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FULL PAPER

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Taeniolella rudis and *Taeniolella longissima* sp. nov. with secondary sympodioconidia from freshwater habitats

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Abstract *Taeniolella rudis*, with secondary sympodioconidia, is illustrated and described and its taxonomic assignment evaluated. A second new species, *Taeniolella longissima*, is described and illustrated. The ecological role of these fungi in the colonization of wood in freshwater habitats is discussed.

Key words Aquatic mitosporic fungi · *Taeniolella* · Taxonomy · Water-cooling towers

Introduction

During our study of the deterioration of timber in water-cooling towers and in rivers, a fungus agreeing with the description of *Taeniolella rudis* (Sacc.) S. Hughes was frequently collected (Hughes 1980). This author also reported the remains of a penicillated branched head borne on the extension of terminal conidia, which was suspected to represent a synanamorph. Our collection differs from that of *T. rudis* in that a synanomorph with sympodioconidia was present, both on beech and on Scots pine wood test blocks exposed in water-cooling towers and in culture. Hughes (1980) has also reported such structures in two collections made in Canada, and a similar collection is known from China (P.M. Kirk, personal communication). Furthermore, a second *Taeniolella* species, with sympodioconidial measurements different from those of *T. rudis*, was also collected from the same habitat. We therefore illustrate and describe these two taxa and compare them to other related species.

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Materials and methods

Untreated sawn test blocks (free of bark) of *Fagus sylvatica* L., *Pinus sylvestris* L., and *Ocotea rodiaei* and treated test blocks of *P. sylvestris* exposed in various water-cooling towers were returned to the laboratory and examined for the occurrence of colonizing fungi. Material was further incubated in sterile plastic boxes as described by Eaton and Jones (1971a,b), and the wood was examined on a regular basis for developing fungi. Type material is deposited in Herbarium IMI and voucher slides are held at the University of Portsmouth by the senior author. Photographs of conidial stages were taken from material mounted in lactophenol.

