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Tropical Australian Freshwater Fungi. II.* *Annulatascus velatispora* gen. et sp. nov., *A. bipolaris* sp. nov. and *Nais aquatica* sp. nov. (Ascomycetes)

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Abstract

Submerged wood was collected from Millaa Millaa Falls and the Clohesy River in north Queensland, and examined for higher fungi. In this paper *Nais aquatica* sp. nov., *Annulatascus velatispora* gen. et sp. nov. and *A. bipolaris* sp. nov. are described.

Introduction

Hyde (1992) reported three new ascomycetes from submerged wood at Millaa Millaa Falls in north Queensland. Few other ascomycetes have been reported from freshwater habitats in Australia, and in this paper descriptions and illustrations of three freshwater fungi are provided. They are *Nais aquatica* sp. nov., *Annulatascus velatispora* gen. et sp. nov., and *A. bipolaris* sp. nov.

Taxonomy

Nais aquatica Hyde, sp. nov. (Figs 1–7)

Ascomata 220–390 μm longa, 115–170 μm diam., immersa vel semi-immersa, membranacea, globosa vel ampulliformes, ostiolata, rostrata, nigra, solitaria vel gregaria. Sine paraphyses, catenophysaticum. Asci deliquescentes, 82 × 46 μm, octospori, saccati, pedunculati, leptodermi. Ascosporae 32–36 × 15–17 μm, hyalinae, ellipsoideae, 1-septatae, ad septum constrictae, et depositis granularibus indentae.

Holotypus: Australia, north Queensland, Millaa Millaa Falls, on submerged wood in a river, July 1990, *K. D. Hyde*, BRIP 17378.

Colonies on potato dextrose agar (PDA), slow-growing, felty, irregularly zonate, grey with pink aerial mycelium, with submersed globose brown chlamydospores, 8–12 μm, but no ascomata produced. Ascomata 220–390 μm long, 115–170 μm diam., immersed or semi-immersed, membranous, globose to ampulliform, ostiole central, beaked, black, solitary or gregarious. Beak short and periphysate. Peridium thin, a single stratum of elongate cells. Paraphyses absent. Catenophyses numerous. Asci deliquescent, 82 × 46 μm (single measurement), 8-spored, saccate, pedunculate, thin-walled throughout, developing from the base of the ascoma. Ascospores 32–36 × 15–17 μm, hyaline, ellipsoid, bi-celled, not constricted at the septa, with a band of refringent globules around the equator. Appendages mostly absent, although present in two ascomata sampled on the same wood. These appendages were hamate at first, then unravelled in water to form filamentous threads.

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Etymology: from the Latin *aquaticus* meaning 'growing in water'.
Mode of life: saprobic.
Habitat: on submerged wood in a river.
Known distribution: Australia.

The genus *Nais* Kohlm. incorporates two taxa with different ascus types, but both with a band of granular globose bodies around the ascospore equator. In *Nais inornata* Kohlm. (the type of the genus), asci deliquesce early and are thin-walled throughout. The species has been found in both brackish and freshwater environments, ascospore appendages commonly being found in collections from the latter (Shearer and Crane 1978). *Nais glitra* Crane & Shearer was recently described from mangroves by Crane and Shearer (1986). In this species ascospores are large (42–59 × 21–31 μm) and asci are semi-persistent and provided with a distinct pore. *Nais aquatica* has larger ascospores (32–36 × 15–17 μm) than *N. inornata* [(19·2–) 21·6–26·4 (–29) × 9·6–14·4 μm: Shearer and Crane 1978; 22–30 × 11·5–15·5 μm: Kohlmeyer and Kohlmeyer 1979] but is similar otherwise and can readily be placed in this genus. For a comparison of *Nais* species see Table 1. *Nais aquatica* differs quite markedly from *Nais glitra*, particularly in ascus structure. The equatorial band of granular globose bodies excludes this taxon from the closely related genera *Aniptodera* Shearer & Miller, *Halosarpheia* Kohlm. & Kohlm. and *Lignincola* Höhnk.

