JOURNAL

OF THE

ARNOLD ARBORETUM

VOL. XXI OCTOBER, 1940 NUMBER 4

A MONOGRAPHIC STUDY OF THE GENUS THYRONECTRIA*

EDGAR V. SEELER, JR.

With five plates

IN THE FAMILY Nectriaceae, of the Hypocreales, is found a small group of species which show many morphological similarities. The most distinctive character possessed by all is the production of muriform septate spores. On the basis of other characters various taxonomists have distributed the species among six genera: *Thyronectria* Sacc., *Pleonectria* Sacc., *Megalonectria* Speg., *Mattirolia* Berl. & Bres., *Thyronectroidea* Seaver, *Pleogibberella* Sacc. But in my judgment they are more properly placed under the two genera, *Thyronectria* and *Pleogibberella*. *Pleogibberella* can reasonably be accepted as defined by Saccardo because the perithecia of its species unlike all the others are blue or violet by transmitted light. Incidentally *Pleogibberella* resembles *Gibberella* except that its spores are muriform.

As a step towards combining the other five, Wollenweber (1928) has already properly reduced *Megalonectria* to synonymy with *Pleonectria*. But all five are so much alike and distinguishable from one another with such uncertainty that there is ample justification for placing all their species under *Thyronectria*, the genus first described. Bringing together this group of about fifteen species greatly simplifies their taxonomic diagnoses.

The genus *Thyronectria* was established by Saccardo in 1875 to include all species of the Nectriaceae with muriform spores. Up to that time they had found a place in the genus *Nectria*. The following year he divided these species between *Thyronectria* and *Pleonectria* gen. nov. on

*Many thanks are gratefully expressed to Prof. J. H. Faull and Dr. D. H. Linder for their generous advice and inspiration.

a supposed difference in their perithecial stromata. Those with perithecia *immersed* in a stroma, taking *T. patavina* as the type (Pl. 5, fig. 1), were defined as species of *Thyronectria,* those with perithecia discrete or cespitose and *seated* on a stroma were defined as species of *Pleonectria,* with *P. Lamyi* as the type. Saccardo's diagrams clearly indicate the distinction he had in mind when he stated that *Pleonectria* (translating from Latin) "differs from *Thyronectria* almost as *Cucurbitaria* from *Thyridium.*" But more extended observations by Seaver (1909) and myself demonstrate that the variable stromatal character was not clearly understood and therefore that there was not adequate justification for the establishment of the genus *Pleonectria.*

Unfortunately the genus type *Thyronectria patavina* Sacc. is not available, but judging from Saccardo's drawings (Pl. 5, fig. 1) Seaver was correct in feeling that a genus based on it should include all known species, as *T. patavina* did not have a truly Valsa-like stroma with entirely immersed perithecia. Studies by the writer all confirm Seaver's conclusion and indicate that the perithecia of typical "Pleonectrias" such as *T. austro-americana* Seeler while apparently discrete or cespitose on a stroma are always covered by layers of stromatal tissue and often subimmersed to the extent of the *Thyronectria* type *T. patavina* Sacc. and that they are certainly identical in development with *T. Xanthoxyli* (Peck) Ell. & Ev., which has always been considered a true *Thyronectria* with immersed perithecia. In all species the perithecia have a light colored (red, orange, or brown) leathery membranaceous wall typical of the Hypocreales and its degree of fleshiness when wet depends on the thickness of this covering of stromatal tissue.

Another supposed differentiating character on the basis of which certain species of *Thyronectria* might be segregated generically is that of spore color. Thus Berlese and Bresadola claimed that certain species have hyaline spores and that others have dark-colored spores. To accommodate the latter they set up the genus *Mattirolia* in 1889. For what appears to be exactly the same reason Seaver (1909) later created *Thyronectroidea* with *T. chrysogramma* Seaver as the type to be the genus repository of dark-spored members of the group. He did not explain why *Mattirolia* was disregarded in that connection. However, spore color differences, just as is true of stroma differences, are neither constant nor sharply defined. As a matter of fact, the spores of all species of *Thyronectria* are yellowish or pale brown at maturity. According to my experience the variations and the differences in degrees of coloring are not constant enough or sufficiently well-defined to serve for generic distinction. It may further be remarked that even for

Seaver's type species *Thyronectroidea chrysogramma* the wall of the ascospore is dark-colored in the inner layer and hyaline in the outer, which is merely an exaggeration of the condition found in the ascospore walls of other species of *Thyronectria*. Hence both *Mattirolia,* assuming that the spores of its species may properly be defined as muriform, and *Thyronectroidea* should be reduced to synonymy.

Regarding *Mattirolia* there is a disturbing fact to which attention has not heretofore been called and of which mention should be made. According to the clear drawings and descriptions of Berlese and Bresadola (Pl. 5, fig. 2, 3) their two species of *Mattirolia* would differ from Saccardo's definition only by colored spores. So the Berlese and Bresadola species, to judge from the descriptions, might simply be transferred to the present *Thyronectria*. However, examination of the genus type *M. roseo-virens* disturbs that easy conclusion. Part of Bresadola's original collection is in the Farlow Herbarium (ex Patouillard). It is a fungus which fits the description externally but its green spores are only two-celled, finally separating into single-celled units (*Chromocrea* Seaver, Mycologia **2:** 58. 1910), so it must be excluded from the muriform spored group. A final decision cannot be rendered, however, until all of the type collection has been examined, because it is possible that in the part of Bresadola's collection studied by Berlese two distinct fungi may be present. This would seem to be borne out by Berlese's illustrations of gross materials as shown in Plate 5, figure 2. The three illustrations in the upper left corner certainly suggest that they represent a fungus different from the one represented immediately below. If this be true, then the part of the type collection in the Farlow Herbarium does not contain any *Mattirolia roseo-virens* as described by Berlese. All of it happens to be externally like what is shown in the three upper illustrations referred to. Surely Berlese must have seen a fungus in the material studied by him with muriform spores such as he figured and described, and on this assumption I am including translations of his two descriptions and giving these species a place in my key.

Of the four generic names that in my opinion should be regarded as synonyms for *Thyronectria* there remains for discussion the genus *Megalonectria* of Spegazzini, a genus to which so far only one valid species has been referred. Its sole distinction from *Thyronectria* is the possession of a *Stilbella* as the conidial stage, and since the erect coremia are often broken off or lacking in limited collections, some confusion has arisen between the two genera. Its separation on this uncertain basis seems unnatural to the author, as included in *Thyronectria* are species showing imperfect spores enclosed in pycnidia, and other species with

Tubercularia-like sporodochia. An elongation of the cushion base in the latter could easily evolve the Megalonectria-Stilbella structure having the conidiophores on the top of a stalk. As a matter of fact such an extension of the base actually occurred in some of my cultures of *T. austro-americana* resulting in something like a coremium. For these reasons the writer has followed Wollenweber in reducing *Megalonectria* to sub-generic rank and is reserving comment on the commonly accepted separation of *Sphaerostilbe* from *Nectria* on this character alone.

In so doing, however, it is freely acknowledged that study of the life histories of individual species of the fungi must be made before "natural" relationships can be known and as Seaver (1909) and Petch (1938) have pointed out, nowhere is such investigation more necessary than in the Hypocreales, many of whose members have been shown to be economically important in their conidial phase. Until that has been done, however, there are no valid reasons for retaining the genus *Megalonectria,* any more than there is for recognizing *Pleonectria, Mattirolia,* and *Thyronectroidea.* All are better regarded as synonyms of *Thyronectria.*

At this point it is fitting to refer to the conidial fructifications of *Thyronectria.* Fuchs was the first to connect a conidial stage experimentally with a species of *Thyronectria* when he reported four forms of spores developed in the life history of *T. berolinensis*: ascospores, ascoconidia (not in the ascus), microconidia (resembling *Tubercularia vulgaris* Tode), and macroconidia (a species of *Fusarium*), the last only in culture on potatoes. Wollenweber (1931), who later studied this species, denied the production of any Fusarium spores. Next Miss Lieneman (1938), as well as the author, observed the microconidia in the stromata of *T. austro-americana* (*T. denigrata*) for which the name *Gyrostroma austro-americanum* is here suggested, and these were also found to be formed from free hyphae in culture. She also concluded that asconidia (myriospores) were sometimes produced in the ascus (an occurrence observed by the writer) under certain conditions of humidity, and that therefore *T. sphaerospora* (Ell. & Ev.) Seaver was a synonym.

The writer has added to this growing list a pycnidial phase for *T. missouriensis,* having grown it in culture, and presents the name *Gyrostroma missouriense* for purposes of convenience in classification. Also observed for the first time are remains of a Gyrostroma stage of *T. balsamea,* and of a Tubercularia sporodochium for *T. antarctica,* although for neither of these was sporulating material available.

To place these new conidial phases in Wollenweber's "key" (1926, p. 184) the following arrangement is offered:

Subgen. 1. **Gyrostromella** Seeler, n. subgen.: stat. conid. *Gyrostroma* Naoumoff referens; conidia continua, minutissima, ovata vel allantoidea.

a. on *Gleditsia* and *Acacia* — North and South America. *Gyrostroma austro-americanum* Seeler [stat. ascig. = *Thyronectria austro-americana* (Speg.) Seeler.]

b. on *Carya* and *Acer* — North America. *G. missouriense* Seeler [stat. ascig. = *T. missouriensis* (Ell. & Ev.) Seaver.]

c. on *Abies* and *Tsuga* — North America. Probably *Gyrostroma* [stat. ascig. = *T. balsamea* (Cke. & Pk.) Seeler.]

Subgen. 2. DENDRODOCHIELLA Wollenweber: stat. conid. *Dendrodochium* Bon. referens; conidia continua, minutissima, cylindracea, recta v. incurva, utrinque rotundata.

a. on *Ribes* — Europe and North America. *Dendrodochium berolinense* Wollenweber [stat. ascig. = *T. berolinensis* (Sacc.) Seaver.]

b. on various hosts — southern South America. Probably *Dendrodochium* [stat. ascig. = *T. antarctica* (Speg.) Seeler.]

Subgen. 3. MEGALONECTRIA (Sacc.) Wollenweber: stat. conid. *Stilbellam* referens; conidia continua, ovata.

a. on various hosts — circum-tropical. *Stilbella cinnabarina* (Mont.) Wollenweber [stat. ascig. = *T. pseudotrichia* (Schw.) Seeler.]

In conclusion of this discussion it should be pointed out here that there are peculiarities of the genus *Thyronectria* which are what might be termed "nectriaceous characters" as contrasted with "sphaeriaceous characters." Besides the light color and soft fleshiness of moist perithecia and stromata there is the lack of true paraphyses. Instead of them there are evanescent branching filaments (pseudoparaphyses) which in the past have been mistaken for paraphyses among the young asci. These grow *downward* from the position later occupied by the ostiole and fill the perithecial cavity before the asci develop and later evanesce leaving the cavity filled with a gelatinous substance. The asci tend to be close-fitting bags around the crowded spores and except in two species (*T. berolinensis* and *T. Lonicerae*) are not specialized for spore discharge by apical thickenings or pores. All the spores have relatively thick and flexible walls made up of an outer envelope and adherent walls of the component cells within; a contrast, for example, with the thin-walled spores in the genus *Cucurbitaria* of the Sphaeriales (see Welch, 1926). These are characters which make the genus a "natural" one as well as one of convenience.

Also to be noted in five of the species of *Thyronectria* is the strong tendency toward the budding of spores within the ascus resulting in the

production of myriads of small hyaline asco-conidia which may in advanced age completely obscure the true ascospores. The misunderstanding of this peculiarity led Saccardo (1878) to establish the genus *Chilonectria* for all "Nectrias" with "myriosporic asci." Now that developmental detail is clear the genus *Chilonectria* is of course no longer tenable and its species migrate into their rightful taxonomic places. In Plate 2, figures 5, 4, 3, 2 and 1, is shown a progression of the budding tendency from *T. berolinensis* (fig. 5) where it occasionally occurs in the perithecium but has not yet been reported within the ascus, to *T. chlorinella, T. balsamea* and *T. Lamyi* (fig. 3, 2, 1) in which budding within the ascus is the normal condition. As stated under *T. austro-americana* (fig. 4) the spores of that species may bud profusely in very damp seasons, but as a rule they do not do so.

As can be seen from the enumeration of species which follows, considerable confusion in classification has arisen because too much stress was laid on the size of stromata and the size of groups of perithecia. Wollenweber (1913) has already stressed these errors. Examination of type specimens and other collections has convinced me that these are characters which depend almost entirely upon the nature of the substratum, in particular the thickness and consistency of the outer bark under which fructifications start and through which they force their way. In the case of *T. austro-americana* the thick bark of the tree trunk causes stromata to be larger in all dimensions and less frequent than does the thin bark of small branches where stromata may be reduced in size and develop in great numbers in close proximity to each other. J. H. Miller (1928) has noted a comparable relationship for *Botryosphaeria Ribis* G. & Dug.

