

## Taxonomy of *Epithele* (Polyporales, Basidiomycota)

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Seventeen species are accepted in the genus *Epithele*, including new species *E. belizensis*, *E. ceracea*, *E. reunionis*, and *E. rywardenii*. Descriptions and illustrations are provided for all species. The generic concept is emended to include *Corticium bambusae*, from Trinidad on bamboo, which lacks sterile hyphal pegs; the new combination *Epithele bambusae* is proposed. The type specimens of *Dendrothele duthieae*, *D. subfusispora*, *Epithele macarangae*, and *Laeticorticium odontoides* were examined and determined to be conspecific with *E. interrupta*. The monotypic genus *Skeletohydnum* is considered distinct from *Epithele*, and *Tubulicium ramonense* is placed in synonymy with *Skeletohydnum nikau*. A new genus, *Myriothele*, is proposed for *Epithele philippiae*, which has urniform basidia and spherical basidiospores. *Xenasma macrosporum* is transferred to *Dextrinocystis*. A key to the accepted species of *Epithele* is presented as well as a preliminary key to the corticioid and polyporoid genera and species with hyphal spines, sterile ridges, and plates.

Keywords: *Epithele typhae*, epithelioid fungi, *Grammothele*, hyphal pegs, *Mycothele*.

In 1899 Patouillard proposed *Epithele* as a section of *Hypochnus* Fr. for effuse species with flocculent, hypochnoid basidiomata and smooth hymenophores interspersed with hyphal pegs originating in the trama. A year later, he raised *Epithele* to generic status (Patouillard 1900). Two species were mentioned – *Epithele typhae* (Fuckel) Pat., the generic type, and *E. dussii* Pat., which later became the type of *Tubulicium* Oberw. In the first comprehensive account of *Epithele*, Boquiren (1971) accepted thirteen species. Jülich (1976), Boidin & Lanquetin (1983), Boidin & Gilles (2000), and Hjortstam & Rywarden (2005) made significant contributions to the systematics of the genus. Recently, Wang *et al.* (2010) described two new species of *Epithele* from China.

In defining the genus, researchers focused primarily on the effuse, crustose basidiomata and hyphal pegs of the taxa, overlooking or minimizing other features such as hyphal peg composition and basidium and basidiospore shape and size. As a result, *Epithele* became a heterogeneous collection of unrelated taxa. In 2012, MycoBank listed 34 species of *Epithele* including

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nine taxa since transferred to other genera. Recently, Duhem (2010) moved *E. ochracea* Bres. to *Hyphodermella* J. Erikss. & Ryvar den, and Roberts (Hjortstam *et al.* 2009) transferred *E. glauca* (Cooke) Wakef. to *Grammothele* Berk. & M. A. Curtis.

In this paper, the genus *Epithele* is reevaluated and the generic concept emended. Seventeen species of *Epithele* are accepted, including four new species. A new genus, *Myriothele*, is proposed to accommodate *E. philippiae*. A key to the accepted species of *Epithele* is provided as well as a preliminary key to the corticioid and polyporoid taxa with hyphal pegs, sterile ridges, and plates.

### Materials and methods

Thin, freehand sections or scrapings from the basidiomata were mounted in Melzer's reagent (Kirk *et al.* 2008) or 1% (wt/vol) aqueous phloxine and 1% (wt/vol) aqueous potassium hydroxide. Cyanophily of basidiospore and hyphal walls was observed in 0.1% cotton blue (wt/vol) in 60% (wt/vol) lactic acid (Kotlaba & Pouzar 1964, Singer 1986). Basidioma sections were mounted in freshly prepared sulfovanillin solution (1 g vanillin, 3 ml distilled water, 8 ml concentrated sulfuric acid); contents of the cystidia turned black in a positive reaction. Drawings were made with a camera lucida attachment on an Olympus BH2 compound microscope. Basidiospores were measured in KOH and phloxine mounts with an oil immersion, 100 × objective. Q values were obtained from dividing average basidiospore length by width (Kirk *et al.* 2008). Basidiospores were often scarce in specimens examined. Thus, Q values based on less than 30 basidiospores are approximate and indicated with an asterisk (\*). Color names are from Kornerup & Wanscher (1978) except that capitalized names are from Ridgway (1912). Photographs of the basidiomata and hymenophores were taken with an Olympus zoom stereomicroscope, model SZH, with a DP12 digital camera system. Herbarium designations follow Index Herbariorum (Thiers 2013). Mycobank (Crous *et al.* 2004) and Index Fungorum (Index Fungorum Partnership 2013) websites were visited many times during the course of this study.

### Taxonomy

***Epithele*** (Pat.) Pat., Essai tax. Hyménomyc. 59. 1900.  
Generic type. – *Epithele typhae* (Pers.) Pat.

Basidioma resupinate, effuse, soft to firm, membranous to ceraceous, odontoid to spinose from emergent sterile pegs; hyphal pegs (absent in one species) originating in subiculum, composed of tramal hyphae, skeletal hyphae, and hyphidia or dendrohyphidia. Hyphal system monomitic, dimitic, or trimitic with clamped or simple-septate, generative hyphae; if dimitic then with thick-walled, hyaline or brown skeletal hyphae or microbinding hyphae. Hymenium a palisade of hyphidia or dendrohyphidia, cystidia,

and basidia. Basidia clavate, cylindrical to subglobose, often with a stalk, (2) 4-sterigmate. Basidiospores globose to allantoid, sometimes biapiculate, apiculus often distinct, refractive, often containing oil-like material, walls hyaline, rarely yellow or light brown, thin to thick, smooth, occasionally rugulose or echinulate, acyanophilous to distinctly cyanophilous, not reacting in Melzer's reagent. Occurring on stems, wood, and bark of herbaceous and woody angiosperms and stems and petioles of ferns.

*Epithele* is characterized primarily by effused basidiomata with hyphal pegs (absent in one species) composed of tramal hyphae, hyphidia or dendrohyphidia, and skeletal hyphae alone or in various combinations. All species have clamped generative hyphae except *E. efibulata*. Generative hyphae are hyaline, occasionally dark yellow, but brown-colored generative hyphae are found in one species, *E. reunionis*. Skeletal and microbinding hyphae can be difficult to find because they are few and buried in the subiculum or produced in the substrate beneath the basidiomata. Basidia are typically clavate with a stalk, although cylindrical and subglobose forms are found in several species. There are three basic basidiospore shapes: allantoid to subfusiform, globose to broadly ellipsoid, and biapiculate. In a few species, basidiospores with rounded or tapered distal ends occur together. The apiculus is distinct and refractive in many species. Although *Epithele* species display a range of basidiospore wall thickness and reaction to cotton blue, spore walls are never thick and strongly cyanophilous (as in *Epithelopsis*). In species with thick-walled spores, the walls do not react with cotton blue or are weakly cyanophilous. Cystidia are often present but inconspicuous. Hyphidia or dendrohyphidia are present in the hymenium in all species. Hyphidia are simple, filamentous, unbranched or sparingly branched structures whereas dendrohyphidia are intricately branched.

*Mycothele* Jülich (1976) is similar to *Epithele* in micromorphology, but its disciform basidiomata are distinctive. Other crustose genera with species that develop hyaline hyphal pegs and thin-walled basidiospores include *Aphanobasidium* Jülich, *Cerinomyces* G.W. Martin, *Dendrothele* Höhn. & Litsch., *Epithelopsis* Jülich, *Grammothele* Berk. & M. A. Curtis, *Pteridomyces* Jülich, and *Skeletohydnum*. Basidium morphology is a reliable way to distinguish most of these genera from *Epithele*. For example, *Aphanobasidium* has pleural basidia whereas *Dendrothele* has suburniform basidia. Basidia in *Cerinomyces* are narrowly clavate with two long, tapering sterigmata. Compared to *Epithele*, *Grammothele* and *Pteridomyces* have significantly smaller clavate basidia and small, cylindrical basidiospores. Short, urniform basidia and hyphal pegs composed of skeletal hyphae characterize *Skeletohydnum*. *Epithelopsis* species have clavate basidia, gloeocystidia, and thick-walled, cyanophilous basidiospores in addition to hyphal pegs composed of skeletal hyphae. Hyaline hyphal pegs are produced in pores of *Grammothelopsis macrospora* (Ryvarden) Jülich (Robledo & Ryvarden 2007), *Megasporoporia* Ryvarden & J. E. Wright, *Megasporia* B. K. Cui, Y.C. Dai & Hai J. Li, and *Megasporoporiella* B. K. Cui, Y. C. Dai & Hai J. Li (Li & Cui 2013).

Hyphal pegs are hyaline in all species of *Epithele* except *E. reunionis* in which brown-colored tramal hyphae are present. Brown hyphae or tramal cystidia are present in hyphal pegs in *Campylomyces* Nakasone, *Corneromyces* Ginns, *Grammothele*, *Pileodon* P. Roberts & Hjortstam, and *Veluticeps* (Cooke) Pat. Basidiomata of *Campylomyces*, *Pileodon*, and *Veluticeps berkeleyi* Pat. are effused-reflexed, woody (Nakasone 2004) and unlike the thin, effused, subceraceous basidiomata of *E. reunionis*. *Veluticeps australiensis* is entirely effuse with a thick, firm, rimose basidioma that turns black in KOH (Nakasone 2004). Basidiospores in *Corneromyces* are thick-walled in KOH, brown, cyanophilous, and amyloid (Ginns 1976).

*Tubulicium* Oberw. does not produce hyphal pegs, but its large, multi-rooted cystidia have been mistaken for pegs. Similarly, *Dacryobolus sudans* (Alb. & Schwein.) Fr. has fertile aculei that sometimes resemble hyphal pegs and is characterized by narrow basidia and small, allantoid basidiospores.

### Key to the accepted species of *Epithele*

1. Basidiospores subglobose to ellipsoid..... 2
- 1\*. Basidiospores biapiculate, subfusiform, cylindrical or allantoid..... 9
2. Basidiospores slightly roughened..... *E. fasciculata*
- 2\*. Basidiospores smooth ..... 3
3. Monomitic hyphal system ..... 4
- 3\*. Dimitic hyphal system..... 8
4. Brown-colored hyphae present in context or hyphal pegs ..*E. reunionis*
- 4\*. Brown-colored hyphae absent ..... 5
5. Basidiospores globose to subglobose, 9–13 × 9–13 μm..... *E. hydnoides*
- 5\*. Basidiospores broadly ellipsoid to ellipsoid..... 6
6. Basidiospores 11–13 μm broad ..... *E. rywardenii*
- 6\*. Basidiospores usually < 12 μm broad..... 7
7. Basidioma white to yellow, basidia short, up to 30 μm long, .....  
.....*E. cylindricosterigmata*
- 7\*. Basidioma dull yellow, basidia larger, 30–55 μm long,..... *E. sulphurea*
8. Skeletal hyphae in hyphal pegs only, dextrinoid ..... *E. ovalispora*
- 8\*. Skeletal hyphae in hyphal pegs and subiculum, not dextrinoid.....  
..... *E. fasciculata*
9. Basidiospores narrowly fusiform, Q = 3.5–4.3, on *Cyperaceae* *E. typhae*
- 9\*. Basidiospores differently shaped, Q = 2–2.8 ..... 10
10. Hyphal pegs lacking ..... *E. bambusae*
- 10\*. Hyphal pegs present ..... 11
11. Dimitic with skeletal hyphae present only in hyphal pegs ..... 12
- 11\*. Monomitic or if dimitic, then skeletal or microbinding hyphae present  
in subiculum as well as hyphal pegs ..... 13
12. Generative hyphae simple-septate, skeletal hyphae scarce in hyphal  
pegs ..... *E. efibulata*

- 12\*. Generative hyphae clamped, skeletal hyphae abundant in hyphal pegs ..... *E. malaiense*  
 13. Generative hyphae simple septate..... *E. efibulata*  
 13\*. Generative hyphae with clamp connections..... 14  
 14. Basidiospores distinctly biapiculate ..... 15  
 14\*. Basidiospores ellipsoid, cylindrical, or subfusiform..... 18  
 15. Basidiospores echinulate or roughened ..... *E. alba*  
 15\*. Basidiospores smooth ..... 16  
 16. Hyphal pegs slender, composed of undifferentiated tramal hyphae ..... *E. lutea*  
 16\*. Hyphal pegs composed of dendrohyphidia..... 17  
 17. Basidiospores with apiculus and distal knob distinctly thick-walled....  
 ..... *E. citrispora*  
 17\*. Basidiospores with only apiculus distinctly thick-walled. *E. interrupta*  
 18. Basidioma ceraceous throughout ..... *E. ceracea*  
 18\*. Basidioma soft to subceraceous..... 19  
 19. Basidiospores cylindrical, 12–14 × 6–7 µm ..... *E. belizensis*  
 19\*. Basidiospores larger, (14) 17–22 × 7–12 µm ..... 20  
 20. Hyphal pegs composed primarily of dendrohyphidia ..... *E. interrupta*  
 20\*. Hyphal pegs composed of undifferentiated tramal hyphae ..... *E. lutea*

### Species descriptions

***Epithele alba*** (Viégas) Boidin, Lanq. & Duhem, Bull. Soc. Mycol. France 112: 113. 1996. – Figs. 1, 2, 14.

≡ *Dendrothele alba* Viégas, Rodriguésia 13: 286. 1940.

≡ *Aleurocorticium album* (Viégas) Lemke, Canad. J. Bot. 42: 755. 1964.

Basidioma resupinate, effuse, irregular colonies coalescing, up to 40 × 20 mm, closely adnate, thin, up to 150 µm thick, soft to membranous, denticulate from hyphal pegs, between pegs smooth, subfelty to felty or subfarinaceous, in thinner areas yellowish grey (4B2), then yellowish white (4A2) to pale yellow (4A3); hyphal pegs cylindrical to conical, 5–6 pegs per mm, up to 200 × 60 µm, terete, single, fragile, readily detached; margin distinct, abrupt, adnate, subfelty, white to pale yellow. – Hyphal system dimitic with clamped generative and microbinding hyphae. – Hyphal pegs originating in subiculum, a fascicle of non-agglutinated tramal hyphae, dendrohyphidia, and encrusting, coarse, hyaline crystals; tramal hyphae 2–3 µm diam., clamped at base, sparsely branched, walls hyaline, thin, smooth or encrusted with coarse, hyaline crystals; dendrohyphidia as described below. – Subiculum a dense tissue of non-agglutinated subicular arising more or less perpendicular from substrate with embedded, coarse, hyaline crystals, microbinding hyphae abundant or absent; subicular hyphae 2.5–4 µm diam., clamped, moderately branched, walls hyaline, thin, smooth; microbinding hyphae 0.5–2 µm diam., aseptate, frequently branched, non-staining, walls hyaline, thick, smooth. – Subhymenium a narrow, dense tissue of short-

celled hyphae; subhymenial hyphae 2.5–3  $\mu\text{m}$  diam., frequently branched, walls hyaline, thin, smooth. – Hymenium a palisade of dendrohyphidia, cystidia, and basidia. – Dendrohyphidia scattered, irregularly filiform, often with short knobby branches at apex, 19–40  $\times$  2–4.5  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Cystidia scattered, fusiform to obclavate, 16–27  $\times$  6–9.5  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, cyanophilous. – Basidia clavate, (35) 40–65  $\times$  12–18  $\mu\text{m}$ , clamped at base, containing oil-like material, walls hyaline, thin, smooth, cyanophilous, 4-sterigmate, sterigmata stout, up to 13  $\times$  4.5  $\mu\text{m}$ . – Basidiospores biapiculate, broadly to narrowly ellipsoid, or subfusiform, with a distinct, refractive apiculus, (15) 16–19 (22)  $\times$  (6.8) 7–11 (13)  $\mu\text{m}$ , average ( $n = 17, 15$ ) 18.2–18.4  $\times$  7.9–10.2  $\mu\text{m}$ ,  $Q = 1.8^* - 2.3^*$ , length exclusive of apiculus and distal peg, 13–16 (17)  $\mu\text{m}$ , average 14.8–15.5  $\mu\text{m}$ ,  $Q = 1.5^* - 1.9^*$ , often filled with oil-like material, walls hyaline, thin to slightly thickened, minutely rugulose or finely echinulate, weakly cyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. – On angiospermous wood and bark; reported from Brazil, Venezuela.

Descriptions and illustrations. – Hjortstam & Ryvar den (2005), Vié gas (1940).

Materials examined. – BRAZIL, São Paulo State, Regio São Paulo, Parque Estadual Fontes do Ipiranga, on wood (and bark), 16–24 Jan 1984, *leg.* D. Pegler, K. Hjortstam & L. Ryvar den, KH 16539 (K–K(M) 167195); Campinas, Moji-Guaçu, Fazenda Campininha, 29–30 Jan 1987, *leg.* D. Pegler, K. Hjortstam & L. Ryvar den 24517 (O); VENEZUELA, Amazonas, Yutajé, 100 m alt., on dead deciduous wood, 12–19 Apr 1997, *leg.* L. Ryvar den 40644 (O); Estado Bolívar, Las Nieves, on dead hardwood, 12 Jun 1995, *leg.* L. Ryvar den 37679 (O).

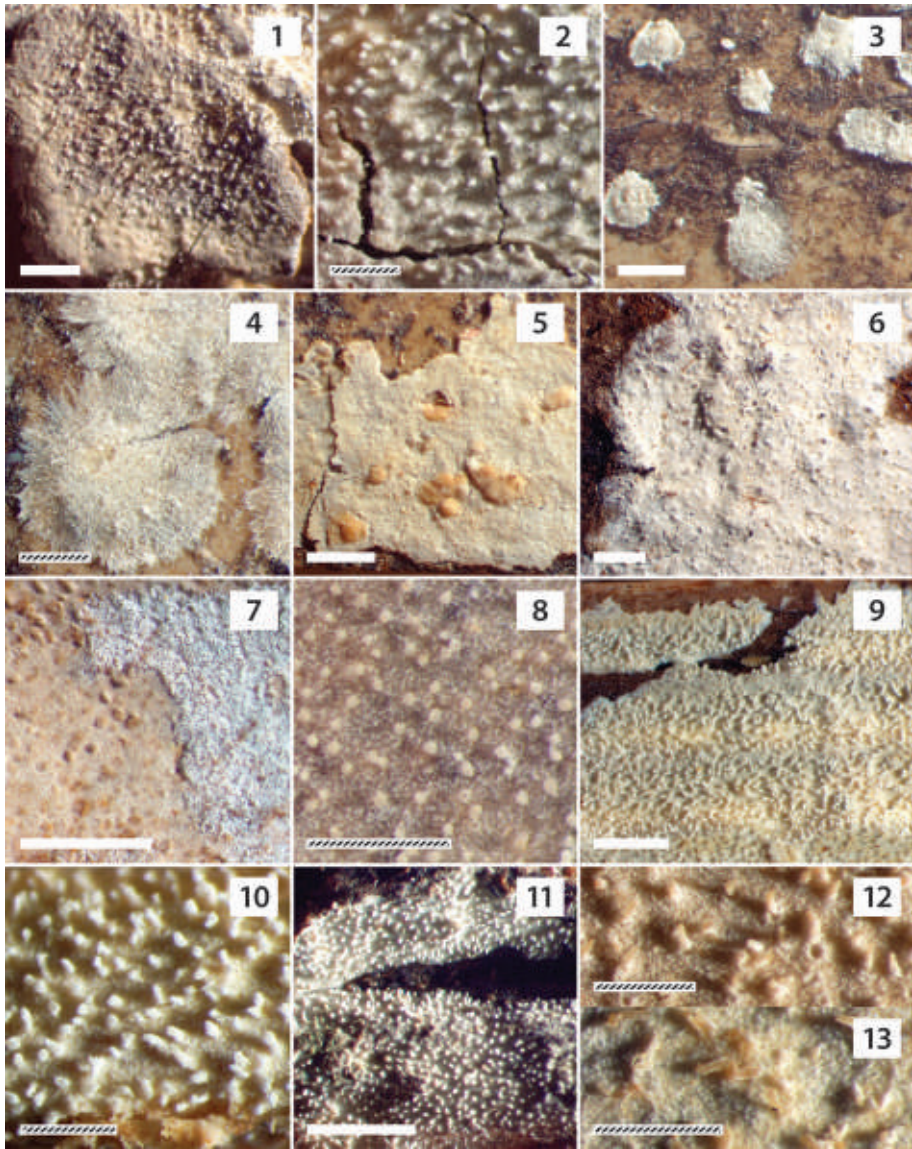
*Epithele alba* is characterized by large, inconspicuously rugulose or echinulate, biapiculate basidiospores. The concept of the species herein follows Hjortstam & Ryvar den (2005). Mature basidia and microbinding hyphae were not present in all specimens examined. Basidia observed were significantly shorter than reported by Vié gas (1940), 80–85  $\times$  12–13  $\mu\text{m}$ . Basidiospores in *E. citrispora* are always smooth but otherwise similar to those of *E. alba*. Occasionally, specimens of *E. interrupta* and *E. lutea* produce nearly biapiculate basidiospores; however, the distal knob is never as distinct and prominent as in *E. alba*.

Lemke (1964) claimed to have examined a portion of the type *D. alba*. This specimen was obtained from TRTC, TRTC 167452, with the date '30 Oct 1939' and collection number 'Inst. Agr. 3158'. Unfortunately, this specimen is not the type because the date and specimen number are different from that stated in the protologue, 25 Sept 1939, no. 3127. Instead, Inst. Agr. 3158 was identified as *Epithele bambusae*.

