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Byssoporia gen. nov.: taxonomy of the mycorrhizal fungus *Poria terrestris*

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Poria terrestris (DC. per Fries) Sacc., recently discovered to be mycorrhizal with roots of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), is separated into five distinct varieties. Separation is based on color of basidiocarps, morphology of rhizomorphs, cultural characteristics, color reactions of tissues to chemotaxonomic reagents, differences between respective Douglas-fir mycorrhizae, and fluorescence of tissue under ultraviolet (UV) (3600 Å (1 Å = 0.1 nm)). *Byssoporia*, a new genus, is proposed for *P. terrestris* and its varieties.

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Les auteurs distinguent cinq variétés chez *Poria terrestris* (DC. per Fries) Sacc., un champignon mycorrhizateur des racines du sapin de Douglas (*Pseudotsuga menziesii* (Mirb.) Franco) et de la pruche de l'Ouest (*Tsuga heterophylla* (Raf.) Sarg.). La distinction entre les variétés est fondée sur la couleur des basidiocarpes, la morphologie des rhizomorphes, les caractéristiques en culture, les réactions de coloration des tissus à des réactifs chimiotaxonomiques, les différences respectives entre les mycorrhizes chez le sapin de Douglas, ainsi que la fluorescence des tissus à la lumière ultra-violette (3600 Å (1 Å = 0.1 nm)). Le nouveau genre *Byssoporia* est proposé pour *P. terrestris* et ses variétés.

[Traduit par le journal]

Introduction

Poria terrestris (DC. per Fries) Sacc. has been considered an inhabitant of woody substrata and capable of causing decay. Its decay capability, however, has never been demonstrated, and only its "associated rot" is known (Lowe 1966; Gilbertson 1974). Killermann (1927) suggested the possible symbiotic consociation of *P. mycorrhizae* Killerm. (= *P. terrestris*) with tree roots when that fungus was described. He found a basidiocarp attached to *Fagus sylvatica* L. rootlets with mycelium enveloping "root hairs." Killermann (1927) did not describe the mycorrhizae but was quite certain that his fungus was mycorrhizal. Killermann's report is the only substantive evidence that indicates a symbiotic role for *P. terrestris* in Europe.

Zak (1969) concluded that *P. terrestris* in North America is mycorrhizal and reported two distinct mycorrhiza-forming "strains": blue and orange staining. More recently, Zak and Larsen (1978) have designated three additional strains or varieties, i.e., rose (var. *lilacinorosea*), yellow (var. *parksii*), and subyellow (var. *sublutea*). Also, the

blue-staining fungus was designated as var. *sartoryi* and the orange-staining as var. *aurantiaca*. Because these five strains differ sharply in several important features, they are formally designated herein as varieties and accorded appropriate nomenclatural status.

Bondartsev and Singer (1941) classified *P. terrestris* as a member of *Byssocorticium* of the Corticiaceae. This interpretation has been maintained by Bondartsev (1953), Parmasto (1968), and Eriksson and Ryvarden (1973). We support the view that *P. terrestris* is allied with the Corticiaceae but cannot, however, advocate *Byssocorticium* for this species. *Poria terrestris* does not have a blue to blue-green pore surface, cyanophilous basidiospores, and subbasidial clamps. The rhizomorph characters and ecological role are viewed as decidedly divergent characters and not typical of *Byssocorticium*. Finally, the poroid surface, although not a conclusive character for the expression of generic affinity, provides additional evidence for generic segregation. Jülich (1972) also holds the opinion that *P. terrestris* does not belong in *Byssocorticium*.

We propose herein the new genus *Byssoporia* to encompass *P. terrestris* and its varieties.

General Comments on the Nature of Rhizomorphs, Mycorrhizae, and Cultures

Zak (1969) and Zak and Larsen (1978) have provided detailed accounts of the nature of rhizomorphs, cultures, and mycorrhizae of vars. *sartoryi* and *aurantiaca* and *lilacinorosea*, *parksii*, and *sublutea*, respectively. However, the more salient features of these structures are summarized below.

Macroscopic and microscopic characters of attached rhizomorphs are rarely included in descriptions of sporocarps. Usually, only their presence, abundance, and prominence are noted. They may be quite distinctive, however, and a detailed analyses of rhizomorph structure may significantly add to our knowledge of a fungus. A distinctive and accurately characterized rhizomorph when free in the substrate or attached to roots or mycorrhizae may, by itself, allow identification of a fungus.

