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A REDESCRIPTION OF SOME GENERA WITH STAUROSPORES

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Three plant-inhabiting fungi with tetraradiate conidia, *Tricornispora bambusae* Bonar, *Fumagopsis triglifioides* Speg., and *Eriosporella calami* (Niessl) Höhn., the type species of monotypic genera, are redescribed and illustrated from type specimens. These genera are regarded as distinct. *Fumagopsis* is possibly closely related to *Kazulia* Nag Raj. Since the type specimen of *Tridentaria* Preuss did not bear a fungus which agreed with the very brief original description, the genus *Tridentaria* Preuss is regarded as doubtful. The nematode-trapping Hyphomycetes formerly placed in *Tridentaria* should be reclassified.

During a study of nematode-trapping fungi certain species of the genus *Tridentaria* Preuss were included. The identity of the type species, *T. alba* Preuss, could not be established with certainty because the fungus was no longer present on the type specimen (Berlin) and the original description (Preuss, 1852) was brief and not illustrated. In 1912 Grove added a second species, *T. setigera* Grove, an aquatic Hyphomycete later reclassified as *Tetracladium setigerum* (Grove) Ingold (1942). Drechsler (1937, 1940, 1961, 1964) added four rhizopod- and nematode-trapping staurosporic Hyphomycetes with solitary, simple, erect conidiophores borne diffusely on the hyphae and not forming sporodochia. Preuss (1852) described *T. alba* as forming acervuli on *Brassica oleracea* with oblong to clavate staurospores (tetraradiate). Drechsler classified his species on the basis of the staurospores. However, the nematode- and rhizopod-trapping species, *T. carnivora, T. glossopaga, T. implicans,* and *T. tylota*, are hyphomycetous and neither sporodochial nor coelomycetous.

Kendrick & Carmichael (1973) and Carmichael & al. (1980) placed the sporodochial genera *Tricornispora* Bonar and *Fumagopsis* Speg. in synonymy with *Tridentaria* but also accepted Drechsler's concept of the genus in that they endorsed it by an illustration of *T. carnivora*. The description given by Preuss could have referred to any number of plant pathogenic genera with acervuli or sporodochia and staurospores, e.g. *Eriosporella* Höhn., *Kazulia* Nag Raj, *Tricornispora, Fumagopsis* etc. These four genera are properly typified and can be regarded as distinct, our reasons being substantiated below. We refrain from regarding *Tridentaria* as synonymous with any one of these.

The type specimens of *Tricornispora, Fumagopsis* and *Eriosporella* were studied, *Kazulia* being well illustrated and described elsewhere (Nag Raj, 1977).

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Tricornispora bambusae Bonar — Figs. 1–4

Tricornispora bambusae Bonar in Mycologia 59: 597. 1967.

Conidiomata amphigenous, on or close to unripe stromata of *Phyllachora orbicula*, forming pale ochraceous, roundish or ellipsoidal leaf spots 5–10 mm in diam., usually strongly pulvinate, erumpent through the epidermis which soon widely opens with a slit, pale brownish to almost orange in colour, 200–800(–1000) × 200–600 µm in size. Basal tissue sometimes reduced to a limited number of hyaline, thin-walled, pseudoparenchymatous cells which fill the stomatal cavities and bear only a few conidiophores, but usually more extended, sporodochial or somewhat acervuloid, composed of a pulvinate mass of hyaline, pseudoparenchymatous, subglobose or prismatic, rather thin-walled cells, 4–12(–20) µm in diam., either free in the host plant tissue and in the basal part intermixed with damaged parenchyma cells, or rising from the stroma of *Phyllachora*, the lower cells being mixed with and difficult to distinguish from the cells of the host fungus. In the superficial region this tissue gradually organises into more or less parallel, sympodially elongating rows of cells, apically bearing the conidiogenous cells. These are short cylindrical, subglobose or pyriform, often hardly differentiated from the subtending rows of conidiophorous cells, 2.5–4.5 × 2.5–7(–10) µm. Conidiogenous cells monoblastic, rarely polyblastic. Conidia hyaline, tetraradiate, composed of a basal main axis, which is cylindrical or clavate, 0–1-septate, not or only slightly constricted at the septa, 9–12 × 4–4.5 µm, bearing 3 apical, rather stiff, elongate, obclavate, often curved arms, which are the broadest just below the middle and taper gradually to the apex, 1–3-septate, rarely somewhat constricted at the septa, (15–)40–75 × 3–4.5 µm in size.

