NEW FUNGI FROM MICHIGAN

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ABSTRACT

A new species of the genus *Paxillus*, *P. vernalis*, characterised by a vinaceous brown spore-print is described, as is a new variety of *Gyroporus cyanescens* based on a colour change of the flesh—*G. cyanescens* var. *violaceotinctus*.*

Paxillaceae.

Spore-prints of nearly all fresh agarics collected are taken as routine in the belief that the colour of the fresh spore-print is important in understanding the taxonomy of this group of fungi regardless of the evidence that under cultural conditions certain *Coprinus* spp. can be induced to lose their spore-pigment and certain *Bolbitius* spp. can be found in the field with paler than normal spores. Whilst examining boletes and related fungi in the summer of 1965, a species of *Paxillus* was collected which resembled *P. involutus* in gross morphology but differed in size and paler colours. However, carrying out the philosophy outlined above it was rather surprising to find that the spore-print, obtained after placing the pileus of this agaric gills down on a piece of paper overnight, was not ochraceous rust as characteristic of the European *P. involutus* (Fr.) Fr. but a much richer, much more chocolate brown ('Verona' to 'Rood's brown' of Ridgway).

When I drew these observations to the attention of Professor A. H. Smith he mentioned he had seen this fungus on several occasions since he had been on the teaching staff at the Biological Station, University of Michigan; he also commented on the fact that it always appeared at about the opening of the summer term. The mushroom season at Pellston, Michigan, during 1965 was late and the spring flora continued past July 4th, an arbitrary date adopted by Prof. Smith for the time about which there is a change over in Northern Michigan from the spring to the summer agaric floras. Carpophore production of this *Paxillus* appeared to be favoured by the conditions prevailing in early summer 1965 and it was observed both in greater number than usual and over a much longer period. Thus several score fruit-bodies were examined in order to ascertain whether there were any important characters other than spore-deposit colour by which it differed from the familiar *P. involutus* and that fungus which has been identified as such in North America.

The results of this study are summarised in the descriptions below, but one can immediately appreciate that on the recognition of this species in the Paxillaceae the range of colour found in the spore-prints of members of that family is extended. Colours in inverted commas refer to those from Ridgway (1912). Abbreviations for National Herbaria follow Lanjouw and Stafleu (1959).

*This research was supported by a Grant from the National Science Foundation of the United States of America (GB–887) made available to me while at the University of Michigan Herbarium.

Paxillus vernalis Watling **sp. nov.** Fig. 1 C.

Pileus 50–200 mm latus, convexus dein plano-convexus, piloso-fibrillosus demum glaber vel fibrilloso-implexus, bubalinus vel pallidus dein fuscans. *Stipes* 30–100 mm longus, 20–40 mm crassus ad basim, glaber vel subfibrillosus, pallidus demum brunneus. *Lamellae* confertae, decurrentes, interdum bifurcae, pallide argillaceae tum vinaceo-brunneae. *Contextus* pallidus tum bubalinus tactu ferrugineus. *Sporae* 6·5–9 × 5–6·5μ, ellipsoideae. *Basidia* tetrasporigera, 25–35 × 7–8μ. *Pleurocystidia* 40–50 × 8–10μ fusiformia vel ventricoso-fusiformia, cervice longa ± acuta; *cheilocystidia* similia.
Typus: Raber Fossil Bed, Chippewa Co., Michigan, 27 viii 1965, *Watling* A1744/C2105 (E & MICH).

Pileus 50–200 mm, broadly convex soon becoming plane, the margin at first inrolled but then expanding and the whole pileus at maturity becoming plane or even shallowly depressed, at first pale dingy buff but in some specimens almost whitish, gradually darkening to snuff brown or dark chamois, even darker on handling or bruising, minutely tomentose at first but gradually becoming matted fibrillose and in some specimens appearing as if felty, margin either ribbed or even. *Stipe* short, 30–100 mm × 20–40 mm, equal or slightly enlarged upwards or downwards, glabrous or slightly fibrillose particularly at maturity with cinnamon brown fibrils, pallid becoming dark brown in age and/or on handling. *Gills* close, decurrent, narrow at first but finally broad, sometimes forked but not conspicuously anastomosing either near the pileus margin or amongst those adjacent to the stipe, dingy pallid buff at first but readily staining dark brown on bruising, gradually darkening in age with a slight vinaceous cast in some lights. *Flesh* thick beneath the disc, pallid, more buff or chamois in the stipe, staining ± rapidly red brown, dull vinaceous with alkali and green with $FeSO_4$; *odour* none to unpleasant and then acidulous; *taste* usually acidulous.

