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## Morphological studies of *Dendrothele* species from North America

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**Abstract:** The new species *Dendrothele gilbertsonii*, from southern Arizona, is distinct from *Dendrothele incrustans* and *Dendrothele microspora* that also have globose to subglobose basidiospores. *Dendrothele pachysterigmata*, with 2–4 sterigmate basidia, is compared to *Dendrothele commixta*, which has 2–3 sterigmate basidia. All five species are described and illustrated.

**Key words:** Agaricales, dendrohyphidia, cyanophilous basidiospores

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**Introduction:** *Dendrothele* Höhn. & Litsch (1907) is a heterogeneous corticioid genus with discoid or crustose basidiomes with a smooth to tuberculate hymenial surface and occasionally with small, sterile pegs. The hyphal system is monomitic, and dendrohyphidia and gloeocystidia are often present. Basidia are suburniform to clavate and bear variously shaped

basidiospores with nonamyloid, often cyanophilous, smooth, hyaline, thin or thickened walls. Lemke (1964, 1965) included 14 species in the first comprehensive study of *Dendrothele* (syn. *Aleurocorticium* P. A. Lemke). Subsequently, many new species have been described. In 2009, 41 accepted species of *Dendrothele* were listed in CortBase (Parmasto et

al. 2004). Molecular phylogenetic studies have shown that *Dendrothele griseocana* (Bres.) Bourdot & Galzin, the generic type of *Dendrothele*, is embedded in the Agaricales clade and closely related to *Lachnella* Fr. and *Cyphellopsis* Donk (Binder et al. 2005, Bodensteiner et al. 2004, Goranova 2003, Langer 2001). Goranova (2003) demonstrated that *Dendrothele* is highly polyphyletic with taxa distributed among eleven lineages in the hymenochaetoid, russuloid, corticioid, and euagarics clades. She concluded that convergences in morphological traits and habitat occurred repeatedly in this group.

In this paper, five species of *Dendrothele sensu stricto* from North America are described and illustrated, including a new species from southern Arizona.

**Materials and Methods:** Thin, freehand sections from basidiomes were mounted in 2% aqueous potassium hydroxide and 1% aqueous phloxine or Melzer's reagent (Kirk et al. 2001) and examined under an Olympus BH2 compound microscope. To facilitate microscopic observations, sections were sometimes pretreated with a drop of hydrochloric acid (37% diluted 1:1 in water) to dissolve the abundant crystals (Boidin et al. 1996). Drawings were made with a camera lucida attachment. Cyanophily of basidiospore and hyphal walls were observed in 0.1% cotton blue in 60% lactic acid (Kotlaba and Pouzar 1964, Singer 1986). Q values were obtained from dividing average basidiospore length by width (Kirk et al. 2001). Basidiospores are often scarce in specimens, thus Q values based on less than 30 basidiospores are approximate. Color names are from Kornerup and Wanscher (1978). Herbarium designations follow that of Holmgren et al. (1998). Argentinian specimens are from the herbarium at Centro de Investigación y Extensión Forestal Andino Patagónico (CIEFAP), Esquel, Chubut, Argentina. CortBase (Parmasto et al. 2004) and the

Aphyllphorales database at CBS (<http://www.cbs.knaw.nl/databases/aphyllo/database.aspx>) were consulted frequently throughout this study.

## Results

***Dendrothele commixta*** (Höhn. & Litsch.) J. Erikss. & Ryvarden, *Corticaceae* North Europe 3: 355. 1975. Figs. 1–2

*Corticium commixtum* Höhn. & Litsch., *Sitzungsberichten Kaiserlichen Akademie Wissenschaften Wien, Mathematisch-naturwissenschaftliche Klasse, Abteilung I*, 116: 821. 1907.

= *Thelephora acerina* var. *quercina* Pers., *Synopsis Methodica Fungorum* 2: 582. 1801.

Basidiomes resupinate, effuse, small linear to orbicular colonies becoming confluent, up to 50 × 25 mm, thin, 150–300 µm thick, occasionally up to 1 mm thick, adnate, firm, subceraceous to crustose, sometimes friable, chalky, or subfuzzy-pubescent; hymenial surface smooth to verruculose, yellowish white [(3–4)A2], yellowish grey (4B2), pale yellow [4A(3–4)], pale orange (5A3), orange grey (5B2), greyish orange (5B3), or brownish orange (5C3); cracks absent or few; margin distinct, abrupt, adnate, dull white to yellowish white (4A2). Hyphal system monomitic with clamped generative hyphae. Subiculum filled with abundant, coarse, hyaline crystals; subicular hyphae 2.5–3.5 µm diam, clamped, moderately to frequently branched, walls hyaline, thin, smooth. Catahymenium poorly developed, composed of scattered dendrohyphidia and basidia embedded in a crystalline matrix. Dendrohyphidia rare, hyphoid, irregular, with short or knobby branches near apex, 15–45 × 2–4 µm, clamped at base, walls hyaline, thin, smooth. Cystidia and gloecystidia none. Basidia suburniform, clavate, or subcylindrical, sometimes with a basal lobe, often medially constricted, usually with a distinct stalk, 21–45 × 5–8 µm, clamped at base, walls hyaline, thin, smooth; sterigmata 2–3, thick, digitate, 10–12 ×

2.5  $\mu\text{m}$ , rarely up to  $16 \times 3 \mu\text{m}$ . Basidiospores ellipsoid to broadly cylindrical, sometimes slightly broader at distal end, adaxial side often flattened, with a small, rounded apiculus,  $(9-10-12(-13) \times (5-6-7.5(-8) \mu\text{m}$ ,  $Q = 1.6-1.7$  ( $n=30$ ), walls hyaline, up to 1  $\mu\text{m}$  thick, smooth, cyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. Common on dead, attached branches and bark of *Quercus*, especially *Q. robur* L., and other angiosperms throughout Europe. Reported from Great Britain (Legon and Henrici 2005, Roberts 1993), Denmark, Norway, Sweden and Finland (Hansen and Knudsen 1997), Spain (Tellería 1990), France (Bourdote and Galzin 1928), Italy (Bernicchia 1990), Austria (Kahr et al. 1996), Poland (Piątek 2001), and Ukraine; rare in the United States (Mississippi).

Type specimens examined. SWEDEN. Ad Stockholm, in truncos vivo *Quercus robur* (bark), Nov 1893, Romell, Fungi exsiccati praesertim scandinavici no. 126, as *Corticium acerinum* Pers. f. *quercus* (holotype S, F127410; isotypes FH and NY NYBG808291).

