

CORTINARIOID SEQUESTRATE (TRUFFLE-LIKE) FUNGI OF WESTERN AUSTRALIA

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Abstract

Revised descriptions are presented of nine previously published cortinarioid sequestrate species, and four new species, occurring in Western Australia. A key to the Western Australian species is also included. The new species, *Descomyces angustisporus*, *Quadrispora tubercularis*, *Cortinarius walpolensis* and *Cortinarius sebosus* are not known to occur outside Western Australia. The Western Australian species represent five of the 11 genera, and nine of the 39 cortinarioid sequestrate species previously known to occur in Australia. In view of the broad distribution of some cortinarioid sequestrate species in Australia, and large areas of the continent poorly explored for these fungi, the current authors believe that the species presented here represent only a portion of the cortinarioid sequestrate fungi present in Western Australia. It is likely that many other species are yet to be collected and/or named.

A.A. Francis & N.L. Bougher (2004). Cortinarioid sequestrate (truffle-like) fungi of Western Australia. *Australasian Mycologist* 23 (1): 1–26.

Introduction

Sixteen genera constitute the informal grouping 'cortinarioid sequestrate fungi' defined as including taxa of sequestrate fungi that at some time, have been placed in either the Cortinariaceae or the Hymenogasteraceae and, as yet, have not been shown to have stronger affinities with taxa outside these families (Francis & Bougher 2003). Sequestrate fungi are those in which the spores mature inside an enclosed fruitbody, remaining there until the fruitbody decomposes or is eaten (Bougher & Lebel 2001). The term sequestrate fungi therefore incorporates fruitbody forms historically described as secotioid or gasteroid as well as agaricoid forms in which the persistent partial veil encloses the hymenophore. A number of sequestrate fungal taxa have been allied with the genus *Cortinarius* and its mushroom-like allies on the basis of various combinations of characteristics including: spore structure, pigmentation and ornamentation; basidiome structure, pigmentation and development; and, similarity in molecular sequence data (e.g. Bougher & Castellano 1993, Moncalvo *et al.* 2002, Peintner *et al.* 2001, Singer 1951). Australia is currently known to have 11 genera of these fungi. Six of the genera are now known to occur in Western Australia.

As discussed in a previous paper (Francis & Bougher 2003) the taxonomy of the sequestrate cortinarioid fungi is in a state of flux with a number of authorities placing taxa included under our definition in other more distantly related families within the Agaricales. We will discuss, for the genera dealt with in this paper, the reasons for their inclusion as sequestrate cortinarioid fungi. Also, the acceptance of some of the genera of cortinarioid sequestrate fungi is contentious. For example, rDNA Internal Transcribed Spacer (ITS) sequences (Peintner *et al.* 2001) support the hypothesis that *Thaxterogaster* is polyphyletic. Accordingly, Peintner *et al.* (2002b) synonymised *Thaxterogaster* under *Cortinarius*. Molecular evidence from other studies also indicates that *Cortinarius* itself is paraphyletic (e.g. Peintner *et al.* 2002a). The *Cortinarius* species detailed in this paper are all secotioid (*sensu* Francis & Bougher 2003), that is with the peridium *not* pileate/expanded but more or less globose enclosing the hymenophore.

The history of collection of sequestrate fungi in Western Australia includes some collections of 19th century Australian naturalists such as James Drummond and a large number of more recent collections held in herbaria at the CSIRO Mycology Forestry and Forest Products Herbarium Perth, OSU, MEL and PERTH. These collections have arisen as a result of more general and often Australia-wide research into the sequestrate fungi. This research

has been summarised by Lebel & Castellano (1999), May (2001) and, with particular focus on the sequestrate cortinarioid fungi, by Francis & Bougher (2003) and the reader is referred to those references for a more in-depth treatment of the history surrounding the collection of sequestrate fungi in Australia. Works detailing the Western Australian sequestrate cortinarioid fungi include Bougher & Syme (1998) which includes colour illustrations of the cortinarioid sequestrate fungi *Dermocybe globuliformis*, *Descomyces albus*, *Cortinarius luteirufescens* and *C. basipurpureus* (the latter two as *Thaxterogaster*). Large areas of Western Australia are poorly explored for sequestrate fungi, and it is likely that many more species of cortinarioid sequestrate fungi remain to be found and/or named. The collections available to the current authors have mostly come from forest regions in the south west of Western Australia and from areas extending inland into lower rainfall woodland regions. In this paper we present revised descriptions of species of cortinarioid sequestrate fungi known to occur in Western Australia, including nine previously published species and four new species.

Methods

Macroscopic characters were described for fresh specimens in the field, which were subsequently air dried as herbarium vouchers. Microscopic examination was carried out with both fresh (when available) and herbarium material. We examined collections lodged mainly at PERTH, MEL, OSU, the Mycology Herbarium, CSIRO FFP, Perth, Australia (coded as 'H' or 'E' numbers) and the working collection of Prof. J. Trappe (coded as 'Trappe' numbers). Collections coded as 'Trappe' numbers are all eventually to be lodged in public herbaria. These have been indicated in brackets after the number. Colour codes for macroscopic features are from Kornerup & Wanscher (1978). Line drawings and measurements of spores in 3% KOH were made with the aid of an Olympus BH2-DA drawing attachment. Congo red was applied to hyaline structures revived in 3% KOH (e.g. basidia). Spore measurements include the hilar appendix but not the ornamentation or perisporium. Shapes are according to Kirk *et al.* (2001). Spores have been drawn at 2000× magnification and other elements at 1000× magnification; figures illustrating both spores and other elements have separate bars indicating 10 µm at the relevant scales.

Results

More than 160 collections of cortinarioid sequestrate fungi from Western Australia were at hand for this work representing a range of morphologically defined taxa. Thirteen species are treated in this paper. Nine previously published species are listed here as occurring either naturally or in plantations/plantings within Western Australia. Of these nine, two (*Cortinarius luteirufescens* and *C. basipurpureus*) are currently known only from Western Australia as are the four new species described in the paper. Additionally, a number of other species (potentially four to eight) are represented in existing collections of Western Australian fungi. However, owing to the poor condition or limited number of collections and absence of macromorphological data, these have not been treated in this paper. Definition of the additional species awaits adequate supporting specimens and data.

As one might expect, different species of sequestrate cortinarioid fungi appear to exhibit different distributions. Sampling for sequestrate fungi has not been exhaustive and large areas of the State remain unexplored for these fungi (and fungi in general). However, based on the data currently available to us, we relate some tentative patterns. In Western Australia most collections of sequestrate cortinarioid species appear to have been centralised on the southern coast, with two of the new species described in this paper coming from further north around the Kellerberrin area—Western Australia wheatbelt. It must be noted that these locations coincide with major focal areas of collecting effort by the CSIRO Forestry and Forest Products mycology group and colleagues. Despite this obvious weakness in the sampling design, it appears that *Descomyces angustisporus* Francis & Bougher *sp. nov.* does to some extent replace *D. albus* and *D. albellus* towards the wheatbelt region. *Cortinarius sebosus* represents the only secotioid *Cortinarius* (*Thaxterogaster*) to be found so far in this drier, more northerly wheatbelt region. Also, the area from Walpole to Two Peoples Bay also appears to be a centre of diversity for sequestrate cortinarioid fungi in Western Australia. Further extensive, well-planned sampling is required if a more accurate picture of the biological resources inherent in our fungal biodiversity is to be better understood.

Key to genera of cortinarioid sequestrate fungi currently recorded from Western Australia. Note: Numbers next to genus names in the key refer to the order in which the genera are treated in this paper.

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| <p>1 Spores with a smooth, rostrate apex.</p> <p>2 Basidiomes secotioid; spores prominently asymmetrical.</p> <p>2: Basidiomes gastroid; spores more or less symmetrical.</p> <p>1: Spores with a rounded, ornamented apex.</p> <p>3 Spores retained in tetrads after release from the basidium.</p> <p>3: Spores not retained in tetrads after release from the basidium.</p> <p>4 Basidiomes pileate; pileus expanded; hymenophore covered by persistent partial veil; pileus, stipe and surrounding conspicuous mycelium bright yellow.</p> <p>4: Basidiomes not as above.</p> <p>5 Basidiomes with a truncate to percurrent (may be dendroid) stipe/columella.</p> <p>5: Basidiomes with columella lacking to truncate, not percurrent.</p> | <p>6. <i>Setchelliogaster</i> (only species currently described from Western Australia, <i>S. australiensis</i>)</p> <p>3. <i>Descomyces</i></p> <p>5. <i>Quadrispora</i></p> <p>2. <i>Dermocybe</i> (only species currently described from Australia, <i>D. globuliformis</i>)</p> <p>1. <i>Cortinarius</i></p> <p>4. <i>Protoglossum</i></p> |
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The six genera included in this work as sequestrate cortinarioid fungi are *Setchelliogaster* Pouzar, *Descomyces* Bougher & Castellano, *Quadrispora* Bougher & Castellano, *Cortinarius* (Pers.) Gray, *Dermocybe* (Fr.) Wünsche and *Protoglossum* Masee. All of these genera fall within the Cortinariaceae as accepted by Peintner *et al.* (2001). In addition, the genera *Setchelliogaster* and *Descomyces*, like *Descolea*, lack the true germ pore characteristic of the Bolbitiaceae in which they were placed by Kirk *et al.* (2001) (Bougher 1987, Bougher & Castellano 1993) and their position among the cortinarioid fungi has been supported by other molecular studies (Martin & Moreno 2001). *Thaxterogaster* has recently been reduced to synonymy under *Cortinarius* by Peintner *et al.* (2002b). Similarities between the two genera had been noted since the first description of *Thaxterogaster* (Singer 1951) and the polyphyly of *Thaxterogaster* had also been suspected (e.g. Horak & Moser 1965, Moser 1964). Bougher & Castellano (1993) discuss the links between *Protoglossum* (*Cortinomyces*) and *Cortinarius*. No conclusions were given in that paper as to the placement of *Quadrispora*, however, the current authors consider basidiome form and spore structure (in all but symmetry) to be sufficiently similar to that of *Cortinarius* (*Thaxterogaster*) and *Protoglossum* to warrant including *Quadrispora* as a sequestrate cortinarioid fungus. *Dermocybe* was initially described as a subgenus of *Cortinarius* (chiefly distinguished by pigment characteristics) and forms a monophyletic group of fungi nested within *Cortinarius* (Chambers *et al.* 1999, Peintner *et al.* 2001). Further discussion on membership within our concept of cortinarioid sequestrate fungi is provided in Francis & Bougher (2002). Thus the main characters uniting the sequestrate cortinarioid fungi are spore characteristics (most commonly brown, ornamented spores which lack a true germ pore) coupled with basidiome characteristics (including pigmentation and peridiopellis structure) the interpretation of which are supported by the analysis of molecular characteristics.

1. *Cortinarius*

Key to species of secotioid *Cortinarius* currently recorded from Western Australia.

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| <p>1 Mature peridium white to off-white.</p> <p>1: Mature peridium not white to off-white.</p> <p>2 Spores 14–21 × 9–18 µm.</p> <p>2: Spores smaller.</p> <p>3 Peridium yellow with slight orange tint, with orange-red stains; spores ovoid to ellipsoidal to oblong-ellipsoidal, 12–15 × 7.5–9 µm.</p> <p>3: Peridium initially cream to pale tan becoming grey-brown or reddish/purplish brown or sometimes grey-violet; spores broad-ovoid to broadly pyriform 10–13 × 7.5–9 µm.</p> | <p>4. <i>Cortinarius walpolensis</i></p> <p>3. <i>C. sebosus</i></p> <p>2. <i>C. luteirufescens</i></p> <p>1. <i>C. basipurpureus</i></p> |
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1. *Cortinarius basipurpureus* (Bouger) Peintner & M.M. Moser, *Mycotaxon* 81: 178 (2002b)
(Figure 1, Plate 2F)

= *Thaxterogaster basipurpureum* Bouger, *Mycotaxon* 63: 43 (1997).

Basidiomes hypogeous, fruiting singly or in groups, under litter, gastroid, 5–15 × 8–25 mm, globose, ellipsoidal to pyriform, often pleated around the stipe. *Peridium* initially cream to pale tan (4B4–5B4) becoming grey-brown or reddish/purplish brown (6F7–7F7 or 10E5) or sometimes grey-violet (duller than 17B3), with a layer of thick non-glutinous slime overlying the peridial surface that is covered in small lumps, not bruising, often with adhering debris, thick (approx. 1 mm), of two layers, outer layer broader and gelatinised, inner layer greyish in section and not gelatinised. *Gleba* loculate, cream when young maturing to dark brown (6E8–7F8), dry, not rapidly disintegrating after maturity, locules to 1 mm broad, empty, may be distinctly radially arranged. *Columella/sterile tissue* a percurrent to truncate stipe, columella to 6 mm broad, stipe to 3 mm long by 5 mm wide, central, terete, tapering, whitish to cream, dry, but with a viscous gelatinous purple collar at junction of peridium and stipe, minutely pubescent, of one layer, solid, base tapering; basal mycelium whitish, inconspicuous. *Macrochemical tests* 15% KOH very dark brown on gleba, FeSO₄ no reaction to dull brown on gleba. *Odour* similar to camphor or mothballs, *taste* not distinctive.

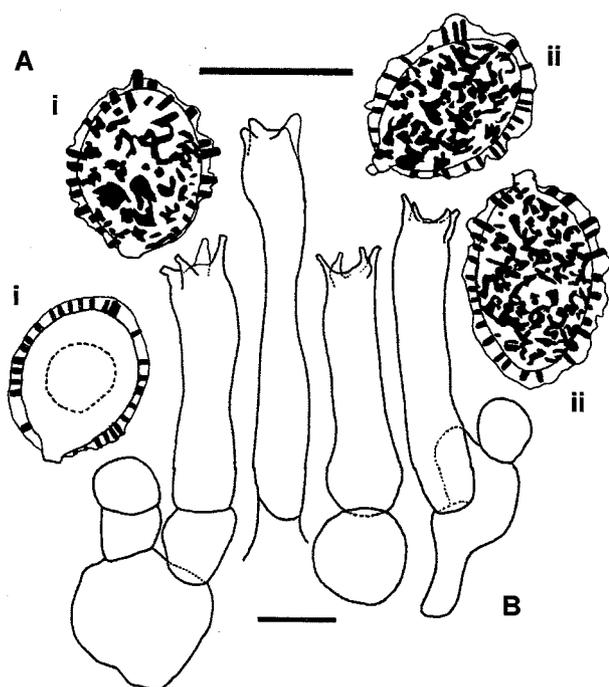


Figure 1. *Cortinarius basipurpureus*. **A** Spores i H6684. ii H62236. Scale bar = 10 μ m. **B** Basidia, hymenial and subhymenial elements H6236. Scale bar = 10 μ m.

