those of *R. pulveracea* usually are densely crowded and bare.

8. *Rosellinia subiculata* (Schweinitz) Saccardo

Sphaeria subiculata Schweinitz, Syn. fung. N. Am. 210. 1831.

Hypoxyton subiculosum Berkeley, Grevillea, 4:52. 1875.

Rosellinia subiculata (Schweinitz) Saccardo, Syll. fung. 1:255. 1882.

Perithecia thin-walled, gregarious or crowded but often more or less scattered in the early stages, about 1 mm. in diameter, globose, black and shining, mostly superficial, seated on a sulphur-yellow, waxy-pruinose subiculum which disappears with age. Ostiola small, papilliform. Asci 80-90 x 6-7 microns, cylindrical, with abundant paraphyses. Ascospores uniseriate or partly biseriate above, inequilaterally elliptical, brown, subacute, 10-12.5 x 5-6.5 microns.

Specimens examined:

Clark Co.: on poplar, Borden, 1909, *J. M. Van Hook* 2442 (IU).

Monroe Co.: on tulip tree, Unionville, October 1911, *J. M. Van Hook* 3554 (IU).

Montgomery Co.: Covington Hill, Crawfordsville, Nov. 12, 1942, *J. Crowder* 1611 (WAB).

This species characteristically produces a sulphur-yellow subiculum which, however, disappears with age. The length of its ascospores (10-12.5 microns), when the subiculum is absent, serves to distinguish it from *R. aquila* (Fr.) Ces. & DeN. (16-27.5 microns) and from *R. thelena* (Fr.) Rab. (18-23 microns).

9. *Rosellinia thelena* (Fries) Rabenhorst

Sphaeria thelena Fries, in Schmidt & Kunze, Mykol. Hefte, 2:36. 1823.

Rosellinia thelena (Fries) Rabenhorst, Kryptogamen-Flora, ed. 2, 2:225. 1887.

Perithecia crowded or gregarious, spherical, with strongly papilliform ostiola, smooth, thin, brittle, brownish-black, about 1 mm. in diameter, seated on a superficial, loosely adherent, densely interwoven but thin, brownish-purple subiculum. Asci cylindrical, stipitate, 8-spored, 90-130 x 8-9 microns (sp. p.), with conglutinated paraphyses. Ascospores uniseriate, oblong, subinequilateral, brown, 18-23 x 6-7 microns, with a short (6-8 microns), hyaline, spine-shaped appendage at each end.

Specimens examined:

Parke Co.: on hemlock, Turkey Run, April 27, 1930, *Hughes* (IU).

The habits of growth and the average sizes of the perithecia of *R. thelena* (Fr.) Rab. and of *R. aquila* (Fr.) Ces. & DeN. are about the same. The ectostromatic tissue of *R. thelena*, however, is thin and brittle while that of *R. aquila* typically is thick and carbonaceous in texture.

USTULINA Tulasne

Ustulina Tulasne, Sel. fung. carp. 2:23. 1863.

Stromata superficial, subeffused, thick, determinate, at first carnose-suberose and clothed with a powdery, cinereous, conidial hymenium, finally rigid, carbonaceous, black and bare, generally more or less hollow. Perithecia immersed, large, with papilliform ostiola. Asci pedicellate, 8-spored, paraphysate. Ascospores ovoid-fusiform, continuous, dark-colored.

Ustulina vulgaris Tulasne

Sphaeria deusta Hoffmann, Veg. Crypt. 1:3. 1787.

Sphaeria versipellis Tode, Fungi Meckl. 2:55. 1791.

Hypoxylon ustulatum Bulliard, Hist. Champ. Franc. 1:176. 1791.

Hypoxylon deustum Greville, Scot. Crypt. Flora, Vol. 4, pl. 324. 1826.

Ustulina vulgaris Tulasne, Sel. fung. carp. 2:22. 1863.