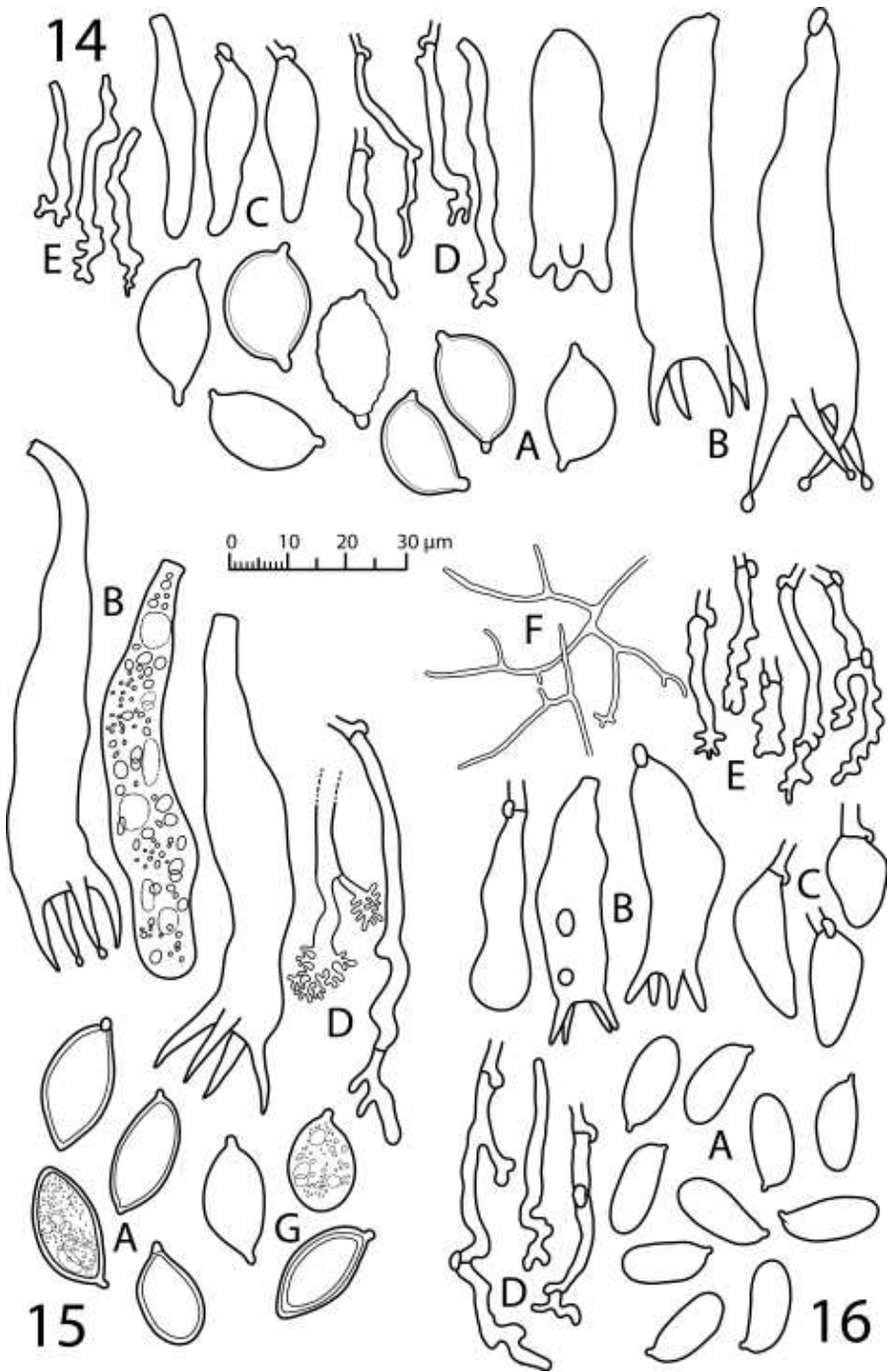
***Epithele bambusae*** (Burt) Nakasone, **comb. nov.** – Figs. 3–5, 15.  
Mycobank no.: MB 803364

Basionym. – *Corticium bambusae* Burt, Ann. Missouri Bot. Gard. 13: 218. 1926.

Basidioma resupinate, effuse, loosely adnate, beginning as small, fragile, circular colonies, coalescing, thin, up to 140  $\mu\text{m}$  thick, at first soft,



**Figs. 1–13.** Basidiomata of *Epithele* species. 1–2. *Epithele alba* (O–LR 24517). 3–4. *Epithele bambusae* (HUH 00258827, holotype of *Corticium bambusae*). 5. Tremellaceous species with ceraceous, tuberculate basidiomata growing on *C. bambusae* holotype. 6. *Epithele belizensis* (CFMR–FP 150826, holotype). 7. *Epithele ceracea* (NY–Dumont VE4608, holotype) on the left over-grown with a white, farinaceous parasite. 8. *Epithele ceracea* (BPI 747078). 9–10. *Epithele citrispora* (LY–LY 8537, holotype). 11. *Epithele cylindricosterigmata* (TNM–F 0009030, holotype). 12–13. *Epithele efibulata* (LY–LY 7863, holotype). White scale bars = 1 mm; cross-hatched scale bars = 0.5 mm.





subfelty to felty, floccose to submembranous, yellowish white (4A2), then becoming dense, subceraceous, smooth to porose, orange white (5A2), pale orange (5A3) to greyish orange (5B4); margin abrupt, distinct or thinning out, detached, fimbriate. – Hyphal system monomitic with clamped generative hyphae. – Subiculum composed of hyphae arranged more or less parallel to substrate, partially agglutinated, sometimes filled with crystalline material; subicular hyphae 2–3.5  $\mu\text{m}$  diam., clamped, sparsely branched, walls hyaline, thin, smooth. – Subhymenium not observed. – Hymenium a moderately dense palisade of dendrohyphidia and basidia. – Dendrohyphidia rare to scattered, irregularly filamentous, occasionally strangulated, 25–55  $\times$  3–5  $\mu\text{m}$ , clamped at base, sparingly or intricately branched at apex, walls hyaline, thin, smooth. – Basidia rare, fragile, often collapsed, clavate with slight median constriction, 52–80 (100)  $\times$  10–13  $\mu\text{m}$ , clamped at base, containing oil-like material, walls hyaline, thin, smooth, 4-sterigmate. – Basidiospores ellipsoid to broadly fusiform, occasionally biapiculate, with a distinct, refractive apiculus, sometimes collapsed, (14) 16–20 (23)  $\times$  (8) 9–10.5  $\mu\text{m}$ , average of holotype ( $n = 30$ )  $17.5 \pm 1.8 \times 9 \pm 0.7 \mu\text{m}$ ,  $Q = 2$ , containing oil-like material, walls hyaline, occasionally pale yellow, slightly thick to 1.5  $\mu\text{m}$  thick at maturity, smooth or appearing rugulose when collapsed, sometimes cyanophilous, sometimes weakly dextrinoid in Melzer's reagent.

**Habitat and distribution.** – On bamboo; known from Trinidad and Brazil.

**Descriptions and illustrations.** – Burt (1926), Liberta (1969).

**Type materials examined.** – TRINIDAD, Port of Spain, Maravel Valley, on bamboo, 1913, *leg.* R. Thaxter, W. G. Farlow 19 (FH-HUH 00258827, holotype; O and FH-HUH 00301188, 00301189, 00301190, isotypes).

**Additional material examined.** – BRAZIL, São Paulo, Campinas, on *Moquinia polymorpha* DC., 30 Oct 1939, *leg.* A. P. Viégas, Inst. Agr. 3158 (TRTC 167452, as *Dendrothele alba*).

*Epithele bambusae* is characterized by soft, smooth basidiomata, large clavate basidia, and large, ellipsoid to biapiculate basidiospores. It is the only species in *Epithele* that does not develop hyphal pegs. Ellipsoid basidiospores of *E. bambusae* are similar to those in *E. efibulata* and *E. interrupta* whereas the biapiculate forms resemble those of *E. alba*. The holotype specimen is parasitized by a sterile tremellaceous fungus that develops discontinuous, ceraceous basidiomata with low, rounded tubercles (Fig. 5), simple-septate hyphae, and acicular hyphidia with amyloid tips. The specimen from Brazil has small, well-delimited basidiomata with fimbriate margins but otherwise similar to the type of *C. bambusae*. Burt (1926) reported that *C. bambusae* is common in the West Indies and Venezuela on bamboo.

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**Figs. 14–16.** Line drawings of microscopic elements. 14. *Epithele alba* (O–LR 40644). 15. *Corticium bambusae* (HUH 00301189, isotype). 16. *Epithele belizensis* (CFMR–FP 150826, holotype). A. Basidiospores, B. Mature and immature basidia, C. Cystidia from hymenia, D. Hyphidia or dendrohyphidia from hymenia, E. Hyphidia or dendrohyphidia from hyphal pegs, F. Microbinding hyphae, G. Basidiospores from holotype of *C. bambusae* (HUH 00258827).

***Epithele belizensis* Nakasone, sp. nov.** – Figs. 6, 16.

MycoBank no.: MB 803365

Basidioma effuse, thin, with small, papillate hyphal pegs; hyphal system dimitic with clamped generative and microbinding hyphae; dendrohyphidia and cystidia present; basidia clavate to suburniform,  $33\text{--}40 \times 8\text{--}12 \mu\text{m}$ , 4-sterigmate; basidiospores cylindrical,  $12\text{--}14 (16) \times (5.5) 6\text{--}7 \mu\text{m}$ , often adherent, walls hyaline, thin to slightly thick, smooth, cyanophilous, not reacting in Melzer's reagent.

Holotype. – BELIZE, Cayo District, Mountain Pine Ridge, Five Sisters Lodge nature trail, on corticate hardwood, 19 Nov 2001, *leg.* K. K. Nakasone, FP 150826 (BPI, CFMR isotype).

Basidioma resupinate, effuse, beginning as small patches, becoming confluent, up to  $20 \times 10 \text{ mm}$ , thin, up to  $150 \mu\text{m}$  thick, soft, membranous, papillose from emergent hyphal pegs, between pegs smooth, subfelty, white, orange white (5A2) to pale orange (5A3); cracks scattered, deep; hyphal pegs papillate, with rounded apices,  $4\text{--}5$  per mm,  $70\text{--}140 \times 40\text{--}60 \mu\text{m}$ , terete, smooth, white; margin appressed, white, distinct, abrupt or rapidly thinning out, fibrillose. – Hyphal system dimitic with clamped generative and inconspicuous microbinding hyphae. – Hyphal pegs a compact fascicle of non-agglutinated tramal hyphae differentiating into terminal dendrohyphidia, lightly encrusted with small, hyaline crystals; tramal hyphae  $2.2\text{--}3 \mu\text{m}$  diam., clamped, sparsely branched, walls hyaline, thin, smooth; dendrohyphidia irregular, strangulated, with knobby branches at apex,  $11\text{--}34 \times 2.5\text{--}3 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Subiculum up to  $100 \mu\text{m}$  thick, composed of partially agglutinated subicular and microbinding hyphae arranged parallel to substrate; subicular hyphae  $2.5\text{--}3 \mu\text{m}$  diam., clamped, moderately to frequently branched, contents cyanophilous, walls hyaline, thin, encrusted with a thin to thick coating of hyaline crystals, acyanophilous; microbinding hyphae inconspicuous, up to  $1 \mu\text{m}$  diam., aseptate, frequently branched usually at right angles, walls hyaline, thickened, smooth. – Hymenium a palisade of dendrohyphidia, cystidia, and basidia. – Dendrohyphidia filiform, irregular, with knobs and short, lateral branches along length, often branched at apex,  $15\text{--}50 \times 2\text{--}3 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Cystidia scarce, subfusiform to obclavate with an obtuse apex,  $15\text{--}17 \times 6\text{--}9 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Basidia clavate, occasionally suburniform, sometimes with a median constriction, often with a short, narrow stalk,  $33\text{--}40 \times 8\text{--}12 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, 4-sterigmate. – Basidiospores cylindrical, often adaxial side flattened, with a small, rounded apiculus,  $12\text{--}14 (16) \times (5.5) 6\text{--}7 \mu\text{m}$ , average ( $n = 33$ )  $13.7 \pm 1.0 \times 6.2 \pm 0.4 \mu\text{m}$ ,  $Q = 2.2$ , often adherent, filled with oil-like materials, walls hyaline, thin to slightly thick, smooth, cyanophilous, not reacting in Melzer's reagent.

Etymology. – Refers to the country of origin, Belize.

Habitat and distribution. – On bark of woody angiosperm; known only from type location.

*Epithele belizensis* is characterized by a thin basidioma, small hyphal pegs, microbinding hyphae, small basidia, and cylindrical basidiospores with

smooth, cyanophilous walls. It is most similar to *E. interrupta* which has thicker basidiomata and larger hyphal pegs, basidia, and basidiospores. Skeletal hyphae are scarce but usually present in *E. interrupta* whereas *E. belizensis* has microbinding hyphae. Small basidia and basidiospores with cyanophilous walls initially suggested placement of *E. belizensis* in *Dendrothele*. However, developing basidia in *Dendrothele* are primarily suburniform whereas in *Epithele* species they are clavate.

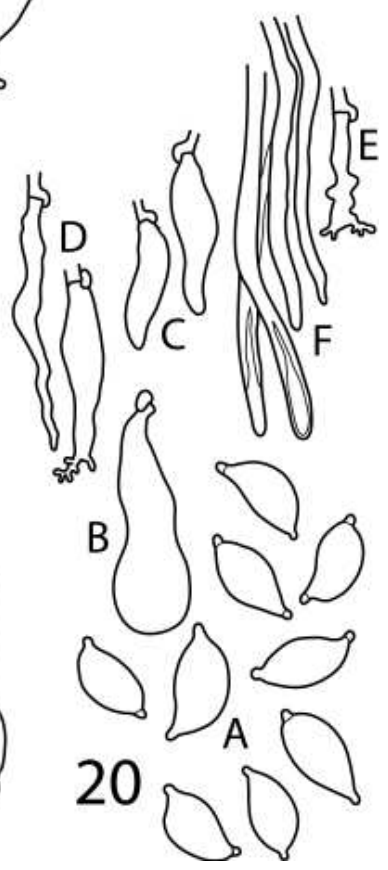
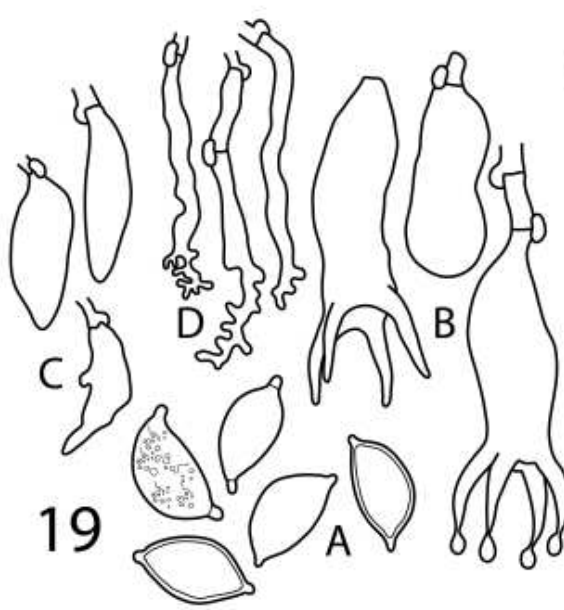
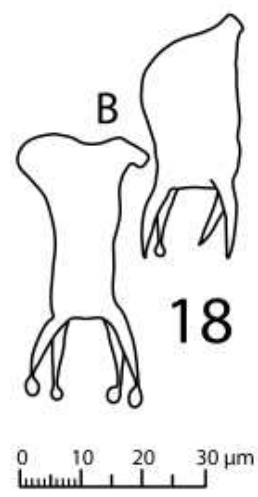
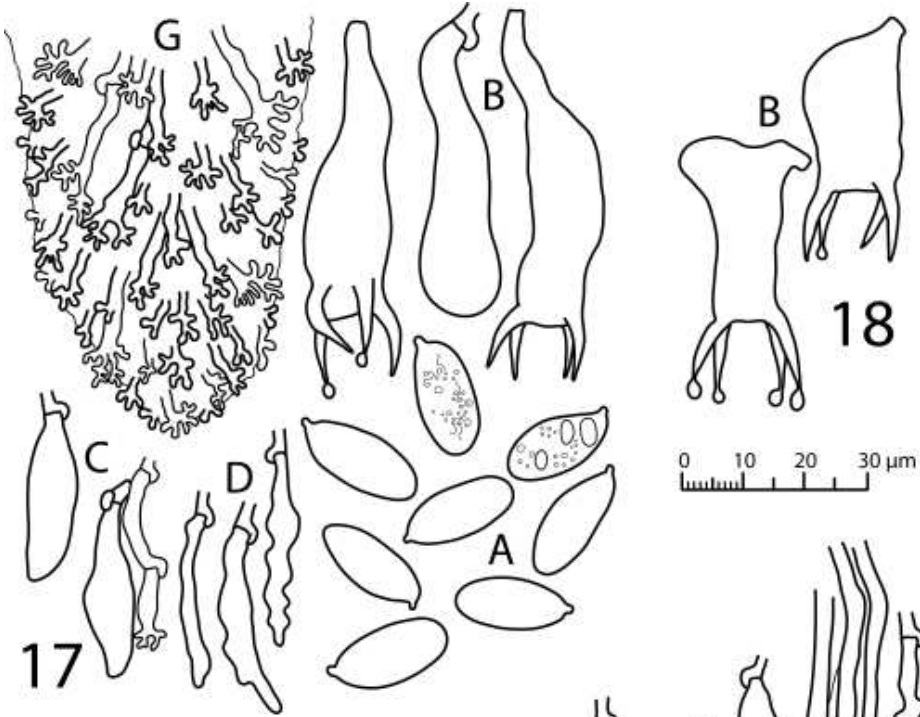
***Epithele ceracea* Nakasone, sp. nov.** – Figs. 7, 8, 17, 18.

Mycobank no.: MB 803366

Basidioma effuse, ceraceous to subceraceous, thin, with short, cylindrical hyphal pegs; hyphal system monomitic with clamped generative hyphae; hyphidia and cystidia present; basidia clavate, stalked, 30–50 × 10–13 µm, 4-sterigmate; basidiospores ellipsoid to subfusiform, (14) 16–19 (20) × 6.8–9 µm, walls hyaline, rarely light brown, thin but thickening near apiculus, smooth, cyanophilous, not reacting in Melzer's reagent.

**Holotype.** – VENEZUELA, Estado Sucre, NW Irapa, trail between Manacal and Los Pocitos, on herbaceous stem, 10 July 1972, *leg.* K. P. Dumont, R. F. Cain, G. J. Samuels, G. Morello & J. Farfan, Dumont–VE4608 (NY; BPI–1105877 and 747078, isotypes).

**Basidioma** resupinate, effuse, up to 75 × 20 mm, closely adnate, thin, 50–75 µm thick, firm, ceraceous to subceraceous, odontoid to verruculose from emergent hyphal pegs, area between pegs smooth, subfelty, yellowish white (4B2), yellowish grey (4B3), greyish orange (5B3), greyish orange [5B(3–4)], brownish orange (6C3), or Avellaneous; hyphal pegs short cylindrical to conical, terete, subceraceous, up to 20 pegs per mm, up to 110 × 60 µm, readily detached, concolorous with hymenium; margin distinct, appressed, adnate, gradually thinning out, white or concolorous with hymenium, fibrillose. – **Hyphal system** monomitic with clamped generative hyphae. – **Hyphal pegs** originating in subiculum, a compact fascicle of agglutinated dendrohyphidia; dendrohyphidia with short, knobby branches at apex, stalk 1.5–4 µm diam., clamped at base, walls hyaline, thin, smooth. – **Subiculum** a compact tissue of agglutinated hyphae arranged parallel to substrate, at first hyphae distinct then less so with age; subicular hyphae 1–4 µm diam., clamped, walls hyaline, thin, smooth. – **Subhymenium** not observed. – **Hymenium** a palisade of hyphidia, cystidia, and basidia. – **Hyphidia** scattered, filiform, strangulated, unbranched, occasionally intricately branched at apex, 25–32 × 2–5 µm, clamped at base, walls hyaline, thin, smooth. – **Cystidia** rare, subfusiform, sometimes stalked, 24–35 × 7–9 µm, clamped at base, walls hyaline, thin, smooth. – **Basidia** clavate, often with a short stalk, 30–50 × 10–13 µm, clamped at base, containing oil-like material, walls hyaline, thin, smooth, 4-sterigmate. – **Basidiospores** ellipsoid to subfusiform with a small, distinct, refractive apiculus, (14) 16–19 (20) × 6.8–9 µm, average of isotype BPI 1105877 (n = 32) 17.6 ± 1.4 × 8.1 ± 0.7 µm, Q = 2.2, containing oil-like material, walls hyaline, rarely light brown, thin but slightly thickened adjacent to apiculus, smooth, cyanophilous, not reacting in Melzer's reagent.



**Etymology.** – Ceraceous, Latin for waxy, referring to texture of the basidioma.

**Habitat and distribution.** – On herbaceous or woody stems; known from Belize, Venezuela.

**Additional materials examined.** – BELIZE, Cayo District, Pine Mountain Ridge, loop alongside of road, on cane stalk, 22 Nov 2001, *leg.* K. K. Nakasone, FP150881 (CFMR); VENEZUELA, Estado Sucre, NW Irapa, trail between Manacal and Los Pocitos, on woody stems, 13 Jul 1972, *leg.* K. P. Dumont, R. F. Cain, G. J. Samuels, G. Morello & J. Farfan, Dumont-VE4923 (NY).

*Epithele ceracea* is characterized by small hyphal pegs, ceraceous to subceraceous basidioma, clamped generative hyphae, and ellipsoid to subfusiform basidiospores with cyanophilous walls. It is distinguished from *E. interrupta* which has a thicker basidioma with a soft, membranous texture, scattered skeletal hyphae, and slightly longer basidiospores. *Epithele belizensis* has a soft, membranous basidioma, smaller basidiospores, and microbinding hyphae.

Type specimens from NY and BPI have an alien species growing over the hymenophore and along the margin. This taxon, well-developed on the holotype, has a white, farinaceous basidioma (Fig. 7), suburniform basidia (Fig. 18), clamp connections, and intricately branched dendrohyphidia; no basidiospores were observed.