Spores bright brown (KOH), axially symmetrical, more or less orthotropic, broad-ovoid to broad-pyriform, (10–) 10.5–12.5 (–13) × 7.5–9 μ m mean of 30 spores 11.0 × 8.5 μ m, Q = 1.39–1.82, 1.62 ± 0.1 (KOH), ornamented with rods and short ridges, ornaments to 2 × 2 μ m in profile appearing irregular and quite densely arranged in face view; perispore yellowish (KOH), obvious, adhering closely to the ornamentation; spores not aggregating; hilar appendix to 2 μ m broad, truncate, entire; spores thin-walled, inamyloid, non-dextrinoid; the apex rounded and ornamented. *Basidia* hyaline, cylindrical to cylindro-clavate, 4-spored, 33–65 × 7–11 μ m. *Cystidia* absent. *Hymenium* palisade, with hyaline, non-gelatinised, clavate (although sometimes becoming globose or pyriform after the basidia collapse), thin-walled, elements to 25 × 35 μ m. *Subhymenium* approximately 10 μ m broad, largely undifferentiated, a layer of hyaline, non-gelatinised, more or less cylindrical, thin-walled, approximately 5–8 μ m broad hyphae. *Hymenophoral trama* parallel, hyaline or yellow-encrusted, non-gelatinised, more or less cylindrical, thin-walled, 3–15 μ m broad hyphae.

Peridiopellis (in longitudinal section) of two layers, outer broader layer: loosely interwoven in a hyaline matrix, hyaline, gelatinised and intact, cylindrical, generally thin-walled (although some hyphae with faint annular wall thickenings, walls to 0.5 μ m thick or small (< 0.5 μ m tall), rounded, undulating interior wall projections), 2–7 μ m broad hyphae; inner layer: interwoven to subparallel, of hyphae encrusted with concentrated clusters of a bright golden yellow (KOH) pigment, non-gelatinised, inflated (sometimes appearing as polygonal cells), thick-walled, 4–10 μ m broad. *Clamp connections* absent.

Habitat and distribution: Abundant throughout coastal south Western Australia in a variety of soils under *Eucalyptus* woodlands and *Gastrolobium* thickets in association with mycorrhizal plants including *Gastrolobium* sp., *Eucalyptus jacksonii*, *Corymbia* [*Eucalyptus*] *calophylla*, *Agonis flexuosa* and *Allocasuarina decussata*. Fruiting June–August.

Collections examined: W.A.: Two Peoples Bay Nature Reserve, Hakea Gully, in thicket dominated by *Gastrolobium* sp., 31 July 1995, coll. A. Danks s.n. holotype PERTH 0425629, isotype H7302. Upper Hakea,

Two Peoples Bay Nature Reserve, under *Gastrolobium*, 31 July 1995, coll. Alan Danks s.n. H0891. Lower Hakea, Two Peoples Bay Nature Reserve, under *Gastrolobium*, 2 Aug. 1995, coll. Alan Danks s.n. H0892. Walpole-Nornalup National Park, The Knoll Drive, parking area, Walpole, under *Corymbia* [*Eucalyptus*] *calophylla*, *Agonis flexuosa*, 6 June 1992, coll. K. Syme & N. Bougher s.n. H6235. Walpole-Nornalup National Park, Shedley Drive, under *Eucalyptus jacksonii* and *Allocasuarina decussata*, 6 June 1992, coll. N. Bougher & K. Syme s.n. H6236. Firebreak Gully, Two Peoples Bay, under *Agonis flexuosa*, 21 Aug. 1992, coll. K. Syme s.n. H6255. Cemetery Road, Walpole-Nornalup National Park, under *Eucalyptus jacksonii*, 13 July 1994, coll. T. Lebel & D. Brown s.n. H6672. Corner of Thomson and Rate Roads, Walpole-Nornalup National Park, under *Eucalyptus jacksonii*, 14 July 1994, coll. D. Brown, T. Lebel & N. Bougher s.n. H6684. Hilltop Road Walpole-Nornalup National Park, 15 July 1994, coll. N. Bougher s.n. H7003. Two Peoples Nature Reserve, Hakea Gully, in thicket dominated by *Gastrolobium* sp., 31 July 1995, coll. A. Danks s.n. H7303.

Etymology: In reference to the purple colour of the flesh at the base of the stipe.

Discussion: Macroscopically, the characteristic purple flesh at the base of the stipe readily distinguishes *Cortinarius basipurpureus* from *Protoglossum violaceum* (see discussion for that species). The peridium of *C. basipurpureus* is also usually darker, duller and with more brown tones than that of *P. violaceum*.

2. *Cortinarius luteirufescens* (Bougher) Peintner & M.M. Moser, *Mycotaxon* 81: 180 (2002b)
(Figure 2, Plate 2A)

= *Thaxterogaster luteirufescens* Bougher, *Mycotaxon* 63: 44 (1997).

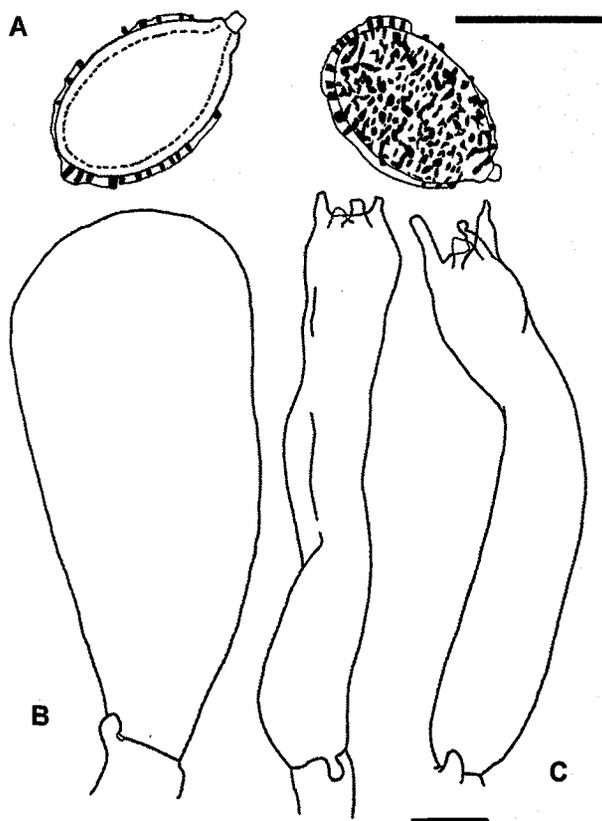


Figure 2. *Cortinarius luteirufescens* H6357. **A** Spores, scale bar = 10 µm. **B** Inflated hymenial element. **C** Basidia, scale bar = 10 µm.

Basidiomes hypogeous to subhypogeous, found growing singly, buried in soil under litter, gastroid, up to 20 mm diam., globose or broadly ellipsoidal, often pleated around the stipe. *Peridium* yellow with slight orange tint (4A6–4B7) with orange-red (6B8 or 7B8) stains in small patches, covered in thick non-glutinous slime, smooth, not bruising, few adhering debris, thick (approx. 1 mm), of two layers, outer layer broader and gelatinised, inner layer whitish in section and not gelatinised. *Gleba* loculate, bright rich brown (7E8–8F7), dry, not rapidly disintegrating after maturity, large irregular locules to 0.5 mm broad, empty, not noticeably radially arranged. *Columella/sterile tissue* a truncate or percurrent stipe-columella, if truncate extending a third to half of the way to the peridium, if percurrent up to 2–3 mm broad within the gleba, stipe very short (up to 1 mm long), white in section, central, terete, tapering, pale dull yellow, dry, but with a viscous gelatinous red collar at junction of peridium and stipe, matted-fibrillose, no obvious layering, solid, base tapering or bulbous; basal mycelium not conspicuous. *Macrochemical tests* 15% KOH on gleba instantly brown darkening further within a few minutes, FeSO₄ not recorded. *Odour* and *taste* not distinctive.

Spores bright brown (KOH), sometimes slightly axially asymmetrical, orthotropic, ovoid to elliptical to oblong-elliptical in both face view and profile excepting some slightly

adaxially flattened spores, 12–15 × 7.5–9 µm mean of 20 spores 13.5 ± 1.0 × 8.5 ± 0.5 µm, Q = 1.44–1.81, 1.64 ± 0.1 (KOH), ornamented with rods and very short ridges, ornaments to 1 µm tall in profile appearing irregular and densely crowded in face view; perisporium pale yellowish (KOH), conspicuous, adhering closely to the ornamentation; spores not aggregating; hilar appendix to 2 µm, conspicuous, tapering to truncate, entire; spores thin-walled, inamyloid non-dextrinoid (orange-brown in Melzer's solution); apex rounded and ornamented. *Basidia* hyaline, cylindro-clavate, 4-spored, 50–83 × 8–16 µm. *Cystidia* absent. *Hymenium* palisade, of yellowish (KOH), non-gelatinised, clavate, ellipsoidal or apically attenuated, thin-walled, 25–70 × 5–38 µm hymenial elements. *Subhymenium* to 58 µm broad, pseudoparenchymatous, of hyaline, non-gelatinised, broad, thin-walled, to 15 µm broad hyphae and end-cells. *Hymenophoral trama* to 40 µm thick, parallel, of hyaline and brown-encrusted, non-gelatinised, cylindrical, thin-walled, 3–11 µm broad hyphae, with some oleiferous hyphae also present. *Peridiopellis* (in longitudinal section) of three layers, the outermost layer to 14 µm thick, interwoven to subparallel, of hyaline, gelatinised and non-gelatinised, narrow cylindrical, thin-walled (though sometimes with minutely peg-like hyaline wall ornamentation), 3–5 µm broad hyphae overlying a middle layer, to 14.5 µm thick, of parallel to subparallel hyphae heavily encrusted with a golden brown (in KOH) pigment, non-gelatinised, inflated (sometimes appearing as polygonal cells), thick-walled, to 22 µm broad (polygonal cells to 30 µm broad), overlaying the innermost layer which is broad (to 613 µm), of interwoven to subparallel, hyaline, non-gelatinised, more or less cylindrical, thin-walled, to 15 µm broad hyphae. *Clamp connections* present in hymenium, rare in peridium.

Habitat and distribution: Known only from two collections from southern Western Australia from among litter under *Corymbia* [*Eucalyptus*] *ficifolia* and *Corymbia* [*Eucalyptus*] *calophylla*. Found fruiting from June–August.

Collections examined: W.A.: Walpole-Nornalup National Park, Nut Road, under *Eucalyptus ficifolia*, 10 June 1993, coll. N. Bougher s.n. holotype PERTH 04259599, isotype H6357. Two Peoples Bay Nature Reserve, Firebreak Gully, under *Corymbia* [*Eucalyptus*] *calophylla*, 13 Aug. 1991, coll. K. Syme KS331/91 H6254.

Etymology: Referring to the yellow, red-stained peridium of this species.

Discussion: *Cortinarius luteirufescens* is known from only two collections. This species may sometimes be confused with *Protoglossum luteum* because of variability in peridium colour and stipe-columella structure. These two, sometimes co-occurring, species are distinguished by the presence, in *Cortinarius luteirufescens*, of orange-red stains on the peridium and a collar of red slime around the stipe in combination with longer, narrower (ellipsoidal to oblong-ellipsoidal) spores, the ornamentation of which is more pronounced towards the apex of the spore. *Protoglossum luteum* by contrast lacks a glutinous collar and stains on its peridium (which may be much darker brown than that of *Cortinarius luteirufescens*), and has strongly globose to broadly ellipsoidal spores with relatively uniform spore ornamentation.

3. *Cortinarius sebosus* A.A. Francis & N.L. Bougher sp. nov.

(Figure 3, Plate 2B)

Inter *Cortinarios* (*sensu* Peintner *et al.* 2002b) hymenophoro incluso saltem usque ad fructificationis maturitatem sic pertans combinatione sporarum relative magnarum grosse ornatarum cum peridio eburneo luteo-griseo obscure purpureove leniter viscido et bulbo basali non concolori distinguenda.

Typus hic designatus PERTH 06234631.

Basidiomes hypogeous, fruiting in small groups within the first 15 cm of soil, secotoid, 12–25 × 10–14 mm, irregularly globose to subpyriform, margin inrolled and somewhat pleated around the base. *Peridium* cream (paler than 5B4), yellow- or greenish grey, or dull purple (near 17D3 to 18E4), slightly viscid when collected, smooth although initially covered with easily removable fibrils that make the peridium feel 'greasy' to the touch radially arranged from the base, not bruising, without much adhering debris, to 1 mm thick, of one layer, grey in longitudinal section. *Gleba* sublamellate of convoluted lamellae, initially white in button stage, then pale pinkish tan (near 6C3 to 6C4) maturing to bright brown (near 7E8), dry, not rapidly disintegrating after maturity, edges of tramal plates smooth and usually entire, lamellae rather loosely packed and radially arranged. *Columella/sterile tissue* a percurrent stipe-columella, to 7 mm broad inside the gleba, in longitudinal section white with a yellow tinge after being cut, central, terete, surface of base on mature specimens usually yellow (near 4A5) but may also be white, cream or orange, dry, smooth (though in some specimens conspicuously covered with white fibrils that extend onto the peridium and appear continuous with the partial veil), not forming

distinct layers, solid, base angular-bulbous, to 8 mm wide, protruding up to 3 mm below the peridium; partial veil inconspicuous but present between inrolled margin and stipe-columella, cortinoid, concolourous with overlying fibrils; basal mycelium inconspicuous. *Macrochemical tests* 15% KOH and FeSO₄ no reaction on peridium, flesh or the gleba. *Odour* is not distinctive and *taste* is slightly sour.

Spores yellow-brown (KOH), pale singly, symmetrical, orthotropic, ellipsoidal to subglobose or obovoid, 14–21 × 9–18 μm, mean of 62 spores 17.5 ± 1.5 × 12 ± 1.5 μm, Q = 0.99–1.63, 1.46 ± 0.11 (KOH), ornamented with warts, rods and small ridges, ornaments to 1 μm tall in profile, ornaments irregular and quite isolated in face view; perisporium yellowish (KOH), conspicuous, usually adhering closely but may flare irregularly (perhaps as a consequence of non-uniform ornament height); mature spores not aggregating; hilar appendix to 1.5 μm, conspicuous, slightly tapering truncate, entire; spores thin-walled, inamyloid, non-dextrinoid (bright yellow brown in Melzer's solution); apex rounded or slightly flattened, ornamented. *Basidia* hyaline to slightly yellowish, clavate but may appear cylindro-clavate to broadly obspathulate if distorted by pressure/slide preparation, 2-spored, 37–55 × 8–13.5 μm. *Cystidia* absent. *Hymenium* a palisade of hyaline, non-gelatinised, clavate to ellipsoidal, thin-walled, to 19 × 11 μm broad clamped elements. *Subhymenium* 5–10 μm broad, undifferentiated, of yellowish, non-gelatinised, more or less cylindrical, often branching, thin-walled, 2.5–4.5 μm broad hyphae. *Hymenophoral trama* to 8.5 μm thick, subparallel to parallel, of hyaline, non-gelatinised, more or less cylindrical, thin-walled, 4–11 μm broad hyphae. *Peridiopellis* (in longitudinal section) of two layers, outer layer 75–200 μm thick, quite loosely interwoven, of hyaline, gelatinised and intact, cylindrical, thin-walled, very thin (approximately 1–2.5 μm broad) hyphae, inner layer 370–450 μm, more tightly interwoven, of yellow-pigmented, non-gelatinised, broad, thin-walled, 8–21.5 μm broad hyphae. *Clamp connections* present in the peridium and hymenophoral trama.

