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ON THE FAMILY TUBEUFIACEAE (PLEOSPORALES)

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SUMMARY

Ten genera are presently accepted in the family Tubeufiaceae. Those genera whose species are extralimital in distribution to temperate North America are considered briefly. *Rebentischia* and *Tubeufia*, with two and seven species respectively in temperate North America, are considered in more detail. *Tubeufia* is subdivided into the sections *Tubeufia*, *Nectrioidea*, *Thaxteriella* and *Acanthostigmina*; new combinations are proposed for *Tubeufia clintonii*, *T. pezizula*, and *T. scopula*.

INTRODUCTION

The family Tubeufiaceae was erected recently (Barr, 1979) to accommodate a number of pleosporaceous fungi that are typically either hypersaprobic on other fungi or on substrates previously colonized by other fungi or hyperparasitic on foliicolous fungi, or parasitic on scale insects, occasionally parasitic on living leaves. The ovoid, globose, ellipsoid or cylindrical ascomata of species in the family are soft and fleshy in consistency, range in pigmentation from none (hyaline) to yellowish, brownish or pinkish to dark vinaceous brown, but not red; surfaces may be smooth or ornamented by protruding cells, hyphal appendages, or setae. The bitunicate asci are clavate or cylindrical and develop from the base of the locule in narrow cellular pseudoparaphyses. Ascospores are hyaline, yellowish, or light vinaceous brown, narrowly oblong or nearly ellipsoid, short to elongate fusoid, or cylindrical, and one or more commonly several septate. The conidial states known for a number of the species are hyphomycetous; sympoduloconidia are typically

helicosporous or staurosporous, but dictyosporous conidia are associated in some taxa.

While fungi possessing these features have been accommodated within the Pleosporaceae ss. lat., in my opinion they form a well-defined family. Pirozynski (1977) suggested that *Tubeufia* could be grouped with *Acrospermum* in the Acrospermataceae and allied with *Cyanoderma* and *Oomyces*. The species of *Acrospermum* are not convincingly bitunicate, although Eriksson (1967) as well as Pirozynski (1977) believed that they were. Sherwood (1977), on the other hand, suggested that *Acrospermum* was more closely allied to members of the Clavicipitaceae. My interpretation of *Acrospermum* and its relatives would place the family in the Xylariales, although the taxa deviate in some respects from typical representatives of the order. The vertically elongate, light-colored ascomata of species of *Acrospermum* are superficially similar to the ovoid or cylindrical ascomata of some species of *Tubeufia*. The locule in species of *Tubeufia* differs in the presence of attached pseudoparaphyses and relatively broadly oblong or cylindrical, thick-walled asci with apical cytoplasmic protrusion from that in species of *Acrospermum* which contains paraphyses with free apical ends and narrowly cylindrical asci with an evenly thickened apex. A transverse or oblique arrangement of peridial cells is seen in a number of fungi with vertically elongate ascomata, e.g., in species of *Acrospermum* (Eriksson, 1967), in species of *Tubeufia*, as in *T. paludosa* and *T. cylindrothecia* (see later), in the elongate beak of *Ophioceras dolichosporum* (Berk. & Curt.) Sacc. (Conway and Barr, 1977). Such an arrangement of peridium cells seems to be for support, an architectural device arrived at by some Ascomycetes that have developed similarly elongate ascomata or beaks. The diagnostic features of the centrum or locule differ in each of these taxa.

Many of the taxa of the Tubeufiaceae are tropical or otherwise extralimital in distribution. In this study the genera that I presently treat in the family are discussed. The species now known to occur in temperate North America receive a more detailed consideration. At least one additional genus probably belongs in the family, composed of species parasitic on rust sori, whose elongate ascospores are spirally twisted in the ascus (Rossman, 1977).

GENERA AND SPECIES

ALLONECTE H. Sydow, Ann. Mycol. 37: 378. 1939.

Allonecte lagerheimii (Pat.) Sydow, the sole species, is a leaf parasite known from Ecuador, whose reddish-brown ascomata penetrate the leaf epidermis by a basal foot. The peridium bears hyphal appendages and the ellipsoid ascospores are one septate (Müller and von Arx, 1962; Rossman, 1979).

BOERLAGIOMYCES Butzin, Willdenowia 8: 39. 1977.

Boerlagella Penzig & Sacc. Malpighia 11: 404. 1897, non Pierre ex Boerlage, 1891 (Sapotaceae).

Von Arx and Müller (1975) observed that the genus was closely related to *Tubeufia*. The type species, *B. velutinus* (Penzig & Sacc.) Butzin, and second species, *B. laxus* (Penzig & Sacc.) Butzin, were both described from Java on decaying wood or culms. *Boerlagiomyces laxus* may be an immature stage of *B. velutinus*. This species has dark brown, soft-walled ascomata that bear hyphal appendages and are seated in a well-developed dark subiculum. The ascospores are hyaline, elongate, narrowly clavate, and multi-septate with vertical septa in a number of the cells. *Boerlagella indica* Tilak et al. (Sydowia 24: 294. 1971) may belong in *Berlesiella* or *Dictyotrichiella* according to the description. The description and illustration of *Thaxteriellopsis lignicola* Sivanesan et al. (Kavaka 4: 39. 1976) are suggestive of *Boerlagiomyces*.

BYSSOCALLIS H. Sydow, Ann. Mycol. 25: 14. 1927.

Petrak (1931) and Pirozynski (1977) included the species of *Byssocallis* in *Puttemansia* but Rossman (1979) retained the two genera separately. Ascospores in the species of *Byssocallis* may have apiculate ends as in species of *Puttemansia* or blunt ends as in species of *Melioliphila*. Ascomata develop on meliolaceous hosts. Rossman (1979) suggested that *Byssocallis* is closely related to *Melioliphila* because of the similarity of ascospore shapes as well as the presence of an associated *Eriomycopsis* conidial state with *B. capensis* (Doidge) Rossman. The type species is *B. phoebes* H. Sydow.

LETENDRAEA Sacc. *Michelia* 2: 73. 1880.

Species with one-septate ascospores, thin-walled pallid ascomata and not known to possess a conidial state are placed in *Letendraea*. *Letendraea helminthicola* (Berk. & Br.) Weese ex Petch (Trans. Brit. Mycol. Soc. 21: 277. 1938), the type species, is European and not yet known from North America. Müller and von Arx (1962) and Samuels (1973) provided descriptions and illustrations of this species. *Letendraea padouk* Nicot & Parguey-Leduc (Compt. Rend. Hebd. Seances Acad. Sci. 248: 1560. 1959) is a similar but larger species from Africa. Some species described in the genus do not belong here: *L. luteola* Ell. & Ev. and *L. rhynchostoma* von Hühnel are species of *Cryptosphaeria*, *L. rickiana* Rehm is a species of *Nectria*, and *L. lasiosphaerioides* Teng is a species of *Didymotrichia*. According to descriptions, other species described in *Letendraea* are also to be removed from the genus, but I have not studied these and cannot suggest their true position at this time.

MELIOLIPHILA Speg. Bol. Acad. Ci. Cordoba 26: 344. 1924 (1923).

The species of this genus have thick-walled, opaque ascomata, clavate, blunt-ended, several-septate ascospores and associated conidial states belonging to *Eriomyopsis* Speg. They are hyperparasitic on meliolaceous taxa in tropical regions. Pirozynski (1977) redescribed the genus and illustrated several species. Rossman (1979) added other species to the genus and clarified synonymy of the type species, *Calonectria graminicola* Speg. non (Berk. & Br.) Wollenw. The earliest name for the type species is *M. volutella* (Berk. & Br.) Rossman (Mycotaxon 8: 551. 1979).

PARANECTRIELLA (P. Henn. ex Sacc.) von Hühnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 119: 899. 1910.

Another tropical genus of hyperparasitic fungi, *Paranectriella* differs from *Melioliphila* in small, pallid, thin-walled, translucent ascomata, appendaged ascospores, and in the *Titaea* conidial state. Pirozynski (1977) redescribed the genus and provided illustrations. Hawksworth and Pirozynski (1977) corrected citation and synonymy of the generic name, typified by *P. juruana* (P. Henn.) Piroz. (Kew Bull. 31: 598. 1977).

PODONECTRIA Petch, Trans. Brit. Mycol. Soc. 7: 146. 1921.

Species with pallid or brightly pigmented ascomata, with granular brown outer coating in some, elongate-clavate multiseptate ascospores, parasitic on scale insects, with *Tetracrium* conidial states belong in *Podonectria*. Only the type species, *P. coccicola* (Ell. & Ev.) Petch, has been collected in southern regions of temperate North America (Florida, Mississippi, Louisiana, Texas) as well as in tropical regions. Rossman (1978) monographed the genus, and described and illustrated eight species worldwide.

PUTTEMANSIA P. Henn. Hedwigia 41: 113. 1902.

The ascomata of the species of *Puttemansia* are thick walled and opaque, and are surrounded by straight or flexuous hyphal appendages. The ascospores are several septate, fusoid or clavate with apiculate or rostrate ends. Conidial states are described (Pirozynski, 1977) as species of *Titaeta* Sacc. or *Guelichia* Speg. (and possibly *Spermatoloncha* Speg.) Rossman (1979) noted the association of *Tetracrium* conidia with ascocarps on lectotype material of *P. lanosa* P. Henn., the type species. Petrak (1931) first recognized that species of *Puttemansia* were not members of the Hypocreales but were "hypocreoid Dothidaceen." Pirozynski (1977) included *Annajenkinsia* Thirum. & Narasimhan (Mycologia 47: 760. 1955) as a synonym of *Puttemansia*, whereas von Arx and Müller (1975) regarded *Annajenkinsia* as a member of the Patellariaceae. According to description and illustration of *A. fungicola* Thirum. & Narasimhan, the species belongs in *Puttemansia*. Petrak (1931) and Pirozynski (1977) included the species of *Byssocallis* in *Puttemansia* but Rossman (1979) retained two separate genera.