Isotype specimen (UC 405186) on leaf of *Bambusa spinosa* Roxb. affected by *Phyllachora orbicula* Rehm, Zaragosa, Nueva Ecija Province, Luzon, Philippine Islands, coll. J. Clemens, 6 Feb. 1929.

On the leaves of *Bambusa* two types of fructification are seen: (i) epiphyllous, shining, dark blackish brown, usually elliptical, up to 1100 × 500 µm, stromata belonging to *Phyllachora orbicula*, surrounded by pale ochraceous to pale orange leaf tissue; (ii) the amphigenous, pale orange fructifications of the *Tricornispora* on a more extended, discoloured part of the leaf or on the stromata of *Phyllachora*. The development of the host fungus is therefore hindered such that ascomata fail to develop. Although the mycelium of the host fungus is distinguished from that of *Tricornispora* with difficulty, there is no experimental or theoretical reason to consider them genetically connected. Bonar (1967) considered the *Tricornispora* a close associate or parasite of *Phyllachora orbicula* and *Broomelia miakei* Hino & Katumoto. The latter was described as having a conidial state similar to *Tricornispora* (Hino & Katumoto, 1955) but Bonar (1967) re-examined the type collection and pointed out that this fungus was no more than a parasite in the stromata of *Broomella miakei*. Anamorphs of *Phyllachora* have been reported in several coelomycetous genera but these are all very different from *Tricornispora* and, moreover, their phylogenetic connection with the *Phyllachora* species concerned is still doubtful or disproved. Many species of *Phyllachora* (including *P. orbicula*) certainly have spermatial states usually classified as *Linochora* Höhn., a genus with scolecosporous or bacilloid spermatia quite different from the staurospores of *Tricornispora* (von Arx & Müller, 1954; Parbery & Langdon, 1963; Parbery, 1967; Kamat & al., 1978). Anamorphs of *Broomella* are found in the coelomycetous genus *Pestalotia* s.l.

(Shoemaker & Müller, 1963). Our observations agree with those of Bonar who stated that the fungus might be a parasite of the mycelium of the *Phyllachora* within the host plant tissue.

Tricornispora bambusae does not fit the description of *Tridentaria alba* Preuss in that it was hyperparasitic and the colonies were not white and spreading. The conidial arms of *T. bambusae* were clavate, rather than elongate obclavate, and much tapered. A species with comparable conidia is *Triglyphium bambusae* A.K. Roy (Roy, 1968), the 3, seldom 4 conidial arms being shorter than those of *Tricornispora bambusae*. The species may differ in that the conidiomata on leaves of *Bambusa tulda* are completely superficial, subglobose or hemispherical. Material of this species could not be obtained. *Triglyphium* Fres. (1852) itself is a doubtful genus. Of the type species, *Tr. album* Fres., no material is in existence; this and a second species, *Tr. niveum* Massee (no material in CMI), are also sporodochial and have tetraradiate conidia with much shorter conidial arms than those of *Tricornispora bambusae*. *Zelopelta* Sutton & Gaur (1984) has conidia similar to or slightly smaller than those of *T. bambusae*, but quite different scutate (pycnothyrial) conidiomata.

Fumagopsis triglifioides Speg.—Figs. 5–6

Fumagopsis triglifioides Speg. in An. Mus. nac. B. Aires, ser. 3, 20: 464. 1910.