Habitat and distribution: Collected from Jarrahdale (average rainfall >1000 mm/yr) under *Eucalyptus marginata* and *Corymbia* [*Eucalyptus*] *calophylla* to Kellerberrin (average rainfall <400 mm/yr) under *Allocasuarina campestris*. Fruiting June and July.

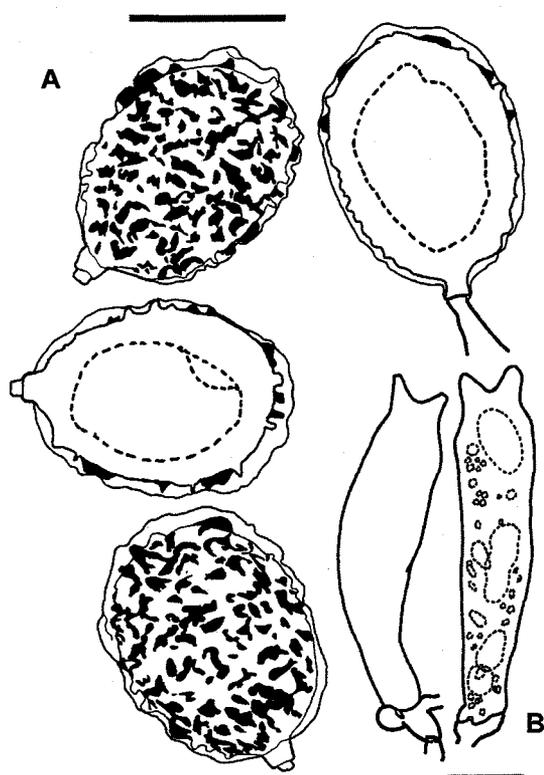


Figure 3: *Cortinarius sebosus* sp. nov. PERTH 06234631. **A** Spores, scale bar = 10 μm. **B** Basidia, scale bar = 10 μm.

Collections examined: W.A.: Hilltop between Site 17A and B, Higginson Road, 16 km along Bencubbin-Kellerberrin Rd, north of Kellerberrin, under *Allocasuarina campestris*, 5 July 1995, coll. W. Dunstan s.n. holotype here designated as PERTH 06234631, isotype H7265. Ashendon Road, next to a siding road, under *Eucalyptus marginata*, *Corymbia* [*Eucalyptus*] *calophylla*, 13 June 1992, coll. N. Bougher, D. Xu, R. Hilton, K. Syme & R. Shultz s.n. H6248. Hilltop site between Site 17A and B, Higginson Rd, 16 km along Bencubbin-Kellerberrin Rd, Kellerberrin, under *Allocasuarina campestris*, 29 June 1995, coll. N. Bougher s.n. H7250.

Etymology: In reference to the greasy fibrils initially covering the peridium of this species.

Discussion: *Cortinarius sebosus* is characterised by the combination of the large, coarsely ornamented spores, and short, white to orange basal 'bulb' that contrasts with the peridium. No other described species of secotioid *Cortinarius* has this combination of characters. *Cortinarius peraurantiacus* Peintner & M.M. Moser and *Cortinarius cartilagineus* (G. Cunn.) Peintner & M.M. Moser also possess small button-like stipe portions. However, these species have smaller spores than *Cortinarius sebosus* (13–15 × 7–9 μm and 14–15 × 8.5–10 μm respectively) and their stipes are concolourous with their peridia. The infrageneric relationships of *Cortinarius sebosus* are currently undetermined; however, a study is being undertaken by

the current authors to assess the phylogenetics of the Australian sequestrate cortinarioid fungi including this species. It should be noted that the term 'greasy' in reference to the peridial fibrils (hence '*sebosus*'), does not refer to any production of lipids on the peridial surface, but is merely used to describe its particularly greasy texture.

4. *Cortinarius walpolensis* A.A. Francis & N.L. Bougher sp. nov.

(Figure 4, Plate 1G)

Cortinarius levisporus primo aspectu maxime simile, sed peridio multo latiore (360–1000 μm crasso), peridiopellis hyphis latioribus luteis non gelatinosis crassiparietis non incrustatis, et basidiis longioribus (36.5–39.5 \times 6.5–9 μm).

Typus hic designatus PERTH 06234623.

Basidiomes hypogeous, fruiting in small groups in deep litter, gastroid, 6–19 \times 4–19 mm, globose, subglobose or turbinate with a flattened apex, often with a short stipe-like basal protrusion. *Peridium* white to off-white sometimes with cinnamon fibrils, dry, fibrillose with a satin sheen, bruising and discolouration of fibrils (cinnamon to brown) inconsistent, without much adhering debris, thin (0.5 mm), of a single layer, white in longitudinal section. *Gleba* loculate, pale-tan brown maturing to ochre-brown, rusty and finally brown (near 7E7 to 7D7), dry, not rapidly disintegrating after maturity, locules to 1 mm long, empty, labyrinthoid with no obvious radial arrangement. *Columella/sterile tissue* a truncate to percurrent columella tapering from the bulbous base towards the apex, 9–12 \times 1–2 mm, white to translucent in section, central, more or less terete, white, dry, silky, of a single layer, solid and fibrous, base bulbous protruding up to 3 mm below peridium; basal mycelium of conspicuous white rhizomorphs. *Macrochemical tests* not recorded. *Odour* faintly fungoid or slightly of iodine, *taste* not recorded.

Spores golden brown (KOH), slightly asymmetrical, heterotropic, elliptical in profile, in face view elliptical but very slightly adaxially flattened, 7–10 \times 3–5.5 μm , mean of 80 spores 8.0 \pm 0.5 \times 5.0 \pm 0.5 μm , Q = 1.45–2.67, 1.72 \pm 0.16 (KOH), ornamented with small warts or rods, ornaments to 0.5 μm in profile, slightly irregular in face view; perispodium absent or inconspicuous and closely adhering; mature spores not aggregating; hilar appendix around 0.5 μm long, conspicuous, equal, truncate, entire; thin-walled, inamyloid, non- to weakly dextrinoid (dark orange-brown); apex rounded and ornamented. *Basidia* yellowish, cylindro-clavate to cylindrical, 4-spored, 36.5–39.5 \times 6.5–9 μm . *Cystidia* absent. *Hymenium* palisade, of brown-yellow, non-gelatinised, inflated, thin-walled, to 25 \times 8 μm clamped elements. *Subhymenium* 5–10 μm wide, pseudoparenchymatous, of brown-yellow, non-gelatinised, short-branched, thin-walled, 3.5–9 μm broad elements. *Hymenophoral trama* 12.5–72.5 μm , subparallel to interwoven, of brown-yellow to hyaline, non-gelatinised, cylindrical, thin-walled, 4.5–17.5 μm broad hyphae. *Peridiopellis* (in longitudinal section) structure varies in a gradient 360–1000 μm thick from the outside towards the hymenium but does not form distinct layers, towards the outermost peridiopellis the hyphae are interwoven (sometimes so tightly as to appear pseudoparenchymatous) and undulating, hyaline, non-gelatinised (nor are those closer to the hymenium), cylindrical to somewhat inflated, thin-walled and 2–11.5 μm broad, closer to the hymenium the hyphae quickly become subparallel, yellow, more uniformly cylindrical, thick-walled (to 2 μm thick), 6–10 μm broad and grade in to the hymenophoral trama. *Clamp connections* present in all tissues but obscured in thick-walled hyphae.

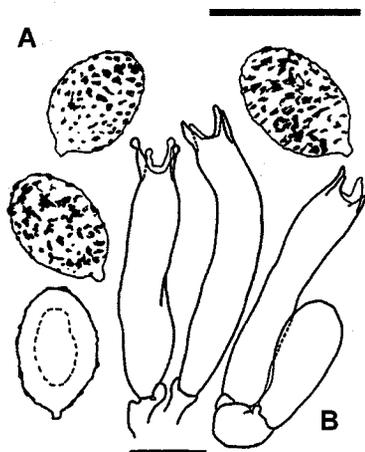


Figure 4: *Cortinarius walpolensis* sp. nov. PERTH 06234623.

A Spores. Note the small size of the spores compared with those of *Descomyces* and *Quadrispora* species, scale bar = 10 μm .

B. Basidia, scale bar = 10 μm .

Habitat and distribution: In Western Australia known from four collections found in deep litter among *Eucalyptus marginata*, *Corymbia* [*E.*] *marginata* and *Allocasuarina campestris* in the Walpole region. Fruiting June and July.

Collections examined: W.A.: Hull Road, Dawson Plantation, near Walpole, under *Eucalyptus marginata* and *Corymbia* [*E.*] *calophylla*, 13 July 1994, coll. T. Lebel s.n. holotype here designated as PERTH

06234623, isotype H6646. Yarra's property, North Walpole Road, under *Allocasuarina campestris*, 12 June 1988, coll. Y. Korczynskyi s.n. H4315. Cemetery Road Walpole-Nornalup National Park, under *Allocasuarina campestris*, 13 July 1994, coll. N. Bougher, M. Brundrett, D. Brown & T. Lebel s.n. H6665. Hilltop Road Walpole-Nornalup National Park, 15 July 1994, coll. T. Lebel s.n. H7005.

Etymology: In reference to the area from which this fungus has been collected.

Discussion: *Cortinarius walpolensis* appears to be closely related to *C. levisporus* (Masse & Rodway) Peintner & M.M. Moser with the two species chiefly distinguished by differences in peridiopellis structure. In *Cortinarius levisporus* (isotype HO100666 Rodway 653 examined), the peridium is a very thin (15–30 µm wide) repent cutis of thin (1–3 µm), slightly gelatinised, hyaline hyphae, with a hyaline encrustation on the outer surface, whereas the peridium of *C. walpolensis* is very broad (360–1000 µm), non-gelatinised and yellow-pigmented, and the broader (2–11.5 µm), thick-walled hyphae have no visible encrustations in KOH. The basidia of *Cortinarius walpolensis* are also larger than those of *C. levisporus* (25–34 × 4–6 µm Beaton *et al.* 1985). Spore size would have suggested placement of both of these species in *Thaxterogaster* section *Microsporogaster* Singer & Smith (1963), however, we await further molecular data as to the phylogenetic status of that section. *Cortinarius walpolensis* is, so far, only known from the south coast region of Western Australia, whereas *C. levisporus* occurs in Victoria and Tasmania (Beaton *et al.* 1985).

2. *Dermocybe*

Dermocybe globuliformis (Bougher) Bougher & Trappe, *Australasian Mycologist* 20: 2 (2002)
(Figure 5, Plate 2C, H)

= *Cortinarius globuliformis* Bougher in Bougher & Malajczuk, *Transactions of the British Mycological Society* 86: 301 (1986).

Basidiomes subhypogeous to hypogeous, fruiting in small groups among litter and soil, pileate, short, squat, pileus 5–30 mm broad, broadly convex, flattening to become plane, finally slightly upturned with or without a depressed centre, margin initially incurved and entire becoming plane and split in older specimens. *Peridium* bright yellow (2A6–2B6) becoming dark grey-brown when exposed to atmosphere for long periods, dry, smooth and shiny to fibrillose, not bruising, without much adhering debris, thin, one-layered. *Gleba* lamellate, gills initially bright yellow maturing to rust brown (6E8), dry, rather fragile, eroded in mature basidiomes, crowded, radially arranged, attachment adnate or subdecurrent. *Columella/sterile tissue* stipe very short in relation to pileus diameter, 2–7 mm long, 2–4 mm broad, central, terete, equal, initially bright yellow becoming dull, of two layers, solid, base rounded but not bulbous; partial veil membranous sometimes remaining entire covering hymenium otherwise splitting radially to absent shiny yellow to dull yellow; basal mycelium conspicuous and matt like, bright yellow. *Macrochemical tests* 15% KOH dull red on peridium and pileus context, bright red on stipe context, dark red-brown to black on lamellae, FeSO₄ no reaction to dull yellow on pileal peridium. *Odour* and *taste* not recorded.

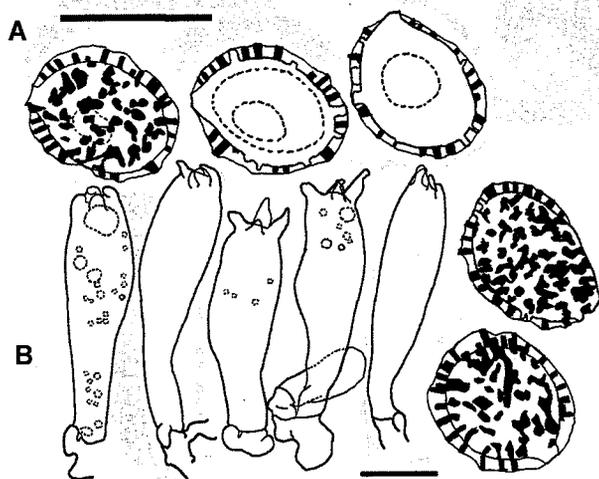


Figure 5: *Dermocybe globuliformis* A Spores. Note the asymmetric shape of the spores. H0359, scale bar = 10 µm. B Basidia. H0359, scale bar = 10 µm.

Spores pale yellowish (in KOH), asymmetric, heterotropic (and ballistosporic), elliptical to subglobose in profile, subglobose in face view, 9–12 × 6–9 µm, mean of 35 spores 10 ± 0.5 × 7 ± 0.5 µm, Q = (1.27) 1.45 ± 0.11 (1.71) in KOH, ornamented with rods and short ridges both to 1 µm tall in profile; perisporium pale yellow, inconspicuous, adhering closely to ornamentation; spores not aggregating; hilar appendix small, inconspicuous, tapering to truncate, entire; spores thick-walled, inamyloid, faintly dextrinoid (dark brown in Melzer's

solution); apex rounded and ornamented. *Basidia* hyaline, clavate, 4-spored, $20\text{--}30 \times 6\text{--}10 \mu\text{m}$. *Cystidia* absent. *Hymenium* palisade, of hyaline to pale red-brown (KOH), non-gelatinised, clavate to cylindrical, thin-walled, $17.5\text{--}21.5 \times 6\text{--}8.0 \mu\text{m}$ elements. *Subhymenium* a narrow, hyaline to pale red-brown (KOH) layer of non-gelatinised, cylindrical, thin-walled, 2–3 μm broad, much branched hyphae. *Hymenophoral trama* parallel of pale pink (KOH), non-gelatinised, more or less cylindrical, up to 12 μm broad hyphae. *Peridiopellis* (in longitudinal section) of a single layer, relatively broad, a repent cutis of red-brown to pale red-brown (pigmentation concentrated in the outer region of the peridiopellis, in KOH), non-gelatinised, cylindrical, thin-walled, 2–5 μm broad hyphae. *Clamp connections* present in peridiopellis and hymenium.

