Some Species of Nummularia Common in Indiana.

Claude E. O'Neal.

The difficulty of distinguishing the various species of *Nummularia*, and even the genus itself from the genus Hypoxylon, is quite evident to anyone who has made any attempt at their classification. In a paper entitled "A Monograph of the Common Indiana Species of Hypoxylon",* C. E. Owens, by the aid of plates and an artificial key, sets forth the characteristics of the common species of the latter genus. The purpose of this paper is to do a similar work with the available species of the genus *Nummularia*.

In the study of *Nummularia*, attention is first directed toward the stromata, which appear as blackish or brownish incrustations on the dead trunks and limbs of our common deciduous trees. In form, the stromata vary greatly, but in general, they belong to two types, one of which may be described as cup-shaped, and the other as convex. The former type is usually orbicular or elliptical in shape, while the latter may be either orbicular, elliptical, or broadly effused with an irregular outline.

The stromata arise beneath the epidermis of the substratum where they may remain concealed for some time, but sooner or later, the epidermis is broken through and the spore-bearing surface is exposed. Sometimes in old specimens the entire epidermis may be removed and the erumpent characteristic overlooked. In some cases the entire cortex may decay and fall away, leaving the stromata standing out on the decorticated surface. Again, some of the more resistant ones may be found in good condition on a log that is ready to drop to pieces from decay.

In width the various Indiana species range from a few millimeters in the cup-shaped forms to several centimeters in the broadly effused types. The thinnest ones that the author has found have been about one-half millimeter thick while some of the cup-shaped forms may have a thickness of

*Proceed. Ind. Acad. Sci. 1911, p. 291.

half a centimeter or more. In the early stages of development in the species described the stromata may be lightly colored, but when the sporidia are mature the color of the fertile layer is black. Sometimes the substratum is stained by the fungus. One species is readily recognized by the characteristic orange color imparted to the wood beneath the stromata. Another species gives a peculiar ring-like marking to both wood and bark.

If a stroma be cut through, the flask-like perithecia are found deeply embedded in it. They are arranged in a single row and open by minute pores (ostiola) on the upper side of the stroma. The ostiola in some species may be rather prominently raised giving the fertile surface a pimpled appearance, or they may be sunken; while in some forms they may be so obscure as to be passed over unnoticed. The edges of the stromata are usually sterile.

The perithecia contain many eight-spored asci. These asci are cylindrical in shape and bear the spores in a single row. They are readily distinguished from the paraphyses with which they are found by their shorter length and the spores which they contain.

The spores of the Nummularias vary greatly in size, color, and shape. The largest ones that the author has observed were about 16 microns long and one-half as broad, while the smallest were about 5 microns long and about 2½ microns wide.

The shape varies from elliptical to orbicular. When the spores are young they are usually hyaline, but as they become older, they turn brown and in some species they finally become opaque.

In general, the Indiana species of Nummularia are saprophytic in habit and consequently have but little economic importance. Under certain conditions, however, *N. discreta** becomes parasitic and causes considerable damage to poorly kept apple trees. To many fruit growers it is known merely as apple canker; others distinguish it as the blister canker. The fungus gains a footing in a wound or in a decayed portion of the tree and spreads to the living parts. The stromata arise upon the mycelia beneath the epidermis of the host. The overlying epidermis shortly becomes dry and papery and sooner or later it is torn and drops away leaving the

*Canker of Apple—Hasselbring, Ill. Exp. Sta. Bull. 70.
Fungous Diseases of Plants—Duggar, pp. 282–284.
Apple Blister Canker and Methods of Treatment—W. O. Gloyer, Ohio Exp. Sta. Cir. 125.
The New York Apple Tree Canker. Bulls. N. Y. Ag. Ex. Sta. Nos. 163 and 185. Paddock.
The Control of Canker in the Orchard—J. R. Cooper, Neb. Hort., Vol. 3, 1913.

cankerous stromata exposed. Since a great deal of damage is done before the stromata are formed, it is necessary to identify the disease from other characteristics. The remedy for this parasite is obviously the proper treatment of wounds and the removal and destruction of affected parts. Care in pruning would in many cases prove a sufficient preventive.