Representative specimens examined. FRANCE. Couzon (Rhône), sur *Quercus robur* vivant, 14 Avril 1963, J. Boidin, LY4487 (LY); Vaugneray (Rhône), sur écorce d'un *Quercus* de grande taille, 28 Avril 1956, J. Boidin, LY2206 (LY); Jumeaux-Vaugneray (Rhône), sur *Q. robur* (bark), 7 Mar 1958, J. Boidin, LY2969 (LY); La Tour de Salvagny, sur *Q. robur* vivant, 3 Feb 1957, J. Boidin, LY2536 (LY). SPAIN. Álava, Amurrio, Lezama, 30TWN0364, 370 m, on *Q. robur* (bark), 24 Jan 1987, I. Salcedo & Grupo 111, MA-Fungi38015 (MA). SWEDEN. Uppland, Löts sn, Fånö, Skärsudden, ek-hassellund vid N. Björkfjärden, på *Q. robur*, 21 Nov 1976, I. Nordin, F127404 (S). UKRAINE. Carpatorossia, ad rivum Kuzy prope vicum Trebusany, alt. 800-1200 m, on *Quercus* (bark), Aug 1934, A. Pilát, as *Aleurodiscus acerinus* (BPI US0284124, NY NYBG295129). UNITED STATES. Mississippi,

Jefferson County, 6.6 miles south Lorman, on bark of hardwood, 16 Oct 1962, D. E. Stone (NY NYBG520179).

Descriptions and illustrations. Boidin et al. (1996), Bourdote and Galzin (1928), Duhem and Michel (2007), Eriksson and Ryvarden (1975), Höhnelt and Litschauer (1907), Roberts (1993).

*Dendrothele commixta* is distinguished by its smooth to verruculose basidiomes, clamped hyphae, 2-3 sterigmate basidia, and ellipsoid basidiospores with thickened, cyanophilous walls. *Dendrothele pachysterigmata* (described below) has basidiospores of similar shape and size but is restricted to *Tsuga* sp. in Ontario, Canada. Additionally, basidiomes of *D. pachysterigmata* are thinner (up to 140  $\mu\text{m}$  thick), subceraceous to pruinose or porulose with clavate to cylindrical basidia commonly with 3-4 sterigmata (Table 1).

*Dendrothele griseocana* and *D. andina* (Pat.) Nakasone also have 2-sterigmate basidia, but they develop sterile hyphal pegs (Nakasone 2006). Other species of *Dendrothele* with 2-sterigmate basidia include *D. citrisporella* Boidin & Duhem, with biapiculate basidiospores (Boidin et al. 1996), and *D. tuberculata* Gresl. & Rajchenb. from Argentina, with a strongly tuberculate hymenial surface and subglobose to broadly ellipsoid basidiospores,  $Q = 1.2-1.3$  (Greslebin and Rajchenberg 1998).

The report of *C. commixta* from New Zealand by Cunningham (1963) could not be confirmed. Nine specimens cited by Cunningham were examined, but none were *D. commixta*. They were identified as *Dendrothele incrustans* (2 specimens), *Dendrothele* sp. (sterile, 3 specimens), *Hyphodontia* sp. (1), *Xenasma* sp. (1), and *Aleurodiscus* sp. (2). Malençon and Llimona (1980) described *D. commixta* from Spain but this specimen has basidia with 3-4 sterigmata and small, acyanophilous basidiospores,  $6.4-8.5 \times 5.2-6.6 \mu\text{m}$ .

***Dendrothele gilbertsonii*** Nakasone sp. nov.

MycoBank No. 515207

Figs. 4–5

*Basidiomata effusa, usque ad 430 µm crassa, ceracea, laevia vel tuberculata, rimis profundis, luteola vel cinereo-cinnamonea, marginibus abruptis. Systema hypharum monomiticum fibulatis. Dendrohyphidia 20–45 × 1–4 µm. Gloeocystidia clavata vel cylindrica, aliquando lobata, 35–50 × 8–12 µm. Basidia clavata vel suburniformia constrictis, 30–50 × 7–12 µm. Basidiospores late ellipsoidea, 10–12.5 × 8–9.5 (–10) µm, tunicis hyalinis, paulo incrassatis, laevibus, cyanophilis. Holotype — UNITED*

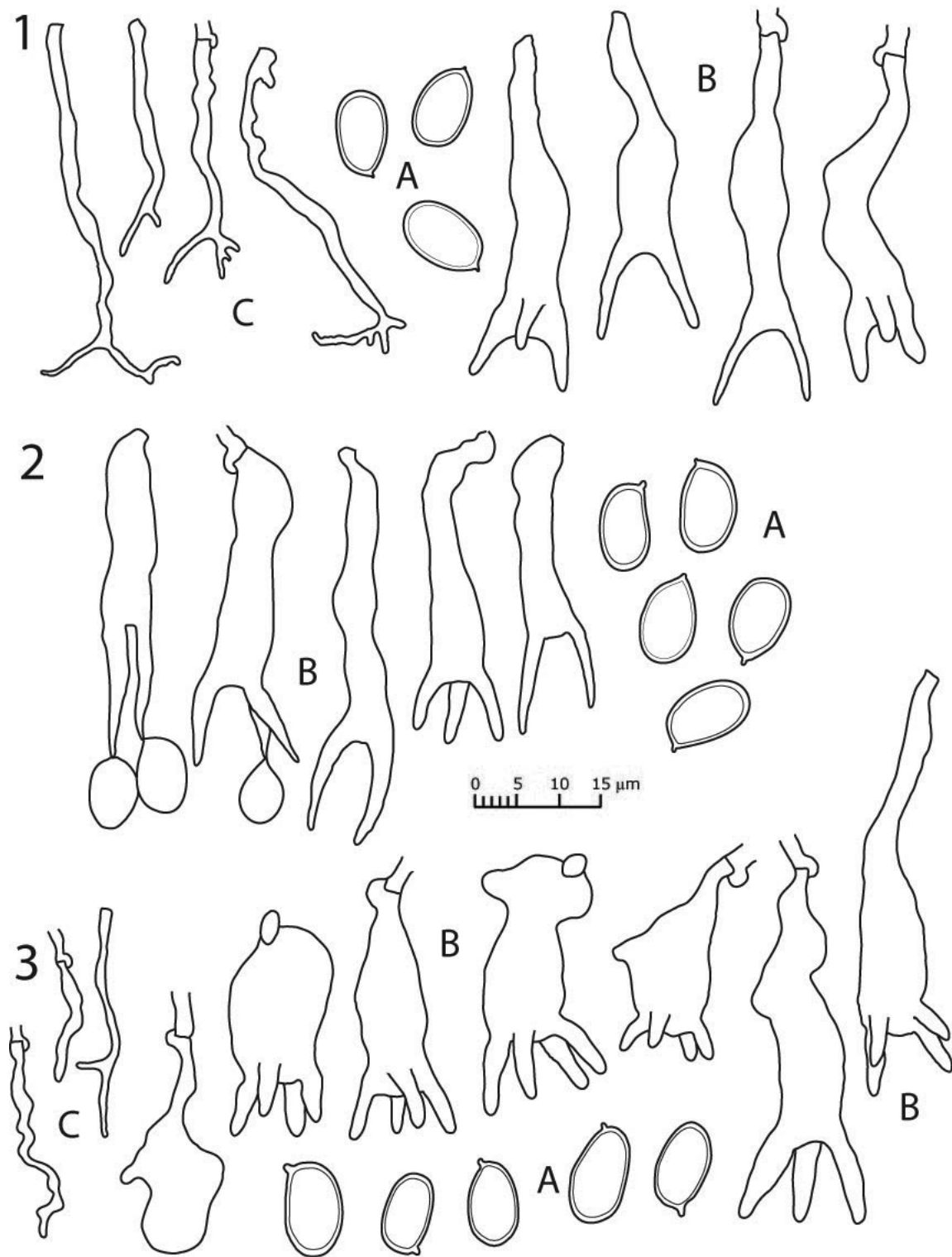
STATES. Arizona, Santa Cruz County, Coronado National Forest, Sycamore Canyon, on bark of *Quercus toumeyi* Sarg., 24 Sep 1970, R. L. Gilbertson 9948, US0285732 (BPI; isotypes ARIZ, CFMR).