Too critical observance of the color of perithecia induced Speggazini to write descriptions of false species, here placed in synonymy with *T. austro-americana* and *T. antarctica,* since this color depends on the humidity during development and on the weathering of the outer layers of cells.

Observations during my research indicate that criteria for species determination in this group must be: (1) the structure and size of ascospores and their arrangement in young and mature asci, (2) the general appearance of perithecia, such as their size, shape, and color, (3) the structure and color of the stromata, always allowing for relatively slight deviations caused by variations in substratum, in the weather of the growing season and the growth-age of the specimen at hand. The key to species included in this paper is an attempt to follow these principles.

DESCRIPTION OF SPECIES

Thyronectria Saccardo, Grevillea **4:** 21. 1875, genus emend.

Pleonectria Saccardo, Nuovo Giorn. Bot. Ital. **8:** 178. 1876.
Chilonectria Saccardo (in part), Michelia **1:** 270. 1878.
Megalonectria Spegazzini, An. Soc. Cient. Arg. **2:** 216. 1881.
Mattirolia Berlese & Bresadola, Micr. Trid. p. 55. 1889.
Thyronectroidea Seaver, Mycologia **1:** 206. 1909.

Stromata erumpent, superficial or subimmersed, sometimes pulvinate, sometimes reduced to a subiculum, with the perithecia usually in cespitose clusters, usually partly immersed in the stroma, rarely discrete; individual perithecia subglobose, crowded, or collapsing, briefly papillate, rough or smooth, often clothed with a yellowish or greenish coat of scales or powder which may disappear with age leaving the bare wall colored orange, red, brown or very dark but never blue and never carbonaceous; both the stromata and perithecia when moist of a fleshy or leathery texture; asci clavate to cylindrical, mostly eight-spored but not always; ascospores hyaline, yellow or dark brown, many-septate and muriform, without appendages such as setae but in some species budding to form myriads of small hyaline conidia which may completely fill the ascus; filamentous pseudoparaphyses, finally evanescent, no true paraphyses. Conidial phases as far as known belong to the Imperfect genera: *Gyrostroma* Naoumoff, *Dendrodochium* Bonorden (or *Tubercularia* Tode), and *Stilbella* Lindau.

Key to Species

A. Perithecia appearing *free* on the stroma; mature spores hyaline to pale yellow-brown.
  1. Perithecia shades of *red*, darkening; for yellow-orange species see under 2.
    a. Perithecia usually cespitose in groups of *more* than 10; ascospores with very *distinct* transverse and 1–2 longitudinal septa; conidial phase Tubercularia-form. ..... 1. *T. antarctica.*
    b. Perithecia usually in groups of *less* than 10; ascospores with numerous *indistinct* transverse and longitudinal septa.
      (1) Mature perithecia *without* olive-yellow scales; ascospores noticeably *constricted* at the 3 major septa; conidial phase *Stilbella.* ..... 2. *T. pseudotrichia.*
      (2) Mature perithecia mostly *with* olive-yellow scales; ascospores *scarcely constricted;* conidial phase *Gyrostroma.* ..... 3. *T. missouriensis.*
  2. Perithecia *orange* to amber colored, often yellow or green powdered; for gray, drab or dark yellow-brown see under 3.
    a. Asci *2–4-spored,* with ascoconidia.

(1) Ascospores 14–27 × 3–4.5 μ; on *Abies* and *Tsuga*. . . . . 4. *T. balsamea.*

(2) Ascospores soon breaking into rounded muriform segments; on *Ulmus*. . . . . 5. *T. chlorinella.*

b. Asci *8-spored,* usually without ascoconidia.

(1) Ascospores 15–21 × 6.5–8.2 μ; on *Ribes*. . . 6. *T. berolinensis.*

(2) Ascospores 100 × 12 μ; on *leaves* of *Coffea*. 7. *T. coffeicola.*

3. Perithecia *gray,* drab or *dark* yellow-brown.

a. Ascospores 8–16 × 4.5–9 μ; on *Gleditsia* and *Acacia*. . . . . 8. *T. austro-americana.*

b. Ascospores 16–27 × 4.5–7.5 μ.

(1) Ascoconidia present; on *Berberis*. . . . . 9. *T. Lamyi.*

(2) Ascoconidia absent; on *Zanthoxylum* and *Rhus*. . . . . 12. *T. Xanthoxyli.*

B. Perithecia appearing almost *covered* by the stroma.

1. Ascospores *hyaline* to pale yellow-brown at maturity.

a. Asci *cylindrical,* with an apical pore; spores narrowly monostichous; on *Lonicera* and *Symphoricarpos*. . . . . 10. *T. Lonicerae.*

b. Asci *clavate,* without apical pore.

(1) Ascospores *finely* muriform, broadly ellipsoid; on *Acer, Cydonia?, Vitis?*. . . . . 11. *T. pyrrhochlora.*

(2) Ascospores *sparsely* muriform, elongate ellipsoid.

(a) Spores scarcely constricted, 16.4–26.8 × 6–8.2 μ; on *Zanthoxylum,* and *Rhus*. . . . . 12. *T. Xanthoxyli.*

(b) Spores constricted, 25 × 9–11 μ (30 × 8); on *Juglans*. . . . . 13. *T. patavina.*

2. Ascospores distinctly *dark* colored at maturity.

a. Mature spores 22–42 × 11–17 μ; on *Ulmus*. 14. *T. chrysogramma.*

b. Mature spores 18–20 × 10–12 μ; on *Alnus*. . . 15. *T. rhodochlora.*

c. Mature spores 15–18 × 9–11 μ; on *Laburnum*. 16. *T. roseo-virens.*

COMPREHENSIVE HOST AND RANGE KEY

HOST	RANGE	SPECIES
Abies	N. America, (Europe?)	4. *T. balsamea*
Acer	N. America	3. *T. missouriensis*
Acer	Europe	11. *T. pyrrhochlora*
Alnus	Europe	15. *T. rhodochlora*
Berberis	Europe & N. America	9. *T. Lamyi*
Carya	N. America	3. *T. missouriensis*
Coffea (leaves)	Java	7. *T. coffeicola*
Gleditsia	N. & S. America	8. *T. austro-americana*

Host	Range	Species
Juglans (*Cydonia? Vitis?*)	Europe	13. *T. patavina*
Laburnum	Europe	16. *T. roseo-virens*
Lonicera	N. America	10. *T. Lonicerae*
Rhus	N. America	12. *T. Xanthoxyli*
Ribes	Europe & N. America	6. *T. berolinensis*
Symphoricarpos	N. America	10. *T. Lonicerae*
Tsuga	N. America	4. *T. balsamea*
Ulmus	N. America	14. *T. chrysogramma*
Ulmus	N. America	5. *T. chlorinella*
Zanthoxylum	N. America	12. *T. Xanthoxyli*
Various	Circumtropical	2. *T. pseudotrichia*
Various	S. America	1. *T. antarctica*

1. **Thyronectria antarctica** (Speg.), n. comb. Plate 1, fig. 1 A–E; Plate 3, fig. 8; Plate 4, fig. 7.

Pleonectria antarctica Spegazzini, Fungi Fuegiani, p. 104, no. 275. 1887.
Pleonectria vagans Spegazzini, Fungi Fuegiani, p. 104, no. 276. 1887.

Perithecia 250–550 μ diam., mostly 300–350, cespitose in pulvinate clusters of from 3 to 25 or more which measure up to 5 × 3.5 mm., rarely single, not usually collapsing, spherical or laterally crowded, bright red-orange, (Brazil Red*) fading or darkening, usually fleshy with the outer surface cracked, ostiolate papillae obtuse or depressed. Seated on a fleshy pseudoparenchymatous reddish orange stroma which shows what appears to be the remains of a Tubercularia stage; erumpent through outer bark.

Asci loosely clavate, short stiped, 72–120 × 30–38 μ p. sp., finally evanescent.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores obliquely uniseriate and much overlapped or irregularly crowded, mostly 8 in each ascus, bluntly terminated cylindrical to broadly fusiform, straight or curved, transversely 6- to 12-septate, mostly 7 to 9, with the septa thick and *distinct* scarcely constricted, and muriform usually by one or two longitudinal divisions, hyaline to pale yellow, 26–41.5 × 9–12.5 μ, commonly 31.5 × 10.5 μ.

Type: on dead branches of *Berberis ilicifolia*, Staten Island, Tierra del Fuego, collected by C. Spegazzini, March 1882.

*Names of colors placed within parentheses are those of Ridgway, R. (1912).

RECORDED HOSTS: *Berberis ilicifolia* Forst., *Drymis Winteri* Forst., *Fagus betuloides* Mirb., *Fagus antarctica* Forst., *Maytenus magellanica* Hook.

RECORDED RANGE: Tierra del Fuego; Chile.

SPECIMENS MICROSCOPICALLY EXAMINED: Lent by Museo de la Plata, herb. Speg. no. 1638 *Pleonectria antarctica* (type); Speg. no. 1571 *P. vagans* (type), Isla de los Estados (Staten Island), Tierra del Fuego, and Speg. no. 1639 (co-type) Usuaia, T. del Fuego. In Farlow Herbarium; *P. antarctica*, leg. Thaxter no. 5308, March 1906, Punta Arenas, Chile.

The collection by Roland Thaxter shows in the center of the stroma an elevated naked cushion which may prove to be the remains of a tubercularoid conidial phase. This has been diagrammed in Plate 3, figure 8.

In gross appearance examples of this species showing small stromata might be confused with some specimens of *T. pseudotrichia*. However, the very definite and thick septa of the spores, showing the individual cells in the outer spore envelope will quickly distinguish *T. antarctica*.

2. **Thyronectria pseudotrichia** (Schw.), n. comb. PLATE 1, FIG. 5 A–E; PLATE 3, FIG. 6 A–C; PLATE 4, FIG. 6; PLATE 5, FIG. 5.

Nectria pseudotrichia (Schweinitz sub *Sphaeria*) Berkeley and Curtis, Exotic Fungi from Schweinitz Herb. no. 72, Jour. Acad. Nat. Sci. Phila. **2**: 289, pl. 25, fig. 9. 1853.

Sphaerostilbe pseudotrichia (Schw.) Berkeley & Broome, Jour. Linn. Soc. **14**: 114. 1875.

Sphaerostilbe nigrescens, Kalchbrenner & Cooke, Grevillea **9**: 15, pl. 136, fig. 24. 1880.

Sphaerostilbe rosea Kalchbrenner, Grevillea **9**: 26. 1880.

Pleonectria megalospora Spegazzini, Fung. Argent. **4**: 82, no. 210. 1881; An. Soc. Cient. Argent. **12**: 216. 1881.

Megalonectria pseudotrichia (Schw.) Spegazzini, Fung. Argent. **4**: 82, no. 211. 1881; An. Soc. Cient. Argent. **12**: 216. 1881.

Megalonectria nigrescens (Kalch. & Cke.) Saccardo, Syll. Fung. **2**: 561. 1883.

Megalonectria coespitosa Spegazzini, Fung. Puig. **1**: 160, no. 310. 1889.

Megalonectria verrucosa A. Möller, Phyc. u. Ascom. Bras. p. 298, pl. 4, fig. 55. 1901.

Megalonectria polytrichia (Schw.) Spegazzini var. *australiensis* P. Hennings, Hedwigia **42**: (79). 1903.

Megalonectria madagascariensis P. Hennings, Voeltzkow, Reise Ostafrika **3**: 29, pl. 3, fig. 21. 1908.

Megalonectria Yerbae Spegazzini, Ann. Mus. Nac. Buenos Aires **17**, 129. 1908.

Pleonectria riograndensis Theissen, Broteria **9**: 143, pl. 7, fig. 26. 1910. and Ann. Mycol. **9**: 64, pl. 5, fig. 30, 31, pl. 6, fig. 53. 1911.

?*Pleonectria heveana* Saccardo, Notae Mycol. **24**: 13. Bull. Orto. bot. Napoli. 1918.

Pleonectria pseudotrichia (Schw.) Wollenweber, Angew. Bot. **8**: 195, pl. III, fig. 26. 1926.

Pleonectria caespitosa (Speg.) Wollenweber, Angew. Bot. **8**: 195. 1926.

Perithecia 200–590 μ diam., often about 380 μ, sometimes single or gregarious but usually in cespitose clusters of from 3 to 20 or more erumpent through outer bark, when dry mostly collapsing and pezizoid; outer surface usually cracked and scaly-furfuraceous, sometimes the scales quite verrucose, scales often lacking especially by weathering leaving the perithecia smooth, color essentially bright orange-red (Scarlet) weathering to dark crimson and drab brown finally almost black; ostiolate papillae sometimes visible, usually concolorous occasionally appearing black; stroma rarely pulvinate, usually a subiculum or short stalk under the perithecia and coremia.

Asci when young slender clavate tapering toward apex, later broad closely following contours of the spores, variable stipe slender, finally evanescent, 50–100 × 10–25 μ, average 70 × 18 μ.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores obliquely biseriate, closely overlapped, almost always 8 per ascus, broadly bulging ellipsoid sometimes curved and slightly tapered terminally, variable, hyaline to pale yellow or light brown, basically 3-septate and constricted with many other often scarcely discernible transverse and longitudinal septa; 15–40 × 7–15 μ, average 25.5 × 10.5 μ; but some collections averaging over 30 μ long, and freak spores being as long as 54 μ.