Except for color, rhizomorphs of the five varieties are alike in gross appearance. Those of var. *sartoryi* are at first white but then become blue-green, blue, and purple in discrete areas. Old rhizomorphs may be solidly purple. Rhizomorphs of var. *aurantiaca* are white, occasionally with small orange-colored portions, but later become uniformly cream to dull yellow. In var. *lilacinorosea*, rhizomorphs are an unchanging white and appear coated with fine crystals. Rhizomorphs of var. *parksii* are a watery pale yellow with spotty orange stains and may become uniformly bright orange as they age. Those of var. *sublutea* are normally sulphur yellow.

Microscopically (100–500 ×), rhizomorphs are alike in basic structure, i.e., a core of large-diameter hyphae sheathed by smaller diameter, entwining hyphae. Rhizomorphs of var. *sartoryi* also have a characteristic loose fringe of nonseptate ‘lacey’ or ‘curly’ hyphae. In var. *lilacinorosea*, rhizomorphs have a distinctive fringe of thin-walled staghorn hyphae. Except for color, rhizomorphs of vars. *aurantiaca* and *parksii* appear identical in structure but lack clamp connections in the former. Those of var. *sublutea* have a characteristic fringe of spiral hyphae.

Nutrient agar cultures of the five forms, developed from surface-sterilized rhizomorphs and mycorrhizal elements, are macroscopically and microscopically distinct. On Melin–Norkrans medium with agar as modified by Marx (1969), radial growth, color, and texture of mats differ. The mat of var. *sartoryi* emits a pronounced roselike fragrance while mats of the other forms are odorless.

Aerial mycelium of var. *sartoryi*, var. *lilacinorosea*, and var. *parksii* contain hyphal strands. Aerial mycelium of var. *parksii* also contain short, small-diameter, yellow-orange rhizomorphs. Conidia are produced only by var. *aurantiaca*. Cultural characteristics of vars. *sartoryi* and *aurantiaca* (blue- and orange-staining forms, respectively) are described in detail by Zak (1969). Those of the vars. *lilacinorosea*, *parksii*, and *sublutea* are described by Zak and Larsen (1978).

Each variety is mycorrhizal with Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). Varieties *sartoryi* and *lilacinorosea* are also mycorrhizal with western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) in western Oregon. None of the varieties has yet been reported mycorrhizal in other geographical areas of North America. Sporocarps are invariably found in close proximity and occasionally connected through rhizomorphs to respective mycorrhizae. Each of the five Douglas-fir mycorrhizae is distinct in color, structure, texture of mantle, and character of the surrounding mycelium and attached rhizomorphs.

Finally, the varieties are readily distinguished by color reactions of their respective sporocarps and mycorrhizae to various chemical reagents. Small pieces of fresh and dried sporocarps and of fresh mycorrhizae were placed on a white porcelain plate, and one or two drops of reagent was applied. Color changes produced within 5 min were noted. Chemotaxonomic reagents used are those given by Singer (1962, pp. 82–94). Capital letters used to designate herbaria are those of Holmgren and Keuken (1974).

Taxonomic Part

Byssoporia M. J. Larsen et Zak, gen. nov. (Aphyllophorales, Corticiaceae, subfam. Athelioideae)

ETYMOLOGY: From *byssinus* (L., adj.) + *porus* (L., n) = *Byssoporia*.

Basidiocarpis effusus, byssoideis, separabilibus; hymenio superficie poro; hyphis subhymeniis afibulatis; hyphis contextis raro fibulatis; basidiis 4-sterigmatibus; basidiosporis late ellipsoideis vel subglobosis, hyalinis, crassiusculus tunicatis non cyanophilis.

HOLOTYPE: *Byssoporia terrestris* (DC. per Fries) Larsen et Zak.

Byssoporia terrestris (DC. per Fries) Larsen et Zak, comb. nov. (basionym: *Polyporus terrestris* DC. per Fries, Syst. Mycol. 1: 383. 1821.)
= *Poria terrestris* (DC. per Fries) Sacc., Syll. Fung. 6: 332. 1888.

