Tubulicium dussii, a corticioid basidiomycete on tree ferns, found in Europe

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Abstract: Based on recent collections from Portugal, *Tubulicium dussii* is described and illustrated. The corticioid species is specialised to tropical tree ferns (*Cyatheales*). In Europe, there are only a few outdoor populations of tree ferns, like in the "Parque Natural de Buçaco" in Portugal. Our collection from this site is apparently the first record of *Tubulicium dussii* (= *T. vermiculare*) in Europe.

Zusammenfassung: Ein Fund von *Tubulicium dussii* aus Portugal wird vorgestellt und ausführlich dokumentiert. Die corticioide Art ist auf die vorwiegend tropisch verbreiteten Baumfarne (*Cyatheales*) spezialisiert. Der Fund aus dem "Parque Natural de Buçaco" in Portugal, der einen der wenigen Baumfarn-Bestände in freier Natur in Europa beherbergt, ist offensichtlich der erste Nachweis von *Tubulicium dussii* (= *T. vermiculare*) in Europa.

Most corticioid fungi are saprobionts usually living on, and disintegrating, woody substrates (trunks and branches of coniferous and deciduous trees). Only a few saprobionts prefer dead parts of herbs, ferns, or mosses, or they grow on the remnants and litter of unidentifiable plant material. BOIDIN (1993) provided an overview and taxonomic key to a number of "filicolous *Aphyllophorales* (predominantly corticioid fungi) in Europe". Nevertheless, only very few species listed in this compilation appear to be strictly specialised to ferns, e.g., *Aphanobasidium filicinum* (BOURD.) JÜLICH, *Athelopsis bananisporus* (BOIDIN & GILLES) HJORTSTAM, *Herpobasidium filicinum* (ROSTR.) LIND., *Repetobasidiellum fusisporum* J. ERIKSS. & HJORTSTAM.

In 1999 and 2001, a *Tubulicium* species was found in the "Parque Natural de Buçaco" (Portugal) where it abundantly fructificated on dead but still attached petioles of the tree fern *Dicksonia antarctica* LABILL. (Soft tree-fern). The trunks of *D. antarctica*, probably the largest *Dicksonia* species, can reach 4-6 m in height (in isolated cases up to 15 m) and a life span of up to 400 years. The crown of this tree fern can contain up to 60-70 dark green roughly textured fronds in a spreading canopy of up to 6 m (under exceptionally good conditions 8 m) in diameter (NICHOLLS 1988, BARCLAY 2002, ANBG 2003).

Beside the tree ferns, the dense forests in the "Parque Natural de Buçaco" are composed of cedars, fir trees, sequoias, lime trees, elm trees, laurel trees, beech trees, rhododendrons, acacias and ash trees, altogether more than 700 species of trees, shrubs

and flowers originating not only from Portugal, but also from as far away as Mexico, Chile, the Himalayas and Japan and from many other places all over the world, all planted and cultivated by generations of Carmelite monks who lived in the area of Buçaco from 1628 to 1834, built a monastery and surrounded the 400 hectares forest with a wall of 5750 meters of length. "The trees in this forest are of a gigantic stature and are rich in essences, fragrances and brilliance" (SIMÕES 2003, GRUPPELAAR-SPIERINGS 2003).

The *Tubulicium* on the tree ferns turned out to be *Tubulicium dussii* (PAT.) OBERW. ex JÜLICH s. lato, hitherto known from Central America, Hawaii, New Zealand, and several other (sub-)tropical places, where it was found invariably on various tree fern species.

***Tubulicium dussii* (PAT.) OBERW. ex JÜLICH,** Persoonia **10**: 335; 1979 (Fig. 1, Colour fig. IX – see p. 122)

Description:
Basidiome resupinate, forming small patches, effused to a few millimeters, surface even, hispid (cystidiate) under a lens, thin, tightly adherent to substratum; clearly delimited (margin distinct and abrupt); whitish.

Microscopic characters:
Basidia: at first almost subglobose, then broadly cylindrical to stoutly clavate, tapering to the base, in older stages rather oblong-cylindrical; 10.5-13.5 x 5-6 µm; with clamp at the base; apparently terminal (but in mounts the base often difficult to observe); 4-sterigmate (no 2-sterigmate basidia seen), sterigmata up to 6 µm long, narrow, eventually strongly arcuate (sickle-shaped).

Basidiospores: sublunate to naviculate (to banana-shaped); at both ends acuminate, in outlines the adaxial side symmetrically rounded to nearly perfectly semicircular, the axial side more or less concave, often „buckled"; (5.5-)6.5-7.5(-9.0) x (2.0-)2.5-3.0 µm, mean length = 7.0 ± 0.8 µm, mean width = 2.5 ± 0.2 µm; length-width-ratio = 2.7-3.2, mean = 2.9 ± 0.3 µm; hyaline, mostly with 1-2 drops; smooth-walled, non-amyloid.