Spore-deposit vinaceous brown (approaching 'Verona' to 'Rood's brown'). *Basidiospores* 6·5–9 × 5–6·5μ ellipsoid, lacking apical differentiation, dull brown in KOH and ochraceous tawny in Melzer's reagent. *Basidia* 4-spored, 25–35 × 7–8μ, elongate clavate. *Pleurocystidia* abundant, ± fusoid to fusoid-ventricose with ± pointed apical extensions, 40–50 × 8–10μ, smooth, thin-walled, slightly yellowish or ochraceous, darker in KOH; *cheilocystidia* similar to pleurocystidia or more variable, a few having much more rounded apices. *Hymenophoral trama* gelatinous, somewhat divergent from a central, darker, floccose strand. *Clamp-connections* present. *Pileus trama* of interwoven hyphae, yellowish to red brown in Melzer's reagent and passing abruptly into a layer of ± parallel, gelatinised hyphae 4–6μ broad making up the thin 'cuticle'; *laticiferous hyphae* few.

On sandy soil in mixed woods containing *Abies balsamea*, *Betula papyrifera* and *Populus tremuloides* (Type: *Watling* A1744/C2105—E & MICH).

Material examined:—
(MICH). Munro Lake, 4 vii 1941, *Smith* 36: 662; Mackinaw City Hardwoods, Emmet Co., 3 vii 1949, *Smith* 32406; Mackinaw City Hardwoods, Emmet Co., 31 vii 1949, *Smith* 32817; Mackinaw City Hardwoods, Emmet Co., 23 ix 1950, *Smith* 36111; Mackinaw City Hardwoods, Emmet Co., 2 viii 1951, *Thiers* 1079; Pellston Hardwoods, Emmet Co., 19 viii 1951, *Smith* 37915; Mackinaw City Hardwoods, Emmet Co., 16 viii 1952, legit *Smith*; University

Biological Station, near Pellston, Cheboygan Co., *K. Macknight*, 22 vi 1953, *Smith* 41265; Mud Lake, Cheboygan Co., 12 vii 1953, *R. L. Shaffer* 1474; Middle Bridge, Maple River, Emmet Co., 14 viii 1953, *H. Bigelow*, *Smith* 42036; Pellston Hills, Emmet Co., 16 viii 1953, *Smith* 42107; Porcupine Mountains State Park, Ontonagon Co., 24 viii 1953, *R. L. Shaffer* 1162; Wilderness Park, Emmet Co., 22 ix 1953, *Smith* 43106; Mackinaw City Hardwoods, Emmet Co., 6 x 1953, *Smith* 43840; Mackinaw City Hardwoods, Emmet Co., 28 vii 1955, *Smith* 49640; Pellston Hills, Emmet Co., 7 viii 1955, *Smith* 50048; Mackinaw City Hardwoods, Emmet Co., 15 vii 1957, *Smith* 57353; Mackinaw City Hardwoods, Emmet Co., 15 vii 1957, *Smith* 40700; Mackinaw City Hardwoods, Emmet Co., 3 viii 1957, *Smith* 37365; Mackinaw City Hardwoods, Emmet Co., 14 ix 1957, *Smith* 58113; Mackinaw City Hardwoods, Emmet Co., 30 vi 1959, *R. L. Shaffer*, *Smith* 60833; Carp Creek, Pellston, Cheboygan Co., 8 vii 1959, *R. L. Shaffer* 2133; University Biological Station, Cheboygan Co., 28 vii 1960, *Smith* 62971; University Biological Station, Cheboygan Co., 1 vii 1961, *Smith* 64808; Pellston, Cheboygan Co., 31 vii 1961, *N. Smith* 135A; Berry Creek, Cheboygan Co., 31 vii 1961, *Smith* 63781; Mackinaw City Hardwoods, Emmet Co., 22 ix 1963, *Smith* 67739; Wilderness Park Point, Emmet Co., 1 x 1963, *Smith* 67763; Wilderness Park, Emmet Co., 1 x 1963, *Smith* 67763; Pellston, Emmet Co., 26 vi 1965, *Smith* 71547. (all Michigan localities, U.S.A.).
(E). University Biological Station, Cheboygan Co., 31 vii 1961, ex *N. Smith* 135A; Mackinaw City Hardwoods, Emmet Co., 15 vii 1957, *A. H. Smith*, *Watling* 4070; Wilderness Park Point, Emmet Co., 1 x 1963, ex *Smith* 67763, *Watling* 4071; Wycamp Lake, Emmet Co., 16 vii 1965, *Watling* A1587/C2151; Wycamp Lake, Emmet Co., *R. Homola & R. Watling*, 18 vii 1965, *Watling* A1772/C2151; Raber Fossil Beds, Chippewa Co., 27 viii 1965, *Watling* A1744/C2151 (Typus); Michigan, legit *Peters* 1162, *Watling* 4062; (all Michigan localities, U.S.A.).