Stilbella cinnabarina (Mont.) Wollenweber, Angew. Bot. **8**: 195, 208, pl. 3, fig. 26. 1926. PLATE 3, FIG. 6 B; PLATE 5, FIG. 5 A, D.

Stilbum cinnabarinum Montagne, Ann. Sci. Nat. sér. 2, **8**: 360. 1837.

Stilbum Kalchbrenneri Saccardo, Syll. Fung. **4**: 570. 1886.

Stilbum fusco-cinnabarinum Spegazzini, Fungi Puig. **1**: 160, no. 310. 1889.

Stilbella rosea (Kalchbr.) Weese, Sitz. Acad. Wiss. Wien Math.-Nat. Kl. **128**: 44. 1919.

This is the conidial phase. Coremia single or in groups of 2–6 from a basal subiculum, with or without surrounding perithecia at their bases, orange-red to dark brown at the bases shading about two-thirds up into straw color, 150–300 μ at base sometimes flattened and tapering slightly upward to the globular head which when dry with its mass of straw-colored spores measures 125–500 μ in diam., conidia 4–7 × 2–3 μ.

TYPE: on bark, Surinam, collected by Hering. Herb. Schweinitz.

RECORDED HOSTS: *Acacia horrida* Willd., *Aleuritis moluccanae* Willd., *Cajanus indicus* Spreng., *Celtis Tala* Gill ex Planch., *Eucalyptus* sp., *Gleditsia triacanthos* L., *Hibiscus Rosa-sinensis* L., *Ilex paraguayensis* Hook., *Leucaena glauca* Benth., *Manihot utilissima* Pohl, *Persea gratissima* Gaertn., *Phaseolus lunatus* L., *Pithecellobium dulce* Benth., *Theobroma cacao* L., and bark and wood from numerous unidentified plants.

RECORDED RANGE: Surinam, Brazil, Mexico, Florida (U. S. A.), Cuba, St. Thomas, Jamaica, Porto Rico, Trinidad, British Guiana, Uganda, Madagascar, Ceylon, Sumatra, Java, Philippines, Australia, New Zealand.

SPECIMENS MICROSCOPICALLY EXAMINED: In Farlow Herbarium, as *Megalonectria pseudotrichia,* Cardin 1912, Cuba; Fink 1915, no. 769, Porto Rico; Wight 1909, Jamaica; Thaxter 1913, Trinidad; Theissen 1904, Brazil; D. H. Linder 1923, nos. 65, 252, 548, Trinidad; Bot. Garden, Buitenzorg 1924, Java; Seeler 1939, Florida. *M. madagascariensis,* Hennings, Madagascar (type). *M. nigrescens,* McOwan, Africa?. *M. verrucosa,* Möller, Brazil. *Pleonectria Eucalypti,* Patouillard, Ecuador (unpub'd type). *P. riograndensis,* Theissen, Brazil (type). In New York Botanical Garden; *Pleonectria megalospora,* Stevenson 1916, Porto Rico.

This species is to the tropics and sub-tropics what *Nectria cinnabarina* is to our latitudes — a world-wide form showing little discrimination as to host and varying as much in its appearance. Though the author has not seen all the types, he feels certain that the wide variation within individual collections studied is sufficient to convict temporary environmental changes as the cause for differences which were given specific or varietal significance. Perithecia on one large piece of bark have been seen to vary between the extreme limits of size given. They have exhibited the complete range of stromatal arrangement, of shape, and a color variation from bright red to plain brown (Verona Brown), or nearly black. Possibly the lack of sharply defined weather seasons in some parts of the tropics accounts for this complete developmental series in a single collection.

3. **Thyronectria missouriensis** (Ell. & Ev.) Seaver, Mycologia **1**: 205. 1909. PLATE 1, FIG. 4 A–D; PLATE 3, FIG. 10 A–C; PLATE 4, FIG. 8–9.

Nectria missouriensis Ellis & Everhart, Jour. Myc. **4**: 57. 1888.
Pleonectria missouriensis Saccardo, Syll. Fung. **9**: 990. 1891.

Paranectria missouriensis Rabenhorst-Winter, Fungi europaei no. 3748. 1891.

Perithecia in rounded clusters of 5–50, very rarely single, on a stroma, 300–530 μ diam., mostly about 425 μ, nearly spherical, usually plump at maturity with concolorous ostiolate papillae, collapsing when young, outer surface scaly furfuraceous (the scales Olive-Yellow), or scales lacking and the base-color exposed a dirty orange (Cinnamon-Rufous), young perithecia reddish when dry (Brazil-Red), more orange when wet. Perithecia and stromata absorb water rapidly becoming leathery and somewhat translucent.

Stromata pulvinate, light yellow-orange within, plectenchymatous, erumpent through outer bark or superficial, measuring up to 5 × 3 mm. and 1 to 2 mm. high.

Asci when young tapering for about one third of their length toward the bluntly rounded apex, at first wall is gelatinous and much thicker than at maturity when asci are crowded clavate, loosely surrounding the spores, finally evanescent, flexible in shape, including stipe 90–125 μ by 18–30 μ diam.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores 2 to 8 crowded irregularly in ascus, hyaline to pale straw-yellow or in aged specimens loose in perithecium and light brown, ellipsoid to pear-shaped, often tapered toward both ends, occasionally very elongate, muriform, constrictions negligible, septa indistinct, 4 to 20, very irregular in number and angle, 20.9–49.2 × 8.2–14.9 μ, average about 25 × 11 μ.

Gyrostroma missouriense, sp. nov. PLATE 3, FIG. 10 A, B; PLATE 4, FIG. 9.

Pycnidiis loculis irregularibus a summo stromae plectenchymatae, non-ostiolatis, parte exteriore rubroceracea; pycnosporidiis continuis, hyalinis, allantoideis vel rectis, 2.7–3.7 × 0.75–1.3 μ; statu ascogeno *Thyronectriae missouriensis* (Ell. & Ev.) Seaver.

Pycnospores hyaline, one-celled, allantoid or straight 2.7–3.7 × 0.75–1.3 μ, borne on hyphae similar to conidiophores of *Tubercularia vulgaris* but inside irregularly shaped non-ostiolate locules in swellings on upper part of stroma. When dry the swellings look like translucent drops of reddish wax. Later they are pushed aside by the developing perithecia and disappear.

TYPE: on bark of dead *Carya alba* near Concordia, Missouri, March 1888, collected by C. H. Demetrio No. 87.

RECORDED HOSTS: *Carya alba* (L.) K. Koch = *C. tomentosa* (Lam.) Nutt., *Carya* sp., *Acer* (*rubrum*?).

RECORDED RANGE: Eastern half of U. S. A., Maine to Carolinas.

SPECIMENS MICROSCOPICALLY EXAMINED: Demetrio no. 87, 1888, no. 276, 1891, Missouri (type and co-type) on *Carya alba,* in New York Bot. Gard., in Farlow Herb., and in Herb. Patouillard 882: 6742. Rabh.-Wint. Fungi eur. no. 3748, leg. Demetrio, March 1886, Perryville, Mo. In Farlow Herb.: Thaxter, West (New) Haven, Conn., 1888–90, variously labeled "*T. sp.*? *T. pyrrhochlora*?" on *Acer sp.* Thaxter, Kittery Point, Me., 1917–18 on *Carya.* Also specimen collected by D. H. Linder on *Carya sp.,* Kittery Point, Me., Nov. 12, 1939.

Description of the pycnidial phase has not been published heretofore. It has been observed by the author in the type collections by Demetrio, in Thaxter's on *Acer,* and in young stages in Thaxter's and Linder's collections on *Carya* from Maine.

As the ascospores become muriform very early and vary so widely in size in one perithecium, care must be taken not to be led astray by spore appearance in a hasty examination of any meager collection. Though morphologically quite different, this species parallels *T. austro-americana* in all stages of development of stromata and of pycnidial and perithecial phases as has been shown in a comparative study of the two from collected material and in culture.

4. **Thyronectria balsamea** (Cke. & Pk.), n. comb. PLATE 2, FIG. 2 A–G; PLATE 3, FIG. 5 A–B.

Nectria balsamea Cooke & Peck, Ann. Rep. N. Y. State Mus. **26**: 84. 1874; Grevillea **12**: 81. 1884.

?*Chilonectria Cucurbitula* Saccardo (in part), Michelia **1**: 280. 1878.

Calonectria balsamea (Cke. & Pk.) Saccardo, Syll. Fung. **9**: 986. 1891.

Scoleconectria balsamea (Cke. & Pk.) Seaver, Mycologia **1**: 200. 1909.

Pleonectria calonectrioides Wollenweber, Fusaria auto. del. **4**: no. 793, 794. 1930; Zeit. Wiss. Biol. Abt. F, Z, **3**: 493. 1931.

Perithecia 300–425 μ diam., cespitose in pulvinate circular clusters of 2 to 20, usually about 12, which measure 0.6–1.3 × 0.6–1.3 mm., usually collapsed when dry, outer surface cracked into thin scales, usually covered with greenish yellow powder or occasionally with powdery yellow warts, wall base color dark orange (Mars Orange to Burnt Sienna), small ostiolate papillae usually visible only when wet; seated on a deeply fissured orange-colored stroma, erumpent through outer bark.

Asci cylindrical, with slender stipe, apex bluntly rounded, thin walled, 75–120 × 6–10.5 μ, finally evanescent.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores variable, uniseriate 1 to 4 in each ascus, mostly 3, elongated ellipsoid or fusoid, somewhat constricted, 3- to 15-septate and irregularly muriform, hyaline 14–27 × 3–4.5 μ, occasionally as short as 7.4 μ and as broad as 5.2 μ, budding very early to form myriads of small, hyaline, one-celled, bacillar ascoconidia, 3–4 × 0.6–1.2 μ, which completely fill the ascus and hide the true ascospores which may finally disintegrate.

There is evidence that the perithecia are preceded on the stroma by irregular pycnidial locules (J. H. Faull no. 6588). Sporulating material of the pycnidial stage has not been available but it will probably fall into the genus *Gyrostroma* Naoumoff.

TYPE: on dead branches of *Abies balsamea,* North Elba, New York, August 1872. Collected by C. H. Peck.

RECORDED HOSTS: *Abies balsamea* Mill.; and by Wollenweber, *Tsuga canadensis* (L.) Carr.

RECORDED RANGE: Minnesota to Newfoundland, to New York.

SPECIMENS MICROSCOPICALLY EXAMINED: In Farlow Herbarium, labeled *Chilonectria cucurbitula,* all on *Abies balsamea;* Brainerd, June 1882, Ripton, Vt.; Sept. 1889, Shelburne, N. H.; ex Burt, Dec. 31, 1894, E. Galway, N. Y.; ex Burt, Nov. 3, 1899, Middlebury, Vt.; July 4, 1902, Shelburne, N. H. Coll. & herb. J. H. Faull, on *Abies balsamea,* no. 6588, July 22, 1922, Bear I., L. Timagami, Ontario; no. 9617, Sept. 15, 1930, near Guelph, Ontario, Canada.

Because of an external similarity this species has been confused with *Ophionectria cylindrospora* (Sollm.) Berl. & Vogl. (see Ell. & Ev. N. A. F. 2–1551) which occurs on *Pinus* in Europe and North America, also rarely on *Abies,* and has in each ascus, in addition to the myriospores, two long filiform spores with an indefinite number of transverse but no longitudinal septa. The exact relationship between these two deserves more study, as shown by J. H. Faull's collections from Bear I., Lake Timagami, Ontario, all on *Abies balsamea*: no. 6588 and no. 9617 show the 2–4 muriform spores of *T. balsamea,* while on the other hand no. 5951 and no. 6578 show in each ascus the two long filiform phragmospores of *O. cylindrospora.* Weese in Centralb. f. Bakt. **42:** 596–602. 1914 discusses at length the European synonymy of *O. cylindrospora* including as his var. *tetraspora* the 4-spored phragmosporous *Pleonectria pinicola* Kirschstein.

In No. Amer. Pyreno. p. 116. 1892 Ellis and Everhart included under

the name *Chilonectria cucurbitula* Curr. both species, now called *T. balsamea* and *O. cylindrospora,* and that name has been applied since indiscriminately to many American collections with myriospores on many different hosts. Of course there should be no confusion with *Nectria cucurbitula* (Tode) Fr. which grows on *Pinus* but has eight 2-celled spores and no myriospores in the ascus.

5. **Thyronectria chlorinella** (Cke.), n. comb. PLATE 2, FIG. 3 A–H.

Nectria chlorinella Cooke, Grevillea **11**: 108. 1883.

Calonectria chlorinella (Cke.) Saccardo, Syll. Fung. **2**: 543. 1883; not as in Ellis & Everhart, No. Amer. Pyreno. p. 113. 1892.