Habitat and distribution: Abundant throughout southern Australia in a variety of soils and eucalypt-dominated vegetation communities. Often seated within bright yellow mycelium at or near the soil surface. Fruiting July and August.

Collections examined: W.A.: Amphion, Mycorrhizal Plots, Dwellingup, under *Eucalyptus marginata*, 5 July 1983, coll. N. Bougher s.n. isotype H0354. Shannon River, Pemberton side of Northcliffe, under *Corymbia* [*Eucalyptus*] *calophylla*, *E. marginata* and associated understorey ('teatree' Myrtaceae), 18 June 1981, coll. N. Malajczuk s.n. H0121. East side of Dwellingup Collie Road just south of Harvey turnoff, 13 Aug. 1981, coll. N. Malajczuk s.n. H0201. Cobiac, Jarrahdale, under *Eucalyptus marginata* and *Corymbia* [*E.*] *calophylla*, 20 July 1983, coll. N. Malajczuk s.n. H0358. 7 Day Road, Manjimup, under *Eucalyptus marginata*, *Corymbia* [*E.*] *calophylla*, 4 Aug. 1983, coll. N. Bougher s.n. H0359. Lockwood Road, Bickley, under *Eucalyptus marginata*, *Corymbia* [*E.*] *calophylla*, 29 June 1992, coll. M. Pearce s.n. H0654. Mundaring Shire Ashendon Rd, under *Eucalyptus marginata* and *Corymbia* [*E.*] *calophylla*, 18 July 1993, coll. M. Castellano Trappe 14637 (PERTH). Mundaring Ashendon Rd, under *Eucalyptus marginata*, 18 July 1993, coll. J. Trappe Trappe 14643 (PERTH). Jarrahdale Serpentine National Park, under *Eucalyptus marginata*, 19 July 1993, coll. M. Castellano Trappe 14660 (PERTH). Brockman Highway 40.3 km from Nannup Brook, under *Eucalyptus marginata*, 21 July 1993, coll. N. Bougher Trappe 14814 (PERTH). Off Narrogin Rd to Williams Rd on Contine Rd, under *Eucalyptus wandoo*, 23 July 1993, coll. J. Trappe Trappe 14943 (PERTH). Williams to York Rd 4.6 km from Wandering Rd junction Dryandra State Forest, under *Eucalyptus accedens*, 23 July 1993, coll. W. Colgan Trappe 14955 (PERTH). Amphion Block, Dwellingup, under *Eucalyptus marginata*, 12 Aug. 1993, coll. N. Malajczuk, N. Bougher & I. Tommerup s.n. H6371. Plavins Block, Murray Road, east of Dwellingup, under *Eucalyptus marginata*, 12 July 1994, coll. s.n. H6640. Cemetery Road, Walpole-Nornalup National Park, under *Eucalyptus jacksonii*, 13 July 1994, coll. N. Bougher s.n. H6677. Hilltop Road Walpole-Nornalup National Park, under *Eucalyptus jacksonii*, *E. diversicolor*, 15 July 1994, coll. N. Bougher M. Brundrett s.n. H7002. Amphion Block, near Murray Road, about 15 km east of Dwellingup, under *Eucalyptus marginata*, 4 July 1995, coll. W. Dunstan s.n. H7260. Amphion Forest Block, off Murray River road, Dwellingup, under *Eucalyptus marginata*, 2 July 1996, coll. J. Catchpole & S. Bolsenbroek s.n. H7327.

Etymology: In reference to the short squat appearance of the basidiomes.

Discussion: *Dermocybe globuliformis* was transferred from *Cortinarius* into the genus *Dermocybe* by Bougher & Trappe (2002) on the basis of its bright pigmentation (a yellow pigment which reacts characteristically with KOH) and phylogenetic position (rDNA sequence data of Peintner *et al.* 2001 accession numbers AF388870, AF388794, AF388775 and AF325582). More collections of *Dermocybe globuliformis* have been lodged in herbaria in Australia than of any other cortinarioid sequestrate species with the possible exception of *Descomyces albus*, probably because of the former's conspicuous colouration and shallow position in the soil. Examination of the range of variation in the Western Australian collections of this species yielded a greater range in spore sizes and more predominantly ellipsoidal spores (Fig. 5A) than indicated previously (Bougher & Malajczuk 1986). The macroscopic red reaction of the peridium with 15% KOH is also seen as soon as sections are placed in 3% KOH and microscopically as a prominent colouration of the tissues of the hymenial elements, subhymenium, hymenophoral trama and peridiopellis.

3. *Descomyces*

Key to species of *Descomyces* currently recorded from Western Australia.

- | | | |
|----|--|----------------------------|
| 1 | Inner peridiopellis a polycystoderm of inflated elements. | 2. <i>Descomyces albus</i> |
| 1: | Inner peridiopellis not a polycystoderm, inflated end cells scattered and intermingled with predominantly cylindrical hyphae. | |
| 2 | Thick-walled golden hyphae copious on peridiopellis; spores citriform, subfusoid or ellipsoidal, with a prominent, often extended rostrum not obscured by the perisporium. | 1. <i>D. albellus</i> |
| 2: | Thick-walled golden hyphae sparse on peridiopellis; spores consistently ellipso-fusoid to subfusoid with a small rostrum frequently obscured by the perisporium. | 3. <i>D. angustisporus</i> |

1. *Descomyces albellus* (Masse & Rodway) Bougher & Castellano, *Mycologia* 85: 282 (1993) (Figure 6, Plate 1D)

= *Hymenogaster albellus* Masse & Rodway in Masse, *Kew Bull. Misc. Inform.* 1898: 126 (1898).

Hymenogaster zeylanicus Petch, *Ann. Roy. Bot. Gard. (Peradeniya)* 6: 207 (1971).

Hymenogaster maideni Rodway, *Pap. & Proc. Roy. Soc. Tasmania* 1920: 157 (1921).

Basidiomes hypogeous, growing singly or in groups amongst litter, gasteroid, 5–30 mm diam., globose, subglobose or irregular. *Peridium* white or cream with yellow tufts or fibrils initially quite dense becoming scattered or disappearing, dry, fibrillose, not bruising, usually without much adhering debris, thin (< 0.5 mm), of two layers, outer layer yellow patchy and more or less fibrillose to tufted, inner layer continuous and white. *Gleba* loculate, initially pale cream or grey becoming dark brown, dry, not rapidly disintegrating after maturity, locules to 1 mm long, empty, no obvious radial arrangement. *Columella/sterile tissue* usually absent, if present a sterile basal pad or dendroid or truncate columella, small, more or less central, variable shape in cross-section, white to cream, dry, of a single layer, solid, base tapering; basal mycelium usually inconspicuous, white. *Macrochemical tests* not recorded. *Odour* and *taste* mildly fungoid but not distinctive.

Spores bright yellow-brown (KOH), symmetrical, orthotropic, citriform, subfusoid or ellipsoidal, 15–21 × 6.5–10.5 µm, mean of 79 spores 18.0 ± 1.5 × 8.5 ± 0.86 µm, Q = 1.78–2.57, 2.11 ± 0.19 (KOH), irregularly, ornamented with rods and short ridges both to 1 µm tall in profile, appearing somewhat irregular and crowded in face view; perisporium yellow-brown (in KOH), conspicuous, may be loose and flaring; spores not usually clumping; hilar appendix large though sometimes obscured by the ornamentation, truncate tapering, entire; spores thick-walled, inamyloid, inconsistently dextrinoid; apex rostrate and unadorned. *Basidia* hyaline but encrusted with a yellow pigment when necrotic, clavate but collapsing soon after maturity, one- and two-spored, 23–40 × 6–10 µm. *Cystidia* absent. *Hymenium* a palisade, of hyaline, non-gelatinised, clavate, thin-walled, to 23 × 13 µm broad basidia and basidioles. *Subhymenium* narrow, poorly differentiated, of hyaline, non-gelatinised, more or less cylindrical though often branching, thin-walled, to approximately 12 µm broad hyphae. *Hymenophoral trama* narrow, parallel to slightly interwoven, of hyaline or pale yellow (in KOH), non-gelatinised, cylindrical, thin-walled, 3 or 4 µm broad hyphae. *Peridiopellis* (in longitudinal section) of two layers, outer layer a relatively thin cutis of golden, non-gelatinised, cylindrical, much-branched, thin- to thick-walled (to 1 µm thick), 4–15 µm broad hyphae; inner layer broader, of interwoven, hyaline, non-gelatinised, thin-walled, cylindrical hyphae (3–7 µm broad) with cylindrical or less commonly vesiculose or pyriform end-cells (up to 35 × 15 µm), the end cells forming a trichoderm as they gradually merge with the outer layer. *Clamp connections* present and conspicuous in all tissues.

Habitat and distribution: Common among *Eucalyptus* dominated forests and woodlands of south Western Australia and in Western Australian plantings under a variety of local and eastern Australian eucalypts. In Australia, fruiting from June to October.

Collections examined: W.A.: Inglehope (near Dwellingup), under *Pinus* sp., 25 June 1981, coll. N. Malajczuk s.n. H0145. Cobiac, Jarrahdale, under *Eucalyptus marginata*, *Corymbia [Eucalyptus] calophylla*, 8 Sept. 1981, coll. N. Malajczuk s.n. H0213. Dieback replant area, Inglehope, near Dwellingup, under *Eucalyptus microcorys*, *Eucalyptus obliqua*, 7 July 1982, coll. N. Malajczuk s.n. H0278. Inglehope Arboretum, under *Eucalyptus obliqua*, *E. saligna*, 7 July 1982, coll. N. Malajczuk s.n. H0280. Gleneagle Forest, 11 Sept. 1982, coll.

N. Malajczuk s.n. H4904. CSIRO Glasshouse, Floreat Park, under *Eucalyptus camaldulensis*, 4 Oct. 1991, coll. *N. Bougher s.n.* H0608. Collie, Nanga Rd, under *Eucalyptus marginata*, 19 July 1993, coll. *J. Trappe* Trappe 14679 (PERTH). Junction of Murray Valley Rd and Nanga Rd, under *Eucalyptus marginata*, 20 July 1993, coll. *J. Trappe* Trappe 14742 (PERTH). Porongurup National Park junction of Woodlands Rd and Scenic Drv, under *Corymbia [Eucalyptus] calophylla* and *E. redacta*, 22 July 1993, coll. *M. Castellano, T. Lebel & W. Colgan III* Trappe 14905 (PERTH). The Knoll Walpole Nornalup National Park, 14 July 1994, coll. *T. Lebel s.n.* H7021. **Other:** Tas.: McRobies Gully, July 1920, coll. *Rodway s.n.* designated as isotype of *Hymenogaster maidenii* HO 100573. Near Hobart, McRobies Gully, date?, coll. *L. Rodway* Rodway 117 designated as isotype of *Hymenogaster albellus* HO 100580 and K. Georges Plain, 3 May 1990, coll. *J. Trappe s.n.* H1425. Sri Lanka, Hakgala, Mar. 1922, coll. *T. Petch s.n.* designated as isotype of *Hymenogaster zeylanicus* PDD 8277.

Etymology: In reference to the off-white peridium.

Discussion: As in *Descomyces albus* the mean spore dimensions of the examined Western Australian collections of *D. albellus* fall within the range of values ($13\text{--}20 \times 7\text{--}13 \mu\text{m}$) initially given in Bougher & Castellano (1993). Some spores, however, are considerably both longer and wider ($15\text{--}21 \times 6.5\text{--}10.5 \mu\text{m}$) than the largest spores referred to by Bougher & Castellano (1993). Again, as in *Descomyces albus*, we believe that this species accommodates a broader range of variation in spore size than previously reported. Because of such variation the presence of a polycystoderm is of primary importance in distinguishing *Descomyces albus* and *albellus*. This can be difficult if the peridium is degraded or the section is suboptimal. *Descomyces albellus* and *D. albus* can co-

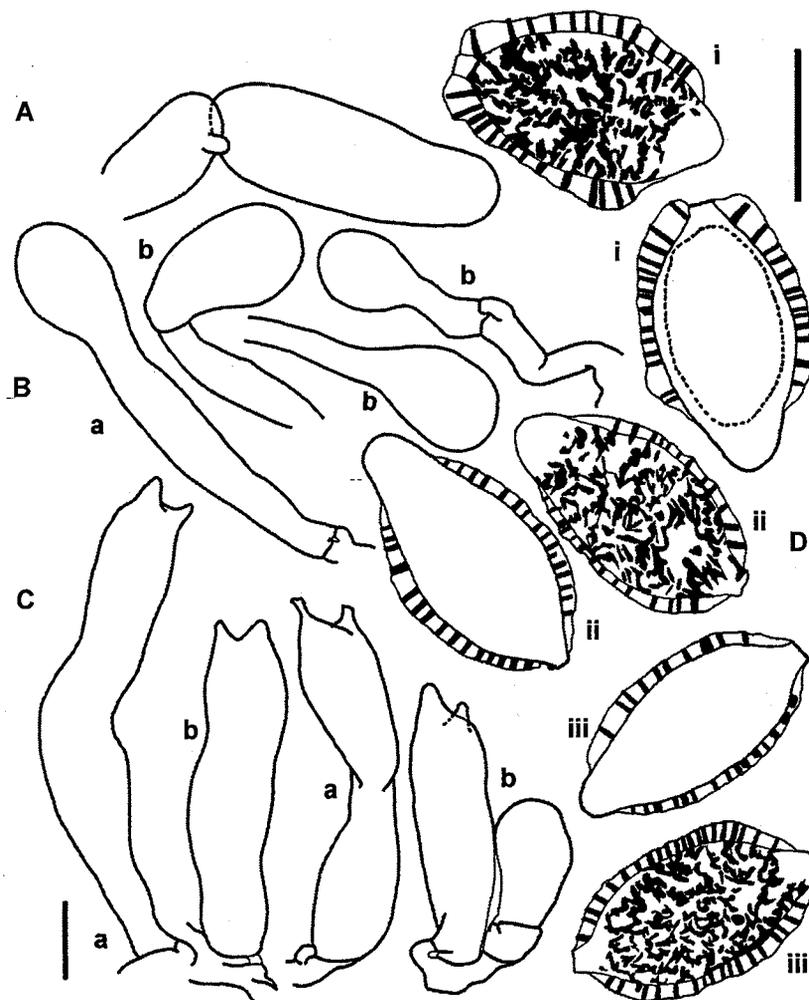


Figure 6: *Descomyces albellus* A Thin-walled golden hyphae of the outer peridium. B Inflated elements of the inner peridium a H7021 b H1425. C Basidia a H1425 b H0721, scale bar for A, B and C = 10 μm . D Spores i H0145 ii H7021 iii H0213, scale bar = 10 μm .

occur in eucalypt plantations and in natural ecosystems, providing ample opportunities for populations to interbreed. The extent of genetic isolation is unknown for these undoubtedly closely related species.