For comparison a description of *Paxillus involutus* is included:—

Pileus 50–120 mm convex at first with a strongly incurved cottony margin, soon becoming expanded and often depressed towards the disc, deep clay or rust yellow at first with ± olivaceous cast when young, viscid at the disc when wet, ± blotchy red brown towards maturity or after bruising downy throughout but particularly towards the margin, becoming smooth, margin persistently inrolled becoming smooth or grooved. *Stipe* up to 75 mm × 8–12 mm, central or slightly excentric, thickened upwards, paler or concolorous with the pileus but soon becoming spotted and streaked with darker brown particularly on handling. *Gills* pale ochraceous then yellow rust but on bruising flushing dingy brown or red brown drying with an olivaceous cast, decurrent, often branched and anastomosing particularly amongst those close to the stipe, crowded, easily detachable from the pileus. *Flesh* yellowish to ochraceous buff in the pileus, more brown towards the base of the stipe, thick, soft and becoming red brown on cutting, negative with Melzer's, pinkish becoming brown with alkali, dingy about yellowish spot with ammonia, and quickly green then olive with $FeSO_4$; *odour* acidulous; *taste* acidulous.

Spore-deposit ochraceous brown ('clay' to 'tawny olive'). *Basidiospores*

8–10 × 5–6 μ, smooth, elliptic, deep yellow brown only slightly darker in KOH and more tawny in Melzer's reagent. *Basidia* 4-spored, clavate, pyriform. *Cheilocystidia* numerous, lanceolate to fusiform 40–65 × (10–) 12–15 (–18)μ; *pleurocystidia* similar, usually less frequent. *Hymenophoral trama* of divergent hyphae with a central, darker, floccose, slightly gelatinised strand; *clamp-connections* present. *Pileus trama* of tightly interwoven hyphae, red-brown in Melzer's reagent, intermixed with numerous, long laticiferous hyphae which pass into the subcutis and trichoderm. *Pileus* '*cuticle*' forming a trichoderm of smooth to scabrate, ± erect, hyaline to slightly yellowish hyphae 10–15 μ broad, rarely with small plates of ornamentation, and intermixed with dark brown irregularly shaped laticiferous hyphae.

In mixed woods, particularly under *Betula verrucosa* and/or *Quercus petraea* in Europe, not infrequently attached or even growing loosely on woody debris.

Differs from *P. vernalis* in the smaller size, colour of the stipe and pileus, structure of the pileus trichoderm and particularly in the colour of the spore-print.

Material examined:—
(ABD) Herb. Dickie (no further data).
(BM) Melderis, Flora Suecica; Petrak, Flora Bohemiae & Moraviae No. 1866; Lundell & Nannfeldt, Fungi Exs. Suecici No. 23; Melderis, Flora Suecica (2nd collection); Herpell, Samml. Hutpilze No. 33; Herpell, Samml. Hutpilze No. 90; Desmazieres, Pl. Crypto. Fr. No. 457; Herb. Plowright; Herb. Ravenel (2 collections); Karsten., Fungi Fennica No. 223; Sydow, Mycotheca Marcheca No. 1506; Klotsch, Herb. Viv. Myc. No. 20; Erbar, Critt. Ital., No. 635.
(E) Near Glasgow, 1830, *Klotsch* (2 collections, no further data); Garscube Estate, Dumbartonshire, 1830, *Klotsch*; Begley, viii 1886, (ex Herb. Cooke?); Wimbledon Common, 8 x 1906, *Ch. E. Hartley Smith*; Under *Quercus petraea*, Copley Wood, Halifax, Yorkshire, 7 viii 1957 (spore-print only); Royal Botanic Garden, Edinburgh, 8 ix 1964; Camghouran, Perthshire, 4 x 1964, *Orton* 2661; Black Wood of Rannoch, Perthshire, 28 ix 1965, *Orton* 2832. Henning, x 1890; Henning, Berlin; Petrak, Flora Bohemiae & Moraviae Exs. Lfg. 38 No. 1866, 25 x 1923; Mackinaw Hardwoods, Emmet Co., Michigan, 23 vii 1965, *Watling* A 789/C1241; Topinabee, near Indian River, Cheboygan Co., Michigan, 24 viii 1965, *Watling* A1233/C1564; Waterloo, near Ann Arbor, Jackson Co., Michigan, 2 ix 1965, *A. H. Smith*, *Watling* A462/C2304; Waterloo, Jackson Co., Michigan, 7 ix 1965, *Watling* A1581/C1840; Beaver Creek, Bonner Co., Idaho, 11 ix 1966, *Watling* 2954; near Post Falls, Kootenai Co., Idaho, x 1966, *Watling* 3926 (2 collections under oak in garden).
(GL) Wimbledon Common, 1906, *Ch. E. Hartley Smith*.