- = *Byssocorticium terrestre* (DC. per Fries) Bond. et Sing., Ann. Mycol. 39: 48. 1941.
 = *Poria mollicula* Bourd., Lloyd Lib. Mus. Mycol. Writ. 4: 543. 1916. (BPI).
 = *Poria parksii* Murr., Mycologia, 13: 175. 1921. (NY, BPI).
 = *Poria sartoryi* Bourd. et L. Maire, Assoc. Fr. Av. Sci. p. 619. 1921 (*not seen* but cited as such in Bull. Soc. Mycol. Fr. 41: 216. 1925.) (PC).
 = *Byssocorticium sartoryi* (Bourd. et Maire) Bond. et Sing., Ann. Mycol. 39: 48. 1941.
 = *Poria terrestris* subsp. *sartoryi* (Bourd. et Maire) Bourd. et Galz., Hym. Fr., p. 655. 1928.
 = *Poria mycorrhiza* Killerm., Hedwigia, 67: 129. 1927(S).

Basidiocarps annual, effused for several centimetres, up to 3 mm thick, separable from the substrate; pore surface at first white to cream, becoming dull cream with orange, rose, pink, blue-green, blue, purple, and yellow areas, finally dull brown in some instances; tubes up to 3 mm long, pores subangular, round, or daedaloid, 2–3/mm, dissepi-

ments becoming thin to lacerate; margin concolorous with, to paler than, the pore surface; rhizomorphs visible to the naked eye, concolorous with, to paler than, the pore surface, up to 0.3 mm diameter; fluorescing various colors under 3660 Å (1 Å = 0.1 nm).

Hyphal system monomitic. Subicular hyphae 2–3(–4.5) μm diameter, sparsely to densely encrusted with granules, septate, clamp connections infrequent, sometimes inflated at the septa; rhizomorphs with core or central hyphae 2.5–11 μm diameter, with or without clamp connections; surface hyphae thin to thick walled, with or without encrustation, 1.5–3 μm diameter, straight, curly, spirallike, or staghornlike in appearance; tramal hyphae similar and continuous with the context, 2–4.5 μm diameter, thin walled, septate, clamp connections absent; basidia transversely septate at the base, clamps absent, 15–25 × 5–6 μm, four sterigmate, clavate; basidiospores hyaline, smooth, 4–5 × 3–3.5 μm, broadly ellipsoid to subglobose, less frequently globose, with wall thickening apparent, obliquely apiculate, acyanophilous, negative in Melzer's reagent.

NORTH AMERICAN VARIETIES OF *B. terrestris*

1. Basidiocarps with portions stained rose, bright red, pale pink, or deep brick orange; or blue-green, blue, or purple2.
1. Basidiocarps with portions stained pale to bright orange, yellow-orange, brown, or yellow; or sulphur-yellow or pale coral3.
2. Basidiocarps with parts stained blue-green, blue, or purple; surface of rhizomorphs comprised of thick-walled curly hyphaevar. *sartoryi*
2. Basidiocarps with portions stained rose, bright red, pale pink, or deep brick orange; surface hyphae of rhizomorphs with noticeable staghorn branchingvar. *lilacinorosea*
3. Rhizomorphs lacking clamp connectionsvar. *aurantiaca*
3. Rhizomorphs with clamp connections4.
4. Subicular hyphae distinctly inflated at hyphal septavar. *sublutea*
4. Subicular hyphae not inflated at hyphal septavar. *parksii*

Byssoporia terrestris var. *aurantiaca* Larsen et Zak, var. nov.

ETYMOLOGY: From *aurantiacus* (*L.*, adj.) = orange. To indicate that parts of basidiocarps and associated structures are orange.

Basidiocarpis cum poris albis, partim aurantiacis; subiculo albo, partim aurantiaco; rhizomorphis albis, partim aurantiacis, hyphis ad centrum 2.5–8 μm, afibulatis; mycorrhizis pinnatiformis, fasciculatis, usque, 3.0 × 4.0 cm, partim luteis vel luteo-aurantiacis, pagina grosse coacto, hyphis interconsociatis grossis.

HOLOTYPUS: U.S.A.: Oregon, Coast Ranges, 15 mi (1 mi ≈ 1.609 km) W of Corvallis, Mary's Peak, associated with brown rotted decayed wood of *Pseudotsuga menziesii*, collected by B. Zak, Zak

collection series and number CS-12-67, 21·XI·1967 (CFMR) and isotype in OSC.