Etymology. Named after the eminent American mycologist Robert L. Gilbertson.

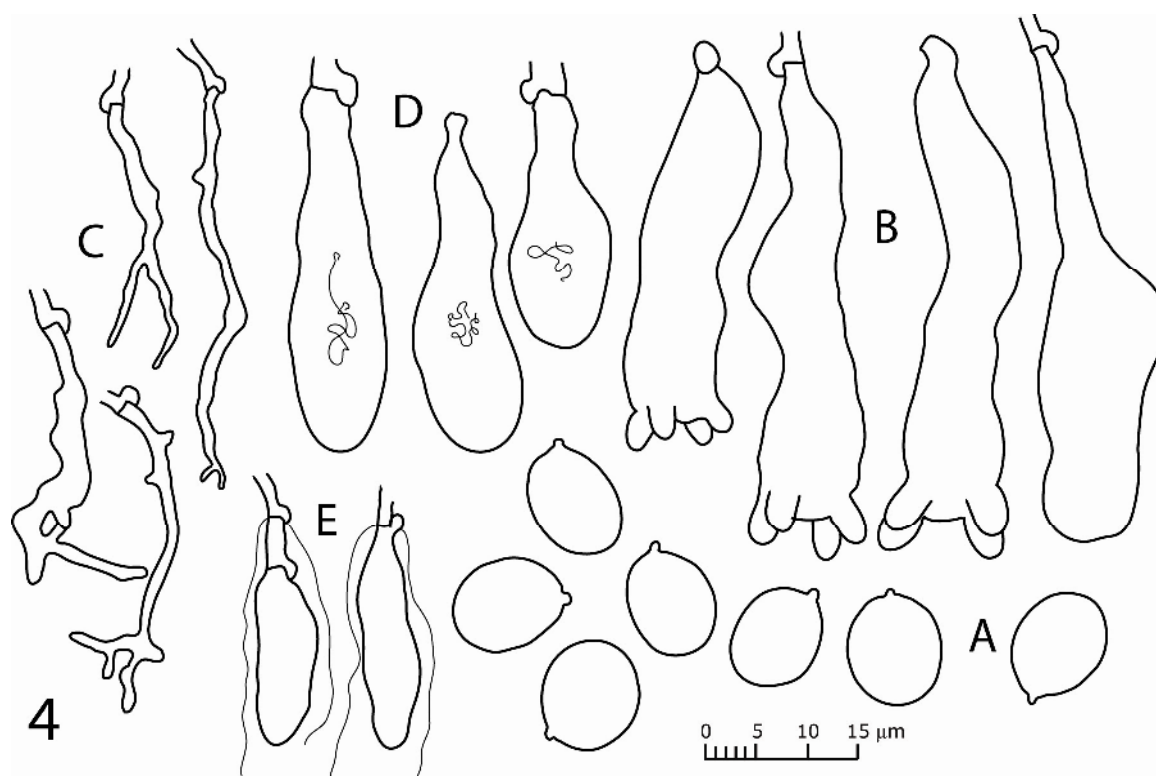
Basidiomes resupinate, effuse, beginning as small, irregular colonies that coalesce, up to 25 × 10 mm, thin to moderately thick, up to 430 µm thick, adnate but easily separated from substrate, soft to subceraceous; hymenial surface smooth to

Table 1. Useful morphological characters to differentiate *Dendrothele commixta* and *D. pachysterigmata*.

Characters	Species <i>Dendrothele commixta</i>	<i>Dendrothele pachysterigmata</i>
Basidiome texture	subceraceous to crustose, sometimes friable and chalky or subfelty and pubescent	subceraceous, pruinose, rarely finely porose
Basidiome thickness (µm)	150–300	up to 140
Basidium shape	suburniform, clavate or subcylindrical, ± basal lobe	clavate to cylindrical, ± basal lobe
Basidium size (µm)	21–45 × 5–8	(14–)20–35(–43) × 7–11
Sterigmata	2–3	(2–)3–4
Basidiospore shape	cylindric to ellipsoid	cylindric
Basidiospore size (µm)	(9–)10–12(–13) × (5–)6–7.5(–8)	(9.5–)10–11(–12) × (5–)5.5–6.5(–7)
Q value	1.6–1.7	1.8–1.9
Substrate	bark of <i>Quercus</i> , esp. <i>Q. robur</i>	bark of <i>Thuja occidentalis</i>
Distribution	common in Europe, rare in the United States (Mississippi)	Ontario, Canada



**Figs. 1–3.** Line drawings of microscopic characters of *Dendrothele commixta* and *D. pachysterigmata*. **Fig. 1.** *D. commixta*, holotype F127410. A, basidiospores; B, basidia; C, dendrohyphidia. **Fig. 2.** *D. commixta*, isotype at FH. A, basidiospores; B, basidia; C, dendrohyphidia. **Fig. 3.** *D. pachysterigmata*, isotype at NY, TRTC13455. A, basidiospores; B, basidia; C, dendrohyphidia.



