
Pyrenomycetes of the Great Smoky Mountains National Park. I. *Diatrype* Fr. (*Diatrypaceae*)

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Ten species of *Diatrype* are reported from the Great Smoky Mountains National Park in the eastern United States. Nine of these are new records for the Park and two (*D. atlantica* and *D. montana*) are described as new species. Descriptions and a key to all of the species of *Diatrype* now known from the Park are provided.

Key words: Ascomycotina, new species, Southern Appalachians, taxonomy, temperate forests.

Introduction

In the most recent edition of the Dictionary of the Fungi (Kirk *et al.*, 2001), the genus *Diatrype* Fr. was listed as comprising 56 species. This number corresponds exactly to the figure given in the monograph by Rappaz (1987b) that is the most comprehensive recent study of the genus. The earlier treatment of *Diatrype* by Berlese (1900) included approximately the same number of species, but the latter is rather outdated and some of the species considered clearly do not belong in the genus *Diatrype*. For example, the taxon treated as *Diatrype tristicha* De Not. by Berlese is a diaporthalean fungus and thus is more correctly recognized as *Valseutypella tristicha* (De Not.) Höhn. However, Berlese's monograph does provide excellent illustrations for many of the valid members of the genus.

The concept of *Diatrype* as delimited by Rappaz (1987b) is somewhat problematic, with in some instances no clear separation between this genus and either *Eutypa* Tul. & C. Tul. or *Eutypella* (Nitschke) Sacc. To cite an example, he treats *Diatrype acericola* De Not. as a member of *Eutypella*, while *Eutypa flavovirens* (Per.: Fr.) Tul. & C. Tul. is considered as belonging to *Diatrype*. His key to the diatrypaceous genera is inconsistent in its application of the

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characters used to distinguish taxa and, as a result, members of *Diatrype* are distributed among several taxonomic assemblages. In one instance Rappaz (1987b) characterizes members of the assemblage that contains *Diatrype* and *Eutypella* as having ‘perithecia collected in pustules of definite shape, while ostioles in groups or not; or perithecia variably aggregated but in this case ostioles in groups and beaks are relatively long (more than the diam. of a perithecium); often in bark’ but then goes on to indicate that another assemblage consisting of *Diatrype*, *Eutypa*, *Cryptosphaeria* has ‘perithecia regularly arranged; distant from each other or close and compressed; [stromata] discrete or widely effuse and less erumpent; ostioles separate; in wood or bark’ (Rappaz, 1987b, p. 310, our translation from the original French). The concept of *Diatrype* adopted herein restricts the genus to those forms with compact or widely effused stromata that do not penetrate host tissues (as is the case in *Eutypa*, *Eutypella* and *Cryptosphaeria*) but are usually erumpent from the bark tissues as pure mycelial masses with separate ostioles on the surface.

There are few publications on the genus *Diatrype* for most regions of North America. Glawe and Rogers (1984) reported six species from the states of Idaho, Oregon and Washington in the Pacific Northwest, and two species [or more exactly three, since *Diatrype platystoma* (Schwein.: Fr.) Berk. was indicated as a synonym of *D. stigma* (Hoffm.: Fr.) Fr.] were reported for Iowa by Tiffany and Gilman (1965). Prior to the study reported herein, only *Diatrype virescens* (Schw.) Curt. was known from the Great Smoky Mountains National Park (Petersen, 1979).

The present paper represents the first in a series of publications on the Pyrenomycetes of the Great Smoky Mountains National Park (GSMNP) in western North Carolina and eastern Tennessee. The specimens upon which the paper is based were collected during a six-week period from late March to early May 2002 and are deposited in the herbarium (VLA) of Institute of Biology and Soil Science, Vladivostok, Russia.

Taxonomy

Diatrype Fr., Summa Veget. Scand., p. 384, 1849.

Type species: Diatrype stigma (Hoffm.: Fr.) Fr.

Stromata widely effuse or verrucose, flat or slightly convex, with discoid or sulcate ostioles at the surface. *Perithecia* mostly in one layer, but sometimes polystichous. *Asci* clavate, 8-spored, usually with long stalks, paraphysate. *Ascospores* allantoid, hyaline or brownish.