Basidiocarps with pore surfaces white but with small discrete areas of orange coloration, with the underside of the subiculum and rhizomorphs colored similarly; core or central hyphae 2.5–8.0 μm diameter, septate, clamp connections absent; mycorrhizae at first pale colored and finally with stained portions yellow and yellow-orange, pinnate, with clusters of pinnate fans up to 3.0 × 4.0 cm, mantle appearing coarse felty, with coarse mycelia interconnecting individual pinnate fans in a cluster.

Fluorescence (3600 Å) of fresh sporophore: pore surface and underside dull white to yellow-cream to light tan; of dried sporophore: pore surface dull white to cream, underside a dull pink-lavender.

Chemical reagent color reactions

Chemical reagent	Fresh basidiocarps	Dried basidiocarps
Chlorovanillin	Pore surface and underside turn dull pink-lavender 2-5 min, erratic	Pore surface and underside turn pink-lavender within 1-2 min, a deep purple after 5 min
NH ₄ OH, concentrated	All tissues immediately turn rusty-brown	Negative to weak pink-orange within 1 min
KOH, 15%	Same as concentrated NH ₄ OH	All tissues become pale, dull orange within 1 min

OTHER SPECIMENS EXAMINED: Oregon, Coast Ranges, Mary's Peak, M. J. Larsen, 6·XI·1971 (FP 133036), 8·XI·1971 (FP 133037, 133038, 133039, 133046), 12·XI·1971 (FP 133064), 29·XI·1971 (FP 133122, 133123, 133124); collected B. Zak, 17·I·1968 (BZ CS-1-68[B]), 28·XIII·1968 (BZ CS-21-68[B]), 6·I·1969 (BZ CS-2-69[C]). All filed in CFMR.

Variety *aurantiaca* occurs in brown rotted wood of old Douglas-fir stumps, logs, and debris in second-growth stands of this species in western Oregon from October to March. This variety has not been found in soil. The fungus rather commonly forms white, pinnate mycorrhizae with roots of Douglas-fir (Zak 1969) and is probably mycorrhizal with western hemlock and other conifer species.

On Melin-Norkrans medium with added agar as modified by Marx (1969), and on potato dextrose agar medium, the raised cottony mat is at first bright white, becoming uniformly cream to light tan. Old mats, especially on a thin medium, often develop rusty-brown radial streaks. Abundant conidiophores with mature spores are produced on aerial hyphae. Cultural characteristics are described by Zak (1969).

Byssoporia terrestris var. *lilacinorosea* Larsen et Zak, var. nov.

ETYMOLOGY: From *lilacinus* (L., adj.) = lilac colored + *roseus* (L., adj.) = rose colored. To indicate that parts of basidiocarps and associated structures are colored an admixture of colors from lilac to rose.

Basidiocarps cum poris albis vel cremeis, partim roseis, subroseolis, ruberis, alboroseis, vel brunneo-aurantiacis; subiculo calcareo-roseolo vel roseolobrunneo; rhizomorphis albis, farinaceis, hyphis ad centrum (2.5-)3-5(-8)µm diam, fibulatis, hyphis superficialibus distincte bifurcatis; mycorrhizis pinnatiformis, albis, hyphis superficialibus distincte bifurcatis.

HOLOTYPE: U.S.A.: Oregon, Coast Ranges, Mary's Peak area west of Philomath, associated with decayed *Pseudotsuga menziesii*, collected B. Zak, Zak collection series and number CS-19-68(B), 13·XII·1968 (CFMR), and isotype in OSC.

Basidiocarps with pore surfaces white to cream but with portions staining rose, bright red, and pale pink to dark rose or deep brick orange, with the underside of the subiculum (in dried specimens) a cream to chalky pink or rose to pinkish brown; rhizomorphs white, appearing farinaceous; surface hyphae with noticeable staghorn branching; core or central hyphae (2.5-)3-5(-8)µm diameter, septate with clamp connections; mycorrhizae white, pinnate, surface hyphae with staghorn branching.

Fluorescence (3660 Å) of fresh basidiocarps: pore surface dark, blue-gray, strongly outlining pores against a white background, with scattered, weak yellow- and occasionally weak rose-colored areas, underside dull blue-gray with rose tint, with scattered, weak rose stains; of dried sporophore: pore surface and underside variegated with cream to tan, rose, deep purple, and pink-brown, surface depressions light cream.

