Microfungi associated with *Podocarpus* leaf litter in South Africa

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Nine microfungi are listed from leaf litter of *Podocarpus* spp. New species include *Chaetopsina mellitolunae* Crous & Seifert, *Rhinotrichella elegans* R.F. Castañeda & Crous, *Parasympodiella podocarpi* Crous & Seifert, *Guignardia podocarpi* Crous and its probable anamorph *Phyllosticta podocarpi* Crous. A key is provided to distinguish the accepted species of *Parasympodiella. Gyrothrix verticiclada* (Goid.) S. Hughes & Piroz., which was found to be morphologically variable, is discussed in detail. New records for South Africa include *Camposporium antennatum* Harkn., *Dactylaria irregularis* de Hoog, *Endophragmiella boewei* (J.L. Crane) S. Hughes, and *Phaeoisaria clematidis* (Fuckel) S. Hughes.

Keywords: Foliicolous fungi, *Chaetopsina mellitolunae, Guignardia podocarpi, Parasympodiella podocarpi, Phyllosticta podocarpi, Rhinotrichella elegans, Podocarpus*, taxonomy, new species.

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Introduction

The foliicolous microfungi occurring on woody hosts in South Africa have been poorly studied. However, progress has been made on fungi occurring on genera such as *Eucalyptus* L'Hérit. and *Syzygium* Gaertn. in the Myrtaceae (Crous 1993; Crous & van der Linde 1993; Crous *et al.* 1995). On *Podocarpus* L'Hérit. ex Pers. species, which are endemic to South Africa, only a few foliar fungi have been recorded (Doidge 1950).

The aim of the present study was to collect leaf litter of the various *Podocarpus* spp. at Kirstenbosch and Stellenbosch botanical gardens, as well as from Knysna, where these trees occur in their natural environment. Three species were commonly encountered, namely *P. henkelii* Stapf ex Dallim. & Jacks., *P. elongatus* (Ait.) L'Hérit. ex Pers. and *P. latifolius* (Thunb.) R. Br. ex Mirb. Of these, leaf litter of *P. henkelii* proved to have hardly any microfungi, whereas litter of the other two were particularly rewarding. Several of the fungi isolated proved to be new records for South Africa, or apparently undescribed taxa. Four new species are described, and five listed as new records. Several fungi correlating closely with their original descriptions are merely listed, while other more variable taxa are discussed in detail.

Materials and Methods

Leaf litter samples were incubated in Petri dish moist chambers at 25°C on the laboratory bench, and examined at regular intervals for the presence of microfungi. Single-conidial isolates were made on 2% malt extract agar (MEA) (Oxoid), and plated onto fresh MEA and carnation-leaf agar (CLA) (Crous *et al.* 1992) plates, incubated at 25°C under near-ultraviolet light, and examined. Cardinal temperature requirements for growth were determined after 8 days at 5–35°C in 5° intervals, with three replicate plates per temperature. The experiment was repeated once. Mounts were prepared in lactophenol, and measurements were made at 1 000× magnification. Averages were derived from at least 30 observations, and the range is given in parentheses. Unless otherwise noted, all microscopic structures are hyaline with smooth, thin walls. Descriptions are based on living material from the natural substrata unless otherwise noted.

Taxonomy

Chaetopsina mellitolunae *Crous & Seifert* sp. nov. (Figure 1)

Mycelium consistens in hyphis ramosis septates in vitro, 1.5–2.5 µm diam. Conidiophora setiformia, recta, parietibus crassis (basi usque ad 2 µm), apicem versus verrucosa, 8–16-septata, 180–360 µm longa, 3–4 µm lata ad septum subapicale, 6–10 µm lata ad septum basale, lutea, pallidiora vel hyalina supra regionem conidiogerem, 2–6 aggregata in stroma cellularum brunnearum; apicibus saepe fertilibus in vitro. Cellulae conidiogerae monophialidicae, rare polyphialidicae in vitro, ampulliformes, 8–13 × 3–4 µm, collis inconspicuis divergentibus vel cylindricis usque ad 2 µm longis; saepe in hyphis in vitro dispositae. Conidia non-septate, cylindrica, recta, in apice obtusa vel acuta, basim obtusa hilo parvo complanato, (11–)14(–17) × (1.5–)2(–3) µm, in massis mucosis aggregata.

Mycelium consisting of branched, septate, hyphae *in vitro*, 1.5–2.5 µm diam. Conidiophores setiform, straight, thick-walled (up to 2 µm at base), becoming verrucose at apex, 8–16-septate, 180–360 µm long, 3–4 µm wide at subapical septum, 6–10 µm wide at basal septum, yellow, becoming pale yellow to hyaline above conidiogenous region; most conidiophores with equivalent, appressed lateral branches near the mid-point, which sometimes branch again, giving rise to phialidic conidiogenous cells directly, or to branches that are cylindrical, ellipsoidal or globose and 4–6 µm long; conidiophores aggregated in groups of 2–6 on a stroma of brown cells on CLA; conidiophore apices frequently becoming fertile *in vitro*. Conidiogenous cells monophialidic, rarely polyphialidic *in vitro*, ampulliform; 8–13 × 3–4 µm, collarettes inconspicuous, divergent or cylindrical, up to 2 µm long; occurring singly, in pairs or whorls on branches, sometimes singly at the apex of the setae, or directly on mycelial hyphae *in vitro*. Conidia non-septate, cylindrical, straight, with apex obtuse to slightly acute, base obtuse with a small flattened hilum, (11–)14(–17) × (1.5–)2(–3) µm on CLA, aggregated in slimy masses.

Colonies on MEA attain a radius of 8–9 mm after 8 days at 20°C in the dark. Cultures are shiny with sparse aerial mycelium; initially white, turning orange. Cardinal temperatures for growth are minimum: above 5°C, optimum: 20°C, and maximum: below 35°C.