Cystidia (lyocystidia): abundant; projecting from the hymenium; robust; conical to subulate, arising from a broad base; 68-82 x 9-12-14.5 µm; young cystidia with regular (straight) outlines and tapering to a sharply pointed apex (strongly acuminate), older cystidia with somewhat undulating outlines and tapering to a blunt apex; young cystidia almost thin-walled to somewhat thick-walled, older ones very thick-walled, in the upper part (and in the roots) finally only a capillary-like lumen remaining; cell wall hyaline, negative to weakly positive in Iodine (with a violet-blueish tint, at most), inner layers slowly soluble in KOH; the base rooted (1-3 roots); apex of young cystidia densely covered by fine to coarse crystals (to an entire length of 20-30 µm), which finally coalesce to larger, smooth plates; older cystidia coated by single hyphae, or a number of hyphae, which entwine around the surface of the cystidia; those hyphae up to about 1.5(-2) µm wide, "coralliform" with innumerable dendritic branches; branches delicate, short (up to about 4-5 µm long), with blunt apex.

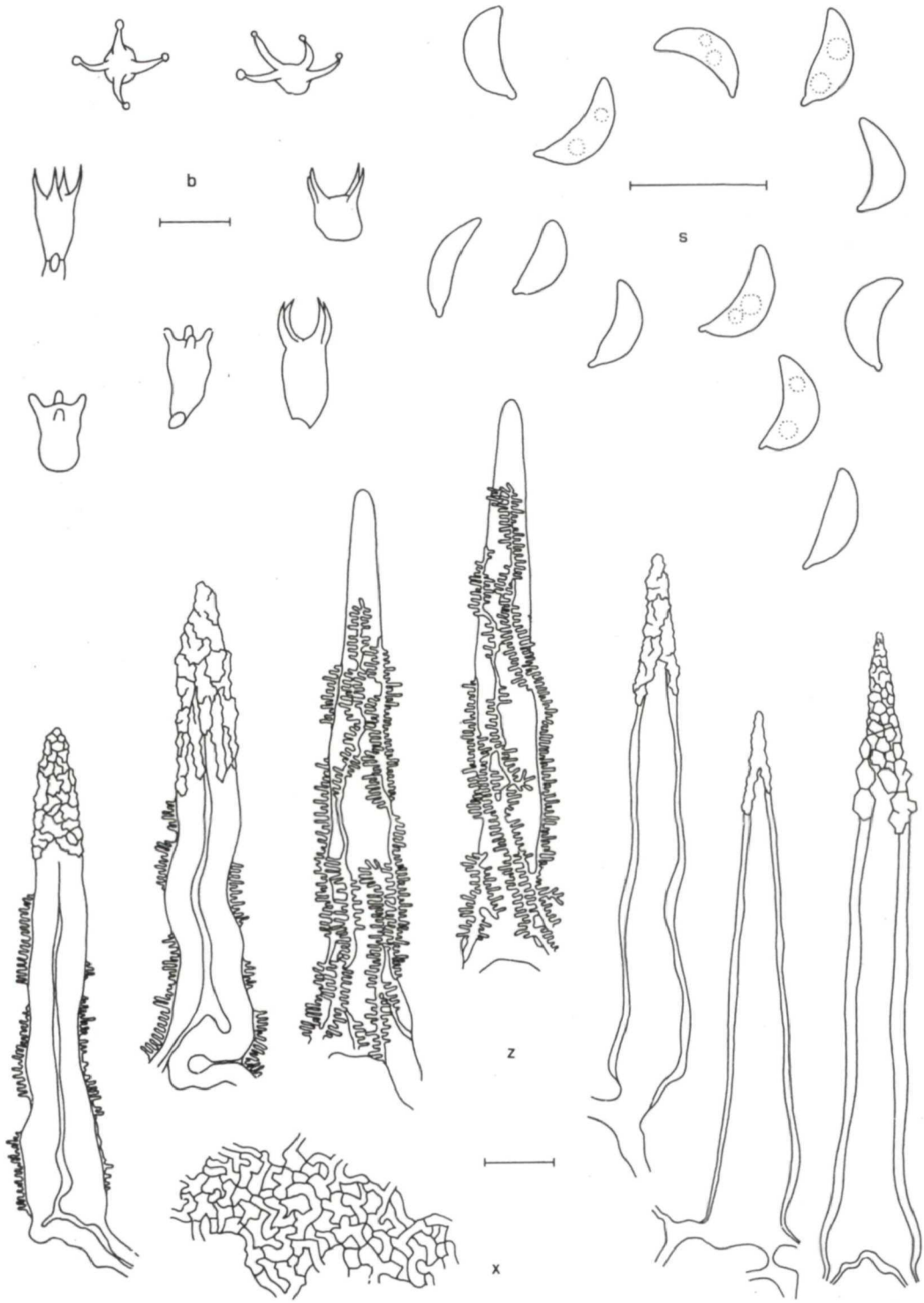


Fig. 1. *Tubulicium dussii* (Herb. WU 21039). *b* Basidia. *s* Spores. *z* Cystidia. Young encrusted cystidia (right), old cystidia sheathed with coralloid hyphae (middle), section of cystidia of intermediate age (left). *x* Hyphal system. – Bar: 10 µm.

Hyphal system: monomitic, short-celled, 1.5-2.0(-2.5) µm diam., much-branched (more or less in right angles), densely arranged (like pieces of a puzzle), apparently conglutinate, therefore difficult to separate into individual cells, but nevertheless the cell outlines more or less distinct; thin-walled, with clamps (mostly difficult to discern).

Ecology: On dead, but still attached petioles of *Dicksonia antarctica*, associated with *Hyphoderma argillaceum* (BRES.) DONK.