A collection under aspens from San Juan Mt. area, Colorado (*Smith* 52651, MICH) may belong to this taxon but differs in having a very viscid pellicle which becomes shiny when drying as well as the cottony margin. The gills are poroid at the apex of the stipe and the base of the stipe stains strongly red-brown on handling.

Boletaceae.

Gyroporus cyanescens (Fr.) Quél. although widespread cannot be called a common bolete either in the British Isles or seemingly in the Great Lake region of North America. I have now had the opportunity to study numerous herbarium collections and several fresh collections of this fungus both from the British Isles and from Michigan, U.S.A. This bolete is easily recognised by the pale, almost hyaline, elliptic spores, which are lemon yellow in mass, the peculiar texture of the pileus, the leathery "rind" to the loosely stuffed stipe and the flesh and tubes changing immediately azure blue. The pileus colour and flesh changing blue immediately separate it from its close relative *G. castaneus*, but it is fairly variable in colour and may range from pallid or white to distinctly ochraceous; the former colour resulted in the taxon *Boletus lacteus* Lév. being described. A variant of this fungus was collected in several places in Michigan (Sugar Island, Chippewa Co., *Watling* A332/C2080; Pickney Rec. area, Livingston Co., *Watling* A492/C2328 etc.) during the summer and fall of 1965, differing markedly in the colour change of the flesh when it was exposed to the air; the flesh changed first lilac then rich purple and finally indigo. Two very good collections from widely separated areas are here described and it was considered that although they should be included in the variability of Fries' species they warrant varietal rank.

Gyroporus cyanescens var. **violaceotinctus** Watling **var. nov.** Fig. 1 A-B.

A typo carne albida, in pileo et in stipite secta obscure lilaceo vel violaceo demum obscure caerulescens differt.

Typus: Sugar Island, Chippewa Co., Michigan, U.S.A., 19 viii 65, *Watling* A323/C2080—E. Differs from the type variety only in the sequence of colour changes of the flesh.

Pileus 35–75 mm, tan to ochraceous at margin, slightly tinted rust or olivaceous tawny at the disc, fibrillose but soon becoming streaky matted, lavender on handling; 'cortex' thick and leathery. *Stipe* concolorous with the pileus, lemon buff or tan at apex, tinted rust below and at maturity slightly ochraceous dotted, streaky tomentose particularly at apex then fibrillose throughout, leathery with a distinct 'rind' of tougher cartilaginous tissue which cracks into fine fissures ('hair cracks') giving to the stipe a distinctly annulate appearance, indigo to handle. *Tubes* 5–8 mm in length, white to pallid then pale lemon yellow with deep lilaceous tinge immediately on cutting, then becoming violet to indigo; *pores* small, unequal, simple, ± rounded, white with a distinct lemon yellow tint, bruising amethyst then more strongly violaceous and finally deep blue which is even retained in the dried material. *Flesh* white or tan in stipe, immediately lilaceous when cut and finally indigo, fading to dirty ochraceous with areas of deep blue, more blue green in stipe base; odour and taste faint, pleasant although mild; when dry containing soluble compounds which turn yellow in ammoniacal solutions and deposit a blue line at the edge of drying mounts when incubated in Melzer's reagent.