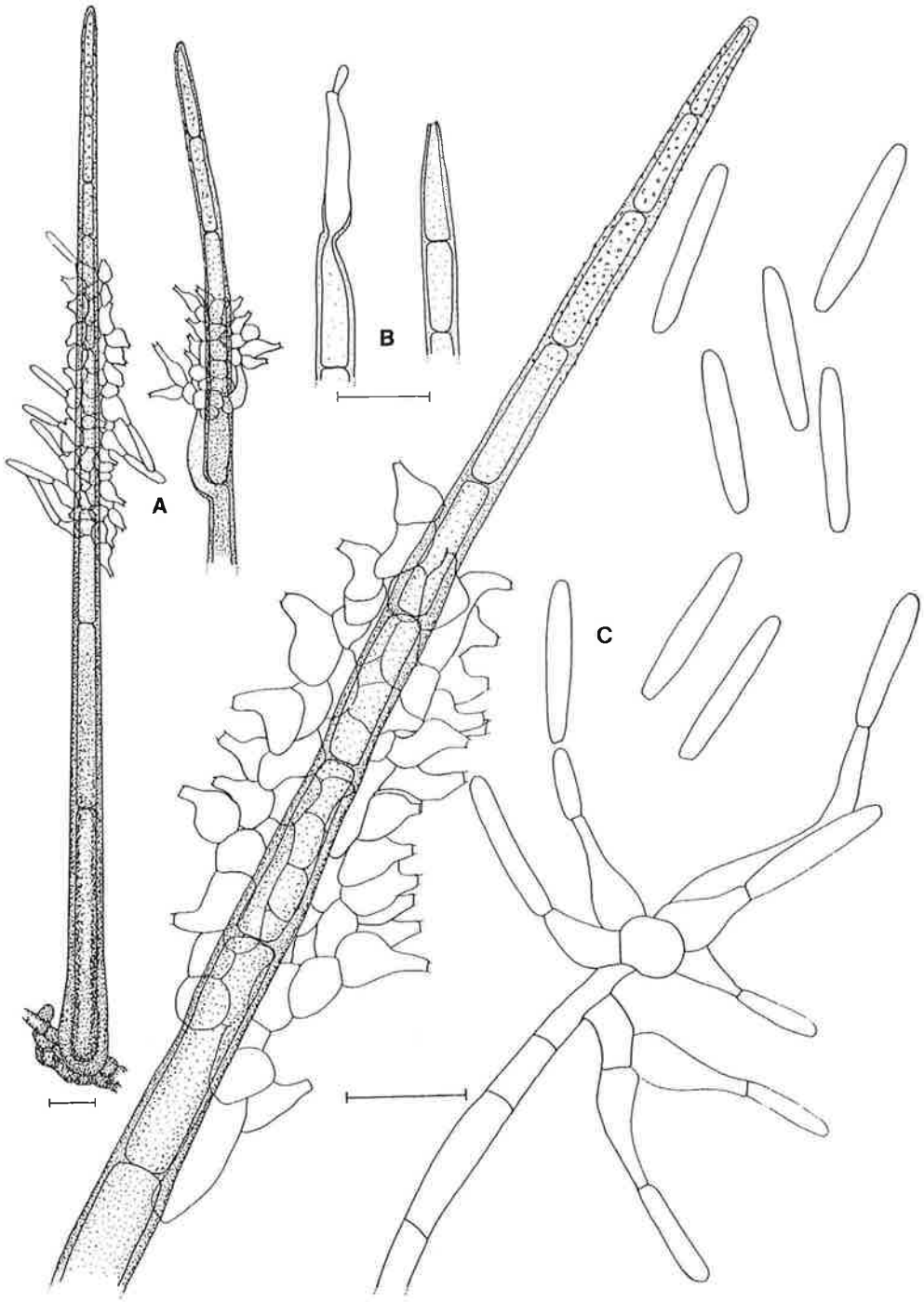


Figure 1 *Chaetopsina mellitolunae* (PREM 51901). A. Conidiophores *in vivo*. B. Setal apices becoming fertile *in vitro*. C. Conidia and conidiogenous cells on a conidiophore and hypha *in vitro* (bar = 10 μm).

Specimen examined: Southern Cape, Knysna, 'big tree', *Podocarpus elongatus* leaf litter, P.W. Crous & J.M. Crous, 9 Jan. 1995, PREM 51901 (holotype), DAOM 221070, culture STE-U 891.

Chaetopsina mellitolunae is morphologically similar to *C. nimbae* Ant. Rambelli, which was described from *Lophira alata* Banks ex Gaertn. collected in south-western Africa (Merli *et al.* 1992). The present collection closely matched the original description in its yellow conidiophores and conidial dimensions. An examination of the type specimen (ROBB 138 A) proved *C. nimbae* to be distinct from our collection. Conidiophores of *C. mellitolunae* are generally straight, not curved, and the conidiogenous cells are not restricted to only one side of the conidiophore. Furthermore, the conidiophores are lighter in colour and taper to more bluntly rounded apices, whereas those of *C. nimbae* are yellow-brown (*in vivo*), and have more acute apices. Phialides and conidiophore branches are also slightly larger, and cultures are generally lighter in colour on potato-dextrose agar than reported for *C. nimbae*. Conidiogenous cells are either mono- or polyphiahdic, and in culture on CLA some setal conidiophores have fertile setal apices, as reported for *C. fulva* Ant. Rambelli by Merli *et al.* (1992).

Guignardia podocarpi *Crous* sp. nov. (Figure 2)

Mycelium immersum, consistens in hyphis septatis, ramosis, laevibus, mediobrunneis, 5–8 μm diam. Ascocarpi sparsi, immerse, sub-

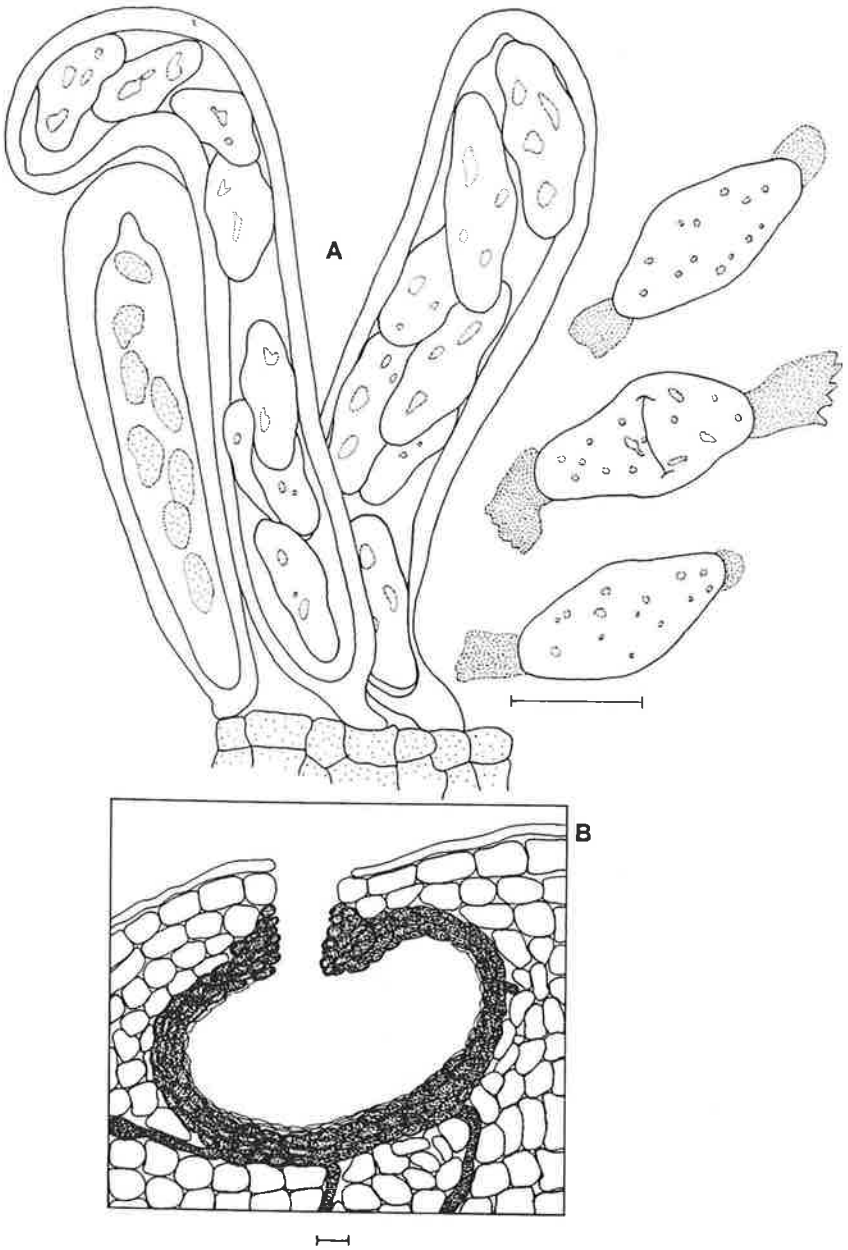


Figure 2 *Guignardia podocarpi* (PREM 51902). A. Bitunicate asci and guttulate ascospores with mucous caps. The horizontal line in the second ascospore is a fold in the exterior cell wall, presumably induced during slide preparation. B. Vertical section through a pseudothecium (bars = 10 μm).

globosi, usque ad 200 μm diam. et 150 μm alti, inter pycnidia, atrobrunnei, solitarii, uniloculares, collo prominenti; parietes 3–6 cellulis crassis, ex textura angulare medio vel atro brunnea, 10–20 × 5–6 μm. Asci clavati vel cylindrici, bitunicati, 8-spori, 60–85 × 14–18 μm. Ascosporae hyalinae, guttulatae, unicellulares, (19–)20(–23) × (7–)8(–9) μm, fusiformes vel ellipsoideae, latiores in mediano, in apice obtusae appendice gelatina exhibentes.