2. *Descomyces albus* (Klotzsch) Bougher & Castellano, *Mycologia* 85: 280 (1993)
(Figure 7, Plate 1C)

- = *Hymenangium album* Klotzsch apud A. Dietr., *Fl. Regn. Boruss.* 7: 466 (1839).
- = *Hymenogaster albus* (Klotzsch) Berk. & Broome, *Ann. Mag. Nat. Hist. ser. 1* 13: 349 (1844).
- = *Hymenogaster klotzschii* Tul., *Fung. Hypogaeal.*: 64 (1851).
- = *Splanchnomyces albus* Corda emend Zobel apud Corda, *Icones Fungorum* 6: 40 (1854).
- Hymenogaster maurus* Maire, *Bull. Soc. Hist. Nat. Afrique. N.* 22: 18 (1931).
- Hymenogaster weiblianus* Maire, *Bull. Soc. Hist. Nat. Afrique N.* 22: 20 (1931).

Basidiomes hypogeous, growing singly or in groups under litter, gasteroid, 5–20 mm diam., globose, subglobose or irregular. *Peridium* white or cream with yellow stains or fibrils initially quite dense becoming scattered or disappearing, dry, fibrillose, not bruising, not much adhering debris, thin, of two layers, outer layer yellow patchy and more or less fibrillose the inner continuous and white. *Gleba* loculate, initially white becoming pale cream or grey finally cinnamon brown, dry, not rapidly disintegrating after maturity, locules to 1 mm long, empty, no obvious radial arrangement. *Columella/sterile tissue* usually absent, if present a sterile basal pad or dendroid or small truncate columella, if dendroid then narrow (strands \pm 1 mm broad), more or less central, variable shape in cross-section, white to cream, dry, of a single layer, solid, base tapering; basal mycelium usually inconspicuous, white. *Macrochemical tests* not recorded. *Odour* and *taste* not recorded.

Spores yellow-brown (in KOH), symmetrical, orthotropic, citriform, $14\text{--}23.0 \times 5.5\text{--}16 \mu\text{m}$, mean of 40 spores $17.5 \pm 1.5 \times 9.0 \pm 1.1$, $Q = 1\text{--}2.67$, 2.01 ± 0.27 (KOH), irregularly though quite closely ornamented with rods and short ridges, both to $3 \mu\text{m}$ tall in profile, appearing irregular and in some specimens crowded; perisporium yellow-brown (KOH), conspicuous, usually adhering relatively closely; spores generally not aggregating; hilar appendix reasonably large, conspicuous though may be obscured by the ornamentation, tapering and truncate, entire; spores thick-walled, inamyloid, inconsistently dextrinoid; apex rostrate and unadorned. *Basidia* hyaline though encrusted with a yellow pigment when necrotic, clavate though collapsing soon after maturity, one- and two-spored, $25\text{--}31 \times 7\text{--}10 \mu\text{m}$. *Cystidia* absent. *Hymenium* a palisade of hyaline, non-gelatinised, clavate to ellipsoidal, thin-walled, to $17 \mu\text{m}$ broad elements. *Subhymenium* variable, from narrow and undifferentiated to a broad hyaline pseudoparenchymatous layer, more or less hyaline, non-gelatinised, cylindrical to inflated cells, thin-walled, to $12 \mu\text{m}$ broad. *Hymenophoral trama* parallel to subparallel, hyaline (KOH), non-gelatinised, cylindrical, to $10 \mu\text{m}$ broad hyphae. *Peridiopellis* (in longitudinal section) of two layers, outer layer a relatively thin cutis of golden, non-gelatinised, cylindrical, much-branched, thick-walled ($1 \mu\text{m}$), $5\text{--}15 \mu\text{m}$ broad hyphae, inner layer broader, interwoven and forming a polycystoderm, of hyaline, non-gelatinised, cylindrical to inflated hyphae with end cells commonly clavate, vesiculose or pyriform, thin-walled, to $20\text{--}35 \times 14\text{--}17 \mu\text{m}$. *Clamp connections* present and conspicuous in all tissues.

Habitat and distribution: Common among *Eucalyptus* dominated natural forests and woodlands of southern Western Australia and also found growing in Western Australia under a variety of eucalypts introduced from eastern Australia. Fruiting in Australia from May to November.

Collections examined: W.A.: CSIRO glasshouse, Floreat Park '*Descomyces albus* from *Eucalyptus globulus* pot cultures 5 months old', (in glasshouse for 4 months) inoculated with isolate E1160, 14 Nov. 1990, coll. I. Tommerup s.n. H0574. Channybearup Plantation Manjimup, *Eucalyptus viminalis*, 20 June 1991, coll. N. Malajczuk & G. Hardy s.n. H0584. CSIRO near Workshop next to Cooling Tower, Floreat, *Eucalyptus marginata*, 14 July 1991, coll. N. Bougher, I. Tommerup & S. Snelling s.n. H0596. Lot 406 Denmark, *Eucalyptus patens*, *Corymbia* [E.] *calophylla*, *Allocasuarina decussata*, 27 June 1992, coll. K. Syme s.n. H0653. CSIRO grounds, near the old workshop, Floreat, *Eucalyptus marginata*, 13 June 2001, coll. S. Bolsenbroek s.n. H0716. Channybearup W.A. MH159014, *Eucalyptus* spp., 9 Sept. 1986, collector unknown s.n. H1056. Quininup, 9 Sept. 1982, coll. J. & M. Trappe s.n. H4903. Walpole North, Dawson Plantation, Hull Road, 30-year-old mixed Eastern States *Eucalyptus* sp., 9 June 1993, coll. N. Bougher s.n. H6355. Walpole-Nornalup National Park, Tingle East Drive, *Eucalyptus jacksonii*, *E. diversicolor*, 11 June 1993, coll. N. Bougher s.n. H6363. **Other**: Tas.: Ritters Tree Farm, 5 May 1990, coll. M. Castellano s.n. H1490. Sheffield Rd, 4 May 1990, coll.

J. Trappe & M. Castellano s.n. H1447. Great Britain, Glasgow, 1830, coll. *J.D. Hooker* (designated as isotype of *Hymenogaster albus* K).

Etymology: In reference to the white peridium.

Discussion: The spores of the Western Australian representatives of *Descomyces albus* show considerable variation in spore size, shape and ornamentation and in the degree of inflation of the hyphae of the polycystoderm. The mean dimensions of the spores of the Western Australia collections examined fell within the range of sizes detailed in Bougher & Castellano (1993); however, both the length and the width of the largest spores

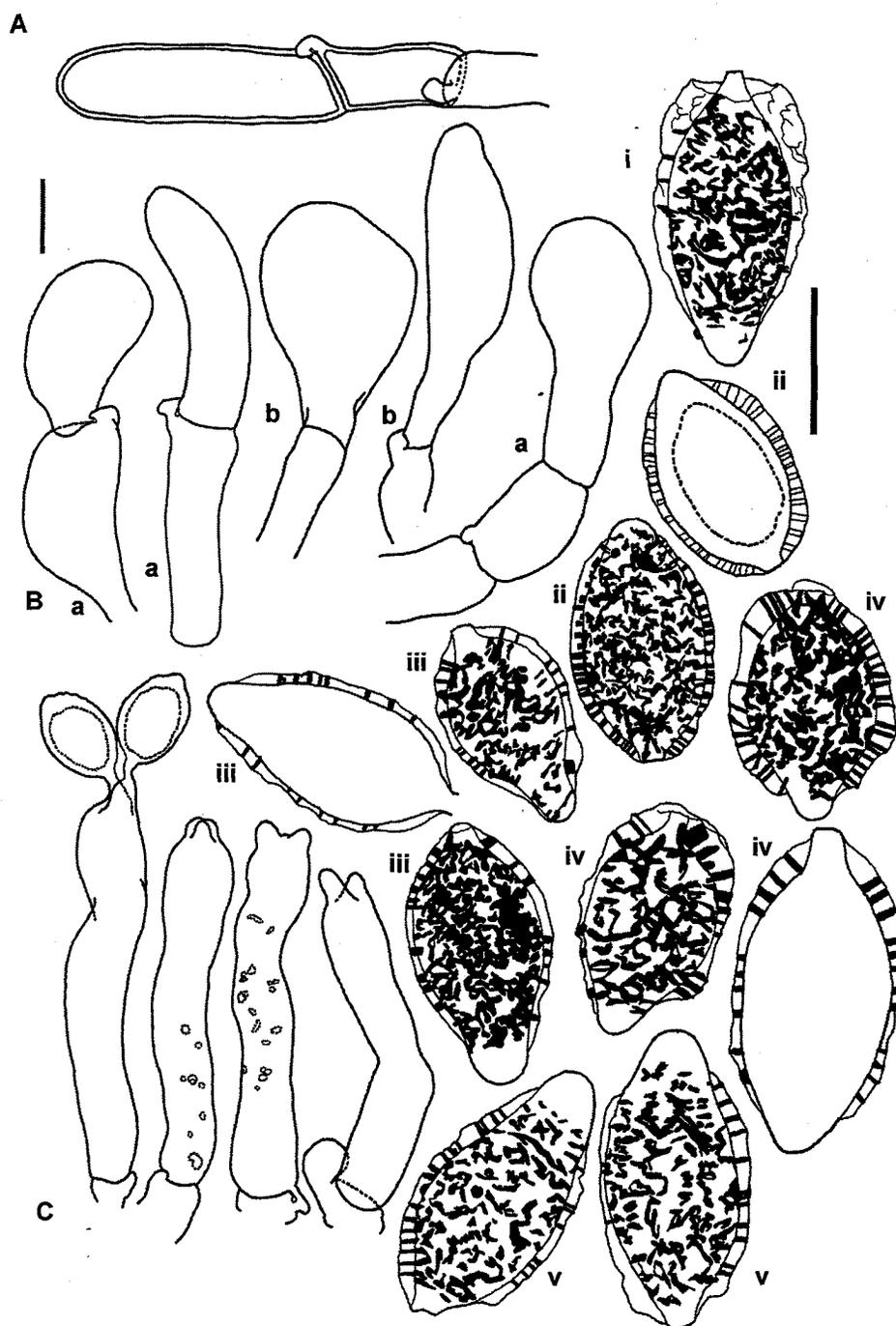


Figure 7: *Descomyces albus* A Thick-walled golden hypha of the outer peridium, H0584. B Inflated elements of the polycystoderm. a H1490 b H4903. C Basidia. H1490, scale bar for A, B and C = 10 μ m. D Spores. Note the large variation in spore size encapsulated within the species concept of *Descomyces albus*. i H0584 ii H1490 iii H0574 iv H0635 v. H4903, scale bar = 10 μ m.

measured (spores $14\text{--}23.0 \times 5.5\text{--}16 \mu\text{m}$) were considerably greater than the extremes given in the 1993 description ($13\text{--}19 \times 7\text{--}11 \mu\text{m}$). Despite this variation, the combined presence of a polycystoderm and overlying golden hyphae leads us to suggest a greater range of variation in spore size in *Descomyces albus* than has been previously recognised.

3. *Descomyces angustisporus* A.A. Francis & N.L. Bougher sp. nov.
(Figure 8, Plate 1B)

Descomyces albellus primo adpectu maxime simile, sed extra-peridiopellis hyphis aureis crassiparietis sparsioribus, et sporis sat uniformiter ellipso-fusiformibus earum rostris relative obtusis et ab perisporiis fere obtectis.

Typus hic designatus PERTH 06234615.

Basidiomes hypogeous, fruiting in small groups within the first 15 cm of soil, gasteroid, to $15 \times 8 \text{ mm}$, ellipsoidal, almost globose to flattened. *Peridium* white (only sparse yellow fibrils), dry, slightly fibrillose (glistening under lens), not bruising, without much adhering debris, thin, fragile, macroscopically of a single layer. *Gleba* loculate, pale fawn when young maturing to bright brown, dry, not rapidly disintegrating after maturity, locules to 1 mm diam., empty, arranged irregularly. *Columella/sterile tissue* usually absent, if present a small sterile base; basal mycelium inconspicuous. *Macrochemical tests* 15% KOH, no reaction on gleba or peridium. *Odour* and *taste* not distinctive.

Spores yellow-brown (KOH), symmetrical to slightly asymmetrical, orthotropic, ellipso-fusoid to subfusoid in both face view and profile though asymmetrical spores slightly adaxially applanate in profile, $15.5\text{--}22.5 \times 7.0\text{--}10.5 \mu\text{m}$, mean of 40 spores $18.5 \pm 2.0 \times 8.5 \pm 0.2$, $Q = 1.84\text{--}2.54$, 2.14 ± 0.2 (KOH), finely ornamented with rods to $1.5 \mu\text{m}$ tall in profile, in face view markings appear crowded and irregular; perisporium brown-yellow (KOH), conspicuous, adhering quite closely to the ornamentation; spores not aggregating; hilar appendix to $1 \mu\text{m}$, prominent though may be obscured by perisporium and ornamentation, tapering and truncate, entire; spores thick-walled, inamyloid, faintly dextrinoid (not deep red); apex more or less rostrate and unadorned, characteristically obscured by the perisporium.

Basidia hyaline, initially long, cylindrical and droplet-filled becoming shorter, more clavate and losing droplets with maturity, 4-spored, $35\text{--}69 \times 9\text{--}13.5 \mu\text{m}$. *Cystidia* absent. *Hymenium* palisade, of hyaline, non-gelatinised, clavate, ellipsoidal or pyriform, thin-walled, $28 \times 9 \mu\text{m}$ end-cells. *Subhymenium* reasonably broad relative to the hymenophoral trama, pseudoparenchymatous, of hyaline, non-gelatinised, inflated, isodiametric, thin-walled, to $12.5 \mu\text{m}$ broad hyphae. *Hymenophoral trama* fairly narrow, subparallel, of hyaline, non-gelatinised, cylindrical, thin-walled, $4\text{--}9 \mu\text{m}$ broad hyphae. *Peridiopellis* (in longitudinal section) of two layers, outer layer: very thin and scattered layer of repent to semi-

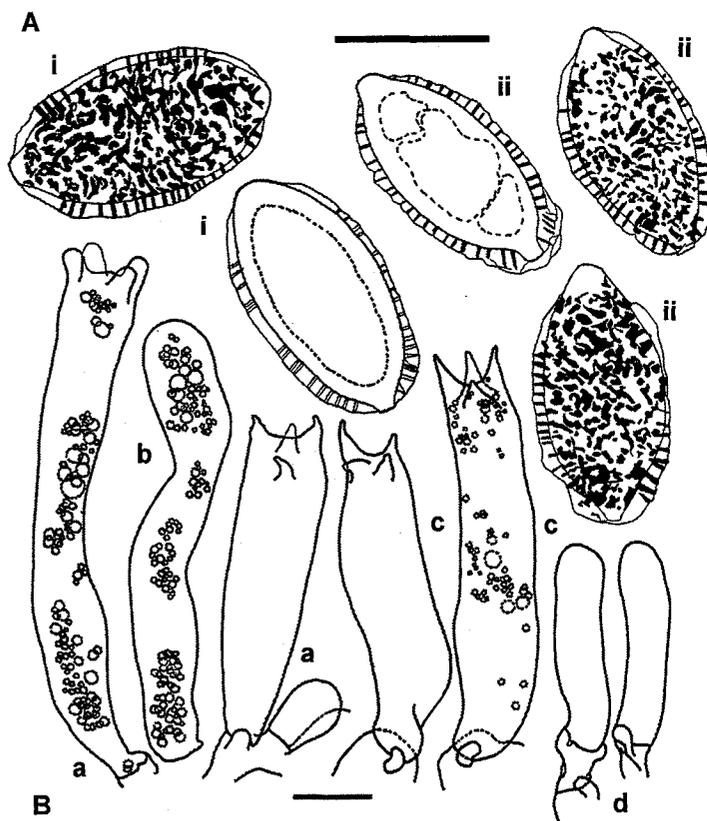


Figure 8: *Descomyces angustisporus* sp. nov. **A** Spores. Note the perisporium usually almost covers the rostrate apex of the spores that in some cases can cause the spores to appear almost oblong in shape. **i** H7282, **ii** H7216, scale bar = $10 \mu\text{m}$. **B** Basidia, basidiolate and hymenial elements. **a** basidia H7282, **b** basidiolate H7282, **c** basidia PERTH 06234615, **d** hymenial elements PERTH 06234615, scale bar = $10 \mu\text{m}$.

erect, hyaline to golden brown, non-gelatinised, cylindrical, thin to thick-walled, 1.5–3 µm broad hyphae; inner layer: much broader than outer layer, of interwoven, hyaline to slightly yellow-brown, non-gelatinised, cylindrical, thin-walled, 2–5 µm broad hyphae. *Clamp connections* present in both layers of the peridiopellis though more conspicuous in the outer layer, also present in the hymenium.