Stromata superficial, effused, repand, pulvinate, thick; at first surface even, white and subtomentose, substance almost gelatinous; becoming hard and tough, undulate-colliculose; finally very brittle and hollow, black. Perithecia large, ovate, densely crowded, monostichous, only the punctiform ostiola projecting. Asci narrow cylindrical, pedicellate, 8-spored, sp. p. 250 x 8-10 microns. Paraphyses slender, evanescent. Ascospores obliquely uniseriate, fusoid, inequilateral or slightly curved, finally opaque, 32-40 x 8-10 microns.

Specimens examined:

- Brown Co.: on American beech, in brush pile, on earthen dam of Ogle Lake, Brown County State Park, Oct. 21, 1945, *Winona H. Welch 9006* (DPU).
- Clark Co.: on fallen elm, Tunnel Mill Reservation, Jeffersonville, April 14, 1933, *R. Dawson* (DPU); on fallen elm tree, Tunnel Mill Reservation, April 14, 1933, *Gray* (DPU); on beech, Borden, Nov. 2, 1908, *J. M. Van Hook 2441* (IU).
- Monroe Co.: on old stump, Bloomington, Oct. 17, 1940, *Lohman* (IU); Bloomington, Fall 1907, *J. M. Van Hook 2239* (IU).
- Montgomery Co.: on bark of fallen log, Pine Hills, S. Crawfordsville, Sept. 1, 1940, *Simmons 1150* (DPU).
- Morgan Co.: on rotting log, ravine N. E. Martinsville, Sept. 20, 1941, *Simmons 1149* (DPU).
- Parke Co.: at base of maple, Turkey Run, Aug. 23, 1917, *Fink & Fuson 166* (MU); on dead wood, Turkey Run State Park, Nov. 20, 1940, *L. Lee* (DPU).
- Putnam Co.: Greencastle, November 1892, no name (DPU); on old stump near springs, Greencastle, Jan. 22, 1908, *Daisy G. Lewis* (DPU); on decaying log, in ravine, Hoosier Highlands, April 27, 1943, *Winona H. Welch 9005* (DPU); on decaying stump of *Ulmus sp.*, DePauw Campus, Nov. 13, 1945, *Simmons 1153* (DPU); on bark of rotting limb, DePauw Arboretum, Oct. 25, 1945, *Simmons 1154* (DPU); on cork at base of trunk of living *Tilia sp.*, DePauw Arboretum, Oct. 25, 1945, *Simmons 1155* (DPU); on cork at base of trunk of living *Fagus sp.*, DePauw Arboretum, Oct. 25, 1945, *Simmons 1156* (DPU).
- Union Co.: on stump, July 21, 1917, *Fink & Fuson 9* (MU).
- Wabash Co.: on elm stump, Roann, March 23, 1908, *Daisy G. Lewis* (DPU).

XYLARIA (Hill) Schrank

Xylaria Hill, Hist. Plant. 62. 1751.

Xylaria (Hill) Schrank, Baierische Flora, 2:566. 1789.

Thamnomycetes Ehrenberg, in Nees, Hor. Phys. Berol. 79. 1820.

Xylariodiscus Hennings, Hedwigia, 38:63. 1899.

Moelleroclavus Hennings, Hedwigia, 41:15. 1902.

Stromata erect or ascending, cylindrical, clavate, filiform, often compressed, simple or branched, of a corky, leathery, or fleshy consistence, black outside, mostly white within. Perithecia sunken in the stroma but more or less prominent, globose or ovate, with short necks and papilliform ostiola. Asci cylindrical, 8-spored. Ascospores elliptical or fusoid, continuous, black, mostly inequilateral.

KEY TO THE SPECIES

- | | |
|---------------------------------------|--------------------------|
| 1. Head fertile throughout..... | 2 |
| Head with apex sterile..... | 4 |
| 2. Stipe bare when mature..... | 3 |
| Stipe villous when mature..... | 2. <i>X. corniformis</i> |
| 3. Ascospores 20-30 microns long..... | 5. <i>X. polymorpha</i> |
| Ascospores 7-8-(15) microns long..... | 1. <i>X. castorea</i> |
| 4. Stipe glabrous..... | 5 |
| Stipe villous..... | 4. <i>X. Hypoxylon</i> |
| 5. Stroma thick, branching..... | 3. <i>X. digitata</i> |
| Stroma filiform..... | 6. <i>X. subterranea</i> |

1. *Xylaria castorea* Berkeley

Xylaria castorea Berkeley, Fl. Nov. Zel. 204. 1855.