Key to species of *Diatrype* known from GSMNP

1. Stromata diatrypelloid, discoid to pulvinate, on *Fagus*..... *D. virescens*
1. Stromata widely and indefinitely effuse..... 2
2. Stromata thin, widely effuse, with sterile margins, developing within bark parenchyma 3
2. Stromata more strongly developed, erumpent from bark parenchyma..... 8
3. Ostioles non-sulcate, on *Quercus*..... *D. atlantica*
3. Ostioles sulcate 4
4. Ascospores 5-8 µm long 5
4. Ascospores 8-12 µm long *D. montana*
5. Ostioles low, faintly stellate 6
5. Ostioles higher, cone-shaped 7
6. Stromata with thin and dark line at margins, on *Fagus*..... *D. decorticata*
6. Stromata without such a line, with steeper margins, on *Quercus*..... *D. stigmaoides*
7. Stromata with sloping margins and rather scattered ostioles, on *Acer*..... *D. spilomea*
7. Stromata with steeper margins and more dense ostioles, on *Betula*..... *D. undulata*
8. Ostioles non-sulcate *D. platystoma*
8. Ostioles sulcate 9
9. Stromata more or less flat, although rather thick, with low sulcate ostioles *D. subaffixa*
9. Stromata strongly convex and folded, densely beset with cone-shaped ostioles.... *D. rappazii*

***Diatrype atlantica* Lar. N. Vassiljeva, sp. nov.** (Figs. 1, 11)

Etymology: referring to the region of the United States where the species was found.

Stromata late effusa, applanata, theobromina, circiter 1 mm crassa. *Perithecia* monostycha, ovoidea, ostiolis discoideis and applanatis praedita. *Asci* clavati, p. sp. 30-40 × 4-6 µm. *Sporidios* allantoideis, hyalinis, (6)7-9(10) × 1.5 µm.

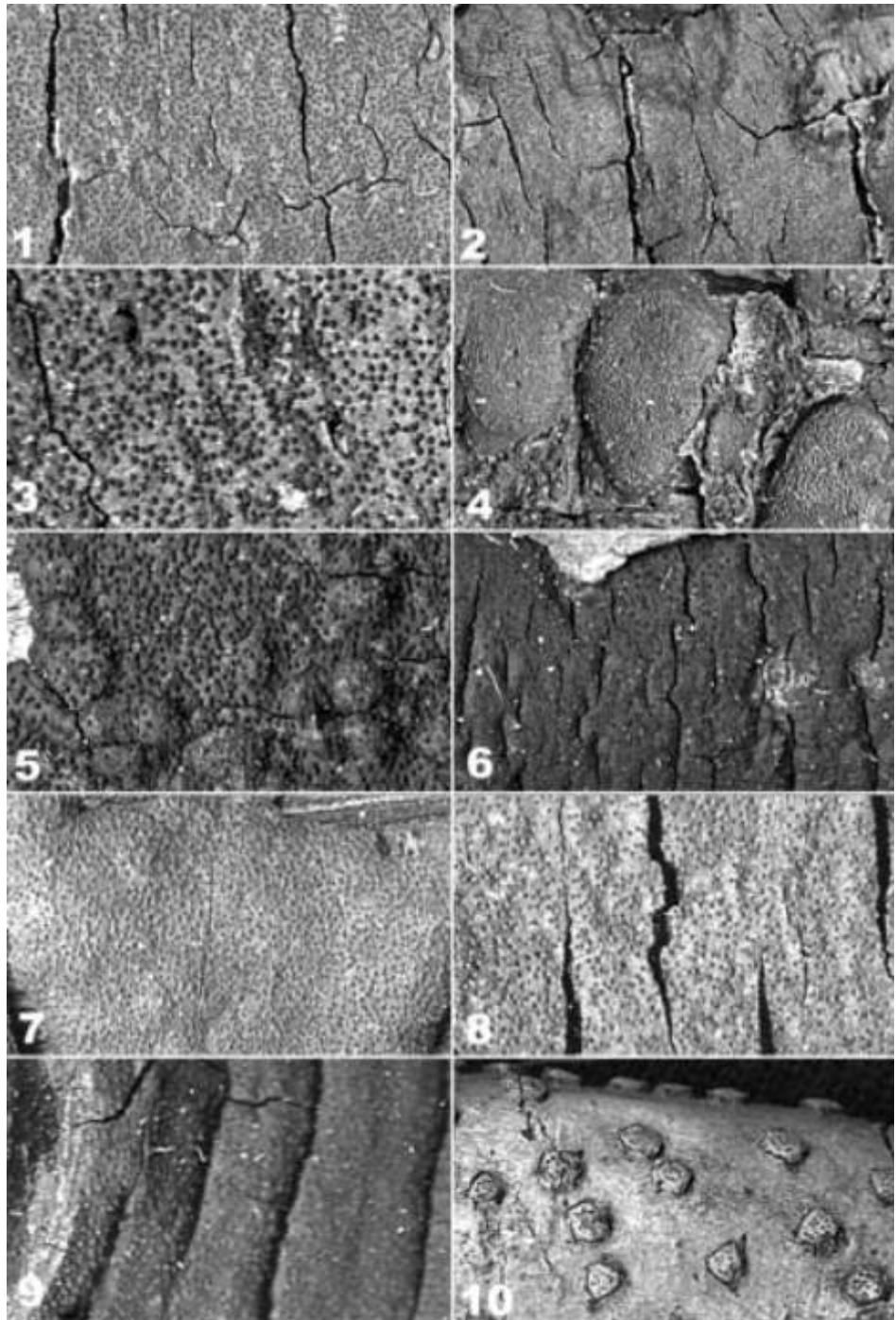
Type in ramis emortuis *Quercus* sp., America borealis, Thutmont vicinity, in veridario Catoctin Montis, Aprilis 27, 1997, Lar. N. Vassiljeva, in Instituto Edapho-Biologico Sectionis Extremi-Orientis Russ. Acad. Sci. (Vladivostok) conservatur.