Specimens examined: Portugal: Beira Litoral, Distr. Coimbra, Parque Natural de Buçaco, 450 m s. m., 40° 33' N, 08° 28' E; 11. 11. 1999 (Herbarium WU 21039); - - 2. 11. 2001 (Herbarium WU 21701); (leg. A. HAUSKNECHT & F. REINWALD, det. W. DÄMON, rev. J. BOIDIN as *T. vermiculare*).

The nomenclatural history of *Tubulicium dussii* (and *T. vermiculare*)

The species is "easily recognized by its conical, thick-walled cystidia that are sheathed in dendritic hyphae, and lunate to falcate spores" (LIBERTA 1960). However, the species has been reported under two names: In general, records from Central America and Hawaii have been published as *T. dussii*, while records from New Zealand and Réunion were named *T. vermiculare*. Though the synonymy of these names was accepted and proved by several mycologists for a long period of time, there are still serious doubts about the conspecifity of *T. dussii* and *T. vermiculare* to this day.

The original description of *Hypochnus dussii* PATOUILLARD (1899: 202) is as follows: "Entièrement résupiné, très mince, fortement adhérent, tendre, formant des plaques blanches ou blanchâtres, elliptiques, bien définies, longues de 3 à 15 millim. et larges d 3 à 4 millim.; à la loupe ces plaques se montrent parsemées d'émergences dressées, blanches, très nombreuses et disposées sans ordre. L'examen microscopique montre qu'elles sont composées d'hyphes accolées en une masse dressée mesurant 80 µm de haut sur 20-25 µm d'épaisseur, fimbriée sur toute sa longueur et ne résentant pas d'éléments épaissis cystidiformes. L'hyménium s'étend sur toute la surface entre les émergences et ne comprend que des basides bi- ou tetraspores mesurant 13 x 6 µm; les spores sont incolores très fortement courbées, larges à la base et atténuées en pointe au sommet, mesurant 6-7 x 2,5-3 µm. La trame sous-hyménienne épaisse d'environ 20 µm est composée d'hyphes grêles et délicates."

PATOUILLARD (1899) stated the similarity of *Hypochnus dussii* and *H. typhae* (PERS.: FR.) PAT., and suggested to unite both species in the new section *Epithele*. Only one year later, he raised the rank of *Epithele* from a section to a genus and included within it the same two species, still thinking that the sheathed cystidia of *Epithele dussii* (PAT.) PAT. were fascicles of hyphae, just like in *Epithele typhae* (PERS.: FR.) PAT. (see WERESUB 1953).

The mistake was pointed out by the Austrian mycologists HÖHNEL & LITSCHAUER (1907) who recognized the cystidia of *Epithele dussii* to be "true *Peniophora*-cystidia" (at that time *Peniophora* included the types of *Tubulicium* and *Tubulicrinis*, for example). *Epithele dussii* was re-named *Peniophora dussii* (PAT.) HÖHNEL & LITSCHAUER, consequently.

Later on, LIBERTA (1960) transferred *Peniophora dussii* to *Xenasma* (together with *Peniophora vermifera* BOURDOT and other species which belong to *Tubulicium* today), due to "the method of basidial development, the rooted base of the cystidia, and the conglutinate or gelatinised condition of the hyphae".

It was OBERWINKLER (1965 a) who defined the genus *Tubulicium*, including *T.*

vermifera (BOURDOT) OBERW., the type of the genus, *T. dussi*, and *T. clematidis* (BOURDOT & GALZIN) OBERW., as "these species are lacking pleurobasidia and therefore must not be left in *Xenasma*". According to the author, *Tubulicium* is close to *Tubulicrinis*, but in the latter the cystidia are not sheathed, they disintegrate in KOH rapidly, the hyphae in the context are loose (not conglutinate), and the basidial development and hymenial structure are different.

In regard to the new combination *Tubulicium dussii*, in OBERWINKLER (1965 a) the reference to the basionym was not given. This was emended later by JÜLICH (1979).

Nearly at the same time (summer 1965), *Tubulixenasma* PARMASTO was described, based on the same type as *Tubulicium* and including *Tubulixenasma dussii* (PAT.) PARMASTO as well (see PARMASTO 1968). However, "supplementary data have shown that *Tubulixenasma* was published in July (not in May, as cited in Index of Fungi), while the description of *Tubulicium* was issued in June" (HJORTSTAM & al. 1988).

A couple of years later, BOQUIREN (1971) turned the tables again when he rediscovered "a close biological kinship" between *T. dussii* and *Epithele typhae*. He returned *T. dussii* to *Epithele* and included all species of *Tubulicium* in the same genus. Thus, *Tubulicium* became a synonym of *Epithele*, but which was not accepted by most European mycologists.

The original description of *Peniophora vermicularis* WAKEFIELD (1915: 371) is: "Fungus effusus, albido-griseus, tenuissimus, sub lente cystidiis hispidulus; subiculum fere nullum. Cystidia subulata, laevia, sed apice incrustata, crasse apice excepto tunicata, basi bifurcata, 45-70 x 8-14 µm, Basidia non visa. Sporae fusiformes, utrinque acutae, arcuatae vel flexuoso-vermiculiformes, 9-11 x 2-3 µm. Hyphae indistinctae, 1 µm diametro."

"*P. vermicularis*" eventually was transferred to *Tubulicrinis* by CUNNINGHAM (1963) and *Tubulicium* by BOIDIN & GILLES (1986).