Perithecia spherical 250–350 μ diam., discrete or cespitose in groups of 2 to 8, rarely more, amber brown and shiny but normally covered with a heavy coat of bright yellow powder or scales with shining ostiolate papillae protruding, not collapsing, seated on a shallow stroma.

Asci clavate, tapering toward apex, short-stiped, 80–90 × 10–15 μ, finally evanescent.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores hyaline, usually 4 in each ascus when young, at first 1- then 3-septate and deeply constricted, soon many-septate and finely muriform, finally separating usually at the three original constrictions into numerous globose or elongated muriform parts, 4.5–8.5 μ diam., which bud myriads of one-celled hyaline ascoconidia, 2–2.5 × 1 μ, filling the ascus.

TYPE: on inner bark of *Ulmus americana,* seaboard of North Carolina, U. S. A. collected by Cooke, April 1881.

RECORDED HOSTS: only *Ulmus americana* L.

RECORDED RANGE: North Carolina and Alabama.

SPECIMENS MICROSCOPICALLY EXAMINED: Ex Herb. Bot. Reg. Kew, H. W. R. 3236, Cooke, No. Car. (type). In Herb. N. Y. Bot. Garden, R. P. Burke, Ala. Sphaer. no. 8, May 1916, Alabama. In Farlow Herbarium, Ravenel, Fungi Amer. Exsicc. no. 736, No. Car. (type).

This description is from type material most kindly sent from Kew Herbarium, which is the same as Ravenel, Fungi Amer. Exsicc. no. 736 much of which is immature and very scanty. It is *not* from Ell. & Ev. No. Amer. Fungi 2–2546 which is *T. Xanthoxyli,* and *not* Ell. & Ev. Fungi Columbiani no. 2006 on *Acer nigrum* collected by Dearness, July 1904, London, Canada, which is a hyalo-phragmosporic sphaeriaceous fungus (*Lasiosphaeria sp.*) and is the same as Dearness' Canadian Fungi "*Nectria chlorinella*" on *Ulmus* and *Tilia* in Farlow Herbarium.

6. **Thyronectria berolinensis** (Sacc.) Seaver, Mycologia **1**: 205. 1909. PLATE 2, FIG. 5 A–F; PLATE 3, FIG. 7; PLATE 4, FIG. 1; PLATE 5, FIG. 4.

Nectria Ribis Niessel, Verh. Nat. Ver. Brünn **2**: 114. 1865. (not *N. Ribis* (Tode) Oudemans, Revis. Champ. Pays Bas **2**: 389. 1897).
Pleonectria Berolinensis Saccardo, Michelia **1**: 123. 1878.
Pleonectria Ribis Karsten, Medd. Soc. Fauna Fl. Fenn. **5**: 42. 1879.
Nectria fenestrata Berkeley & Curtis, Cooke in Grevillea **12**: 81. 1884.
Pleonectria fenestrata (Berk. & Curt.) Berlese & Voglino, in Sacc. Syll. Fung. Addit. 216. 1886.

Perithecia 250–390 μ diam., cespitose in pulvinate clusters of 15 or more, 0.25–3 × 1–10 mm., very rarely single, always collapsing when dry, flattened-spherical and leathery when wet; outer surface cracked with tops of scales smooth or minutely granular, from bright orange color (Orange-Rufous) to dark brown, ostiolate and minutely papillate; seated on a deeply fissured stroma which is yellow-orange within, darker outside, pseudoparenchymatous of angular cells, leathery when wet, erumpent through outer bark.

Asci cylindrical, short-stiped, apex bluntly rounded and slightly thickened and flat on inside with apical pore, wall not noticeably thicker when young, 90–120 × 9–12 μ (Fuchs, 130–185 × 10–12).

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores uniseriate, mostly 7 to 8 occasionally as few as 2 in each ascus, elongated oval to bluntly terminated cylindrical, mostly straight, 5- to 8-septate, typically 7, and muriform by 1 to 3 divisions, not constricted, hyaline to straw yellow, 15–21 × 6.5–8.2 μ, average 19.5 × 7.5 μ; when loose in the perithecium occasionally budding small unicellular hyaline conidia, a condition not as yet observed within asci.

Dendrodochium berolinense Wollenweber, Zeit. Parasitenkd. **3**: 492. 1931. PLATE 5, FIG. 4 a–c.

Stroma cerebriform or tubercularoid, erumpent, pale yellow to orange-red. Conidia pinkish tawny or pale golden in mass, ovoid-cylindrical, straight or curved, unicellular, 2.7–7 × 1–2 μ, mostly about 3.6 × 1.3 μ, borne at the apices of irregularly or verticillately densely fasciculate branches on the top of the sporodochium.

TYPE: on dead branches of *Ribes aureum* (?), Berlin Botanical Garden, Germany, collected by P. Magnus.

RECORDED HOSTS: *Ribes aureum* Pursh, *R. cereum* Dougl., *R. cognatum* Greene, *R. floridum* L'Herit., *R. klamathense* (Cov.) Standl., *R. lacustre* Poir., *R. longiflorum* Nutt., *R. nigrum* L., *R. Grossularia* L.,

R. rotundifolium Michx., *R. rubrum* L., *R. sativum* Syme, *R. setosum* Lindl., *R. sp.*

RECORDED RANGE: Great Britain, in Europe north to Finland, to eastern Russia, south to Italy. In North America, California (once), Oregon, North Dakota to southern Ontario (Canada), Labrador, New Hampshire, Massachusetts to Maryland, west to Colorado.

SPECIMENS MICROSCOPICALLY EXAMINED: In Farlow Herbarium, Vogel, 1909, Germany; Zimmerman, 1909, Germany; Brenckle no. 261, No. Dak.; University Toronto Herb. no. 3299, Ont., Canada; Darker no. 5593, Ont., Canada; Spalding no. 26, Mich.; Burt, 1909, Vt.; Ellis, Potsdam, N. Y.; Thaxter, Newton, Mass.; Setchell, 1888, Conn.

This and *T. austro-americana* are the only two species of *Thyronectria* which have been proved parasitic. Fuchs (1913) demonstrated experimentally that in the Dendrodochium stage it causes a limited stem canker of cultivated currants in Germany. Wollenweber (1931) denied Fuchs' other contention that there were Fusarium macroconidia produced. The conidial stages have not been available for study here.

7. **Thyronectria coffeicola** (Zimm.), n. comb.

Pleonectria coffeicola A. Zimmermann, Centralblatt f. Bakt., Parasit. u. Infekt. **8**: 118. 1902.

Perithecia superficially seated on a thin almost hyaline stroma, spherical, with an ostiolate papilla, brownish, 350 μ diam. Asci 8-spored, broad. Spores sickle-shaped, blunt on both ends, hyaline, with up to 20 cross-walls and a few longitudinal walls, constricted at the cross-walls, the single cells often showing irregular differences in width, often breaking up into several parts, 100 × 12 μ.

On living leaves of *Coffea liberica* Hiern, in Buitenzorg Botanic Garden.

The above is a direct translation from Zimmermann's German description as cited under the *P. coffeicola* synonym above. This species is included on the basis of the original description, no specimen having been available for study. The extremely long spores and the habitat on living leaves set it apart from all other species of *Thyronectria*.

8. **Thyronectria austro-americana** (Speg.) Seeler, Jour. Arnold Arb. **21**: 405. 1940. PLATE 2, FIG. 4 A–H; PLATE 3, FIG. 11 A–B; PLATE 4, FIG. 10–11.

Pleonectria austro-americana Spegazzini, Fungi Argentini **2**: 27. 1880.
Pleonectria denigrata Winter, Bull. Torrey Bot. Club **10**: 49. 1883.
Pleonectria guaranitica Spegazzini, Fungi Guaranitici **1**: 105. 1883.

Nectria sphaerospora Ellis & Everhart; Bessey & Webber, Ann. Rep. Nebraska State Board Agric. **1889**: 193. 1890.

Chilonectria crinigera Ellis & Everhart, Proc. Phila. Acad. **1890**: 246. 1891.

Pleonectria nigropapillata Starbäck, Arkiv för Botanik **2**: 13, fig. 25–28. 1904.

Thyronectria denigrata (Winter) Seaver, Mycologia **1**: 204. 1909.

Thyronectria sphaerospora (Ell. & Ev.) Seaver, Mycologia **1**: 206. 1909. This was suggested as synonymous with *T. denigrata* by C. Lieneman in Mycologia **30**: 501–509, fig. 46–47. 1938.

Perithecia in rounded clusters, crowded, seated on or embedded in a stroma, 200–450 μ diam., mostly about 280 μ, spherical to top-shaped, not collapsing, outer surface when dry, brittle, finely wrinkled (granulate) yellow-brown or gray, darkening, with dark often black and shining ostiolate papillae. Perithecia absorb water rapidly becoming fleshy to leathery and somewhat translucent.

Stromata pulvinate, fissured, outer cells dark brown, inner light yellow-brown, leathery when wet, compactly plectenchymatous, erumpent (usually) through lenticels of outer bark, measuring up to 12 × 6 and to 3 mm. high depending on the substratum, very rarely on decorticated wood.

Asci when young clavate to cylindrical, thick gelatinous-walled, when mature membranaceous following the contours of the spores, usually short-stiped, 60–110 × 8–19 μ, finally evanescent.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores typically 8 in each ascus, uniseriate or irregularly crowded, hyaline at first, finally pale straw yellow, ellipsoid to pear-shaped, unevenly 3- to 6-septate and muriform, divided into 10 to 24 slightly swollen cells, 8–16 × 4.5–9 μ, commonly 12 × 6.5 μ. Occasionally while still in ascus budding to form many ascoconidia or myriospores, a peculiarity which led to the description of a separate species, *T. sphaerospora* (Ell. & Ev.) Seaver.

Gyrostroma austro-americanum, sp. nov. PLATE 3, FIG. 11 A, B.; PLATE 4, FIG. 10.

Pycnidiis loculis irregularibus a summo stromae plectenchymatae pulvinatae, non-ostiolatis, parte exteriore lutescente-brunnea; pycnosporidiis continuis, hyalinis, parvo-ovoideis, 1.8–3.6 × 0.6–1.6 μ, statu ascogeno *Thyronectriae austro-americanae* (Speg.) Seeler.

Pycnospores borne in irregularly shaped cavities in upper part of the stroma and escaping through meandering passages leading to the surface between the perithecia. Before the perithecia mature these passages

terminate in globular or ovoid swellings on the stroma which rupture to exude the spores in orange-yellow "horns." Pycnospores in mass orange-yellow, singly hyaline, ovoid to ellipsoid, one-celled, 1.8–3.6 × 0.6–1.6 μ borne on the tips of clusters of simple or branched slender hyphae within the pycnidial cavity.

TYPE: on *Acacia* sp., Parque de Palerma, Buenos Aires, Argentina, collected by C. Spegazzini — his herb. no. 658. In North America it has been found only on *Gleditsia triacanthos* L. and called *Pleonectria denigrata* Winter or *T. denigrata* (Wint.) Seaver.

RECORDED HOSTS: only as listed under type.

RECORDED RANGE: Brazil, Paraguay and in North America Nebraska to Massachusetts to Florida, and Alabama to Kansas.

SPECIMENS MICROSCOPICALLY EXAMINED: Lent by Museo de la Plata, Herb. Speg: no. 1624 *P. guaranitica* (type) leg. Balansa no. 2759, Aug. 1881, Guarapi, Brazil; no. 1636 *P. denigrata* on *Gleditsia triacanthos* L., Oct. 1905, Buenos Aires, det. Speg.; no. 1640 *P. austro-americana* (co-type), May 1883, Chaco.

In New York Botanical Garden: ex herb. Speg. no. 658 *P. austro-americana* (type), Buenos Aires; ex Balansa Pl. du Paraguay no. 3944 *P. guaranitica* (co-type), Aug. 16, 1883, Guarapi, Paraguay; ex H. J. Webber no. 18 *Chilonectria crinigera* (type), Nov. 1888, Lincoln, Nebraska.

In Farlow Herbarium: Ellis Notebook **4:** 65, ex H. J. Webber, no. 18 *Nectria sphaerospora* (type); *P. denigrata* on *Gleditsia triacanthos* as follows: leg. Kellerman, June 1882 (type) which is the same collection as Exsiccati Rabh.-Wint. Fungi eur. no. 2948 and as Ellis N. A. F. no. 1334; Carver, Dec. 1902, Tuskeegee, Ala.; Commons, Oct. 1889, Wilmington, Del.; Fink, Oct. 1918, Union Co., Ind.; Langlois, Feb. 1886, Plaquimines Co., La.; Morgan no. 27, 1896, Preston, Ohio; Seeler, Oct. 1936, Nantucket, Mass., same as Guba, Nantucket Fungi no. 197, and will be issued in Reliquiae Farlowianae. On *Gleditsia japonica* Miq., leg. Seeler, Feb. 1940, Arnold Arboretum, Mass.

The long synonymy for this species indicates its variability under different environmental and substratal conditions. Its life history studied in culture and in the field and a careful comparison of types further prove this and bring to light the constant characters; the structure and context of stromata and perithecia, the small pycnospores in irregular locules, the method of development of asci and ascospores.