***Epithele citrispora*** Boidin, Lanq., & Gilles, *Mycotaxon* 16: 467. 1983. – Figs. 9, 10, 19, 20.

Basidioma resupinate, widely effuse, oblong to linear colonies becoming confluent, up to 100 × 70 mm, adnate, thin, up to 180 µm thick, firm, subceraceous, denticulate from emergent hyphal pegs with smooth, felty areas between pegs, yellowish white to pale yellow [4A(2–3)], Light Buff, or Cartridge-Buff; hyphal pegs cylindrical to conical, terete, 8–10 per mm, up to 215 × 65 µm, protruding up to 130 µm; margin distinct, abrupt, adnate, fibrillose, white to pale yellow. – Hyphal system trimitic, with clamped generative, skeletal, and microbinding hyphae. – Microbinding hyphae abundant in substrate, rigid yet delicate, 0.2–0.3 µm diam., frequently branched often at right angles, lumen lacking, walls hyaline, smooth, acyanophilous, not reacting to Melzer's reagent. – Hyphal pegs originating in subiculum, a dense fascicle of partially agglutinated skeletal and tramal hyphae, often encrusted with coarse, hyaline crystals, sometimes skeletal hyphae terminating just below peg apex, then tramal hyphae extending into

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**Figs. 17–20.** Line drawings of microscopic elements. **17.** *Epithele ceracea*. B, C, and D from NY–Dumont VE4608, holotype; A and G from BPI 1105877, isotype. **18.** Basidia of parasite on holotype of *E. ceracea*. **19.** *Epithele citrispora* (LY–LY 9013). **20.** *Epithele citrispora* (LY–LY 8537, holotype). A. Basidiospores, B. Mature and immature basidia, C. Cystidia from hymenia, D. Hyphidia and dendrohyphidia from hymenia, E. Hyphidia and dendrohyphidia from hyphal pegs, F. Skeletal hyphae from hyphal peg, G. Hyphal peg.

apex and developing into dendrohyphidia; tramal hyphae 2–4  $\mu\text{m}$  diam., clamped, rarely branched, walls hyaline, thin, smooth, occasionally encrusted; skeletal hyphae tapering slightly to apex, 2–3.5  $\mu\text{m}$  diam., aseptate, unbranched, walls hyaline, up to 1.5  $\mu\text{m}$  thick but thinning toward apex, smooth, acyanophilous, not reacting in Melzer's reagent. – *Subiculum* up to 150  $\mu\text{m}$  thick, composed of a thin layer of indistinct, compressed, agglutinated hyphae next to substrate, about 20  $\mu\text{m}$  thick, and an upper layer of moderately dense trama of non-agglutinated subicular and skeletal hyphae arranged more or less parallel to substrate at first then curving into hymenium; subicular hyphae 2–3.5  $\mu\text{m}$  diam., clamped, moderately branched, walls hyaline, thin to 0.5  $\mu\text{m}$  thick, smooth; skeletal hyphae as described above. – *Subhymenium* up to 30  $\mu\text{m}$  thick; subhymenial hyphae 2.5–3.5  $\mu\text{m}$  diam., clamped, frequently branched, short-celled, walls hyaline, thin, smooth. – *Hymenium* a palisade of terminal skeletal hyphae, dendrohyphidia, cystidia, and basidia. – *Skeletal hyphae* originating in subiculum, terminating in hymenium, as described above. – *Dendrohyphidia* numerous, filamentous to obclavate, often with short, knobby branches at apex, 15–45  $\times$  2.5–6  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – *Cystidia* scattered, subfusiform, 18–25  $\times$  5–8  $\mu\text{m}$ , clamped at base, contents homogeneous, walls hyaline, thin, smooth. – *Basidia* clavate, suburniform, or cylindrical with a median constriction, (28) 32–40 (50)  $\times$  9–12  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to 13  $\times$  4  $\mu\text{m}$ . – *Basidiospores* biapiculate, distal end and apiculus typically thick-walled, refractive, (14) 17–19.5 (20.3)  $\times$  (6) 7.2–9 (9.5)  $\mu\text{m}$ , average ( $n = 30, 33$ ) 15.8–18.4  $\times$  6.9–8.6  $\mu\text{m}$ ,  $Q = 2.2$ –2.3, containing oil-like material, walls hyaline, thin to 1  $\mu\text{m}$  thick, smooth, acyanophilous, not reacting in Melzer's reagent.

*Habitat and distribution.* – On wood and bark of angiosperms; reported from Gabon, Ivory Coast, and Cameroon (Hjortstam *et al.* 1993).

*Description and illustration.* – Boidin & Lanquetin (1983).

*Type material examined.* – GABON, N. de Libreville à 13.5 km, sur bois mort, 21 jan 1978, *leg.* G. Gilles 1070 (LY-LY 8537, holotype).

*Additional materials examined.* – GABON, N. de Libreville à 31.5 km, forêt de la Mondah, sur bois mort, 3 dec 1978, *leg.* G. Gilles 1320 (LY-LY 9013); IVORY COAST, Abidjan, forêt du Téké, 29 avril 1973, *leg.* G. Gilles 210 (LY-LY 7158).

*Epithele citrispora* is characterized by hyphal pegs composed of skeletal and tramal hyphae and distinctly biapiculate, smooth basidiospores. Skeletal hyphae are found in the subiculum and hymenium also. Other *Epithele* species with biapiculate basidiospores are readily distinguished from *E. citrispora*. Biapiculate basidiospores in *E. alba* are minutely rugulose or echinulate, and *E. bambusae* lacks hyphal pegs. Basidiospores that are nearly biapiculate occur infrequently in *E. interrupta* and *E. fasciculata*; the former has hyphal pegs composed primarily of dendrohyphidia and the latter has simple-septate generative hyphae. Gorjón & de Jesus (2012) describe a species from the Brazilian Amazon that is very similar to *E. citrispora* but with narrower basidiospores, 5.5–7  $\mu\text{m}$  diam.

***Epithele cylindricosterigmata*** H. C. Wang & Sheng H. Wu, Mycologia 102: 1155. 2010. – Figs. 11, 21.

Basidioma resupinate, widely effuse, beginning as small linear or irregular colonies, coalescing, thin, up to 70  $\mu\text{m}$  thick, firm, denticulate from emergent hyphal pegs, between pegs smooth, subporoid to subfelty, white, yellowish white (4A2), yellowish grey (4B2), or greyish yellow (4B3); cracks none; hyphal pegs abundant, cylindrical to conical, 12–14 per mm, 100–150  $\times$  20–45  $\mu\text{m}$ , protruding up to 75  $\mu\text{m}$  beyond hymenium, single; margin abrupt, distinct. – Hyphal system monomitic with clamped generative hyphae. – Hyphal pegs originating deep in subhymenium, a tight fascicle of strangulated tramal hyphae with dense clusters of hyaline crystals embedded at base, sometimes with long, filamentous hyphae radiating from apex; tramal hyphae irregular, strangulated, 1–2  $\mu\text{m}$  diam., sparsely branched, often with short lateral branches or knobs, walls hyaline, thin, smooth. – Subiculum not observed. – Subhymenium up to 30  $\mu\text{m}$  thick, an open, slightly thickening, non-agglutinated tissue of upright hyphae; subhymenial hyphae even to strangulated, 1.5–2.5  $\mu\text{m}$  diam., clamped, frequently branched, walls hyaline, thin, smooth. – Hymenium a moderately dense palisade of hyphidia, cystidia, and basidia. – Hyphidia filamentous or irregular, tapering slightly to apex, 22–50 (72)  $\times$  2.5–5  $\mu\text{m}$ , clamped at base, rarely with short lateral knobby branches, walls hyaline, thin, smooth. – Cystidia scarce or absent, subfusiform, obclavate or cylindrical, (10) 14–22  $\times$  5–8  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Basidia numerous, clavate to broadly cylindrical, often with a slight median constriction, often tapering to a short stalk, 23–30  $\times$  10–11.5  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata cylindrical, stout. – Basidiospores scattered, ellipsoid to broadly lacrymoid, often tapering slightly to a distinct, thick-walled, refractive apiculus, (9.2) 10–11 (12)  $\times$  (6.8) 7.2–8 (8.5)  $\mu\text{m}$ , average ( $n = 21$ ) 10.5  $\pm$  0.6  $\times$  7.5  $\pm$  0.4  $\mu\text{m}$ ,  $Q = 1.4^*$ , containing oil-like material, walls hyaline, thin, smooth, acyanophilous, not reacting in Melzer's reagent.

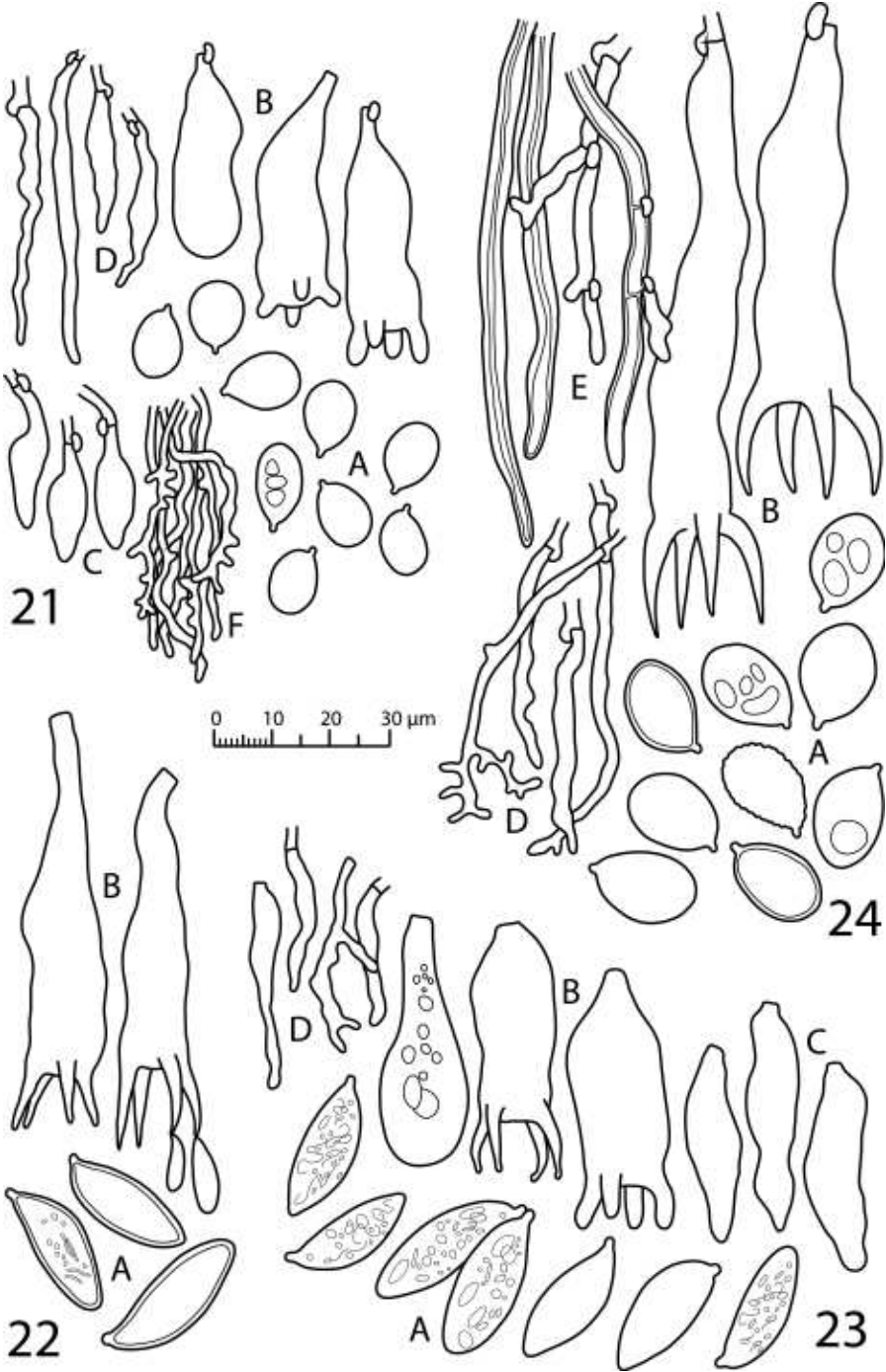
Habitat and distribution. – On corticate branches of woody angiosperms; reported from Vietnam and Taiwan.

Description and illustration. – Wang *et al.* (2010).

Type material examined. – VIETNAM, Ba Vi National Park, alt. 1200 m, on branch (corticate) of angiosperm, 3 Jul 1998, *leg.* S. H. Wu and S. Z. Chen, Wu 9807–42 (TNM-F 0009030, holotype).

Additional material examined. – TAIWAN, Taipei, Hsintien-Pinglin, close to Hsintien, alt. 200 m, on (corticate) branch of *Villebrunea pedunculata* Shirai, 13 Mar 1988, *leg.* S. H. Wu 880313–8 (TNM-F 0015447).

*Epithele cylindrosterigmata* is characterized by numerous, small hyphal pegs, short basidia, and ellipsoid to broadly lacrymoid basidiospores. The microscopic elements in the paratype specimen are generally smaller than corresponding structures in the holotype. In addition, cystidia were observed only in the paratype specimen. *Epithele sulphurea* has larger, ellipsoid basidiospores with cyanophilous walls and yellow basidiomata.





***Epithele efibulata*** Boidin, Lanq. & Gilles, Mycotaxon 16: 470. 1983. – Figs. 12, 13, 22, 23.

**Basidioma** resupinate, widely effuse, beginning as small linear or circular colonies, coalescing, up to 80 × 15 mm, adnate, moderately thin, up to 300 µm thick, soft, denticulate from emergent hyphal pegs, area between pegs smooth, with numerous shallow pits from dislodged pegs, yellowish white (4A2), pale yellow (4A), or orange white (5A2); hyphal pegs abundant, conical, 6–7 pegs per mm, 180–250 × 22–36 µm, single, fragile, readily dislodged; margin distinct, adnate, abrupt, edges short-fimbriate. – **Hyphal system** dimitic with simple-septate generative hyphae and skeletal hyphae, but appearing monomitic. – **Hyphal pegs** originating at subiculum-subhymenium interface, protruding up to 200 µm beyond hymenium, a dense, agglutinated fascicle of tramal and occasional skeletal hyphae, often dendrohyphidia developed along sides and at apex, sometimes encrusted with hyaline crystals; tramal hyphae 1.5–3 µm diam., simple septate, unbranched, walls hyaline, thin to 0.5 µm thick, smooth; skeletal hyphae rare, tapering to subacute apex, 1.5–3 µm diam., aseptate, unbranched, walls up to 1.5 µm thick, hyaline, smooth, acyanophilous, not reacting in Melzer's reagent. – **Subiculum** up to 60 µm thick, a dense, compact layer of compressed, agglutinated hyphae arranged parallel to substrate; subicular hyphae 2–3.5 µm diam., simple septate, walls hyaline, thin to slightly thickened, smooth. – **Subhymenium** up to 150 µm thick, an open, thickening, non-agglutinated trama of empty, degraded, nonstaining, indistinct hyphae and hymenial elements penetrated by ascending, staining, strangulated hyphae and abundant, embedded, small, crystalline materials; subhymenial hyphae 1.5–2.2 µm diam., simple-septate, moderately branched, walls hyaline, thin, smooth or encrusted with short, rod-like crystals. – **Hymenium** a dense palisade of dendrohyphidia, cystidia, and basidia. – **Dendrohyphidia** scattered to numerous, filamentous, often with short, knobby branches at apex, 20–40 × 2–4 µm, simple septate at base, walls hyaline, thin, smooth. – **Cystidia** scattered, subfusiform, apex obtuse or subacute, 20–35 × 5–8 µm, simple septate at base, walls hyaline, thin, smooth. – **Basidia** clavate to broadly, cylindrical, often with a slight median constriction, (25) 35–55 × 10–14.5 µm, simple septate at base, walls hyaline, thin to slightly thickened, smooth, 4-sterigmate, sterigmata up to 13 × 2.5 µm. – **Basidiospores** subfusiform, occasionally nearly biapiculate, tapering to a distinct, thick-walled, refractive apiculus, 18.8–24 (26) × 7–10 (10.5) µm, average (n = 30, 31) 22.2–23.3 × 8.4–8.8 µm, Q = 2.6, containing oil-like material, often agglutinated, walls

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**Figs. 21–24.** Line drawings of microscopic elements. **21.** *Epithele cylindricosterigmata* A, B, D, and F from TNM-F 0009030 (holotype), C from TNM-F 0015447. **22.** *Epithele efibulata*. A from LY 9155, B from LY 9187. **23.** *Epithele efibulata* (LY-LY 7863, holotype). **24.** *Epithele fasciculata* (PDD-PDD 17690, holotype of *Acanthophysium fasciculatum*). A. Basidiospores, B. Mature and immature basidia, C. Cystidia from hymenia, D. Hyphidia and dendrohyphidia from hymenia, E. Skeletal and tramal hyphae from hyphal pegs, F. Hyphal peg.

hyaline, thin or pale yellow, up to 1  $\mu\text{m}$  thick, smooth, acyanophilous, rarely weakly cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.** – On stems of monocots in the *Arecales*; known only from Gabon.

**Description and illustration.** – Boidin & Lanquetin (1983).

**Type material examined.** – GABON, Makokou, sur *Raphia* sp., 17 mai 1976, leg. J. Boidin (LY-LY 7863, holotype).

**Additional materials examined.** – GABON, 16 km N de Libreville, forêt de la Mondah, sur rachis de palme d'*Elaeis guineensis* Jacq., 18 feb 1979, leg. G. Gilles 1447 (LY-LY 9167); sur *Raphia*, 10 feb 1979, leg. G. Gilles 1436 (LY-LY 9155).

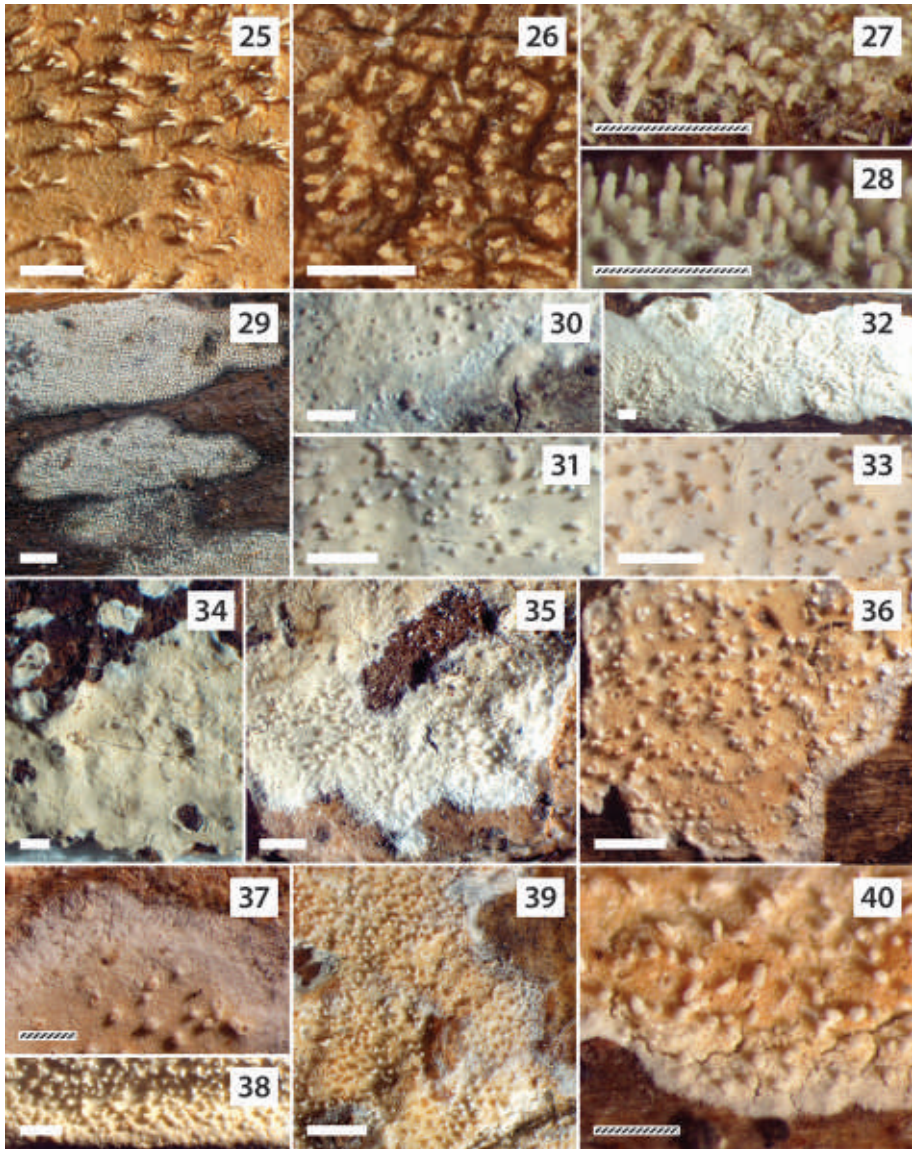
*Epithele efibulata* is characterized by a soft, mostly non-agglutinated basidioma, simple-septate hyphae, and large, subfusiform basidiospores. Skeletal hyphae embedded in the hyphal pegs are easily overlooked. *Epithele efibulata* is the only species in the genus that lacks clamp connections; otherwise, it is microscopically similar to *E. interrupta*, which has clamped generative hyphae.

***Epithele fasciculata*** (G. H. Cunn.) Boidin & Gilles, Bull. Soc. Mycol. France 102: 302. 1986. – Figs. 24–26.

≡ *Acanthophysium fasciculatum* G. H. Cunn., New Zealand Dept. Sci. Ind. Res. Bull. 145: 330. 1963.

≡ *Dendrothele fasciculata* (G. H. Cunn.) P. A. Lemke, Persoonia 3: 366. 1965.