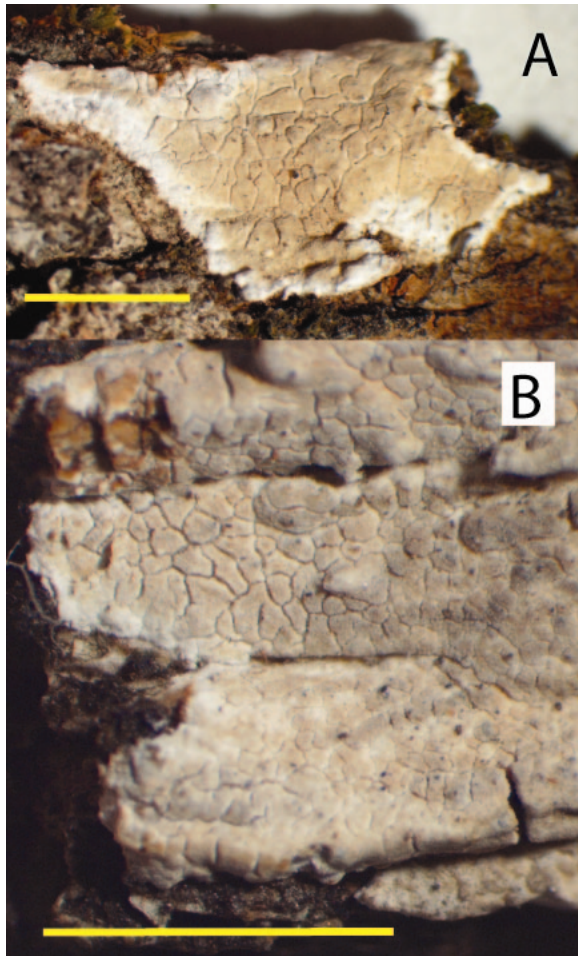
**Fig. 4.** Line drawings of microscopic characters of *Dendrothele gilbertsonii*, holotype US0285732. A, basidiospores; B, basidia; C, dendrohyphidia; D, gloecystidia; E, repetitive basidia.

tuberculate, orange white (5A2), pale orange (5A3), orange grey (5B2), greyish orange [5B(3-4)], yellowish white (4A2), or grayish white; cracks extensive, deep, sometimes forming polygons; margin well-defined, abrupt, adnate, concolorous with hymenial surface with a narrow, white fringed edge. Hyphal system monomitric with clamped generative hyphae. Subiculum a dense, agglutinated tissue with abundant, embedded, hyaline crystals; subicular hyphae 1.5–3.5  $\mu\text{m}$  diam, clamped, moderately branched, walls hyaline, thin to slightly thickened, smooth. Catahymenium a dense, compact tissue composed of embedded crystals, dendrohyphidia, gloecystidia, and basidia. Dendrohyphidia abundant, filiform, with knobs or short lateral branches at apex, occasionally elaborately branched, 20–45  $\times$  1–4  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, sometimes coated with a brown, mucilaginous material or a

thin, hyaline, crystalline sheath. Gloecystidia clavate to cylindrical, sometimes with a basal lobe, 35–50  $\times$  8–12  $\mu\text{m}$ , tapering to 1.5–3  $\mu\text{m}$  diam at base, with a basal clamp, sometimes with resinous contents, contents not reacting with sulfovanillin, walls hyaline, thin, smooth. Basidia clavate to suburniform, sometimes repetitive, with median constrictions, sometimes stalked, 30–50  $\times$  7–12  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth; 4-sterigmate. Basidiospores broadly ellipsoid with a small, distinct apiculus, sometimes adherent, 10–12.5  $\times$  8–9.5(–10)  $\mu\text{m}$ ,  $Q = 1.3$  ( $n = 15\text{--}20$ ), walls hyaline, slightly thickened, smooth, cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.** Uncommon on bark and wood of *Quercus*. Known only from the type locality in southern Arizona.





**Fig. 5.** Basidiomes of *Dendrothele gilbertsonii*, holotype US0285732. A, basidiome with white margin; B, close-up of rimose basidiome. Scale bar = 3 mm.

Additional specimen examined. UNITED STATES. Arizona, Santa Cruz County, Coronado National Forest, Sycamore Canyon, on bark of *Quercus arizonica* Sarg., 21 Jan 1975, E. R. Canfield 71-24 (ARIZ).

*Dendrothele gilbertsonii* is characterized by small, discrete brownish orange basidiomes, clamped hyphae, gloecystidia and broadly ellipsoid basidiospores. The morphologically similar species *Dendrothele incrustans* lacks gloecystidia, produces globose to subglobose basidiospores and softer, thinner basidiomes (Table 2). Similar broadly ellipsoid basidiospores are found in *D. tuberculata* Gresl. & Rajchenb. *D.*

*andina* (Pat.) Nakasone, *D. griseocana* (Bres.) Bourdot & Galzin and *D. commixta*; however, in these species the basidia are regularly 2-sterigmate. Other species with similar basidiospores include *Dendrothele acerina* (Pers.) P.A. Lemke and *D. wojewodae* Pouzar that develop distinctive cystidia with an apical appendage, whereas *D. americana* Nakasone and *D. tanzaniana* Nakasone develop sterile hyphal pegs. The specimens of *D. gilbertsonii* cited herein were originally reported as *Aleurocorticium griseocanum* (Bres.) P. A. Lemke (Gilbertson et al. 1972).

***Dendrothele incrustans*** (P. A. Lemke) P. A. Lemke, *Persoonia* 3: 366. 1965. Figs. 6–9  
*Aleurocorticium incrustans* P. A. Lemke, *Canadian Journal of Botany*. 42: 739. 1964.  
*Vuilleminia incrustans* (P. A. Lemke) Parmasto, *Conspectus systematis corticiacearum* p. 149. 1968.