Habitus *D. decorticata* (Pers.: Fr.) F. Rappaz similis est, sed ostiolis discoideis differt.

Stromata widely effuse, sometimes surrounding twigs, flat, chocolate coloured, about 1 mm thick, with shallow discoid or ring-like ostioles at the surface. *Perithecia* in a single layer, ovoid. *Asci* clavate, p. sp. 30-40 × 4-6 µm. *Ascospores* allantoid, hyaline, (6)7-9(10) × 1.5 µm.

Holotype: USA, Maryland, near Thutmont, Catoctin Mountain Park, on dead branches of *Quercus* sp., 27 April 1997, Larissa N. Vasilyeva, Institute of Biology and Soil Science, Far East Branch of the Russian Far East, Vladivostok (VLA).

Notes: The stromata of *D. atlantica* on *Quercus* spp. are superficially very similar in appearance to those of *D. decorticata* on *Fagus*. Both



Figs. 1-10. Stromata of species of *Diatrype* known from GSMNP. **1.** *D. atlantica*. **2.** *D. decorticata*. **3.** *D. montana*. **4.** *D. platystoma*. **5.** *D. rappazii*. **6.** *D. spilomea*. **7.** *D. stigmaoides*. **8.** *D. subaffixa*. **9.** *D. undulata*. **10.** *D. virescens*.

sometimes form a thin glaze-like covering over the substrate upon which they occur. However, those of the former species differ in having discoid or ring-like ostioles. *Diatrype atlantica* differs from *D. platystoma* (also with discoid, although more prominent, ostioles) in the same manner that *D. decorticata* differs from *D. undulata*, namely in having thinner stromata and shallow ostioles that are stellate and not so prominent. Judging from the photographs provided in the paper by Pirozynski (1974), it seems likely that figures 3 and 6 represent *D. atlantica*, while figures 4 and 7 illustrate *D. platystoma*.

Material examined: *Diatrype atlantica* was found for the first time in the U.S. National Fungus Collections (Beltsville) among specimens of *Diatrype stigma* (Hoffm.: Fr.) Fr. (BPI 577825, 578480, 578499, 578505, 578506, 578722, 578730, 578741). The characteristic chocolate colored stromata with ring-like ostioles, restriction to *Quercus* spp., and a distribution apparently limited to the eastern United States were the most important features that distinguished this new species from *D. stigma*. The distribution suggested the name for *D. atlantica*; it appears to be absent in the western ('Pacific') states.

Localities in GSMNP: Twin Creeks; Purchase Knob; Cades Cove (Schoolhouse Gap Trail; Scott Mountain Trail).

Diatrype decorticata (Pers.: Fr.) F. Rappaz, Mycol. Helvetica, 2: 398 (1987).
(Figs. 2, 12)

Sphaeria stigma Hoffm. var. *decorticata* Pers., Syn. Meth. Fung., p. 21 (1801).