Mycelium immersed, consisting of septate, branched, medium-brown hyphae, 5–8 μm diam. Ascocarps sparse, immersed, subepidermal, subglobose, up to 200 μm diam. and 150 μm in height, intermixed amongst pycnidia, dark brown, solitary, uni-locular with a prominent neck; wall consisting of 3–6 layers of *textura angularis*, cells 10–20 × 5–6 mm, medium to dark brown. Asci clavate to cylindrical bitunicate, 8-spored, 60–85 × 14–18 μm. Ascospores evenly distributed in asci, hyaline, guttulate, unicellular, (19–)20(–23) × (7–)8(–9) μm, fusiform-ellipsoidal, wider in middle, guttulate, ends obtuse with polar gelatinous appendages.

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, Jun. 1994, PREM 51902 (holotype).

As far as we could establish, no taxa of this group have been described from *Podocarpus*. Pseudothecia of *G. podocarpi* occurred on several leaves in close association with pycnidial conidiomata of a *Phyllosticta* species and a *Leptodothiorella* Höhn. microconidial synanamorph. In his review of the genus, van der Aa (1973) accepted that different *Phyllosticta* species are generally associated with different hosts. As *Phyllosticta* spp. are well established anamorphs of *Guignardia* (Bissett 1986a, 1986b), this species is subsequently described below as the suspected anamorph of *G. podocarpi.*

Phyllosticta podocarpi *Crous* sp. nov.(Figure 3)

Conidiomata pycnidialia, dispersa, immersa, subepidermalia, erumpescentia, subglobosa, solitaria, unilocularia, usque ad 60 μm diam.,

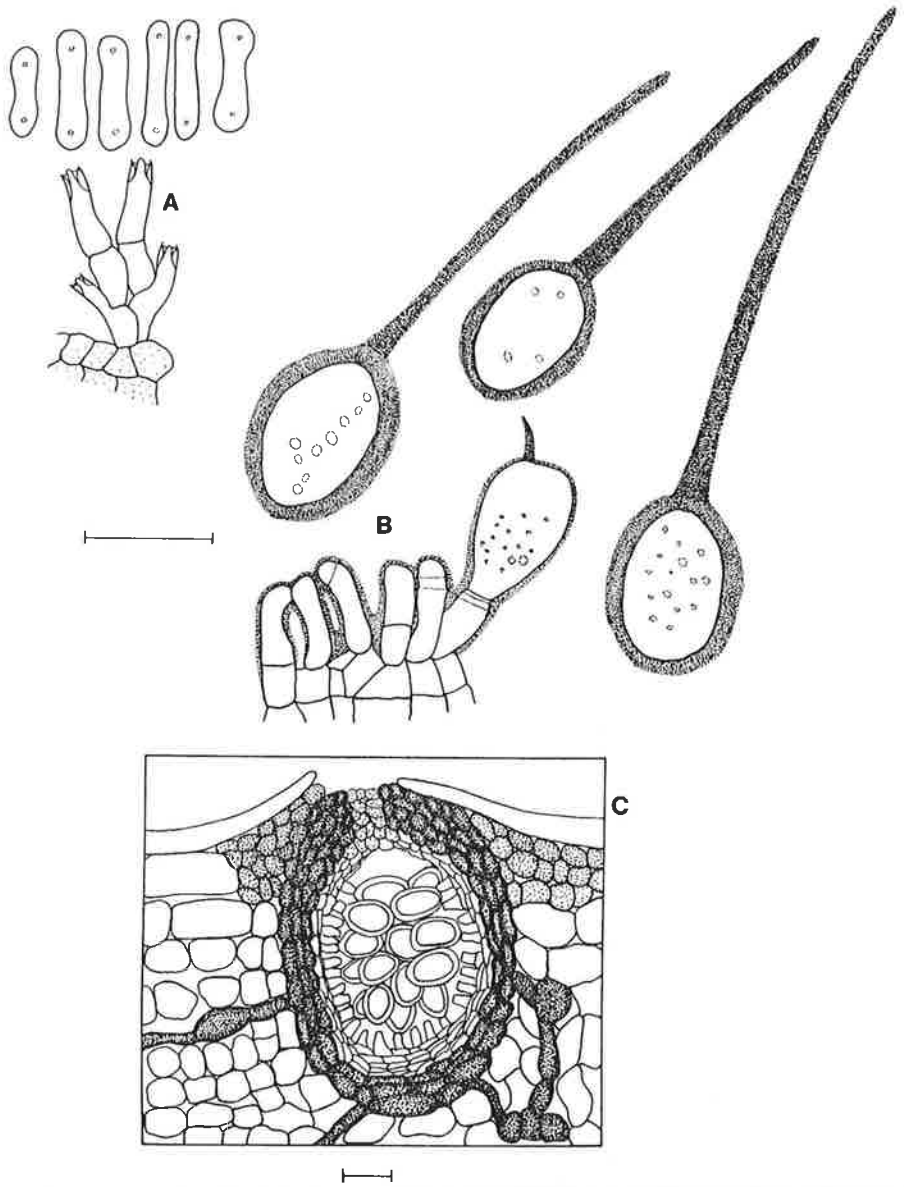


Figure 3 *Phyllosticta podocarpi* (PREM 51903). A. Microconidia and conidiophores. B. Macroconidia and conidiogenous cells. C. Vertical section through a conidioma (bars = 10 μm).

90 μm alta; paries consistens in 3–4 stratis cellularum brunnearum texturae angularis et strato interiore cellularum hyalinarum complanatarum. Cellulae conidiogerae cylindricae, 7–12 × 3–5 μm proliferationibus 1–3 inconspicuis percurrentibus ad apicem. Conidia unicellularia, guttulata, late ellipsoidea vel subglobosa, (10–)14(–17) × (8–)9(–10) μm tegmentis mucosis persistentibus ca. 1 μm crasses; appendicibus apicalibus 10–40 μm longis, base ca. 1.5–2 μm diam., acuta obtusa. Microconidia expulsa in cirris albis ex conidiomatis immersis subepidermalibus pycnidialibus. Microconidiophora ramosa, 0–2-septata, 10–25 × 3–4 μm. Cellulae microconidiogenae cylindricae, prominenter crassae periclinaliter, 7–11 × 3–3.5 μm. Microconidia bacillaria apicibus obtusis tumidis, unicellularia, (6–)10(–11) × (2–)2.5(–3) μm.

Conidiomata pycnidial, scattered, immersed, subepidermal, becoming erumpent, subglobose, solitary, unilocular, up to 60 μm diam, and 90 μm high; wall composed of 3–4 layers of brown cells of *textura angularis*, 7–20 × 4–7 μm, and an inner layer of flattened cells. Conidiogenous cells cylindrical, 7–12 × 3–5 μm, with 1–3 inconspicuous percurrent proliferations at the apex. Conidia unicellular, guttulate, broadly ellipsoidal to subglobose, (10–)14(–17) × (8–)9(–10) μm with persistent mucous coats, *ca.* 1 μm thick; apical appendages 10–40 μm long, *ca.* 1.5–2 μm diam. at the base, tapering to an acutely rounded apex. Microconidia exuding as white cirri from immersed, subepidermal pycnidial conidiomata. Microconidiophores irregularly branched, 0–2-septate, 10–25 × 3–4 μm. Microconidiogenous cells cylindrical, with prominent periclinal thickening, 7–11 × 3–3.5 μm. Microconidia bacillar with swollen, obtuse ends, unicellular, (6–)10(–11) x (2–)2.5(–3) μm.