Basidiomes resupinate, effuse, beginning as small, linear or irregular colonies, coalescing, thin, up to 180  $\mu\text{m}$  thick, adnate, soft, subcretaceous, finely pruinose or farinaceous; hymenial surface smooth, white to yellowish white (4A2), yellowish grey (4B2), rarely orange grey (5B2) or brownish orange (6C3); scarcely to extensively cracked; margin distinct, abrupt or rapidly thinning out, adnate, pruinose. Hyphal system monomitic with clamped generative hyphae. Subiculum a tissue of partially agglutinated subicular hyphae entirely obscured by abundant, embedded, coarse, hyaline crystals; subicular hyphae 1.2–3  $\mu\text{m}$  diam, clamped, moderately branched, uneven to tortuous, walls hyaline, thin to slightly thickened, smooth. Catagymenium composed of dendrohyphidia and basidia obscured by abundant, coarse, hyaline crystals. Dendrohyphidia abundant, simple to elaborately branched with knobs and short irregular prongs, 20–40  $\times$  0.5–3  $\mu\text{m}$ , clamped at base, walls hyaline, thin, coated with a thin, even layer of loosely adherent crystals, occasionally smooth. Cystidia and gloecystidia none. Basidia

urniform at first then suburniform, sometimes clavate, often medially constricted,  $35\text{--}50(-60) \times 9.5\text{--}13\text{ }\mu\text{m}$ , up to  $90\text{ }\mu\text{m}$  long in Argentinean specimens, clamped at base, walls hyaline, thin, smooth; 4-sterigmate, sterigmata up to  $15 \times 3\text{ }\mu\text{m}$ . Basidiospores globose, subglobose, or broadly ellipsoid, with a distinct, rounded apiculus,  $9\text{--}12(-13) \times 8\text{--}10\text{ }\mu\text{m}$ ,  $Q = 1.1\text{--}1.3$  ( $n = 4\text{--}14$ ), often adherent, walls distinct, hyaline, thin to slightly thickened, smooth, weakly cyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. Uncommon on corticate twigs and branches of various angiospermous and gymnospermous shrubs and trees. Known from Canada (British Columbia), United States (California), Guadeloupe (Boidin et al. 1996), Argentina (Greslebin and Rajchenberg 1998), and New Zealand.

Type specimen examined. UNITED STATES. California, Humboldt County, Trinidad, Spruce Cove, on (corticate twigs of) *Picea sitchensis* (Bong.) Carrière, 7 Sep 1946, H. E. Parks 7025, TRTC150881, as *Aleurocorticium incrustans* (holotype TRTC).

Additional specimens examined. ARGENTINA. Dpto. Rio Grande, Tierra del Fuego, Estancia Indiana, on (corticate) *Nothofagus antarctica* (G. Forst.) Oerst., 8 Nov 1998, A. Greslebin 1801 (CIEFAP). Dpto. Chubut, Rio Senguerr, Lago La Plata, on (corticate) *N. pumilo* (Poepp. & Endl.) Krasser, 26-28 Mar 1996, A. Greslebin 574 (CIEFAP). CANADA. British Columbia, Vancouver Island, Beaver Lake, on dead standing *Acer macrophyllum* Pursh, 19 Jun 1948, H. S. Jackson, TRTC38775 (TRTC); Gold Stream Park, on *Abies grandis* Lindl., 30 Jun 1948, H. S. Jackson, TRTC38533 (TRTC); road to Sooke, on (corticate twigs of) *Taxus brevifolia* Nutt., 28 Jun 1948, H. S. Jackson, TRTC38532 (BPI US0284527, TRTC). GUADELOUPE. Au-dessus de Carrière, petit ravin au S. du départ de la trace Victor Hugues, sur arbre vivant, 12 Aug 1975, J. Boidin LY7697 (LY). NEW ZEALAND. Auckland,

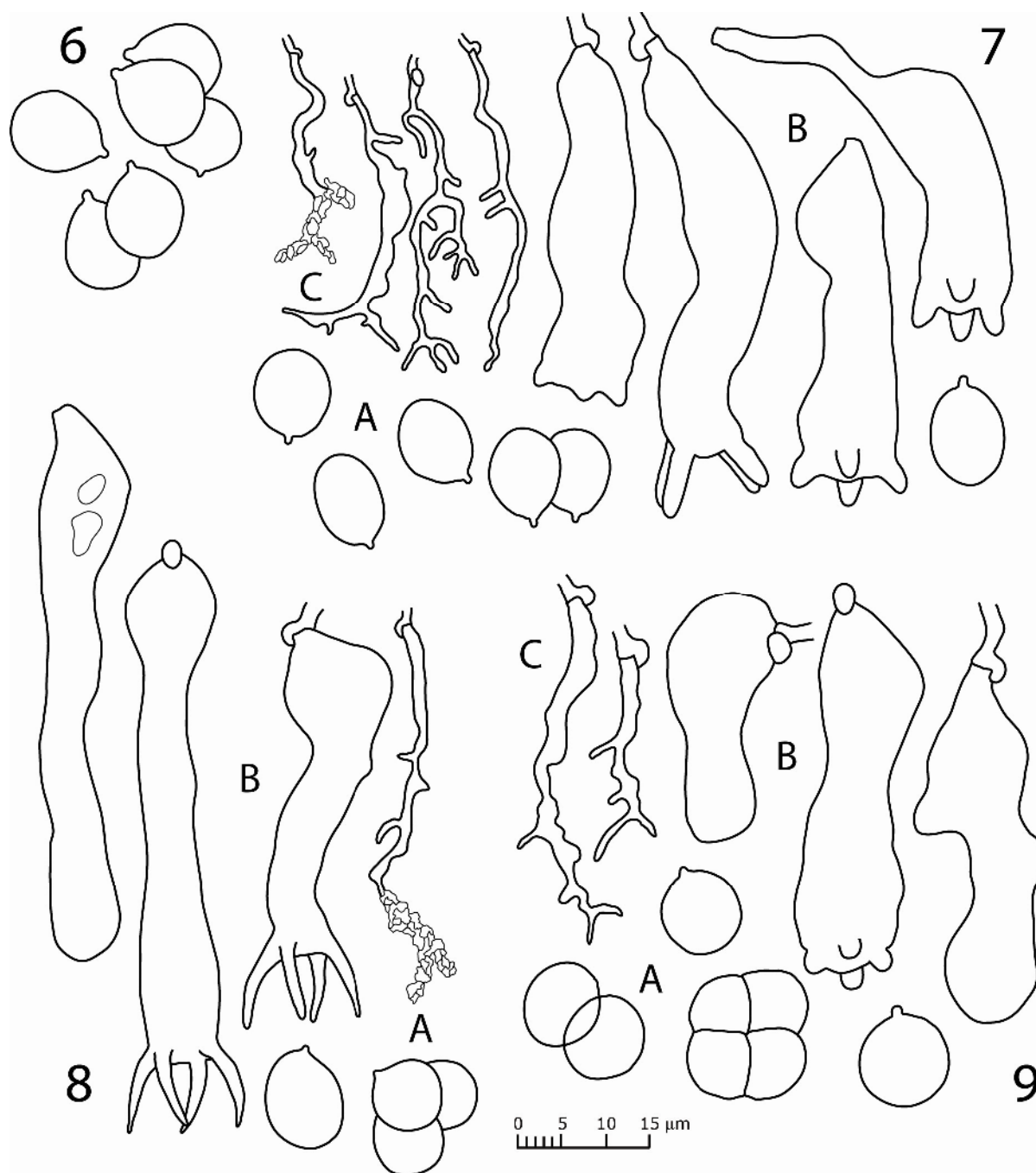
Rangitoto Island, on *Dodonaea viscosa* Jacq. (bark), Jul 1950, J. M. Dingley PDD10588, as *Corticium commixtum* (PDD). Wellington, Featherston, on *Fuchsia excorticata* L.f. (twigs), Nov 1951, J. M. Dingley PDD11231, as *Corticium commixtum* (PDD). UNITED STATES. California, Humboldt County, Trinidad, Spruce Cove, on *Spiraea douglasii* Hook. (corticate twigs), Feb 1948, H. F. Parks 7203, US0284526 (BPI); on *Ribes menziesii* Pursh (corticate branches), Mar 1948, H. E. Parks 7216, US0284524 (BPI); on corticate (twigs of) *Ribes sanguineum* Pursh, Mar 1948, H. E. Parks 7218, US0284525 (BPI).