Chemical reagent color reactions

Chemical reagent	Fresh basidiocarps	Dried basidiocarps
Chlorovanillin	Pore surface turns weak pink to pink-orange in 5-10min, underside pink-orange in 1-3 min, more intense in 5-10min	Pore surface and underside turn pale orange to orange-red within 2 min
FeSO ₄	Pore surface, bruise points, and cut surfaces of underside turn dull blue-gray within 3-5 min	Dissepiments turn black and pore walls and underside dull blue-gray within 3-5 min

Chemical reagent color reactions

Chemical reagent	Fresh basidiocarps	Dried basidiocarps
NH ₄ OH, concentrated	Pore surface turns dull yellow to yellow-orange within 5 min; underside no change	Both surfaces unchanged to almost immediately bright pink to bright red, depending on initial color
KOH, 15%	Pore surface turns deep maroon in 3–5 min, underside unaffected	Pore surface and underside almost immediately turn blue-purple, then red-purple to maroon; after 5 min, all tissues are dull orange
Sulfoformol	Pore surface and especially underside turn pale lemon yellow in 1 min and pale orange after 5 min	Both surfaces turn pale yellow to pale orange in 1 min, becoming strong, drab orange in 5 min

OTHER SPECIMENS EXAMINED: Oregon, Coast Ranges, Mary's Peak, collected M. J. Larsen, 8·XI·1971 (FP 133041, 133043, 133045), 12·XI·1971 (FP 133069, 133071, 133072), 29·XI·1971 (FP 133121); collected B. Zak, 6·I·1969 (CS-2-69[A], CS-2-69[E]), 13·III·1970 (CS-2-70[C]); collected B. Zak and L. Froidevaux (CS-7-72[D]). All specimens on file in CMFR.

Variety *lilacinorosea* occurs in brown rotted wood of old Douglas-fir stumps, logs, and debris in second-growth stands of this species in western Oregon from October to March (has not been found in soil). The fungus forms white, pinnate mycorrhizae with roots of *P. menziesii* and western hemlock and probably with other conifer species.

On Melin–Norkrans medium with added agar as modified by Marx (1969), the raised cottony mat is first bright white, becoming dull white with or without a pink or rose tint. Cultural characteristics and mycorrhizae formed by this species are described by Zak and Larsen (1978).

Byssoporia terrestris var. *parksii* (Murr.) Larsen et Zak, comb. et stat. nov.
= *Poris parksii* Murr., Mycologia, 13: 175. 1921.

HOLOTYPE: California, Saratoga, the Boy's Outing Farm, "beneath leaves on roots of tanbark oak in a dense oak forest," collected H. E. Parks, 965, 13·I·1921 (NY), and isotypes in BPI, SYRF, K, and S.

Basidiocarps with pore surfaces pale yellow and parts with orange stains, uniformly deep yellow-orange when dry, some areas stained brown, with the underside of the subiculum yellow with occasional orange stains and finally drying distinctly yellow; subicular hyphae not inflated at septa; rhizomorphs pale yellow with parts dull to bright orange, core or central hyphae of rhizomorphs 4–11 μm diameter, septate, and with infrequent clamp connections; mycorrhizae green-tinted yellow, pinnate to ramiform.

Fluorescence (3660 Å) of fresh basidiocarps: young pore surface pink to pink-orange, and orange stains bright yellow-orange to orange, underside pink with orange zones and orange parts a bright yellow; pore surface of dried basidiocarps: dull, pink-gray with deep rust-orange stains, underside strong pink blending into orange with some yellow along margin.

Chemical reagent color reactions

Chemical reagent	Fresh basidiocarps	Dried basidiocarps
FeSO ₄	All tissues become black within 2–5 min	All tissues become gray to black within 2–5 min
NH ₄ OH, concentrated	All tissues turn bright orange within 0.5 min	All tissues turn bright orange within 2 min
KOH, 15%	All tissues turn bright orange within 0.5 min	All tissues turn bright orange within 1 min

OTHER SPECIMENS EXAMINED: Canada: Alberta, Banff National Park, Mosquito Creek on *Picea*, R. L. Gilbertson 6395 and 6442, 29·VII·1966 (CFMR). U.S.A.: Arizona, Chiricahua Mts., Coronado National Forest, near Portal, on *Picea engelmannii* Parry, J. L. Lowe and R. L. Gilbertson