No material of *Pleonectria nigropapillata* was available for study but Starbäck's type description and photographs indicate clearly that it should be placed here in synonymy.

It might be well to mention here that *Nectria nigrescens* Cooke, Grevillea **7**: 50. 1879 type on *Gleditsia* from South Carolina had 2-celled spores and so is not synonymous.

Thyronectria austro-americana grows readily in pure culture producing a fine white mycelial mat, micro-conidia after the manner of *Sporotrichum,* pycnidial stromata, and rarely perithecia.

The author has shown this fungus to be the cause of a bark canker of *Gleditsia triacanthos* L. and of a fatal vascular thrombosis of *G. japonica* Miq. — Seeler (1940).

9. **Thyronectria Lamyi** (Desm.), n. comb. PLATE 2, FIG. 1 A–F; PLATE 3, FIG. 9; PLATE 4, FIG. 12.

Sphaeria Lamyi Desmazières, Ann. Sci. Nat. sér. 2, **6**: 246. 1836.
Nectria Lamyi De Notaris, Sphaer. Ital. p. 13, pl. 9. 1863.
Pleonectria Lamyi Saccardo, Mycoth. Venet. no. 688. 1876; Michelia **1**: 324. 1879.

Perithecia spherical to top-shaped, 250–380 μ diam., grouped in multiple rows or as many as 50 cespitose in pulvinate clusters on a deeply fissured, pseudoparenchymatous, usually prominent stroma (sometimes merely a subiculum), outer surface brown (Burnt Sienna) darkening almost to black especially around the ostiolum, often with a furfuraceous coat of olive gray scales.

Asci loosely clavate, of varying shape and size to fit the crowded contents, 100–130 × 12–30 μ, when young thick-walled and gelatinous tapering to a rounded apex.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores usually 8 in each ascus, very variable in size and shape, elongated ellipsoid, constricted at the septa, the component cells bulging and often separating, 3- to 9-septate and irregularly muriform, 16–27 × 4.5–7.5 μ, budding on short basidia very many small ascoconidia, 3–3.5 × 0.9–1.1 μ, which soon obscure the true ascospores.

TYPE: on dead branches of *Berberis vulgaris* L., Limoges, France, collected by Lamy.

RECORDED HOSTS: *Berberis vulgaris* L. and *B. sp.*?

RECORDED RANGE: Sweden, Germany, Hungary, western Russia, Italy, France. In North America only the collections of R. F. Cain and H. S. Jackson from Wilcox Lake, Ontario, Canada, University of Toronto Herbarium no. 4167 and no. 6064.

SPECIMENS MICROSCOPICALLY EXAMINED: In N. Y. Bot. Garden, Saccardo Mycoth. Ital. no. 1306, Italy. In Farlow Herbarium, Herb.

Univ. Toronto no. 4167 and no. 6064, Ontario, Canada; Leg. Newadowski, 1912, Russia, ex herb. Bucholtz no. 2014, and ex Theissen. In von Höhnels slides, Kryptogamae exsiccatae no. 822, Hungary, and ex Desm., Nob. pl. crypt. 2 ser. 839. no. 39, France (type).

This species was the basis for Saccardo's genus *Pleonectria* (Mycoth. Ven. no. 688, 1876) because he considered the perithecia to be free and seated on the stroma rather than embedded in it. The author, however, does not believe this distinction valid as the outer covering of the perithecia is stromatic material, and the degree of immersion in the stroma is a variable character within any species.

Thyronectria Lamyi should not be confused with the larger cracked black carbonaceous perithecia of *Cucurbitaria berberidis* (Pers.) Gray, which show thin-walled brown muriform ascospores, and which often occur on the same host branch.

10. **Thyronectria Lonicerae,** sp. nov. PLATE 1, FIG. 3 A–E; PLATE 3, FIG. 2; PLATE 4, FIG. 4, 5.

Peritheciis 250–375 μ diam. subsphaeroidibus, 2–25 laxe vel dense gregariis 0.5–3 × 0.5–2.1 mm., ostiolo prominulo papillato, in stromo prosenchymato fere immersis, membranis (30 μ crassis) muratis, peridermio hospitis elevato, vix erumpentibus, rubro-aurantiis, brunneis.

Ascis cylindraceis, sursum cum foramine parvo immaturis, 100–135 × 9–12 μ (p. sp.), evanescentibus. Pseudoparaphysibus numerosis, filamentosis, decendentibus, ramosis, evanescentibus, paraphysibus veris nullis.

Ascosporidiis oblique monostichis, octosporis, hyalinis vel pallide stramenticie-luteis, elongato-ellipsoideis, muriformiis, regulariter et recte transverse 7-septatis et longitudinaliter sparse divisis, non constrictis, 18–23 × 6.4–7.7 μ.

Hab. in ramis emortuis corticatis *Lonicerae involucratae* Banks, Empire, Colo. leg. Bethel no. 256 et *Symphoricarpi occidentalis* Hook., Northville, S. Dak., leg. Brenckle S. Dak. Fungi no. 1780.

Perithecia 250–375 μ diam., sub-spherical, crowded together in groups of 2 to 25 which measure 0.5–3 × 0.5–2.1 mm., embedded in a shallow light-sand-colored loosely prosenchymatous stroma with only the upper quarter and the short ostiolate papilla protruding and showing the dark red-orange wall color, wall thin (30 μ) distinct, membranaceous, drawing up from below on drying but the top not collapsing, scarcely erumpent through the outer bark.

Asci cylindrical following closely the contours of the spores, short-stiped, when young slightly thickened at the apex with a central pore, 100–135 × 9–12 μ, finally rupturing or evanescent.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores obliquely uniseriate scarcely overlapped, typically 8 per ascus, elongated ellipsoid tapering slightly toward both ends, straight or slightly curved, very distinctly and neatly 7-septate and sparsely muriform by one or two discontinuous divisions, 18–23 × 6.4–7.7 μ.

TYPE: on dead branches of *Lonicera involucrata* Banks, Empire, Colorado, U. S. A., May 22, 1897, collected by E. Bethel no. 256, labeled *T. Patavina,* (in Farlow Herb.); and co-type on *Symphoricarpos occidentalis* Hook., Northville, South Dakota, U. S. A., Jan. 1927, collected by J. F. Brenckle, S. Dak. Fungi no. 1780, determined by Petrak as *T. Xanthoxyli* (in Farlow Herb. and N. Y. Bot. Garden).

The type specimens are the only ones known and examined. This species can be distinguished at a glance through the microscope from *T. pyrrhochlora* and *T. Xanthoxyli* by its long slender asci with an apical pore when young, and by its monostichous smooth spores with neat right angle cross-walls and few longitudinal septa. Its habit sets it apart from other species of *Thyronectria.*

11. **Thyronectria pyrrhochlora** (Auersw.) Saccardo, Michelia **1**: 325. 1878. PLATE 2, FIG. 7 A–F; PLATE 3, FIG. 1.

Nectria pyrrhochlora Auerswald, Rabenhorst in Hedwigia **6**: 88. 1869.
Pleonectria pyrrhochlora Winter, Rabh. Krypt. Fl. **12**: 108. 1884.

Perithecia 250–350 μ diam., erumpent through slits in outer bark in double or triple rows of up to 50 (1.5 × 20 mm.), embedded up to the short ostiolate papillae in a light brown plectenchymatous shallow stroma, rarely discrete, not collapsing, wall color (Antique Brown) with a bright (Green-Yellow) powder on upper surface.

Asci cylindrical to clavate, short-stiped, thin-walled, following contours of spores, finally evanescent 67–97 × 17–22 μ.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores obliquely uniseriate or upper 4 crowded, typically 6 to 8 in each ascus, short blunt ellipsoid, scarcely constricted, hyaline to pale straw-yellow, transversely 5- to 7-septate and *finely muriform* by numerous thin irregular longitudinal septa, terminal septa radially placed, 15–20 × 7.5–10.5 μ.

See *T. Xanthoxyli* which this externally resembles.

TYPE: on *Acer campestre,* Arnstad, Germany, collected by Fleischhack.

RECORDED HOSTS: *Acer campestre* L., *Cydonia oblonga* Mill., *Vitis vinifera* L.

RECORDED RANGE: Germany, France, Hungary, Portugal.

SPECIMENS MICROSCOPICALLY EXAMINED: In Farlow Herb.; Rabh. Fungi eur. no. 1234, Germany (type), and in herb. von Höhnel and N. Y. Bot. Garden; Rehm Ascomyceten no. 40, on *Acer campestre*, May 1870, Sugenheim, France, also in herb. von Höhnel and N. Y. Bot. Garden.

12. **Thyronectria Xanthoxyli** (Peck) Ellis & Everhart, No. Amer. Pyreno. p. 92. 1892. PLATE 2, FIG. 6 A–F; PLATE 3, FIG. 4; PLATE 4, FIG. 2.

Valsa Xanthoxyli Peck, Ann. Rep. N. Y. State Mus. **31**: 49. 1879.
Pseudovalsa Xanthoxyli Saccardo, Syll. Fung. **2**: 137. 1883.
Fenestella Xanthoxyli Saccardo, Syll. Fung. **2**: 332. 1883.
Valsonectria virens Harkness in Ellis & Everhart, No. Amer. Fungi 2–1549. 1886.
Thyronectria virens Harkness in Ellis & Everhart, No. Amer. Pyreno. p. 92. 1892.

Perithecia spherical to crowded-ovoid, 250–350 μ in diam., in clusters of from 1 to 25, mostly 4 to 6, which measure 0.6–2 × 0.6–3 mm., not collapsing, embedded (rarely appearing free) in the upper part of a light brown plectenchymatous to pseudoparenchymatous stroma which may be pulvinate or reduced to a subiculum, at first covered with a powdery or furfuraceous yellow-green coat, often with the short dark ostiolate papillae protruding slightly, later darkening by the loss of the yellow powder; actual wall of perithecium dark amber-brown; stroma seated on inner bark and erumpent through the epidermis.

Asci loosely clavate, short-stiped, thin-walled, finally evanescent, 75–105 × 15–23 μ.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores crowded biseriate, typically 8 in each ascus, bluntly terminated, ellipsoid, often curved, scarcely constricted, hyaline to pale straw-yellow to light brown, transversely 5- to 8-septate, muriform, 16.4–26.8 × 6–8.2 μ, most collections averaging between 17.5–24 × 7–8 μ.

TYPE: on *Xanthoxylum americanum* Mill., West Troy, New York, collected by C. H. Peck, Oct. 1878.

RECORDED HOSTS: *Zanthoxylum americanum* Mill., *Rhus diversiloba* Torr. & Gray, *Rhus glabra* L., *Rhus typhina* L.

RECORDED RANGE: North America only; California, North Dakota,

Michigan, Ontario (Canada), Ohio, New York, Connecticut, Massachusetts.

Specimens Microscopically Examined: In N. Y. Bot. Garden, *Valsa Xanthoxyli* (type), Peck no. 3402, West Troy, N. Y.; *T. Xanth.*, Stevens, July 1927, Fargo, No. Dak. In Farlow Herbarium, E. & E. N. A. F. 2–1549, *V. virens* (type), leg. Harkness, Sausalito, Calif.; E. & E. N. A. F. 2–2546, *Nectria chlorinella,* leg. Dearness no. 1484, 1890, London, Ontario — also labeled *T. virens.*; E. & E. N. A. F. 2–3310, *T. Xanth.,* leg. Dearness, July 1895, London, Ontario; *T. chlorina,* Thaxter no. 1626, Oct. 7, 1899, Arlington Hts., Mass.; *T. chrysogramma,* Thaxter no. 412, New Haven, Conn.; *T. virens,* Thaxter no. 1631, Mar. 1890, New Haven, Conn.; ex herb. Univ. Ga. no. M 3989 *T. pyrrhochlora,* leg. Miller, Jan. 27, 1926, Athens, Ga.

Seaver (1909) placed this species in synonymy with the European *T. pyrrhochlora* which it resembles externally but from which it differs in that its spores are more slender, slightly longer, and not finely muriform, septa are thicker and transverse septa more regular, perithecia usually show a more prominent dark papilla.

13. **Thyronectria patavina** Saccardo, Fungi Ven. Novi v. Crit. **4:** 23. 1875. Plate 5, fig. 1.

Acervuli Valsa-shaped, scattered, concealed at first by the raised outer-bark, scarcely erumpent; perithecia in a single layer, globoid, ¼–⅓ mm. diam., outside yellow-powdered, context reddening slightly, waxy-membranaceous, subtranslucent; ostioles papillate, very short and most converging, but free; asci cylindrical-clavate, 80–90 × 12 μ, apex rounded, attenuated downwards, thickly and shortly stiped, surrounded by a wall of minutely septate threadlike paraphyses which overtop the asci, 8-spored; spores obliquely monostichous or 2-rowed, oblong, 25 × 9–11 μ, rarely 30 × 8 μ, superficially with small swellings, straight or more often curved, at first full of oil drops, later thinly and profusely 7- to 9-septate, muriform, both very weakly, hyaline; small spores often mixed with the asci are cylindrical, curved 3–4 × 0.5 μ, hyaline.