REBENTISCHIA Karsten, Fungi Fenniae Exsiccati No. 881 (in sched.) 1869; Mycol. Fenn. 2: 14. 1873.

Ascomata at first immersed in loose outer layers of periderm or cortex of host, remaining immersed or becoming erumpent superficial, separate or few grouped, globose, somewhat depressed, or ovoid, often collabent in age, apex blunt; peridium soft and fleshy, composed of pseudoparenchymatous cells, light to dark vinaceous brown externally, toward interior of narrow compressed layers of hyaline or vinaceous-tinged cells, pigment encrusted on surface of outermost cells; surface often roughened by protruding cells or short hyphae; subiculum hyphae sparse. Asci from base of

locule, bitunicate, oblong clavate, octosporous or occasionally only four maturing; pseudoparaphyses narrow cellular, occupying apical pore region. Ascospores hyaline at first, becoming light dull brown or light vinaceous brown, narrowly clavate, usually slightly curved, apex rounded, tapered to base, several septate, primary septum near base, basal cell remaining hyaline, becoming elongate and setiform, secondary septa formed in upper region, mid cells more strongly pigmented than upper cell, cells uniglobulate, wall smooth, overlapping biseriolate in the ascus.

Conidial state not known with certainty. Short denticulate conidiogenous cells have been observed attached to the lower peridium or to associated light brown hyphae near base of ascomata. One collection of *R. massalongii* (Barr 6714) in culture formed small, dark brown pycnidia, 110-165 μm diam. Conidia were hyaline, ellipsoid, 5 x 2.5 μm , and were produced from small hyaline cells that lined the cavity. This seems to be an *Asteromella* spermatial state.

On woody or suffrutescent stems and branches, at times around old, partially healed cankers.

Type species: *Rebentischia pomiformis* Karst. = *R. massalongii* (Mont.) Sacc.

Von Arx and Müller (1975) synonymized *R. pomiformis* with *R. massalongii*, the earlier name, as Saccardo (1877) had suggested. A number of species have been described in the genus, although there appear to be only two valid entities, quite similar to one another, but differing in habitat and in size ranges. These may be recognized by the following characters, essentially those used by Berlese (1894, pl. XVIII, figs. 4, 5):

1. On suffrutescent stems of shrubs and vines; main body of ascospore 17-25(-30) x 4-6(-7.5) μm*R. unicaudata*
1. On woody branches of trees; main body of ascospore (22-) 28-38(-40) x 6-9(-10) μm*R. massalongii*

Müller (1950) recorded both *R. massalongii* and *R. unicaudata*, as well as *R. typhae*, from Switzerland. *Rebentischia typhae* H. Fabre (Ann. Sci. Nat. Bot., Ser. VI, 9: 88. 1878) has been removed from the genus to *Buergerenerula* by von Arx (1977). Those specimens labelled *R. typhae* that I examined, e.g., Rehm Ascomyceten 1137 (NY), bore only a large variant of *Lophiostoma dacryosporum* H. Fabre, with dark brown

five-(six)-septate ascospores that taper to the pallid basal cell. *Rebentischia ulmicola* Fautr. & Lamb. (Rev. Mycol. 54. 1897) (In Saccardo and Sydow, 1899) is probably identical with *R. massalongii*, and *R. thujana* Feltgen (Vorstud. Pilz. Luxemb., Nachtr. 3: 223. 1903) appears to be the same according to the description. Saccardo (1883) included *R. ranella* (Berk. & Rav.) Sacc. in his synopsis of species of *Rebentischia*. Ellis and Everhart (1892) entered this name under *Rosellinia rattus* (Schw.) Ell. & Ev., but observed that the generic position was uncertain. Although I have seen no specimens, the description of *Sphaeria ranella* Berk. & Rav. does not suggest a species of *Rebentischia*. Other species described in *Rebentischia* have not been studied, i.e., *R. taurica* Naoumov & Dobr. (Mat. Mycol. Phytopathol. Leningrad 8(2): 136. 1929), *R. brevicaudata* Guyot (Ann. Serv. Bot. Tunis. 28: 132. (1955) 1958), and *R. costi* Bat. et al. in Batista & Bezzera (Publ. Inst. Micol. Univ. Recife 385: 7. 1963). Both *R. anodendri* Tilak & R. Rao (Sydowia 21: 308. (1967) 1968) and *R. elaeodendri* Tilak & Srin. (Sydowia 24: 95. (1970) 1971) were described with muriform ascospores and do not belong in *Rebentischia*.

Rebentischia massalongii (Mont.) Sacc. Nuovo Giorn. Bot.
Ital. 8: 12. 1876. Figs. 1, 2

Sphaeria massalongii Mont. Syll. Gen. Sp. Crypt. p. 237.
1856.

Rebentischia pomiformis Karst. Fungi Fenniae Exsiccati
No. 881. 1869; Mycol. Fenn. 2: 97. 1873.

Ascomata globose or slightly depressed, erumpent superficial at maturity, collabent on drying, (220-)300-440(-495) μm diam, black under low magnification; peridium soft, composed of several layers of pseudoparenchymatous cells, variable in width, (10-)24-35 μm wide; surface roughened with protruding cells or short hyphae, vinaceous brown pigment encrusted on outer layers of cells. Asci 82-120 x 15-22 μm , clavate; pseudoparaphyses narrow cellular, 1.5-2.5 μm wide. Ascospores (22-)28-38(-40) x 6-9 μm , at maturity 4-(5)-septate in narrowly obovoid main body, hyaline basal cell and setiform base 7-24 μm long, cell 3.5-4.5 μm wide, tapered to 1-1.5 μm wide, apical cell hyaline or faintly pigmented, mid cells light clear vinaceous brown, contents multiguttulate young, with one or two globules per cell at maturity, wall smooth.

On woody branches or trunks, often surrounding old cankers. Europe and North America.

Material examined: EUROPE: AUSTRIA: *Salix* sp., Herb. F. v. Hühnel, Sonntagsberg, leg. Strasser; Langenschönbichl 1. Tulln, 3 Jun 1905, leg. von Hühnel (both FH). FINLAND: *Acer platanoides* L., P. A. Karsten, Finland Fungi 881 (NY, part of type of *R. pomiformis*, sparse and overmature). NORTH AMERICA: USA: Maine: *Acer pensylvanicum* L., Barr 3266, 3268; *Abies balsamea* (L.) Mill., Barr 3214A, 3428 (MASS); Massachusetts: *Ulmus americana* L., Barr 6507 (MASS); *Ilex verticillata* (L.) Gray, Barr 6633 (MASS); *Robinia pseudo-acacia* L., Barr 6714 (MASS).

Rebentischia unicaudata (Berk. & Br.) Sacc. Atti Soc. Veneto-Trentini Sci. Nat. 4: 88. 1875; Syll. Fung. 2: 12. 1883. Fig. 3

Sphaeria unicaudata Berk. & Br. Ann. Mag. Nat. Hist. ser. 3, 3: 18 (373). 1859.

Ascomata globose, depressed or ovoid, often remaining partially immersed, (100-)220-330(-440) μm diam, black under low magnification; peridium soft, composed of few or several layers of pseudoparenchymatous cells, (10-)20-30 μm wide; surface roughened by protruding cells or smooth, vinaceous brown pigment encrusted on outer layers of cells. Asci (40-)60-100 x (10-)12-15(-18) μm , clavate; pseudoparaphyses narrow cellular, 1.5-2 μm wide. Ascospores 17-25(-30) x 4-6(-7.5) μm , at maturity 4-septate in narrowly obovoid main body, hyaline basal cell and setiform base 4-15 μm long, cell 4 μm wide, tapered to 1-1.5 μm wide, apical cell hyaline, mid cells light vinaceous brown, contents multi-guttulate young, one or two globules per cell at maturity, wall smooth.

On suffrutescent stems and branches of shrubs and vines. Europe and North America.

Material examined: EUROPE: AUSTRIA: *Clematis*, Weese, Eumycetes sel. exs. 542 (BPI); Krypt. exs. 1921 (BPI, NY); Graz, leg. G. de Niessl (BPI); Rehm Ascomyceten 241b (FH); *Berberis* sp., Herb. F. v. Hühnel, Tumpen, Ötztal, Tirol (FH). FINLAND: *Ribes alpinum* L., Barr 5675 (MASS). FRANCE: *Clematis*, Roumeguere, Fungi sel. exs. 4857 (NY); *Sambucus nigra* L., Roumeguere, Fungi sel. exs. 6186 (NY). HUNGARY: *Clematis*, Rehm Ascomyceten 241 (NY). SWITZERLAND: *Clematis vitalba* L., Kt. Wallis, St. Gingolph, 7 May 1962, leg. E. Müller (BPI); "15", Frauenfeld (NY). YUGOSLAVIA: *Clematis*, Fungi montenegrini, St. Monasserium, Pira, 24 Aug 1904, leg. F. Bubák (BPI). NORTH AMERICA: USA:

Massachusetts: *Rubus* sp., Barr 6224 (MASS).

TUBEUFIA Penzig & Sacc. *Malpighia* 11: 517. 1897.