Table 1. Characteristics of *Nais* species

	N. ornata	*N. aquatica*	*N. glitra*
Ascomata	240–500 μm diam.; black	115–170 μm diam., 220–390 μm long; black	400–544 μm diam.; cream coloured then black
Asci	80–150 × 20–35 μm; no apical pore	82 × 46 μm; no apical pore	240–312 × 43–62 μm; apical pore
Ascospores	(19·2) 21·6–26·4 (–30) × 9·6–15·5 μm	32–36 × 15–17 μm	42–59 × 21–31 μm

Annulatascus Hyde, gen. nov.

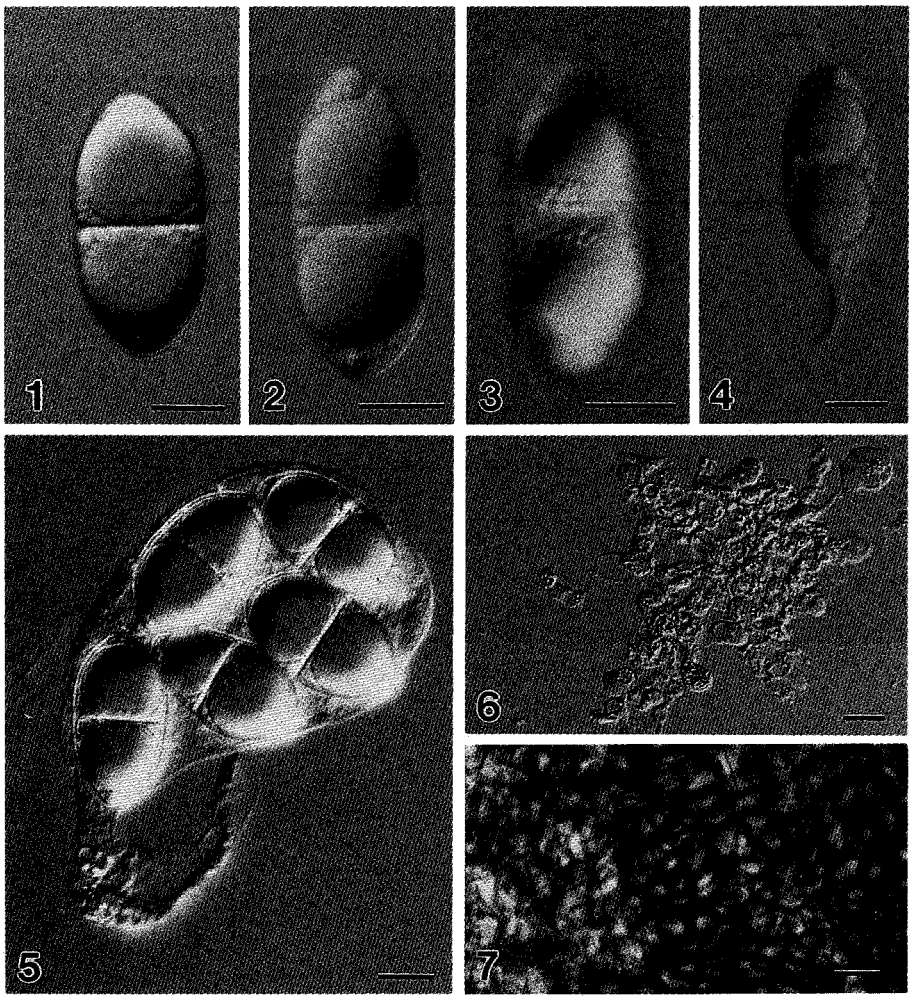
Ascomata globosa vel subglobosa, immersa, semi-immersa, vel superficiales, carbonacea, ostiolata, rostrata, nigra, solitaria vel gregaria. Collum periphysaticum. Peridium nigrum, e textura angulari compositum. Paraphysibus crassis, septatis, numerosis et angustatis. Asci octospori, cylindrici, leptodermi, pedunculati, cum apparatu apicali. Ascosporae unicellularae, fusiformes, hyalinae, uniseriatae, cum tunica gelatinosae vel appendiculatae. Typus generis *Annulatascus velatispora* Hyde.

Ascomata globose or subglobose, immersed, semi-immersed or occasionally superficial, carbonaceous, ostiolate, beaked, black, solitary or gregarious. Neck black and periphysate. Peridium black, of textura angularis, cells lighter and more elongate towards the centre. Paraphyses wide, septate, tapering and numerous. Asci 8-spored, cylindrical, unitunicate, thin-walled, pedunculate, with a large apical apparatus. Ascospores 1-celled, or later 4-celled, fusiform, hyaline, uniseriate, surrounded by a thin sheath or with appendages.