(Lowe 10001), 8·IX·1958 (SYRF); Coconino National Forest, on *Pinus ponderosa* Laws., R. L. Gilbertson 7557, 21·IX·1967 (CFMR); California, Mt. Tamalpais, Marin County, on decayed wood, H. E. Parks 2983, 12·XII·1925 (BPI); Colorado, Roosevelt National Forest, Cameron Pass, on con-

ifer log, J. L. Lowe, R. W. Davidson, and T. E. Hinds (Lowe 6043), 13·VIII·1955 (SYRF); Arapaho National Forest, Fraser Experimental Forest, Fraser, on conifer, J. L. Lowe, R. W. Davidson, and T. E. Hinds (Lowe 6178), 21·VIII·1955 (SYRF); Fools' Creek Road, on *Pinus contorta* Dougl., J. L. Lowe, R. W. Davidson, and T. E. Hinds (Lowe 6245, 6251, 6265, 6280), 22·VIII·1955 (SYRF); Roosevelt National Forest, Cameron Pass, on conifer wood, J. L. Lowe and R. L. Gilbertson (Lowe 6349 and 6353), 25·VIII·1955 (SYRF); Idaho, Payette National Forest, Fish Creek Summit, on conifer log, J. L. Lowe and R. L. Gilbertson (Lowe 6893a), 10·IX·1956 (SYRF); Montana, Glacier National Park, Lake McDonald, on and in old western hemlock log, R. L. Gilbertson 872, 20·X·1954 (SYRF); Echo Lake, on conifer log, R. L. Gilbertson 892, 23·X·1954 (SYRF); Glacier National Park, on Douglas-fir, R. L. Gilbertson 4560, 11·VII·1964 (CFMR); New Jersey, Newfield, on *Pinus*, J. B. Ellis 28 (FH, BPI); New York, Warrensburg, on *Populus*, J. L. Lowe 14092, 25·IX·1965 (SYRF); North Carolina, Chapel Hill, on *Quercus*, J. L. Lowe 2831, 2837, 2844, 2847, 13·X·1945 (SYRF) 2895 and 2985, 17·X·1945 (SYRF), and 2934, 18·X·1945 (SYRF); on *Pinus*, J. L. Lowe 2852, 14·X·1945 (SYRF); Oregon, Coast Ranges, Mary's Peak, on and in decayed wood of *Pseudotsuga menziesii* partially buried in soil, M. J. Larsen, FP 133044, 8·XI·1971 (CFMR), and B. Zak, CS-20-68(D), 26·XII·1968 (CFMR), CS-2-69(D and F), 6·I·1969 (CFMR), CS-2-70(A), 13·III·1970 (CFMR); Pennsylvania, Huntington County, Harry's Valley, on *Quercus*, J. L. Lowe 2752, 16·IX·1945 (SYRF); Virginia, Shenandoah National Forest, near Hoover Camp, on soil of roof of small pocket in bank of Rapidan River, R. W. Davidson, 7·X·1934 (SYRF, BPI).

Byssoporia terrestris var. *parksii* is the most widely distributed of the presently recognized varieties. In the west, it is found in brown rotted wood of Douglas-fir stumps, logs, and slashings in second-growth stands in western Oregon from October to March. In eastern North America, it is associated, primarily, with brown rotted wood of

Quercus sp. and less frequently with *Populus* sp. and *Pinus* sp. We have found no distinct differences between western and eastern collections of what we refer to as var. *parksii*. It has not been found on soil. The fungus forms yellow, pinnate to ramiform mycorrhizae with roots of Douglas-fir and is probably mycorrhizal with western hemlock and other conifer species.

On Melin-Norkrans medium with added agar as modified by Marx (1969), the mat is first raised, white to white with a yellow-green tint, coarsely cottony; the older mat is appressed to raised (up to 1mm), coarsely felty, white to cream with tan and dark gray-brown zones. Additional characteristics of mycorrhizae formed by this variety and cultures are given by Zak and Larsen (1978).

Byssoporia terrestris var. *sartoryi* (Bourd. et L. Maire) Larsen et Zak, comb. et stat. nov.

≡ *Poria sartoryi* Bourd. et L. Maire, Assoc. Fr. Av. Sci. p. 619.1921 (not seen but cited as such in Bull. Soc. Mycol. Fr. 41: 216. 1925.)

≡ *Poria terrestris* subsp. *sartoryi* (Bourd. et Maire) Bourd. et Galz., Hym. Fr. p. 655. 1928.