Descriptions & illustrations. Boidin et al. (1996), Greslebin and Rajchenberg (1998).

*Dendrothele incrustans* is distinguished by soft, subceraceous basidiomes, abundant dendrohyphidia, absence of gloecystidia, and adherent, globose to subglobose basidiospores. Microscopic examination of specimens is challenging because the abundant crystals obscure the fragile, mature basidia that collapse soon after maturity and the scarce basidiospores. North American specimens are thinner and less well developed than those from the other countries. Basidiospores of *D. incrustans* are most similar in size and shape to those of *D. gilbertsonii* which has subceraceous basidiomes and gloecystidia, whereas *Dendrothele microspora* has smaller basidiospores,  $7.5\text{--}8.5 \times 6.2\text{--}6.9\text{ }\mu\text{m}$  (Table 2).

This is the first report of *D. incrustans* from New Zealand; the specimens were originally identified as *Corticium commixtum* (Cunningham 1963). *Dendrothele incrustans* was reported from Louisiana by Gilbertson and Blackwell (1987), but the specimen, MB2318, appears to be an undescribed taxon characterized by a ceraceous basidiome, compact euhymenium, smooth, globose basidiospores,  $7\text{--}8(-9.5) \times 7.2\text{--}8(-9.5)\text{ }\mu\text{m}$ , and lacking dendrohyphidia and cystidia. Similarly, *D. incrustans* from Arizona on juniper,





**Figs. 6–9.** Line drawings of microscopic characters of *Dendrothele incrustans*. **Fig. 6.** Basidiospores from holotype H. E. Parks 7025. **Fig. 7.** Paratype US0284526, H.E. Parks 7203. A, basidiospores; B, basidia; C, dendrohyphidia. **Fig. 8.** Specimen NR1801. A, basidiospores; B, basidia; C, dendrohyphidium. **Fig. 9.** Paratype US0284527, TRTC 38532. A, basidiospores; B, basidia; C, dendrohyphidia.

Table 2. Critical characters to differentiate *Dendrothele gilbertsonii*, *D. incrustans* and *D. microspora*.

Characters	Species <i>Dendrothele gilbertsonii</i>	<i>Dendrothele incrustans</i>	<i>Dendrothele microspora</i>
Basidiome texture	soft to subceraceous, smooth to tuberculate	soft, subcretaceous, finely pruinose or farinaceous	subceraceous to crustaceous, pruinose or felty, smooth, rarely tuberculate
Basidiome thickness (µm)	up to 430	up to 180	up to 150 (–350)
Basidium size (µm)	30–50 × 7–12	35–50 (–90) × 9.5–13	20–35(–50) × 6–8
Gloeocystidia (µm)	clavate to cylindrical 35–50 × 8–12	none	clavate 30–65 × 5.5–13
Basidiospore shape	broadly ellipsoid	globose to broadly ellipsoid	globose to ellipsoid
Basidiospore size (µm)	10–12.5 × 8–9.5(–10)	9–12(–13) × 8–10	(6–)7–8(–9) × (5.5–)6– 7(–8)
Q value	1.3	1.1–1.3	1.0–1.4
Substrate	bark and wood of <i>Quercus</i>	corticate twigs and branches of various angiosperms and gymnosperms	corticate twigs and branches of various angiosperms and gymnosperms
Distribution	United States (Arizona)	Canada (British Columbia), United States (California), Guadeloupe, Argentina, New Zealand	eastern Canada and eastern United States

RLG10020, (Gilbertson and Lindsey 1975) rare hyphal pegs and was reidentified as *Dendrothele americana* Nakasone (Nakasone 2006). Bernnichia (1990) reported two specimens of *D. incrustans* from Italy, but specimen 5027 is *D. wojewodae* which has cystidia with an apical appendage.

***Dendrothele microspora*** (H. S. Jacks. & P. A. Lemke) P. A. Lemke, *Persoonia* 3: 367. 1965.

Figs. 10–12

*Aleurocorticium microsporum* P. A.

Lemke, *Canadian Journal of Botany* 42: 745. 1964.

Basidiomes resupinate, effuse, beginning as small, irregular patches, confluent, up to 30 × 20 mm, thin to moderately thin, up to 150 (–350) µm thick, closely appressed, subceraceous to crustaceous, pruinose or felty; hymenial surface smooth or irregularly tuberculate, yellowish white to pale yellow [4A(2–3)], yellowish grey (4B2), or greyish yellow [4(B–C)3]; cracks sparse to moderately dense; margin distinct, abrupt or rapidly thinning out, adnate, usually paler than hymenial surface. Hyphal system monomitric with clamped generative hyphae. Subiculum a tissue of partially agglutinated subicular hyphae obscured by abundant, fine to coarse, hyaline crystals; subicular hyphae 1.5–3 µm diam,