Acanthostigmina von Hühnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 118: 1499. 1909.

Thaxteriella Petrak, *Ann. Mycol.* 22: 63. 1924.

Ascomata superficial, separate or grouped, in thin or well-developed subiculum, cylindric, ovoid or globose, in some species collabent on drying, small to medium sized, pallid, light or brightly colored or dull brownish, grayish, black or vinaceous, apex bluntly papillate, surface glabrous or pulverulent with protruding cells or short setose or bearing hyphal appendages; peridium soft and fleshy, composed of pseudoparenchymatous cells, external region hyaline, light colored, reddish brown or vinaceous brown, with pigment encrusted on surface usually, and internal region hyaline, cells more compressed, thickened at upper sides around apex. Asci from base of locule, bitunicate, oblong or clavate, usually octosporous; pseudoparaphyses narrow cellular. Ascospores hyaline, light yellowish or light brownish after discharge, elongate fusoid or clavate, inequilateral often slightly curved, several septate, not usually constricted at septa, contents guttulate becoming homogeneous and refractive in age, wall smooth, overlapping bi- or triseriate or in fascicles in the ascus. Conidial states often species of *Helicosporium* or *Helicoma*; conidiphores \pm setiform, arising from superficial hyphae, conidigenous cells denticulate, as sympodially proliferating lateral pegs; conidia hyaline or light yellowish brown, hooked or helicosporous, (one celled) several septate. Additionally, a *Monodictys* state is known for *T. amazonensis*: conidigenous cells as lateral branches of hyphae, forming stalk cell and single conidium; conidia dark brown, elongate or irregular in shape, muriform. Samuels et al. (1979) also described an *Asteromella*-like state obtained in culture for this species. Hughes (1978) illustrated features of a species of *Tubeufia* associated with *Pendulispora venezuelanica* M. B. Ellis, a fungus that has coiled conidium initials that develop into muriform pigmented conidia.

Hypersaprobic, on decaying woody or herbaceous substrates often over old ascomata or mycelium of other ascomycetes, in tropical and temperate regions.

Type species (lectotype): *T. javanica* Penzig & Sacc. = *T. paludosa* (Crouan & Crouan) Rossman.

Tubeufia was erected (Penzig and Saccardo, 1897) to accommodate three species from Java: *T. javanica*, *T. coronata* and *T. anceps*, all with vertically elongate, fleshy, white or pallid ascomata and elongate fusoid ascospores. In 1909a von Hühnel described *T. helicomyces* and transferred *Ophionectria cylindrothecia* Seaver to *Tubeufia*. Seaver (1909) included *O. cylindrothecia* and *O. cerea* in his concept of *Ophionectria*. Von Hühnel (1919) discussed and distinguished a number of taxa with characters somewhat similar to those of *Tubeufia*. He separated *Ophionectria*, based on *O. trichospora* (Berk. & Br.) Sacc., from *Tubeufia*, removed *T. anceps* to *Ophionectria*, and added *T. cerea* (Berk. & Curt.) von Hühnel to *Tubeufia*, selecting *T. javanica* Penzig & Sacc. as the lectotype species. Later studies by Booth (1964) and Rossman (1977) confirmed that *O. trichospora* is a hypocreaceous fungus.

Webster (1951) demonstrated in culture the connection between *T. helicomyces* and the associated *Helicosporium* state. Booth (1964) emended the concept of *Tubeufia*, recognizing variability in shape of ascomata, as well as the occurrence in some species of short hyphal setae on the peridium. He described the *Helicosporium* states of *T. cerea* and his new species *T. rugosa*. In *Tubeufia* Booth included species with cylindrical to ellipsoid ascomata -- *T. javanica*, *T. coronata*, *T. anceps*, *T. cylindrothecia*, and *T. nigrotuberculata* Hino & Katumoto, and species with ovoid to doliform ascomata -- *T. cerea*, *T. helicomyces*, and *T. rugosa*. Booth excluded *T. aselepiadis* Bat. & Garnier (Mem. Soc. Broteriana 14: 67-69. 1961) because the species has unitunicate asci and nonseptate ascospores; according to Rossman (1979) this name is a synonym of *Saccardomyces socius* P. Henn. Pirozynski (1972) transferred *T. nigrotuberculata* to *Herpotrichia*. *Tubeufia minuta* Munk (Bot. Not. 119: 179. 1966) has much tapered small ascospores, small ascomata, and perhaps is better disposed in *Herpotrichiella* (Rossman, pers. comm.). *Tubeufia corynespora* Munk (Bot. Not. 119: 189. 1966), described from Denmark and also known from West Germany (Hilber and Hilber, 1978) has dark ascomata and ascospores 50-65 x 3.5-4 μ m. The species would fit in section Thaxteriella. *Tubeufia acaciae* Tilak & Kale (Sydowia 23: 11. (1969) 1970) from India has violet to red, setose or appendaged ascomata. Pirozynski (1972) described and illustrated both conidial and ascosporic states of *T. helicoma* (Phil. & Plowr.) Piroz.,

the older epithet for *T. rugosa*. Pirozynski also provided details on the morphology and conidial state of *Thaxteriella pezizula* (Berk. & Curt.) Petrak.

Petrak (1924) erected *Thaxteriella* for *T. corticola*, collected in Puerto Rico. Later (Petrak, 1953) he made the combination *T. pezizula*, and remarked that this species, widespread in southeastern USA, was probably identical with *T. corticola*. Pirozynski (1972) examined the part of *T. corticola* in Herb. IMI, found it to be in poor condition, but noted that it seemed to be the same as *T. pezizula*. According to the original description of *T. corticola*, it could well be a collection of *T. pezizula*. *Thaxteriella* has been separated from *Tubeufia* on the bases of dark-colored, globose, collabent ascomata seated in a well-developed subiculum versus light-colored, cylindric, ovoid or globose ascomata in a slight subiculum, and on variations in the conidial states. When the species of *Tubeufia* were compiled and compared with *Thaxteriella pezizula*, it became evident that differences between *T. pezizula* and *Tubeufia helicoma* were not of greater magnitude than those between *T. helicoma* and *T. paludosa* or *T. helicoma* and *T. cerea*. Separation of both *T. helicoma* and *T. paludosa* into *Thaxteriella* was contemplated, but the relationship between these and species of *Tubeufia* seems better expressed by arranging them in several sections within one genus. While this manuscript was in preparation, accounts of *Thaxteriella roraimensis* Samuels & Müller (1979) and three species of *Tubeufia* (Samuels et al., 1979) appeared; the discussion of these species further convinced me that the arrangement proposed here is preferable given our present knowledge of these fungi.

In 1909b, von Hühnel erected *Acanthostigmina* for *Lasiosphaeria minuta* Fuckel. He compared this species with *Acanthostigma nectrioideum* Penzig & Sacc., a species with globose-ovoid ascomata and soft brown peridium ornamented with dark setae around the apex. He decided these two were identical and made the combination *A. minuta* (Fckl.) von Hühnel. My study of specimens and slides from the Hühnel Herbarium (FH) shows that they are indeed identical, and also that North American specimens of *Acanthostigma clintonii* (Peck) Sacc. belong to the same taxon. Von Arx and Müller (1975) considered *Acanthostigmina* to be synonymous with *Tubeufia* and I agree. On the other hand, I consider that *Acanthostigmella* von Hühnel with the type species *A. genuiflexa* is different from *Tubeufia* and belongs in the Herportrichiellaceae of the Chaetothyriales (Barr, 1977).

Rossmann (1977) disposed of some of the species excluded from *Ophionectria*, and provided expanded synonymy for *T. cerea* and *T. paludosa*, with the latter the earliest epithet for the type species. Additional information on a number of tropical species was provided by Rossmann (1979), with transfers of species from *Calonectria*, and by Samuels et al. (1979) and Samuels and Müller (1979).

The conidial states associated with several species of *Tubeufia* are striking: often a brightly pigmented -- yellow green, olive green or bright brown -- turf of erect setiform conidiophores arises from decumbent hyphae; the conidiophores bear coiled conidia from either lateral or terminal conidiogenous cells. Linder's (1929) superb renderings of helicosporous Fungi Imperfecti include two species that he recognized with ascosporic states, *Helicosporium nematosporum* Linder with *Lasiosphaeria nematospora* Linder (= *Tubeufia helicoma*) and *Helicoma curtisii* Berk. with *Lasiosphaeria pezizula*, in addition to several species later linked with species of *Tubeufia*. Von Hühnel (1909a) noted a *Helicosporium* conidial state with *T. helicomyces* and Webster (1951) made the cultural connection of *T. helicomyces* with *Helicosporium phragmitis* von Hühnel. Hughes (1958) recognized *Helicoma muelleri* Corda, the type species of *Helicoma*, as a state of *Lasiosphaeria pezizula*, and *Helicosporium vegetum* Nees, the type species of *Helicosporium*, as a state of *Ophionectria cerea*. Booth (1964) described both the *H. vegetum* state of *T. cerea* from natural association and from culture and the *Helicosporium* state of *T. rugosa*. Pirozynski (1972) provided detailed accounts of some variations in conidial states and distinguished between *Helicoma muelleri* conidial state of *Thaxteriella pezizula*, and *Helicosporium pannosum* (Berk. & Curt.) R. T. Moore conidial state of *Tubeufia helicoma*. In *Helicoma muelleri* the conidium develops from a terminal conical denticle or two or three from sympodial succession of the terminal denticle, whereas in *Helicosporium pannosum* and other species of *Helicosporium*, the conidia develop from sympodially proliferating pegs lateral on setiform conidiophores.