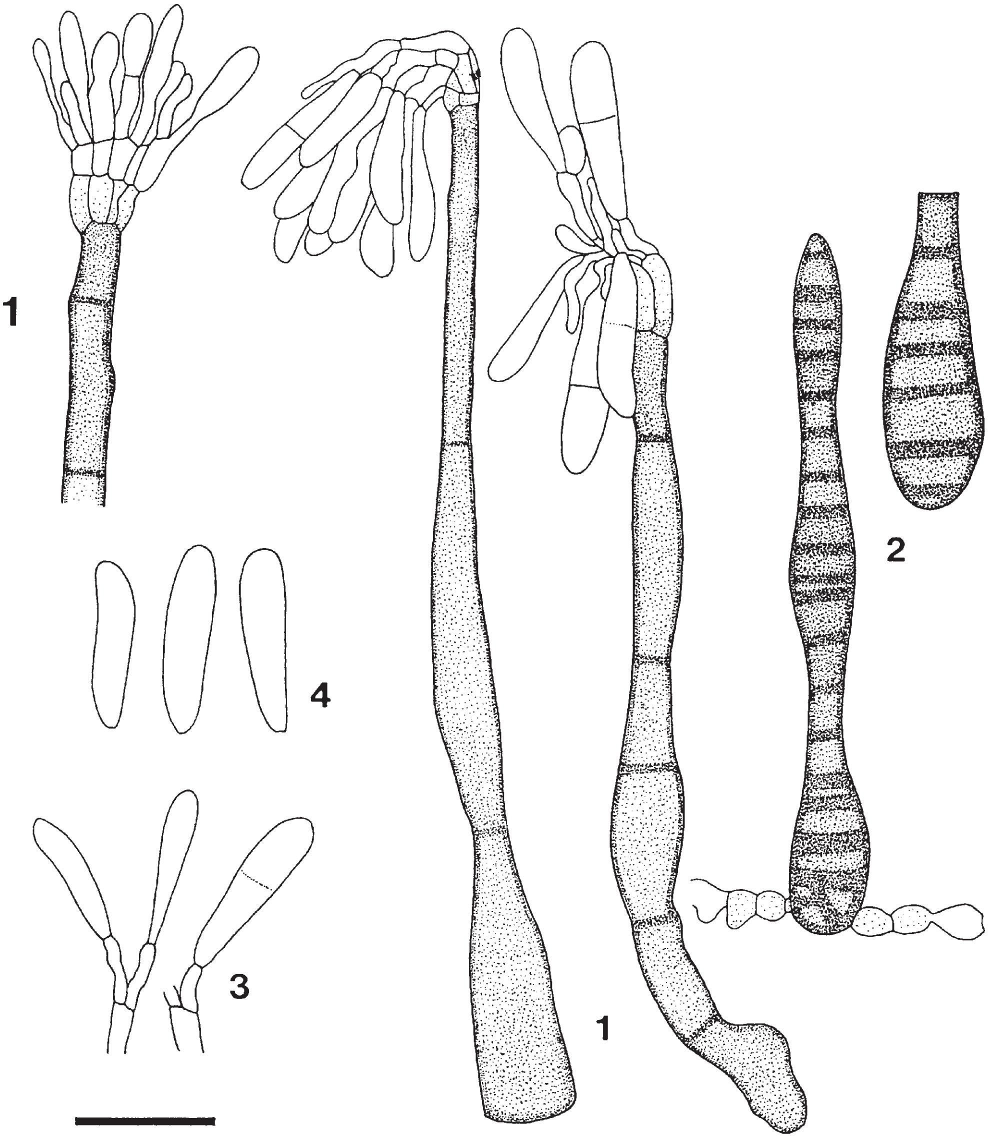
Taxonomic descriptions

Taeniolella rudis (Sacc.) S. Hughes

Figs. 1–4, 9, 10, 12, 13, 15

= *Septonema hormiscium* Sacc. (1882)

Taeniolella conidiophores appearing after incubation in damp chambers for 2–3 weeks (Jones 1971), erect, borne in groups on the wood surface, each attached by a bulbous base from which fine brown hyphae ramify into the wood. Acropetal chains of conidia are simple, 132–210 μm high, 4–4.5 μm in the constricted region, 9.5–10.5 μm in the swollen region, cylindrical with regular swellings, brown to black, septate, thick-walled, smooth, composed of 3–5 fusoid segments that become the macroconidia (Figs. 2, 9, 10). Macroconidia in a single, simple, acropetal chain, fusoid, up to 11-septate, dark brown, 42–59 × 4–10.5 μm (Figs. 1, 9). The terminal macroconidium becoming two to three times dichotomously branched at the tip to form hyaline "metullae" in a penicillate head and on which are borne the conidiogenous cells, 6–13 × 1.5–2 μm (n = 15) (Figs. 1, 3, 12, 13, 15, 19). Conidia, in a head, clavate to subnavicular, thin-walled, 2-septate (occasionally 3-septate), with a truncate base, 18–25 × 4–6.5 μm (n = 50) (Figs. 3, 4, 19).



Figs. 1–4. *Taeniolella rudis*. Line drawings. **1** Acropetal chains of macroconidia (not yet septate), penicillate heads, and developing conidia growing on wood. **2** Septate mature macroconidia. **3** Conidiogenous cells and secondary sympodioconidia. **4** Mature, hyaline, 1–2 septate conidia. Drawn from material on Scots pine test blocks. *Bars* 10 μm

Habit: saprobic on various timber species: on Scots pine test block exposed for 12 weeks in a water-cooling tower at Little Barford power station, England, January 24, 1962. IMI 386834.