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, Jun. 1994, PREM 51903 (holotype).

Parasympodiella podocarpi *Crous & Seifert* sp. nov. (Figure 4)

Mycelium ex hyphis septatis, ramosis, laevibus, olivaceis vel brunneis, 2–4 μm diam compositum. Conidiophora mononematosa, macronematosa, non ramosa, cylindrica, recta, parietibus crassis, basim brunnea et subtiliter verrucosa, pallidiora et laeviora versus regionem conidiogerem versus basim 10–14 μm lata, apicem 6–11 μm lata, regione fertili terminantia, 95–270 μm longa et 8–14 μm

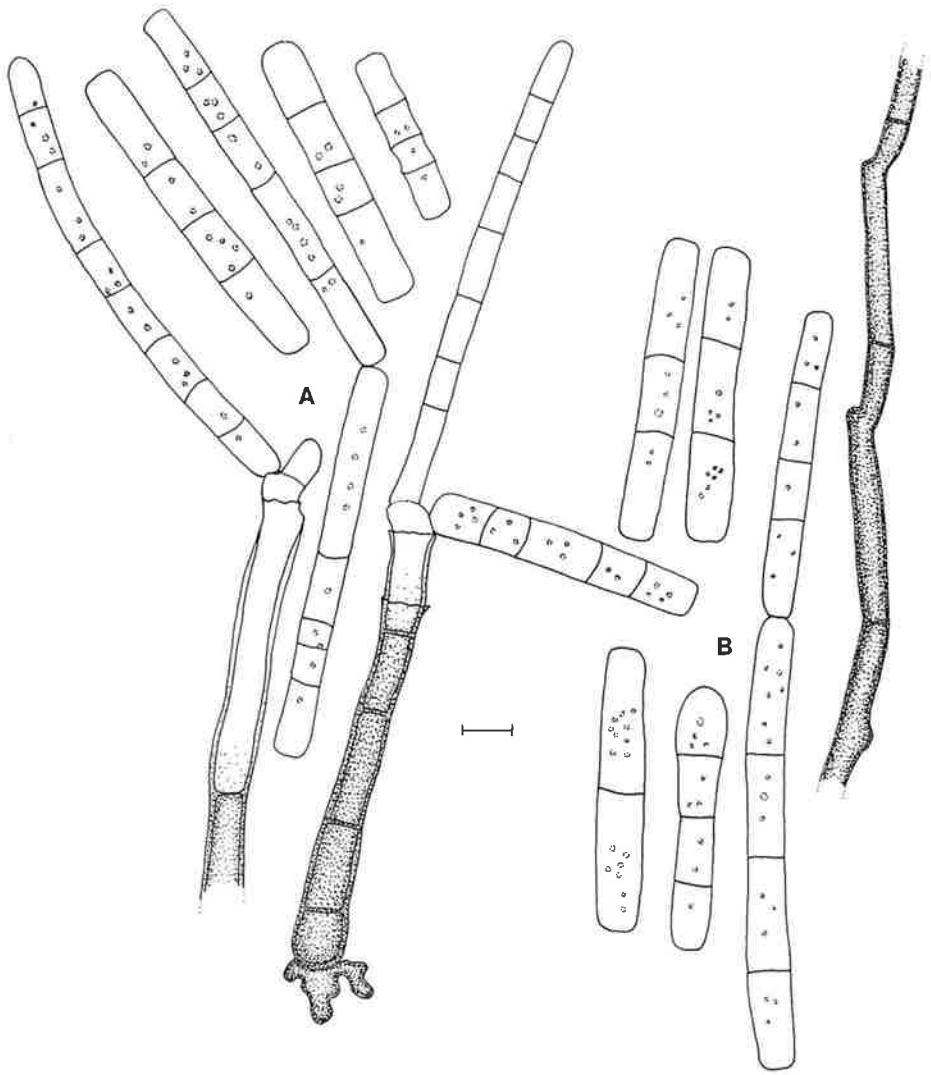


Figure 4 *Parasympodiella podocarpi* (PREM 51904). Conidiophores and conidia *in vivo* (A), and *in vitro* on CLA (B) (bar = 10 µm).

lata, 4–11-septata (in vivo), catenas longas formantia; couidiophora usque ad 1 000 µm longa in vitro. Cellulae conidiogerae terminales, in conidiophoris incorporatae, indeterminatae, irregulariter sympodiales, 25–65 × 5–6 µm pallide brunneae vel hyalinae, 5–65 µm inter locos conidiogeres. Conidia holothallica, sicca, catenulata, guttulata, recta vel plus minusve curvata, apicem et basim conidiorum intercalariorum truncata, conidiis apicalibus apicibus obtusis et basim truncatis, (0–)3(–7)-septatis, (30–)62(–140) × (6–)7(–9) µm in vivo, 1(–3)-septatis, (30–)45(–70) × (5–)8(–14) µm in vitro.

Mycelium consisting of septate, branched, smooth, olivaceous to brown hyphae, 2–4 µm diam. Conidiophores mononematous, macronematous, unbranched, cylindrical, straight, thick-walled (up to 1.5 µm), dark brown and finely verrucose at the base, becoming smoother and lighter brown towards the conidiogenous region, 10–14 µm wide at the base, 6–11 µm wide at the apex, terminating in a smooth fertile region, 95–270 µm long and 8–14 µm wide, 4–11-septate (*in vivo*), giving rise to chains of conidia; conidiophores up to 1 000 µm in length *in vitro*. Conidiogenous cells terminal, integrated, indeterminate, irregularly sympodial, 25–65 × 5–6 µm, light brown to hyaline, with 5–65 µm between conidiogenous loci. Conidia holothallic, dry, catenate, guttulate, straight to slightly curved, cylindrical, apex and base of intercalary conidia truncate, apical conidia with obtuse apices and truncate bases, (0–)3(–7)-septate, (30–)62(–140) × (6–)7(–9) µm *in vivo*, 1(–3)-septate, (30–)45(–70) × (5–)8(–14) µm *in vitro*; conidial chains appear sinuous as the conidia are developing.

Colonies on MEA attain a radius of 4–6 mm after 6 days at 15°C in the dark. Cultures are diffuse, spreading, with irregular margins of black fascicles of hyphae, extending beneath the agar surface, forming swollen, brown, chlamydospore-like cells, 12–25 × 8–15 µm; colony centres are dark brown to black with sparse aerial mycelium. Cardinal temperatures for growth are minimum: below 10°C, optimum: 15°C, and maximum: below 30°C.

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, Aug. 1994, PREM 51904 (holotype), DAOM 221069, culture ST'E-U 790, IMI 364301.