Stromata simple, solitary, rising from a reddish-brown, spongy, irregularly shaped base 1-2 cm. high; stipes short (less than 2 cm. long); heads subclavate to clavate, somewhat compressed or flattened, 1-4.75 cm. high and 0.5-1 cm. wide, brown to brownish-black, smooth to minutely areolate from depressions in the surface, with a few scattered, protruding ostiola, obtusely rounded at the apex, fertile throughout. Perithecia compact to scattered, generally compressed because of crowded condition, measuring about 0.33-0.75 mm. in diameter. Asci cylindrical, 8-spored, sp. p. 50-80 x 5-7.5 microns with a slender stipe one-third to one-half as long. Ascospores brown, uniseriate, elliptical, slightly inequilateral, 7-15 x 4-7 microns.

Specimens examined:

Hendricks Co.: on log, Aug. 8, 1917, *Sylvia Fuson 130* (MU).

Monroe Co.: on dead stump, Bloomington, Jan. 21, 1902, *Mutchler* (IU).

Putnam Co.: on rotting log, DePauw Arboretum, Oct. 25, 1945, *Simmons 1176* (DPU); on rotting bark, in ravine, DePauw Arboretum, Oct. 10, 1941, *Simmons 1177* (DPU); on decaying stump, ravine S. W. DePauw Arboretum, *Roy Veselinovich* (DPU).

Stromata of *X. castorea* Berk. may resemble the smaller growth forms of *X. polymorpha* (Pers.) Grev. Ascospore measurements of the two species show those of *X. castorea* to average 7-8 microns in length with a maximum of 15 microns while those of *X. polymorpha* are 20-30 microns long.

2. *Xylaria corniformis* Fries

Sphaeria corniformis Fries, Elench. Fung. 2:57. 1828.

Xylaria corniformis Fries, Summa Veg. Scand. 381. 1849.

Stromata usually single and scattered but sometimes two or three are connected at the base, simple, club-shaped, not compressed,

obtuse at the apex, fertile throughout, the heads of the mature specimens divided into small, variously shaped areas (areolate-rimose), brownish-black, rough with papilliform ostiola, 3-6 mm. in diameter, 2.5-5 cm. in height; stipes short, black, villous, arising from a spongy, brownish-purple, tubercular base. Perithecia compact, compressed because of crowded condition, 0.33-0.5 mm. across. Asci cylindrical, somewhat stipitate, 8-spored, sp. p. 45-70 x 5-6 microns. Ascospores obliquely uniseriate, inequilaterally elliptical, rounded at the ends, brown, 7.5-12 x 4-5.5 microns.

Specimens examined:

Monroe Co.: on dead beech, Unionville, Oct. 21, 1911, *Owens* (IU).

Montgomery Co.: *Hensmer* (IU); on old log, in wood near Sugar Creek, near Crawfordsville, Sept. 1, 1917, *Fink & Fuson 393* (MU).

Posey Co.: on oak log in Schuffle Pond, May 13, 1939, *Winona H. Welch 5817* (DPU).

Putnam Co.: Fern, October 1892, *L. M. Underwood* (DPU, IU).

The stipes of many species of *Xylaria* are bare in mature specimens, but *X. corniformis* Fr. characteristically retains its villous appearance. In contrast to *X. Hypoxylon* (L.) Grev., which also is villous in age, the stromata of *X. corniformis* are fertile throughout while those of *X. Hypoxylon* are sterile at the apices.

3. *Xylaria digitata* (Linnaeus) Greville

Clavaria Hypoxylon Schaeffer, Icon. Fung. Pl. 265. 1761.

Sphaeria clavata Hoffmann, Veg. Crypt. Vol. 1, pl. 4. 1787.

Sphaeria digitata Ehrenberg, Beiträge, 6:7. 1792.