Material examined: *Taeniolella rudis* (as *Septonema hormiscium*): IMI 31196 wooden planks (coniferous) on ground, Botany field station, Cambridge, S.J. Hughes, July 16, 1948; unidentified worked wood (a box). Tapton Elms, Taptonville Road, Sheffield, J. Webster, February 7, 1957; hardwood plank, Dungerren, Kent, B.C. Sutton & K. Pirozinsky, October 8, 1963, and many collections on timber in water-cooling towers (Ince, Cheshire, England, UK (Eaton 1972).

The description given above, with the exception of the penicillate heads, agrees with that of Hughes (1980) for *T. rudis*.

Penicillate heads, with secondary conidia aggregated into slimy heads, are reminiscent of *Sterigmatobotrys macrocarpa* (Corda) S. Hughes. However, it differs from *T. rudis* in lacking macroconidia; the conidiophores are longer, and the conidia are shorter. Both species grow on dead, decaying wood, and *S. macrocarpa* has been collected by us on timber slats in service and test blocks in water-cooling towers (Eaton and Jones 1971a,b; Eaton 1972).

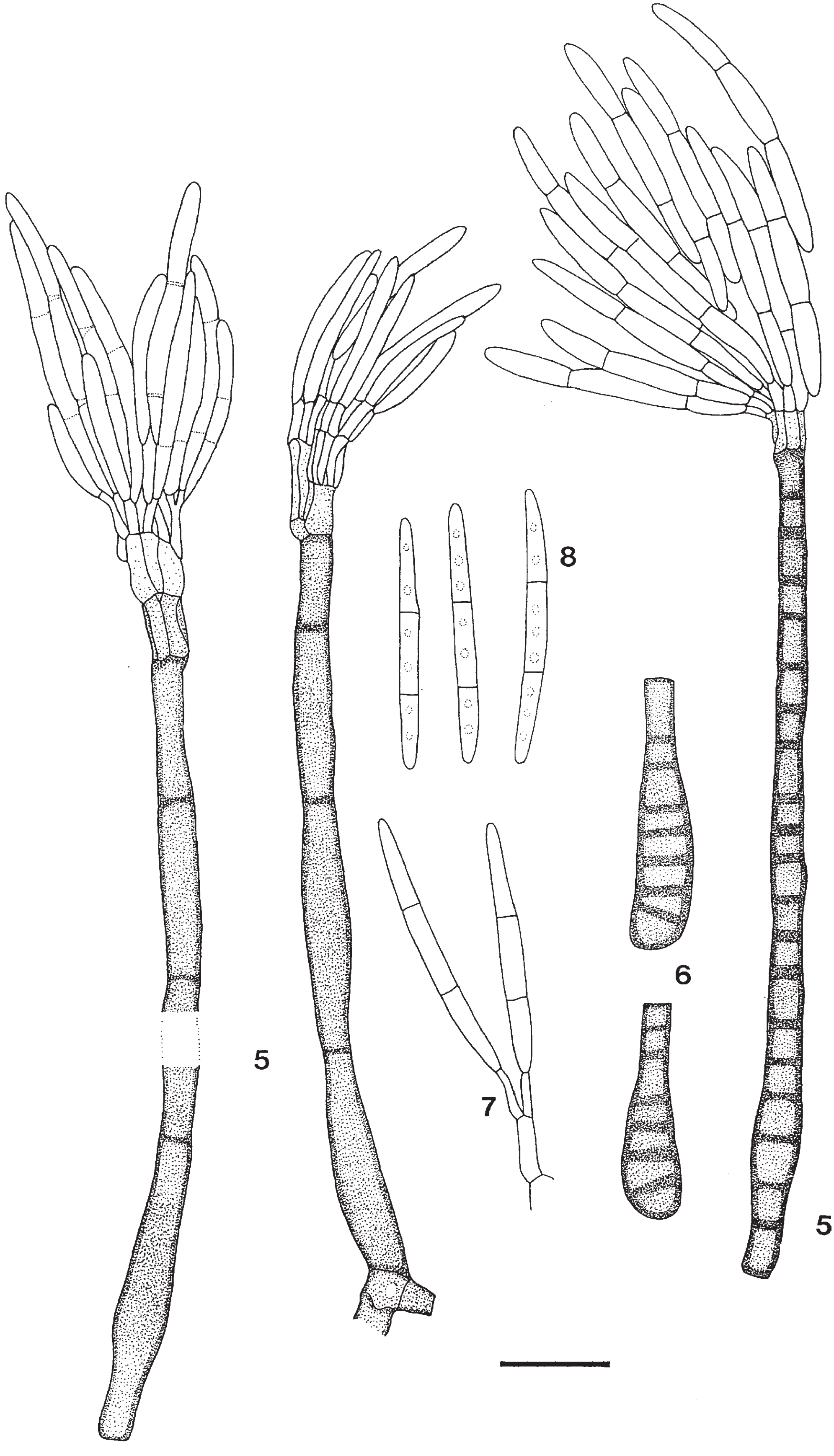
Hughes (1980) reported terminal branching structures on some conidia of *T. rudis* in DAOM Herbarium. Likewise, we also observed penicillate heads in collections made by Professor J. Webster and deposited as *S. hormiscium* in Herbarium IMI. Jones and Oliver (1964) reported *S. hormiscium* on test panels exposed in the River Tywi, South Wales; the macroconidia measured 37.5 × 10 μm (n = 25) with (3) 6–10 septa and conidiophores 72.5 × 9.5 μm (n = 25).