Habitat on the bark of rotten branches of *Juglans regia* L., associated with *Thyridaria incrustans,* from Padua, Italy, Dec. 1874.

The foregoing is a direct translation of Saccardo's description in Latin. It will be noted that Saccardo describes "paraphyses" for this species. If the structures referred to are of the same nature as corresponding structures in other species of *Thyronectria* they are not true paraphyses, but "pseudoparaphyses" as explained elsewhere in this paper. None of the earlier mycologists distinguished between paraphyses and pseudoparaphyses. This species has not been available for study.

14. **Thyronectria chrysogramma** Ellis & Everhart, Proc. Acad. Nat. Sci. Phila. **1890:** 245. 1891. PLATE 1, FIG. 2 A–D; PLATE 3, FIG. 3; PLATE 4, FIG. 3.

Mattirolia chrysogramma Saccardo, Syll. Fung. **9:** 993. 1891.

Thyronectria virens Harkness var. *chrysogramma* Ellis & Everhart, No. Amer. Pyreno. p. 93. 1892.

Thyronectroidea chrysogramma (Ell. & Ev.) Seaver, Mycologia **1:** 206. 1909.

Perithecia single and nearly spherical or in compact groups of 2 to 13, mostly 3 to 6, and crowded top-shaped, upper one-third bulging but covered up to the necks by stromatal tissue, base embedded, 300–550 μ diam., mostly 380–450 μ, never collapsing, outer surface scaly furfuraceous, bright yellow, darkening, with black shining, protruding ostiolate papillae, leathery when wet.

Stromata, from a thin subiculum to a flat cushion, dirty straw yellow within, outside brownish except where covered by furfuraceous yellow scales, fleshy when wet, plectenchymatous to pseudoparenchymatous, usually about 0.8 mm. long, 1 mm. broad, 1 mm. thick, occasionally slightly larger seated on inner bark, erumpent through the outer bark.

Asci when young tapering toward the apex, walls slightly thicker than at maturity when asci are loose clavate bags surrounding spores, finally evanescent, flexible in shape, about one half the asci with 8 spores and short-stiped, the other asci with from 2 to 8 spores 120–150 × 22–35 μ.

Pseudoparaphyses pendent from roof of the perithecium, numerous, filamentous, branched, evanescent, no true paraphyses.

Ascospores 2 to 8, biseriate or crowded irregularly in the ascus, short ellipsoid with bluntly rounded ends, outer envelope hyaline, inner cell walls very thick and becoming dark brown, 7- to 12-septate, finely muriform, 22–42 × 11–17 μ, average 32.5 μ × 13.5 μ.

No conidial phase has yet been found.

TYPE: on *Ulmus americana* L., Manhattan, Kansas, March 1889, collected by Kellerman and Swingle no. 1421. And co-type on *Ulmus*, Potsdam, New York, 1857, collected by Ellis.

RECORDED HOST: *Ulmus americana* L.

RECORDED RANGE: Ontario (Canada), New York, Missouri, Kansas.

SPECIMENS MICROSCOPICALLY EXAMINED: In Farlow Herbarium, leg. Kellerman and Swingle, Kansas (type); A. P. Morgan no. 21, 1897, Preston, Ohio (co-type); herb. Ellis, leg. Dearness, June 2, 1893, London, Canada (co-type).

This species has been reported on *Ulmus americana* only. In general it differs from other American species of *Thyronectria* in the one feature

of having the inner cell walls of the ascospores thickened and distinctly colored.

15. **Thyronectria rhodochlora** (Mont.), n. comb. PLATE 5, FIG. 3.

Sphaeria rhodochlora, Montagne, Syll. Gen. Spec. Crypt. p. 276, no. 795. 1856.

Mattirolia rhodochlora (Mont.) Berlese, Atti Cong. Bot. Int. Gen. 1892, p. 574, pl. 22, fig. 4, 5. 1893.

Perithecia gregarious or later crowded into a mound but no stroma manifest, superficial (the outer bark having fallen off), covered with light green villose mycelium, globoid, at first rose-colored on sides then brown, provided with a papilla which is first rose then black, ⅓ mm. diam.; asci clavate, 90–100 × 18–22 μ; spores ovoid, often asymmetrical, irregularly transversely 4- to 7-septate, divided into cells by longitudinal septa, at first hyaline then yellowing and finally smoky, 18–20 × 10–12 μ.

Habitat on the bark of dead *Alnus glutinosa* (L.) Gaertn., near Rochecardon, Lyons, France.

Unfortunately, on account of current war conditions, it has not been possible to secure the type material from Europe. It is included, however, for the sake of completeness and the description given is a direct translation from Berlese in the reference cited above.

16. **Thyronectria roseo-virens** (Berl. & Bres.), n. comb. PLATE 5, FIG. 2.

Mattirolia roseo-virens Berlese & Bresadola, Micromyces Tridentini p. 55, no. 110, fig. 3. 1889.

Stromata scattered, covered by the bark, then emerging by breaking through, stretched out or seated on the wood very rarely effused, pulvinate, outside rose or red, disc yellow-green or more or less completely olivaceous, inside pale golden; perithecia more or less stiped, various in size, ovoid or deformed, ostiole obtuse or scarcely prominent, inside completely yellow or (because of mature spores) brown, hollow; asci cylindrical, short-stiped, poorly paraphysate, 110–120 × 15–18 μ, 8-spored; spores irregularly monostichous, ellipsoid, broadly rounded on both ends, very often transversely 3-septate, rarely 5-septate, middle cells or even the end cells divided by a longitudinal septum, 15–18 × 9–11 μ, scarcely constricted, olive-yellow, with small oil drops.

On the bark of branches of *Cytisus Laburnum* L. (now called *Laburnum anagyroides* Med.) near Trent, Italy.

As stated in the introduction there is some confusion surrounding this species because of the fact that a piece of the type collection in the

Farlow Herbarium (Patouillard **884:** 6749) shows green two-celled minutely verrucose spores which separate into single-celled units. These spores would place it in Seaver's genus *Chromocrea* (Mycologia **2:** 58. 1910). Externally the part of the type examined resembles the three sectional drawings by Berlese in the upper left corner of my Plate 5, fig. 2, but *not* the other figures pictured there so clearly. This discrepancy can only be explained when the original material in Italy which inspired these drawings is examined.

For the sake of completing this discussion of muriform spored "Nectrias," it has been assumed that Berlese confused two distinct fungi in the same collection. Therefore *T. roseo-virens* is included here on the basis of the foregoing, translated directly from the type description cited above, and on the basis of the drawings in the lower right part of Plate 5, fig. 2.

DOUBTFUL SPECIES

17. **Thyronectria sambucina** Ellis & Everhart, Bull. Torrey Bot. Club **24:** 458. 1897.

On dead stems of *Sambucus,* Buena Vista, Colo., June 1897 (Bethel, no. 315 a). Perithecia 6–12 in a cortical stroma, globose, about ⅓ mm. diam., brown and coriaceous, their minute papilliform inconspicuous ostiola united in a flat or slightly concave dark brown disk which raises the whitened epidermis into distinct pustules and soon bursts through it; asci cylindrical, p. sp. 130–150 × 18–20 μ; 8-spored, short-stipitate, with abundant but evanescent filiform paraphyses; sporidia uniseriate, oblong-elliptical, about 7-septate, and muriform, slightly constricted in the middle, straw-yellow, 20–25 × 12–14 μ.

In company with *Coryneum sambucinum* Ell. & Ev. and *Tubercularia Sambuci* Cda.

The type in the Farlow Herbarium, Ellis Notebook p. 31, no. 176, does not show any muriform-spored Pyrenomycete, and Mr. J. A. Stevenson reports that after a careful search he and Miss Cash can find no specimen of this species either in the Bethel Herbarium or the U. S. Dept. Agric. collections.

Judged solely on the basis of the foregoing copy of the description, as cited, *T. sambucina* is not synonymous with any other species of *Thyronectria.* Therefore without the support of any valid specimen in the collections of either the authors or of the collector, the status of *T. sambucina* must be regarded as doubtful.

EXCLUDED SPECIES

The following four species names were at one time under the genus *Pleonectria,* but have been correctly reduced to synonymy by the writers cited.

18. **Pleonectria lichenicola** (Crouan) Saccardo, Michelia **1:** 325. 1879.

This is a synonym for *Ciliomyces oropensis* (Cesati) von Höhnel, Sitz. Akad. Wiss. Wien Math.-Nat. Kl. Abt. I, **115:** 672–673, 1 fig. 1906.

19. **Pleonectria appendiculata** Vouaux, Bull. Soc. Myc. France **28:** 193. 1912.

This was reduced to synonymy with *Ciliomyces oropensis* (Cesati) von Höhnel (see no. 18 above) by Weese in Centralb. f. Bakt. **42:** 603–604. 1914.

20. **Pleonectria lutescens** Arnold, Flora **68:** 222. 1885.

This is a synonym for *Xenonectriella lutescens* (Rehm) Weese, Sitz. Akad. Wiss. Wien Math.-Nat. Kl. Abt. I, **128:** 746–750, fig. 1–4. 1919.

21. **Pleonectria pinicola** Kirschstein, Verhandl. Bot. Ver. Prov. Brandenburg **48:** 59. 1907.

This is a synonym for *Ophionectria cylindrospora* (Solm.) Berl. & Vogl. var. *tetraspora* Weese, Centralb. f. Bakt. **42:** 596–602. 1914.

EXPLANATION OF PLATES

Plate 1.

Camera lucida drawings of asci and spores. Spores as seen in an approximately median longitudinal plane.

Fig. 1. *Thyronectria antarctica* (Speg.) Seeler. (A) Mature ascus. × 470. (B) Apex of immature ascus. × 1150. (C–E) Ascospores. × 1150. (A, C, D) are from type material. (B, E) from Thaxter's no. 5308.

Fig. 2. *Thyronectria chrysogramma* Ellis & Everhart. (A) Mature ascus. × 470. (B) Apex of immature ascus. × 1150. (C, D) Ascospores. × 1150. All from type material.

Fig. 3. *Thyronectria Lonicerae* Seeler. (A) Mature ascus. × 470. (B) Apex of immature ascus. Note the apical pore. × 1150. (C–E) Ascospores. × 1150. All from type material.

Fig. 4. *Thyronectria missouriensis* (Ell. & Ev.) Seaver. (A) Mature ascus. Two of the eight spores are drawn with dashed lines behind other spores at the top. × 470. (B) Apex of immature ascus. × 1150. (C, D) Ascospores. × 1150. All from Demetrio's no. 276, a co-type.

Fig. 5. *Thyronectria pseudotrichia* (Schw.) Seeler. (A) Mature ascus. × 470. (B) Apex of immature ascus. × 1150. (C–E) Ascospores. × 1150. All from Thaxter's Trinidad collection of 1913.

PLATE 2.

Camera lucida drawings of asci and spores. Spores as seen in an approximately median longitudinal plane.

Fig. 1. *Thyronectria Lamyi* (Desm.) Seeler. (A) Mature ascus containing eight ascospores and crowded with ascoconidia. × 470. (B) Apex of immature ascus. × 1150. (C) Surface view of ascospore budding conidia, crushed from ascus. × 1150. (D) Ascoconidia. × 1150. (E, F) Ascospores without appended conidia. × 1150. (A–E) from Newadowski, 1912. (F) from Univ. Toronto Herb. 6064.

Fig. 2. *Thyronectria balsamea* (Cke. & Pk.) Seeler. (A) Mature ascus containing three ascospores and crowded with ascoconidia. × 470. (B) Surface view of ascospore budding conidia, crushed from ascus. × 1150. (C–G) Ascospores without appended conidia. × 1150. (A, C, E) from Brainerd, Vt. 1882. (B, D, F, G) from J. H. Faull Herb. 9617.

Fig. 3. *Thyronectria chlorinella* (Cke.) Seeler. (A–D) serial stages in development of asci. (A) Immature ascus containing four 2-celled ascospores. × 470. (B) Immature ascus containing four 3–4-celled ascospores. × 470. (C) Immature ascus containing four ascospores deeply constricted at the original septa depicted in B, and showing other vague transverse and longitudinal septa. × 470. (D) Mature ascus containing the parts of the four original spores and crowded with ascoconidia. × 470. (E) Surface view of ascospore fragment budding conidia, crushed from ascus. × 1150. (F) Ascoconidia. × 1150. (G–H) Ascospore fragments without appended conidia. × 1150. (A–C) from Burke, Ala. Sphaer. 8. (D–H) from type.

Fig. 4. *Thyronectria austro-americana* (Speg.) Seeler. (A) Mature ascus. × 470. (B) Apex of immature ascus. × 1150. (C–F) Ascospores. × 1150. (G) Pycnospores of Gyrostroma phase. × 1150. (H) Surface view of ascospore producing conidia, crushed from ascus. × 1150. (C, E, F, G) from type. (A, B, D) from the type of *Pleonectria denigrata* Winter. (H) from type of *Nectria sphaerospora* Ell. & Ev.