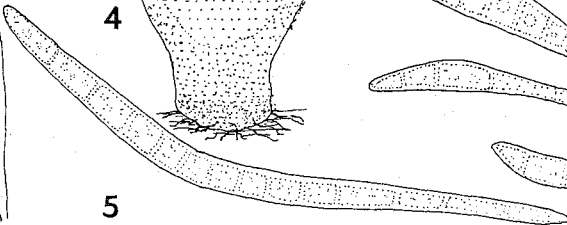
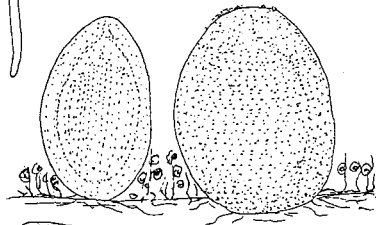
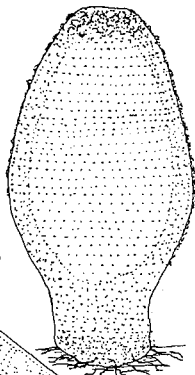
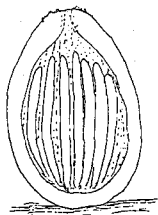
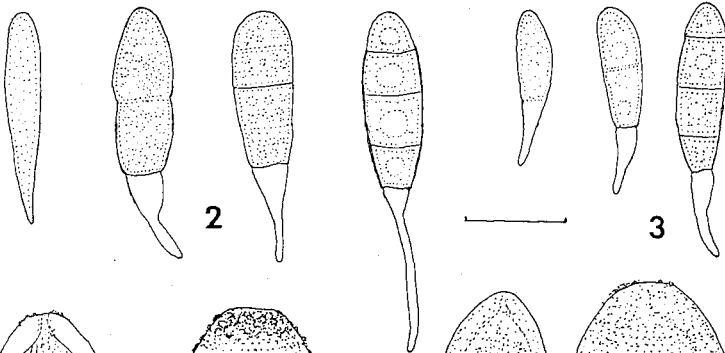
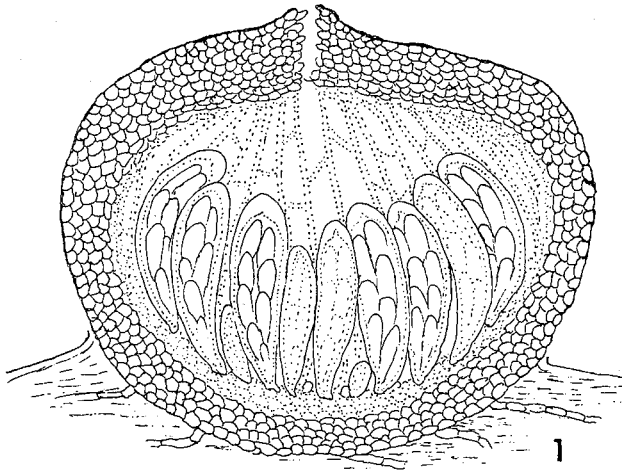
The picture is not that clear, however. Many collections of species of *Tubeufia* bear associated conidial fungi that are neither *Helicoma* nor *Helicosporium*. Hughes (1978) reported a New Zealand species of *Tubeufia* associated with conidiophores and dictyosporous conidia of *Pendulispora venezuelanica* M. B. Ellis. Samuels et al. (1979) described and discussed in some detail tropical collections of *Tubeufia*

amazonensis from which developed a *Monodictys*-like conidial state, and a *Helicomyces*-like, unicellular, hooked rather than coiled conidial state for *Tubeufia palmarum*. Certainly additional studies of collections of *Tubeufia* are required to determine not only variations in conidial states but also the limits of species. The following key to sections and species of *Tubeufia* known in temperate North America outlines my concepts from a study of temperate and some tropical material, as well as information from the literature.

1. Ascomata ellipsoid or cylindric, whitish, pallid or brightly pigmented, blackening on drying; peridium ornamentation when present of hyphae or protruding cells; rarely short setae.....Sect. *Tubeufia*..2
1. Ascomata globose or ovoid.....3
 2. Ascospores 40-55(-65) x 3-5 μm , (6-)7-9-(13-)septate.
T. cylindrothecia
 2. Ascospores (70-)100-200(-230) x (2-)3.5-7(-8) μm ,
up to 35-septate.....*T. paludosa*
3. Ascomata brightly pigmented due to external granules; peridium ornamentation when present of hyphae or protruding cells.....Sect. *Nectrioidea*
One temperate zone species; ascospores (27-)30-52 x 2.5-3.5(-4.5) μm , 7-10-(13-)septate.....*T. cerea*
3. Ascomata vinaceous, grayish or blackish brown pigmented.4
 4. Peridium ornamentation when present of hyphae or protruding cells.....Sect. *Thaxteriella*..5
 4. Peridium ornamentation of dark, thick-walled, tapering setae, rarely reduced to dark protruding cells.....Sect. *Acanthostigmina*..6
5. Ascospores (25-)35-60(-65) x (6.5-)8-12(-13) μm ,
(5-)7-9-(11-)septate.....*T. pezizula*
5. Ascospores (52-)60-100(-130) x 4-6.5(-8) μm , up to
25-septate.....*T. helicoma*
6. Ascospores (19-)32-45(-54) x (2.5-)3.5-5.5(-6) μm ,
7-septate.....*T. clintonii*
6. Ascospores (40-)56-80(-125) x (2-)2.5-3.5(-4.5) μm ,
11-septate.....*T. scopula*

Tubeufia sect. *Tubeufia*

Ascomata ellipsoid or cylindric, hyaline, white, yellowish pinkish or becoming darkened or black at maturity and on drying; peridium smooth or ornamented at apex with protruding cells or short to elongate thick-walled hyphal appendages, rarely with setae, inner region never pigmented, surface cells horizontally elongate.



Type species: *T. paludosa*.

In addition to *T. paludosa* and *T. cylindrothecia*, regarded as variants of one species by Rossman (1977), *T. helicosporium*, *T. pachythrix* (Rehm) Rossman, *T. stromaticola* (P. Henn.) Rossman, and the species briefly described by Hughes (1978) and associated with *Pendulispora venezuelanica*, belong in the section. The first three species are linked with *Helicosporium* conidial states (but see discussion).

Tubeufia paludosa (Crouan & Crouan) Rossman, Mycologia 69: 383. 1977. Figs. 4, 5

Nectria paludosa Crouan & Crouan, Florule du Finistere, p. 38. 1867.

Ophionectria paludosa (Crouan & Crouan) Sacc. Michelia 1: 323. 1878.

Tubeufia javanica Penzig & Sacc. Malpighia 11: 517. 1897.

Tubeufia coronata Penzig & Sacc. Malpighia 11: 517. 1897.

Ascomata vertically elongate, ellipsoid or cylindrical, 165-300 μm diam, 245-330(-550) μm high, light yellowish becoming dull grayish translucent or dull brown, blackened at base; peridium soft, several layers of pseudoparenchymatous cells, 15-18 μm wide; surface glabrous, rugose with protruding cells or bearing short or elongate thick-walled, hyphal appendages, up to 45-115 μm long, 2-4 μm wide, surface cells often in horizontal rows, pigment encrusted on surface in patches. Asci (80-)140-195(-280) x 10-13(-25) μm , elongate cylindrical; pseudoparaphyses narrow cellular. Ascospores elongate clavate, (70-)100-200(-230) x (2-)3.5-7(-8) μm , hyaline, pale yellowish or pinkish, often curved, up to

Figs. 1, 2. *Rebentischia massalongii*: 1. Ascoma in section (Barr 3266). 2. Stages in maturation of ascospores (Barr 6507). Fig. 3. *R. unicaudata*, stages in maturation of ascospores (Rehm Ascom. 241b). Figs. 4, 5. *Tubeufia paludosa*: 4. Outline of ascoma in section (Dumont PA 1709) and surface view (isolectotype of *T. javanica*) showing aspect of horizontally arranged cells and protruding pigment-encrusted cells. 5. Maturing ascospore (Thaxter, Florida) and tip of mature ascospore (Dumont PA 1709). Figs. 6, 7. *T. cylindrothecia*: 6. Outline of ascomata in turf of conidiophores and conidia (Fungi of Bermuda 67). 7. Three ascospores, variation in shape and septation (Dumont CO 1725). Standard line = 60 μm for Fig. 1; 15 μm for Figs. 2, 3, 5, 7; 150 μm for Figs. 4, 6.

35-septate, not constricted at septa, cells containing numerous guttules or homogeneous, wall smooth, often thickened over tips.

On woody substrates or large monocots such as bamboo or palm, often over stromata of other ascomycetes.

Material examined: USA: Massachusetts: Barr 2839a (MASS); Florida: Coconut Grove, R. Thaxter (2 collections, FH). PANAMA: Dumont PA 1838, 1709, 1907 (NY). COLOMBIA: Dumont CO 247 (NY). VENEZUELA: Dumont VE 2993, 3139, 2426, 2577, 2657, 3147, 3974, 5052, 5258, 6462, 6644, 6955 (NY). JAVA: Tjibodas, 5.2.1897, Penzig (Höhnell Herb., FH; isolecotype of *T. javanica*).