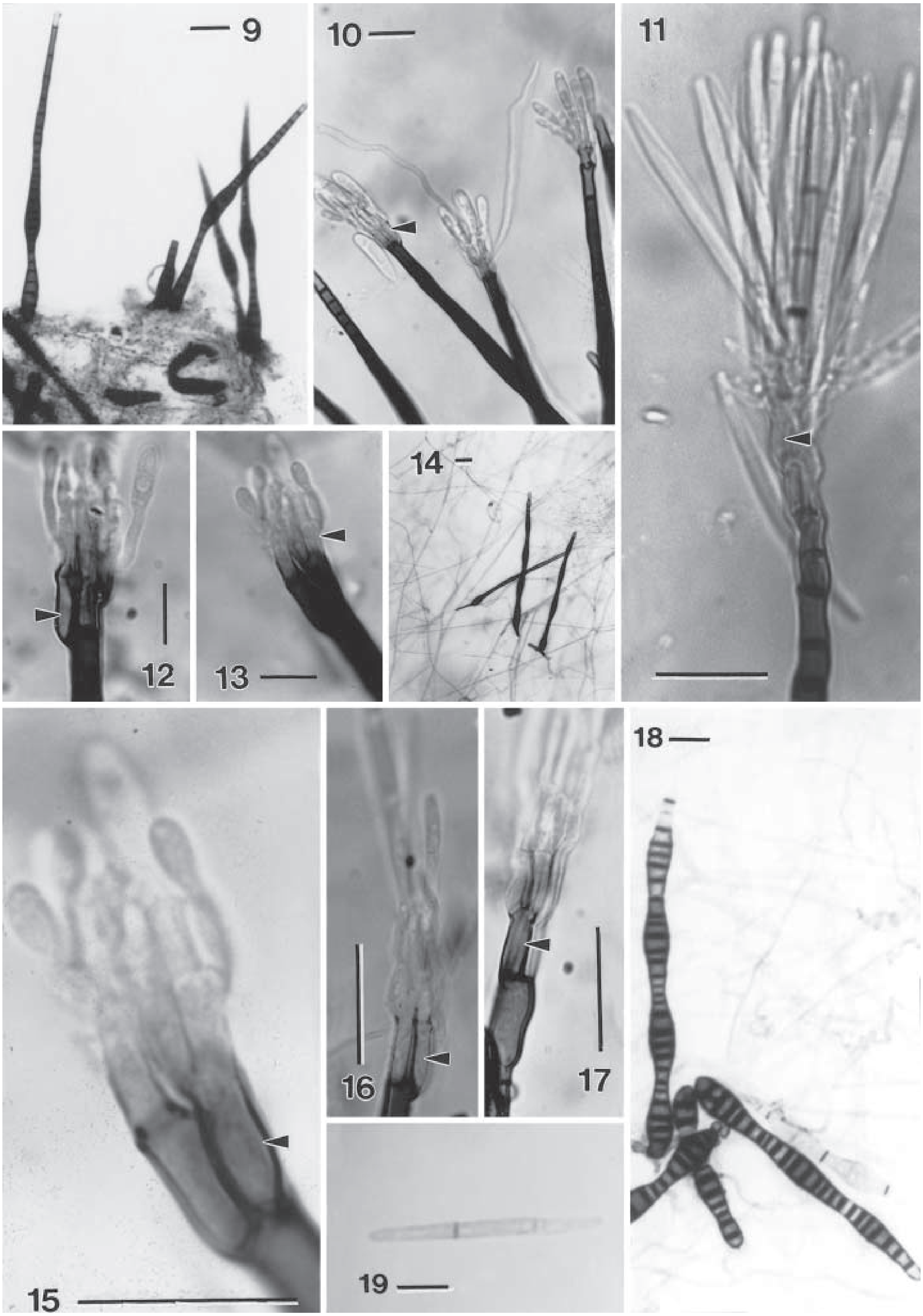
Taeniolella longissima R.A. Eaton & E.B.G. Jones, sp. nov. Figs. 5–8, 11, 14, 16–18