Etymology: from the Latin *annulata* meaning 'ringed' and *ascus*, in relation to the distinct apical ring-like body.

Annulatascus velatispora Hyde, sp. nov. (Figs 8–18 and 30–33)

Ascomata usque ad 450 μm alta, 260-410 μm diam., globosa vel subglobosa, immersa, ostiolata, papillata, nigra, periphysata, solitaria vel gregaria. Peridium 38–60 μm crassum, nigrum, e textura angulari compositum. Paraphysibus crassis, septatis, numerosis, et angustatis. Asci 220–290 × 12–18 μm, octospori, cylindrici, leptodermi, pedunculati,

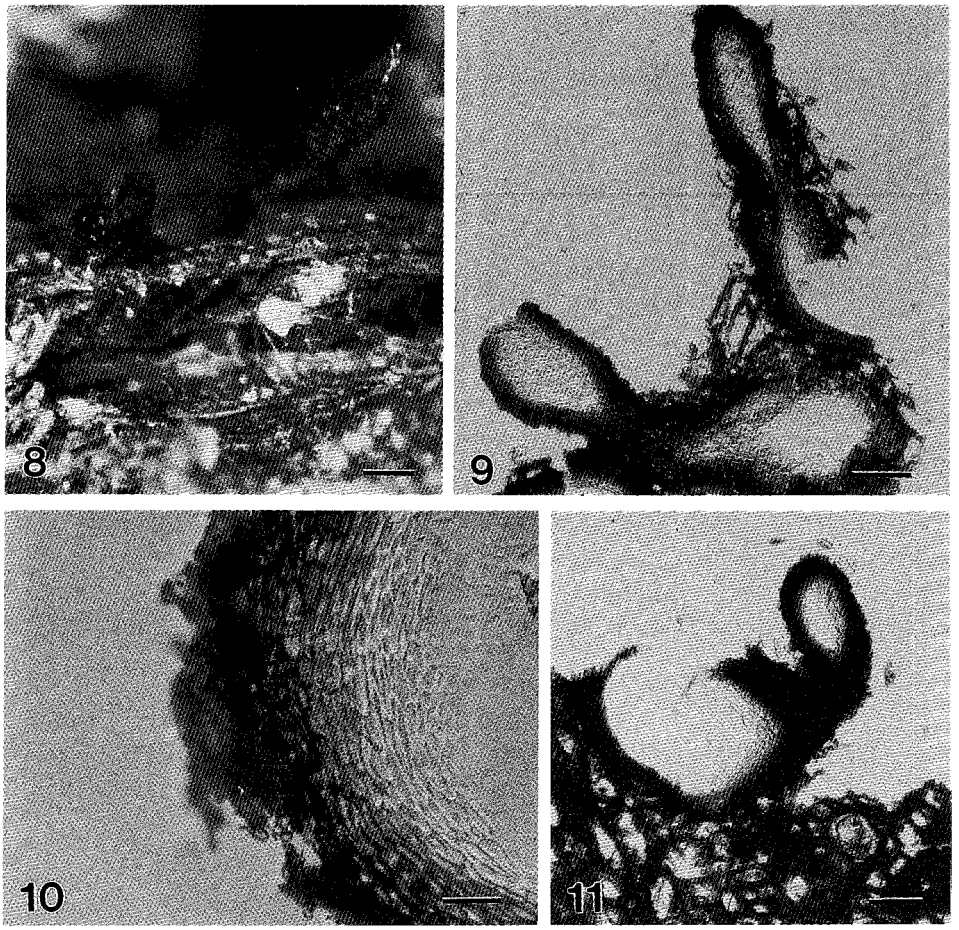


Figs 1–7. *Nais aquatica.* Interference light contrast micrographs: *1–4*, ascospores, note the equatorial band of granular globose bodies (in *3*) and appendages (in *4*); *5*, ascus; *6*, catenophyses; *7*, face view of ascoma wall. Scales: 10 μm.

cum apparatu apicali. Ascosporae 26–42 × 9–12 μm, unicellularae, fusiformes, hyalinae, uniseriatae, verruculosae, cum tunica gelatinosae.