On the presumable synonymy of *T. dussii* and *T. vermiculare*

In the course of her study of *Peniophora* species sect. *Tubuliferae*, WERESUB (1961, and already in previous papers) apparently was the first who investigated the type collections of both *Hypochnus dussii* and *Peniophora vermicularis*. She comments on the taxonomical relationship as follows: "It was Professor ROGERS who pointed out to me that this taxon [*P. vermicularis*] was possibly identical with *P. dussii*. A comparison of the two type collections has established this synonymy, in spite of the differences apparent in the descriptions; i.e., the generally greater size of all structures in *P. dussii*, but with an overlapping of the size ranges in *P. vermicularis*, and the more consistent occurrence of pseudoamyloidity in *P. dussii*. But being able to accept these as the normal variation possible within a species, I do not hesitate to discard the name *P. vermicularis* as a synonym of *P. dussii*."

This argumentation has been confirmed without any restrictions by LIBERTA (1960) in his in-depth study of *Xenasma*, and by OBERWINKLER (1965 a) when he defined the genus *Tubulicium*. Unfortunately, OBERWINKLER (1965 a) did not examine the type of *T. dussii* (but only the type of *T. vermiculare*), nor did CUNNINGHAM (1963) who published an accurate description and an impressive drawing of *T. vermiculare*.

Based on collections of *T. vermiculare* from Réunion, and on collections of *T. dussii* from Guadeloupe, BOIDIN & GILLES (1986) doubted about the conspecifity of these

taxa. They found the spores of *T. dussii* (in their own collections from Guadeloupe) to be 11.5-14 x 2.5-3 µm (mean = 12.70 x 2.62 µm), with tapering apex, but not acuminate and not sickle-shaped, whereas in *T. vermiculare* the spores are smaller and "lunate with acuminate ends" (as described earlier by CUNNINGHAM 1963). However, BOIDIN & GILLES (1986) conceded a possible variation in the size and shape of the spores (like in *T. vermiferum*, the type species of *Tubulicium*).

In the same way, *T. dussii* and *T. vermiculare* are treated as separated species by DOMAŃSKI (1992) and KISIMOVA-HOROVITZ & al. (1997).

HJORTSTAM & al. (1998) resume tersely, "*T. vermiculare* was said to have more tightly curved basidiospores", but in their opinion "the difference is slight and the species is here considered a synonym of *T. dussii*".

In regard to the shape of the spores, the collections from Portugal clearly correspond with *T. vermiculare*. This was confirmed by J. BOIDIN (in litt. 2001) who re-examined our collections and found "the shape is exactly as in *T. vermiculare*, i.e. acuminate at both ends, though the size is rather small compared to descriptions in the literature".

Anyway, except from this we can not see any distinguishing character, and therefore accept the synonymy of *T. dussi* and *T. vermiculare*.

Morphological characters

Our collections from Portugal match the detailed descriptions of *T. dussii* (*T. vermiculare*) given by PATOUILLARD (1899), WAKEFIELD (1915), LIBERTA (1960), WERESUB (1961), CUNNINGHAM (1963), OBERWINKLER (1965 a), BOQUIREN (1971), BOIDIN & GILLES (1986), GILBERTSON & HEMMES (1997) and KISIMOVA-HOROVITZ & al. (1997). Most of the descriptions are illustrated with drawings of the microscopical characters.

Table 2 summarises the size of the cystidia, basidia, and basidiospores reported in the literature. The data partly vary within a wide range, but overlap, and demonstrate the variation of the species. The data from *T. dussii* and *T. vermiculare* do not differ significantly.

Beyond these size measurements, the descriptions in the literature show an overall uniformity. Nevertheless, a few exceptions should be noted: CUNNINGHAM (1963) mentions (and figures) basidiospores which "sometimes adhere in fours, or pairs". According to OBERWINKLER (1965 a), "the inner layer of the cystidia wall reacts strongly amyloid". GILBERTSON & HEMMES (1997) observed only basidia with a simple-septate base. LIBERTA (1960) unmistakably reports (and illustrates) pleurobasidia ("the base bifurcate"). Also WERESUB (1961) states that "the pleurobasidiate structure is almost certain". This, of course, would contradict the definition of the genus *Tubulicium* (see OBERWINKLER 1965 a) and would raise the question about an appropriate systematic position of its members again. Curious enough, the genus *Tubulixenasma*, though based on the same type as *Tubulicium*, was considered to be pleurobasidiate (see BOQUIREN 1971).

Table 1. Comparison of the size of cystidia, basidia, and basidiospores in *Tubulicium dussii* (*T. vermicularis*), as reported in publications since 1899. All measures in µm.