This fungus has been reported on several other hosts including Amelanchier but in these cases the economic importance is insignificant.

KEY TO THE COMMON INDIANA SPECIES.

I. Stroma cup-shaped with perithecia opening on the concave side. (A).

II. Stroma convex or plane. (B).

A. Stroma prominent, orbicular, with a thick, raised margin; stroma 4 to 7 mm. across; spores globose or subglobose, 10-16 microns .....1. *N. discreta.*

A. Stroma erumpent-superficial, either orbicular or elliptical: margin not so thick nor so regularly bulging as in the preceding species; concave part ½ to 1 cm. across. Spores subinequilateral, 10-15x5-6 microns .....2. *N. repanda.*

B. Stroma dull black, orbicular, elliptical, or broadly effused; ostiola rather prominently raised, 3-5 per linear mm. Spores 12-16x6-8 microns .....3. *N. bulliardi.*

B. Stroma shiny black, more or less furrowed, staining the wood of the substratum orange color. Spores 12-16x5-7 microns..4. *N. tinctor.*

B. Stroma thin, orbicular, suborbicular or linear; ostiola depressed; ranging from ½ to 1 cm. across. Spores 4½-5x2-2½ microns..... .....5. *N. microplaca.*

Descriptions.

1. *Nummularia discreta,* (Schw.) Tul. Plates I and II.

Sphaeria discinola, Schw. Syn. Car. No. 63.
Sphaeria discreta, Schw. Syn. N. Am. 1249.
Sphaeria excavata, Schw. l. c. 1250 (Sec. spec. in herb. Schw.)
Nummularia discreta, Tul. Sel. Carp. II, p. 45.

Stroma erumpent, circular or subcircular, sometimes uniting to form elongated patches, cup-shaped when mature, with a thick raised margin; ashen or grayish yellow, becoming black; the concave surface at first white

punctate from the minute ostiola which are hardly visible when mature. The bark and wood beneath the stromata are marked with a black circumscribing line. Perithecia arranged in a single row, oval or ovate-cylindrical, about one millimeter long, usually rather abruptly contracted above into a short neck and extending to the base of the stroma. Asci cylindrical, 140-170x10-15 microns (E. & E., 110-120x10-12); spore bearing part, 110-125x 10-15 microns. Paraphyses, long and filiform. Sporidia subglobose, almost hyaline at first, finally becoming opaque, 10-16 microns in diameter. (11-13 Gloyer. 10-12 E. & E.)

On dead trunks and branches of Pyrus malus: quite common on the living trees as well. Practically every orchard visited in Hendricks, Putnam and Monroe counties, Indiana, as well as Delaware County, Ohio, showed traces of this fungus. Gloyer reports it especially abundant in southern Ohio. Reported on Amelanchier canadensis, Newfield, N. J., and on Gleditschia triacanthos, Ohio, (Morgan): also (See Saccardo in Syll.) on Sorbus, Ulmus, Cercis and Magnolia.

On apple trees this fungus usually attacks the trunks and larger limbs, making somewhat sunken, cankerous areas several inches in length. The dead bark is separated from the sound by a distinct line and cracks occur along this boundary. At the beginning, living spots within the cankerous area give the affected parts a mottled appearance. This distinguishes it at this stage from other cankers.

2. *Nummularia repanda*, (Fr.) Nke.

Sphaeria repanda, Fr. S. M. II, p. 346. Obs. Mycol. I, p. 168.
Hypoxylon repandum, Fr. Summa Veg. Sc. p. 383.
Nummularia pezizoides, E. & E. Bull. Torr. Club. XI. p. 74.
Nummularia repanda, Nitsch. Pyr. Germ. p. 57.
Exsic. Fckl. F. Rh. 2178. Thum. M. U. 1460.