**Basidioma** resupinate, widely effuse, adnate, beginning as circular to oblong colonies, confluent, up to 90 × 30 mm, up to 500  $\mu\text{m}$  thick, soft to somewhat firm, subceraceous to subcrustaceous, denticulate to minutely spinose from numerous hyphal pegs, between pegs smooth, subfelty-farinaceous, yellowish white (4A2), pale yellow (4A3), orange white (5A2), pale orange (5A3), greyish orange (5B4), Cartridge Buff, Cream-Buffer, Light Ochraceous Buff, or Cinnamon-Buffer with Ochraceous Tawny or Tawny-Olive patches; cracks numerous, forming irregular polygons; hyphal pegs abundant, conical to cylindrical, 3–4 pegs per mm, up to 600 × 100  $\mu\text{m}$ , terete, single, brittle, readily breaking off at base; margin closely adnate, abrupt, rapidly thinning out, white, smooth, subfelty to finely porose, nearly white, pale yellow (4A2) to light yellow (4A3). – **Hyphal system** dimitic with clamped generative and skeletal hyphae. – **Hyphal pegs** arising from subhymenium and subiculum, embedded up to 150  $\mu\text{m}$ , a compact fascicle of tramal and occasional skeletal hyphae with dendrohyphidia developed along sides; tramal hyphae 2–4.5  $\mu\text{m}$  diam., clamped, sparingly branched, walls hyaline, thin to 1.5  $\mu\text{m}$  thick, smooth, acyanophilous; skeletal hyphae embedded, 3–4  $\mu\text{m}$  diam., aseptate, unbranched, with a narrow lumen, gradually tapering toward apex, walls hyaline, up to 2  $\mu\text{m}$  thick, smooth, acyanophilous, not reacting in Melzer's reagent; dendrohyphidia weakly differentiated, irregular, with knobby protuberances, 2–4  $\mu\text{m}$  diam., walls hyaline, thin, smooth. – **Subiculum** up to 350  $\mu\text{m}$  thick, a compact tissue of non-agglu-



**Figs. 25–40.** Basidiomata of *Epithele* species. **25–26.** *Epithele fasciculata* (PDD–PDD 17690, holotype of *Acanthophysium fasciculatum*). **27.** *Epithele hydnoides* (BPI 0285229, holotype). **28–29.** *Epithele hydnoides* (ARIZ–AN031201). **30–31.** *Epithele interrupta* (LY–LY 5395, holotype of *Epithele macarangae*). **32.** *Epithele interrupta* (O–Rammeloo 4641). **33.** *Epithele interrupta* (O–Rammeloo 4663, isotype of *Laeticorticium odontoides*). **34.** *Epithele interrupta* (S–F 14859, isotype). **35.** *Epithele interrupta* (CFMR–HHB 6583, holotype of *Dendrothele subfusispora*). **36–37.** *Epithele interrupta* (O–LR 24627). **38.** *Epithele interrupta* (TNM–Wu 9705–5). **39.** *Epithele lutea* (TNM–F 0004540). **40.** *Epithele lutea* (TNM–F 0015469, holotype). White scale bars = 1 mm; cross-hatched scale bars = 0.5 mm.

minated, intertwined subicular and skeletal hyphae with small, embedded crystals, sometimes hyphae next to substrate collapsed, indistinct, degraded; subicular hyphae 2–3.5  $\mu\text{m}$  diam., clamped, moderately branched, walls hyaline, thin to thickened, smooth; skeletal hyphae scattered, 1–5  $\mu\text{m}$  diam., aseptate, sparingly to moderately branched, walls hyaline, up to 2  $\mu\text{m}$  thick, smooth. – Subhymenium up to 35–55  $\mu\text{m}$  thick, a dense, compact tissue often with embedded crystals; subhymenial hyphae 2–3.5  $\mu\text{m}$  diam., frequently branched, short-celled, walls hyaline, thin, smooth. – Hymenium 70–90  $\mu\text{m}$  thick, a dense palisade of dendrohyphidia and basidia with embedded crystals. – Dendrohyphidia numerous, filamentous, strangulated, 25–65  $\times$  2–3  $\mu\text{m}$ , clamped at base, simple to moderately branched, walls hyaline, thin, smooth. – Basidia clavate to subcylindrical, 55–80  $\times$  11–13  $\mu\text{m}$ , clamped at base, containing oil-like material, walls hyaline, thin, sometimes thickened at base, smooth, 4-sterigmate, sterigmata up to 15  $\times$  3  $\mu\text{m}$ . – Basidiospores ellipsoid, with a distinct, rounded apiculus, (13.5) 14–16.5  $\times$  (9) 9.5–11.5 (12)  $\mu\text{m}$ , average ( $n = 30, 30$ ) 15–15.6  $\times$  10.5–11.7  $\mu\text{m}$ ,  $Q = 1.3$ –1.4, often containing oil-like or refractive material, walls hyaline, thin to 0.8  $\mu\text{m}$  thick, smooth, sometimes finely rugulose in KOH, acyanophilous or weakly cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.** – On bark and wood of angiosperms; reported from New Zealand.

**Description and illustration.** – Cunningham (1963, p. 167).

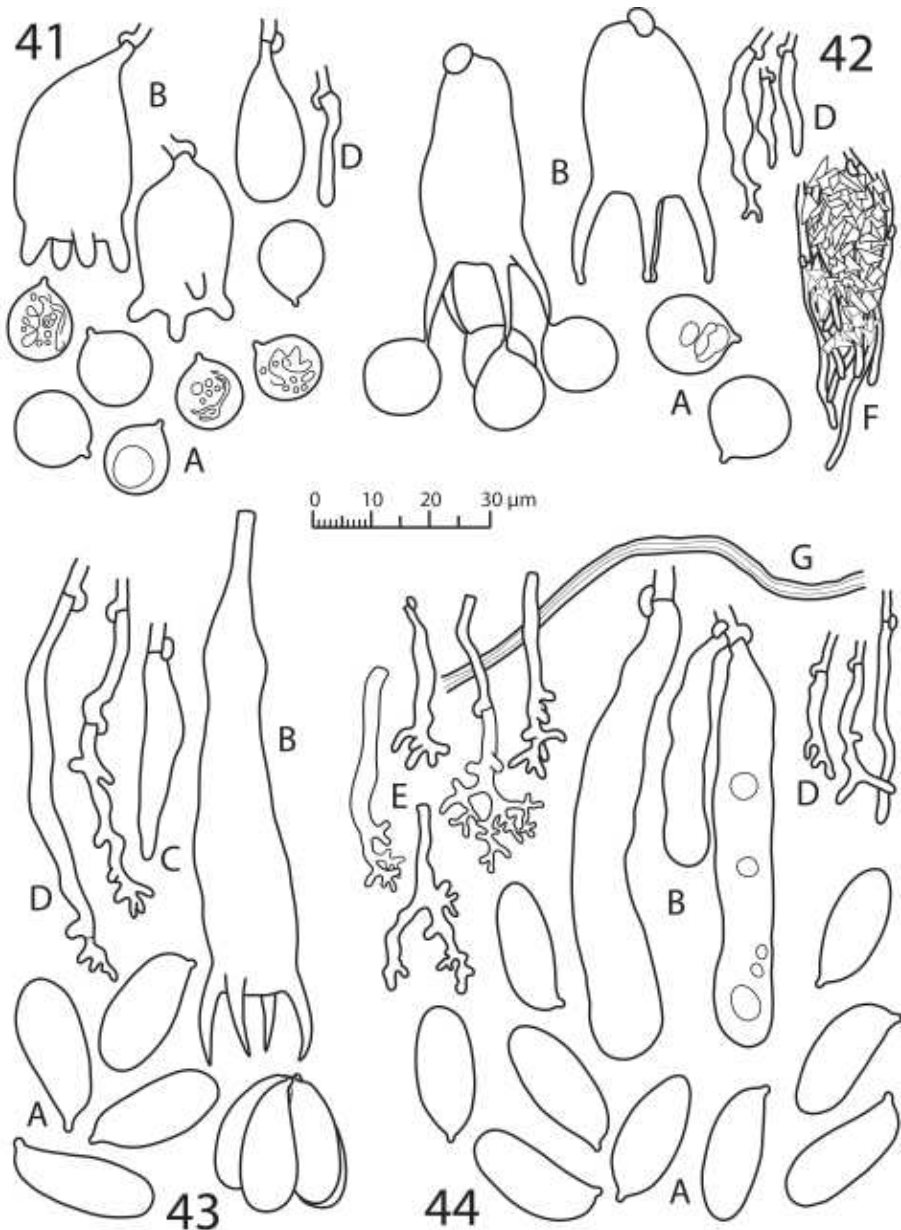
**Type material examined.** – NEW ZEALAND, Wellington, Carterton, Carter's Beach, 150 ft., on (decorticate) *Alectryon excelsum* Gaertn., 18 Dec 1952, leg. G. H. Cunningham (PDD–PDD 17690, holotype; BPI-0285883, isotype).

**Additional materials examined.** – NEW ZEALAND, Wellington, Carterton, Carter's Reserve, 55 m., on (corticate branch of) *Beilschmiedia tawa* Kirk, 18 Dec 1952, leg. G. H. Cunningham, PDD 17688 (BPI-0285882); on *Meliccytus ramiflorus* J. R. Forst. & G. Forst., 18 Dec 1952, leg. G. H. Cunningham (PDD–PDD 17689); on (branches of) *Coprosma robusta* M. Raoul, 18 Dec 1952, leg. G. H. Cunningham (PDD–PDD 17687).

*Epithele fasciculata* is characterized by hyphal pegs, a dimitic hyphal system with thick-walled skeletal hyphae, large basidia, and large ellipsoid basidiospores. In KOH preparations, but not in Melzer's reagent or cotton blue, basidiospore walls sometimes appear finely rugulose or echinulate. *Epithele cylindricosterigmata* is somewhat similar but with smaller basidia and ellipsoid basidiospores. The report of *E. fasciculata* from Venezuela (Hjortstam & Ryvardeen 2005) is described below as the new species *E. ryvardeenii*.

***Epithele hydnoides*** Burt, Ann. Missouri Bot. Gardens 10: 188. 1923. – Figs. 27–29, 41, 42.

**Basidioma** resupinate, effuse, closely adnate, beginning as linear to oblong patches, confluent, up to 30  $\times$  10 mm, thin, up to 50  $\mu\text{m}$  thick, subceraceous, denticulate with abundant hyphal pegs, area between pegs smooth to subporoid, often nearly invisible, yellowish white (4A2), pale yellow (4A3), or yellowish grey (4B2) to greyish yellow (4B3); hyphal pegs cylindrical to



**Figs. 41–44.** Line drawings of microscopic elements. **41.** *Epithele hydroides* (BPI 0285229, holotype). **42.** *Epithele hydroides* (ARIZ-AN017995). **43.** *Epithele interrupta* (PREM-PREM 31393, holotype of *Dendrothele duthieae*). **44.** *Epithele interrupta* (S-F 14859, isotype). A. Basidiospores, B. Mature and immature basidia, C. Cystidia from hymenia, D. Hyphidia and dendrohyphidia from hymenia, E. Dendrohyphidia from hyphal pegs, F. Apex of encrusted hyphal peg.

conical, heavily encrusted with coarse, hyaline crystals, 8–9 pegs per mm, up to  $150 \times 50 \mu\text{m}$ , readily breaking off at base; margin abrupt, rapidly thinning and disappearing into a narrow, dark brown zone. – Hyphal system monomitic with clamped generative hyphae. – Hyphal pegs originating in subiculum, a fascicle of partially agglutinated tramal hyphae and abundant, coarse, hyaline crystals; tramal hyphae  $1.5\text{--}2.5 \mu\text{m}$  diam., clamped, sometimes with short, knobby branches, walls hyaline, thin, encrusted. – Subiculum up to  $20 \mu\text{m}$  thick, composed of agglutinated hyphae arranged more or less parallel to substrate; subicular hyphae  $1\text{--}2 \mu\text{m}$  diam., clamped, sparingly to moderately branched, even, walls hyaline, thin to slightly thickened, smooth. – Subhymenium a narrow, compact, agglutinated tissue of indistinct hyphae. – Hymenium up to  $30 \mu\text{m}$  thick, composed of hyphidia and basidia. – Hyphidia scattered, filamentous to subulate, rarely with short, knobby branches at apex,  $13\text{--}26 \times 2\text{--}4 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Basidia broadly ovoid to broadly cylindrical, with or without a short stalk,  $21\text{--}36 \times 14\text{--}19 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to  $14 \times 3 \mu\text{m}$ . – Basidiospores globose to subglobose, sometimes compressed,  $9\text{--}13 \times 9\text{--}13 \mu\text{m}$ , average ( $n = 17$ )  $10.9 \times 10.4 \mu\text{m}$ ,  $Q = 1.0^*$ , sometimes adherent in clusters of four, walls hyaline, slightly thickened, smooth, weakly cyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. – On stems of *Cibotium* and *Cyathea* (*Cyatheales*), reported once on *Acacia koa* A. Gray; known from Hawaii.

Descriptions and illustrations. – Boquiren (1971), Burt (1923), Gilbertson & Hemmes (1997).

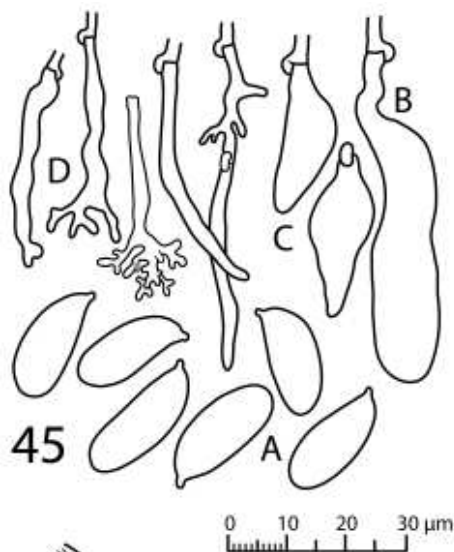
Type materials examined. – UNITED STATES, Hawaii, on dead stems of *Cibotium* sp., 1921, leg. F. L. Stevens 957 (BPI-0285229, holotype; BPI-0285230, isotype).

Additional materials examined. – UNITED STATES, Hawaii, Hawaii County, South Hilo District, Saddle Road, kipuka at mile 10.5, on *Cibotium glaucum* (Sm.) Hook. & Arnott, 5 Jan 1996, leg. R. L. Gilbertson 20936 and 20941 (ARIZ-AN031198, AN031201); mile 18, on *Cibotium* sp., 9 Aug 1991, leg. R. L. Gilbertson 17265 (ARIZ-AN017995); Kalopa State Park, on *Cibotium* sp., 22 Oct 1991, leg. R. L. Gilbertson 18666 (ARIZ-AN017997).

*Epithele hydnoides* is characterized by abundant, small hyphal pegs, broadly ovoid basidia, and globose to subglobose basidiospores with smooth, weakly cyanophilous walls. It is most similar to *E. ryvardeenii* which has morphological similar basidiomata but larger basidiospores. The report of *E. hydnoides* from Réunion by Boidin & Gilles (1986) is described as the new species *E. reunionis* below. *Epithele reunionis* has slightly larger basidiospores than *E. hydnoides* in addition to brown-colored subicular hyphae.

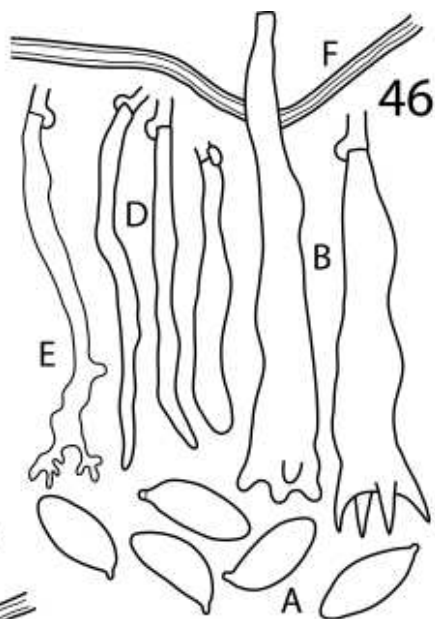
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**Figs. 45–48.** Line drawings of microscopic elements. **45.** *Epithele interrupta* (LY-LY 5395, holotype of *Epithele macarangae*). **46.** *Epithele interrupta* (O-Rammeloo 4663, isotype of *Laeticorticium odontoides*). **47.** *Epithele interrupta* (CFMR-HHB 6583, holotype of *Dendrothele subfusispora*). **48.** *Epithele interrupta* (O-LR 24622). A. Basidiospores, B. Mature and immature basidia, C. Cystidia from hymenia, D. Hyphidia and dendrohyphidia from hymenia, E. Dendrohyphidia from hyphal pegs, F. Skeletal hyphae from context.

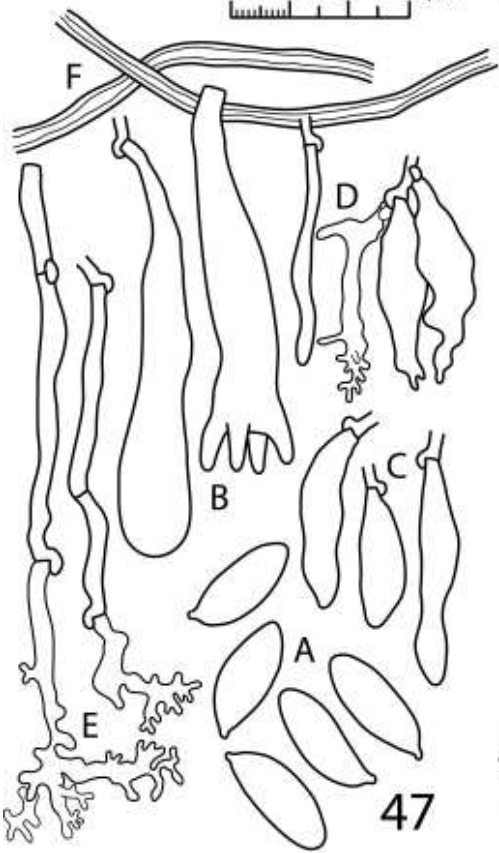


45

0 10 20 30  $\mu\text{m}$



46



47



48

***Epithele interrupta*** Bres., Bull. Jard. Bot. État Bruxelles 4: 25. (1913) 1914.  
– Figs. 30–38, 43–48.

= *Dendrothele duthieae* P. H. B. Talbot, Bothalia 6: 478. 1956.

= *Epithele duthieae* (P. H. B. Talbot) Boidin, Lanq. & Duhem, Bull. Soc. Mycol. France 112: 115. 1996.

= *Laeticorticium odontoides* Ryvar den, Bull. Jard. Bot. Belg. 48: 92. 1978, as 'odontoides'.

= *Epithele macarangae* Boidin & Lanq., Mycotaxon 16: 477. 1983.

= *Dendrothele subfusispora* Burds. & Nakasone, Mycotaxon 17: 255. 1983.

= *Epithele subfusispora* (Burds. & Nakasone) Hjortstam & Ryvar den, Synopsis Fungorum 20: 29. 2005.

Basidioma resupinate, effuse, moderately thick, up to 500  $\mu\text{m}$  thick, beginning as small circular or irregular colonies, confluent, soft, subceraceous to membranous, denticulate to verruculose from emergent hyphal pegs, sometimes with extensive smooth, farinaceous, or felty areas between pegs, yellowish white [(3–4)A2], pale yellow (4A3), pale orange (5A3), light orange (5A4), greyish orange [5B(3–4)], Cartridge Buff or Cream-Buffer; cracks few or absent; context white, loose, cottony; hyphal pegs scattered to abundant, often irregularly distributed, conical, cylindrical, or irregularly tuberculate with white, rounded or tufted apices, up to 6 per mm, up to 300  $\times$  140  $\mu\text{m}$ , single or fused, readily detached leaving behind a circular depression; margin loosely adnate, occasionally detached, thinning out, fibrillose, fimbriate to cottony or distinct, abrupt, slightly raised, white to yellow, thickly fimbriate. – Hyphal system dimitic with clamped generative and skeletal hyphae, although often appearing monomitic. – Hyphal pegs originating from subiculum, a fascicle of non-agglutinated tramal hyphae with embedded, coarse, hyaline crystals, at apex dendrohyphidia encrusted with fine, hyaline crystals; tramal hyphae 3–4  $\mu\text{m}$  diam., clamped, sparingly branched, even, walls hyaline, thin to slightly thickened, smooth, sometimes weakly dextrinoid; dendrohyphidia abundant at peg apex, developed from tramal hyphae, with irregular knobby branches, up to 55  $\times$  2.5–3.5  $\mu\text{m}$ , clamped at base, walls hyaline, thin, encrusted with tiny, hyaline crystals. – Subiculum up to 300  $\mu\text{m}$  thick, with a bi-layered construction – basal layer next to substrate up to 75  $\mu\text{m}$  thick, a dense tissue of agglutinated subicular and skeletal hyphae (rare or absent) arranged more or less parallel to substrate and coarse, hyaline crystals, then hyphae turning into hymenium, forming a less dense, more open trama of partially or non-agglutinated hyphae; subicular hyphae 2–4  $\mu\text{m}$  diam., clamped, sparingly to moderately branched, even, walls hyaline, thin to slightly thickened, smooth; skeletal hyphae scarce, sometimes absent, 1.5–3.5  $\mu\text{m}$  diam., aseptate, unbranched, nonstaining in phloxine, walls hyaline, up to 1.5  $\mu\text{m}$  thick, smooth. – Subhymenium up to 65  $\mu\text{m}$  thick, a dense, thickening, compact tissue of indistinct, upright, short-celled hyphae; subhymenial hyphae, 1.5–3  $\mu\text{m}$  diam.,



frequently branched, walls hyaline, thin, smooth. – Hymenium up to 110  $\mu\text{m}$  thick, a dense palisade of hyphidia, dendrohyphidia, cystidia, and basidia. – Hyphidia filiform, tapering to a subacute apex, simple, rarely branched, 17–60  $\times$  1.5–4  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Dendrohyphidia cylindrical, rarely clavate to subfusiform, with a few short pegs or knobs along length or elaborately branched at apex, 18–60  $\times$  2–8  $\mu\text{m}$ , clamped at base, walls hyaline, thin, often encrusted with fine, hyaline crystals. – Cystidia scarce, embedded, obclavate to subfusiform, 21–45  $\times$  5–13  $\mu\text{m}$ , clamped at base, with homogenous contents, walls hyaline, thin, smooth. – Basidia clavate, tapering gradually to a distinct stalk, 30–60 (80)  $\times$  9–12 (15)  $\mu\text{m}$ , stalk, 3–4  $\mu\text{m}$  diam., clamped at base, often containing oil-like material, walls hyaline, thin, smooth, (2) 4-sterigmate, sterigmata up to 15  $\times$  3  $\mu\text{m}$ . – Basidiospores cylindrical, ovoid, or pip-shaped, occasionally subfusiform or nearly biapiculate, with a distinct, thick-walled, refractive apiculus, (14) 17–22 (25)  $\times$  (6) 7–9 (10)  $\mu\text{m}$ , average ( $n = 32, 33, 33, 35$ ) 18.3–20.2  $\times$  7–8.1  $\mu\text{m}$ ,  $Q = 2.5$ –2.7, containing granular, oil-like material, often aggregated into clusters of four, walls hyaline, slightly thickened, smooth, acyanophilous, rarely weakly cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.** – Bark and wood of angiosperms, petioles of oil palm, *Elaeis* sp.; reported from Argentina (Hjortstam & Ryvar den 2005), Brazil (Gorjón & de Jesus 2012), Burundi, Central African Republic, Congo, South Africa, Taiwan, Thailand (Choeyklin *et al.* 2011), USA (Florida), Venezuela.

**Descriptions and illustrations.** – Boidin & Lanquetin (1983, as *E. interrupta* and *E. macarangae*), Burdsall & Nakasone (1983, as *D. subfusispora*), Hjortstam & Ryvar den (2005), Ryvar den (1978, as *L. odontioides*), Talbot (1956, as *D. duthieae*).