Holotypus: Australia, north Queensland, Millaa Millaa Falls, on submerged wood in a river, July 1990, *K. D. Hyde*, BRIP 17373.

Colonies on PDA slow-growing, pellicular, feathery, dark brown, with oval chlamydospores 9–16 μm diam., no ascomata produced. Ascomata up to 450 μm high, 260–410 μm diam., globose or subglobose, immersed or semi-immersed, occasionally superficial, carbonaceous, solitary or mostly gregarious, ostiole central or lateral, beaked, black. Beak up to 384 μm long, 140 μm diam., periphysate. Peridium 38–60 μm thick, composed of large brown melanised angular cells with large lumina towards the outside and lighter thin-walled elongate cells towards the centre. Paraphyses wide, septate, tapering, numerous, longer than asci and occurring between asci and extending into the lower neck. Asci 220–290 × 12–18 μm, 8-spored, cylindrical, thin-walled, peduncle tapering, with a large elongate non amyloid apical apparatus (7–8 μm long × 4–5 μm wide), developing from the base of the ascoma. Ascospores 26–42 × 9–12 μm, unicellular, up to 3 septate in some mature specimens, fusiform, hyaline, uniseriate, verruculose, surrounded by a thin irregular sheath.



Figs 8–11. *Annulatascus velatispora. 8*, semi-immersed ascoma. *9-11*, interference light contrast micrographs: *9, 11*, section through ascoma; *10*, peridium which is composed of melanised angular cells towards the outside, and hyaline flattened cells towards the inside. Scales: *8, 9, 11* = 100 μm, *10* = 10 μm.

Etymology: from the Latin *velum* meaning 'veil', and *spora*, in reference to the ascospore sheath.

Mode of life: saprobic.

Habitat: on submerged wood in a river.

Known distribution: Australia.