Some of these collections grouped under *T. paludosa* may be separated eventually: Samuels et al. (1979) restrict *T. paludosa* to specimens with helicosporeous conidia, and note that Dumont PA 1838 had associated *Monodictys*-like conidia and that a collection from New Zealand produced a *Monodictys*-like state. Dumont PA 1838, macroscopically similar to other collections of *T. paludosa*, is considerably larger and has differently shaped ascomata than *T. amazonensis* Samuels et al. (1979) which also has a *Monodictys*-like state. Dumont VE-3147 was associated with *Pendulispora venezuelanica*, and could be identical with the collection described from New Zealand by Hughes (1978).

Rossmann's (1977) concept of *T. paludosa* encompasses material with shorter ascospores that I separate as *T. cylindrothecia*, as well as the narrow-spored *T. helicomyces* not yet seen from North America. Her synonymy for *T. paludosa* also includes *T. anceps* Penzig & Sacc. (*Ophionectria anceps* (Penzig & Sacc.) von Höhnell). The ascospores were described as 35-42 x 4-5 μ m, but the asci were said to be apophysate in contrast to those of *T. javanica* and *T. coronata* described at the same time. Rossmann (1979) reduced *Calonectria effugiens* Penzig & Sacc. (Malpighia 11: 515. 1897) to synonymy under *T. paludosa*. The ascospores are in the size range of *T. cylindrothecia*, 45-69 x 4.5-5 μ m, but she noted that *Alternaria*- and *Acrوديctys*-like conidia were associated, so this entity too may represent a separate species.

Tubeufia cylindrothecia (Seaver) von Höhnell, Sitzungsber.

Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1,
68: 1479. 1909. Figs. 6, 7

Ophionectria cylindrothecia Seaver, Mycologia 1: 70. 1909.

Ascomata vertically elongate, ellipsoid or elongate ovoid, (135-)165-275(-355) μm diam, (220-)275-385(-440) μm high, pale yellowish, creamy, grayish, or light translucent brownish, darkened at base; peridium soft, several layers of pseudoparenchymatous cells, 15-20 μm wide; surface glabrous or rugose with projecting cells or short setae at apex, pigment encrusted in patches on surface, surface cells often in horizontal rows. Asci (50-)85-140 x 9-15 μm , cylindric clavate; pseudoparaphyses narrow cellular. Ascospores elongate clavate or fusoid, tapering to ends, 40-55(-65) x (2.5-)3-5 μm , often bent or curved, (5-)7-9-(13)-septate, not constricted at septa, contents with numerous guttules or one globule per cell, wall smooth.

Conidial state: *Helicosporium roseum*: Turf white or pinkish, composed of upright setiform conidiophores arising from recumbent hyphae, bearing conidiogenous cells laterally; conidial coils 30-45 μm diam, cells 2-4.5(-5.5) μm wide, several septate.

On old wood or monocot culms and leaves, often over over-mature ascomycetes.

Material examined: USA: Massachusetts: Waverly, 12 Oct 1899, R. Thaxter (FH); Texas: Big Thicket Scenic Area, near Coldspring, San Jacinto Co., 26 Aug 1967, C. T. Rogerson (NY). BERMUDA: Seaver and Waterston, Fungi of Bermuda 61B, 67A, 67C, 83, 406, 408, 410C (NY); B. & J. Dodge, Aug 1911 (NY); Paget Marsh, 16 Jan 22, H. H. Whetzel (NY), same data as Bermuda Fungi (BPI). TRINIDAD: Maraval Valley, Port of Spain, 1912-13, R. Thaxter (FH); Emperor Valley, Port of Spain, 1912-13, R. Thaxter (FH). PANAMA: Valley of upper Rio Chirique Viejo, prov. Chiriqui, 1 Jul 1935, G. W. Martin (BPI, as *T. margarita* ined.). COLOMBIA: Dumont CO 1725, 1998 (NY). VENEZUELA: Dumont VE 2695 (NY).

Ophionectria cylindrothecia was described from Ohio on old corn stalks (Seaver, 1909) but I have not located the collection. Other collections determined by Seaver as this species were those from Bermuda. The collection from Texas is only tentatively assigned to *T. cylindrothecia*. Rogerson obtained the conidial state in culture, noted that conidial coils were small (10-12 μm wide) and only once or twice coiled. The aspect of ascomata and sizes of structures determined my identification.

Tubeufia sect. *Nectrioides* Barr, sect. nov.

Ascomata globosa vel ovoidea, pigmentifera vivide; peridium hyphis vel cellulis protrudentibus ornatum.

Species typica: *T. cerea*.

Tubeufia cerea is the only species of the section recognized from temperate North America. *Tubeufia palmarum* (Torrend) Samuels et al. and *T. aurantiella* (Penz. & Sacc.) Rossman are tropical members of the section.

Samuels et al. (1979) noted that in both *T. cerea* and *T. palmarum* conidia arise from thin-walled pegs that proliferate sympodially and that no apparent scar remains on either the conidium or the conidiogenous peg after dehiscence. *Helicosporium vegetum* is the conidial state of *T. cerea*, whereas that of *T. palmarum* is *Helicomycetes*-like, with conidia one celled and hooked rather than coiled.

- Tubeufia cerea* (Berk. & Curt.) von Hühnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 128: 562. 1919. Figs. 14, 15
- Sphaeria cerea* Berk. & Curt. Grevillea 4: 108. 1876.
- Calonectria cerea* (Berk. & Curt.) Sacc. Syll. Fung. 2: 551. 1883.
- Ophionectria cerea* (Berk. & Curt.) Ell. & Ev. North Amer. Pyrenomycetes, p. 118. 1892.
- Nectria fulvida* Ell. & Ev. J. Mycol. 1: 140. 1885.
- Calonectria fulvida* (Ell. & Ev.) Berl. & Vogl. Addit. Syll. Fung. p. 212. 1886.
- Dialonectria fulvida* (Ell. & Ev.) Ell. & Ev. J. Mycol. 2: 122. 1886.
- Ophionectria briardi* Boudier, Rev. Mycol. p. 226. 1885.
- Ophionectria episphaeria* Karsten, Hedwigia 28: 26. 1889.
- Ophionectria everhartii* Ell. & Galloway, J. Mycol. 6: 32. 1890.
- Calonectria belonospora* Schroet. Krypt. Flora von Schlesien 3: 261. 1894.
- Ophionectria belonospora* (Schroet.) Sacc. Syll. Fung. 11: 366. 1895.
- Ophionectria briardi* var. *longipila* Starbäck, Bot. Not. 218-219. 1898.
- Ophionectria belonospora* var. *unicaudata* Feltgen, Vorstud. Pilz Luxemb. Nachtr. 3: 308. 1903.
- Ophionectria cupularum* Kirschst. Verh. Bot. Vereins Prov. Brandenburg 48: 60. 1906.
- Ophionectria anonae* Rao, Sydowia 25: 72-73. 1971.

Ascomata globose or ovoid, (90-)120-160 μm diam, greenish yellow, dull yellow, yellowish brown; peridium 22-33 μm wide in upper regions, 10-12 μm wide near base, surface usually pulverulent with protruding cells or with short hyphal appendages, 22-33 μm long, pigment as crystalline granules on walls of surface cells. Asci 55-74 x 7.5-12 μm , clavate; pseudoparaphyses narrow cellular. Ascospores elongate fusoid, (27-)30-52 x 2.5-3.5(-4.5) μm , hyaline, often curved, (5-)7-10-(13)-septate, not constricted at septa, cells containing numerous guttules, finally coalescing into one globule, wall smooth.

Conidial state: *Helicosporium vegetum*: Forming bright yellowish-green turf of upright setiform conidiophores, becoming ochraceous or brownish in age; conidiogenous cells produced laterally as thin-walled pegs. Conidia coiled two or three times, multiseptate, coils 10-15(-20) μm diam, cells 1-1.5 μm wide.

On overmature stromata of other Ascomycetes, and on surrounding wood.

Material examined: NORTH AMERICA: CANADA: Newfoundland: Waghorne 755a (NY); Quebec: Barr 2160 (MASS); Ontario: London, 3 Aug 1895, J. Dearness (FH, NY). USA: Maine: Barr 3337, 3359, 3360a, 3363, 5900c (MASS); York, 14 Sep 1891, R. Thaxter (FH, NY); New Hampshire: Barr 4000a (MASS); near Loring, Chocorua, W. G. Farlow (FH); Chocorua, Sep 1906, Aug 1910, Farlow (FH); Waterville, 1 Sep 1935, J. R. Hansbrough (NY); Shelburne, Sep 1889, R. Thaxter (FH, two collections); Vermont: Barr 4465, 4475 (MASS); Massachusetts: Barr 5240, 5199, 6012, 6013 (with *T. clintonii*) (MASS); Harvard Forest, Petersham, 19 Aug 1949, C. T. Rogerson (NY); New York: Camp Arnot, SE of Cayuga, Schuyler Co., 20 Sep 1970, Rogerson & G. J. Samuels (NY); Catskill Mts., Ulster Co., 1 Aug 1974, Rogerson et al. (NY); N. side of Hinckley Reservoir, Herkimer Co., 15 Sep 72, Rogerson et al. (NY); Stony Clove, Greene Co., 12 Oct 1968, Rogerson & S. J. Smith (NY); 4 mi. E. of Maplecrest, Greene Co., 8 Sep 1972, Rogerson & Samuels (NY); trail to Lake Ann, Mt. McGregor, Saratoga Co., 10 Oct 1968, Rogerson & Smith (NY); NE end of Lake Tiorati, Orange Co., 23 Oct 75, Rogerson (NY); Twin Valleys Camp, near Wadhams, Essex Co., 9 Sep 1967, Rogerson (NY); SE of Speculator, Hamilton Co., 4 Aug 1967, Rogerson & Smith (NY); Winnie Hill, N. of Oneonta, Otsego Co., 21 Sep 1963, Rogerson (NY); woods near Tompkins Pond, Dutchess Co., 9 Oct 1965, Rogerson (NY); Ellenville Ice Chasms, Ulster Co., 14 Aug 1963, Rogerson (NY); woods near Eagle Valley,