Clavaria digitata Linnaeus, Syst. Veg. ed. 15, 1010. 1798.

Xylaria digitata (Linnaeus) Greville, Flora Edin. 356. 1824.

Hypoxylon digitatum Link, Handbuch, 3:348. 1833.

Stromata erect, tufted, connate below, thick, dark-brown, leprose-velutinous, becoming glabrous, round and simple, gradually attenuated above, rarely obtuse or 2-3 dichotomously divided, rarely more or less compressed or forked, covered at first with the white conidial hymenium. Fertile head occupying the middle of the stroma, attenuated below into a short stipe and ending above in a sterile apex. Perithecia numerous, densely crowded, slightly prominent, with papilliform ostiola. Asci cylindrical, long-pedicillate, 8-spored, sp. p. 100-120 x 7 microns. Ascospores overlapping-uniseriate, navicular-fusoid, subobtuse and slightly curved, dark brown, 12-16 x 5-6 microns.

Specimens examined:

Montgomery Co.: on old wood, Ladoga, Aug. 20, 1910, *H. W. Anderson* (MU).

The apices of the stromata of *X. digitata* (L.) Grev., like those of *X. Hypoxylon* (L.) Grev., are sterile. The stipes of mature specimens of *X. digitata* are glabrous while those of *X. Hypoxylon* are woolly-tomentose.

4. *Xylaria Hypoxylon* (Linnaeus) Greville

- Valsa digitata* Scopoli, Fl. Carniol. 2:398. 1722.
Clavaria Hypoxylon Linnaeus, Fl. Suec. ed. 2, 457. 1755.
Clavaria hirta Batsch, Elench. Fung. Cont. 1:229. 1786.
Sphaeria cornuta Hoffmann, Veg. Crypt. 1:11. 1787.
Clavaria cornuta Bulliard, Hist. Champ. Franc. 1:193. 1791.
Sphaeria Hypoxylon Persoon, Obs. Mycol. 1:20. 1796.
Sphaeria ramosa Dickson, Plant. Crypt. Brit. 4:27. 1801.
Xylaria Hypoxylon (Linnaeus) Greville, Flora Edin. 355. 1824.
Sphaeria digitata Bolton, Fungi Hal. 3:130. 1891.

Stromata simple to variously branched, cylindrical to compressed, black, 0.75-4.5 cm. high, pointed and sterile at the apices; heads larger than stipe, roughened by more or less prominent, ovate, papilliform ostiola, interior white, fibrous; stipes one-fourth to one-half length of stroma, generally cylindrical, with a brownish woolly-tomentose base, more or less simple with branching in or at the base of the fertile head. Perithecia thickly crowded, 0.33-0.5 mm. in diameter, globose to slightly compressed, more or less erumpent. Asci cylindrical with a long stipe (sometimes one-half total length of ascus), sp. p. 75-80 x 5.5-8 microns, 8-spored. Ascospores obliquely uniseriate, fusoid, inequilateral, obtuse at each end, brown to black, 9-16 x 4.5-6 microns.

Specimens examined:

- Hendricks Co.: on *Acer sp.*, Dec. 26, 1912 (IU).
 Monroe Co.: on ash, Unionville, Oct. 21, 1911, *Owens* (IU); on oak, Unionville, Nov. 7, 1910, *Owens* (IU); on decayed maple bark, Bloomington, Jan. 30, 1931, *Martens* (IU).
 Parke Co.: on bark of *Quercus alba*, Turkey Run State Park, Trail No. 7, June 13, 1943, *Winona H. Welch 9009* (DPU).
 Putnam Co.: Greencastle, April 22, 1908, *Daisy G. Lewis* (DPU); on dead fallen log, Hoosier Highlands, Sept. 16, 1941, *Simmons 1179* (DPU); on fallen, rotting log of *Salix sp.*, DePauw Arboretum, Nov. 13, 1941, *Simmons 1180* (DPU).
 Rush Co.: on a rotten log, 1.5 miles N. Rushville, Dec. 28, 1932, *Floyd Shuttleworth* (DPU).