**Type materials examined.** – BURUNDI, District du Rwanda-Burundi, West of road Mutambara-Bururi, forest gallery of the Siguvyaye, on (corticate branch) in litter layer, 20 Sep 1974, *leg.* J. Rammeloo 4663 (O, isotype of *L. odontioides*); CENTRAL AFRICAN REPUBLIC, Bébé près Boukoko, sur branchettes mortes, 11 mai 1965, *leg.* J. Boidin (LY-LY 5395, holotype of *E. macarangae*); (DEMOCRATIC REPUBLIC OF THE) CONGO, Mayidi, 1 Feb 1910, *leg.* Vanderyst (S-F 14859, isotype of *E. interrupta*); SOUTH AFRICA, (Knysna area?), on bark, no date, *leg.* A. V. Duthie 187 (PREM-PREM 31393, holotype of *D. duthieae*); UNITED STATES, Florida, Alachua County, Upper Sugar Foot Prairie, on corticate branches of *Ostrya virginiana* K. Koch, 14 Jul 1972, *leg.* H. H. Burdsall, Jr., HHB 6583 (CFMR, holotype of *D. subfusispora*).

**Additional materials examined.** – BRAZIL, Parana, Fazenda São Pedro, General Carneiro, on *Bambusa* twigs, 16 Sep 1989, *leg.* A. A. R. de Meijer 7359 (CFMR); São Paulo, Parque Estudual Fontes do Ipiranga, on palm, 16–24 Jan 1987, *leg.* D. Pegler, K. Hjortstam & L. Ryvar den, LR 24622 and LR 24627 (O, as *E. subfusispora*); BURUNDI, District du Rwanda-Burundi, West of road Mutambara-Bururi, forest gallery of the Siguvyaye, on (corticate branch) in litter layer, 20 Sep 1974, *leg.* J. Rammeloo 4641 and 4654 (O, as *L. odontioides*); CENTRAL AFRICAN REPUBLIC, La Maboké, on *Macaranga spinosa* Müll. Arg., 12 mai 1965, *leg.* J. Boidin (LY-LY 5410, as *E. macarangae*); TAIWAN, Taitung, Orchid Island, on branch of angiosperm, 1 May 1997, *leg.* S. H. Wu & J. Y. Tseng, Wu 9705–6 and 9705–5 (TNM, as *E. macarangae*); VENEZUELA, Estado Aragua, Parque Nacional H. Pitié r, on hardwood, 25 Apr 1998, *leg.* L. Ryvar den 40833 (O, as *E. subfusispora*).

*Epithele interrupta* is a widely distributed and morphologically variable species characterized by hyphal pegs and large cylindrical to subfusiform basidiospores. The skeletal hyphae are easily overlooked because they are often scarce, deep in the subiculum. Similarly, cystidia are often missed because of their scarcity and small size. Noticeable variation in basidioma thickness, distribution and morphology of hyphal pegs, and basidiospore size and shape were observed among the specimens examined. Lacking consistent and compelling morphological evidence for recognizing distinct taxa, a broad species concept of *E. interrupta* is proposed.

*Epithele interrupta* is morphologically similar to *E. belizensis*, *E. ceracea*, and *E. lutea*. Compared to *E. interrupta*, *E. lutea* has larger basidiospores and hyphal pegs composed of undifferentiated tramal hyphae whereas *E. belizensis* has significantly smaller basidiospores and hyphal pegs. The basidiospores of *E. ceracea* are slightly shorter but similar in shape to those in *E. interrupta*, and its basidioma is ceraceous throughout and lacks skeletal hyphae.

*Dendrothele duthieae* and *E. macarangae* are recognized as synonyms of *E. interrupta* for the first time. The holotype of *D. duthieae* is in good condition and consists of two small colonies with average basidiospore size ( $n = 25$ )  $18.5 \pm 1.5 \times 8.9 \pm 0.7 \mu\text{m}$ ,  $Q = 2.1^*$ . Although *D. duthieae* was placed in synonymy with *D. alba* by Lemke (1965), this was not accepted by Boidin *et al.* (1996) or Hjortstam & Ryvarden (2005) who cited differences in basidiospore shape. The holotype of *E. macarangae* is in good condition. It appears to be a young basidioma because it is thin, 110  $\mu\text{m}$  thick, with small, rounded hyphal pegs. When first described, *E. macarangae* was distinguished from *E. interrupta* by the lack of skeletal hyphae (Boidin & Lanquetin 1983); however, scattered skeletal hyphae in the subiculum were observed in the holotype and paratype specimens cited above.

The isotype of *E. interrupta* is a small specimen, 40  $\times$  10 mm, in excellent condition with abundant basidiospores although no cystidia were observed. It is unusual in that numerous skeletal hyphae were observed in the subiculum. Hjortstam & Ryvarden (2005) reported that the basidiospores sometimes appeared slightly rugose in KOH and Melzer's reagent in the type specimens of *E. interrupta* they examined. *Laeticorticium odontioides* was first synonymized with *E. interrupta* by Hjortstam & Larsson (1995, p. 23). In the isotype examined above, hyphal pegs were small, cylindrical or conical with rounded apices, up to 200  $\times$  60  $\mu\text{m}$ , and irregularly distributed. When describing *D. subfusispora*, Burdsall & Nakasone (1983) failed to mention the presence of hyphal pegs, skeletal hyphae, and cystidia.

***Epithele lutea*** H. C. Wang & Sheng H. Wu, Mycologia 102: 1156. 2010. – Figs. 39, 40, 49, 50.

Basidioma resupinate, effuse, beginning as small circular or oblong colonies, coalescing, thin, up to 325  $\mu\text{m}$  thick, soft, denticulate from emergent hyphal pegs, area between pegs smooth, felty, orange white (5A2), pale or-

ange (5A3), or greyish orange [5B(3–4)], with scattered cracks; hyphal pegs abundant, cylindrical to conical, up to 14 per mm, up to  $200 \times 55 \mu\text{m}$ , protruding up to  $130 \mu\text{m}$  beyond hymenium, fragile, brittle, readily detached, white, not encrusted; margin adnate, distinct, thick, woolly, white. – Hyphal system monomitic with clamped generative hyphae. – Hyphal pegs originating in subiculum, a dense, agglutinated fascicle of poorly differentiated hyphae; tramal hyphae  $1.4\text{--}3 \mu\text{m}$  diam., inconspicuously clamped, unbranched, sometimes knobby at apex, walls hyaline, thin, smooth. – Subiculum up to  $275 \mu\text{m}$  thick with a bi-layered construction – basal layer next to substrate up to  $50 \mu\text{m}$  thick, a dense, agglutinated tissue of hyphae arranged parallel to substrate, then curving toward hymenium, upper layer an open, non-agglutinated tissue of upright hyphae and abundant, embedded, small, cubical, hyaline crystals (in holotype); subicular hyphae  $1.5\text{--}3 \mu\text{m}$  diam., clamped, rarely to moderately branched, walls hyaline, thin, smooth or encrusted. – Subhymenium an indistinct tissue of non-agglutinated, short-celled hyphae; subhymenial hyphae  $1.8\text{--}2.5 \mu\text{m}$  diam., clamped, frequently branched, walls hyaline, thin, smooth. – Hymenium a dense palisade of hyphidia, cystidia, and basidia. – Hyphidia filamentous with short knobby branches at apex,  $20\text{--}55 \times 2\text{--}4 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Cystidia subfusiform, obclavate or clavate, tapering to an obtuse apex,  $20\text{--}40 \times 5\text{--}12 \mu\text{m}$ , clamped at base, contents staining deeply in phloxine, walls hyaline, thin, smooth. – Basidia clavate,  $75\text{--}95 \times 14\text{--}15 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, 4-sterigmate. – Basidiospores scarce to numerous, often collapsed, subcylindrical to fusiform, occasionally nearly biapiculate, with a prominent, thick-walled, refractive apiculus,  $(17) 21\text{--}25 (27.5) \times 9\text{--}10.5 (12) \mu\text{m}$ , average ( $n = 32, 35$ )  $23.3\text{--}23.6 \times 9.8\text{--}9.9 \mu\text{m}$ ,  $Q = 2.3\text{--}2.4$ , containing cyanophilous and oil-like material, walls at first hyaline, thin, weakly cyanophilous, then dark yellow, up to  $2 \mu\text{m}$  thick, smooth, acyanophilous, not reacting in Melzer's reagent.

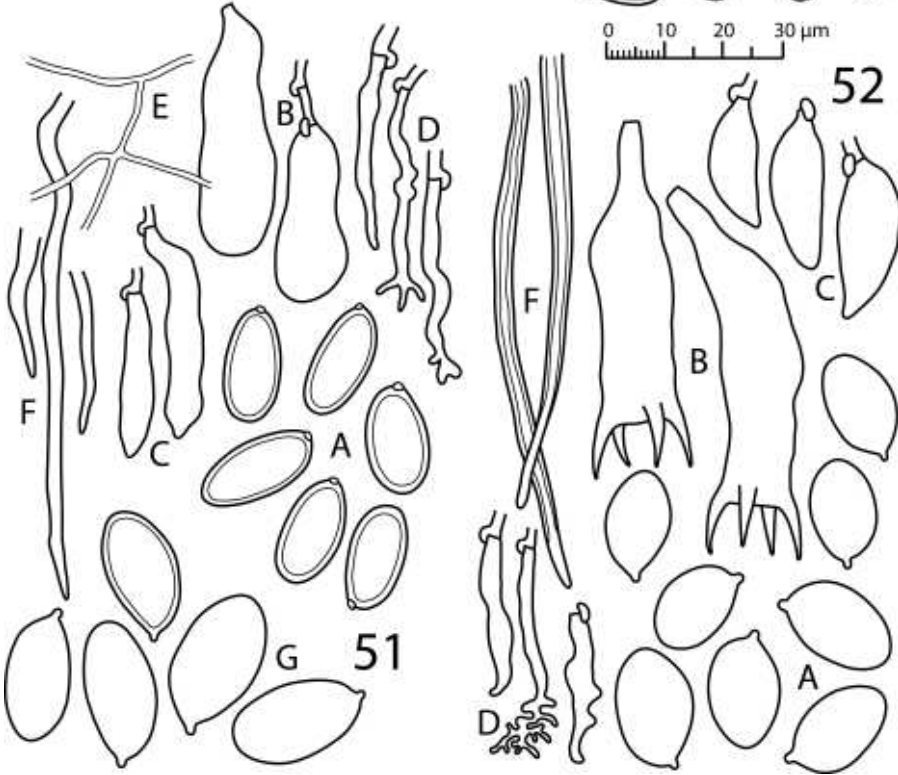
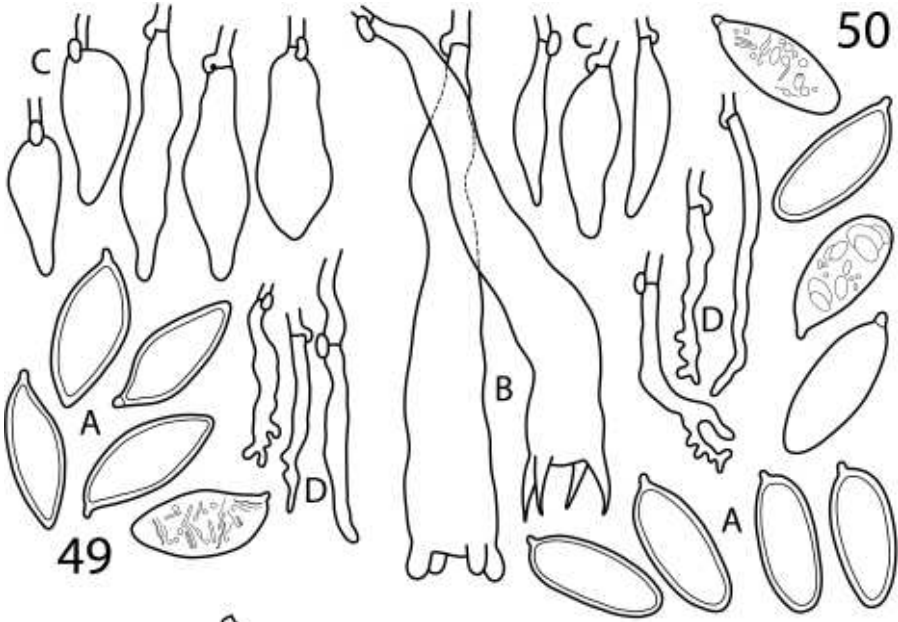
**Habitat and distribution.** – On bark of angiosperms, culms of *Daemonorops margaritae* (Hance) Becc.; known from type location, Taiwan.

**Description and illustration.** – Wang *et al.* (2010).

**Type material examined.** – TAIWAN, Kaohsiung, Liukuei, Shanping, alt. 750 m, on culm of *D. margaritae*, 7 Nov 1991, *leg.* S. H. Wu 911107–64 (TNM-F 0015469, holotype).

**Additional material examined.** – TAIWAN, Ilan, Fushan Botanical Garden, alt. 600 m, on branch of angiosperm, 30 Sep 1995, *leg.* C. Y. Chien, Wu 9509–43 (TNM-F 0004540).

*Epithele lutea* is characterized by slender hyphal pegs composed of undifferentiated hyphae and large, narrowly ellipsoid to fusiform basidiospores. Some differences were observed between the holotype and paratype specimens. For example, the holotype has abundant crystals embedded in the context and fusiform, nearly biapiculate basidiospores whereas the paratype specimen lacks crystals and has subcylindrical to subfusiform basidiospores. This species is most similar to *E. interrupta* which has skeletal hyphae, smaller basidiospores, averaging  $18.3\text{--}20.2 \times 7\text{--}8 \mu\text{m}$ , and hyphal pegs composed of dendrohyphidia.



***Epithele malaiensis*** Boidin & Lanq., Mycotaxon 16: 479. 1983. – Figs. 51, 53.

Basidioma resupinate, effuse, irregular colonies coalescing, thin, up to 60  $\mu\text{m}$  thick, firm, subceraceous, denticulate from emergent hyphal pegs, between pegs smooth, subporoid to subfelty, orange white (5A2); hyphal pegs abundant, conical to cylindrical, apices subacute to rounded, often broken off, 6–7 per mm, up to 200  $\times$  70  $\mu\text{m}$ , fragile, brittle, terete; margin distinct, abrupt, adnate, white, fibrillose. – Hyphal system appearing dimitic with clamped generative and skeletal hyphae, but actually trimitic with microbinding hyphae also. – Microbinding hyphae abundant in substrate, 0.7–1.5  $\mu\text{m}$  diam., aseptate, frequently branched usually at right angles, walls hyaline, thickened, smooth, non-staining. – Hyphal pegs originating in subiculum, a fascicle of agglutinated, rigid skeletal hyphae encrusted with fine to coarse hyaline crystals; skeletal hyphae gradually tapering to an acute apex, 1.8–3.2  $\mu\text{m}$  diam., unbranched, walls hyaline, up to 1.5  $\mu\text{m}$  thick, smooth or encrusted with hyaline crystals, acyanophilous, not reacting in Melzer's reagent. – Subiculum up to 20  $\mu\text{m}$  thick, a thin, dense trama of compressed, often indistinct, agglutinated hyphae arranged more or less parallel to substrate; subicular hyphae irregular, contorted, 1.5–3.5  $\mu\text{m}$  diam., clamped, moderately branched, walls hyaline, thin, smooth. – Subhymenium not observed. – Hymenium a palisade of hyphidia, cystidia, and basidia. – Hyphidia abundant, simple to sparsely branched at apex, 25–35  $\times$  2–3  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth or finely encrusted. – Cystidia scarce, cylindrical to subclavate, with an obtuse or subacute apex, 25–35  $\times$  5–6  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Basidia 30–45  $\mu\text{m}$  long with 4-sterigmata (Boidin & Lanquetin 1983), immature forms clavate to broadly cylindrical, sometimes with a stalk, walls hyaline, thin, smooth. – Basidiospores from squash mounts cylindrical with a distinct, small, refractive apiculus, (15) 16–20.3 (22)  $\times$  (8) 8.5–9.5 (10)  $\mu\text{m}$ , average ( $n = 33$ ) 17.9  $\pm$  1.6  $\times$  8.9  $\pm$  0.4  $\mu\text{m}$ ,  $Q = 2.0$ , walls hyaline, thin at first then brownish yellow, up to 2  $\mu\text{m}$  thick, smooth, weakly cyanophilous, not reacting in Melzer's reagent; from spore drops 18–22  $\times$  (9.5) 10–12 (12.5)  $\mu\text{m}$ , average ( $n = 35$ ) 19.6  $\pm$  1.1  $\times$  11.2  $\pm$  0.9  $\mu\text{m}$ ,  $Q = 1.8$ , walls hyaline, thin to 0.7  $\mu\text{m}$  thick, smooth, acyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. – On palm (*Arecales*); reported from Singapore, China (Maekawa & Zang 1995).

Description and illustration. – Boidin & Lanquetin (1983).

Type material examined. – SINGAPORE, MacRitchie Reservoir, sur *Calamus*, 19 août 1977, leg. J. Boidin (LY–LY 8252, holotype).

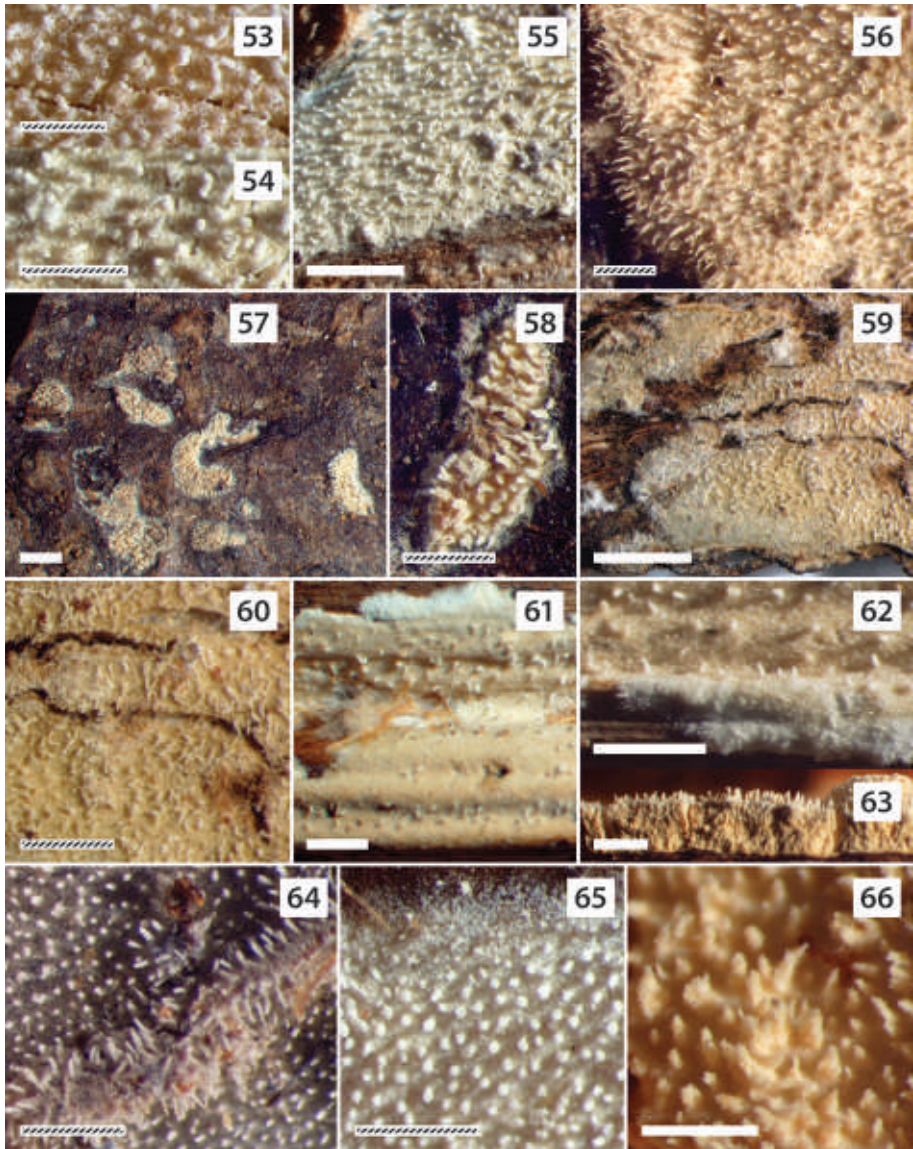
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**Figs. 49–52.** Line drawings of microscopic elements. **49.** *Epithele lutea* (TNM–F 0015469, holotype). **50.** *Epithele lutea* (TNM–F 0004540). **51.** *Epithele malaiensis* (LY–LY 8252, holotype). **52.** *Epithele ovalispora* (LY–LY 7928, holotype). A. Basidiospores, B. Mature and immature basidia, C. Cystidia from hymenia, D. Hyphidia and dendrohyphidia from hymenia, E. Microbinding hyphae, F. Skeletal hyphae from hyphal pegs. G. Basidiospores from spore drop of *E. malaiensis* holotype.

*Epithele malaiensis* is characterized by a trimitic hyphal system, hyphal pegs composed of rigid skeletal hyphae, and cylindrical basidiospores with hyaline, thin walls that become thick, brownish yellow. Microbinding hyphae were abundant in the substrate just below the basidioma. Differences in size and morphology of basidiospores from squash mounts and spore drops were unexpected. As in *E. malaiensis*, hyphal pegs in *E. ovalispora* and *Skeletohydnum nikau* are composed primarily of skeletal hyphae. These species are readily distinguished from *E. malaiensis* for skeletal hyphae in *E. ovalispora* are dextrinoid and *Skeletohydnum* has small, distinctly urniform basidia. Microbinding hyphae were observed also in *E. alba*, *E. belizensis*, and *E. citrispora*.