Orange Co., 28 Jun 60, Rogerson & R. H. Petersen (NY); Pack Demonstration Forest, Warren Co., 25 Sep 1971, Rogerson (NY); same data, Samuels (NY); Indian Pass Trail, Essex Co., 14 Aug 1970, Rogerson et al. (NY); West Canada Creek, Trenton Falls, Herkimer Co., 19 Sep 1969, Rogerson et al. (NY); Lake Sherman, Warren Co., 25 Sep 1971, Samuels (NY); S. J. Smith 45649, 45665 (NY ex NYS); New Jersey: Ellis & Everhart, Fungi Col. 1361 (MASS); Newfield, Oct 1885, J. B. Ellis (NY as *Nectria fulvida*; FH, type of *N. fulvida*); Newfield, 6 Jul 1890, type of *Ophionectria everhartii* (FH); Hutcheson Memorial Forest, Somerset Co., 27 Oct 1970, Rogerson et al. (NY); Michigan: Barr 5388 (MASS); Cross Village, Emmet Co., 24 Jul 1962, Rogerson (NY); Whitehouse Landing Road, Chippewa Co., 25 Jul 1967, Rogerson (NY); near Upper Falls, Tahquamenon State Park, Luce Co., 3 Aug 1964, Rogerson (NY); Rees's Bog, N. of Burt Lake, Cheboygan Co., 9 Aug 1971, Rogerson (NY); Mackinaw City, Emmet Co., 9 Aug 1971, Rogerson (NY); S. of Whitefish Bay, Hiawatha National Forest, Chippewa Co., 11 Aug 1971, Rogerson (NY); Ohio: Ellis & Everhart N.A.F. 2598 (MASS); Illinois: Allerton Park near Monticello, Piatt Co., 15 Aug 1965, Rogerson (NY); Minnesota: Cloquet Forest Research Center, St. Louis Co., 25 Aug 1972, Rogerson (NY); North Carolina: Highlands, Macon Co., 13 Aug 1961, Petersen & Rogerson (NY); Collins Creek, Swain Co., 18 Oct 1960, Rogerson (NY); Utah: Mt. Ogden Park, Ogden, Weber Co., 12 Jun 1971, Rogerson (NY). EUROPE: BELGIUM; ex IMI 68112 (NY); AUSTRIA: Rehm Ascom. 1783 (NY). USSR: Mycotheca Rossica 120 as *Ophionectria belonospora* (BPI, NY).

Tubeufia cerea is the most common north-temperate representative of the genus. This species is readily recognized under low magnification by the yellowish pulverulent ascomata that are globose with a somewhat collabent aspect. Old stromata of *Diatrype stigma* (Hoffm. ex Fries) Fries, *Graphostroma platystoma* (Schw.) Piroz., and species of *Eutypa*, *Eutypella*, and *Hypoxyylon* are the most common substrates, but the species has been collected over other fungi, e.g., *Bertia moriformis* (Tode ex Fries) de Not.

The synonymy for the ascosporic state is essentially that provided by Rossman (1977) while that for the conidial state is taken from Hughes (1958). *Ophionectria palmarum* Torrend is now recognized as a species of *Tubeufia* (Samuels et al., 1979). Rossman (1979) added as probably synonymous with *T. cerea* *Calonectria aurea* Ade (Hedwigia 64: 304. 1923) (non *C. aurea* (Crouan & Crouan) Sacc., 1878).

Munk provided the first "modern" description of *T. cerea* (1957, as *Ophionectria cerea*). Both Barr (in Bigelow and Barr, 1963) and Booth (1964) made the unnecessary combination of *Tubeufia cerea*, without realizing that von Höhnell (1919) had already transferred the species. Booth described and illustrated the species in detail.

Tubeufia sect. *Thaxteriella* (Petraek) Barr, stat. nov.
Thaxteriella Petraek, Ann. Mycol. 22: 63. 1924.

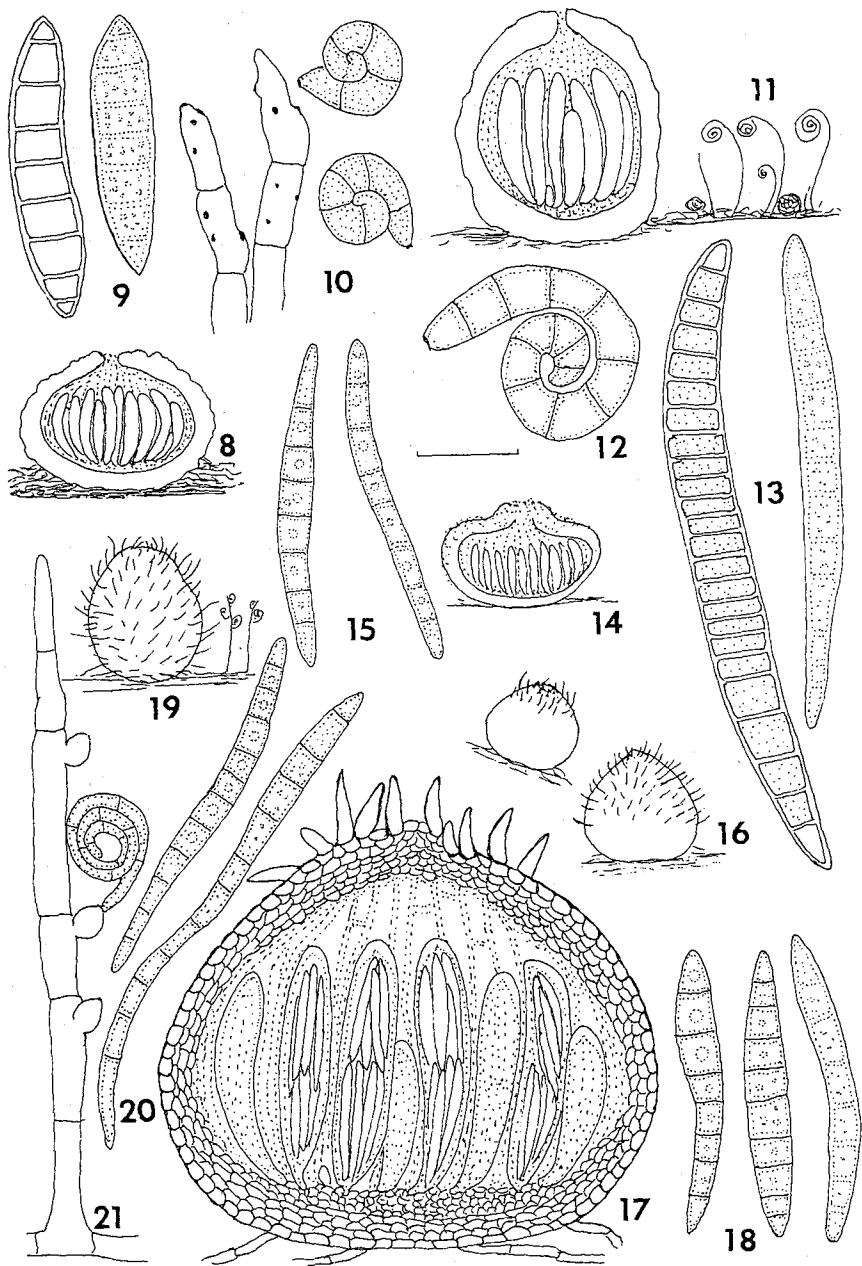
Ascomata globose or ovoid, vinaceous, grayish or blackish brown pigmented; peridium smooth or ornamented with protruding cells or short thick-walled hyphae.

Type species: *Thaxteriella corticola* Petraek (= *Tubeufia pezizula*).

Tubeufia pezizula usually has a well-developed subiculum, ascomata that are collabent when dry, and produces *Helicoma* conidia. The ascospores are shorter and wider than those of *T. helicoma*, in which the subiculum is often poorly developed and the ascomata are not collabent on drying. Other species belonging in this section are *T. amazonensis* Samuels et al., *Thaxteriella roraimensis* Samuels & Müller, and probably *Tubeufia corynespora* Munk. *Thaxteriella indica* Dharme & Müller (Sydowia 23: 77-78. 1970 (1969)) probably belongs here too. This species is similar in aspect to *Tubeufia pezizula* but is larger -- the ascospores are 15-20-septate and measure 60-100 x 9-12 μ m.

The *Helicoma* states of *Tubeufia pezizula* and *Thaxteriella roraimensis* bear at each conidiogenous locus a flat, refractive scar but not an obvious pore, whereas in *Tubeufia paludosa* the locus appears as a refractive, circular, cicatrized scar with a pore in the middle (Samuels and Müller, 1979; Samuels et al., 1979).

Tubeufia pezizula (Berk. & Curt.) Barr, comb. nov. Figs. 8-10
Sphaeria pezizula Berk. & Curt. Grevillea 4: 106. 1876.
Lasio-sphaeria pezizula (Berk. & Curt.) Sacc. Syll. Fung. 2: 195. 1883.
Herpotrichia pezizula (Berk. & Curt.) Ell. & Ev. North Amer. Pyrenomycetes p. 160. 1892.
Thaxteriella pezizula (Berk. & Curt.) Petraek, Sydowia 7: 110. 1953.
Sphaeria helicophila Cooke, Grevillea 6: 145. 1878.
Melanomma helicophilum (Cooke) Sacc. Syll. Fung. 2: 112. 1883.