clamped, moderately branched, irregular, walls hyaline, thin to slightly thickened, smooth. Catagymenium poorly developed, obscured by crystals, composed of dendrohyphidia, gloeocystidia, and basidia. Dendrohyphidia abundant, simple to elaborately branched at apex,  $30-40 \times 0.5-3 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth or encrusted with fine, hyaline crystals. Gloeocystidia rare to numerous, clavate to obclavate,  $30-65 \times 5.5-13 \mu\text{m}$ , clamped at base, evenly stained in phloxine, walls hyaline, thin, smooth. Basidia often collapsed at maturity, urniform at first, then suburniform with medial constrictions, occasionally clavate and stalked,  $20-35(-50) \times 6-8 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth; 4-sterigmate, sterigmata up to  $10 \times 1.5 \mu\text{m}$ . Basidiospores globose, subglobose to ellipsoid, with a distinct, small apiculus,  $(6-7)-8(-9) \times (5.5-6)-7(-8) \mu\text{m}$ ,  $Q = 1.0-1.4$  ( $n = 6-15$ ), often in clusters, contents resinous, walls distinct, hyaline, thin, smooth, sometimes faintly cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.** Common on corticate twigs and branches of angiospermous shrubs and trees, occasionally on *Juniperus* and *Taxodium*. Known from eastern Canada and United States.

**Representative specimens examined.** CANADA. Ontario, York Co. Richmond Hill, woods north of Summit Golf Course, on *Quercus* sp., 21 Nov 1936, H. S. Jackson TRTC9864 (FH); Brant County, Blue Lake, on *Carya* sp. (bark), 13 Oct 1956, R. F. Cain, TRTC32834, US0285738 (BPI). UNITED STATES. Connecticut, East Granby, on *Ulmus americana* L. bark of living tree, 9 Dec 1939, H. G. Eno, FP81426, US0283990 (BPI). Florida, Putnam County, Palatka, on *Juniperus silicicola* (Small) L. H. Bailey, 8 Aug 1985, R. L. Gilbertson 15690 (ARIZ). Illinois, Jackson County, Shawnee Nat. Forest, Little Grand Canyon, on *Carya* sp., 10 Sep 1983, H. H. Burdsall, Jr. 11770 (CFMR); on bark of *Acer drummondii* Hook. & Arn., 21 Oct 1989, H. H.

Burdsall, Jr. 12986 (CFMR). Michigan, Marquette County, Big Bay, Huron Mountain Club, Ann Lake Trail, on *Acer* sp. (bark), 27 Aug 1976, H. H. Burdsall, Jr. 9241 (CFMR). Mississippi, Stoneville, station forest, on *Cornus florida* L. (corticate) branch, 13 Oct 1955, P. L. Lentz, FP106811 (CFMR). Wisconsin, Sauk County, Devil's Lake State Park, on bark of living *Carya ovata* (Mill.) K. Koch, 24 Sep 1993, T. J. Volk 93-120 (CFMR).

**Description and illustration.** Lemke (1964).

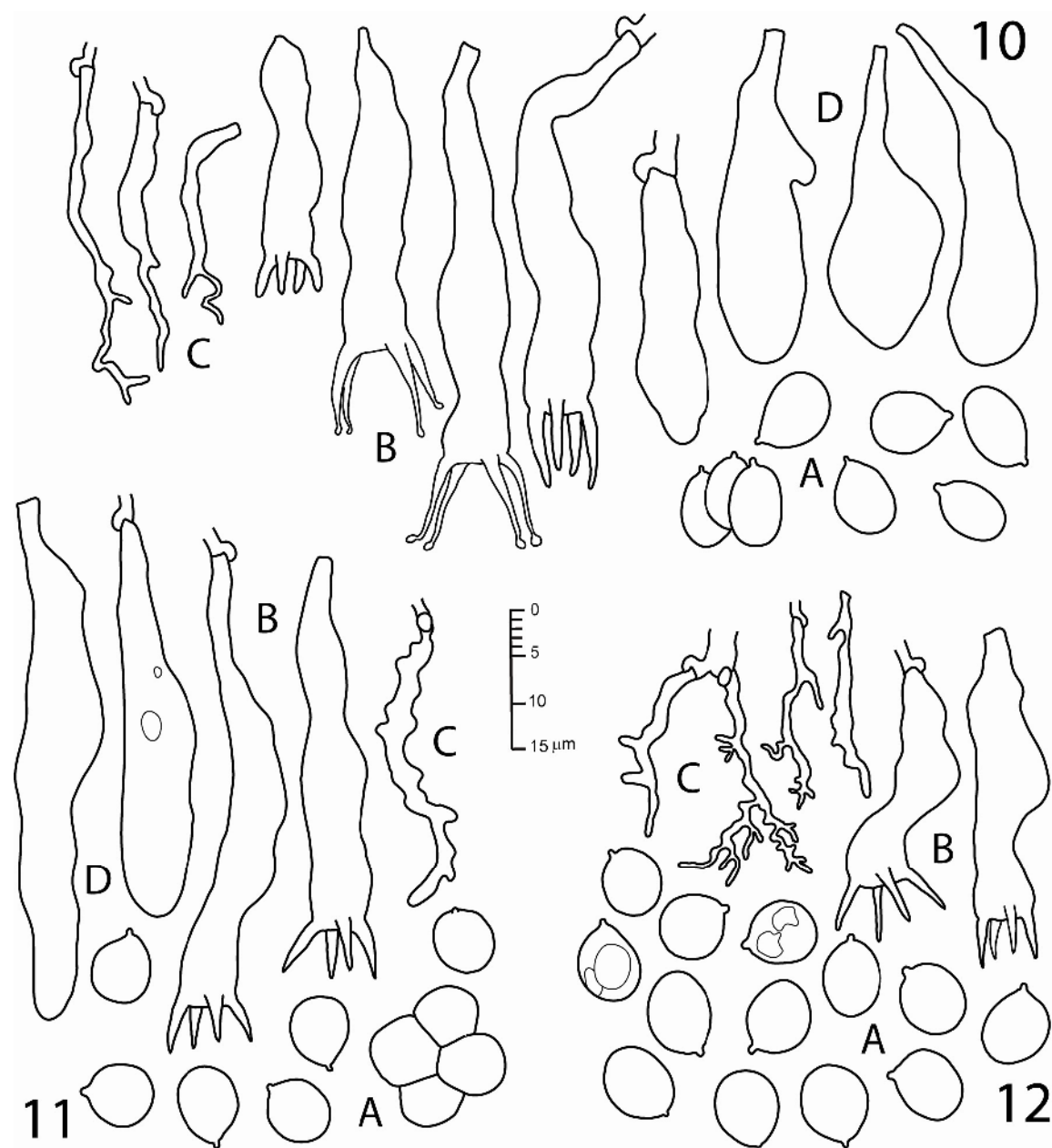
*Dendrothele microspora* is characterized by small, dingy white basidiomes, finely branched dendrohyphidia, gloeocystidia, and small, globose to ellipsoid basidiospores. As with many *Dendrothele* species, specimens are generally difficult to study because the context is completely filled with crystalline materials. Although Lemke (1964) described simple-septate hyphae, clamp connections were present in all the specimens examined and in cultures (Nakasone 1990). Its small basidiospores can be used to differentiate *D. microspora* from other *Dendrothele* species with globose to ellipsoid spores from North America (Table 2). In Goranova's (2003) molecular analysis of *Dendrothele*, *D. microspora* (TJV93-120) was shown to be closely related to *D. griseocana*.