The stipes of mature specimens of *X. Hypoxylon* (L.) Grev. typically have woolly-tomentose bases while those of the occasionally similar *X. digitata* (L.) Grev. are bare.

5. *Xylaria polymorpha* (Persoon) Greville

Valsa clavata Scopoli, Fl. Carniol. 398. 1722.

Xylaria clavata Schrank, Baierische Flora, 2:566. 1789.

Clavaria digitata Bulliard, Hist. Champ. Franc. 1:192. 1791.

Clavaria hybrida Bulliard, Hist. Champ. Franc. 1:194. 1791.

Sphaeria polymorpha Persoon, Comm. fung. clav. 17. 1797.

Xylaria polymorpha (Persoon) Greville, Fl. Edin. 355. 1824.

Sphaeria digitata Müller, Fl. Danica, 15:6. 1852.

Stromata solitary or several cespitose-connected at the base, upright, thick, bare, at first dirty-brown, becoming black, not shiny, variable in size, 2-11 cm. high and 0.5-3 cm. thick, irregular in shape; simple, cylindric, subattenuated above and below, mostly obtuse; obovate, compressed; more or less sublobate-divided; globose; or otherwise variable in form. Perithecia crowded, compressed, 0.5-1 mm. in diameter, ovate or globose. Ostiola papilliform. Asci cylindrical, long stipitate, 8-spored, sp. p. 120-180 x 7.5-10 microns. Ascospores uniseriate, elliptical or fusoid, subacute at the ends, subinequilateral or curved, continuous, brown, 20-30 x 6-10 microns.

Specimens examined:

Monroe Co.: on *Acer sp.*, Unionville, Nov. 7, 1910, *Owens* (IU).

Montgomery Co.: on stump, July 27, 1917, *Sylvia Fuson 110* (MU); on old wood, near Crawfordsville, *Bruce Fink 182* (MU); Bal Hinch, S. W. Crawfordsville, Oct. 9, 1940, *Simmons 1103* (DPU).

Putnam Co.: at base of stump on hillside, Monon Springs, Greencastle, Oct. 1, 1932, *Shuttleworth* (DPU); on ground at Monon Springs, near Greencastle, *R. W. Barnett* (DPU), on stump of tree, Greencastle, April 18, 1908, *Florence Mieceae* (DPU); on locust stump, Putnamville, May 25, 1908, *Minnie Bowen* (DPU).

Tipton Co.: on wood, George Auble yard, Kempton, Aug. 2, 1929, *G. Auble, Jr.* (WAB).

Union Co.: on logs in wood, July 25, 1917, *Bruce Fink 76* (MU).

Some forms of stromata of *X. polymorpha* (Pers.) Grev. may resemble those of *X. castorea* Berk. Ascospore measurements serve in making a distinction between the two species, those of *X. polymorpha* (20-30 x 6-10 microns) being relatively larger than those of *X. castorea* (7-15 x 4-7 microns).

6. *Xylaria subterranea* (Schweinitz) Saccardo

Sphaeria subterranea Schweinitz, Syn. fung. N. Am. 189. 1831.

Xylaria subterranea (Schweinitz) Saccardo, Syll. fung. 1:338. 1882.

Stromata filiform, simple or branching from the base, attached to the matrix by a thin, felt-like subiculum, 3 inches to nearly a foot in length, 1-2 mm. thick, at first light-colored from the conidial layer,

then black, sterile at the apex. Perithecia ovate-globose, about 0.5 mm. in diameter, unequally crowded or scattered at intervals along the stroma, solitary or 2-4 together, prominent, with conic-papilliform ostiola. Asci (sp. p.) cylindrical, 75-85 x 5 microns, with slender stipes and abundant paraphyses. Ascospores uniseriate, oblong-elliptical, attenuated at the ends, subinequilateral, 10-12 x 4-5 microns.

A collection of *X. subterranea* (Schw.) Sacc. is reported for Indiana by Van Hook.¹¹ The specimen is not found among other collections deposited in the herbarium of Indiana University. The species is included in the present study on the basis of Van Hook's report.

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