Mycelium superficial, forming an extended greyish-blackish network, indefinite in shape, 4–20 μm thick, composed of repeatedly branched, thin-walled, greyish brown, septate hyphae, strongly constricted at the septa, 3–5(–10) μm in diam., gradually changing into a pellicle of more compact prosenchyma close to the conidiomata. Setae borne on the hyphae, dark brown, thick-walled, aseptate, with a tapering (or pointed) tip on a broad or forked base, 3–6 μm wide, but up to 20 μm wide at the base, more than 200 μm long (almost all setae were broken in the specimen examined). Conidiomata sporodochial, hemispherical, 150–180(–200) μm in diam., 40–70(–85) μm high, prosenchymatous in the basal layers, pseudoparenchymatous in the middle and superficial layers, composed of greyish brown, irregularly shaped cells, 4–10(–15) μm in size. Setae erect, rising from the middle of the sporodochia, similar in shape and size to those of the pellicle. Conidiogenous cells discrete, directly on the superficial cells of the sporodochia, ampulliform, hyaline or faintly olivaceous near the conidiogenous locus, 4–10 × 5–8 μm in size, holoblastic. Conidia hyaline, tetraradiate, composed of a main axis which is subcylindrical or clavate 0–1-septate, not constricted at the septa, 10–18 × 2.0–2.8 μm, bearing 2 or 3 apical branches with 1–2 (rarely 3) septa, strongly constricted at the first septum, not constricted at the second septum, (12–)20–24 × 2.0–2.5 μm.

Holotype specimen (LPS) on *Lucuma neriifolia*, Argentina, La Plata, Isla Santiago, coll. C. Spegazzini, 14 Nov. 1909.

There are some deviations from the original description: the conidiogenous cells were described as filiform, 20–30 × 1.5–2 μm, but such structures could not be observed. The short ampulliform conidiogenous cells rise directly from the rather compact pseudoparenchymatous tissue of the conidiomata. Since it is this character which mainly distinguishes *Fumagopsis* from *Kazulia* Nag Raj (1977), the latter genus may be a more devel-

oped stage of *Fumagopsis*, although the conidia of *Kazulia* also have longer branches with more septa. In addition the structure of the superficial stroma of *Kazulia* does not differentiate this genus from *Fumagopsis*. Another difference might be the septation of the setae in *Kazulia*, but the setae in the type specimen of *Fumagopsis* were broken. Spegazzini also described and figured conidia with 3-septate branches; we observed only one such branch, some 2-septate and many 0–1-septate (developing) branches, another reason to suppose that the genus *Fumagopsis* is based on an unripe collection. We refrain from merging the genera until fresh material becomes available. Both genera mentioned differ from *Tricornispora* in the completely superficial growth and in the setose sporodochia; there is no doubt that they differ at the generic level. *Phalangispora* Nawawi & Webster (1982) mainly differs from all three genera in the branching pattern of the conidia and the polyblastic conidiogenesis.

In placing *Fumagopsis* and *Tricornispora* in synonymy with *Tridentaria* sensu Drechsler, Kendrick & Carmichael (1973) apparently stressed the similarity of the conidia but paid less regard to the different characters of the conidiogenous cells and conidiomata. *Tridentaria* sensu Drechsler is a well-defined genus which differs both morphologically and ecologically from the type species of *Tricornispora* and *Fumagopsis*.

Eriosporella calami (Niessl) Höhn.—Figs. 7–9

Eriosporella calami (Niessl) Höhn. in Sber. Akad. Wiss. Wien 125: 109. 1916 — *Cryptosporium calami* Niessl in Hedwigia 17: 176. 1878. *Pseuderiospora castanopsidis* Keissler in Anz. Akad. Wiss. Wien 60: 75. 1923.