Habitat and distribution: *Descomyces angustisporus* is fairly widely distributed throughout the south-west of Western Australia, particularly in coastal vegetation and in woodlands of the wheatbelt region, fruiting among *Eucalyptus astringens*, *E. gomphocephala*, *E. wandoo* and *E. accedens* in association with *Casuarina*, *Gastrolobium*, *Acacia* and *Melaleuca* species. Fruiting June to September.

Collections examined: W.A.: Kawana Rd, Dryandra State Forest, off Wandering Narrogin Road, 21 June 1995, coll. N. Bougher s.n. (holotype here designated as PERTH 06234615, isotype H7216). Dryandra State Forest, *Eucalyptus astringens*, 19 Aug. 1986, coll. D. Murray s.n. H2027. Rottnest Island, 25 Sept. 1982, coll. N. Malajczuk Trappe 6985 (OSC #82231). Ludlow National Park, Laymans picnic area, under *Melaleuca* sp. and *Eucalyptus gomphocephala*, 20 July 1993, coll. J. Trappe Trappe 14763 (PERTH). Off Narrogin to Williams Rd on Contine Rd, under mixed *Eucalyptus wandoo* and *E. accedens*, 29 July 1993, coll. T. Lebel, W. Colgan, M. Castellano & J. Trappe Trappe 14948 (PERTH). Off Narrogin to Williams Rd on Cowecker Rd, under *Eucalyptus* sp. and *Casuarina fraseriana*, 23 July 1993, coll. M. Castellano Trappe 14951 (PERTH). Site 18, grazed (tree 3), 31 km along Bencubbin-Kellerberrin Rd, north of Kellerberrin, *Eucalyptus wandoo*, 6 July 1995, coll. W. Dunstan & S. Bolsenbroek s.n. H7272. Site 17B, Higginson Road, 16 km along Bencubbin-Kellerberrin Rd, North of Kellerberrin, *Eucalyptus wandoo* and *Gastrolobium*, 19 July 1995, coll. I. Tommerup s.n. H7282. Site 17B, Higginson Road, 16 km along Bencubbin-Kellerberrin Rd, North of Kellerberrin, *Eucalyptus wandoo*, *Gastrolobium* and *Acacia* sp., 19 July 1995, coll. N. Bougher s.n. H7283. Site 290, (Tree 8, ungrazed), near Pullen Rd, of Bencubbin-Kellerberrin Rd, 35 km north of Kellerberrin, *Eucalyptus wandoo*, 7 Sept. 1995, coll. W. Dunstan s.n. H7322. Site 290, T 10, ungrazed), near Pullen Rd, off Bencubbin-Kellerberrin Rd, 35 km north of Kellerberrin, *Eucalyptus wandoo*, 7 Sept. 1995, coll. I. Tommerup, W. Dunstan & S. Bolsenbroek s.n. H7325. Site 17, ungrazed, off Higginson Rd, off Bencubbin-Kellerberrin Rd, Kellerberrin, *Eucalyptus wandoo*, 1 Aug. 1996, coll. I. Tommerup s.n. H7350.

Etymology: In reference to the narrow spores of this species.

Discussion: The macroscopic appearance and spore morphology of *Descomyces angustisporus* is typical of the genus *Descomyces*. When fresh, the gleba is bright chestnut brown and the peridium is a 'cleaner' white than those of *Descomyces albus* and *D. albellus* (presumably because of the relative sparseness of the golden, veil-remnant hyphae that are prominent in the latter two species (Bougher & Castellano 1993)). *Descomyces angustisporus* is considered most closely related to *D. albellus* on the basis of its peridiopellis and spore structure. As in *Descomyces albellus*, the peridium of *D. angustisporus* contains only few and scattered (if any) swollen elements; however, in the latter species the spores are consistently ellipso-fusoid (with the rostrum much less prominent/elongated than in *D. albellus* c.f. Figures 8A and 6D) and the ornamentation and perisporium, frequently extend quite a long way towards the apex and surround the hilar appendix. Field observations suggest that *Descomyces angustisporus* may replace *D. albellus* and *D. albus* to some degree in the more arid regions of the Western Australian wheatbelt (though *D. angustisporus* is also known to occur much further south and in coastal regions). The testing of this hypothesis will require further sampling to accurately establish distributions. The genus *Descomyces* has been represented by *D. albellus* in the molecular studies of both Glen *et al.* (2001) and Peintner *et al.* (2001); however, as yet no published phylogeny has examined multiple collections of more than one species of the genus. Such research should provide more information on the reliability of characteristics such as spore and peridiopellis morphology in differentiating these fungi.

4. *Protoglossum*

Key to species of *Protoglossum* currently recorded from Western Australia.

- 1: Peridium yellow, orange to copper red; spores broadly ellipsoidal to subglobose, 9.5–14.5 × 7–13 µm.
- 1: Peridium violet fading to greyish violet or greyish brown; spores broadly ellipsoidal, 9.5–15.5 × 6.5–9 µm.

1. *Protoglossum luteum*

2. *P. violaceum*

1. *Protoglossum luteum* Masee, *Grevillea* 19: 94 (1891)
(Figure 9, Plate 2D, E)

= *Hymenogaster luteus* (Masee) G. Cunn., *Proc. Linn. Soc. New South Wales* 59: 169 (1934) *non* Vittad. 1931.

= *Cortinomyces luteus* (Masee) Bougher & Castellano, *Mycologia* 85: 277 (1993).

Hysterangium atratum Rodway, *Pap. & Proc. Roy. Soc. Tasmania* 1919: 112 (1920).

Hymenogaster atratus (Rodway) Zeller & C.W. Dodge in C.W. Dodge & Zeller, *Ann. Missouri Bot. Gard.* 21: 656 (1934).

Hymenogaster effodiendus G. Cunn., *Trans. Roy. Soc. South Australia* 75: 14 (1952).

Cortinomyces effodiendus (G. Cunn.) Bougher & Castellano, *Mycologia* 85: 279 (1993).

Basidiomes subhypogeous, often growing singly, protruding from the ground, gastroid, 10–50 × 10–20 mm, globose, subglobose, cylindrical or irregular, may be taller than broad in some specimens. *Peridium* colour is apparently dependent on exposure and method of preservation (May 1995), underground portions may be yellowish, while exposed portions tend to be orange to copper red, peridium viscid, smooth, not bruising, without much adhering debris, thin, of two layers, outer layer gelatinised, inner layer pale in longitudinal section. *Gleba* loculate, tan (near 5C6) then brown (near 6F6), dry, not rapidly disintegrating after maturity, locules approx. 1 mm diam., empty, not radially arranged. *Columella/sterile tissue* usually absent, if present a small sterile basal pad or narrowly tapering truncate columella, to 1.5 mm thick at the base, essentially central, terete (though very small), pale to cream; basal mycelium inconspicuous. *Macrochemical tests* not recorded. *Odour* and *taste* not recorded.

Spores dark rust brown (in KOH), symmetrical, orthotropic, broadly ellipsoidal to subglobose, 9.5–14.5 × 7–13 µm, mean of 63 spores 13.0 ± 1.0 × 9.5 ± 1.0 µm, Q = 0.93–1.61, 1.36 ± 0.26 (KOH), irregular rods and short ridges sometimes tapering towards their apices but not spinose, up to 1.5 µm tall; perisporium pale yellow-brown (KOH), conspicuous, closely adhering, covering apex; mature spores not aggregating; hilar appendix 1.5 × 1 µm, conspicuous, tapering truncate, entire; spores thick-walled, inamyloid, non-dextrinoid; apex rounded and ornamented. *Basidia* hyaline to yellow and necrotic, clavate, (2-) 4-spored, 32–56.5 × 6–10.5 µm. *Cystidia* absent. *Hymenium* palisade, of basidia and hyaline, non-gelatinised, clavate, thin-walled, 20–45 × 8–10.0 µm broad elements. *Subhymenium* narrow (only one or two isodiametric cells subtending each hymenial element)

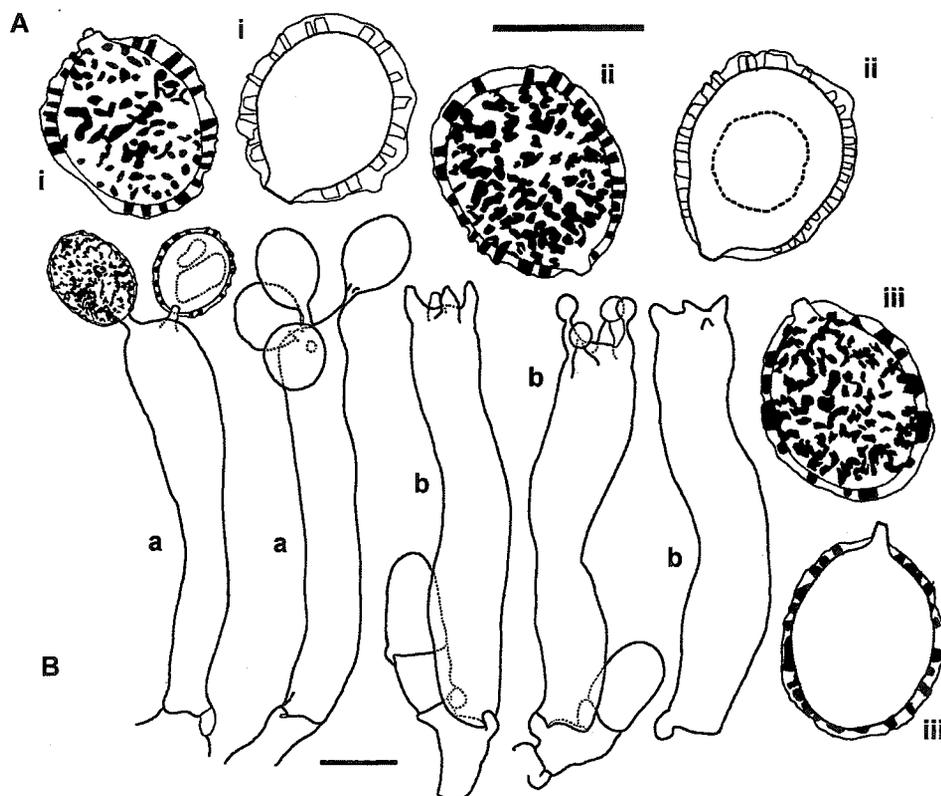


Figure 9: *Protoglossum luteum* A. Spores i H0175. ii H7660. iii H7259, scale bar = 10 µm.
B Basidia. a H7259. b H7660, scale bar = 10 µm.



A



B



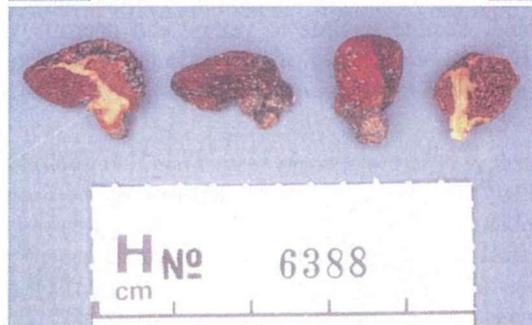
C



D



E



F



G

Plate 1. Basidiomes of: **A** *Setchelliogaster australiensis* H1023, scale bar = 2 cm. **B** *Descomyces angustisporus*. **C** *Descomyces albus*. **D** *Descomyces albellus*. **E** *Quadrispora oblongispora*. **F** *Quadrispora tubercularis* sp. nov. **G** *Cortinarius walpolensis*.