Entonym: *longissima* in reference to the longer conidia

Coloniae effusae, nigrae. Mycelium plerumque in substrato immersum. Conidia superficialia in ligno. Catenae acropetae 151–238 μm altae, 9–11.5 μm latae, ad septa

Figs. 5–8. *Taeniolella longissima.* Line drawings. **5** Chains of macroconidia before septa are formed, penicillate head, and conidia. **6** Septate dark brown mature macroconidia. **7** Conidiogenous cells. **8** Mature, hyaline, falcate 1–2 septate conidia. Drawn from material on Scots pine test blocks. *Bars* 10 μm





Figs. 9, 10, 12, 13, 15. Light photomicrographs of *Taeniollela rudis*. **9** Chains of macroconidia growing on wood. **10**, **12**, **13**, **15** Penicillate heads, with "metullae" (*arrowheads* in **10**, **12**, **13**, **15**), conidiogenous cells, and developing conidia

Figs. 11, 14, 16–19. Light photomicrographs of *Taeniolella longissima*. **11**, **16**, **17** Penicillate heads borne on the macroconidia with "metullae" (*arrowheads*) and elongate, hyaline, septate conidia. **18** Chains of acropetal mature macroconidia, dark brown and septate, growing on agar. **19** Hyaline falcate 2-septate conidium. **14**, **18** Material from a corn meal agar plate. All other photographs from material on Scots pine test blocks. *Bars* 10 μm