Sphaeria decorticata (Pers.) DC. in DC. & Lamarck, Fl. Franç., 3: 289 (1805).

Sphaeria stigma Hoffm. var. *decorticata* Pers.: Fr., Syst. Mycol., 2: 350 (1823).

Stromatosphaeria decorticata (Pers.: Fr.) Grev., Fl. Edin., p. 357 (1824).

Diatrype stigma (Hoffm.: Fr.) Fr. var. *decorticata* (Pers.: Fr.) Fr., Summa Veget. Scand., p. 385 (1849).

Illustration: Chlebicki and Krzyzanowska, 1995, fig. 1F.

Stromata effuse, irregular, immersed in the bark parenchyma, exposed only with upper pallid- or deep-brown surface covered by low stellate ostioles; black entostromatic columns extending into the lower bark. *Asci* p. sp. 30-40 × 4-6 µm. *Ascospores* hyaline, 6-8 µm long.

Habitat: On dead branches of *Fagus grandifolia* Ehrh.

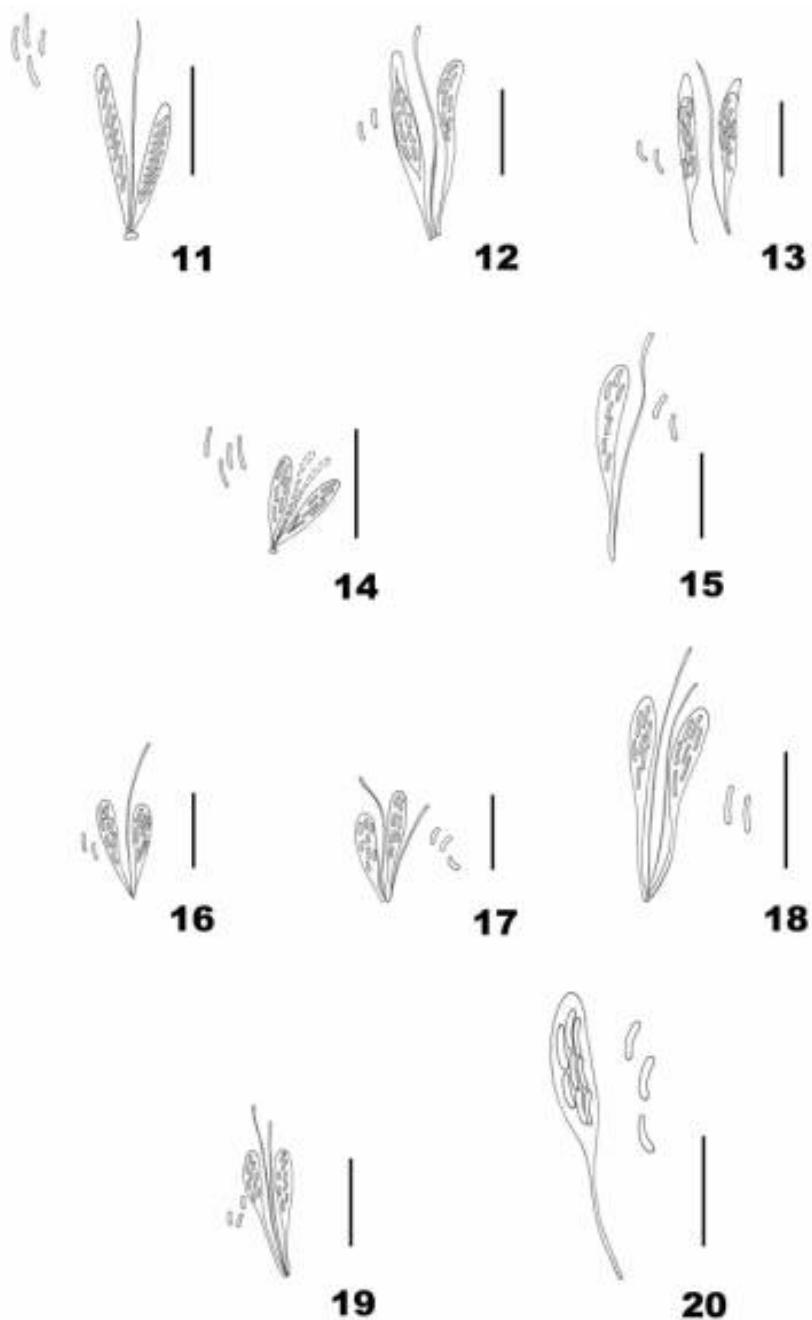
Localities in GSMNP: Cosby (Cosby Creek); Greenbrier (Porters Creek Trail); Cataloochee (Pretty Hollow Gap Trail); Purchase Knob (Hemphill Bald Trail).