***Epithele ovalispora*** Boidin & Lanq., Mycotaxon 16: 482. 1983. – Figs. 52, 54, 55.

Basidioma resupinate, effuse, irregular oblong colonies coalescing, up to 250  $\mu\text{m}$  thick, soft, denticulate from emergent hyphal pegs, area between pegs smooth, subfelty to subfarinaceous, light yellowish white (4A2); hyphal pegs abundant, cylindrical with entire, subacute to rounded apices, 7–9 per mm, 150–200  $\times$  25–50  $\mu\text{m}$ , terete, fragile, readily detached; margin distinct, abrupt, adnate, edges thickly fimbriate. – Hyphal system dimitic with clamped generative and skeletal hyphae. – Hyphal pegs originating in subiculum, embedded about 70  $\mu\text{m}$ , a fascicle of skeletal hyphae lightly encrusted with coarse, hyaline crystals or occasionally entwined with dendritic hyphae; skeletal hyphae, found only in hyphal pegs, slightly tapering to an obtuse apex, 70–100  $\times$  2.3–2.5  $\mu\text{m}$  diam., unbranched, walls hyaline, up to 1  $\mu\text{m}$  thick, thinning toward apex, smooth or encrusted with closely adnate, hyaline crystals, cyanophilous, dextrinoid; dendritic hyphae 1.5–2  $\mu\text{m}$  diam., clamped, contorted, with short, peg-like branches, walls hyaline, thin, smooth. – Subiculum 35–55  $\mu\text{m}$  thick, a tissue of agglutinated, hyphae arranged parallel to substrate; subicular hyphae 2–3  $\mu\text{m}$  diam., clamped, walls hyaline, slightly thickened, smooth. – Subhymenium up to 20  $\mu\text{m}$  thick, a moderately loose tissue of upright, not agglutinated hyphae; subhymenial hyphae 2.5–3  $\mu\text{m}$  diam., clamped, moderately branched, walls hyaline, thin, smooth. – Hymenium about 70  $\mu\text{m}$  thick, a palisade of hyphidia, cystidia, and basidia. – Hyphidia filiform, sometimes with short, knobby branches at apex, 23–30  $\times$  2–4  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Cystidia obclavate to subfusiform, 20–30  $\times$  7–9.5  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Basidia clavate, often stalked, 45–50  $\times$  10–12  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to 12  $\times$  2.5  $\mu\text{m}$ . – Basidiospores ellipsoid with distinct, refractive apiculus, 15–18 (19.5)  $\times$  9.3–10.8 (12.3)  $\mu\text{m}$ , average ( $n = 30$ ) 16.8  $\pm$  1.1  $\times$  10.2  $\pm$  0.7  $\mu\text{m}$ ,  $Q = 1.6$ , containing oil-like material, walls hyaline, thin to slightly thickened, smooth, cyanophilous, not reacting in Melzer's reagent.



**Figs. 53–66.** Basidiomata of *Epithele* species. **53.** *Epithele malaiensis* (LY-LY 8252, holotype). **54–55.** *Epithele ovalispora* (LY-LY 7928, holotype). **56.** *Epithele reunionis* (LY-LY 11670, holotype). **57–58.** *Epithele ryvardeenii* (O-LR 35541, holotype). **59–60.** *Epithele sulphurea* (BPI 0285234, isotype). **61–62.** *Epithele typhae* (S-F 5292). **63 and 66.** *Myriothele philippiae* (LY-LY 14069). **64.** *Skeletohydnum nikau* (USJ-USJ 53880, holotype of *Tubulicium ramonense*). **65.** *Skeletohydnum nikau* (LY-LY 8819, holotype of *Epithele guadelupensis*). White scale bars = 1 mm; cross-hatched scale bars = 0.5 mm.

Habitat and distribution. – On palm; known from Gabon, the type locality.

Description and illustration. – Boidin & Lanquetin (1983).

Type material examined. – GABON, Makokou, sur *Ancistrophyllum*, 24 mai 1976, leg. J. Boidin (LY-LY 7928, holotype).

*Epithele ovalispora* is characterized by fragile hyphal pegs composed of dextrinoid skeletal hyphae, subfusiform cystidia, and large, ellipsoid basidiospores. Hyphal pegs of *E. ovalispora* are morphologically similar to those in *Skeletohydnum* and *E. malaiense* except that skeletal hyphae in the latter taxa are not dextrinoid. *Epithele fasciculata* has basidiospores that are similar to that of *E. ovalispora* but differs in basidioma texture and hyphal peg morphology.

***Epithele reunionis* Nakasone, sp. nov.** – Figs. 56, 67, 68.

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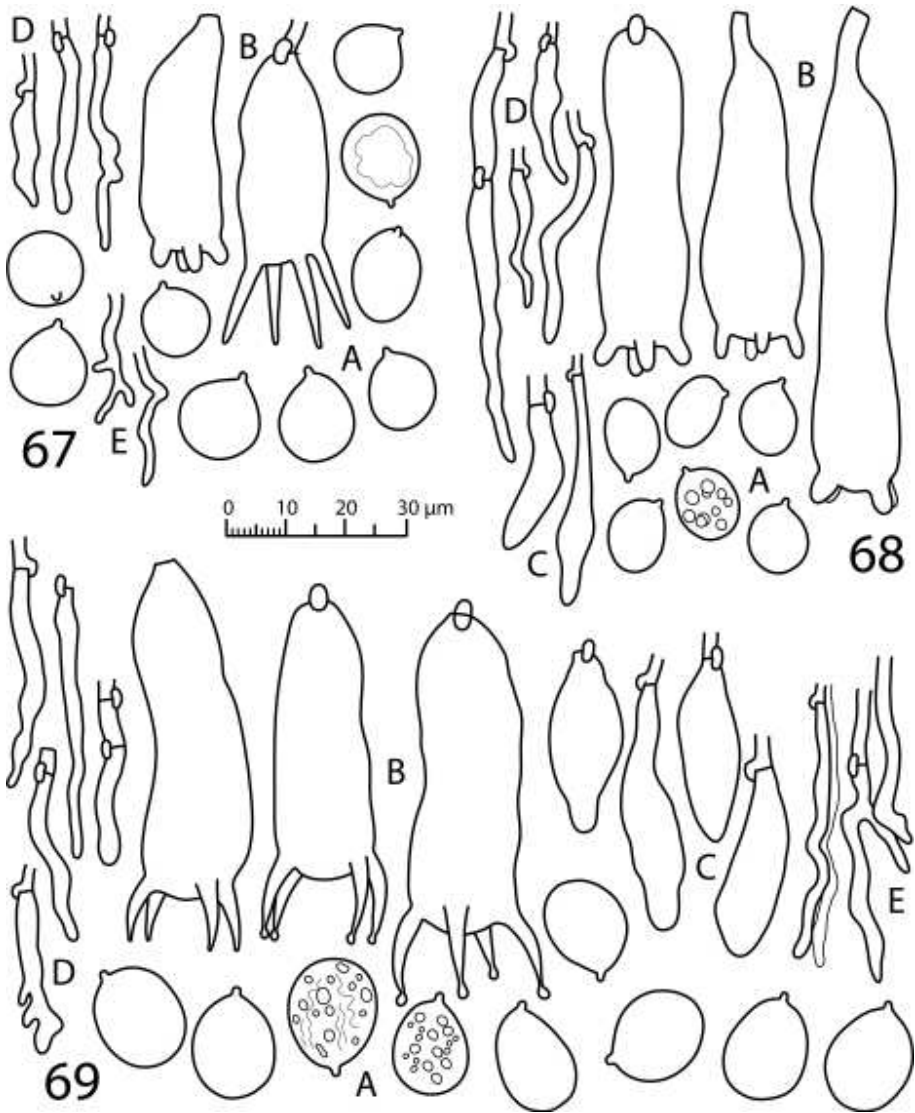
Basidioma effuse, subceraceous to membranous, denticulate from emergent hyphal pegs; hyphal system monomitic with clamped generative hyphae, brown-colored hyphae present in subiculum and often in subhymenium and hyphal pegs; hyphidia simple; cystidia none; basidia broadly clavate to cylindrical with short stalk; basidiospores globose to subglobose, (8.8) 9.5–12 (14) × (7.5) 8–11 (11.5) μm, walls hyaline, thin to slightly thickened, smooth, weakly cyanophilous, not reacting in Melzer's reagent.

Holotype. – Réunion, St. Philippe, le Baril, sur *Cyathea*, à 400 m d'alt, 6 mai 1985, leg. G. Gilles (LY-LY 11670).

Basidioma resupinate, effuse, irregular colonies coalescing, up to 22 × 15 mm, closely adnate, thin, up to 350 μm thick, moderately firm, subceraceous to membranous, denticulate from emergent hyphal pegs, between pegs smooth, felty to subporoid, orange white, (5A2), greyish orange [5(A–B)3], or pale orange (5A3); hyphal pegs cylindrical to conical, up to 14 pegs per mm, up to 250 × 60 μm, terete, single; margin distinct, abrupt, adnate, fimbriate, sordidly white to light brown.

Hyphal system monomitic with clamped generative hyphae. – Hyphal pegs originating deep in subiculum, a fascicle of non-agglutinated, strangulated tramal hyphae and clusters of coarse, hyaline crystals, often with brown-colored hyphae in the base, central core, or throughout peg, protruding up to 150 μm beyond hymenium; tramal hyphae 1.5–3 μm diam., clamped, sparsely branched, even to strangulated, walls hyaline or brown, thin, smooth. – Subiculum up to 40 μm thick, a dense tissue of agglutinated hyphae arranged more or less parallel to substrate; subicular hyphae 1.8–3 μm diam., clamped, moderately branched, walls hyaline or brown, slightly thickened, smooth. – Subhymenium up to 250 μm thick, a dense, thickening, agglutinated, sometimes stratified, lacunose tissue of upright hyphae with large clusters of coarse, hyaline crystals; subhymenial hyphae 2.2–3.2 μm diam., moderately branched, walls hyaline to brown, thin, smooth. – Hymenium a dense palisade of hyphidia and basidia. – Hyphidia numerous, filiform, occasionally strangulated, rarely subfusiform, tapering to an obtuse apex, 17–40 (60) × 2.5–5 μm, clamped at base, walls hyaline, thin,





**Figs. 67–69.** Line drawings of microscopic elements. **67.** *Epithele reunionis* (LY-LY 11670, holotype). **68.** *Epithele reunionis* (LY-LY 11646, paratype). **69.** *Epithele rywardenii* (O-LR 35541, holotype). A. Basidiospores, B. Basidia, C. Cystidia from hymenia, D. Hyphidia and dendrohyphidia from hymenia, E. Hyphae from hyphal pegs.

smooth. – Basidia broadly clavate to cylindrical, often with a distinct, short stalk, 30–50 (70) × 12–15 μm, clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to 14 × 2.5 μm. – Basidiospores globose to subglobose, with a distinct, blunt apiculus, (8.8) 9.5–12 (14) × (7.5)

8–11 (11.5)  $\mu\text{m}$ , average ( $n = 30, 31$ ) 10.9–11.4  $\times$  8.8–10.6  $\mu\text{m}$ ,  $Q = 1.1$ –1.2, filled with oil-like material, walls hyaline, thin to slightly thickened, smooth, weakly cyanophilous, not reacting in Melzer's reagent.

**Etymology.** – Named after the country of origin, Réunion.

**Habitat and distribution.** – On *Cyathea* sp.; known from Réunion.

**Description and illustration.** – Boidin & Gilles (1986, as *E. hydroides*).

**Additional materials examined.** – RÉUNION, St. Philippe, au dessus du Baril, alt. 400 m., sur *Cyathea* sp. mort au sol, 7 mai 1985, *leg.* J. Boidin (LY–LY 11646); forêt de Bebour, near Piton de Bebour, rain-forest about 1400 m over sea-level, on aerial roots of *Cyathea* sp., 19 Mar 2007, *leg.* Th. Rödel 8931 (Herb. Dämmrich).

*Epithele reunionis* is characterized by brown-colored hyphae in the context and hyphal pegs, broadly clavate or cylindrical basidia, and globose to subglobose basidiospores with weakly cyanophilous walls. The thin, subicular hyphal layer of agglutinated, brown-colored hyphae is diagnostic for this species. The hyphal pegs are composed of weakly differentiated tramal hyphae, and some of these hyphae are brown-colored also. Originally, Boidin & Gilles (1986) identified their specimens as *Epithele hydroides*, but this species lacks pigmented hyphae, has much thinner basidiomata, and develops fragile hyphal pegs. The similar species *E. ryvardenii* lacks pigmented hyphae and has larger basidiospores compared to *E. reunionis*.

***Epithele ryvardenii* Nakasone, sp. nov.** – Figs. 57, 58, 69.

Mycobank no.: MB 803368

**Basidioma** effuse, subceraceous to membranous, denticulate from emergent hyphal pegs; hyphal system monomitic with clamped generative hyphae; hyphidia simple; cystidia scarce, subclavate to subfusiform; basidia broadly clavate with short stalk; basidiospores broadly ellipsoid to subglobose, 13–16  $\times$  11–13  $\mu\text{m}$ , walls hyaline, thin to slightly thick, smooth, weakly cyanophilous, not reacting in Melzer's reagent.

**Holotype.** – Venezuela, Estado Aragua, Maracay, Rancho Grande Biological Station, on hardwood, 24 Nov 1994, *leg.* L. Ryvarden 35541 (O–919503).

**Basidioma** resupinate, effuse, beginning as small, distinct, irregular colonies, up to 4  $\times$  2 mm, coalescing, moderately thin, 100–330  $\mu\text{m}$  thick, firm, subceraceous to membranous, denticulate from emergent hyphal pegs, area between pegs subporoid to subfelty, pale orange (5A3) to greyish orange [5B(3–4)]; cracks absent; hyphal pegs abundant, conical, 10–14 per mm, up to 200  $\times$  60  $\mu\text{m}$ , smaller near margin, terete; margin distinct, appressed, adnate, narrow, thin, white, fibrillose. – **Hyphal system** monomitic with clamped generative hyphae. – **Hyphal pegs** originating deep in subiculum, protruding up to 100  $\mu\text{m}$  beyond hymenium, a compact, dense fascicle of undifferentiated hyphae and embedded, hyaline crystals; tramal hyphae 1.5–2.5  $\mu\text{m}$  diam., sparsely branched, walls hyaline, thin, encrusted or smooth. – **Subiculum** an agglutinated tissue of vertically arranged hyphae, next to substrate dense, compact, dark yellow then becoming more open, lacunose, with embedded clusters of short, rod-like crystals; subicular hyphae 2.2–

3.5  $\mu\text{m}$  diam., clamped, moderately branched, walls hyaline to dark yellow, thin to slightly thickened, smooth. – Subhymenium a narrow, dense tissue of agglutinated hyphae similar to subicular hyphae. – Hymenium a dense palisade of hyphidia, cystidia, and basidia. – Hyphidia filamentous, tapering slightly to apex, occasionally with short lateral knobs at apex, 18–40  $\times$  3  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Cystidia scarce, subclavate to subfusiform, with rounded or subacute apex, 25–35  $\times$  7–9  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Basidia numerous, broadly clavate, tapering abruptly to a short stalk, 38–50  $\times$  16–17  $\mu\text{m}$ , 3–4  $\mu\text{m}$  diam. at base, clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to 12  $\times$  2.5  $\mu\text{m}$ . – Basidiospores scattered, broadly ellipsoid to globose, often tapering slightly to a distinct, small apiculus, 13–16  $\times$  11–13  $\mu\text{m}$ , average ( $n = 23$ ) 14.8  $\pm$  0.8  $\times$  12.1  $\pm$  0.8  $\mu\text{m}$ ,  $Q = 1.2^*$ , containing oil-like material, walls hyaline, thin to slightly thickened, smooth, weakly cyanophilous, not reacting in Melzer's reagent.

**Etymology.** – Named for Leif Ryvardeen, Norwegian mycologist extraordinaire.

**Habitat and distribution.** – On decorticate hardwood; known from Venezuela.

*Epithele ryvardeenii* is distinguished by small, irregular, discrete colonies, broadly clavate basidia, and globose to broadly ellipsoid basidiospores. It is most similar to *E. hydnooides* which has morphologically similar basidioma colonies but smaller hyphal pegs and smaller, spherical basidiospores. Although based on a scant material, the holotype is well-developed and the taxon well-characterized.

***Epithele sulphurea*** Burt, Ann. Missouri Bot. Garden 6: 265. (1919) 1920. – Figs. 59, 60, 70.

Basidioma resupinate, effuse, small, irregular colonies coalescing, up to 13  $\times$  5 mm, up to 250  $\mu\text{m}$  thick, subceraceous to membranous, hispid from emergent hyphal pegs, area between pegs smooth, subfelty to felty, dull yellow (3B3) to greyish yellow [4(B–C)4]; hyphal pegs narrowly conical with acute apices, up to 10 pegs per mm, up to 200  $\times$  20  $\mu\text{m}$ , single, concolorous; margin distinct, appressed, short fimbriate. – Hyphal system monomitic with clamped generative hyphae. – Hyphal pegs originating deep in subiculum, extending up to 100  $\mu\text{m}$  beyond hymenium, a fascicle of agglutinated, undifferentiated tramal hyphae; tramal hyphae 1.5–3  $\mu\text{m}$  diam., clamped, unbranched, walls hyaline, thin, smooth. – Subiculum up to 200  $\mu\text{m}$  thick, a dense tissue of non-agglutinated, intertwined hyphae; subicular hyphae 1.8–2.5  $\mu\text{m}$  diam., clamped, moderately branched, walls hyaline, thin, smooth. – Hymenium up to 60  $\mu\text{m}$  thick, a dense palisade of hyphidia and basidia. – Hyphidia filamentous, 25–42  $\times$  3–4  $\mu\text{m}$ , clamped at base, unbranched, walls hyaline, thin, smooth. – Basidia clavate, occasionally with a slight median constriction, (33) 40–54  $\times$  9–14  $\mu\text{m}$ , clamped at base,

walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to  $20 \times 3 \mu\text{m}$ . – Basidiospores ellipsoid,  $(10.8) 11.5\text{--}12.5 (13.5) \times (7.2) 8\text{--}9 (12) \mu\text{m}$ , average of isotype ( $n = 40$ )  $12.1 \pm 0.8 \times 8.2 \pm 0.8 \mu\text{m}$ ,  $Q = 1.5$ , occasionally containing oil-like material, walls hyaline, thin to slightly thickened, smooth, cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.** – On *Sabal palmetto* (Walt.) Lodd., woody angiosperms; reported from Florida, Hawaii (Gilbertson *et al.* 2002).

**Descriptions and illustrations.** – Boquiren (1971), Burt (1919).

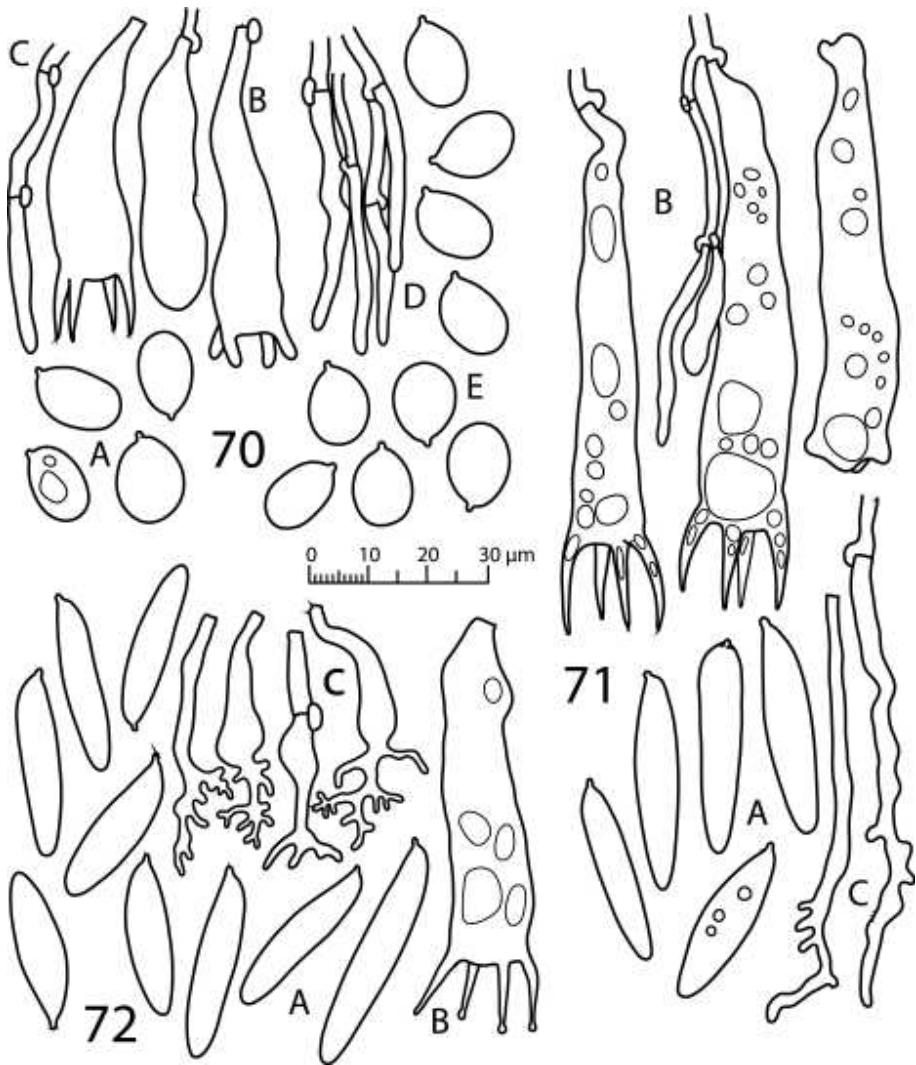
**Type materials examined.** – UNITED STATES, Florida, Palm Beach, on palmetto, autumn 1897, *leg.* R. Thaxter 52 (FH-HUH 00301399, holotype; BPI-0285234, isotype).

*Epithele sulphurea* is characterized by pale yellow basidiomata, narrowly conical hyphal pegs composed of undifferentiated hyphae, and large, ellipsoid basidiospores with cyanophilous walls. It is most similar to *E. cylindricosterigmata* which has thinner basidiomata, smaller basidia (up to  $30 \mu\text{m}$  long), and smaller basidiospores, average size  $10.5 \times 7.5 \mu\text{m}$ , with acyanophilous walls. *Epithele fasciculata* and *E. ovalispora* have significantly larger ellipsoid basidiospores compared to *E. sulphurea*.

***Epithele typhae*** (Pers.) Pat., *Essai tax. Hyménomyc.* p. 60. 1900. – Figs. 61, 62, 71, 72.

≡ *Athelia typhae* Pers., *Mycol. Eur.* 1: 84. 1822.