Stroma erumpent-superficial, orbicular or subelliptical, ½ to 1 cm. in diameter, concave and often with a thin, erect, rather broad margin, reddish-gray at first, finally black; disk mammillose from the projecting ostiola. Perithcia monostichous, immersed, ovate-oblong, ½ to ¾ mm. long, crowded, causing the sides to be somewhat compressed. Asci cylindrical, subsessile, eight-spored, 110-120x8 microns, with long filiform paraphyses. Sporidia obliquely uniseriate, narrow ovate, obtuse, subinequilateral, dark brown, 8½-14x4-7½ microns. (E. & E. 11-14x4-5 microns; Sacc. in Syll., 15-16x6-7 microns.) Readily distinguished from N. discreta by its differently shaped spores and its mammillose disk.

On Hicoria, Clark County, Indiana. (Van Hook); on wood and bark, Topeka, Kans. (Craigin), and on bark, Ottawa, Canada (Macoun); on bark of Ulmus americana Missouri. (Demetrio). On Sorbus aucuparia in Europe.

3. *Nummularia bulliardi*, Tul. Plate III, Figs. 1, 2 and 3.

Hypoxylon nummularium, Bull. Champ. tab. 468, fig. 4.
Sphaeria nummularia, D. C. Flore Fr. II, p. 290.
Sphaeria anthracina, Schm. & Kze. Mycol. Hefte 1, 55.
Sphaeria clypeus, Schw. Syn. N. Am. 1219.
Nummularia clypeus, Cke. IX, 507.
Exsic. Ell. N. A. F. 85. Rab. F. E. 2956. Rehm, Asc. 977.
Illustrations. (See Sacc. XX, p. 202, for list of.)

Stroma at first covered by the epidermis, soon erumpent, almost superficial and free, convex, orbicular or oval, sometimes irregular in shape or broadly effused, black inside and out, punctulate from the slightly prominent ostiola, clothed at first with a reddish or rusty layer of conidia. Perithecia rather large, ovate, black, loosely included in the packed cells of the stroma. Asci cylindrical with very short stalks, spore-bearing part 115-140x7-10 microns (E. & E. 100-115x10 microns), with long, stout paraphyses. Spores eight, uniseriate, elliptical, hyaline becoming opaque, 10-23x5-10 microns, mostly about 15-20x6-8 (E. & E. 12-15x7-9. Sacc. 12-14x9-10 microns.

In the field this species is liable to be confused with certain species of Diatrype (Fig. 2, Plate III) but may be readily distinguished from them by the color of its spores. Collected in abundance in Brown, Clark, Hendricks, Monroe and Putnam counties, where it usually attacks the beech and more rarely the maple. Reported common on the dead trunks and limbs of various deciduous trees in Europe and North America. According to Ellis and Everhart, it occurs for the most part on oak in the vicinity of Newfield, N. J.

4. *Nummularia microplaca*, (B. & C.) Cke. Plate IV, Fig. 4.

Diatrype microplaca, B. & C. Journ. Linn. Soc., X, p. 586.
Anthostoma microplacum, Sacc. Syll. I, p. 298.
Nummularia microplaca, Cke. Syn. 837.
Exsicc., Rav. Fungi Car. IV, 39. Rav. Fung. Am. 355. E. & E. N. A. F. Second Ser. 1556.
Illus., Revue Myc. VII, (1885) tab. 52, fig. 3.

Stroma orbicular to subelliptical, ½ to 1 cm. across, or elongated 1-4x½-1 cm. or by confluence extending for long distances in grooves of the bark. It forms a thin carbonaceous crust, black, arising beneath the epidermis but soon becoming bare, surface even, faintly punctulate from the minute ostiola, which are not prominent but slightly depressed, the opening at first filled with a white farinaceous matter. Perithecia ovate-globose, small (less than one-half mm. across), arranged in a single row. Spore-bearing part of the ascus 40-50x4 microns (E. & E. 25x3 microns), or with the base about 60-80 microns long (Sacc. 37-50x4-5. E. & E. 45-50 long). Spores uniseriate, ends mostly slightly overlapping, elliptical, inequilateral, pale brown, 5-7½x2½-3 microns (E. & E. 4½-5x2-2½. Sacc. 5-6x3½-4).

Should not be confused with Hypoxylon Sassafras which has very prominent perithecia while N. microplaca appears smooth and has stroma depressed.