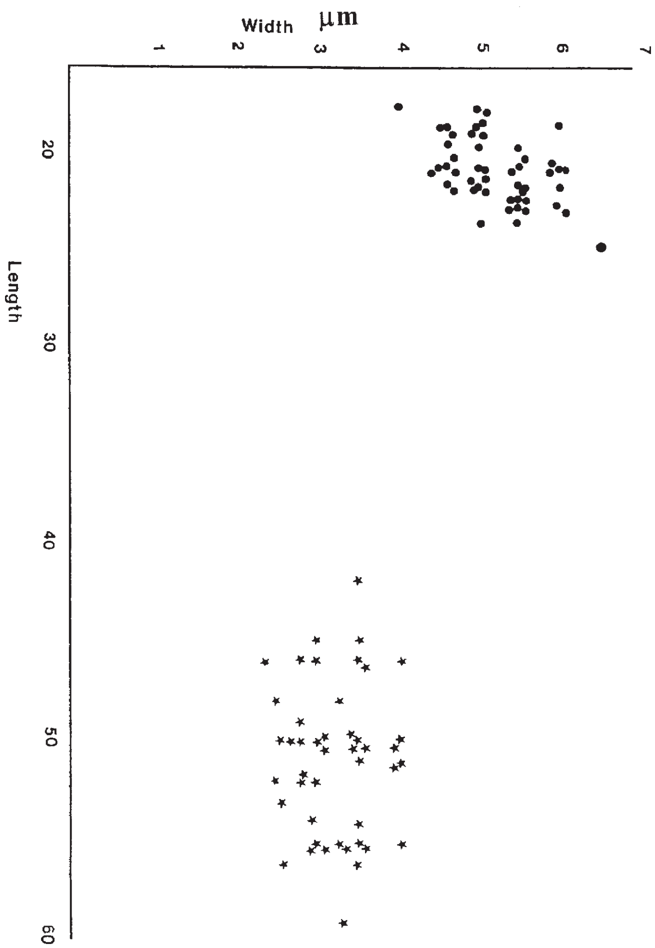


Fig. 20. Scatter diagram of the conidial measurements of *Taeniolella rudis* (*dots*) and *T. longissima* (*stars*)

4–4.5 µm latae, simplices, erectae, rectae vel curvatae, atro-brunneae, tenuitunicatae, ex 3–5 segmenti fusoideis compositae. Macroconidia 6–11-septata, atro-brunnea, 42–59 × 4.11.5 µm. Metullae, ad apicem macroconidii formantes, hyalinae, 9–11 µm longae. Cellulae conidiogenae, 20–32 × 2 µm. Conidia 42–60 × 2.5–4 µm, hyalina, falcata, fusiformia, apice rotundata, ad basim truncata, 2-septata, parietibus exilis laevibus praedita, in capitulum mucosum formantia.

Colonies on wood forming black shining patches. Acropetal chains of conidia 151–238 µm in length, 4–4.5 µm wide in the constricted region, 9–11.5 µm wide in the broadest region, simple, erect, straight or slightly curved, dark brown, thick-walled, smooth, composed of 3–5 fusoid segments (Figs. 5, 6, 14). Macroconidia initially aseptate, forming 3–5 fusoid segments but later becoming septate (Figs. 5, 14). Macroconidia borne in a single, simple, acropetal chain, fusoid, 6–11-septate, dark brown, 42–59 × 4–11.5 µm (n = 50). "Metullae" are produced at the tip of the macroconidia, hyaline, 9–11 µm long (Figs. 5, 7, 11, 16, 17). Conidiogenous cells subtended by the "metullae," 20–32 × 2 µm (n = 25) (Fig. 7). Conidia 42–60 × 2.5–4 µm, hyaline, falcate, fusiform, 2-septate, not constricted at the septa, thin-walled, smooth, apically rounded, basally truncate (Fig. 8), forming slimy heads when incubated in damp chambers.

Colonies (from *Taeniolella longissima* conidia) on corn meal agar growing slowly, dark gray to brown, forming dark brown chains of macroconidia (Fig. 14).

Habit: saprobic.

Holotype: on Scots pine test block exposed for 64 weeks in the pond of a water-cooling tower at Connah's Quay power station, North Wales, IMI 386835.

Collections examined: many collections on timber slats in service and test blocks from Connah's Quay, England, UK.

Data presented in Fig. 20 show that these two *Taeniolella* species can easily be distinguished by their conidial measurements and morphology as they separate into two distinct groups when the length/width dimensions are plotted. These differences are maintained when both species are grown in culture and allowed to sporulate.