**Basidiomata** resupinate, widely effuse, irregular colonies coalescing, up to  $300 \mu\text{m}$  thick, soft, subceraceous to membranous, denticulate with smooth, felty areas between scarce to numerous hyphal pegs, yellowish white (4A2), pale yellow (4A3), light yellow (4A4), or greyish orange (5B5); hyphal pegs narrowly conical with acute apices, 2–4 per mm, up to  $180 \times 90 \mu\text{m}$ , single, terete, fragile, brittle; margin distinct, adnate, abrupt or thinning out, white, finely fibrillose to fimbriate. – **Hyphal system** monomitic with clamped generative hyphae. – **Hyphal pegs** originating in subiculum, a dense, non-agglutinated fascicle of tramal hyphae and dendrohyphidia; tramal hyphae  $2\text{--}3 \mu\text{m}$  diam., clamped, sparingly branched, walls hyaline, thin, smooth; dendrohyphidia as described below. – **Subiculum** up to  $90 \mu\text{m}$  thick, a trama of partially agglutinated hyphae arranged more or less parallel to substrate; subicular hyphae  $2.5\text{--}5 \mu\text{m}$  diam., clamped, moderately branched, walls hyaline, thin, smooth. – **Subhymenium** up to  $35 \mu\text{m}$  thick, a moderately dense tissue of upright, non-agglutinated, short-celled hyphae; subhymenial hyphae  $3.5\text{--}5 \mu\text{m}$  diam., clamped, moderately branched, walls hyaline, thin, smooth. – **Hymenium** up to  $70 \mu\text{m}$  thick, a palisade of dendrohyphidia and basidia. – **Dendrohyphidia** abundant, filiform to obclavate, sparsely to intricately branched at apex,  $25\text{--}70 \times 2\text{--}7 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – **Basidia** scarce to abundant, clavate, sometimes with a slight median constriction, usually with a stalk,  $50\text{--}75 \times 9\text{--}12 \mu\text{m}$ , clamped at base, containing oil-like material, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to  $16 \times 3 \mu\text{m}$ . – **Basidiospores** narrowly fusiform to sub-



**Figs. 70–72.** Line drawings of microscopic elements. **70.** *Epithele sulphurea* (HUH 00301399, holotype). **71.** *Epithele typhae* (S-F 5292). **72.** *Epithele typhae* (GB-KHL 11914). A. Basidiospores, B. Basidia, C. Hyphidia and dendrohyphidia from hymenia, D. Hyphal elements from hyphal pegs from *E. sulphurea* (BPI 0285234, isotype), E. Basidiospores from *E. sulphurea* (BPI 0285234, isotype).

fusiform, with a distinct, refractive apiculus, 21–30 (35) × (5) 6–7 (7.8) μm, average (n = 20, 25) 23–26 × 6.2–6.7 μm, Q = 3.5\*–4.6\*, containing oil-like material, walls hyaline, thin or brownish yellow, up to 1 μm thick, smooth, sometimes weakly cyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. – On stems and leaves of *Scirpus*, sedges (*Poales*); widespread in Europe.

Descriptions and illustrations. – Boquiren (1971), Bourdot & Galzin (1928, p. 240), Christiansen (1960, p. 234), Eriksson & Ryvar den (1975), Höhn el & Litschauer (1906), Jülich (1976), Patouillard (1900).

Materials examined. – AUSTRIA, Oberösterreich, Gmunden, Tastelberg, “Krottensee”-Moor, 480 m.s.m., on *Carex*, 21 Sep 1994, leg. W. Dämon (Herb. Dämon-KS94.095A); DENMARK, Lolland, Favrst ed skov, on *Carex acutiformis* Ehrh. stem, 4 Oct 2007, leg. H. Knudsen, EL144-07 (GB-GB003-5024); GERMANY, Hessen, Vorderer Odenwald/Schweizer Loch bei Seeheim, an vorjäh rigen Blattbasen, von *C. acutiformis*, 31 Oct 1986, leg. H. Grosse-Brauckmann (GB-GB003-5003); POLAND, (no location), on *Scirpus silvatica* (stem and leaves), Oct, leg. Eichler (S-F 127396); SWEDEN, Sverige, Skåne, Fjälkestad, Balsberget, on *C. acutiformis* stem, 17 Sep 1996, leg. H. Knudsen (S-F 5292); Västergötland, Varnhem par., Höjentorp, east of Drottningkullen, on *C. acutiformis* (stem), 6 Sep 2003, leg. K.-H. Larsson 11914 (GB-GB003-5025).

*Epithele typhae* occurs in Europe on leaves and stems of sedges. It is characterized by large, narrowly fusiform to subfusiform basidiospores with thin or thickened walls and a distinct, refractive apiculus. Other species of *Epithele* have broader or shorter fusiform basidiospores. For a complete synonymy, see speciesfungorum.org or mycobank.org (MB121600).

Reports of *E. typhae* from Vanuatu (Maekawa 2002), Okinawa (Maekawa 1994), Tamil Nadu, India (Natarajan & Kolandavelu 1997), and Brazil (Rick 1959) need to be verified.

### Species excluded from *Epithele sensu stricto*

*Epithele bisterigmata* Boidin, Gilles & Duhem, Bull. Mens. Soc. Linn. Lyon 69: 193. 2000.

Basidioma resupinate, widely effuse, adnate, up to 300  $\mu$ m thick, subceraceous to ceraceous, velutinous from abundant, emergent, short hyphal pegs, area between pegs smooth, yellowish white (4A2), greyish yellow (4B3), pale orange (5A2) to greyish orange [5B(2-3)]; hyphal pegs narrowly cylindrical, brittle, up to about 20 per mm, up to 55  $\times$  15  $\mu$ m; margin adnate, rapidly thinning out, fibrillose to pruinose. – Hyphal system monomitic with clamped generative hyphae. – Hyphal pegs originating in upper subhymenium, a compact fascicle of agglutinated, weakly differentiated tramal hyphae; tramal hyphae even to irregular, 1-2  $\mu$ m, clamped, rarely branched, walls hyaline, thin, smooth. – Subiculum not observed. – Subhymenium up to 250  $\mu$ m thick, a thickening, agglutinated, lacunose tissue of degraded hyphae; subhymenial hyphae 1.5-3  $\mu$ m diam., clamped, sparingly to moderately branched, walls hyaline, thin, smooth. – Hymenium up to 35  $\mu$ m thick, a dense palisade of hyphidia and basidia. – Hyphidia filamentous, 15-25  $\times$  2-3  $\mu$ m, clamped at base, rarely branched, walls hyaline, thin, smooth. – Basidia clavate, 22-35  $\times$  8-11  $\mu$ m, clamped at base, walls hyaline, thin, smooth, 1-2-sterigmate. – Basidiospores globose to subglobose, 7.2-9  $\times$  7-8  $\mu$ m, walls hyaline, thin, smooth, weakly cyanophilous, not reacting in Melzer’s reagent.

Habitat and distribution. – On *Bambusa* stems; reported from Réunion.

Description and illustration. – Boidin & Gilles (2000).

Type material examined. – RÉUNION, Salazie IV, sur bambou, 27 avril 1998, leg. G. Gilles 98/184, (LY-LY 17427, holotype).

Additional materials examined. – RÉUNION, La Ravine Ango, sur bambou au sol, 19 avril 1998, leg. G. Gilles 135 (LY-LY 17385); Sainte-Rose, sur bambou mort au sol, 14 août 1990, leg. B. Duhem 2609 (LY-LY 15889).

*Epithele bisterigmata* is characterized by abundant, minute hyphal pegs, a thick, agglutinated, lacunose subhymenium, clavate basidia with 1–2 sterigmata, and globose basidiospores. *Epithele cylindricosterigmata* also has small basidia, up to 30 µm long, but a softer, non-agglutinated subhymenium, and larger hyphal pegs and basidiospores. Because of its unusual combination of characters, *E. bisterigmata* is not accepted in *Epithele*. It may be related to *Grammothele* Berk. & M. A. Curtis; DNA sequence data may be necessary to determine its proper placement.

*Epithele canariensis* (Manjón & G. Moreno) Hjortstam, Manjón & G. Moreno, Mycotaxon 33: 257. 1988.

≡ *Aphanobasidium canariense* (Manjón & G. Moreno) Boidin & H. Michel, Bull. Mens. Soc. Linn. Lyon 69: 197. 2000.

Descriptions and illustrations. – Bernicchia & Gorjón (2010), Gorjón & Bernicchia (2010), Manjón & Moreno (1982), Melo (1994).

*Aphanobasidium canariense* has fertile spines and pleural basidia which excludes it from *Epithele*. It has been placed in four genera since its introduction in 1982; a brief taxonomic history is summarized by Gorjón & Bernicchia (2010) and Piątek (2005). Complete synonymy is available in Bernicchia & Gorjón (2010, p. 129).

*Epithele capitata* D. P. Rogers & Boquiren, Mycologia 63: 942. 1971.

≡ *Dextrinocystis capitata* (D. P. Rogers & Boquiren) Gilb. & M. Blackw., Mycotaxon 33: 378. 1988.

Descriptions and illustrations. – Boquiren (1971), Burdsall & Nakasone (1983), Gilbertson & Blackwell (1988).

*Dextrinocystis capitata* is readily recognized by its soft, woolly-tomentose basidiomata, multi-rooted, thick-walled, conical cystidia with dextrinoid walls and capped with a cluster of pendent crystals, suburniform basidia, and cylindrical, slightly curved basidiospores. A rare species, it is known from southeastern United States on dead culms of palm and bamboo (Gilbertson & Blackwell 1988), Colombia (Hjortstam & Ryvarden 2000), and Venezuela (Hjortstam & Ryvarden 2007). *Dextrinocystis* may be related to *Tubulicium* Oberw. and is postulated to belong in the *Hydnodontaceae* Jülich (Larsson 2007).

*Epithele dussii* (Pat.) Pat., Essai tax. Hyménomyc. p. 59. 1900.

= ***Tubulicium dussii*** (Pat.) Oberw. ex Jülich, Persoonia 10: 335. 1979.

Descriptions and illustrations. – Boquiren (1971), Dämon & Hausknecht (2003), Liberta (1960), Oberwinkler (1965).

Large, thick-walled, conical cystidia with 1–3 roots, small clavate to cylindrical basidia, and lunate basidiospores characterize *T. dussii*. Dämon & Hausknecht (2003) provide a thorough morphological, nomenclatural, and literature study of *T. dussii*, including a synopsis of the disputed synonymy with *Peniophora vermicularis* Wakef.

*Epithele fuciformis* (Berk.) Höhn. & P. Syd., Ann. Mycol. 4: 551. 1906.

≡ ***Laetisaria fuciformis*** (Berk.) Burds., Trans. Br. Mycol. Soc. 72: 420. 1979, as ‘(McAlpine) Burds.’

Descriptions and illustrations. – Burdsall (1979), McAlpine (1906), Stalpers & Loerakker (1982).

*Laetisaria fuciformis* develops structures resembling hyphal pegs, variously described as tufts, antler-like, or clavarioid, that are pink and gelatinous when fresh. It is further characterized by pink basidioma with simple-septate hyphae, sphaeropedunculate probasidia, and ellipsoid to pip-shaped basidiospores. It causes red thread disease of turf grasses in cool, humid areas of temperate Europe, North America and Australasia (Stalpers & Loerakker 1982). Phylogenetic studies place *L. fuciformis* in the *Corticiales* K.-H. Larss. and close to the anamorphic genus *Marchandiomyces* Diederich & D. Hawksw. (Diederich *et al.* 2011).

*Epithele fulva* G. Cunn., Trans. Roy. Soc. New Zealand 83: 631. 1956.

= ***Epithelopsis fulva*** (G. Cunn.) Jülich, Persoonia 8: 457. 1976.

Descriptions and illustrations. – Cunningham (1956), Greslebin (2002), Jülich (1976), and Lepp (2004).

Diagnostic characters of *E. fulva* include a dimitic hyphal system, hyphal pegs composed of skeletal hyphae, gloeocystidia, clavate basidia, and smooth, thick-walled, cyanophilous basidiospores. The presence of gloeocystidia and basidiospores with thick, cyanophilous walls excludes *E. fulva* from *Epithele*.

*Epithele galzinii* Bres., Bull. Soc. Mycol. France 27: 264. 1911.

≡ ***Pteridomyces galzinii*** (Bres.) Jülich, Persoonia 10: 331. 1979.

Small, clavate basidia (9–18 × 4–6 µm) and small, cylindrical basidiospores (5–9 × 3–4 µm) preclude *E. galzinii* from *Epithele*. It is rare species found on dead fronds of ferns from France (Boidin & Gilles 1986, Bourdot & Galzin 1928) and possibly New Zealand (Cunningham 1963). Some authors opt to follow Hjortstam (1991) who placed *E. galzinii* in *Athelopsis* Oberw. ex



Parmasto. The ceraceous, crustaceous basidioma of *E. galzinii*, as described by Bourdot & Galzin (1928), and densely arranged hyphae (Jülich 1979), however, are unlike the pellicular, loose textured basidioma of typical *Athelopsis* species (Gorjón *et al.* 2012). In addition, a recent molecular phylogenetic study indicates that *Athelopsis*, in the *Atheliales* clade, is not a monophyletic genus (Binder *et al.* 2010). Two species of *Athelopsis* included in the study, *A. subinconspicua* (Litsch.) Jülich and *A. glaucina* (Bourdot & Galzin) Oberw. ex Parmasto, the generic type, were placed in distantly related clades.

*Epithele glauca* (Cooke) Wakef. ex Cleland, Toadstools and mushrooms and other larger fungi of South Australia 2: 256. 1935.

≡ *Grammothele glauca* (Cooke) P. Roberts, Kew Bull. 64: 358. 2009.

Description and illustration. – Hjortstam *et al.* (2009).

Type material examined. – (AUSTRALIA, Queensland), Brisbane, on wood, no date, *leg.* F. M. Bailey (NY–NY 0310088, isotype).

*Grammothele glauca* is characterized by a gray-colored basidioma, hyphal pegs composed of reddish brown skeletal hyphae, hyphidia, clavate basidia, and ellipsoid to ovoid basidiospores, 6–7 (8) × 3–3.8 μm. It is known only from Australia.

*Epithele macrospora* (Liberta) Boquiren, Mycologia 63: 949. 1971.

≡ *Xenasma macrosporum* Liberta, Mycologia 52: 899. (1960) 1962.

≡ *Dextrinocystis macrospora* (Liberta) Nakasone, **comb. nov.**

Mycobank no.: MB 803369

Descriptions and illustrations. – Boquiren (1971), Liberta (1960).

Type material examined. PANAMA, Chiriquí Province, Valley of Upper Rio Chiriquí Viejo, alt 1600–1800 m, on decayed wood, 28 June 1935, *leg.* G. W. Martin 2097 (BPI–1105922, isotype).

This is a striking species with large, multi-rooted, conical cystidia with thick, dextrinoid walls, suburniform basidia, and cylindrical basidiospores with weakly cyanophilous walls, 12–19 × 4.5–7 μm. It is closely related to *Dextrinocystis capitata* which has similar cystidia, basidia, and basidiospores, 11–13 × 3–5 (6) μm. Thus, the transfer to *Dextrinocystis* is proposed. Unfortunately, the dextrinoid reaction of the cystidial walls is not permanent and appears to fade over time. Liberta (1960) noted that the inner lamellae of the cystidial walls were “strongly pseudoamyloid” near the base, but I did not observe this reaction 52 years later. *Dextrinocystis macrospora* is excluded from *Epithele* because it develops suburniform basidia as depicted in Boquiren (1971). It is known only from the original collection from Panama; the holotype could not be located at ISC, ILL, or NY. *Xenasma macrosporum* was transferred to *Tubulicium* (Moreno & Esteve-Raventós 2007). Although *Tubulicium* is characterized by large, rooted, conical cystidia, it also has clavate basidia with a short stalk and sigmoid, vermicular, or fusoid basidiospores that taper apically.

*Epithele nikau* G. Cunn., Trans. Royal Soc. New Zealand 83: 629. 1956. – Figs. 64, 65, 73–76.

= *Skeletohydnum nikau* (G. Cunn.) Jülich, Persoonia 10: 331. 1979.

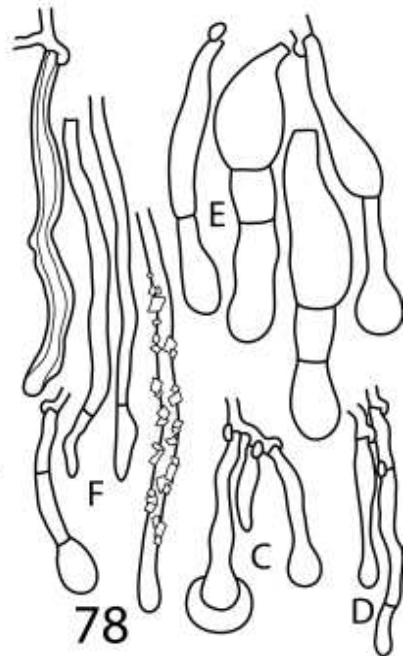
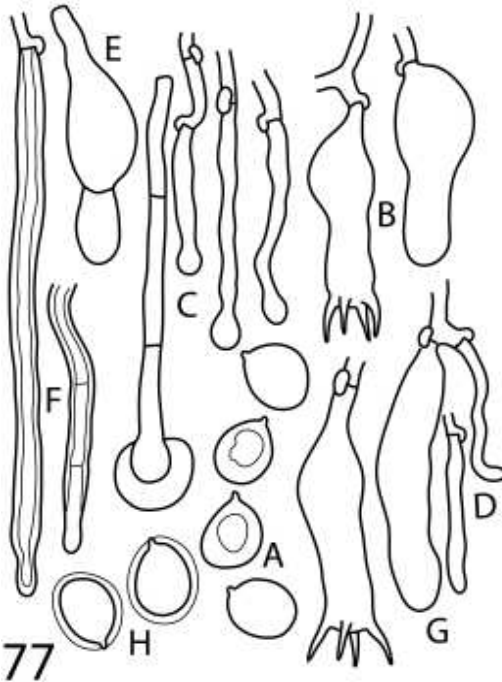
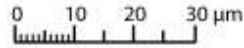
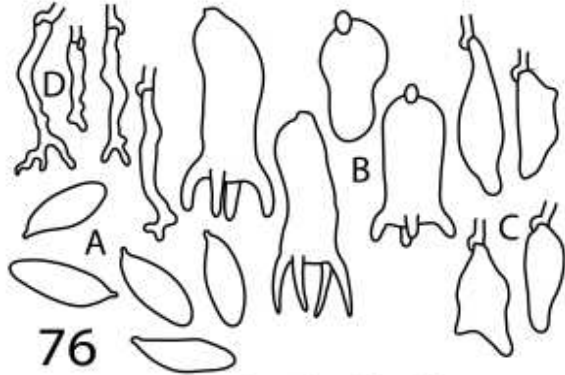
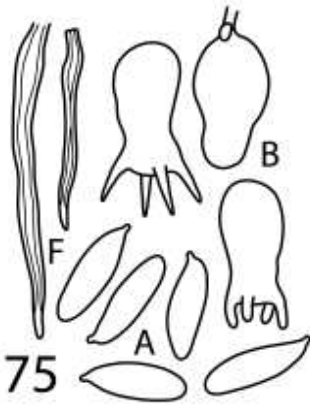
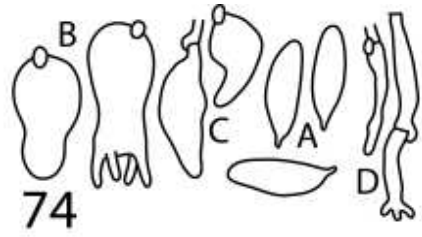
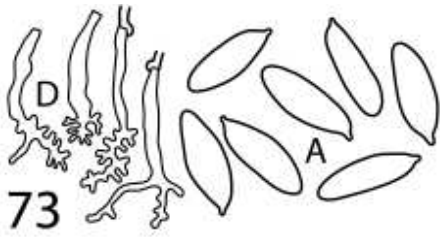
= *Epithele guadelupensis* Boidin & Lanq., Mycotaxon 16: 473. 1983.

= *Tubulicium ramonense* Kisim.-Hor., Oberw. & L. D. Gómez, Rev. Biol. Tropica 45: 1313. (1997) 1998.

Basidioma resupinate, widely effuse, beginning as small, linear or orbicular colonies, coalescing, up to 20 × 4.5 cm, closely adnate, thin, up to 55 µm thick, soft to subceraceous, velutinous from emergent hyphal pegs, area between pegs smooth, continuous to porose, Cream Color, Cream-Buff, yellowish white (4A2), pale yellow (4A3), yellowish grey (4B2), or greyish yellow [4B(3–4)]; hyphal pegs abundant, conical or cylindrical, 90–215 × 16–45 µm, 7–10 pegs per mm, terete, brittle, fragile; margin distinct, adnate, rapidly thinning out, short-fimbriate. – Hyphal system dimitic with clamped generative and thick-walled skeletal hyphae. – Hyphal pegs originating in subiculum, a fascicle of agglutinated skeletal hyphae with a flared, multi-rooted base, then cylindrical or tapering to apex, upper peg encrusted with tiny, closely appressed, hyaline crystals, often encased by an additional layer of coarse, hyaline crystals, sometimes dendritic hyphae enclosing entire structure; skeletal hyphae >30 × 1.5–4 µm, tapered to an acute tip, unbranched, walls refractive, hyaline, up to 1.5 µm thick, smooth at first then encrusted, acyanophilous, rarely weakly dextrinoid. – Subiculum a narrow layer of agglutinated, indistinct hyphae arranged parallel to substrate and numerous crystal aggregates; subicular hyphae 2–3 µm diam., clamped, walls hyaline, thin, smooth. – Subhymenium not observed. – Hymenium a palisade of dendrohyphidia, cystidia, and basidia. – Dendrohyphidia scarce to numerous, 12–35 × 2–3 µm, clamped at base, simple to intricately branched, walls hyaline, thin, smooth. – Cystidia inconspicuous, scarce, obclavate to subfusiform, tapering to a subacute apex, 14–26 × 5–9 µm, clamped at base, walls hyaline, thin, smooth. – Basidia urniform, sometimes clavate or cylindrical, 17–30 × 6.5–11 µm, clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to 13 × 2 µm. – Basidiospores ellipsoid at first, then subfusiform to cylindrical, slightly curved, tapering to a distinct, refractive apiculus, (10) 13–15 (18) × 4–5.8 (6.5) µm, average (n = 30, 30, 31, 31) (11.7) 13.6–14.9 × 4.5–5.5 µm, Q = 2.5–3.1, containing oil-like material, often agglutinated in clusters of four, walls hyaline, thin, smooth, acyanophilous or weakly cyanophilous, not reacting in Melzer's reagent.