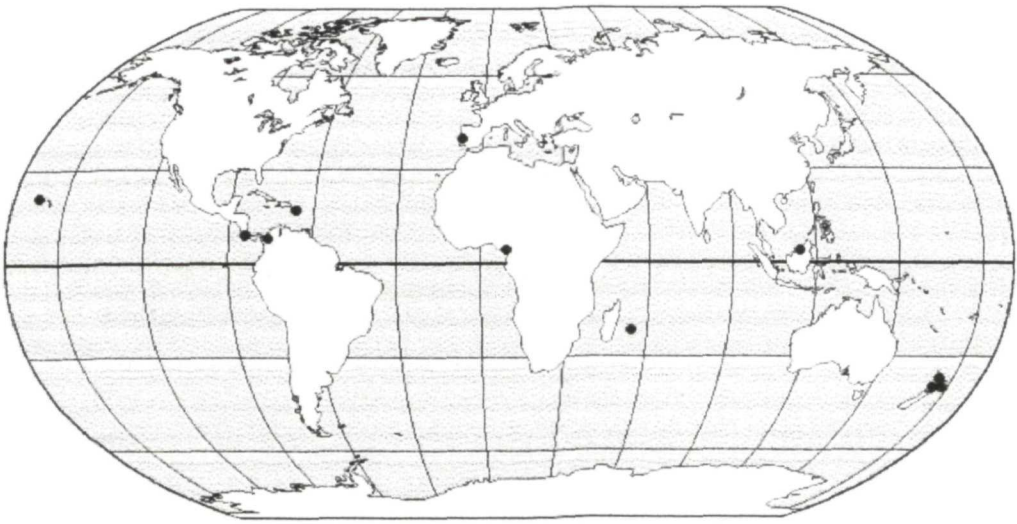
Reference, *T. dussii*/*T. vermiculare*	**Size of cystidia (µm)**	**Size of basidia (µm)**	**Size of basidio-spores (µm)**
PATOUILLARD (1899) – *T. dussii* (type)	80 x 20-25	13 x 6	6-7 x 2.5-3
WAKEFIELD (1915) – *T. vermiculare* (type)	45-70 x 8-14	n/a	9-11 x 2-3
LIBERTA (1960) – merged data (both types)	55-100 x 8.5-15	12.5-17 x 5-6	7.5-14 x 2.5-3.5
WERESUB (1961) – *T. dussii* (type)	55-115 x 7-13.5	15 x 6-10	7.8-15 x 2.5-3.5
WERESUB (1961) – *T. vermiculare* (type)	50-75 x 10-11	12-17 x 5-6	7.5-10 x 2.5-3
CUNNINGHAM (1963) – *T. vermiculare*	40-80 x 8-12	10-16 x 5-6	9-11 x 3.5-4
OBERWINKLER (1965 a) – *T. vermiculare* (type)	40-70(-100) x 6-10 (-15)	12-17 x 5-6	7-9(-14) x 2.5-3-3.5
BOQUIREN (1971) – *T. dussii*	50-85 x 8-15	12-18 x 5-6	7-11 x 2.5-3.5
BOIDIN & GILLES (1986) – *T. vermiculare*	45-82 x 7-12	10-14 x 6	8-10 x 2.5-3(-3.5)
GILBERTSON & HEMMES (1997) – *T. dussii*	60-85 x 9-15	13-15 x 6-8	10-14 x 2-3
KISIMOVA-HOROVITZ & al. (1997) – *T. dussii*	50-70 x 8-17	10-13 x 4-5	7.5-10 x 2.5-3.5
KISIMOVA-HOROVITZ & al. (1997) – *T. vermiculare*	50-60 x 6-7	8-9 x 4-5	8.5-10 x 2-3
This report – *T. dussii* s. lato	68-82 x 9-12-14.5	10-13.5 x 5-6	5.5-9.0 x 2.0-3.0

Distribution and ecology

Tubulicium dussii s. lato has been reported from Central America (Guadeloupe, Costa Rica, Colombia), Hawaii, Africa (Cameroon, Réunion), Asia (Brunei Darussalam), and New Zealand (see Table 2, Fig. 2).

The distribution of *T. dussii* s. lato is limited by the distribution of its substrate, i.e. tree ferns. Consequently, it can be considered as a "pantropical and subtropical species" (HJORTSTAM & al. 1998).

Fig. 2. Distribution of *Tubulicium dussii* s. lato in the world based on collection localities reported so far.



In the "Parque Natural de Buçaco", the tree ferns *Cyathea australis* (R. BR.) DOMIN (Rough tree-fern) and *Dicksonia antarctica* (Soft tree-fern) are not native, of course, but have been imported from tropical countries and cultivated by Carmelite monks in the 17th or 18th century. The Nature Park is situated less than 40 km of the Atlantic coastline, the climate is mild, with an average annual total precipitation of about 1500 mm, 130 annual days of rain, rare and quick frosts and exceptionally snows in the winter. Fogs are very frequent and dense, especially in the summer and autumn. The temperature oscillates between 39–40 °C in the summer and around 1 °C in the winter (SIMÕES 2003, GRUPPELAAR-SPIERINGS 2003).

Dicksonia antarctica, like other tree ferns, is relatively cold-tender and often destroyed from temperatures below zero. However, the hardiness seems to vary according to the provenance from which the plant originates. Recently, efforts have been made to introduce hardier provenances which might be able to withstand temperatures down to near -10 °C before they are severely damaged (BARCLAY 2002). In this case, and due to the global warming, the "distribution" of tree ferns in Europe, i.e. the region where it can grow without protection, may extent in future.

So far, outdoor stands of tree ferns are known from only a few places in Europe where unprotected specimens have been planted and established successfully, like in the "Parque Natural de Buçaco" and in the "Sintra World Heritage" (ESMM 2003) in Portugal, or at the Logan Botanical Gardens in Scotland (BARCLAY 2002).