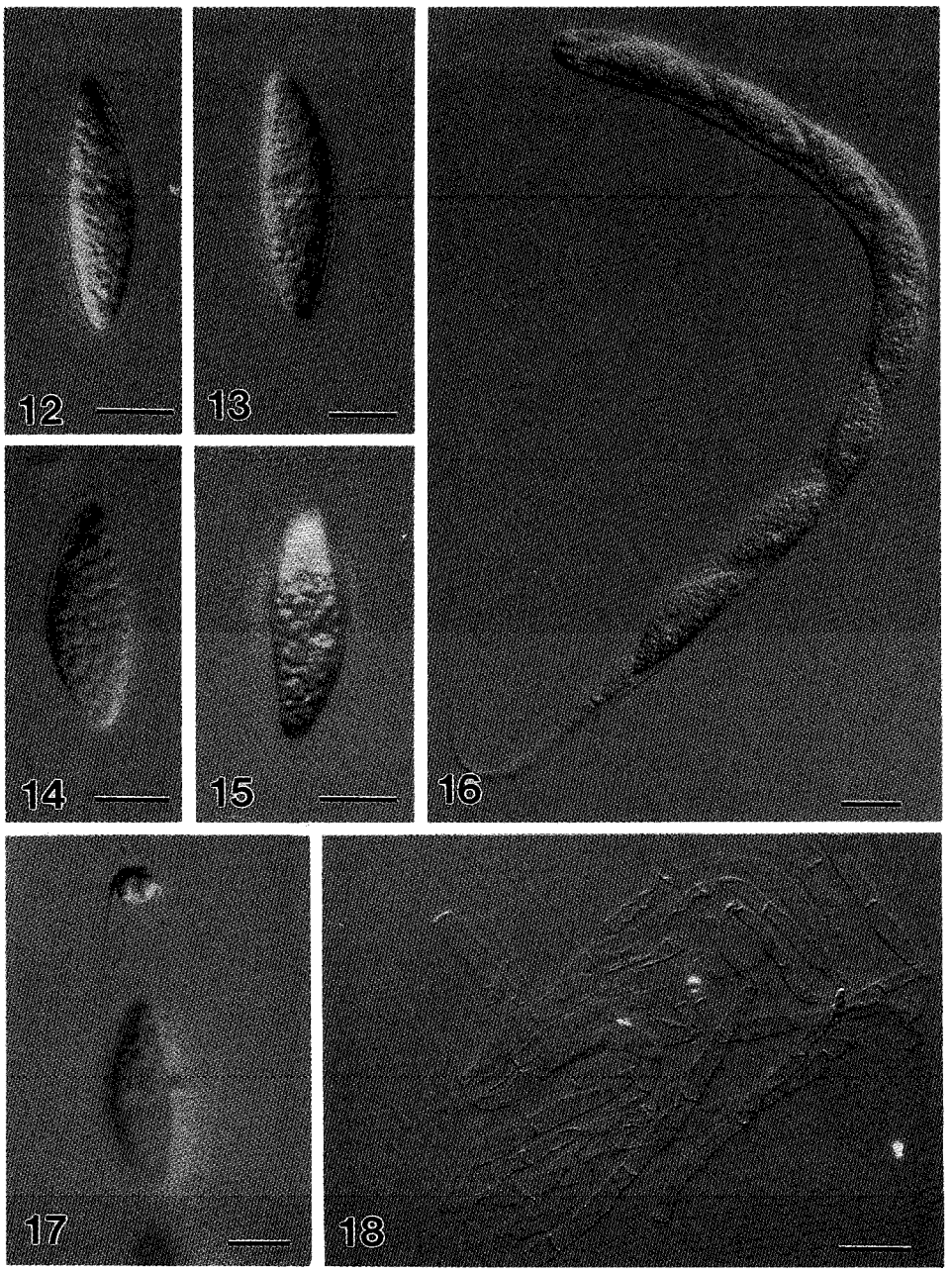
Other Material Examined

Australia, north Queensland, Clohesy River, on submerged wood, November 1990, *K. D. Hyde* BRIP 19241.

Annulatascus bipolaris Hyde, sp. nov. (Figs 19–29)

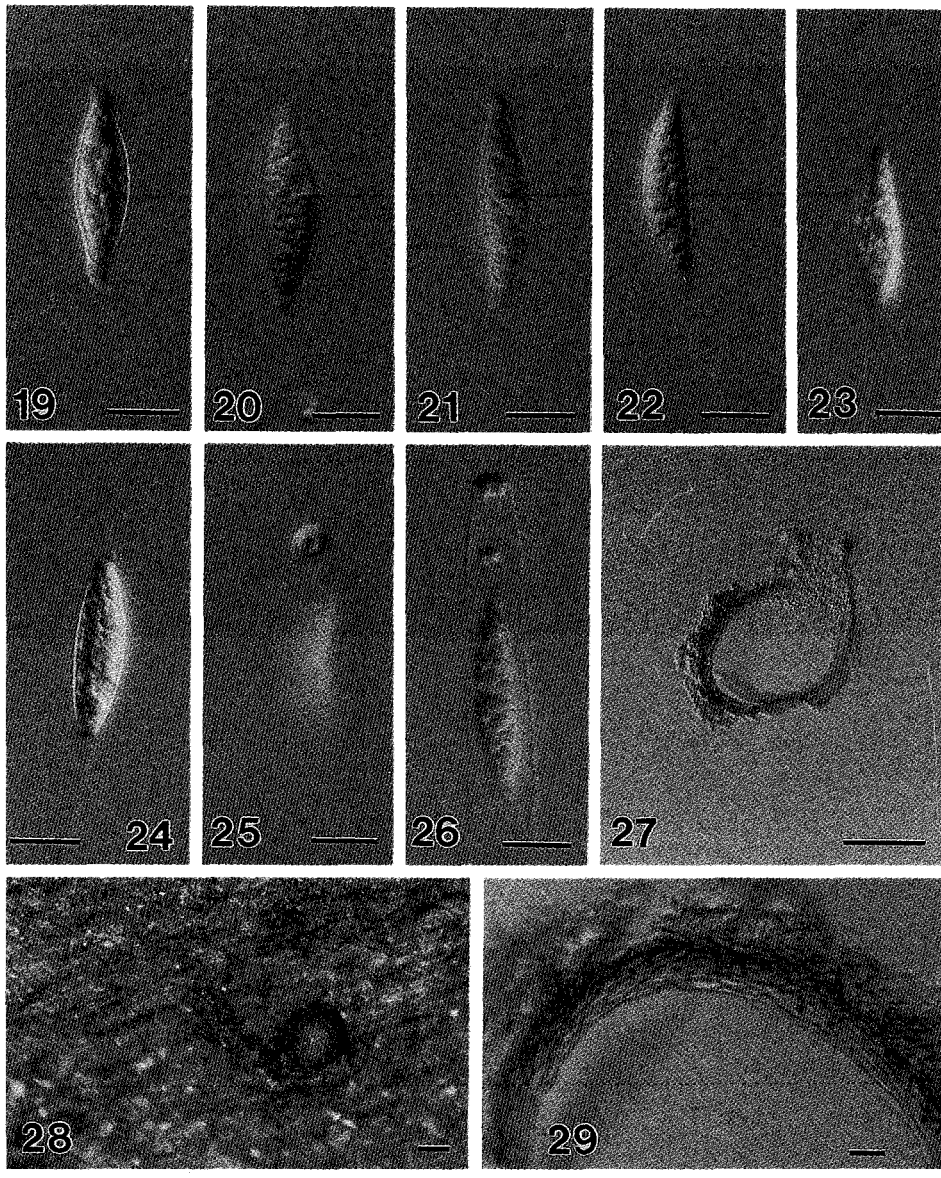
Ascomata 155–235 μm diam., globosa vel subglobosa, immersa, semi-immersa vel superficiales, nigra, coriacea, ostiolata, papillata, solitaria. Collum longum, lateralium, nigrum, periphysaticum. Paraphysibus latis, septatis et angustatis. Peridium nigrum, e textura angulari compositum. Asci 174–205 × 9–10·5 μm, octospori, leptodermi, cylindrici, pedunculati, cum apparatu apicali. Ascosporae 21–30 × 6·5–8·5 μm, unicellularae, hyalinae, uniseriatae, fusiformes et appendiculatae.