We have examined collections of the following species of *Taeniolella: T. alata* (Ehrenb.) S. Hughes (DAOM 96751, JAMH 1343, I19155, 9026, 102332), *T. andropogon* Yadav & Lal. (IMI 100044), *T. exilis* (P. Karst.) S. Hughes (IMI 76361), *T. faginea* (Fuckel) S. Hughes, *T. multiplex* (Berk. & M.A. Curtis) S. Hughes (IMI 69758, 45318), *T. muricata* (Ellis. & Everh.) S. Hughes (IMI 109834, 109833), *T. plantaginis* (Corda) S. Hughes, *T. stilbospora* (Corda) S. Hughes (IMI 133623), and *T. subsessilis* (Ellis. & Everh.) S. Hughes (IMI 109869, 109870, 109871); none were shown to have produced sympodioconidia as found in *T. rudis* and *T. longissima*. However, type material of *T. exilis* did possess a penicillate head.

Ecological observations

Both species commonly occurred on test blocks exposed in water-cooling towers. *Taeniolella rudis* was common in a water-cooling tower at Ince electricity power station, where freshwater was circulating, whereas *T. longissma* was found only in water-cooling towers at Connah's Quay power station with brackish water circulating (Table 1). Both species appeared to be more common on Scots pine test blocks, even on pine test blocks treated with a copper chrome arsenic (CCA) wood preservative (Table 1). In an exposure test of Scots pine panels in 16 water-cooling towers around the United Kingdom, *T. rudis* was recorded most commonly, occurring at 7 sites including Ince, while *T. longissima* was present only at Darlington and Connah's Quay.

The wood decay ability of the two fungi was investigated (Eaton 1969). Monocultures were inoculated into autoclaved test jars containing either beech or Scots pine sapwood blocks (5 × 2.5 × 0.25 cm). The blocks were placed in damp Vermiculite, previously saturated with a mineral salts solution based on the Eggins and Pugh (1962) medium supplemented with glucose solution, incubated at 28°C for 15 weeks, and then oven dried at 85°C to constant weight. Decay was measured as mean percent (%) weight loss of

Table 1. Collections of *Taeniolella rudis* at Ince and *T. longissima* at Connah's Quay water-cooling towers from wood panels exposed for up to 48 weeks

Weeks[a]	Connah's Quay				Ince			
	Beech[b]	Scots pine[b]	Greenheart[b]	Treated pine	Beech	Scots pine	Greenheart	Treated Scots pine
6A	−	+	−	−	−	−	−	−
6B	+	+	−	−	−	+	−	−
12A	−	−	−	−	−	−	−	−
12B	−	+	−	−	−	+	−	−
18A	−	−	−	−	−	+	−	+
18B	−	−	−	−	−	+	−	−
24A	−	−	−	−	−	+	−	+
24B	−	−	−	−	−	+	−	−
30A	−	−	−	−	−	+	−	+
30B	−	+	+	−	−	+	−	−
36A	−	+	+	+	−	+	−	−
36B	−	+	−	−	−	+	−	−
42A	−	+	−	+	−	+	−	−
42B	−	−	−	−	−	−	−	−
48A	−	+	−	+	−	+	−	−

[a] A, test run from 24 Oct. 1962 to 14 Oct. 1963; B, test run from 6 July 1965 to 7 June 1966
[b] Beech, *Fagus sylvatica* L.; Scots pine, *Pinus sylvestris* L.; Greenheart, *Ocotea rodiaei*

replicate blocks, and the blocks were sectioned to determine the presence of soft rot decay cavities in the wood cell walls.

Taeniolella rudis gave minimal weight loss values of 2.8% and 2.4% in beech and Scots pine, respectively, but did exhibit soft rot decay cavities. *Taeniolella longissima* produced a weight loss of 4.5% attributed to soft rot attack in beech, but no weight loss or soft rot decay in Scots pine.

In the same experiment, two water-cooling tower isolates of *Chaetomium globosum* Kunze yielded weight losses due to soft rot decay of 27.8% and 33.5% in beech and 6.7% and 4% in Scots pine. These values not only confirm the low natural durability of beech against decay fungi when compared to Scots pine, but also highlight the weak soft rot ability of the *Taeniolella* isolates compared to other wood-inhabiting Ascomycota and mitosporic fungi isolated from timber in water-cooling towers.

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