Byssosphaeria helicophila (Cooke) Cooke, Grevillea 15:
123. 1887.

Thaxteriella corticola Petrak, Ann. Mycol. 22: 63. 1924.

Ascomata globose, (220-)300-450 μm diam, collabent on drying, reddish or vinaceous brown to dull grayish brown or blackish, surface dull or shining, apex with broad blunt pore area; peridium 30-50(-55) μm wide, nearly equal in width throughout, cells large, outer layers vinaceous brown, paler toward interior, surface smooth or roughened by protruding cells with encrusting pigment. Asci 100-145 x 20-32 μm , clavate, pseudoparaphyses narrowly cellular. Ascospores elongate fusoid, (25-)35-60(-65) x (4-)8-12(-13) μm , hyaline, becoming dull yellowish brown in age except end cells remaining hyaline, (5-)7-9-(11-)septate, not constricted at the septa, cell contents minutely guttulate becoming homogenous and refractive, walls smooth.

Conidial state: *Helicoma muelleri* Corda, Icon. Fung. 1:
15. 1837.

Helicosporium muelleri (Corda) Sacc. Michelia 2: 129.
1880.

Helicomycetes muelleri (Corda) Pound & Clements, Bull.
Minnesota Geol. Nat. Hist. Surv. 9: 659. 1896.

Helicoma curtisii Berk. Grevillea 3: 106. 1875.

Helicomycetes curtisii (Berk.) Pound & Clements, Bull.
Minnesota Geol. Nat. Hist. Surv. 9: 659. 1896.

Helicosporium tiliiae Peck, Bull. Torrey Bot. Club 34:
103. 1907.

Figs. 8-10. *Tubeufia pezizula* (Barr 5456): 8. Outline of ascoma in dense subiculum. 9. Ascospores. 10. Tips of conidiophores and two conidia. Figs. 11-13. *T. helicoma*: 11. Outline of ascoma in turf of conidiophores and conidia (Linder 811, type of *Lasiosphaeria nematospora*). 12. Conidium (Linder 811). 13. Ascospores (left, Thaxter, Chile; right Plowright, type of *Sphaeria helicoma*). Figs. 14, 15. *T. cerea*: 14. Outline of ascoma (Barr 5240). 15. Ascospores (Barr 3337). Figs. 16-18. *T. clintonii*: 16. Outline of ascomata (upper, type of *Acanthostigma nectrioideum*, Java; lower, Peck, type of *Sphaeria clintonii*). 17. Ascoma in section (Barr 6013). 18. Ascospores (Peck, type of *Sphaeria clintonii*). Figs. 19-21. *T. scopula*: 19. Outline of ascoma (Ellis, 1880). 20. Ascospores (Peck, type of *Sphaeria scopula*). 21. Conidiophore bearing conidiogenous cells and conidium (Ellis, 1880). Standard line = 60 μm for Fig. 17; 15 μm for Figs. 9, 10, 12, 13, 15, 18, 20, 21); 150 μm for Figs. 8, 11, 14, 16, 19.

Conidiophores arising from recumbent hyphae of subiculum, brown or nearly black; conidia from terminal conidial denticle, or two or three from sympodial succession of terminal denticles; conidia coiled ca. $1\frac{1}{2}$ times, hyaline or light brownish, septate, up to 20 μm wide in coil, cells. ca. 6–8 μm wide, wall smooth.

On dead woody branches or trunks, at times growing over other old Ascomycetes; collected from species of *Acer*, *Alnus*, *Berchemia*, *Castanea*, *Eugenia*, *Liquidambar*, *Populus*, *Prunus*, *Quercus*, *Tilia*, *Vitis*.

Material examined: NORTH AMERICA: CANADA: Ontario: London, J. Dearness (NY); Aurora, 1 Oct 1933, R. F. Cain (NY); USA: Maine: Barr 3568 (MASS); Kittery Point, Aug 1920, R. Thaxter (FH, NY); New Hampshire: Chocorua, Aug 1906, W. G. Farlow (FH); Shelburne, Aug 1891, Thaxter (FH); Intervale, 1901, Thaxter (FH); Massachusetts: Barr 6278 (MASS); Magnolia, July 1903, Farlow (FH); Waverly, Oct 1899, Thaxter (FH); Connecticut: W. C. Sturgis, no data (NY); New Haven, 1888–89, Thaxter (FH); West Haven, 1888–89, Thaxter (FH); New York: Michigan Hollow, near Danby, Tompkins Co., 4 Sep 1952, C. T. Rogerson (NY); New Jersey: Ellis N.A.F. 649 (MASS), 696b (MASS, NY); Ellis & Everhart Fungi Col. 1624 (MASS); Newfield, Apr 1878, 18 Apr 1878, Summer 1878 (FH), Feb 1880, 4 Nov 1887, all J. B. Ellis (NY); Michigan: Barr 5456 (MASS); Pennsylvania: Bethlehem, Oct 1880 (NY); Moshannon Dam, Center Co., 8 Oct 1939, J. W. Sinden (NY); Ohio: Morgan 611 (NY); Preston, 1887, A. P. Morgan (FH); Illinois: Metropolis, Oct 1919, C. J. Humphrey (BPI); Allerton Park near Monticello, Piatt Co., 15 Aug 1965, Rogerson (NY); South Carolina: Ellis N.A.F. 967 (MASS); Georgia: Ellis N.A.F. 696a (MASS, NY); Barr 6448, 6469 (MASS); GA numbers 7515–7523 inclusive (GA); Alabama: Auburn, 11 Jan 1896 (NY), 1 Feb 1896, F. S. Earle & L. M. Underwood (BPI, NY); Jan 1897 (BPI, NY); 16 Jan 1897 (BPI, NY); Florida: GA numbers 7524, 7525, 7526 (GA); Ravenel Fungi Amer. Exs. 196 (FH, NY); Longwood, 9 Feb 1940, C. L. Shear (BPI); Brooksville, 7 Mar 1942, Shear (NPI); Plymouth, 27 Mar 1893, Mar 1895, W. C. Sturgis (NY); Mar 1893 (FH); Louisiana: Barr 6338c (MASS); St. Martinsville, 20 Nov 1890, 19 Apr 1888, A. B. Langlois (FH); Missouri: Comm. Dr. Winter, June 1884 (NY); Rabenhorst-Winter-Pazschke, Fungi eur. 3962 (NY). BERMUDA: Expl. of Bermuda 1413–b, 1437–b, 1528 (NY). JAMAICA: 1909, A. E. Wright (FH). PUERTO RICO: West Indian Expl. 1013 (NY); Dorado, 26 July 1913, J. R. Johnston (NY). GUADELOUPE: Riviere St. Louis, 1902, P. Duss

(NY); GRENADA: Grand Etang, R. Thaxter (NY).

Pirozynski (1972) also described the fungus from Africa, and Goos (1980) reported it from Hawaii.

Linder (1929) described both the ascosporic and conidial states of *Tubeufia pezizula* (as *Lastiosphaeria pezizula* and *Helicoma curtisii*). Hughes (1958) clarified nomenclature of *Helicoma muelleri*, the type species of the genus, and included *Helicosporium tiliae* in synonymy. Pirozynski (1972) added *Helicoma curtisii* to synonymy and provided descriptions and illustrations of variation in both states of the species.

- Tubeufia helicoma* (Phill. & Plowr.) Pirozynski, Mycol. Pap. 129: 30. 1972. Figs. 11-13
Sphaeria helicoma Phill. & Plowr. Grevillea 6: 26. 1877.
Lastiosphaeria helicoma (Phill. & Plowr.) Sacc. Syll. Fung. 2: 192. 1883.
Lastiosphaeria nematospora Linder, Ann. Missouri Bot. Gard. 16: 289. 1929.
Tubeufia rugosa Booth, Mycol. Pap. 94: 13. 1964.

Ascomata globose or ovoid, (130-)180-385 μm diam, (150-)208-550 μm high, light brown, grayish brown, or blackish brown, surface glabrous, pulverulent or rugulose with protruding cells, apex broadly rounded, opening by small pore; peridium of pseudoparenchymatous cells, 26-32 μm wide. Asci 120-200 x 15-25 μm , broadly cylindric, pseudoparaphyses narrow cellular, extending into apical pore region. Ascospores (52-)60-100(-130) x 4-6.5(-8) μm , hyaline or light yellowish, elongate clavate, tapering to ends, more strongly tapering to basal end, (7-)9-15-25-septate, slightly or not constricted at septa, cell contents multiguttulate, in one or two parallel fascicles in the ascus.

Conidial state: *Helicosporium pannosum* (Berk. & Curt.)

R. T. Moore, Mycologia 49: 582. 1957.

Drepanospora pannosa Berk. & Curt. apud Berk. Grevillea 3: 105. 1875.

Helicosporium serpentinum Linder, Ann. Missouri Bot.

Gard. 16: 288. 1929.

Helicosporium nematosporum Linder, Ann. Missouri Bot.

Gard. 16: 288. 1929.

Helicosporium elinorae Linder, Ann. Missouri Bot. Gard.

16: 290. 1929.