Holotypus: Australia, north Queensland, Clohesy River, on submerged wood in a river, November 1990, *K. D. Hyde*, BRIP 17374.



Figs 12–18. Interference light contrast micrographs of *Annulatascus velatispora*: *12–15*, ascospores, note the mucilaginous sheath; *16*, ascus; *17*, ascus apical apparatus; *18*, paraphyses. Scales: 10 μm.

Ascomata 155–235 μm diam., globose or semi-globose, immersed, semi-immersed or superficial, black, coriaceous, ostiolate, beaked, mostly solitary. Beaks long, lateral and curving upwards, black, with periphyses. Paraphyses up to 4 μm wide, septate, tapering, numerous, longer than asci and occurring between asci and extending into the lower neck. Peridium composed of elongate melanised angular cells, lighter and more elongate towards the centre. Asci 174–205 × 9–10·5 μm, 8-spored, thin-walled, long-cylindrical, pedunculate, with a large elongate non amyloid apical apparatus (4 μm long × 6 μm wide), developing from the base of the ascoma. Ascospores 21–



Figs 19–29. Interference light contrast micrographs of *Annulatascus bipolaris*: *19–24*, ascospores, the appendage is firstly pad-like (*19–22*), then is drawn out to form filamentous strands (*23, 24*); *25–26*, ascus apical apparatus; *27*, section through ascoma; *28*, superficial ascoma; *29*, peridium composed of melanised angular cells towards the outside and inner hyaline flattened cells. Scales: *19–26*, *29* = 10 μm, *27–28* = 100 μm.