Of the remaining described species of *Parasympodiella* Ponnappa with conidia devoid of septal plugs, *P. podocarpi* is most similar to *P. elongata* Crous, M.J. Wingf & W.B. Kendr. (1995), *P. minima* J.L. Crane & Schokn. (1982), *P. clarkii* B. Sutton (1978) and *P. longispora* (Tokum. & Tubaki) Tokum. However, it can easily be distinguished from *P. elongata* (20–40 × 6–12 µm; 0–2-septate), *P. minima* (11. 5–14.5 × 1. 5–2 µm; 3-septate), and *P. clarkii* (15–19 × 2.5–3 µm; 3-septate) which all have smaller conidia. In conidial dimensions, *P. podocarpi* is most similar to *P. longispora*, which produces 1(–3)-septate conidia *in vitro*, 32–68 × 9–15 µm (Tokumasu & Tubaki 1983), rather similar to

those we report for *P. podocarpi*. In culture, conidia of the type strain (CBS 544.84) produced 1–2(–5)-septate conidia, 35–130 × 6–9 µm. Chlamydospore-like structures were also observed to occur in the conidiophores (as nodal swellings) and in the mycelium. The growth rate of *P. longispora* at 25°C is 6 cm in 10 days, whereas that of *P. podocarpi* is reported to be 1–3 mm after 10 days at this temperature. Furthermore, although *P. longispora* produces abundant chlamydospores on malt agar (Tokumasu & Tubaki 1983), *P. podocarpi* only exhibited sparse chlamydospore formation, embedded in the agar of old cultures. Sutton *et al.* (1982) reported the presence of a *Stylaspergillus* B. Sutton *et al.* synanamorph for *P. laxa* (Subram & Vittal) Ponnappa. Tokumasu (1987) reported a similar *Stylaspergillus* anamorph from needles of *Pinus* in Japan that also had *P. longispora* present, but he was unable to confirm the connection in culture because conidia of the former anamorph did not germinate. We have not observed such a synanamorph in our cultures or specimens of *P. podocarpi*.

Discrepancies between conidiophore proliferation, conidial septation and conidial dimensions observed *in vitro* and *in vivo* for *P. podocarpi* bring to light problems in describing species from cultures alone. Although pure cultures can be grown under standardized conditions and thus make careful comparisons possible, there is a tendency for variation to occur in culture for some fungi. In many fungi with phragmoconidia, for example, conidia produced in culture have fewer septa than those produced in nature. In the cercosporoid complex, however, conidia again tend to be longer and develop numerous septa in culture (Crous *et al.* 1989). In constrast to *P. longispora*, cultures of *P. podocarpi* had shorter conidia and longer conidiophores than observed in nature.

A key to distinguish the species presently accepted in *Parasympodiella* is provided below.

Key to species

1. Conidia 3-septate, less than 20 µm in length **2**
   Conidia if 3-septate, longer than 20 µm **3**
   2. Conidia 11.5–14.5 × 1.5–2 µm ..... ***P. minima***
      Conidia 15–19 x 2.5–3 µm ..... ***P. clarkii***
3. Conidia 3-septate with punctiform septal plugs, 18–50 × 6–8 µm ..... ***P. laxa***
   Conidia without septal plugs **4**
   4. Conidia 3–4-septate, 31–33 × 2 µm ..... ***P. africana***
      Conidia 0–multi-septate, more than 5 µm wide **5**
5. Conidia 0–2-septate, 20–40 × 6–12 µm ..... ***P. elongata***
   Conidia with 1–5 septa on MEA, up to 70 µm long **6**
   6. Conidia 32–68 × 9–15 µm *in vivo*, 35–130 × 6–9 µm *in vitro*, forming numerous chlamydospores in vegetative hyphae, 23–46 × 10–25 µm, growing profusely at 25°C, occurring on *Pinus* ..... ***P. longispora***
      Conidia 30–140 x 6–9 µm *in vivo*, 30–70 × 5–14 µm *in vitro*, chlamydospores sparse, embedded in agar, 12–25 × 8–15 µm, growth stunted at 25°C, occurring on *Podocarpus*. ..... ***P. podocarpi***

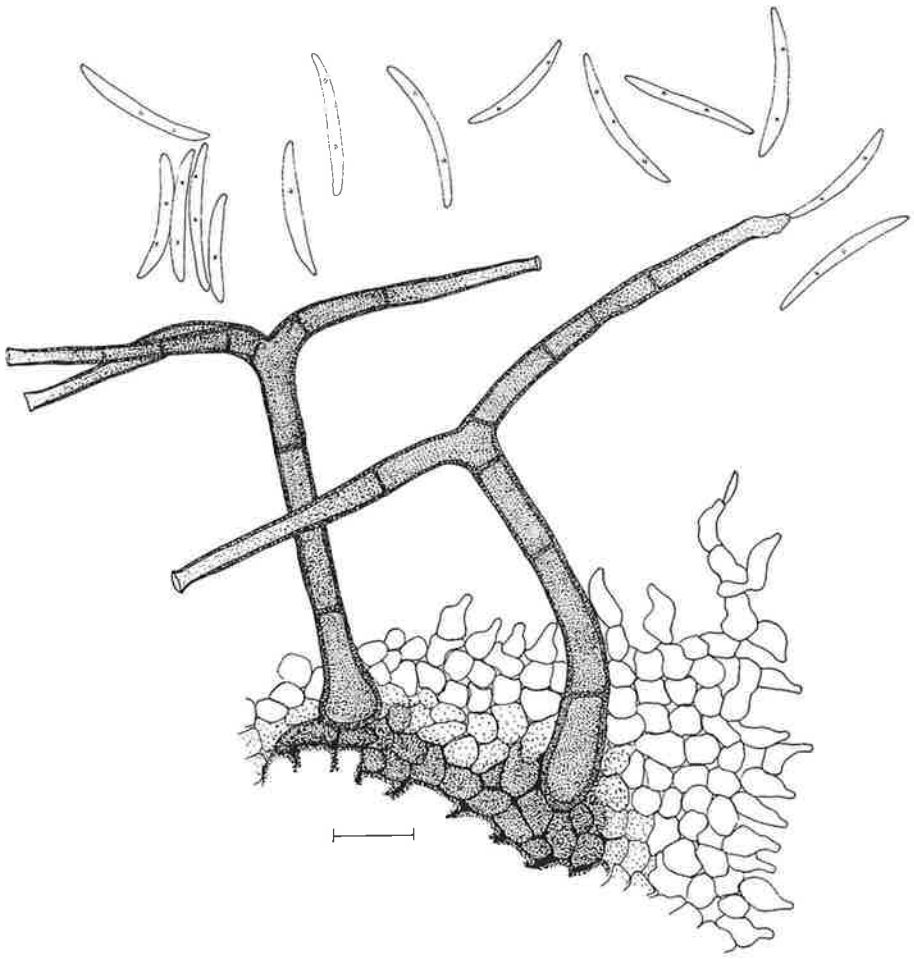


Figure 5 Setae, conidia and conidiogenous cells of *Gyrothrix verticiclada in vitro* on MEA (PREM 51906) (bar 10 = µm).

Gyrothrix verticiclada *(Goid.) S. Hughes & Piroz.*, Can. J. Bot. 9: 42 (1971) (Figures 5, 9–13)

Peglionia verticiclada Goid., *Malpighia* 34: 7 (1935).

Mycelium immersed and superficial, consisting of branched, septate, hyaline to brown hyphae, 1.5–3 µm diam.; forming a large stroma consisting of smooth, brown, isodiametric cells on which the setae and conidiogenous cells are situated. The stroma is embedded in the host tissue (Hughes & Pirozynski 1971), or is formed beneath the agar surface in culture, giving colonies a dark brown to black appearance; strains lose some of their ability to form stromatic tissue with subsequent subculturing. Setae straight, erect, thick-walled, dark brown, becoming lighter brown in the upper two cells, occurring singly, or arranged in tight clusters, 50–80 µm tall (measured from base to below primary branch), 3.5–6 µm wide (at first basal septum), 4–7-septate, seldomly unbranched, frequently branching at the same locus to form 2–6 lateral branches nearly equal in length, 10–50 × 4–6 µm, 1–3-septate, primary branches sometimes branch dichotomously to form secondary branches, 17–35 × 3.5–4 µm, 1–3-septate; branch apices obtuse when immature, becoming swollen and fertile via small denticles or bumps, finally bursting open to appear like collarettes typical of phialides of *Dictyochaeta* Speg. spp. Conidiogenous cells smooth, olivaceous, irregular, straight, or geniculate-sinuous, ampulliform to lagenifom, 5–10 × 3–4 µm *in vivo*, 10–23 × 3–4.5 µm *in vitro*, giving rise to conidia via inconspicuous annellations. Conidia forming in a slimy mass around the base of setae (rarely at branch apices), hyaline, falcate, tapering to blunt apices, non-septate with a few minute guttules, (15–)17(–21) × (1.5–)2 µm

Colonies on 2% malt-extract agar (MEA) attain a radius of 8–11 mm after 8 days at 25°C in the dark. Cultures are dark brown to black with little aerial mycelium on MEA. Cardinal temperatures for growth are minimum: below 10°C, and maximum: below 30°C.