Fig. 5. *Thyronectria berolinensis* (Sacc.) Seaver. (A) Mature ascus. × 470. (B) Apex of immature ascus. Note the apical pore, × 1150. (C–E) Ascospores. × 1150. (F) Surface view of ascospore budding conidia while loose in perithecium — not within ascus. × 1150. (A, C, D, E) from Univ. Toronto Herb. 3299. (B) from Brenckle 261. (F) from Burt, Vt.

Fig. 6. *Thyronectria Xanthoxyli* (Pk.) Ellis and Everhart. (A) Mature ascus. × 470. (B) Apex of immature ascus. × 1150. (C–F) Ascospores. × 1150. All except (B) are from type. (B) from Thaxter 1626.

Fig. 7. *Thyronectria pyrrhochlora* (Auersw.) Saccardo. (A) Mature ascus. × 470. (B) Apex of immature ascus. × 1150. (C–F) Ascospores. × 1150. All from Rehm, Ascomyceten 40.

PLATE 3.

Diagrammatic representation of median vertical sections through the long axis of stromata. Drawn with camera lucida to the scale shown above Fig. 9. × 14.

FIG. 1. *Thyronectria pyrrhochlora* (Auersw.) Saccardo. From type material, Rabenhorst's Fungi eur. no. 1234. FIG. 2. *T. Lonicerae* Seeler. From type material, Bethel no. 256. FIG. 3. *T. chrysogramma* Ellis and Everhart. From Dearness' collection of 1892. FIG. 4. *T. Xanthoxyli* (Pk.) Ellis and Everhart. From Thaxter no. 412. FIG. 5. *T. balsamea* (Cke. & Pk.) Seeler. (A) Pycnidial stroma of Gyrostroma stage. From J. H. Faull Herb. no. 6588. (B) Perithecial stroma. From Burt's collection of 1894. FIG. 6. *T. pseudotrichia* (Schw.) Seeler. (A, C) Perithecial stromata from Thaxter's collection of 1913. (B) Coremium of *Stilbella cinnabarina* (Mont.) Wollwr. from Wright's collection of 1909. FIG. 7. *T. berolinensis* (Sacc.) Seaver. From Brenckle no. 261. FIG. 8. *T. antarctica* (Speg.) Seeler. From Thaxter no. 5308. Note the Tubercularia type of sporodochium to the left of the center. FIG. 9. *T. Lamyi* (Desmz.) Seeler. From Newadowski's 1912 collection ex Bucholtz Herb. no. 2014. FIG. 10. *T. missouriensis* (Ell. & Ev.) Seeler. (A) Pycnidial stroma of *Gyrostroma missouriense* Seeler. From Thaxter no. 1629. (B) Perithecial stroma with remains of Gyrostroma stage on the left. (C) Perithecial stroma showing large thin-walled mature perithecium on the right. (B, C) From Thaxter no. 1625. FIG. 11. *T. austro-americana* (Speg.) Seeler. (A) Pycnidial stroma of *Gyrostroma austro-americanum* Seeler, before development of the perithecia. (B) Perithecial stroma showing remains of Gyrostroma locules close below the perithecia. Both from Seeler's collection of 1936.

PLATE 4.

Photographs of external appearance of stromata of several species. All to scale shown to the left of Fig. 9. × 10.

FIG. 1. *Thyronectria berolinensis* (Sacc.) Seaver. Perithecial stroma, from Newadowski's 1912 collection ex herb. Theissen, on *Ribes*. FIG 2. *T. Xanthoxyli* (Pk.) Ellis and Everhart. From Thaxter no. 1626, on *Rhus*. FIG. 3. *T. chrysogramma* Ellis and Everhart. Perithecial stromata, from Dearness' collection of 1892, on *Ulmus*. FIG. 4. *T. Lonicerae* Seeler. Perithecial stroma, from Bethel no. 256, on *Lonicera* (type). FIG. 5. *T. Lonicerae* Seeler. Perithecial stroma, from Brenckle's So. Dak. Fungi no. 1780, on *Symphoricarpos* (co-type). FIG. 6. *T. pseudotrichia* (Schw.) Seeler. Perithecial stromata, from Theissen's collection from Brazil. FIG. 7. *T. antarctica* (Speg.) Seeler. Perithecial stroma, from Thaxter no. 5308, on *Berberis*. FIG. 8. *T. missouriensis* (Ell. & Ev.) Seeler. Perithecial stromata, from Thaxter no. 1625 on *Acer*. FIG. 9. *T. missouriensis* (Ell. & Ev.) Seeler. Pycnidial stroma of *Gyrostroma missouriense* Seeler from Thaxter's collection of April 1917 on *Carya*. FIG. 10. *T. austro-americana* (Speg.) Seeler. Pycnidial stroma showing emerging "ribbons" of pycnospores of *Gyrostroma austro-americanum*

Seeler, from Seeler no. 418. FIG. 11. *T. austro-americana* (Speg.) Seeler. Perithecial stroma, from Seeler's collection of 1936 on *Gleditsia*. FIG. 12. *T. Lamyi* (Desmz.) Seeler. Perithecial stroma. Bark of host twig has been cut away on both sides to afford a clearer view. From Univ. Toronto Herb. no. 4167 on *Berberis*.

PLATE 5.

Photographs of illustrations from the literature.

Fig. 1. *Thyronectria patavina* Saccardo, the genus type. From a drawing by P. A. Saccardo in Fungi Italici Autographice Delineati, Plate 153. 1877. Note: perithecia are only partially embedded and not truly valsoid.

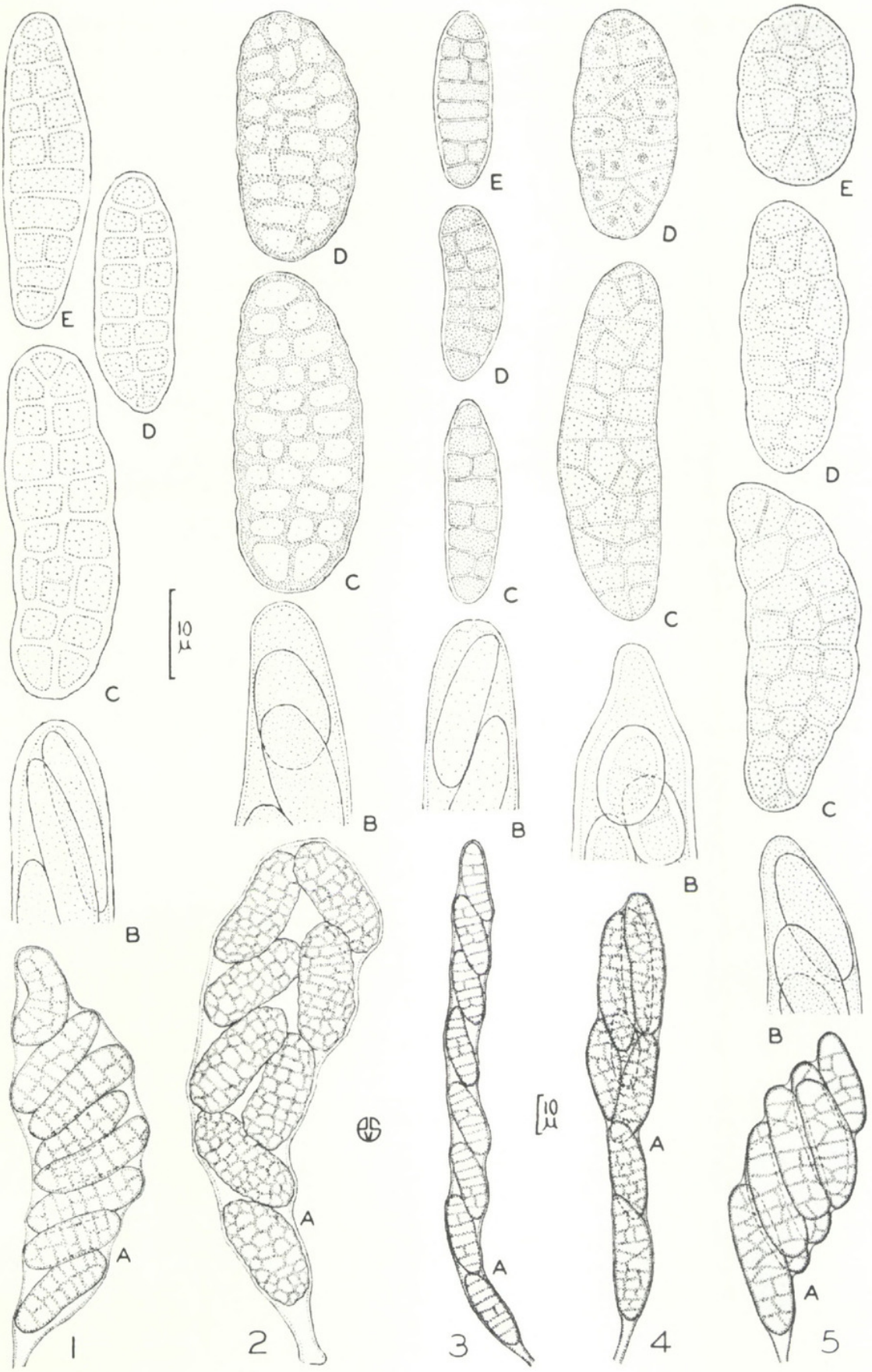
Fig. 2. *Mattirolia roseo-virens* Berlese & Bresadola. From a drawing by A. N. Berlese in Mycromyces Tridentini, Plate 5, fig. 3. 1889.

Fig. 3. *Mattirolia rhodochlora* (Mont.) Berlese. From a drawing by A. N. Berlese in Atti de Congresso Botanico Internazionale di Genova 1892, Plate 22, fig. 4 and 5. 1893.

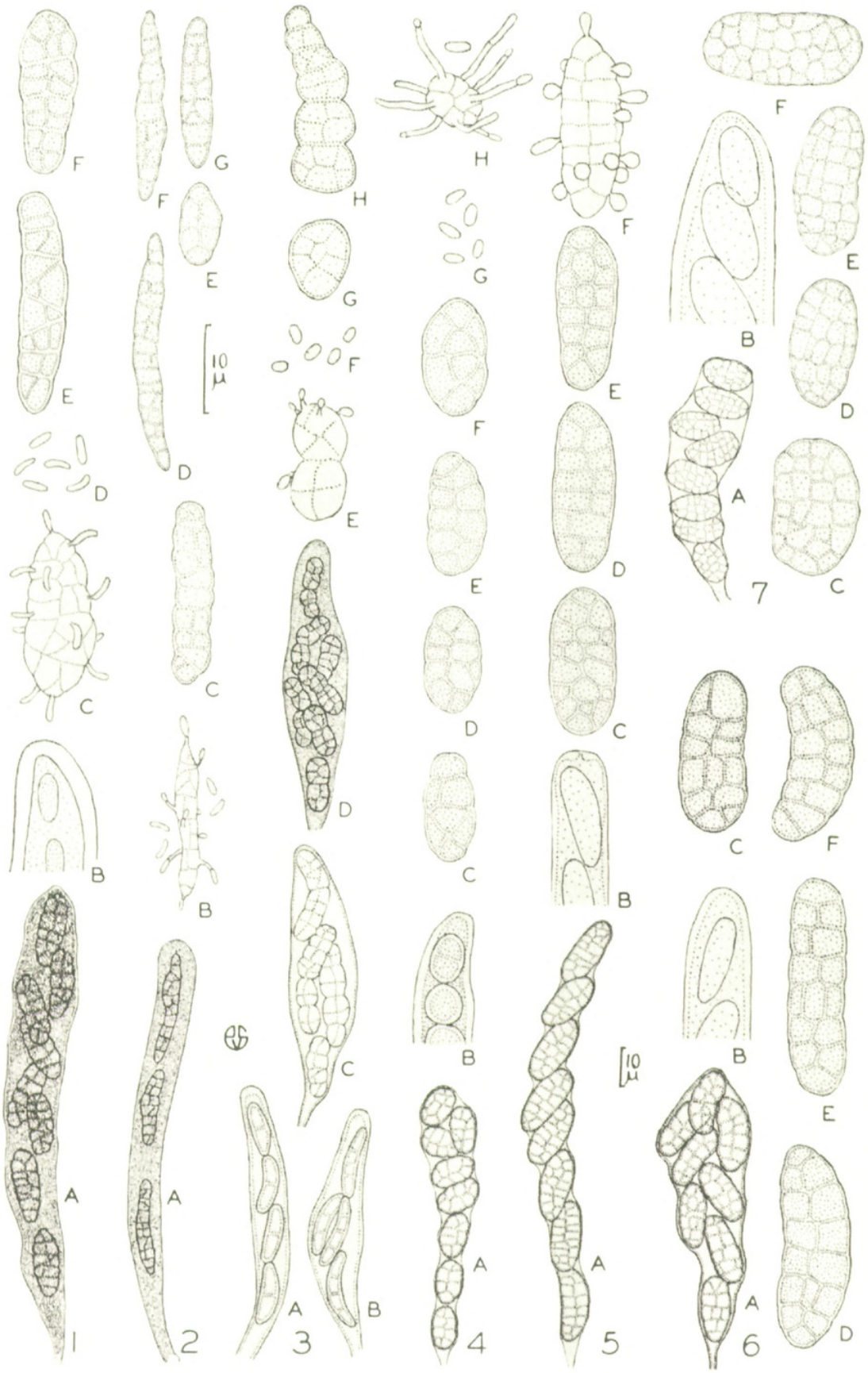
Fig. 4. *Pleonectria berolinensis* Saccardo. From a drawing by H. W. Wollenweber in Sorauer's Handbuch der Pflanzenkrankheiten (5 ed.) 2 (1), Plate 160. p. 571. 1928. Note the Dendrodochium conidial phase at the top.