Turf brown, conidiophores arising from recumbent hyphae; conidia coiled, coils (35-)45-60(-100) μm diam, cells 4.5-8

μm wide. Also present in some collections dark brown, muriform, globular "conidia," 32-40 μm diam, in the turf (perhaps initials of ascomata).

On dead, decaying woody branches and logs, on sawdust, and on large monocot culms.

Material examined: NORTH AMERICA: USA: Louisiana: Honey Island Swamp, near Pearl River, St. Tammany Parish, 6 Jun 1976, S. J. Hughes (rotten log) (NY, ex DAOM 155883). SOUTH AMERICA: BRITISH GUIANA: Plantation Vryheid, Demerara River, 2 Feb 1924, D. H. Linder 881 (two collections, type of *Lasiosphaeria nematospora* according to labels, FH); Reliquiae Farlowianae 842, same collection data, on sheaths of manicole palm (*Euterpe* sp.) (FH, NY); Botanic Garden, Georgetown, 4 Oct 1923, Linder 236, palm sheath (with slide, FH). CHILE: Corral, Dec 1905, 1905-1906, R. Thaxter, on decorticated wood (FH, two collections). EUROPE: ENGLAND: Sphaeriacei Britannici III, 53 (C. B. Plowright), Brandon, Nov 1876, on sawdust (isotype, NY).

Pirozynski (1972) recorded collections from Tanzania and New Zealand, while Hughes (1978) added a number of collections from New Zealand, reporting that it was a common species in that country. Goos (1980) reported the fungus from Hawaii.

Linder (1929) described the ascospores of *Lasiosphaeria nematospora* as 45-58 x 3.1-3.6 μm and 5-11-septate, but in the authentic material that I examined they measured 100-130 x 4-5 μm and were up to 25-septate. While Pirozynski included *Helicosporium elinorae* as one of the synonyms of the conidial state of *Tubeufia helicoma*, he observed that *Lasiosphaeria elinorae* is indeed a species of *Lasiosphaeria*. Pirozynski (1972) described *T. helicoma* in detail, and suggested that *Helicosporium viride* (Corda) Sacc. and its synonymous names were probably identical with *H. pannosum*; presumably also *H. indicum* P. R. Rao & D. Rao and *H. nizamabadense* P. R. Rao & D. Rao (Mycopathol. Mycol. Appl. 24: 27-34. 1964) are variants of the same fungus.

Tubeufia sect. *Acanthostigmia* (v. Hhnel) Barr, stat. nov.
Acanthostigmia v. Hhnel, Sitzungsber. Kaiserl. Akad.
 Wiss., Math.-Naturwiss. Cl., Abt. 1, 118: 1499.
 1909.

Ascomata globose or ovoid, vinaceous or dark brown

pigmented; peridium ornamented with dark brownish-black setae.

Type species: *Sphaeria clintonii* Peck.

Tubeufia clintonii and *T. scopula* are similar in aspect and differ from other species in *Tubeufia* by the presence of dark setae on the ascomata. The peridium, however, is soft and vinaceous tinged, similar to peridia in species of sect. *Thaxteriella*. The two species are readily separated by ascospore sizes. No conidial state has been associated with certainty with *T. clintonii*, but a *Helicosporium* state, agreeing with *H. aureum*, is associated with ascomata in several collections of *T. scopula*.

Tubeufia clintonii (Peck) Barr, comb. nov. Figs. 16-18

Sphaeria clintonii Peck, Ann. Rep. New York State Mus.
30: 65. 1878 (for 1876).

Acanthostigma clintonii (Peck) Sacc. Syll. Fung. 2: 210.
1883.

Lasiosphaeria minuta Fuckel, Symb. Mycol. p. 148. 1870.

Acanthostigma minuta (Fckl.) Sacc. Syll. Fung. 2: 209.
1883.

Acanthostigmia minutum (Fckl.) v. Hühnel, Sitzungsber.
Kaiserl. Akad. Wiss. Math.-Naturwiss. Cl., Abt. 1,
118: 1499. 1909.

Acanthostigma nectroidewum Penzig & Sacc. Icon. Fung.
Javanicorum, p. 18. 1904.

Ascomata globose or ovoid, 90-180(-240) μm diam, grouped or scattered on thin brown subiculum, with broad apex; peridium bright brown with vinaceous tinge, velvety over entire surface or around apex only with dark brown, stiff, pointed setae, (10-)30-90(-104) μm long, 4.5-6(-7.5) μm wide near base. Asci 50-90(-100) x (11-)13-20 μm , pseudoparaphyses narrow cellular. Ascospores (19-)32-45(-54) x (2.5-)3.5-5.5(-6) μm , elongate fusoid, often curved or bent, hyaline to light yellowish brown, (2-)5-7-(11-)septate, not constricted at septa, cell contents minutely guttulate, wall smooth.

Conidial state not known with certainty; a collection from New Jersey bears conidiophores from peridium of the ascomata and from basal subiculum. The conidiophores have lateral inflated cells. A few coiled conidia are present, coils ca. 30 μm diam, cells ca. 5 μm wide.

On rotting wood of deciduous trees, over old ascomycete stromata.

Material examined: NORTH AMERICA: CANADA: Quebec: Fabius 7230 (MASS); Ontario: Cattle Island, Lake Timagami, 8 Sep 1933, R. F. Cain (FH, NY). USA: New Hampshire: Shelburne, Aug 1894, W. G. Farlow (FH); Massachusetts: Barr 6013 with *T. cerea* (MASS); New York: Buffalo, Erie Co., Nov, G. W. Clinton ("Alden" in protolog) (type of *Sphaeria clintonii*, NYS); Michigan Hollow, Tompkins Co., 12 May 1947, J. Natti (NY); New Jersey: Newfield, 25 Mar 1889, J. B. Ellis (NY); Louisiana: St. Martinsville, 1 Jan 1890, A. B. Langlois (FH, Flora Ludoviciana 2243). BRITISH WEST INDIES: Grand Etang, Grenada, 1912-13, R. Thaxter (FH). SOUTH AMERICA: VENEZUELA: Dumont VE 2695 part (NY). EUROPE: Rehm Ascom. 1568; Sonntagsberg, 1906, Strasser (as *Acanthostigma minutum*, v. Hhnel Herb. in FH). ASIA: JAVA: Tjibodas, 1897, v. Hhnel (two slides in v. Hhnel Herb. in FH, as *A. nectrioideum*).

The specimens that von Hhnel (1909b) referred to in erecting *Acanthostigmia* are identical with North American collections. Although Fuckel's *Lasiosphaeria minuta* is the oldest name, the epithet cannot be utilized in *Tubeufia* because of *T. minuta* Munk (1966).

- Tubeufia scopula* (Cooke & Peck) Barr, comb. nov. Figs. 19-21
Sphaeria scopula Cooke & Peck, Ann. Rep. New York State Mus. 32: 51. 1880. "1879" (for 1878).
Acanthostigma scopula (Cooke & Peck) Peck, Bull. New York State Mus. 1(2): 22. 1887.
Lasiosphaeria scopula (Cooke & Peck) Sacc. Syll. Fung. 9: 852. 1891.

Ascomata globose conic or ovoid, 165-280(-385) μm diam, covered thickly with dark, nonseptate setae, 37-90 μm long, 4.5-7.5 μm wide near base; peridium vinaceous brown, relatively soft, pseudoparenchymatous, 27-32 μm wide. Asci 67-100(-130) x 11-15(-22) μm , oblong, pseudoparaphyses narrow cellular. Ascospores (40-)56-80(-125) x (2-)2.5-3.5(-4.5) μm , hyaline, elongate fusoid, often bent or slightly curved, (6-)11-(13-)septate, not constricted at septa, cell contents minutely guttulate, wall smooth.

- Associated conidial state: *Helicosporium aureum* (Corda) Linder, Ann. Missouri Bot. Gard. 16: 279. 1929.
Helicomycetes aureus Corda, Icon. Fung. 1: 9. 1837.
Helicosporium pilosum Ell. & Ev. Bull. Torrey Bot. Club 24: 476. 1877.
 ? *Helicosporium olivaceum* Peck, Ann. Rep. New York State Mus. 27: 102. 1875 (for 1873).

Turf yellowish to olivaceous green, becoming dull brown, conidiophores elongate from recumbent hyphae, 390-600 μm long, 5.5-7.5 μm wide below and tapering to 2 μm wide above; conidiogenous cells lateral, inflated and bladderlike, 5.5 x 5.5-10 μm . Conidia pale yellowish in mass, coiled three times, coil 16-25 μm wide, cells 1-2.5 μm wide.

On decorticated coniferous wood, rarely on wood of deciduous trees.

Material examined: NORTH AMERICA: USA: New York: Adirondack Mts., Aug 1878, C. H. Peck (type of *Sphaeria scopula*, NYS); Knowersville, Albany Co., July, Peck (NYS); New Jersey: Newfield, Oct 1880, J. B. Ellis (two collections, NY); Newfield, Sep 1878, Ellis (FH); 1877, Ellis (NY); Ellis N.A.F. 125 of *Helicosporium olivaceum* (MASS); Florida: Grasmere, 30 Mar 1893, W. C. Sturgis (two collections, FH, NY); Louisiana: Ellis N.A.F. 184; Langlois Flora Ludoviciana 661 (FH, NY); Alabama: Tuskegee, 26 Aug 1901, G. W. Carver (FH). EUROPE: AUSTRIA: Wiener Wald, 21 May 1903, V. Hühnel (v. Hühnel Herb. in FH).

Tubeufia scopula is usually collected on coniferous substrates. The species has larger sizes than *T. clintonii* but otherwise is closely related.

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