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**Figs. 73–78.** Line drawings of microscopic elements. **73.** *Skeletohydnum nikau* (BPI 0285233, isotype of *Epithele nikau*). **74.** *Skeletohydnum nikau* (USJ–USJ 53880, holotype of *Tubulicium ramonense*). **75.** *Skeletohydnum nikau* (NY–VE 4478). **76.** *Skeletohydnum nikau* (LY–LY 8119, holotype of *Epithele guadelupensis*). **77.** *Myriothele philippiae* (LY–LY 16860, holotype of *Epithele philippiae*). **78.** *Myriothele philippiae* (LY–LY 14069). A. Basidiospores, B. Basidia, C. Cystidia from hymenium, D. Hyphidia and dendrohyphidia from hymenia, E. Cystidia embedded in context, F. Hyphal elements from hyphal pegs, G. Gloeocystidium, H. Basidiospore walls swollen in KOH.



**Habitat and distribution.** – On stems of monocots in the *Zingiberales* and *Arecales*; reported from Costa Rica (Kisimova-Horovitz *et al.* 1998, as *T. ramonense*), Gabon (Boidin & Lanquetin 1983), India (Natarajan & Kolandavelu 1997), Java (Hjortstam & Ryvarden 2005), New Zealand (Cunningham 1956, 1963), Réunion (Boidin & Gilles 1988), Seychelles (Hjortstam & Ryvarden 2009), Taiwan (Wu 1998), USA-Hawaii (Gilbertson *et al.* 2002), and Venezuela (Liberta & Navas 1978).

**Descriptions and illustrations.** – Boidin & Lanquetin (1983 as *E. guadelupensis* and *E. nikau*), Boidin & Gilles (1988), Boquiren (1971), Cunningham (1956; 1963, p. 146), Hjortstam & Ryvarden (2009), Kisimova-Horovitz *et al.* (1998, as *T. ramonense*).

**Type materials examined.** – COSTA RICA, Alajuela Province, San Ramón, Reserva forestal, (on bracts and petioles of decaying palms), 13 Mar 1991, *leg.* L. Kisimova-Horovitz 186-I (USJ– USJ 53880, holotype of *T. ramonense*); GUADELOUPE, Maison de la forêt Parc National, Bras David, rachis de palmier de *Prestoea montana* Hook.f. au sol, 4 oct 1976, *leg.* J. Boidin (LY–LY 8119, holotype of *E. guadelupensis*); NEW ZEALAND, Auckland, Waitakere Ranges, Cascade Kauri Park, 250 m, on *Rhopalostylis sapida* H. Wendl. & Drude, 3 Apr 1954, *leg.* S. D. Baker, PDD 14244 (BPI–0285233, isotype of *E. nikau*).

**Additional materials examined.** – GABON, Libreville, forêt de la Mondah, sur *Ancistrophyllum secundiflorum* G. Mann & H. Wendl., 30 mai 1976, *leg.* J. Boidin (LY–LY 8004); sur bois mort, 21 jan 1979, G. Gilles 1406 (LY–LY 9119); NEW ZEALAND, Auckland District, Piha, Glen Esk Valley, on (decorticate) *R. sapida*, 12 May 1951, *leg.* J. M. Dingley (PDD–PDD 11199) and 12 Apr 1953, *leg.* J. M. Dingley (PDD–PDD 14247); Titirangi, Wood Bay, on *R. sapida*, 14 May 1965, *leg.* R. F. R. McNabb (PDD–PDD 24515); Huia, on *R. sapida*, 8 Jan 1955, *leg.* J. M. Dingley, PDD 14246 (BPI–0285232); Orewa, on *R. sapida*, 23 Jan 1949, *leg.* P. M. Ambler (PDD–PDD 7376); RÉUNION, le 6 Baril I, sur *Acanthophoenix crinita* H. Wendl., 14 avril 1987, *leg.* J. Boidin (LY–LY 12933, LY 12935); VENEZUELA, (Estado) Sucre, near El Rincon, along trail N of Manacal, N.W. of Irapa, on herbaceous stem, 9 Jul 1972, *leg.* K. P. Dumont, R. F. Cain, G. J. Samuels, G. Morillo, and J. Farfan, Dumont–VE4478 (NY, BPI–01105876, 747072).

*Skeletohydnum* was described in 1979 and remains monotypic (Jülich 1979). It is distinguished by hyphal pegs composed of hyaline, skeletal hyphae, urniform basidia, and thin-walled, elongate basidiospores. Most authors follow Boidin & Lanquetin (1983) and consider *Skeletohydnum* a synonym of *Epithele*. However, the significance of the basidium shape and size in *S. nikau* has not been properly appreciated by authors. I believe that the urniform basidia of *S. nikau* are significantly different and distinct from that of *E. typhae*, the type of *Epithele*. Therefore, *S. nikau* is excluded from *Epithele* and accepted in *Skeletohydnum*.

*Skeletohydnum nikau* is characterized by hyphal pegs composed of conglomerate skeletal hyphae, urniform basidia, and ellipsoid to subfusiform basidiospores. It is widely distributed in the tropical to subtropical zones. Basidiospore size is quite variable in this species. For example, Boidin & Gilles (1988) reported the average basidiospore size of the holotype of *E. guadelupensis* as  $16 \pm 1.2 \times 5.2 \pm 0.3 \mu\text{m}$ ,  $Q = 3.1$ , whereas in my measurements from the same specimen, the average was ( $n = 25$ )  $14.2 \pm 1.1 \times 5.5 \pm 0.4 \mu\text{m}$ ,  $Q = 2.6^*$ . Basidiospore size of LY 8004 from Gabon is smaller still at ( $n = 30$ )  $11.7 \pm 1.2 \times 4.7 \pm 0.5 \mu\text{m}$ ,  $Q = 2.5$ .

*Tubulicium ramonense* is a later synonym of *S. nikau*; the hyphal pegs were mistaken for multi-rooted cystidia. The holotype at USJ is in excellent condition. I agree with Boidin & Gilles (1988) that *E. guadelupensis* is conspecific with *S. nikau*. The report of *E. nikau* from Japan needs confirmation (Maekawa 1998). As described, the specimen has distinctly clavate basidia and occurs on branch of a broad-leaved tree; it may be conspecific with *E. interrupta*.

*Epithele ochracea* Bres., Ann. Mycol. 18: 49. 1920.

≡ ***Hyphodermella ochracea*** (Bres.) Duhem, Bull. Soc. Mycol. France 125:158. (2009) 2010.

After studying the type of *E. ochracea*, Duhem (2010) proposed its transfer to *Hyphodermella* J. Erikss. & Ryvarden. Characterized by fascicles of agglutinated, encrusted hyphae, simple-septate generative hyphae, cylindrical, clavate or suburniform basidia, and ellipsoid basidiospores, 6–9 (11) × (3.6) 4–5.5 μm, *E. ochracea* is a typical species of *Hyphodermella*.

*Epithele philippiae* Boidin & Gilles, Bull. Mens. Soc. Linn. Lyon 69: 195. 2000. – Figs. 63, 66, 77, 78.

Basidioma resupinate, widely effuse, irregular oblong colonies coalescing, up to 80 × 10 mm, up to 1.5 mm thick, soft, denticulate from emergent hyphal pegs, areas between pegs finely farinaceous, pale yellow (4A3), light yellow (4A4), pale orange (5A3), or Cream Buff, rimose; hyphal pegs abundant, conical with entire or bristly acute apices, 7–11 per mm, up to 500 × 80 μm, terete; margin abrupt, edges farinaceous to pulverulent. – Hyphal system monomitic with clamped generative hyphae. – Hyphal pegs originating in subiculum, protruding up to 300 μm, a fascicle of tramal hyphae lightly encrusted with small, angular crystals; tramal hyphae slightly tapering or slightly inflated at apex, sometimes with a slight constriction near apex, 2.5–3.5 μm diam., clamped at base, walls hyaline, thin to 1 μm thick, thinning toward apex, sparsely encrusted. – Subiculum up to 55 μm thick, a tissue of partially agglutinated, compressed hyphae arranged parallel to substrate; subicular hyphae 2 μm diam., clamped, walls hyaline, slightly thickened, smooth. – Subhymenium thickening, a dense, non-agglutinated tissue of distinct, upright hyphidia, cystidia, hyphae, and embedded basidiospores and crystal clusters; subhymenial hyphae 2.8–3.5 μm diam., clamped, moderately branched, walls hyaline, thin, smooth. – Hymenium a palisade of hyphidia, cystidia, and basidia. – Hyphidia filiform, 23–30 × 2–3 μm, clamped at base, simple, walls hyaline, thin, smooth. – Cystidia of three types: (1) obclavate to utriform, 40–50 × 8–11 μm, clamped at base, often with secondary septa, walls hyaline, thin, smooth; (2) filiform to narrowly obclavate, 22–60 × 2–3 μm, with a capitate apex, 5–7 μm diam., enclosed by a bulbous globule, up to 12 μm diam., observed in water mounts only, clamped at base, walls hyaline, thin, smooth; (3) gloeocystidia, rare, cy-

lindrical,  $40 \times 8 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. – Basidia spherical at first, then urniform, with or without a stalk,  $28\text{--}48 \times 5\text{--}10 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth, 4-sterigmate, sterigmata up to  $12 \times 2.5 \mu\text{m}$ . – Basidiospores broadly ellipsoid to subglobose,  $8.7\text{--}11 (11.6) \times 7.1\text{--}9 (9.5) \mu\text{m}$ , average ( $n = 30, 31$ )  $9.8\text{--}10 \times 8.1\text{--}8.3 \mu\text{m}$ ,  $Q = 1.2$ , containing one or more oil-like globules, contents cyanophilous, walls hyaline, thin to slightly thickened, swelling in KOH, smooth, weakly cyanophilous, not reacting in Melzer's reagent.

Habitat and distribution. – On wood and bark of *Philippia* (*Ericaceae*); known only from Réunion.

Description and illustration. – Boidin & Gilles (2000).

Type material examined. – RÉUNION, Col de Bellevue, alt. 1650 m., sur *Philippia* sp., 4 mai 1997, leg. G. Gilles 97-028 (LY-LY 16860, holotype).

Additional materials examined. – RÉUNION, Col de Bellevue, sur *Philippia montana* Klotzch, 20 mai 1990, leg. J. Boidin (LY-LY 14177); Palmistes VI, sur *Philippia* arbuste vivant, 5 avril 1999, leg. G. Gilles 99-057 (LY-LY 17674); Maïdo 1bis-90, alt 1500 m, sur *Ericacée*, 13 mars 1990, leg. J. Boidin (LY-LY 14069).

*Epithele philippiae* is characterized by hyphal pegs, a thickened, non-agglutinated context, capitate cystidia, urniform basidia, and subglobose basidiospores with walls that swell in KOH. The bulbous globules on the capitate cystidia were not observed in mounts with KOH or Melzer's reagent. This is a striking species that is clearly not related to *Epithele* or the *Polyporales*. Because of its unique features, a new genus and combination is proposed below.

***Myriothele* Nakasone, gen. nov.**

Mycobank no.: MB 803370

Basidioma thick, soft, denticulate from emergent hyphal pegs; hyphal system monomitic with clamped generative hyphae; subhymenium thickening, a non-agglutinated tissue of upright hyphidia, cystidia and hyphae; basidia distinctly urniform, clamped at base, 4-sterigmate; basidiospores broadly ellipsoid to subglobose with hyaline, smooth, acyanophilous, and inamyloid walls that swell in KOH.

Generic type. – *Epithele philippiae* Boidin & Gilles

Etymology. – *Myrio-*, Greek for countless, very many + *thele*, Greek for nipple, referring to numerous hyphal pegs in the basidioma.

***Myriothele philippiae* (Boidin & Gilles) Nakasone, comb. nov.**

Mycobank no.: MB 803371

Basionym. – *Epithele philippiae* Boidin & Gilles, Bull. Mens. Soc. Linn. Lyon 69: 195. 2000.

*Epithele vermifera* (Bourdot) Boquiren, Mycologia 63: 954. 1971.

= ***Tubulicium vermiferum*** (Bourdot) Oberw. ex Jülich, Persoonia 10: 335. 1979.

Descriptions and illustrations. – Bernicchia & Gorjón (2010), Boquiren (1971), Hjortstam *et al.* (1988), Kisimova-Horovitz *et al.* (1998), Liberta (1960), Maekawa (1994), Oberwinkler (1965).

This is a widely distributed and distinctive species with multi-rooted, thick-walled, conical cystidia, subclavate to cylindrical basidia with a short stalk, and flexuous, sigmoid to navicular basidiospores. It is the generic type of *Tubulicium* Oberw. and classified in the *Trechisporales* K.H. Larss.

### ***Epithele* species of unknown disposition**

Type specimens of the taxa listed below were not available for study. Hjortstam & Ryvarden (2005) excluded these species from *Epithele*.

*Epithele bambusina* Rick, Iheringia 4: 87. 1959.

This taxon has scopiform cystidia, irregularly ovate, faintly pigmented, punctate-scabrous basidiospores, and stalked, clavate basidia,  $20\text{--}30 \times 15\text{--}20 \mu\text{m}$ , with 4 sterigmata.

*Epithele horridula* Rick, Brotéria 36: 148. 1940.

Because the basidiospores are described as “triangulari-irregularibus,  $5 \times 4 \mu\text{m}$ ,” it is unlikely that this taxon is an *Epithele* species.

*Epithele nivea* Rick, Iheringia 4: 87. 1959.

The cylindrical basidiospores,  $6 \times 3\text{--}4 \mu\text{m}$ , are smaller than any *Epithele* species discussed herein.

*Epithele straminea* Rick, Iheringia 4: 87. 1959.

This species has small subspherical basidiospores,  $6 \times 7 \mu\text{m}$ .

### **Discussion**

*Epithele* is a morphologically diverse genus as presented here and may not represent a monophyletic entity. On one extreme is the generic type, *Epithele typhae*, with its large, stalked, clavate basidia and narrowly fusiform basidiospores and on the other extreme *E. hydnoides*, with its short, broadly ovoid basidia and globose to subglobose basidiospores. *Epithele cylindricosterigmata* and *E. belizensis* also appear to be outliers because of the small size and atypical shape of the basidia. Hyphal pegs are the most conspicuous feature of the genus, although they are absent in one species. A great variation in hyphal peg construction, composition, size, shape, density and distribution was observed.

In addition to distinctive morphological features, *Epithele* is noteworthy in other aspects. For example, almost all species have a restricted distribution limited to a single locale or continent. The exceptions are *Epithele sulphurea*, known from Florida and Hawaii, and *E. interrupta*, reported from Africa, Asia, South America and North America. Only the type species, *E. typhae*, is known from temperate Europe; all other species are reported from the tropics-subtropics. Although most *Epithele* species occur on woody an-

giosperms, others prefer ferns, bamboo, palm petioles, or stems of sedges and grasses. Finally, there are surprisingly few specimens of *Epithele* species. Except for *E. alba*, *E. interrupta*, and *E. typhae* most species of *Epithele* are known only from the type and a few additional collections.

Boquiren (1971) took a broad view of the genus. Of the thirteen species she accepted, five became generic types – *E. capitata* for *Dextrinocystis*, *E. fulva* for *Epithelopsis*, *E. galzinii* for *Pteridomyces*, *E. nikau* for *Skeletohydnum*, and *E. vermifera* for *Tubulicium*. Only four species, *E. hydroides*, *E. interrupta*, *E. sulphurea*, and *E. typhae*, are accepted in *Epithele* and described above.

Molecular phylogenetic studies place *Epithele* in the *Polyporales*, a sister clade to *Grammothele* (Larsson 2007, Miettinen & Rajchenberg 2012, Wu *et al.* 2007). Only a few species of *Epithele* have been sequenced. One of these, *Epithele macarangae* Wu 9705–5 (Wu *et al.* 2007) is re-identified herein as *E. interrupta*. Future phylogenetic studies will be valuable to determine the generic limits of *Epithele* and the importance of morphological features such as hyphal peg construction and basidium and basidiospore shape and size.

Hyphal pegs are found in many corticioid, polyporoid, and tremelloid species. A preliminary key is presented to the genera and species of corticioid and polyporoid basidiomycetes with hyphal pegs, plates, and ridges. Included in the key are some taxa now excluded from *Epithele* s.s. whereas genera with multi-rooted cystidia, such as *Tubulicium* and *Dextrinocystis*, are not included. In some corticioid species that produce fertile spines, the developing spines may appear sterile at first; these are omitted also.

**Preliminary key to genera and species of corticioid and polyporoid basidiomycetes with sterile hyphal pegs, plates, and ridges**

- 1. Basidia septate ..... e.g., *Heterochaete*, *Exidiopsis*, *Sebacina*, *Stypella*
- 1\*. Basidia not septate ..... 2
- 2. Basidiomata stipitate, pileate ..... *Mycobonia*
- 2\*. Basidiomata effused, effused-reflexed or cupulate ..... 3
- 3. Basidiomata effused-reflexed ..... 4
- 3\*. Basidiomata effused, cupulate, or disciform ..... 5
- 4. Hyphal system dimitic, hyphal pegs fusing to form thin plates... *Pileodon*
- 4\*. Hyphal system monomitic, hyphal pegs single, not fusing.....  
..... *Veluticeps berkeleyi*
- 5. Hymenophore composed of pores or of hyphal pegs fused into ridges or plates..... 6
- 5\*. Hymenophore basically smooth but denticulate from emergent hyphal pegs, hyphal pegs not fused ..... 12
- 6. Hymenophore distinctly poroid..... 7
- 6\*. Hymenophore irregularly poroid or with sterile ridges or plates ..... 9
- 7. Basidiospores 5–10 µm long (11–15 µm long in *G. delicatula*) .....  
..... *Grammothele*



- 7\* Basidiospores 10–20  $\mu\text{m}$  long (6–7.8  $\mu\text{m}$  long in *Megasporoporia minor*)..... 8
8. Basidiospores thick-walled, dextrinoid.. *Grammothelopsis macrospora*
- 8\*. Basidiospores thin-walled, not dextrinoid .....  
.....*Megasporia, Megasporoporia, Megasporoporiella*
9. Hyphal system di- or trimitic, dendrohyphidia often present ..... 10
- 9\*. Hyphal system monomitic, dendrohyphidia absent..... 11
10. Skeletal hyphae brown, darkening in KOH..... *Grammothele lineata*
- 10\*. Skeletal hyphae hyaline, unchanged in KOH.....*Theleporus sp*
11. Hymenophore composed of long, anastomosing ridges, hyphae hyaline, unchanged in KOH, not reacting in Melzer's reagent .....  
.....*Hymenogramme javensis*
- 11\*. Hymenophore composed of angular, irregular pores, hyphae brown in KOH, dextrinoid .....*Porogramme*
12. Hyphal pegs brown from pigmented hyphae or cystidia..... 13
- 12\*. Hyphal pegs hyaline ..... 17
13. Basidiomata cupulate with free, involute margins, hyphal walls gelatinized.....*Campylomyces*
- 13\*. Basidiomata effused, hyphal walls not gelatinized..... 14
14. Basidiospores 18–31  $\times$  7–10  $\mu\text{m}$ , walls 2–2.5  $\mu\text{m}$  thick, brown, amyloid .  
..... *Corneromyces kinabalui*
- 14\*. Basidiospore size varied, walls up to 2  $\mu\text{m}$  thick, hyaline to dark yellow, not amyloid..... 15
15. Basidia 22–28  $\mu\text{m}$  long ..... *Grammothele glauca*
- 15\*. Basidia >30  $\mu\text{m}$  long ..... 16
16. Basidiospores globose to subglobose ..... *Epithele reunionis*
- 16\*. Basidiospores allantoid to cylindrical ..... *Veluticeps australiensis*
17. Basidia pleural..... *Aphanobasidium canariense*
- 17\*. Basidia clavate, suburniform or urniform ..... 18
18. Basidia primarily suburniform or urniform..... 19
- 18\*. Basidia clavate or with a sphaeropedunculate probasidia ..... 22
19. Dimitic, hyphal pegs composed of skeletal hyphae with walls up to 1.5  $\mu\text{m}$  thick.....*Skeletohydnum*
- 19\*. Monomitic, hyphal pegs composed of dendrohyphidia with thin walls or tramal hyphae with walls up to 1  $\mu\text{m}$  thick..... 20
20. Basidiospore walls swelling in KOH..... *Myriothele philippiae*
- 20\*. Basidiospore walls not swelling in KOH ..... 21
21. Hymenium and context obscured by crystals, lageniform cystidia absent ..... *Dendrothele*
- 21\*. Hymenium and context with few crystals, lageniform cystidia present.  
..... *Hyphodontia gamundiae*
22. Hyphae with simple septa..... 23
- 22\*. Hyphae with clamp connections ..... 27
23. Gloeocystidia present, basidiospores amyloid..... *Gloiothele lamellosa*
- 23\*. Gloeocystidia absent, basidiospores not amyloid ..... 24

24. Probasidia present, basidiomata often with pink to pale red colored areas ..... *Laetisaria fuciformis*
- 24\*. Probasidia absent, basidiomata not pink or pale red ..... 25
25. Basidia with 2 sterigmata .....  
..... *Pteridomyces bisporus* (= *Athelopsis bicornis*)
- 25\*. Basidia with 4 sterigmata ..... 26
26. Hyphal pegs heavily encrusted, basidiospores ovoid to cylindrical .....  
*Hyphodermella*
- 26\*. Hyphal pegs sparsely encrusted, basidiospores subfusiform .....  
..... *Epithele efibulata*
27. Lageniform and capitate cystidia present ..... *Hyphodontia gamundiae*
- 27\*. Lageniform and capitate cystidia absent ..... 28
28. Basidia narrowly clavate to clavate with 1–2 sterigmata ..... 29
- 28\*. Basidia clavate with 4 sterigmata ..... 30
29. Sterigmata 9–30 µm long, basidiospores cylindrical or curved .....  
..... *Cerinomyces*
- 29\*. Sterigmata up to 9 µm long, basidiospores subglobose .....  
..... *Epithele bisterigmata*
30. Basidiomata small, disciform, known only from New Zealand .....  
..... *Mycothele disciformis*
- 30\*. Basidiomata effused, known throughout the world ..... 31
31. Basidiospores thick-walled, strongly cyanophilous ..... *Epithelopsis*
- 31\*. Basidiospores thin to thick-walled, acyanophilous to cyanophilous, if  
thick-walled then acyanophilous or weakly cyanophilous ..... *Epithele*

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