Diatrype montana Lar. N. Vassiljeva, sp. nov. (Figs. 3, 13)

Etymology: referring to the mountains in which the specimen was collected.

Stromata late effusa, irregulares, cortex interior innata, pallide vel atro brunnea, tota superficie ostioli conici et sulcati obiecta, linea nigra substrato adsunt. *Asci* clavati, p. sp. 30-35 × 6-7 µm. *Sporidiis* allantoideis, hyalinis, 8-12 × 1.5 µm.

Typus in ramis emortuis indeterminatus, America borealis, in verdario Smoky Mountains, Martius 29, 2002, Lar. N. Vassiljeva, in Instituto Edapho-Biologico Sectionis Extremi-Orientis Russ. Acad. Sci. (Vladivostok) conservatur.



Figs. 11-20. Asci and ascospores of species of *Diatrype* known from GSMNP. **11.** *D. atlantica*. **12.** *D. decorticata*. **13.** *D. montana*. **14.** *D. platystoma*. **15.** *D. rappazii*. **16.** *D. spilomea*. **17.** *D. stigmaoides*. **18.** *D. subaffixa*. **19.** *D. undulata*. **20.** *D. virescens*. Bars = 20 μm .

Habitus *D. decorticata* (Pers.: Fr.) F. Rappaz similis est, sed ostiolis and ascospores majoribus differt.

Stromata widely effuse, irregular, immersed in bark parenchyma, exposed only with upper pallid- or deep-brown surface densely covered by rather high sulcate ostioles, with a black zone in substrate. *Asci* p. sp. $30-35 \times 6-7 \mu\text{m}$. *Ascospores* hyaline, $8-12 \times 1.5 \mu\text{m}$.

Holotype: USA, Tennessee, the Great Smoky Mountain National Park [Cosby (Snake Den Ridge Trail)], on dead branches of undetermined tree, March 29, 2002, Larissa N. Vasilyeva, Institute of Biology and Soil Science, Far East Branch of the Russian Far East, Vladivostok (VLA).

Notes: *Diatrype montana* is superficially similar to *D. decorticata*. Rappaz (1987b) indicated that *D. concolor* (Schwein.) Cooke, a species known from the eastern United States, is also similar to *D. decorticata*, but *D. montana* differs from both in having larger ascospores and more prominent ostioles.

Diatrype platystoma (Schwein.: Fr.) Berk., Grevillea, 4: 95, 1876. (Figs. 4, 14)

Sphaeria platystoma Schwein., Schrift. Nat. Ges. Leipzig, 1: 31 (1822).

Sphaeria platystoma Schwein.: Fr., Syst. Mycol., 2: 351 (1823).

Valsa platystoma (Schwein.: Fr.) Kuntze, Rev. Gen. Pl., 3: 540 (1898). *Graphostroma platystoma* (Schwein.: Fr.) Piroz. Can. J. Bot., 52: 2131 (1974).

Illustrations: Berlese, 1900, Tab. CXXIII; Pirozynsky, 1974, fig. 4, 7.

Stromata widely effuse, brown but often looking like black velvet due to the tightly crowded, black and discoid ostioles at their surface. *Asci* elongated, $30-40 \times 4-6 \mu\text{m}$. *Ascospores* (5)7-10 μm long.

Habitat: On dead branches of *Acer* spp.

Localities in GSMNP: Cosby (Appalachian Trail; Big Creek Trail; Gabes Mountain Trail; Lower Mt. Cammerer Trail; Snake Den Ridge Trail); Purchase Knob (Hemphill Bald Trail).