≡ *Byssocorticium sartoryi* (Bourd. et L. Maire) Bond. et Sing., Ann. Mycol. 39: 48. 1941.

HECTOTYPE: France, Bois du Donon (Vosges), sur bois très pourris, sapin, L. Maire 1628 (Bourdot Herb. 31395) III·1921 (PC).

Basidiocarps with pore surfaces white but with parts blue-green, blue, or purple, with the underside of the subiculum similarly stained; rhizomorphs white but with parts pale to dark blue, sometimes totally purple; core or central hyphae of rhizomorphs 2.4–5.5 μm diameter, septate, some clamp connections present, surface of rhizomorphs comprised of characteristic thick-walled curly hyphae with narrow lumina; mycorrhizae pinnately compound with clusters up to 3.0 cm across, white to dull white with parts blue-green, green, or purple.

Fluorescence (3660 Å) of fresh sporophore: pore surface and underside white; pore surface of dried sporophore: dull white to dull pink-lavender, underside dull pink to pink-lavender.

Chemical reagent color reactions

Chemical reagent	Fresh basidiocarps	Dried basidiocarps
Chlorovanillin	Dissepiments turn purple in 1 min; underside becomes purple in 1 min	Pore surface and underside turn light reddish purple in 0.5 min, deep reddish purple in 1 min
KOH, 15%	Pore surface and underside immediately turn orange-pink	Pore surface and underside turn pale orange within 0.5 min

Chemical reagent color reactions

Chemical reagent	Fresh basidiocarps	Dried basidiocarps
Melzer's	Pore edges turn brilliant green in 1 min, walls remain white. Underside becomes brilliant green in 1 min	No reaction
Sulfoformol	Pore walls turn orange almost immediately. After 1 min, walls are pink and pore edges a bright red. Underside becomes bright red after 1 min	Pore surface and underside turn a deep reddish-brown within 5 min

OTHER SPECIMENS EXAMINED: Oregon, Coast Ranges, Siuslaw National Forest, Mary's Peak, on bark and in brown rotted wood of *Pseudotsuga menziesii*, M. J. Larsen, 12·XI·1971 (FP 133066, CFMR), and 16·XI·1971 (FP 133079, CFMR); near Alsea, in and on brown rotten wood of Douglas-fir, M. J. Larsen, (FP 133426, CFMR); Willamette National Forest, 4 mi N of Cascadia, on brown rotted wood of Douglas-fir, M. J. Larsen, 17·XI·1972 (FP 133507, 133508, 133509, 133511, 133517, CFMR); Siuslaw National Forest, Mary's Peak area, Philomath, in decaying wood of Douglas-fir, B. Zak, CS-11-67, 21·XI·1967 (CFMR); under bark slab of Douglas-fir stump, B. Zak, CS-1-68(A), 17·I·1968 (CFMR); on decayed wood of Douglas-fir, B. Zak, CS-21-68(A), 28·XII·1968 (CFMR); Cascadia, near Fernview Campground on U.S. 20, on conifer wood, B. Zak and A. Yusha, CS-3-72(A and B), 16·X·1972 (CFMR); Washington, Gifford Pinchot National Forest, near Randle, on conifer wood, B. Zak and A. Yusha, CS-4-72(A and B), 20·X·1972 (CFMR).

Collections of this fungus have been found in brown rotted wood of old Douglas-fir stumps, logs, and debris in second-growth stands of this species in western Oregon from October to March. One collection came from mineral soil free of any large pieces of decayed wood in an old-growth Douglas-fir stand; sporocarps were nestled in cavities in soil, along roots. The fungus forms white, pinnate mycorrhizae with roots of Douglas-fir and western hemlock (Zak 1969).

On Melin-Norkrans medium with added agar as modified by Marx (1969), and on potato dextrose agar medium, the raised, cottony mat is first bright white. At age 5 weeks, the center is purple, grading outward to deep blue, blue-green (colors are same as sporocarp stains), and finally, to a narrow to moderately broad white margin. The nature of mycorrhizae and cultural characteristics are further described by Zak (1969).

Byssoporia terrestris var. *sublutea* Larsen et Zak, var. nov.

ETYMOLOGY: From *sub-* (L. comp. form) =

somewhat + *luteus* (L., adj.) = yellow. To indicate pigmentation of parts of basidiocarps and associated structures.