Abundant near Bloomington, Indiana, on Sassafras officinale; reported on the same host in South Carolina (Ravenel) and in Ohio (Morgan and Kellerman); on Persea, Georgia (Ravenel).

5. *Nummularia tinctor*, (Berk.) E. & E. Plate IV, Figs. 1-3.
   Sphaeria tinctor, Berk. Lond. Jour. Bot. IV, p. 311.
   Hypoxylon tinctor, Cke. Syn. 996.
   Diatrype?? tinctor, (Berk.) Sacc. Syll. I, 200.
   Exsic., E. & E. N. A. Fungi, Second Ser. 1789.

Stroma very hard and brittle, much effused, showing the irregularities of the surface on which it grows, 1mm. thick, black, with surface almost smooth, but distinctly papillose from the projecting ostiola as seen under the hand-lens, wood beneath the stroma stained a beautiful reddish-orange color, and rendered very hard. Perithecia monostichous, crowded, elongated (¾ mm. in length), covered above with the stromatic layer. Asci 100-140x6-10 microns (E. & E. 112x7-8). Spore-bearing part of ascus 75-120 long (E. & E. 90-100). Filiform paraphyses in abundance. Spores uniseriate, pale brown, conspicuously uniguttulate, oblong navicular, 13-20x5-8 microns (E. & E. 15x6).

On Platanus, Fagus, Acer, Ulmus and Cercis in the vicinity of Bloomington, Indiana (Van Hook). Occurs throughout the Mississippi valley and in the south as far east as Florida.

In this paper, free use has been made of North American Pyrenomycetes by Ellis and Everhardt. The descriptions have been re-written to suit the material at hand. Especially has it been found necessary to revise the measurements of parts as seen under the microscope. The author wishes also to make due acknowledgment to Prof. J. M. Van Hook, of Indiana University for material and valuable assistance in the preparation of this paper.

Indiana University,
Bloomington, Indiana.

PLATE I.

Figures 1 and 2. Where Nummularia discreta thrives. Much of this is due to N. discreta. (From photos by the author in Hendricks County, Indiana.)