Notes: *Diatrype platystoma* was segregated out into the genus *Graphostroma* by Pirozynski (1974), primarily on the basis of an association with the *Nodulisporium* conidial state that is characteristic of the *Xylariaceae*. Some peculiarities of the asci and ascospores also were mentioned but only in comparison with *Xenotypa*, which belongs in the *Diaporthales*. The differences between *Diatrype* and *Xenotypa* (as members of different orders) actually exist, but asci and ascospores in *Diatrype platystoma* do not differ from those found in other species of *Diatrype*. In addition, Pirozynski lumped what are clearly two different species (*D. platystoma* and *D. atlantica*) under a single name.

Barr (1985: 561) placed *Graphostroma* in the *Calosphaerales*, and this disposition was ‘based in particular upon the centrum which is entirely similar to that in species of *Romellia* and *Calosphaeria*, as well as others in the order. This is a major diagnostic character that separates the order from the *Xylariaceae* and *Diatrypaceae*’. However, the centrum of *Diatrype platystoma*

is not entirely similar to that of the calosphaeriaceous fungi, although both have ascii and their associated paraphyses forming a kind of rosette.

The observation has been made that the organization of ascogenous hyphae, croziers, ascii and paraphyses of diatrypaceous fungi (for example, *Diatrype stigma*) is similar to the pattern observed in *Calosphaeria* and *Graphostroma* (Samuels and Candoussau, 1996: 54), but calosphaeriaceous fungi are usually illustrated as having ascii in a peculiar sympodial arrangement with broad, longer than the ascii, band-like paraphyses (Barr, 1985; Romero and Minter, 1988). *Diatrype platystoma* does not possess this sympodial type and is characterized by fasciculate ascii, which are typical for the *Diatrypaceae*.

Recently, Barr *et al.* (1993) suggested that *Graphostroma platystoma* was an anomalous member of the *Calosphaeriales*, and a family of its own, namely the *Graphostromataceae*, was created. It is interesting to note that the characters of the anamorph that served as the basis for the segregation of *Diatrype platystoma* into the separate genus *Graphostroma* (Pirozynski, 1974) are now recognized as shared in common with diatrypaceous fungi. Samuels and Candoussau (1996: 56) indicated that ‘The *Graphostromataceae* also shares characters of the *Diatrypaceae*, most notably the anamorph’ and conidiogenesis in *Nodulisporium* is consistent with that found in the *Diatrypales* (G. Samuels, pers. comm.). In such a case, there are no significant differences between the *Graphostromataceae* and the *Diatrypaceae*, and their names should be synonymous.

***Diatrype rappazii* (Chleb.) Lar. N. Vassiljeva, comb. nov.** (Figs. 5, 15)

Diatrype subaffixa (Schwein.) Cooke var. *rappazii* Chleb. in Chlebicki & Krzyzanowska, Sydowia, 47: 24 (1995).

Illustrations: Chlebicki and Krzyzanowska, 1995, fig. 1C, 6C-D, 7A, 9A.

Stromata strongly convex, cushion-like and folded, brown, beset with conical and black, slightly sulcate ostioles. *Asci* p. sp. 26-30 × 6-8 µm. *Ascospores* (7)8-10 µm long.

Habitat: On dead branches of *Acer* sp.

Locality in GSMNP: Purchase Knob (Hemphill Bald Trail).

Notes: This species was described as a variety of *D. subaffixa* by Chlebicki and Krzyzanowska (1995), who reported it only from Poland. However, the stromata in our specimen are very characteristic and differ from all other species of the genus. They are remarkably similar to stromata of *D. subaffixa* var. *rappazii* illustrated in the photograph (l.c., fig. 1C) provided in the paper by Chlebicki and Krzyzanowska (1995).

Fungal Diversity

Diatrype spilomea Syd. in Smarods, Fungi latv. exs., N 149, 1934. (Figs. 6, 16)

Illustration: Rappaz, 1987b, fig. 6D.

Stromata effuse, black, with sloping margins and scattered cone shaped and sulcate ostioles; black entostromatic columns extending into the lower bark. *Asci* 25-30 × 4-6 µm. *Ascospores* 5-7 µm long.

Habitat: On dead branch of *Acer* sp.

Locality in GSMNP: Cades Cove (Scott Mt. Trail).

Diatrype stigmaoides Kauffman, Pap. Mich. Acad. Sci., Arts Let., 11: 166 (1930). (Figs. 7, 17)

Illustration: Rappaz, 1987b, fig. 6E.