Basidiocarpis cum poris obscurocremeis vel obscurocorallinescens, interdum pactim obscurocorallinescens; subiculo similiter coloribus; hyphis subiculis inflatis ad septis; rhizomorphis sulphureis vel obscurocorallinescens, hyphis ad centrum 5–8 μm diam, fibulatis, inflatis ad septis, hyphis superficialibus distincte spiralibus; mycorrhizis pinnatiformis, sulphureis vel obscurocorallinescens, hyphis superficialibus distincte spiralibus.

HOLOTYPE: Oregon, Willamette National Forest, on U.S. 20, 15 mi E of Cascadia, in mineral soil mixed with decayed wood under *Pseudotsuga menziesii* and *Tsuga heterophylla*, B. Zak and L. Froidevaux, Zak collection series and number CS-6-72(D), 24·XI·1972 (CFMR), and isotype in OSC.

Basidiocarps with pore surfaces at first dull cream, becoming pale dull coral or with parts only dull coral; underside of subiculum similarly colored; subicular hyphae distinctly inflated at septa; rhizomorphs sulphur-yellow to pale coral, core or central hyphae 5–8 μm diameter, septate with clamp connections frequent, surface hyphae assuming a spiral form, 2.5–3.5 μm diameter; mycorrhizae in pinnate fans, becoming clustered and clumped, sulphur yellow and often becoming pale coral, surface hyphae assuming a spiral form.

Fluorescence (3660 Å) of young mantle and rhizomorphs deep maroon.

Chemical reagent color reactions¹¹

Chemical reagent	Dried basidiocarps
Gum guaiac (in 95% ethanol)	Underside yellow in 1 min then fading
H ₂ SO ₄ , concentrated	In 1 min, underside particularly rhizomorphs, turns bright reddish orange; pore surface similar, but reaction slower and not as intense
KOH, 15%	Underside and especially rhizomorphs turning bright orange, and then becoming dull orange

Chemical reagent color reactions^a

Chemical reagent	Dried basidiocarps
NH ₄ OH, concentrated	Underside and especially rhizomorphs bright reddish orange to pale dull maroon, quickly fading
Alpha-naphthol	Pore surface and underside quickly turn pale dull pink

^aTests with sulfovanillin, pyrogallol, Melzer's reagent, FeSO₄, guaicol, and sulfobenzaldehyde were negative or results were erratic.

OTHER SPECIMENS EXAMINED: U.S.A.: Oregon, Willamette National Forest, 3 mi N of Mountain House, in mineral soil and brown rotted conifer wood under *P. menziesii* and *T. heterophylla*, M. J. Larsen 17·XI·1972 (FP 133515, CFMR); Mexico, Morelos, northeast of Cuernavaca, on old leaves and rotten wood in a subtropical *Quercus* forest, J. Trappe, 3485, 12·IX·1972 (CMFR).

Discussion

We have considered extra-North-American names that are apparently facultative synonyms of *B. terrestris*. We assume from our experience with the species and its varieties in western North America that the 'strains' exhibiting different characteristics from the varieties presented here, will, in all probability, be additional distinct varieties with similar degrees of specialization. It is not surprising, even in light of this specialization, to find *B. terrestris* var. *sartoryi* in two widely separated geographical areas, as many other fungus species (mycorrhizal symbionts or nonsymbiotic wood inhabitants) have circumglobal distributions. What is noteworthy of var. *sartoryi*, though, is its apparent confinement to the Pacific Northwest in North America as are vars. *lilacinorosea* and *aurantiaca*. In contrast, however, var. *sublutea* ranges from the Pacific Northwest south to central Mexico, while var. *parksii* apparently occurs throughout the forested areas of North America.

A limited number of European collections representative of *B. terrestris* have been examined,

including the nomenclatural types of *P. mycorrhiza*, *P. mollicula*, and *P. sartoryi*. The type of *P. terrestris* fa. *corticiformis* Bourd. & Galz. was not available for examination. Only *P. sartoryi* can be equated with forms that occur in North America. We would also emphasize that the type of *Poria sartoryi* does not contain mycorrhizal structures; therefore, comparisons of respective mycorrhizae could not be made.

Poria mycorrhiza and *P. mollicula* probably represent additional distinct varieties, as do some individual collections that we have examined from Sweden and Switzerland.

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