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongus* leaf litter, P.W. Crous, Aug 1994, PREM 51906, DAOM 221067, IMI 364302, STE-U 786-788.

This fungus was originally described in Italy from leaf litter of *Laurus nobilis* L. and *Prunus cerasus* L. by Goidanich (1935), who erected a new genus *Peglionia* Goid. with *P. verticiclada* as type. Verona and Benedek (1967) commented that this fungus closely resembled species of *Gyrothrix* (Corda) Corda and *Circinotrichum* Nees. In 1963 two collections of this fungus were obtained from *Knightia excelsa* R. Br. in New Zealand. In a subsequent study, Hughes & Pirozynski (1971) reduced *Peglionia* to synonymy with *Gyrothrix*, and also introduced a new name for this species as *G. verticiclada* (Goid.) S. Hughes & Piroz. The latter decision was chiefly based upon the branched setae present in both *Peglionia* and *Gyrothrix*, but that are lacking in *Circinotrichum*. In these genera, conidia are formed on conidiogenous cells that are situated around the base of the setae. The exact mode of conidiogenesis is unclear, but minute annellations can be seen at the apices of conidiogenous cells in *Circinotrichum* and *Gyrothrix* (Ellis 1971) (Figure 7). Furthermore, Castañeda and Kendrick (1990) introduced the genus *Selenodriella* Castañeda & W.B. Kendr. for species with minute denticles at the apices of their conidiogenous cells (Figure 8). In *G. verticiclada*, however, we could distinguish indistinct annellations at the apices of conidiogenous cells (Figures 9–13). Conidia were observed to be borne in whorls of 2–6 at the apices of conidiogenous cells. In a scanning electron microscopy study of the conidiogenesis of *Gyrothrix circinata* (Berk. & M.A. Curtis) S. Hughes, Nakagiri and Ito (1991) illustrated the same arrangement of conidia. Conidiogenous cells were shown to have a collarette, with several denticle-like structures situated within the apex of the conidiogenous cell. These illustrations suggest, therefore, that the first conidium is probably produced holoblastically, and that the flat-tipped structures may be a compressed form of percurrent proliferation. The proliferation period of ontogeny is reduced, giving rise to inconspicuous scars on the apex within the collarette. Conidia then develop laterally to each other, and are borne in whorls as also seen in *G. verticiclada*. Onofri (1995) showed a similar mode of conidiogenesis in a culture of *Circinotrichum maculiforme* Nees, where the first conidium is produced holoblastically. Additional conidia are produced enteroblastically, with several loci forming laterally on the enteroblastic wall of the conidiogenous cell, appearing as small, flat-tipped scars in the illustrations of Nakagiri and Ito (1991) for *G. circinata*.

A closer examination of the apices of the dichotomously branching setae of *G. verticiclada* showed them to frequently become swollen, and to be open at maturity, appearing like a giant phialide. When young material is studied, however, small denticles are observed at the branch apices, to which conidia are attached in clusters. With age, these apices become swollen to the outside, whereupon they burst, appearing like an open phialide with a flared collarette, somewhat resembling that of the genus *Dictyochaeta*.