Conidiomata developing intraepidermally, flat or lens-shaped, rupturing the upper layers of the multilayered epidermis, remnants of which wear away over the old fruit-bodies, resulting in completely open, disciform, whitish acervuli. Basal stroma 2–5 cells thick and composed of isodiametrical, thin-walled, hyaline cells, 3–6 μm in diam., near the edges of the conidiomata slightly larger and up to 12 μm in diam., remaining attached to the epidermal remnants. Conidiophores rising from the basal tissue, hyaline, short-cylindrical or elongated, occasionally sympodially branched, 10–15(–17) × 1.5.–3 μm, but sometimes much reduced so that the conidiogenous cells develop directly from the basal tissue. Conidiogenous cells subglobose, short-conical or cylindrical, phialidic with a minute thickening inside the apical pore, 2.5–7 × 2.5–4 μm. Conidia tetraradiate, composed of a main axis which is cylindrical, truncate at the base with a small marginal cellular appendage, 0–1-septate, hyaline, 9–12(–15) × 1.5–2.3 μm, bearing apically 3 diverging, rather slender and flexuous hyaline arms, 3–4(–5)-septate, tapering to the tips, 40–65 × 1.8–2.2 μm.

Isotype specimen (CBS H–3306) Rabenhorst Fungi europ. exsicc. Klotzii herbarii vivi mycol. Ed. 3, 245a, on dead leaves of *Calamus*, Calcutta, India, collected by S. Kurz.

Eriosporella was redescribed by Sutton (1980) from another part of the type collection. His description agrees with our observations except in that he did not refer to the typical cellular appendages of the basal cell of the conidium. The appendage is not seen in all the conidia as it often breaks off, leaving only a remnant of the very slender appendage attached to the conidiogenous locus. The appendage is seen more frequently on

conidia with non-septate main axes, than on conidia with a 1-septate main axis. Nag Raj & DiCosmo (1981) noted the appendage but described the conidiogenous cells as 'annelides.....with up to three annellations'. However, we were able to confirm the observations made by Sutton (1980) who regarded the conidiogenous process as phialidic.

The synonymy of *Pseuderiospora castanopsidis* Keissler is not very clear from the original description (Keissler, 1923; presented again as 'nov. spec.' in 1937), but Sutton (1977) based the synonymy on a study of the type specimen.

The fungus is different from *Tridentaria, Tricornispora, Fumagopsis* and *Kazulia* in the melanconeacious way of growth and the short appendages and long and slender branches of the conidia.

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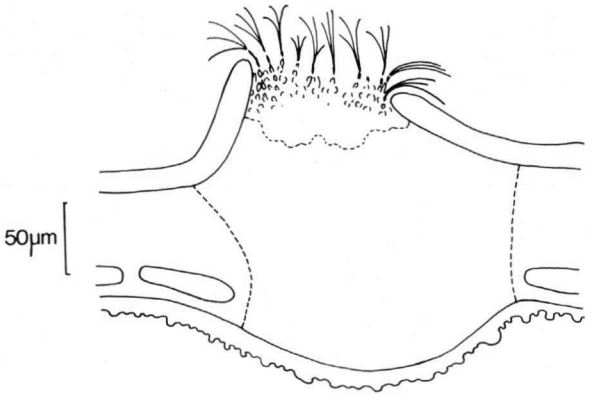

Fig. 1. *Tricornispora bambusae.* — Showing the position of a conidioma on a stroma of *Phyllachora orbicula* (from type specimen UC 405186).