Fig. 5. *Pleonectria pseudotrichia* (Schw.) Wollenweber. Note the Stilbella conidiospores at the top. From same source as Fig. 4.

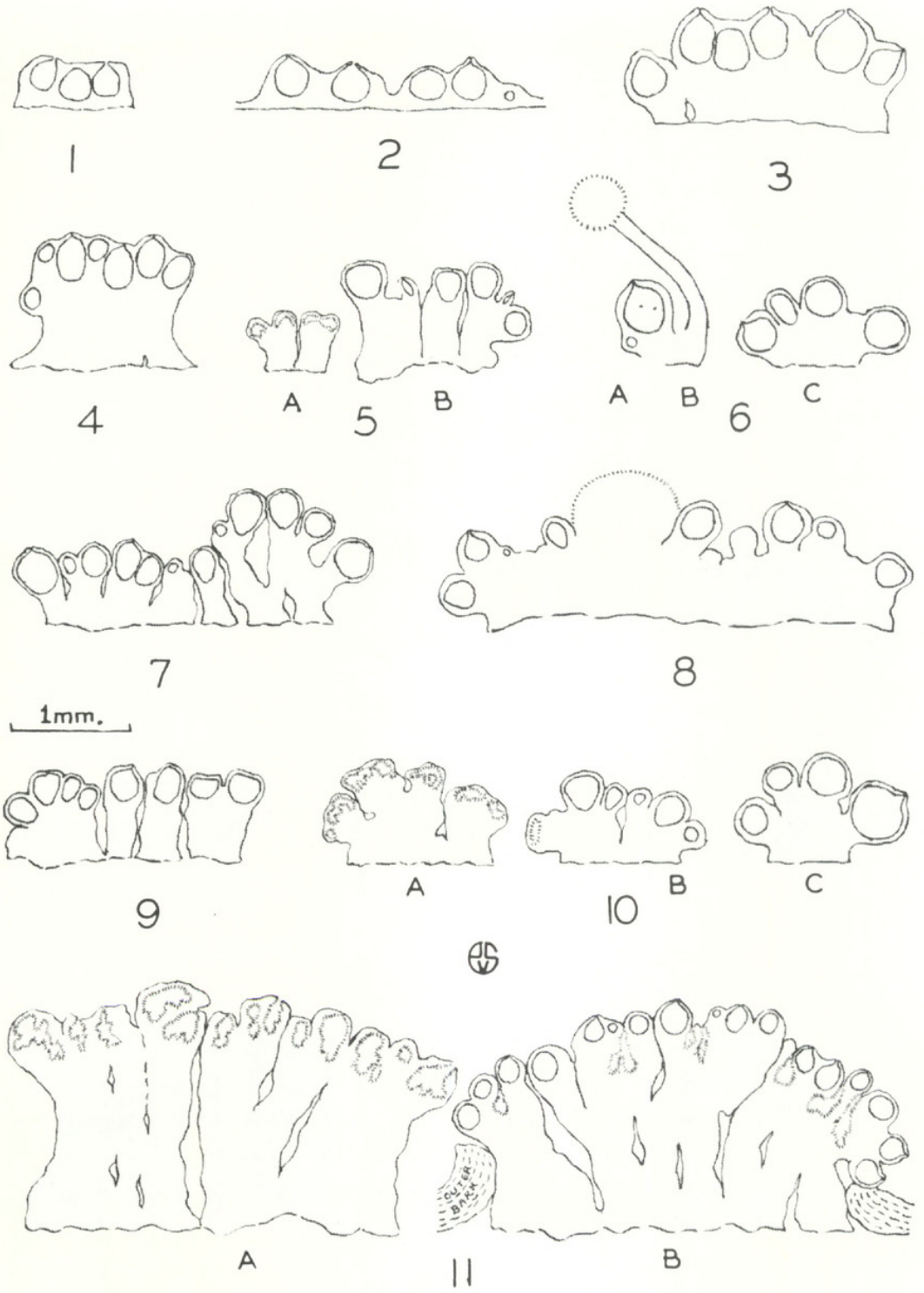
LABORATORY OF FOREST PATHOLOGY,
ARNOLD ARBORETUM,
HARVARD UNIVERSITY.



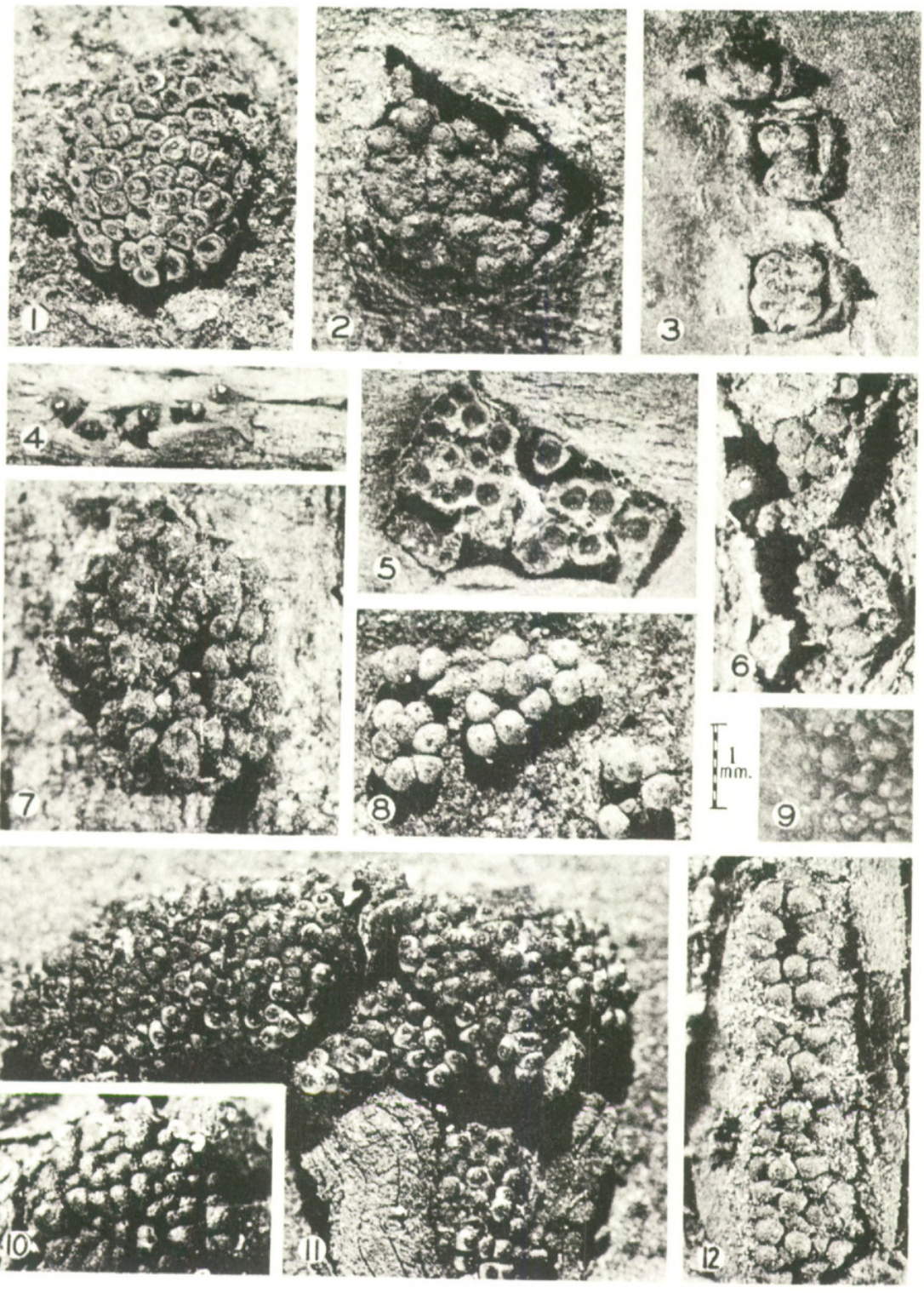
THYRONECTRIA



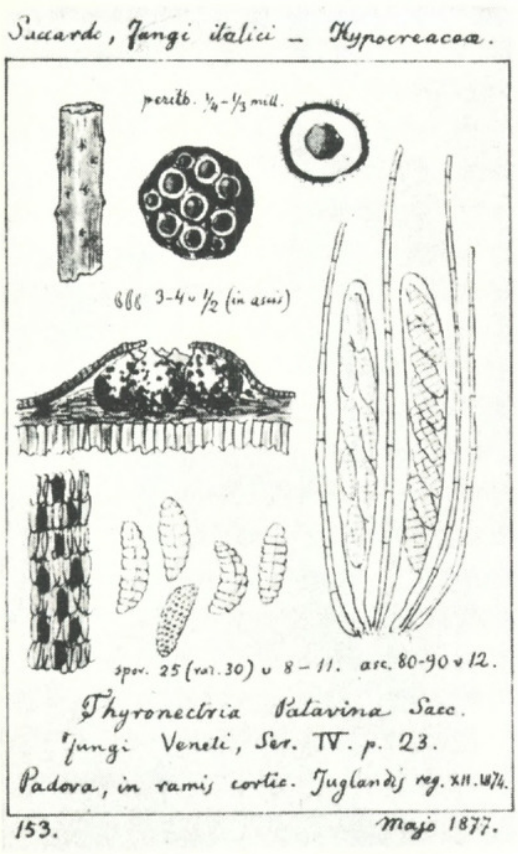
THYRONECTRIA



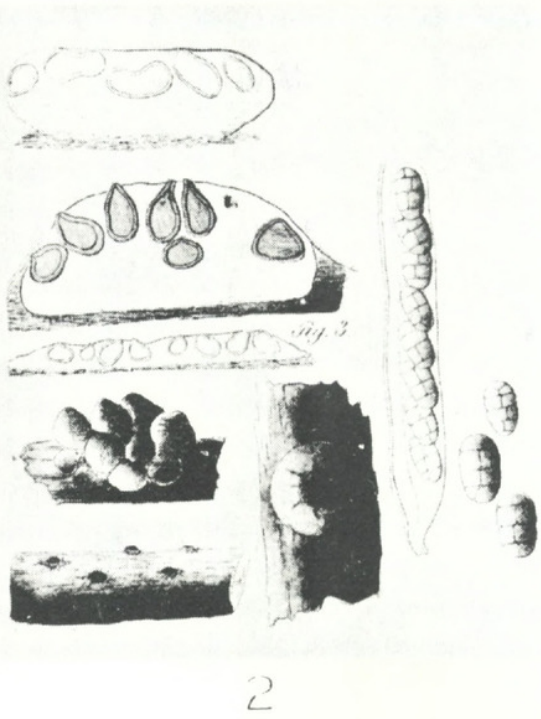
THYRONECTRIA



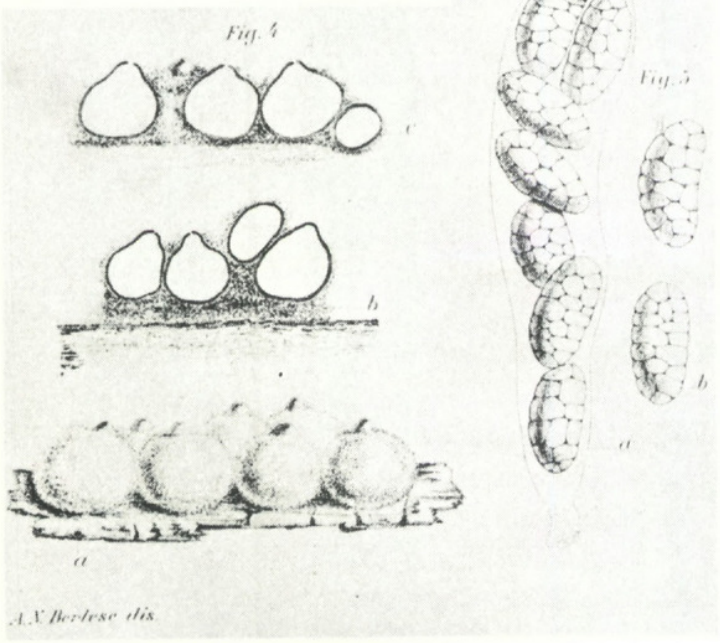
THYRONECTRIA



1



2



3

4

5

THYRONECTRIA