Stromata widely effuse, irregular, brown, with numerous conical and sulcate ostioles at the surface and black ventral zone within the substrate. *Asci* clavate, p. sp. 25-30 × 5-6 µm. *Ascospores* biseriate, almost hyaline, or slightly smoky, 5-7 µm long.

Habitat: On dead branches of *Quercus* spp.

Localities in GSMNP: Cosby (Low Gap Trail); Cades Cove (Scott Mountain Trail).

Notes: The collection from the Great Smoky Mountains National Park is first record of *D. stigmaoides* from eastern North America. The species was previously known only from western regions of the United States (Glawe and Rogers, 1984; Rappaz, 1987b).

Diatrype subaffixa (Schwein.) Cooke, Grevillea, 12: 5, 1883. (Figs. 8, 18)

Sphaeria subaffixa Schwein., Trans. Amer. Philos. Soc., ser. 2, 4: 194 (1832).

Nummularia subaffixa (Schwein.) Sacc., Syll. Fung., 1: 401 (1882).

Illustrations: Rappaz, 1987b, fig. 6F; Chlebicki and Krzyzanowska, 1995, figs. 1A-B, 2A-C, 3B, 4, 5, 6A-B, 9B.

Stromata widely effuse, thick, brown, with prominent, dark, sulcate ostioles at the surface. *Asci* 30-40 × 4-6 µm. *Ascospores* (7)8-10(11) µm long.

Habitat: On dead branches of unidentified trees.

Localities in GSMNP: Cosby (Snake Den Ridge Trail; Lower Mt. Cammerer Trail)

Diatrype undulata (Pers.: Fr.) Fr., Summa Veget. Scand., p. 385, 1849.

(Figs. 9, 19)

Sphaeria undulata Pers., Syn. Meth. Fung., p. 21 (1801).

Sphaeria undulata Pers.: Fr., Syst. Mycol., 2: 350 (1823).

Stromatosphaeria undulata (Pers.: Fr.) Grev., Fl. Edin., p. 356 (1824).

Stictosphaeria undulata (Pers.: Fr.) Fuckel, Fungi Rhen., N 1044 (1864).

Illustrations: Rappaz, 1987a, fig. 9; 1987b, fig. 6C; Chlebicki and Krzyzanowska, 1995, fig. 1D, 8E-F, 9C, E.

Stromata effuse but sometimes cushion-like, usually strongly undulating, rarely flat, with distinctly marked steep margin and dark surface, ostioles cone-shaped, three-to-four sulcate; black entostromatic columns extending into the lower bark. *Asci* p. sp. $30-40 \times 5-7 \mu\text{m}$. *Ascospores* $4.5-6 \mu\text{m}$ long.

Habitat: On dead branches of *Betula* spp.

Localities in GSMNP: Cosby (Gabes Mountain Trail; Low Gap Trail; Snake Den Ridge Trail); Newfound Gap (Appalachian Trail); Purchase Knob (Hemphill Bald Trail).

Notes: Our collection of this species appears to be only the second record from North America. Previous reports by Rappaz (1987a,b) and Chlebicki and Krzyzanowska (1995) were based upon the same collection, which was from New Jersey.

Diatrype virescens (Schwein.) M.A. Curtis, Geol. Nat. Hist. Surv. North Carol., 3: 141, 1867. (Figs. 10, 20)

Sphaeria virescens Schwein., Trans. Amer. Phil. Soc., ser. 2, 4: 195 (1832).

Diatrype disciformis (Hoffm.: Fr.) Fr. var. *virescens* (Schwein.) Berk., Grevillea, 4: 95 (1876).

Valsa virescens (Schwein.) Kuntze, Rev. Gen. Pl., 3: 540 (1898).

Illustration: Berlese, 1900, Tab. CXVIII; Fungi Canadensis, N 73.

Stromata diatrypellloid, disc-shaped, flat or slightly convex, 2.5-4 mm diam., often with yellow-green, later brown surface and several sulcate ostioles. *Asci* clavate, p. sp. $35-40 \times 4-6 \mu\text{m}$. *Ascospores* $(10)12-14 \times 2.5-3 \mu\text{m}$.

Habitat: On dead branches of *Fagus grandifolia* Ehrh.

Localities in GSMNP: Cosby (Cosby Creek); Cades Cove (Turkey Pen Ridge Trail).

Notes: This fungus is restricted to *Fagus grandifolia* and has been reported only from North America.

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