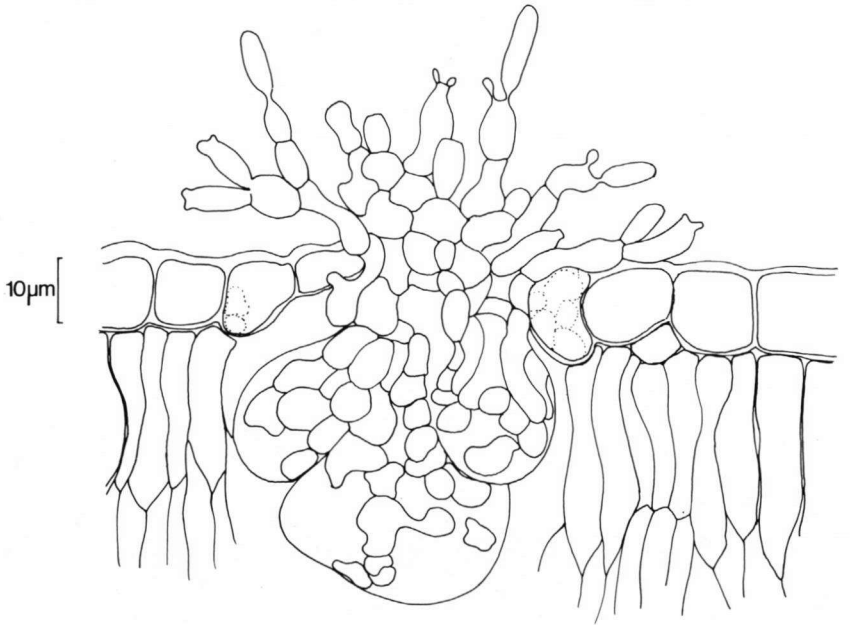

Fig. 2. *Tricornispora bambusae.* — Early development of conidioma in stomatal cavity of *Bambusa spinosa* leaf.

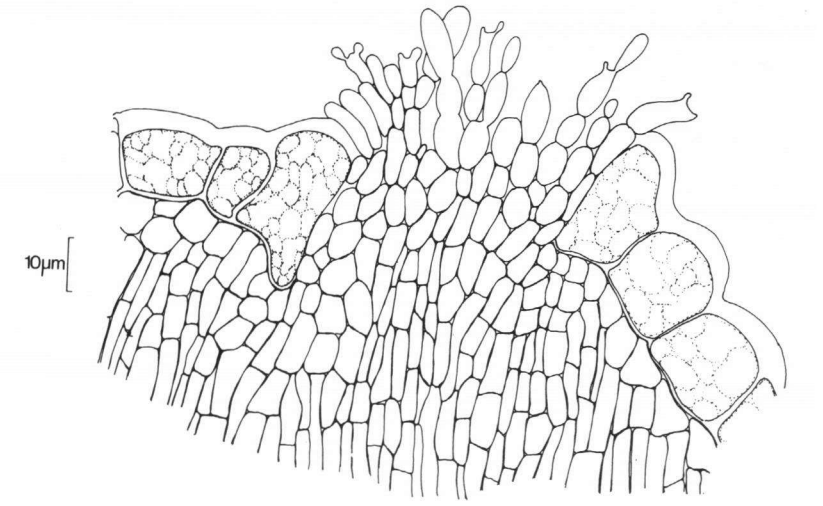

Fig. 3. *Tricornispora bambusae.* — Conidioma developing on stroma of *Phyllachora orbicula.*

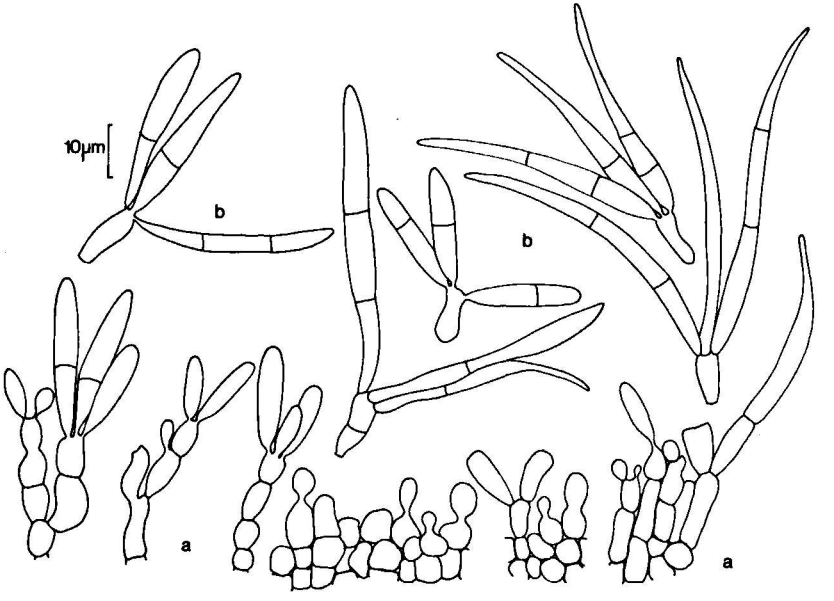

Fig. 4. *Tricornispora bambusae.* — a. Conidiogenous cells and conidial development. — b. Conidia after secession.