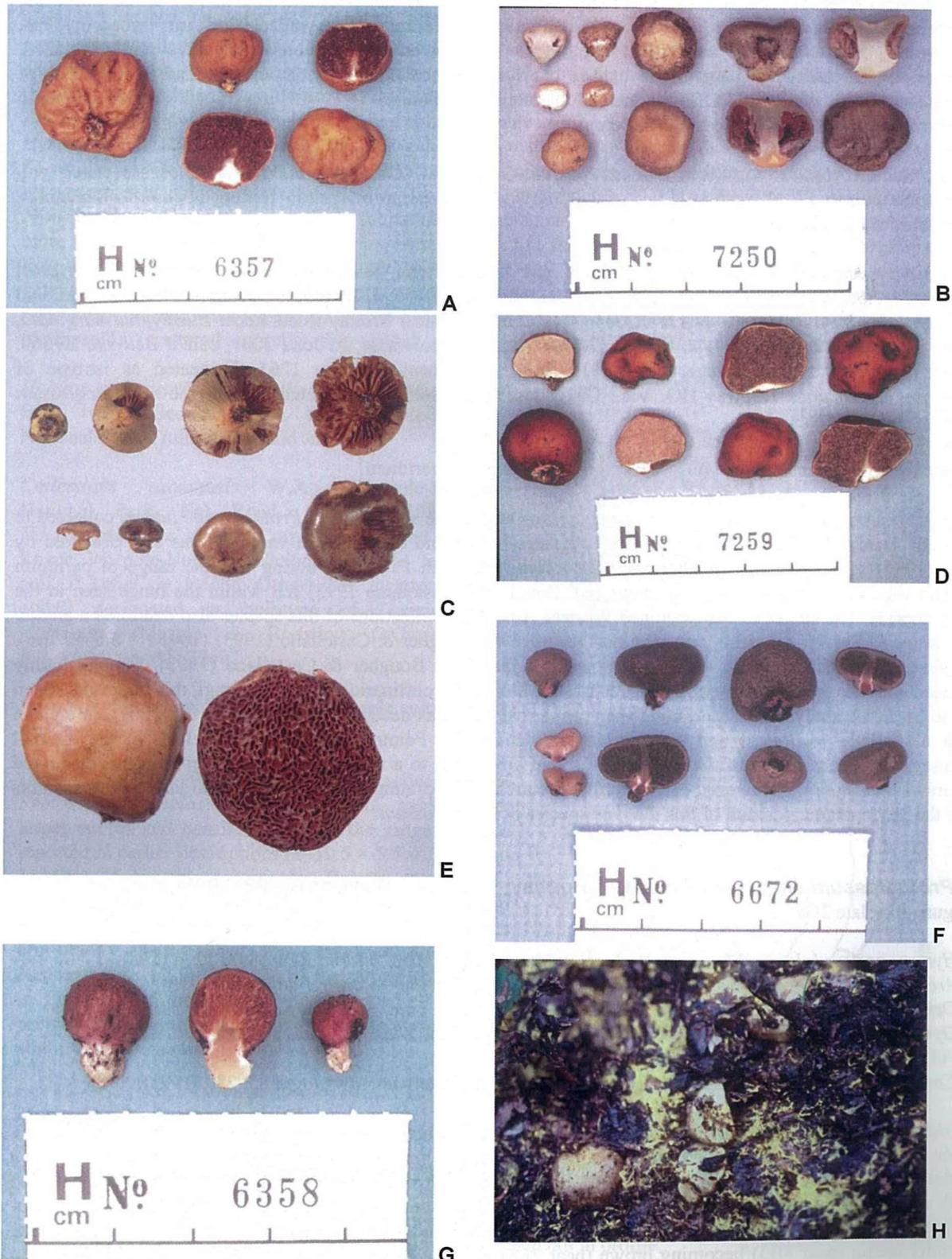


Plate 2. Basidiomes of: A *Cortinarius luteirufescens* H6357. B *Cortinarius sebosus*. C *Dermocybe globuliformis*, H0359, scale bar = 2 cm. D & E *Protoglossum luteum* D H7259, E H0175, scale bar = 2 cm. F *Cortinarius basipurpureus* compare G *Protoglossum violaceum*, Note the truncate stipe-columella in these specimens. H The prominent (yellow) mycelium of *Dermocybe globuliformis* in the field.

pseudoparenchymatous to hyphal in appearance, of more or less hyaline, non-gelatinised, more or less short cylindrical to irregular, thin-walled, to 22 µm broad hyphae. *Hymenophoral trama* narrow to 20 µm wide, parallel, of yellow or brown (KOH), non-gelatinised, cylindrical, thin-walled, 2–8 µm broad hyphae. *Peridiopellis* (in longitudinal section) of two layers, outer layer a broad cutis of hyaline, non-gelatinised, cylindrical, thin-walled, 2–5 µm broad hyphae overlying a pseudoparenchymatous or broad hyphal layer of golden brown or yellow (KOH) pigmented, sometimes gelatinised, 10–15 µm broad elements. *Clamp connections* present though rare in the peridium.

Habitat and distribution: Known in Western Australia from jarrah (*Eucalyptus marginata*) forest associated with *Eucalyptus marginata*, *Corymbia* [*Eucalyptus*] *calophylla* and *Bossiaea*. Found fruiting in June to September (June and July in Western Australia).

Collections examined: W.A.: Pine Creek Road near Scatter Road, Manjimup, under *Corymbia* [*Eucalyptus*] *calophylla*, *Bossiaea*, 27 July 1981, coll. N. Malajczuk s.n. H0175. Hilltop Road Walpole-Nornalup National Park, 15 July 1994, coll. T. Lebel s.n. H7004. Amphion Block, near Murray Road, under *Eucalyptus marginata*, 4 July 1995, coll. W. Dunstan s.n. H7259. Delany Walk, Walpole area, 25 June 2001, coll. J Bell s.n. H7660. *Other*: Tas.: Mt Nelson Range, Sept. 1919, coll. L. Rodway Rodway 1265 designated as isotype of *Hysterangium atratum* Rodway HO. Vic.: Clarendon, date?, coll. ?, designated as holotype of *Protoglossum luteum* Masee K859.

Etymology: In reference to the yellowish colour of the exposed peridium.

Discussion: A broad range of peridium colours occurs among the specimens of *Protoglossum luteum* collected in Western Australia, ranging from yellowish to orange-brown and brown. Such variation was also observed by May (1995) who synonymised *Hymenogaster effodiendus* with *P. luteum* noting that the range of peridium colours used to distinguish *H. effodiendus* (c.f. Bougher & Castellano 1993) fell within the range seen in the latter species. The spores of the examined Western Australian collections of this species also exhibited a greater size range (9.5–14.5 × 7–13.0 µm) than that recorded by Bougher & Castellano (1993) (10–14 × 8.5–12 µm). However, the mean sizes lie within the range designated by Bougher & Castellano (1993). Though highly reduced and thus lacking many of the characteristics linking the cortinarioid agaricoid fungi, this fungus has been found by DNA analysis to nest among the cortinarioid fungi, as accepted by Peintner *et al.* (2001), in a clade with *Cuphocybe melliolens* and *Cortinarius corrugatus*. The Peintner *et al.* (2001) analysis of the Internal Transcribed Spacer region of the nuclear ribosomal DNA lead to a four-way polytomy between this clade and others of their major cortinarioid clade. Further research incorporating other regions should lead to new insights into the phylogenetic position of this the type species of *Protoglossum*.

2. *Protoglossum violaceum* (Masee & Rodway) T.W. May, *Muelleria* 8: 288 (1995) (Figure 10, Plate 2G)

- = *Hymenogaster violaceus* Masee & Rodway in Masee, *Bull. Misc. Inform. Kew* 1898: 127 (1898).
- = *Arcangeliella violacea* (Masee & Rodway) C.W. Dodge, *Compar. Morph. Fungi* 487 (1928).
- = *Dendrogaster violaceus* (Masee & Rodway) G. Cunn., *Proc. Linn. Soc. New South Wales* 59: 172 (1934).
- = *Gymnoglossum violaceum* (Masee & Rodway) G. Cunn., *New Zealand J. Sci. Technol.*, ser. B, 22: 300 (1941).
- = *Cortinomyces violaceus* (Masee & Rodway) Bougher & Castellano, *Mycologia* 85: 280 (1993).

Basidiomes hypogeous, found growing singly or in small groups under litter, gasteroid, 13–30 × 10–20 mm, globose, broadly to irregularly ellipsoidal, with a stipe that is generally not taller than the peridium. *Peridium* violet (16E7–17B6) fading to greyish violet (17B3) or greyish brown (near 6E4), glutinous becoming less-so with age, smooth to slightly lumpy, not bruising, without much adhering debris, approximately 1 mm thick, two-layered, outer layer gelatinised, inner layer not gelatinised and pale in longitudinal section. *Gleba* loculate, initially cream (near 8B3) becoming brown (near 7E8), dry, not rapidly disintegrating after maturity, locules to 1 mm long, empty, irregular to radially arranged. *Columella/sterile tissue* a truncate stipe-columella, 3.5 × 2 mm, essentially central, terete, columella truncate, stipe portion may be concolourous with the peridium or white, dry, smooth, not forming distinct layers, solid, flesh cream to white, sometimes violet in immature specimens, base rounded protruding up to 4.5 mm below peridium; basal mycelium inconspicuous. *Macrochemical tests* 15% KOH darkens peridium, FeSO₄ gleba darkening slightly. *Odour* yeasty, *taste* not distinctive.

Spores dull brown (KOH), symmetrical, orthotropic, broadly ellipsoidal, $9.5\text{--}15.5 \times 6.5\text{--}9 \mu\text{m}$, mean of 61 spores $12 \pm 1.0 \times 7.5 \pm 0.5 \mu\text{m}$, $Q = 1.52\text{--}1.82$, 1.66 ± 0.08 (KOH), ornamented with small warts and ridges; perisporium yellowish (KOH) though inconspicuous, adhering closely; mature spores not aggregating; hilar appendix $0.5 \mu\text{m}$, generally conspicuous but may be obscured by ornamentation, subequal truncate, entire; spores thin-walled, inamyloid, non-dextrinoid (yellow-brown in Melzer's solution); apex rounded and ornamented. *Basidia* pale yellowish, yellow-brown when collapsed, clavate, (2-) 4-spored, $31\text{--}53 \times 9\text{--}13 \mu\text{m}$. *Cystidia* absent. *Hymenium* palisade, of hyaline (KOH), non-gelatinised, cylindrical to clavate, thin-walled, broad elements $15.5\text{--}33 \mu\text{m}$ broad. *Subhymenium* $11\text{--}30 \mu\text{m}$ thick, subcellular to more or less undifferentiated, of hyaline (KOH), non-gelatinised, subglobose, cylindrical or irregularly short-branched, thin-walled, to $19 \mu\text{m}$ broad hyphae. *Hymenophoral trama* $25\text{--}40 \mu\text{m}$ thick, subparallel to pseudoparenchymatous, of hyaline (KOH), non-gelatinised, more or less cylindrical, thin- to thick-walled (to $1.5 \mu\text{m}$ thick), to $45 \mu\text{m}$ broad hyphae. *Peridiopellis* (in longitudinal section) of two layers, outer layer to $208 \mu\text{m}$, a loosely interwoven cutis, of hyaline (KOH), gelatinised, more or less cylindrical, thin-walled, $2\text{--}4 \mu\text{m}$ broad hyphae, inner layer to $42 \mu\text{m}$, more tightly interwoven, of yellowish hyphae (in water) becoming hyaline in KOH, non-gelatinised, more or less cylindrical to ellipsoidal (scattered end-cells), thin-walled, $10\text{--}17.5 \mu\text{m}$ broad hyphae. *Clamp connections* none seen.

Habitat and distribution: In Western Australia, known from two collections from the Walpole-Nornalup National Park. Fruiting June and July.

Collections examined: W.A.: Walpole-Nornalup National Park, Nut Road, 10 June 1992, coll. N.L. Bougher s.n. H6358. Corner of Nut and Ficifolia Roads, Walpole-Nornalup National Park, 14 July 1994, coll. T. Lebel s.n. H6688. **Other:** Tas. location?, date?, coll.?, designated as holotype of *Gymnoglossum violaceum* (Massee & Rodway) G.Cunn., coll. L. Rodway s.n. AD 22607.

Etymology: In reference to the violet/purple colour of the peridium.

Discussion: The Western Australian collections of *Protoglossum violaceum* reported here exhibit both larger spores and basidia sizes than the range of sizes reported in earlier descriptions ($7\text{--}10.5 \times 5.5\text{--}7.5 \mu\text{m}$ and $11\text{--}42 \times 4\text{--}10 \mu\text{m}$ respectively, Beaton *et al.* 1985, Dodge & Zeller 1936, Massee 1898, Rodway 1924 and Singer & Smith 1960). Mature basidiomes of this species are readily distinguished from those of *Cortinarius basipurpureus* by the absence of the purple colouration in the flesh of the base of the pseudostipe, the less prominent spore ornamentation and perisporium and the slightly longer spores.

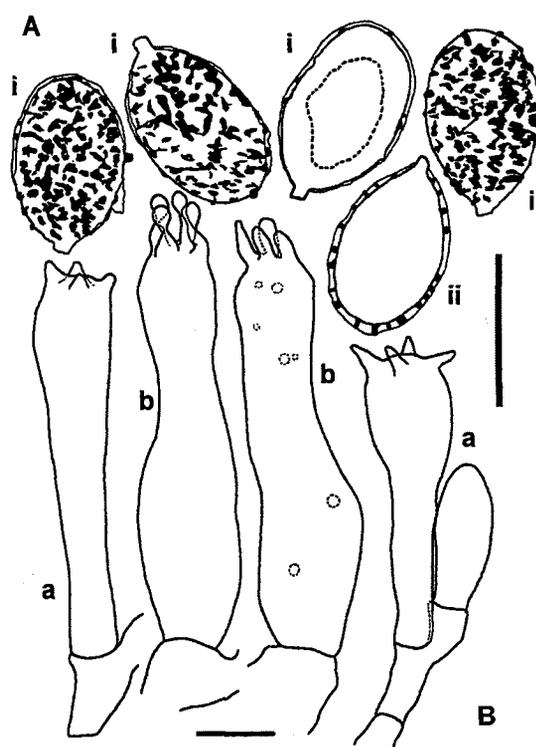


Figure 10: *Protoglossum violaceum* A. Spores i. H6688. ii. H6358, scale bar = $10 \mu\text{m}$. B. Basidia. a H6688. b H6358, scale bar = $10 \mu\text{m}$.

5. *Quadrispora*

Key to species of *Quadrispora* currently recorded from Western Australia.

- 1 Spores ellipsoidal to oblong, $13\text{--}18 \times 7\text{--}10 \mu\text{m}$, ornamented with crowded, irregular tubercles (to approximately $1.5 \mu\text{m}$ in diam.) and ridges (to approximately $3 \mu\text{m}$ long), ornaments to $1 \mu\text{m}$ tall in profile.
- 1: Spores subobovoid, $12.5\text{--}17 \times 7\text{--}10 \mu\text{m}$, coarsely ornamented with irregular tubercles (to approximately $3 \mu\text{m}$ in diam.) and ridges (to approximately $6 \mu\text{m}$ long), ornaments to $2 \mu\text{m}$ tall in profile.

1. *Quadrispora oblongispora*

2. *Q. tubercularis*

1. *Quadrispora oblongispora* (G.W. Beaton, Pegler & T.W.K. Young) Bougher & Castellano, *Mycologia* 85: 286 (1993)
(Figure 11, Plate 1E)

= *Hymenogaster oblongisporus* G.W. Beaton, Pegler & T.W.K. Young, *Kew Bulletin* 40: 188 (1985).

Basidiomes hypogeous found fruiting in small groups underneath the litter layer, gastroid, 5–20 mm diam., subglobose or ellipsoidal, slightly tapering at the base. *Peridium* warm brown (near 7E8) to apricot yellow, drying to greyish yellow, initially viscid and smooth, drying with a silky sheen, not bruising, without much adhering debris, thick, of one gelatinised layer. *Gleba* loculate, grey to dark brown (near 7E7), dry, not rapidly disintegrating after maturity, locules to 0.5–1.5 mm diam., empty, no radial pattern evident. *Columella/sterile tissue* absent or a protruding basal pad/pseudostipe¹, 5 × 5 mm, cream or brown in longitudinal section, central, more or less terete, surface obscured by the thick gelatinous layer that appears to be continuous with that covering the peridium, not forming distinct layers, solid or with a narrow hollow centre, base emergent, narrow to bulbous; basal mycelium inconspicuous. *Macrochemical tests* not recorded. *Odour* not distinctive and *taste* not recorded.