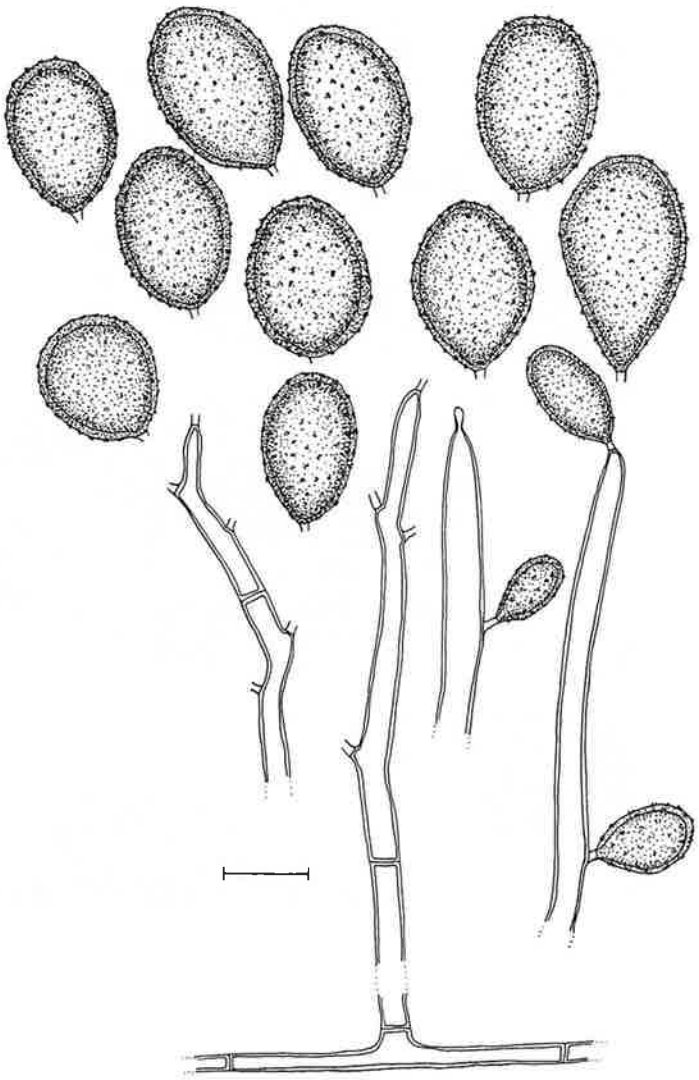
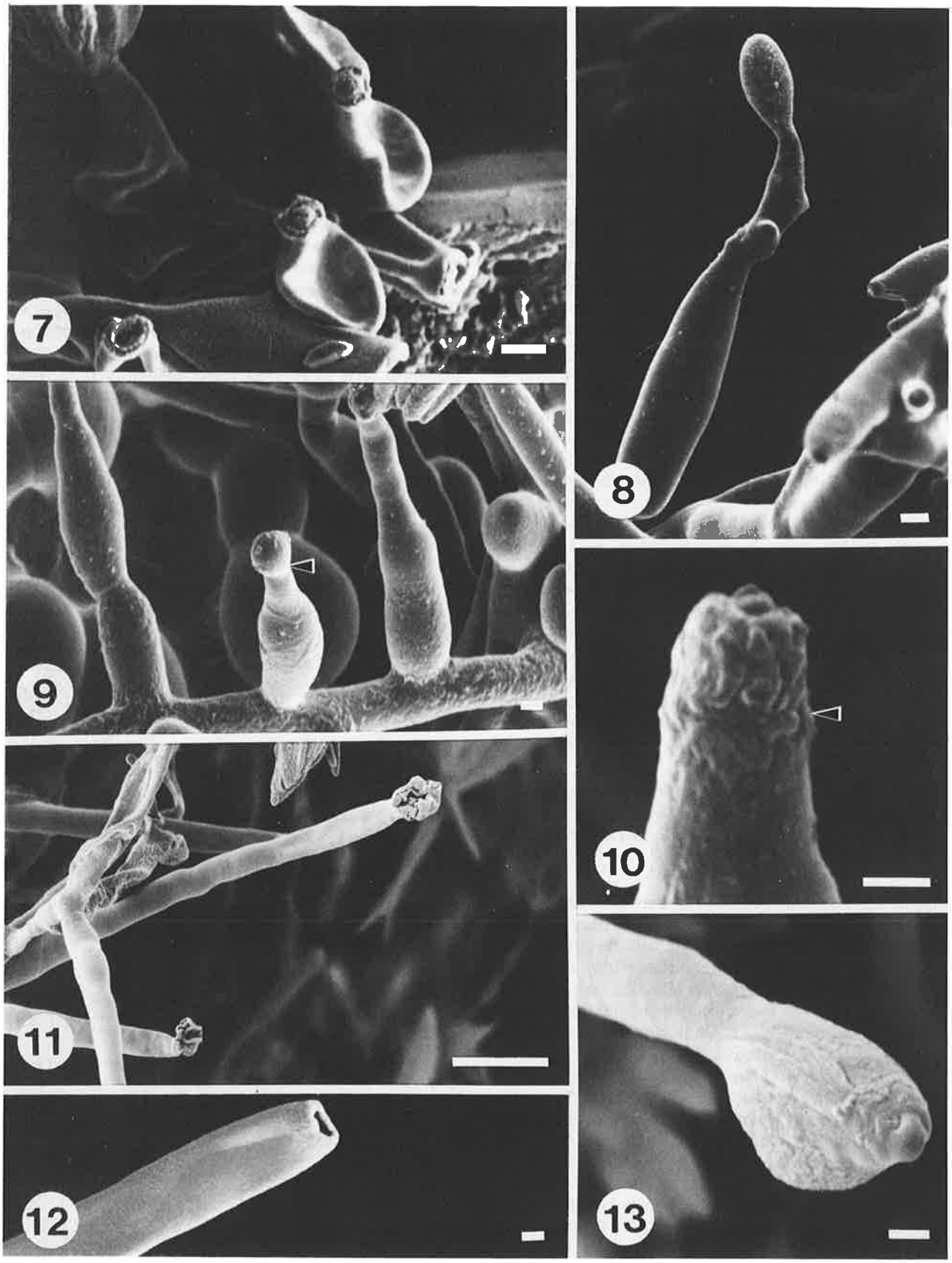
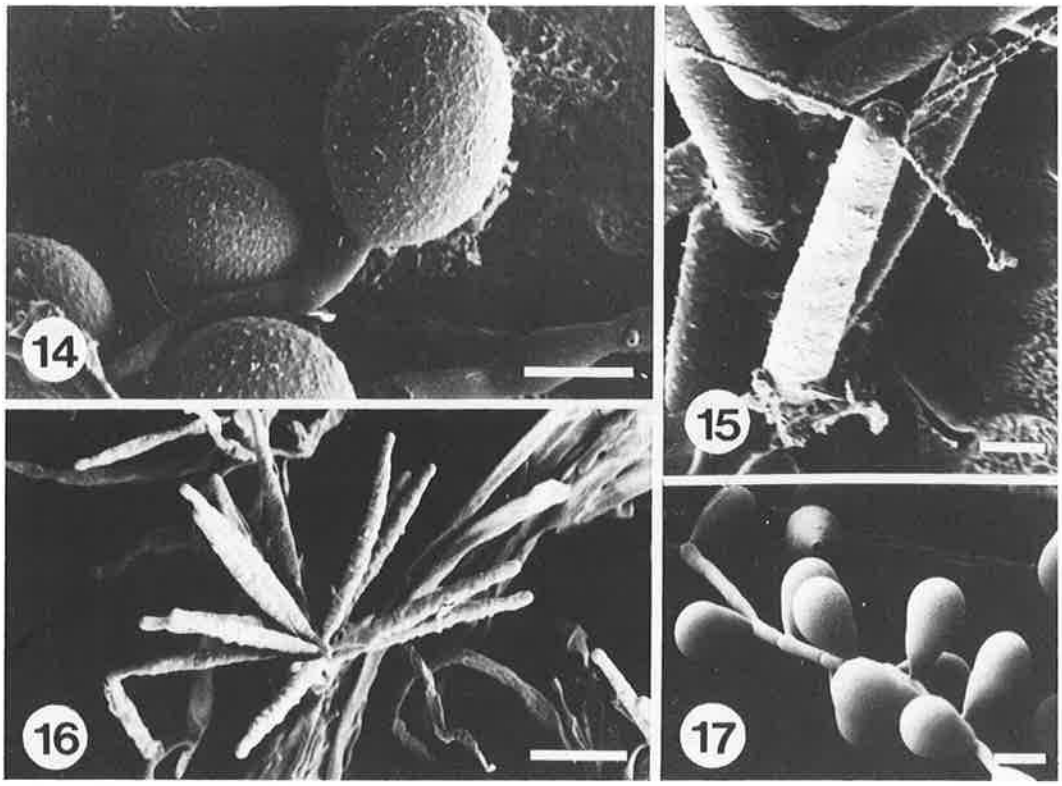


Figure 6 Conidia and conidiophores of *Rhinotrichella elegans* (PREM 51905) (bar 10 = µm).



Figures 7–13 Conidiogenous cells and setae of *Gyrothrix* and *Selenodriella*. **7.** Percurrent annellations at the apices of conidio-genous cells of a *Gyrothrix* sp. (bar = 1 μm). **8.** Denticles at the apex of a conidiogenous cell of a *Selenodriella* sp. (bar = 1 μm). **9–13.** *Gyrothrix verticiclada* (PREM 51906). **9.** Outside cell layer (arrowed) that was involved in the holoblastic formation of the first conidium (bar = 1μm). **10.** Warty swelling developing at the setal apex (arrow) (bar = 1 μm). **11.** Enlarged apical warty swellings on setae, that can also be fertile (bar = 10 μm). **12.** Empty cell at setal apex without warty swelling (bar = 1 μm). **13.** Protoplasm leaking from apical cell after discharge of warty swelling (bar = 1 μm).



Figures 14–17 Conidia of various microfungi (bars = 10 µm). **14.** *Rhinotrichella elegans* (PREM 51905). **15.** *Camposporium antennatum* (STE-U 667). **16.** *Dactylaria irregularis* (PREM 51908). **17.** *Endophragmiella boewei* (PREM 51909).

Rhinotrichella elegans *R.F. Castañeda & Crous* sp. nov. (Figures 6, 14)

Mycelium copiosum, ex hyphis septatis, ramosis, laevibus, hyalinis, 1.5–2 µm diam. compositum. Conidiophora conspicua mononematosa, erecta, flexuosa, simplicia, interdum ramosa, cylindrica, septata, apice leviter geniculata, hyalina, basim 300–780 µm alta et 4–6.5(–8) µm crassa. Cellulae conidiogerae polyblasticae, terminales et intercalares, sympodialiter extendentes, in conidiophoris incorporatae, incoloratae, denticulatae, denticulis conspicuis, cylindricis, translucidis, 1–2 pm longis praeditae. Conidia obovata, interdum obpyriformia vel eflipsoidea, minime verrucosa vel levia, primo hyalina, tarde pallide brunnea vel dilute cinnabarina, unicellularia, acropleurogena, sicca, (19–)29(–37) × (14–)18.5(–22) µm ad basim rotunda, appendice, truncato, translucido, conspicuo, 1–2.5 µm longo (reliquiis cellularum conidiogerium) praedita. Teleomorphosis ignota.