Spore-deposit pale lemon yellow. *Basidiospores* 9–11 × 5–6 μ, elliptic, very pale yellow to almost hyaline in water, little if any colour in KOH and yellowish in Melzer's reagent when mature but some immature spores may

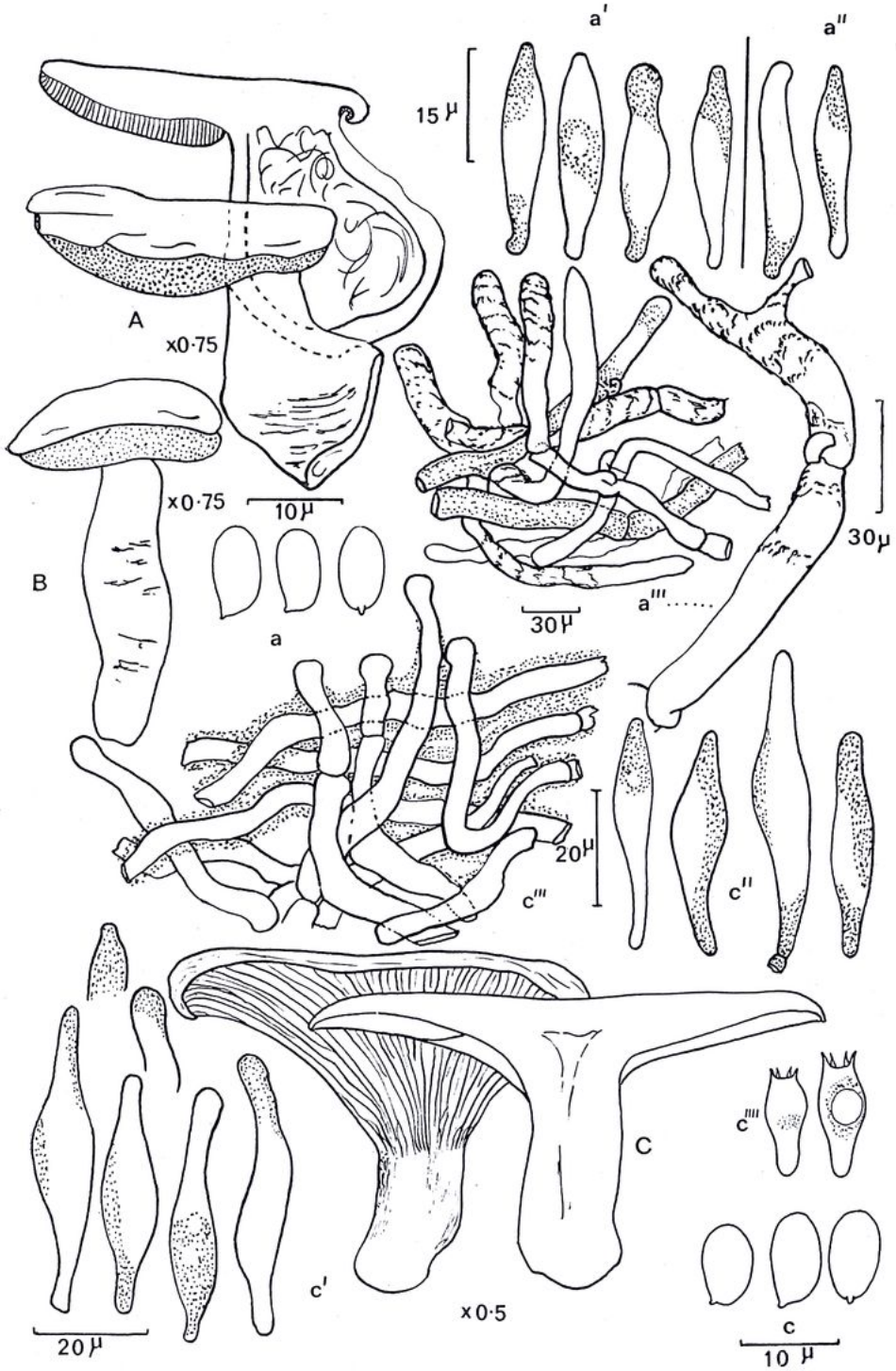

FIG. 1. A & B. *Gyroporus cyanescens* var. *violaceotinctus* Watling; C. *Paxillus vernalis* Watling. A. Habit sketch A323/C2080 (Type), a basidiospores, a′ cheilocystidia, a″ pleurocystidia, a‴ L.S. of pileus showing trichoderm layer; single trichoderm element more highly magnified. B. Habit sketch A492/C2328. C. Habit sketch A1744/C2105, c basidiospores, c′ cheilocystidia, c″ pleurocystidia, c‴ L.S. of pileus showing trichoderm elements in gelatinised matrix, c⁗ basidia.

appear dextrinoid. *Basidia* 4-spored, clavate 18–23·5 × 8–9 μ with sterigmata up to 3·5 μ long. *Cheilocystidia* lageniform, 22·5–27·5 × 4·5–7·5 μ; *pleurocystidia* similar but infrequent. *Clamp-connections* present. Anatomy of pileus as in type variety.