The report of *D. microspora* from Arizona (Gilbertson et al. 1979) is erroneous; specimen RLG11392 is likely a species of *Radulomyces*.

***Dendrothele pachysterigmata*** (H. S. Jacks. & P. A. Lemke) P. A. Lemke, *Persoonia* 3: 357. 1965. Fig. 3

*Aleurocorticium pachysterigmatum* H. S. Jacks. & P. A. Lemke, *Canadian Journal of Botany* 42: 750. 1964.

Basidiomes resupinate, effuse, forming circular, irregular or linear colonies, confluent, thin, up to



**Figs. 10-12.** Line drawings of microscopic characters of *Dendrothele microspora*. **Fig. 10.** Specimen TJV 93-120. A, basidiospores; B, basidia; C, dendrohyphidia. **Fig. 11.** Specimen US0284107. A, basidiospores; B, basidia; C, dendrohyphidium. **Fig. 12.** Specimen HHB 9241. A, basidiospores; B, basidia; C, dendrohyphidia.

140  $\mu\text{m}$  thick, adnate, subceraceous, pruinose, occasionally finely porose; hymenial surface smooth to slightly uneven, yellowish grey (4B2), orange white (5A2), pale orange (5A3), orange grey (5B2), to brownish grey (5C2); margin adnate, abrupt or gradually thinning out,

concolorous with hymenial surface. Hyphal system monomitic with clamped generative hyphae. Subiculum thin, filled with hyaline crystals; subicular hyphae 1.5–2.5  $\mu\text{m}$  diam, clamped, moderately branched, walls hyaline, thin, smooth, cyanophilous. Catagymenium

composed of dendrohyphidia and basidia embedded in a matrix of hyaline crystals. Dendrohyphidia scattered to absent, hyphoid, rarely branched,  $15\text{--}30 \times 1.2\text{--}2 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. Cystidia and gloeocystidia none. Basidia clavate to cylindrical, occasionally with a basal, lateral lobe, stalk long, flexuous or short, straight,  $(14\text{--})20\text{--}35\text{--}(43) \times 7\text{--}11 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, cyanophilous; sterigmata  $(2\text{--})3\text{--}4$ , stout,  $8\text{--}12 \times 2.5\text{--}3 \mu\text{m}$ . Basidiospores cylindrical,  $(9.5\text{--})10\text{--}11\text{--}(12) \times (5\text{--})5.5\text{--}6.5\text{--}(7) \mu\text{m}$ ,  $Q = 1.8\text{--}1.9$  ( $n = 6\text{--}16$ ), walls hyaline, distinctly thickened, smooth, cyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. Uncommon on corticate twigs and branches, occasionally bare wood, of *Thuja occidentalis* L. Known only from Ontario, Canada.

Type specimen examined. CANADA. Ontario, Nipissing District, Algonquin Park, near Lake of Two Rivers, *T. occidentalis*, 15 Sep 1938, H. S. Jackson, TRTC13455, NYBG525857 (isotype NY).

Specimens examined. CANADA. Ontario, York County, swamp north of Mt. Albert, on *Thuja* (corticate twigs), 28 Oct 1938, H. S. Jackson, TRTC13357, NYBG525856 (NY) and on (decorticate) *T. occidentalis*, 19 Oct 1950, H. S. Jackson, TRTC1411, NYBG525862 (NY); woods east of Maple, on *Thuja* (corticate twigs), 12 Oct 1936, H. S. Jackson, TRTC13356, NYBG525859 (NY); south of Aurora, on *T. occidentalis* (corticate twigs), 23 Jun 1937, H. S. Jackson, TRTC12681, NYBG525861 (NY); Renfrew County, Pt. Alexander, on *Thuja* (bark), 7 Sept 1947, H. S. Jackson, TRTC22484, NYBG525858 (NY) and 13 Sep 1939, H. S. Jackson, TRTC14352, NYBG525860 (NY); Chalk River, Petawawa Forest Reserve, on *Thuja* branches (corticate) on tree, 5 Sep 1941, H. S. Jackson, TRTC17437, NYBG525855 (NY) and 1 Sep 1941, H. S. Jackson TRTC17468, NYBG525863 (NY).  
Description and illustration. Lemke (1964).

*Dendrothele pachysterigmata* is characterized by stalked, clavate basidia with 2 to 4, stout sterigmata and cylindrical basidiospores with slightly thickened, cyanophilous walls.

*Dendrothele commixta* has basidiospores of similar shape and size, but its basidia are regularly 2–3 sterigmate (Table 1). Moreover, *D. commixta* occurs on angiospermous bark, especially *Quercus*, and develops rather thick, ceraceous to crustose basidiomes with smooth to warty hymenial surfaces. The basidia of *Dendrothele minima* Duhem are similar to those of *D. pachysterigmata* but its basidiospores are significantly smaller,  $7\text{--}9 \times 4.5\text{--}5.5 \mu\text{m}$  (Duhem and Michel 2007).

*Dendrothele pachysterigmata* appears to be restricted to *Thuja* and Ontario, Canada. Of the four specimens reported from outside Ontario, none could be confirmed as *D. pachysterigmata*. Specimens of *D. pachysterigmata* from New York on *Carya ovata* (Lemke 1964) and from France (LY18443) on *Chamaecyparis* (Boidin et al. 2004) could not be located by curators at NY and LY, respectively. The Mexican specimen on *Odostemon* (NYBG525865) cited by Lemke (1964) is *Dendrothele jacobi* Duhem & H. Michel whereas the Louisiana specimen on juniper, MB2005, (Gilbertson and Blackwell 1985) has long, 4-sterigmate basidia ( $35\text{--}65 \times 6\text{--}7 \mu\text{m}$ ) and may be an undescribed species of *Dendrocorticium*.

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