Mycelium abundant in culture, composed of septate, branched hyphae, 1.5–2 µm diam. Conidiophores undifferentiated, mononematous, erect, flexuous, mostly unbranched, cylindrical septate, slightly geniculate at the apex, colourless, 300–700 µm tall; 4–6.5(–8) µm wide at the base. Conidiogenous cells polyblastic, terminal and intercalary, proliferating sympodially, integrated, denticulate, with conspicuous, cylindrical denticles, 1–2 µm long. Conidia obovate, sometimes obpyriform to ellipsoid, finely verrucose to smooth-walled, initially hyaline, becoming pale brown to orange-red, thick-walled, 0-septate, acropleurogenous, dry, (19–)29(–37) × (14–)18.5(–22) µm, base rounded but with a conspicuous, clear, truncate, hyaline appendage (remains of the conidiogenous cell), 1–2.5 µm long. Teleomorph unknown.

Colonies on MEA attain a radius of 18–30 mm after 8 days at 15°C in the dark. Cultures are floccose to cottony, initially white, turning orange. Cardinal temperatures for growth are minimum: below 5°C, optimum: 15°C, and maximum: below 30°C.

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, 31 Aug. 1993, PREM 51905 (holotype), DAOM 221068, culture ST'E-U 668.

The genus *Rhinotrichella* G. Arnaud ex de Hoog was erected by Arnaud (1953) without a Latin diagnosis, and was validated by de Hoog (1977) with *R. globulifera* de Hoog as type species. The latter has globose, smooth or finely verrucose, pale ochraceous conidia, 9–12 µm diam. Matsushima 1983 described an additional species, *R. macrospora* Matsush., with smooth, pale brown, globose conidia, 15–19 µm diam, and a synanamorph resembling a species of *Aspergillus* P. Micheli ex Link (not illustrated). Both these species are clearly distinct from *R. elegans*, which has larger conidia.

During the course of this study numerous other hyphomycetes were also isolated. As far as we could establish, several have not previously been recorded from South Africa. However, as their morphology closely corresponds with that of their respective descriptions, they are merely listed below.

Other new records

Camposporium antennatum *Harkn.*, Bull. Calif. Acad. Sci. 1: 37–38 (1884) (Figure 15) (*fide* Ellis 1971).

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, 31 Aug. 1993, STE-U 667.

Dactylaria irregularis *De Hoog*, Stud. Mycol. 26: 124 (1985) (Figure 16)

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, 31 Aug. 1993, PREM 51908.

Endophragmiella boewei *(Crane) S. Hughes*, N.Z. J. Bot. 17: 147 (1979) (Figure 17) (*fide* Ellis 1976).

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, 31 Aug. 1993, PREM 51909, STE-U 670.

Phaeoisaria clematidis *(Fuckel) S. Hughes*, Can. J. Bot. 36: 795 (1958) (*fide* Ellis 1971).

Specimen examined: Western Cape Province, Stellenbosch, Botanical Garden, *Podocarpus elongatus* leaf litter, P.W. Crous, 26 Sept. 1994, PREM 51907, STE-U 813.

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References

ARNAUD, G. 1953. Mycologie concrète: genera II (suite et fin). *Bull. trimest. Soc. mycol. Fr.* 69: 265–306.

BISSETT, J. 1986a. A note on the typification of *Guignardia*. *Mycotaxon* 25: 519–522.

BISSETT, J. 1986b. *Discochora yuccae* sp. nov. with *Phyllosticta* and *Leptodothiorella* synanamorphs. *Can. J Bot.* 64: 1720–1726.

CASTAÑEDA, R.F. & KENDRICK, B. 1990. Conidial fungi from Cuba: II. *Univ. Waterloo, Biol. Ser.* 33: 1–61.

CRANE, J.L. & SCHOKNECHT, J.D. 1982. Hyphomycetes from freshwater swamps and hammocks. *Can. J. Bot.* 60: 369–378.

CROUS, P.W. 1993. New and interesting records of South African fungi. 13. Foliicolous microfungi. *S. Afr. J Bot.* 59: 602–610.

CROUS, P.W., PHILLIPS, A.J.L. & WINGFIELD, M.J. 1992. Effects of cultural conditions on vesicle and conidium mophology in species of *Cylindrocladium* and *Cylindrocladiella*. *Mycologia* 84: 497–504.

CROUS, P.W. & VAN DER LINDE, E.J. 1993. New and interesting fungi. 11. *Eucalyptus* leaf fungi. *S. Afr. J. Bot.* 59: 300–304.

CROUS, P.W., WINGFIELD, M.J. & KENDRICK, W.B. 1995. Foliicolous dematiaceous hyphomycetes from *Syzygium cordatum*. *Can. J. Bot.* 73: 224–234.

CROUS, P.W., WINGFIELD, M.J., MARASAS, W.F.O. & SUTTON, B.C. 1989. *Pseudocercospora eucalyptorum* sp. nov., on *Eucalyptus* leaves. *Mycol. Res.* 93: 394–398.

DE HOOG, G.S. 1977. The black yeasts and allied Hyphomycetes. *Stud. Mycol.* 15: 1–222.

DE HOOG, G.S. 1985. Taxonomy of the *Dactylaria* complex, IV–VI. *Stud. Mycol.* 26: 1–124.

DOIDGE, E.M. 1950. The South African fungi and lichens to the end of 1945. *Bothalia* 5: 1–1094.

ELLIS, M.B. 1971. Dematiaceous Hyphomycetes. Commonwealth Mycological Institute. Kew.

ELLIS, M.B. 1976. More Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew.

GOIDANICH G. 1935. Un nuovo genere de Demaziacee amerospore. *Malpighia* 34: 5–9.

HUGHES, S.J. & PIROZYNSKI, K.A. 1971. New Zealand fungi 15. *Beltraniella, Circinotrichum*, and *Gyrothrix* (Syn. *Peglionia*). *Can. J Bot.* 9: 39–45.

MATSUSHIMA, T. 1983. *Matsushima Mycol. Mem.* 3: 1–89 (Kobe).

MERLI, S., GAROFANO, L., RAMBELLI, A. & PASQUALETTI, M. 1992. *Chaetopsina nimbae,* a new species of dematiaceous hyphomycetes. *Mycotaxon* 44: 323–331.

NAKAGIRI, A. & ITO, T. 1991. *Gyrothrix circinata* Descriptive catalogue of IFO fungus collection XII. *IFO Res. Commun.* 15: 137–139.

ONOFRI, S. 1995. Scanning electron microscopy of conidiogenesis in *Circinotrichum maculiforme*. *Mycotaxon* 55: 289–293.

SUTTON, B.C. 1978. Three new hyphomycetes from Britain. *Trans. Br. mycol. Soc.* 71: 167–171.

SUTTON, B.C., ALCORN, J.L. & FISHER, P.J. 1982. A synanamorph of *Parasympodiella laxa*. *Trans. Br. mycol. Soc.* 79: 339–342.

TOKUMASU, S. 1987. *Parasympodiella longispora* comb. nov., and its distribution in pine forests. *Trans. mycol. Soc. Japan* 28: 19–26.

TOKUMASU, S. & TUBAKI, K 1983. *Bahusakala longispora* sp. nov., and its geographical distribution in the pine forests of Japan. *Trans. mycol. Soc. Japan* 24: 425–431.

VAN DER AA, H.A. 1973. Studies in *Phyllosticta*. 1. *Stud Mycol.* 5: 1–110.

VERONA, O. & BENEDEK, T. 1967. Iconographia Mycologics. *Mycopath. Mycol. appl.* suppl. 20: Plate A 515.