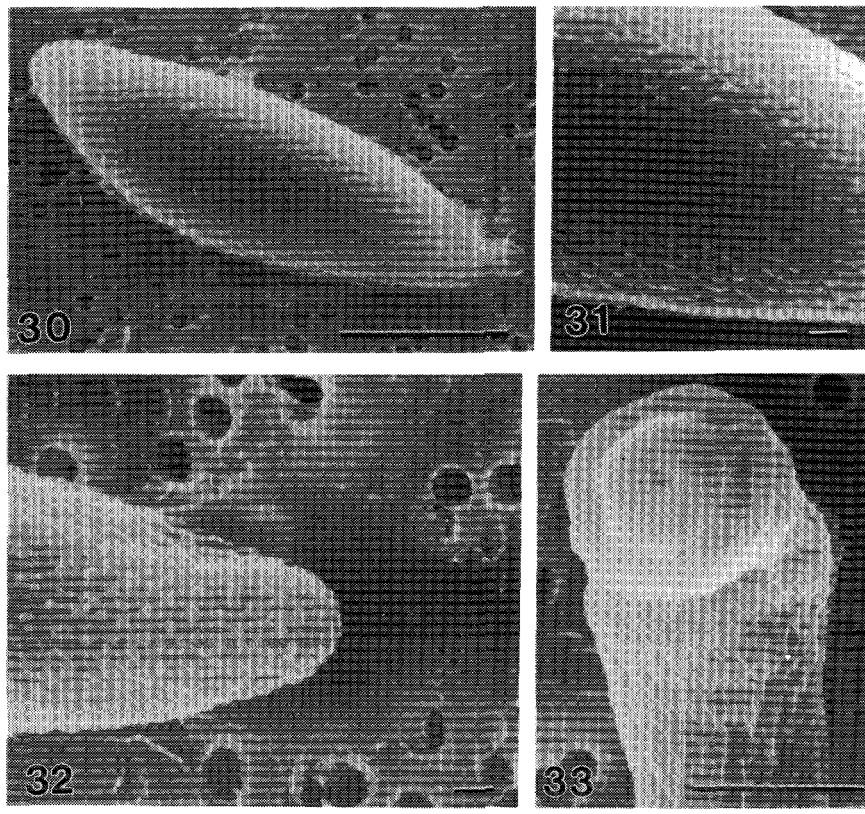
30 × 6·5–8·5 μm, unicellular, hyaline, uniseriate, fusiform, with polar appendages. Appendages at first pad-like, mucilaginous (2·5–3·5 μm long), eventually spreading to form drawn out strands.

Etymology: from the Latin *bipolaris* meaning 'bipolar', in relation to the polar appendages at each end of the ascospore.

Mode of life: saprobic.

Habitat: on submerged wood in a river.

Known distribution: Australia.



Figs 30–33. SEM micrographs of *Annulatascus velatispora: 30–32*, ascospores, note the verruculose wall ornamentation and mucilaginous sheath (seen in *32*); *33*, apex of ascus illustrating ring. Scales: 30, 33 = 10 μm, 31, 32 = 1 μm.

The placement of *Annulatascus* in the Clypeosphaeriaceae (*sensu* Barr 1990) should be considered. However, in the sections of the ascoma cut I could find no evidence of a clypeus, even reduced to a few cells. With its tapering paraphyses, *Annulatascus* is best placed in the Xylariales, Lasiosphaeriaceae (*sensu* Barr 1990), where it keys closest to *Iodosphaeria* Samuels, Muller & Petrini. It differs from *Iodosphaeria* (Samuels *et al.* 1987) in several important aspects, in particular the non-amyloid apical ring. *A. bipolaris* differs from *A. velatispora* in ascospore size and in the presence of polar appendages in the former and a sheath in the latter. Three-celled spores were observed in some mature specimens of *A. velatispora*, but not in those of *A. bipolaris*. *A. bipolaris* differs from *Ceriospora caudaesuis* Ingold, also from freshwater, as the ascospores are two-celled in the latter species (Ingold 1951).

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References

Barr, M. E. (1990). Prodromus to nonlichenized, pyrenomycetous members of the class Hymenoascomycetes. *Mycotaxon* **39**, 43–184.

Crane, J. L., and Shearer, C. A. (1986). *Nais glitra* an ascomycete from red mangrove in Everglades National Park, Florida. *Transactions of the British Mycological Society* **86**, 509–12.

Hyde, K. D. (1992). Tropical Australian freshwater fungi. I. Some ascomycetes. *Australian Systematic Botany* **5**, 109–16.

Ingold, C. T. (1951). Aquatic ascomycetes: *Ceriospora caudae-suis* n. sp. and *Ophiobolus typhae*. *Transactions of the British Mycological Society* **34**, 210–17.

Kohlmeyer, J., and Kohlmeyer, E. (1979). 'Marine Mycology. The Higher Fungi.' (Academic Press: New York.)

Samuels, G. J., Müller, E., and Petrini, O. (1987). Studies in the Amphisphaeriaceae (*sensu lato*) 3. New species of *Monographella* and *Pestalosphaeria*, and two new genera. *Mycotaxon* **28**, 473–99.

Shearer, C. A., and Crane, J. L. (1978). The distribution of *Nais inornata*, a facultative marine ascomycete. *Mycotaxon* **7**, 443–52.

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