Spores dark yellow-brown (KOH), asymmetrical, heterotropic, adaxially applanate, ellipsoidal or oblong, 14.5–17.5 × 5–7.5 μm, mean of 20 spores 16.0 ± 1.0 × 6.5 ± 0.5 μm, Q = 2.21–3, 2.54 ± 0.27 (KOH), ornamented with warts or small tubercles (to approximately 1.5 μm in diam.) and ridges (to approximately 3 μm long), ornaments to 1 μm tall in profile, crowded and irregular in face view; perisporium pale yellow (KOH), conspicuous, more or less flaring, continuous between spores; spores for the most part remaining aggregated in tetrads after release from the basidium; hilar appendix up to 1.5 μm long, conspicuous though may be obscured by ornamentation and perisporium, tapering and truncate, entire; spores thin-walled, non-dextrinoid, inamyloid, non-dextrinoid (orange-brown in Melzer's solution); apex rounded and ornamented. *Basidia* hyaline, broadly clavate, 4-spored, 25–35 × 8.5–11 μm. *Cystidia* absent. *Hymenium* palisade, hyaline, non-gelatinised, elements clavate to pyriform, thin-walled. *Subhymenium* a broad, pseudoparenchymatous, hyaline, non-gelatinised, layer of inflated, thin-walled, to 12 μm broad cells. *Hymenophoral trama* parallel or slightly interwoven, hyphae hyaline, non-gelatinised, 3–13 μm broad. *Peridiopellis* (in longitudinal section) of one layer, to 600 μm broad, of interwoven, hyaline, gelatinised or intact, narrow, cylindrical, sometimes dissolved and irregular, thin-walled, 1–4 μm broad hyphae. *Clamp connections* present throughout the peridium and hymenium but small and inconspicuous.

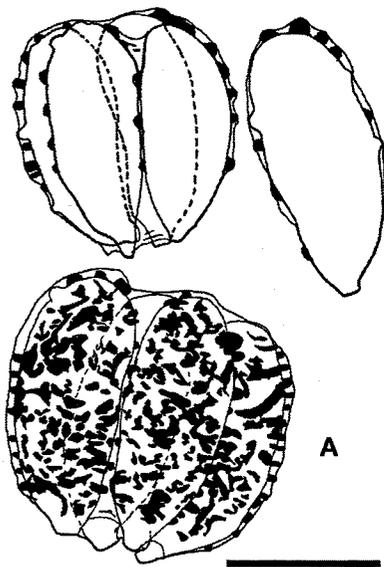


Figure 11: *Quadrispora oblongispora* H6671. A Spores. The spores of this species are often released in tetrads held together by the gelatinous perispore, scale bar = 10 μm.

Habitat and distribution: Known in Western Australia from a single record from the Walpole region, fruiting in woodlands close to *Eucalyptus jacksonii*. Fruiting June–August.

Collections examined: W.A.: Cemetery Road, Walpole-Nornalup National Park, under *Eucalyptus jacksonii*, 13 July 1994, coll. T. Lebel s.n. H6671. Other: Vic.: Rubicon, 30 June 1974, coll. G. Crichton & G. Beaton Beaton 64 designated as holotype of *Hymenogaster oblongisporus* K. Macedon Regional Park, 31 Aug. 1982, coll. A.C. Beaglehole Beaton 76 designated as iso-paratype of *Hymenogaster oblongisporus* K.

Etymology: In reference to the ellipsoidal to oblong shape of the spores.

Discussion: *Quadrispora oblongispora* is distinguished from *Q. musispora* Bougher & Castellano (not known in Western Australia) by the colour of the peridium (apricot yellow as compared with violet in *Q. musispora*) and host plants (*Eucalyptus* species versus *Nothofagus* species). *Quadrispora oblongispora* is differentiated from *Quadrispora tubercularis* by having longer, less prominently ornamented spores, and a single layered peridium (see discussion for *Q. tubercularis*).

¹ The term pseudostipe as used by Beaton *et al.* (1985) refers to the external stipe-like protrusion of a sterile base rather than the extension of a columella (either percurrent or truncate).

2. *Quadrispora tubercularis* N.L. Bougher & A.A. Francis sp. nov.
(Figure 12, Plate 1F)

Species sporarum ornamentis tubercularibus grandioribus aquilioribus (in KOH) et peridiopelli bistrata a congeneribus diversa.

Typus hic designatus PERTH 0090403.

Basidiomes subhypogeous, a small collection found protruding from the sand, gastroid, to 12 mm diam., subglobose to pyriform. *Peridium* brown (when dried), viscid or gelatinous when fresh, smooth, not bruising, without much adhering debris, thin, of two layers, outer layer broader and gelatinised, inner layer cream in section and not gelatinised. *Gleba* loculate, bright orange-brown, dry, not disintegrating rapidly after maturity, locules to 1 mm broad, empty, not noticeably radially arranged. *Columella/sterile tissue* absent to present as a percurrent columella, to 6.5 × 2 mm within the gleba, cream to yellowish in section, central, more or less finely terete, of one layer, solid, with an emergent angular-bulbous base protruding up to 5 mm below the peridium; basal mycelium not seen. *Macrochemical tests* not tested. *Odour* and *taste* not tested.

Spores dark orange-brown (KOH), symmetrical to very slightly adaxially flattened, heterotropic, subobovoid, 12.5–17 × 7–10 µm, mean of 20 spores 14.0 ± 1.0 × 8.0 ± 0.5 µm, Q = 1.65–2, 1.81 ± 0.11 (KOH), ornamented with quite large tubercles (to approximately 3 µm in diam.) and ridges (to approximately 6 µm long), ornaments to 2 µm tall in profile, the ornaments are irregular and less crowded than those of *Quadrispora oblongispora*; perisporium yellowish in KOH, conspicuous, generally adhering closely to ornamentation but sometimes fragmenting or flaring; spores aggregating in tetrads; hilar appendix short, inconspicuous (short, broad and

commonly obscured by ornamentation), tapering and truncate, entire; thin-walled, inamyloid, non-dextrinoid (light yellow brown in Melzer's solution); apex rounded and ornamented. *Basidia* hyaline, yellow when collapsed, clavate (collapsing soon after maturity), 4-spored, quite variable in size (actual range undetermined due to almost all basidia having collapsed). *Cystidia* absent. *Hymenium* palisade, hyaline but for necrotic basidia, non-gelatinised though badly degraded, vesiculose broadly obpyriform to cylindrical hymenial elements, thin-walled, 18–29 µm broad. *Subhymenium* collapsed. *Hymenophoral trama* interwoven to subparallel, hyaline to bright yellow-brown in KOH, non-gelatinised, 5–12 µm broad. *Peridiopellis* (in longitudinal section) of two layers, the outer broader layer of interwoven, hyaline, partly gelatinised, cylindrical, thin-walled, 1.5–5 µm broad clamped hyphae embedded in a hyaline matrix, abruptly meeting the inner layer of tightly interwoven, yellow-encrusted, non-gelatinised, inflated, thin-walled hyphae (appearing as interlocking polygonal cells), 10 to 60 µm broad. *Clamp connections* present in the outer peridiopellis and hymenophoral trama.

Habitat and distribution: Known from a single collection from among south western coastal heath/open woodland of Two Peoples Bay. Found fruiting in July.

Collection examined: W.A.: Two Peoples Bay Nature Reserve, West Gully number 7 off Mt Gairdner, vegetation type not recorded, *G. Smith s.n.* (holotype here designated as PERTH 0090403, isotype H6388).

Etymology: Latin, in reference to the coarse tuberculate spore ornamentation that distinguishes this species from others in the genus.



Figure 12: *Quadrispora pyriformis* sp. nov. PERTH 00960403. A Spores. Note the broader, more coarsely ornamented spores of this species compared with those of *Quadrispora oblongispora*, scale bar = 10 µm. B Basidia, scale bar = 10 µm.

Discussion: The much more prominent spore ornamentation, the much darker spores (in KOH) and the presence of a two-layered peridiopellis in *Quadrispora tubercularis* distinguishes this species from others in the genus described by Bougher & Castellano (1993). The spores of *Q. tubercularis* are also wider than those of *Q. musispora*. A current project by the authors aims to use molecular attributes to assess the phylogenetics of the known species of *Quadrispora* including *Q. tubercularis*. Further collections of *Q. tubercularis* are needed to characterise the extent of morphological variability in the features of this species as the specimens studied did not revive well from the air-dried state.

6. *Setchelliogaster*

Setchelliogaster australiensis G.W. Beaton, Pegler & T.W.K. Young, *Kew Bull.* 40: 169 (1985)
(Figure 13, Plate 1A)

Basidiomes hypogeous to subhypogeous, fruiting in small groups within the first 10 cm of soil, secotioid, 10–13 mm diam., conical, subglobose to flattened-ellipsoidal but with a thick, short stipe from which the peridium pulls away exposing the gleba. *Peridium* light orange (5A5) with darker brown discolourations (to 8F8), becoming greyish orange when air-dried, dry, glabrous, not bruising, without much adhering debris, to 1 mm thick, of a single layer which is pale in longitudinal section. *Gleba* labyrinthoid to sublammellate, light yellow to reddish golden (2A2 to 6C7), dry, not rapidly disintegrating after maturity, locules 0.5–1 mm diam., sometimes showing strong radial arrangement towards the base and with the gleba adnate to the stipe. *Columella/sterile tissue* a percurrent stipe-columella, 4–6 × 1–2 mm within the gleba, central, cylindrical terete, light yellow (M.3Y/8.7/4.4), dry, smooth, not forming distinct layers, solid, base bulbous, protruding up to 1 cm below the peridium; basal mycelium inconspicuous. *Macrochemical tests* not recorded. *Odour* and *taste* not recorded.

Spores yellow-brown (KOH), asymmetric, heterotropic, amygdaliform to subfusoid to narrowly citriform (spore shape variable both within and between collections (see Fig. 13A), 8.5–19 × 7–9.5 µm, mean of 59 spores 15.5 ± 2.0 × 8.0 ± 0.5 Q = 1–2.27, 1.92 ± 0.2 (KOH), ornamentated with small warts, rods or ridges, to 1.5 µm tall, less prominent towards base and apex; perisporium hyaline (KOH), reasonably conspicuous, though usually closely adhering may become fragmented and wrinkled; mature spores not aggregating; hilar appendix to 1 µm,

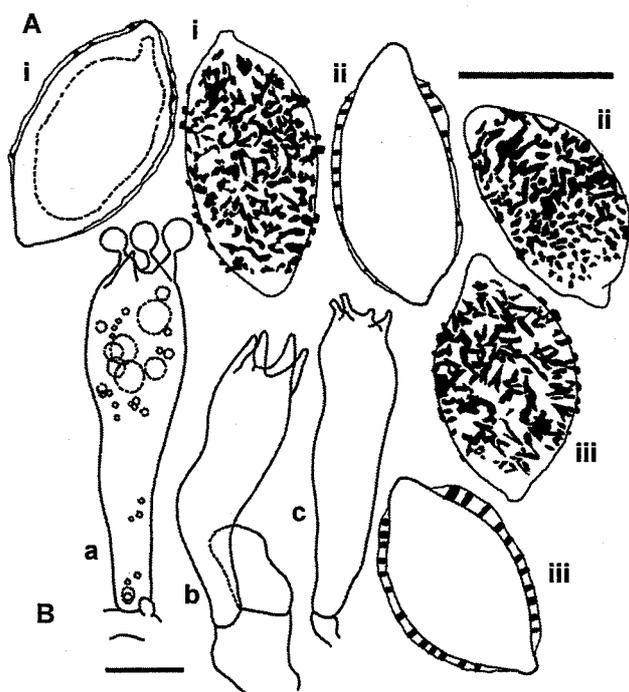


Figure 13: *Setchelliogaster australiensis* A Spores. Note the strongly amygdaliform to citriform shape. i H7317, ii G. Beaton 39, iii H1023, scale bar = 10 µm. B Basidia a H1023 b G. Beaton 39 c H7317. Scale bar = 10 µm.

conspicuous, tapering and truncate, entire; spores thick-walled (to 1.5 µm), inamyloid, non- to faintly dextrinoid (spores orange-brown to pinkish brown or reddish brown in Melzer's solution); apex rostrate and unadorned. *Basidia* hyaline, though becoming slightly yellow-brown when collapsed, cylindro-clavate, 4-spored, 35–50 × 8–11 µm. *Cystidia* absent. *Hymenium* palisade, of hyaline, non-gelatinised, clavate to inflated, thin-walled, to 19 µm broad elements. *Subhymenium* 18–25 µm broad, pseudoparenchymatous, of hyaline, non-gelatinised, isodiametric, thin-walled, to 19 µm broad elements. *Hymenophoral trama* 200–275 µm broad, parallel, of pale brown, non-gelatinised, cylindrical, thin-walled, 3–10 µm broad hyphae. *Peridiopellis* (in longitudinal section) of a single layer, up to 180 µm broad, forming a stratified epithelium of brown, gelatinised, inflated, thin-walled, 20–55 × 15–37 µm elements. *Clamp connections* present in hymenial tissues.

Habitat and distribution: This species is not currently considered a Western Australian native. It is only known in Western Australia from collections amongst nursery stock and inoculated plantations of *Eucalyptus globulus*, and has not

been recorded in forests or woodlands. Found fruiting July to September.

Collections examined: W.A.: CSIRO Perth W.A., in glasshouse pots with *Eucalyptus globulus* seedlings inoculated with H1023 from Tasmania (see below), 20 Aug. 1987, coll. N. Bougher NB182 (H1023). Five Acre Nursery W.A., MH143062, in pots with *Eucalyptus globulus* seedlings inoculated with H1023 from Tasmania (see below), 20 July 1990, coll. B. Thomson s.n. (H1573). Northcliffe (Bebes site), in *Eucalyptus globulus* plantation inoculated with H1023 from Tasmania (see below), 8 Sept. 1990, coll. N. Malajczuk s.n. (H4317). **Other:** Vic.: Apollo Bay end of Turtons track, partially exposed under *Eucalyptus* debris, 19 July 1982, coll. K. & G. Beaton Beaton 39 (isotype MELU). Tas.: Lone Star Provenance Trial TAS.EQ244375, in *Eucalyptus globulus* plantation, 10 July 1986, coll. N. Malajczuk & T. Burgess s.n. (H1023).

Etymology: Beaton *et al.* (1985) allocated the epithet 'australiensis', noting that this was the first *Setchelliogaster* species recorded from Australia.

Discussion: Lago *et al.* (2001) in examining this species found veil remnants resembling those of *Descomyces* on the stipe of young *Setchelliogaster australiensis* specimens. The current authors did not see such hyphae but given the relatedness of the two genera (*e.g.* Peintner *et al.* 2001) we do not find it surprising that such hyphae should occur in *Setchelliogaster*. All Western Australian collections of *Setchelliogaster australiensis* available for study can be traced back to a fungus isolated from Tasmania (H1023). The apparent absence of naturally occurring representatives of this species in Western Australia is somewhat surprising in view of the abundance of this species in other parts of Australia (Lago *et al.* 2001). Also the apparent absence of *Setchelliogaster tenuipes* in Western Australia is also quite unexpected as it is widely distributed in eucalypt forests in other parts of Australia and in eucalypt plantations throughout many parts of the world (Lago *et al.* 2001).

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