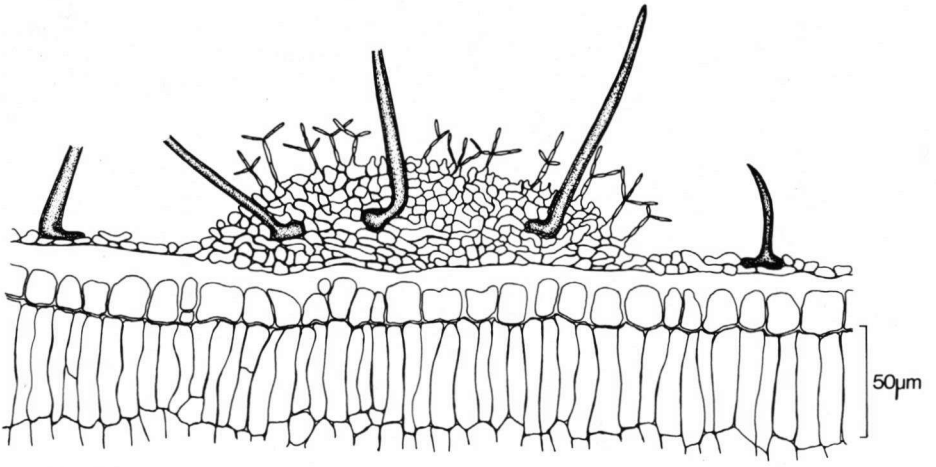

Fig. 5. *Fumagopsis triglifioides.* — Setose conidioma and pellicle (from type specimen LPS).

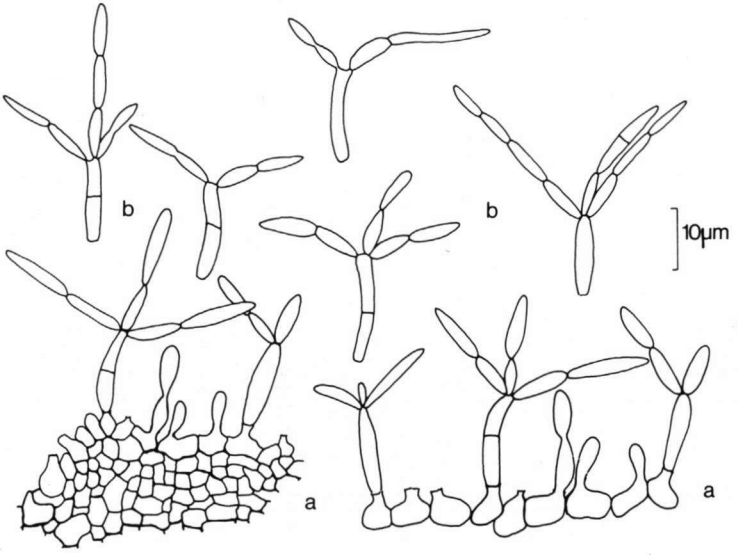

Fig. 6. *Fumagopsis triglifioides.* — a. Conidiogenous cells and conidial development. — b. Conidia.

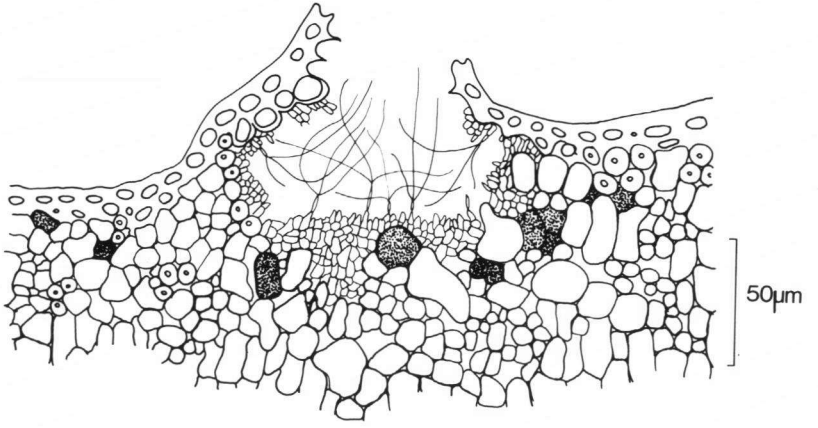

Fig. 7. *Eriosporella calami.* — Vertical section of conidioma (from isotype specimen CBS).