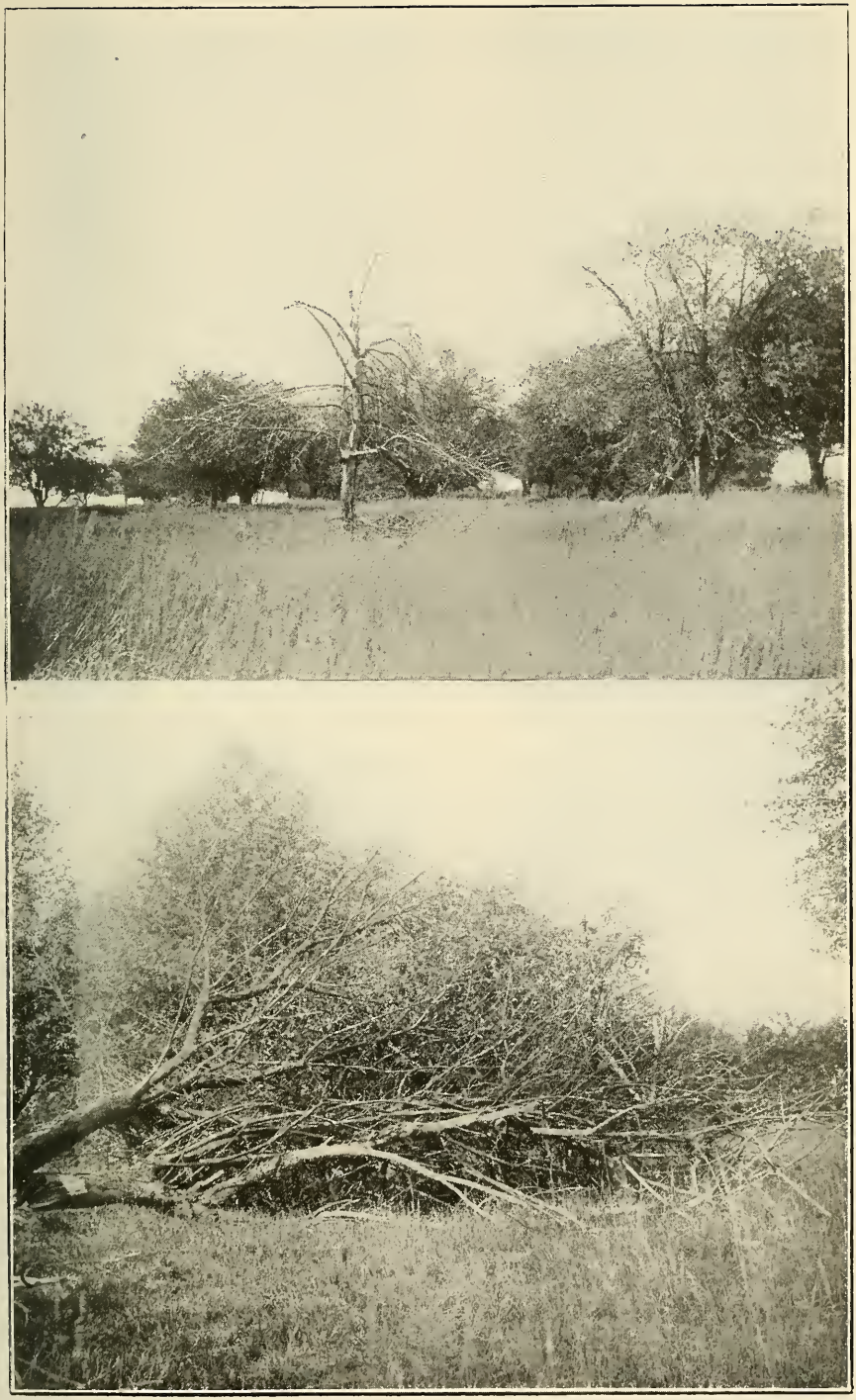

PLATE II.

Figure 1. Nummularia discreta on decorticated apple limbs. (Reduced.)

Figure 2. Same natural size.

Figure 3. Same before the bark has fallen away. (Natural size.)

Figure 4. Under side of a piece of bark showing white stains of the fungus. (Natural size.)

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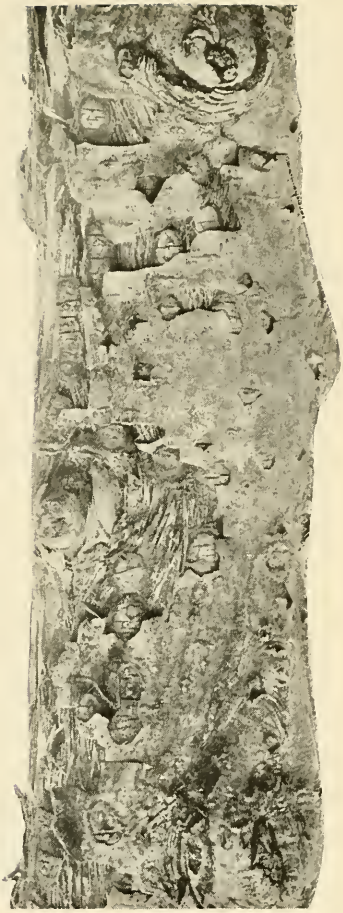

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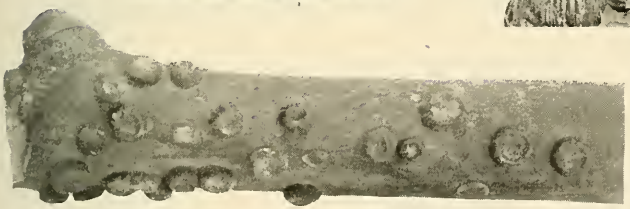

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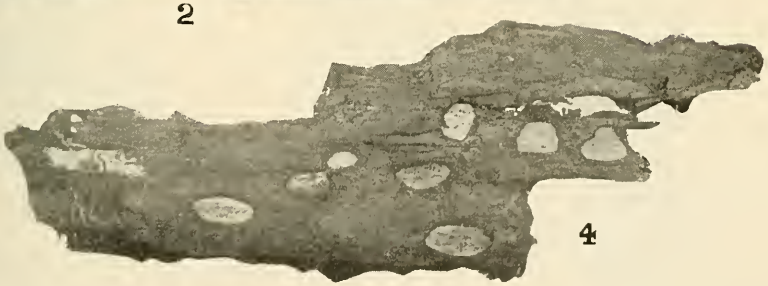