Both from Portugal and from Great Britain, *T. dussii* s. lato has not been reported yet (TELLERÍA 1993, BMS 2003). An overview of "*Aphyllophorales* on ferns in Europe" (BOIDIN 1993) contains no reference to *T. dussii* or to tree ferns as substrates of *Aphyllophorales* in general. Furthermore, in the literature available there is no report of *T. dussii* collected from tree ferns cultivated under protection either. Even though, it might be promising to check dead petioles of tree ferns inside heated greenhouses for the occurrence of *T. dussii*.

Table 2. Distribution and ecology of *Tubulicium dussii* s. lato.

Locality	Ecology	Reference
Guadeloupe: Tannes, Bois des Bains, 1899, coll. C. DUSS	on old petioles of *Alsophila aspera*	PATOUILLARD (1899), WERESUB (1961), MINTER & al. (2003) (as *T. dussii*)
Guadeloupe		BOIDIN & GILLES (1986; as *T. dussii*)
Costa Rica: Reserva de San Ramón, Prov. de Alajuela, 4. 9. 1991	common on dead parts of tree ferns	KISIMOVA-HOROVITZ & al. (1997; as *T. dussii*)
Costa Rica: Estación Biológica de Las Cruces, 1300 m, Prov. de Puntarenas, 30. 12. 1993	on petioles of tree ferns	KISIMOVA-HOROVITZ & al. (1997; as *T. vermiculare*)
Colombia: Dept. Magdalena, Sierra Nevada de Santa Maria, Cerro Quemado Trail, coll. G. W. MARTIN	*Cyathea medullaris*, *Hemitelia smithii*	LIBERTA (1960), BOQUIREN (1971) (as *T. dussii*)
Hawaii: 6 collections, 1945-1947, 11. Nov. – 1. January	on living and dead petioles of *Cibotium chamissoi*	BOQUIREN (1971; as *T. dussii*)
Hawaii: 20 collections	*Cibotium chamissoi*, *C. glaucum*	GILBERTSON & HEMMES (1997; as *T. dussii*)
Cameroon: South West Province, Korup National Park, trail to Rengo Rock Camp, lowland rain forest, 3. 5. 1996	on dead fern stems	ROBERTS (2000; as *T. dussii* s. lato)
Réunion: Forêt de Bébour	*Cyathea borbonica*, *C. excelsa*	BOIDIN & GILLES (1986; as *T. vermiculare*)
Brunei Darussalam: Temburong Distr., Bukit Belalong	on dead fern stems	HJORTSTAM & al. (1998; as*T. dussii*)
New Zealand: Rotorua, Whakarewarewa, 1914, coll. W. N. CHEESMAN	on a fern petiole	WAKEFIELD (1915), WERESUB (1961; as *T. vermiculare*)
New Zealand: Auckland, Kauri park, Birkdale; Rotorua, Earthquake Flat; Taranaki, Mt Egmont	on dead pendent stipes of *Cyathea medullaris*, *C. smithii*	CUNNINGHAM (1963; as *T. vermiculare*)
Portugal: Beira Litoral, Distr. Coimbra, Parque Natural de Buçaco, 1999, 2001	*Dicksonia antarctica*	this report (*T. dussii* s. lato)

The tree ferns belong to the *Cyatheales* (*Pteridophyta*) which comprise about 630-680 species (HASSLER & SWALE 2001). The substrates of *T. dussii* s. lato as reported in the literature, are *Alsophila* and *Sphaeropteris* (*Cyatheaceae*), and *Cibotium* (*Dicksoniaceae*) (see Table 2), namely *Alsophila aspera* (L.) R. BR., *A. borbonica* (DESV.) R. M. TRYON [= *Cyathea borbonica* DESV.], *A. smithii* (HOOK f.) R. M. TRYON, [= *Cyathea smithii* HOOK f., = *Hemitelia smithii* (HOOK f.)], *Sphaeropteris excelsa* (ENDL.) R. M.

TRYON [= *C. excelsa* ENDL.], *S. medullaris* (FORST. f.) BERNH. [= *C. medullaris* (FORST. f.) SWARTZ], *Cibotium chamissoi* KAULF., *C. glaucum* (SM.) HOOK. & ARN.

Dicksonia, the substrate of the collections from Portugal, has not been mentioned as a substrate of *T. dussii* s. lato so far.

In conformity with GILBERTSON & HEMMES (1997), we found this corticioid fungi to be a saprobiont confined to dead tissue. The authors observed *T. dussii* on both "persistent senescent petioles on standing live plants or fallen petioles at the base of living plants", while we have seen fructifications only on still attached dead petioles.

GILBERTSON & HEMMES (1997) list 26 species of fungi on tree ferns in Hawaii, five of which are new to science, among them *Athelia cibotii* GILB. & HEMMES spec. nova, characterized by cylindric, slightly curved to distinctly allantoid spores of 5-7 x 2-2.5 µm of size. In the authors experience, "*Tubulicium dussii* and *Athelia cibotii* are the two most common fungi on tree ferns".

Other species of *Tubulicium* OBERWINKLER (1965 a)

The genus *Tubulicium* was named by OBERWINKLER (1965 a) after the striking tube-like cystidia (tubulus = narrow tube; -icium reminds of *Corticium*). The author defines the genus as follows: "Hyphae conglutinate, mostly indistinct, hyaline. Cystidia oblong-conical, the base considerably broadened and arising from some mostly thick-walled 'carrier hyphae' (multi-rooted); cystidia thick-walled, built up of layers, often encrusted or sheathed by hyphae, respectively; walls dissolve in KOH after a while, inner wall layer in some cases amyloid or pseudoamyloid; basidia clavate-pedunculate to cylindrical-pedunculate, mostly developing singly and terminally; spores of various shapes, hyaline." Special emphasis is placed by OBERWINKLER (1965 a) on the peculiar type (shape and development) of the basidia which he calls "podobasidia".