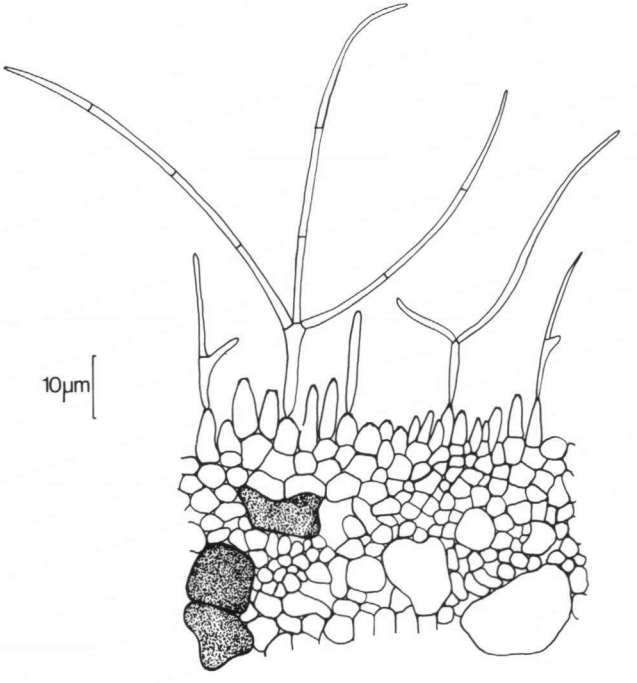

Fig. 8. *Eriosporella calami.* — Conidiogenous cells and conidial development.

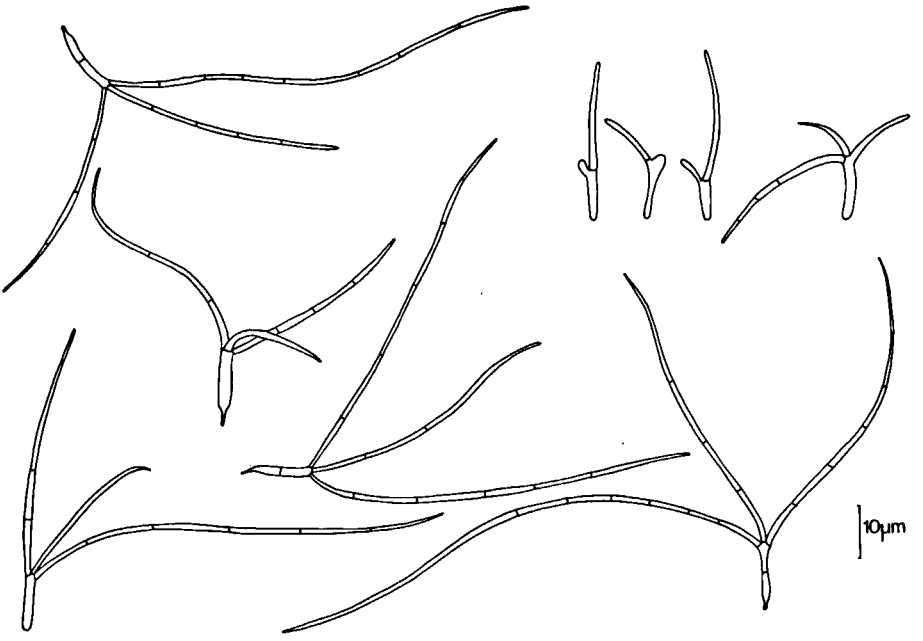

Fig. 9. *Eriosporella calami.* — Young conidia and conidia after secession.