On clayey-sandy soils (mineral) under *Betula papyrifera* and *Acer* spp., Sugar Island, Chippewa Co., Michigan, U.S.A., 19 viii 1965, *Watling* A323/C2080 (Type). Green Lake near Pickney, Livingston Co., Michigan, 8 ix 1965, *Watling* A492/C2328.

For completeness a full description of the type variety is given below:—

Gyroporus cyanescens (Fries) Quélet var. **cyanescens**

Basionym: *Boletus cyanescens* Bull. ex Fr. in Systema Mycologicum, 395, 1821.

Pileus 40–100 mm, tan, dingy white or ochraceous, floccose scaly to velvety scaly or fibrillose, or coarsely tomentose and becoming matted, paler towards the margin and possibly with sepia flush at the disc at maturity, blue on handling; 'cortex' thick and leathery and margin entire. *Stipe* concolorous with the pileus or paler particularly at the apex, or flushed lemon or citron in places and at maturity slightly ochraceous dotted, pruinose tomentose and leathery with a distinct 'rind' of tough leathery or cartilaginous tissue which cracks into lesions giving to the stipe a distinct zoned appearance, but rarely deep enough to show pithy inner zone, bluish to handle. *Tubes* 6–7 mm in length, white then pale lemon yellow with greenish tinge bruising at first greenish blue finally blue; *pores* small, unequal, simple ± rounded, bruising forcibly blue green or directly blue. *Flesh* white then greenish yellow when cut and finally azure blue, greenish blue in stipe rind and usually more cobalt blue in the pith, fading to dirty ochraceous; with $FeSO_4$ reddish violet, Melzer's reagent negative, HCl red, and NaOH and NH_4OH yellow; odour and taste faint, pleasant although mild.

Spore-deposit pale lemon yellow. *Basidiospores* (7–) 9–11 × 4·5–6 μ, elliptic, very pale yellow to almost hyaline in water, little if any darker in KOH, yellowish in Melzer's reagent when mature but some immature spores may appear dextrinoid. *Basidia* 4-spored, 18–23·5 × 8–9 μ (sterigmata up to 3·5 μ long), clavate. *Cheilocystidia* lageniform, 22·5–27·5 × 4·5–7·5 μ; *pleurocystidia* similar but infrequent. *Clamp-connections* present, particularly common on cortical hyphae. *Hymenophoral trama* of slightly gelatinised, divergent hyphae with a distinct central strand which is brownish in KOH and tawny in Melzer's reagent; *subhymenium* (and infrequently in a few areas of the trama) bluish green in Melzer's reagent. *Context hyphae* loosely interwoven, slightly reddish brown when revived in Melzer's reagent. *Pileus cutis* of hyaline to slightly coloured, hardly disarticulating, roughened hyphae, 10–17·5 (–20) μ broad forming a loose easily collapsing trichoderm, abruptly passing into a compacted zone of parallelly arranged, narrow, slightly thicker walled hyphae (5–7 μ broad) which appear red brown in Melzer's reagent; this zone gradually passes into a loosely interwoven zone of hyphae 5·5–8 (–10) μ broad with little iodine affinity before passing into pileus trama of floccose interwoven hyphae.

On sandy-clayey (mineral) soils under scrub birch, *Betula verrucosa* (*Henderson* 4596, *Orton* 1540 & *Watling* C233), *Corylus avellana* (*Watling*

C2646) in Europe and under second growth Maple–Poplar in Great Lake region of North America (*Watling* A252/C1932, A1874/C2272 & A1669/C1983) but it is recorded by several authors, including Pearson (1946) and Lange & Hora (1963), from European spruce woods (cf. *Watling* C2862 from mixed conifer woodland Michigan and A252/C1932). Kühner and Romagnesi (1953) have been found to be correct in their statement of habitat i.e. 'sols siliceux'. Although the new variety described from Michigan was found in frondose woodland on all occasions it was collected in areas which were typified by very sandy soils.

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Acknowledgment

The author is extremely grateful to Prof. A. H. Smith, University of Michigan Herbarium for making available facilities for study and placing in his hands material and personal field notes collected over many years.