Tubulicium vermiferum (BOURD.) OBERW., the type species of *Tubulicium*, is characterized by sigmoid to vermicular spores of about 15–25 x 3.0–5.0 µm (thus considerably larger than in *T. dussii* s. lato). The species is well known (e.g., WAKEFIELD 1915, LIBERTA 1960, CHRISTIANSEN 1960, WERESUB 1961, CUNNINGHAM 1963, BOQUIREN 1971, JÜLICH 1984, BOIDIN & GILLES 1986, HJORTSTAM & al. 1988, BOIDIN & GAIGNON 1992) and probably has a world-wide distribution. In Europe, *T. vermiferum* has been reported from, e.g., the Balearic Islands (TELLERÍA & MELO 1997), France (BOURDOT & GALZIN 1927, GAIGNON 1993) and Great Britain (BMS 2003). In North Europe, the species is rare, "with few localities in the South-western part of Sweden and Western Norway, usually on bark of living trees and bushes; e.g., *Salix*, *Corylus*" (HJORTSTAM & al. 1988), and a collection from Denmark (CHRISTIANSEN 1960). In Central Europe, *T. vermiferum* was found twice (3. 11. 1962, 19. 5. 1964) in the Bavarian Alps (OBERWINKLER 1965 a), whereas there are no reports from Austria (DÄMON 2001).

Beside *T. dussii* s. lato and *T. vermiferum*, currently six more species are accepted in *Tubulicium*: *T. capitatum* (ROGERS & BOQUIREN) BURDSALL & NAKASONE 1983, type from Florida, USA (BOQUIREN 1971); *T. filicicola* (G. H. CUNN.) OBERWINKLER (1965 b), type from New Zealand; *T. junci-acuti* BOIDIN & GAIGNON (1992), type from Corsica; "*T. macrosporum* (LIBERTA 1960) auct.", type from Panama; *T. ramonense* KISIM., OBERW. & L. D. GÓMEZ, type from Costa Rica (KISIMOVA-HOROVITZ & al. 1998); *T. rhaphidosporum* (BOIDIN & GILLES) OBERW., KISIM. & L. D. GÓMEZ

in KISIMOVA-HOROVITZ & al. (1998), type from Réunion (BOIDIN & GILLES 1986). A key to the species of *Tubulicium* is provided by BOIDIN & GAIGNON (1992).

One more species, *Litschauerella clematidis* (BOURD. & GALZIN) J. ERIKSS. & RYV., is very close to *Tubulicium*. Actually, during the last century *L. clematidis* was often placed in the same genera as today's members of *Tubulicium*, and was even accepted in *Tubulicium* by OBERWINKLER (1965 a). The spores of *L. clematidis*, however, are not worm-shaped and smooth, but globose to ovate and asperulate. On account of this, ERIKSSON & RYVARDEN (1976) and HJORTSTAM & al. (1988) preferred to keep *Litschauerella* and *Tubulicium* as separated genera.

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References

ANBG (Australian National Botanic Gardens), 2003: *Dicksonia antarctica* – the soft tree fern. – [http://www.anbg.gov.au/gnp/interns-2003/dicksonia-antarctica.html] – Visited 2003-09-01.

BARCLAY, I., 2002: Cold-hardy tree-ferns. – [http://www.angelfire.com/bc/eucalyptus/treeferns/] – Last modified 2002-12-08.

BMS (British Mycological Society), 2003: The Great Britain checklist of fungi. – [http://194.203.77.69/fieldmycology/GBCHKLST/gbspecies.asp?intFDNum=18692] – Visited 2003-09-01.

BOIDIN, J., 1993: Les *Aphyllophorales* filicoles en Europe. – Bull. Féd. Mycol. Dauphiné-Savoie **129**: 20-30.

— GAIGNON, M., 1992: *Tubulicium junci-acuti* nov. sp. (*Basidiomycotina*) en provenance de la Corse. – Bull. Mens. Soc. Linn. Lyon **61**: 260-264.

— GILLES, G., 1986: Basidiomycètes Aphyllophorales de l'île de la Réunion II. Les genres *Tubulicrinis*, *Tubulicium* et *Litschauerella*. – Bull. Soc. Mycol. France **102**: 279-290.

BOQUIREN, D. T., 1971: The genus *Epithele*. – Mycologia **63**: 937-957.

BOURDOT, H., GALZIN, A., 1927: Hyménomycètes de France. Reprint 1969. – Biblioth. Mycol. **23**.

CHRISTIANSEN, M. P., 1960: Danish resupinate fungi. Part II. *Homobasidiomycetes*. – Dansk Bot. Ark. **19**.

CUNNINGHAM, G. H., 1963: The *Thelephoraceae* of Australia and New Zealand. – New Zealand Dep. Sci. Ind. Res. Bull. **145**: 1-359.

DÄMON, W., 2001: Die corticioiden Basidienpilze des Bundeslandes Salzburg (Österreich). Floristik, Lebensräume und Substratökologie. – Biblioth. Mycol. **189**: 1-413.