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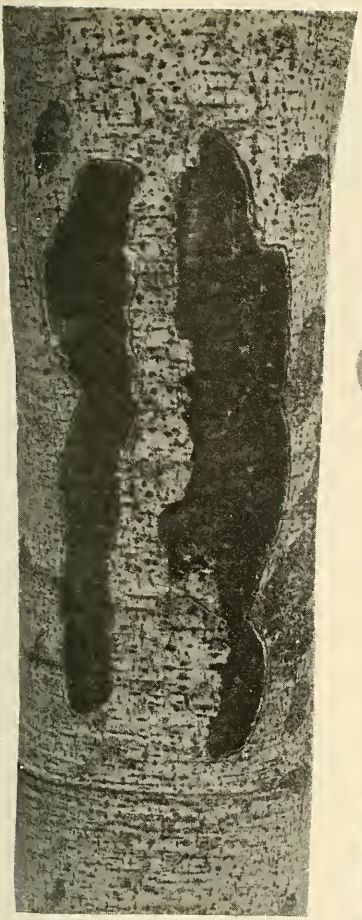
PLATE III.

Figure 1. Nummularia Bulliardi on beech, showing a common form of stroma. (Natural size.)

Figure 2. A stroma of a fungus (Diatrype) very similar to N. Bulliardi. (Natural size.)

Figures 3 and 4. Orbicular stromata of Nummularia Bulliardi on beech. (Natural size.)

Figure 5. Stroma taken from a log which was falling to pieces. (Natural size.)



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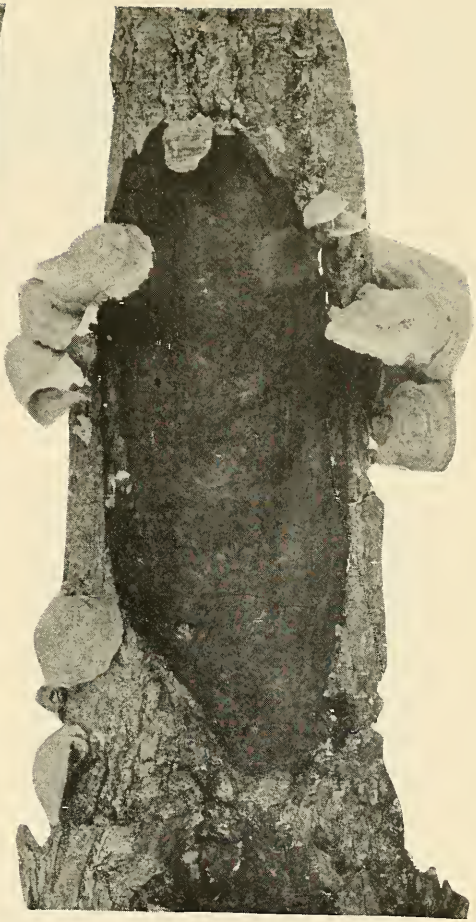

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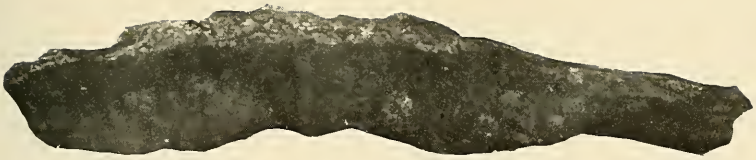
PLATE IV.

Figure 1. Nummularia tinctor. (Natural size.)

Figure 2. Same showing section of the wood beneath stroma. The dark colored parts are a beautiful orange.

Figure 3. Same showing furrowed stroma. (Natural size.)

Figure 4. Nummularia microplaca on Sassafras. Closely resembles Hypoxylon Sassafras. (Natural size.)



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