DOMAŃSKI, S., 1992: Mała flora grzybów 1, *Basidiomycetes* 7. *Corticiaceae*: *Sarcodontia–Ypsilonidium*, *Christiansenia* & *Syzygospora*. – Kraków: Polska Akad. Nauk, Inst. Bot.

ERIKSSON, J., RYVARDEN, L., 1976: The *Corticiaceae* of North Europe. 4. *Hyphodermella–Mycoacia*. – Oslo: Fungiflora.

ESMM (Escola Secondária de Mem Martins), 2003: Sintra Património Natural. – [http://atelier.hannover2000.mct.pt/mosaico/paginas/pr474/] – Visited 2003-09-01.

GAIGNON, M., 1993: Pour une lecture actualisée des "Hymenomycetes de France" de BOURDOT et GALZIN (suite). – Bull. Soc. Mycol. France **109**: 223-245.

GILBERTSON, R. L., HEMMES, D. E., 1997: Notes on fungi on Hawaiian tree ferns. – Mycotaxon **62**: 465-487.

GRUPPELAAR-SPIERINGS, P., 2003: Portugal. Quinta do Rio Dão. – [http://www.quintadoriodao.com/eng/out/bussaco.html] – Visited 2003-09-01.

HASSLER, M., SWALE, B., 2001: Checklist of ferns and fern allies. – [http://homepages.caverock.net.nz/~bj/fern/list.htm] – Last updated 2001-10-07.

HJORTSTAM, K., LARSSON, K.-H., RYVARDEN, L., 1988: The *Corticiaceae* of North Europe. 8. *Thanatephorus–Ypsilonidium*. – Oslo: Fungiflora.

— ROBERTS, P. J., SPOONER, B. M., 1998: Corticioid fungi from Brunei Darussalam. – Kew Bull. **53**: 805-827.

HÖHNEL, F. VON, LITSCHAUER, V., 1907: Beiträge zur Kenntnis der Corticieen (II. Mitteilung). –

Sitzungsber. Kaiserl. Akad. Wissensch. Math.-Naturw. Klasse **116**: 739-852.

JÜLICH, W., 1979: Studies in resupinate Basidiomycetes. VI. On some new taxa. – Persoonia **10**: 325-336.

— 1984: Die Nichtblätterpilze, Gallertpilze und Bauchpilze. – In: GAMS, H., (Fund.): Kleine Kryptogamenflora II b/1. – Stuttgart, New York: Fischer.

KISIMOVA-HOROVITZ, L., OBERWINKLER, F., GÓMEZ P. L. D., 1997: Basidiomicetos resupinados de Costa Rica. *Litschauerella*, *Subulicystidium* y *Tubulicium* (Corticiaceae s. l.). – Rev. Biol. Trop. **45**: 1310-1320.

LIBERTA, A. E., 1960: A taxonomic analysis of section *Athele* of the genus *Corticium*. I. Genus *Xenasma*. – Mycologia **52**: 884-914.

MINTER, D. W., PORTALES, J. M., VILARÓ, M. C., 2003: Electronic distribution maps of Caribbean fungi. – [http://www.biodiversity.ac.psiweb.com/carimaps/0216165_.htm] – Visited 2003-09-01.

NICHOLLS, D., 1988: *Dicksonia antarctica* – Soft Tree Fern. – [http://www.home.aone.net.au/byzantium/ferns/descriptions/dicksonia/dicksonia.html].

OBERWINKLER, F., 1965 a: Primitive Basidiomyceten. Revision einiger Formenkreise von Basidienpilzen mit plastischer Basidie. – Ann. Mycol., ser. II, 19.

— 1965 b: Die Gattung *Tubulicrinis* DONK s. l.. – Z. Pilzk. **31**: 12-48.

PARMASTO, E., 1968: Conspectus systematis Corticiacearum. – Tartu: Inst. Zool. Bot. Acad. Sci. R. P. S. S. Estoniae.

PATOUILLARD, N., 1899: Champignons de la Guadeloupe. – Bull. Soc. Mycol. France **15**: 191-209.

ROBERTS, P., 2000: Corticioid fungi from Korup National Park, Cameroon. – Kew Bull. **55**: 803-842.

SIMÕES, A. F. R., 2003: Mata do Buçaco. – [http://www.asterisco.com.pt/bucaco/circuitos/botanico3.html] – Visited 2003-09-01.

TELLERÍA, M. T. (ed.), 1993: Bases corológicas de Flora micológica Ibérica, números 250-375. – Cuad. Trab. Fl. Micol. Ibér. (Madrid) **6**: 1-180.

— MELO, I., 1997: An annotated list of the *Aphyllophorales* of the Balearic Islands. – Mycotaxon **65**: 353-377.

WAKEFIELD, E. M., 1915: On a collection of fungi from Australia and New Zealand. – Royal Bot. Gardens (Kew) Bull. Misc. Inform. **8**: 361-377.

WERESUB, L. K., 1953: Studies of Canadian *Thelephoraceae*. X. Some species of *Peniophora*, section *Tubuliferae*. – Canad. J. Bot. **31**: 760-778.

— 1961: Typification and synonymy of *Peniophora* species sect. *Tubuliferae* (*Corticiaceae*). – Canad. J. Bot. **39**: 1453-1495.