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Microfungi on the Pandanaceae: a revision of the hyphomycete genus *Balaniopsis* with two new species

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Abstract During research into microfungi that inhabit decaying parts of the monocotyledonous family Pandanaceae, three species of *Balaniopsis* were collected. One is *Balaniopsis africana* as originally described and illustrated by Kiffer as *Balanium africanum*. The second species is conspecific with the specimen treated as *Balaniopsis africana* by Kirk, but is introduced here as a new species, *Balaniopsis kirkii*. The third, *Balaniopsis dendroidea*, is a new species from Australia.

Key words *Balaniopsis* · *Balanium* · Mitosporic fungi · *Pandanus* · Taxonomy

Introduction

Kirk (1985) reported on a fungus found on a dead frond stalk of *Cyathea* sp. in Kenya, which he determined as *Balanium africanum* Kiffer. Because of differences in conidiophore characteristics between his specimen and *Balanium stygium* Wallr., the type species of *Balanium* Wallr., Kirk (1985) proposed a new genus, *Balaniopsis* P.M. Kirk, with the single species *Balaniopsis africana* (Kiffer) P.M. Kirk. Although both *Balaniopsis* and *Balanium* have rhexolytic conidial secession, Kirk (1985) stated that *Balaniopsis* differed by producing conidia in short, branched chains on conidiophores that are unbranched and show percurrent proliferation. This combination of charac-

ters was considered to be different to that of any other hyphomycete genus.

Balanium africanum is a distinctive species with more or less triangular conidia, long narrow denticles, and conidiophores with alternating light–dark–light pigmented cells (Ellis 1976). The specimen described and illustrated by Kirk (1985) has obovoid conidia, wider and shorter denticles than *Bm. africanum*, and uniform coloration along the conidiophore. Kirk (1985) believed these differences occurred because Kiffer's specimen was isolated from soil and grown on agar, whereas his specimen was described from a natural substrate. Because of this belief, Kirk's generic and specific descriptions were based on his own collection, even though Kiffer's specimen is referred to as the holotype. Kirk (1985) described the conidia as being produced in short branched chains that are delimited by short separating cells. This interpretation is not followed by the current authors, who refer to the basal conidium of Kirk (1985) as the conidiogenous cell. Ellis (1976) also interpreted the "basal conidium" of *Bm. africanum* as a conidiogenous cell.

In an ongoing study of the saprophytic microfungi that inhabit members of the monocotyledonous family Pandanaceae (McKenzie 1991, 1995; Hyde 1994, 1997; McKenzie and Hyde 1996; Whitton et al. 1999, 2000), we collected three species of *Balaniopsis*. We confirm that *Balanium africanum* as described and illustrated by Kiffer (1973) is distinct from Kirk's fungus, P.M. Kirk 1587, and the unusual character of light–dark–light pattern of pigmentation of conidiophore cells is not the result of growth on an artificial medium. Two additional species are included in *Balaniopsis*, one conspecific with the specimen (P.M. Kirk 1587 = IMI 285443), described and illustrated by Kirk (1985), and a third distinct by having di- or trichotomously branching conidiophores and somewhat spherical conidia. Due to additional species and the reinterpretation of the conidiogenous cells, an emended generic description for *Balaniopsis* is provided below, and a synopsis of the genus is given in Table 1. Because of difficulties with quarantine requirements no living cultures were prepared, and all descriptions are from dried herbarium specimens. The dichotomous key and synopsis table incorporate measure-

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Table 1. Synopsis of *Balaniopsis*

Species	Conidiophores		Conidiogenous cells		Conidia	
	Size (µm)	Pigmentation	Size (µm)	Denticle no.	Size (µm)	Shape
<i>B. africana</i>	Up to 200 × 5–10	Light–dark–light	10–16.5 × 12–13 ^a	3–5 ^a	9–12 × 7–10	Triangular to clavate
<i>B. dendroidea</i>	360–750 × 11–14	Concolorous	12–19 × 10–15	4–9	8.5–13 in diameter	Spherical
<i>B. kirkii</i>	155–265 × 8–12	Concolorous	17–23 × 13.5–18	4–10	12.8–14.5 × 9.5–11	Broadly obovoid

^a Ascertained from accompanying illustrations (Ellis 1976)

ments taken both from current specimens and from the literature.

Taxonomy

Balaniopsis P.M. Kirk, Mycotaxon **23**:308, 1985.

Mycelium immersed or superficial, composed of branched, septate, smooth, pale brown to brown hyphae, with or without hyphopodial branches. Conidiophores macronematous, mononematous, solitary or in small groups, erect, unbranched, irregularly branched or di-, trichotomously branched, straight, curved or slightly flexuous, smooth, septate, brown to dark brown, or with a light–dark–light pigmentation pattern, paler toward the apex, sometimes with percurrent proliferations through the apex. Conidiogenous cells integrated, terminal, denticulate, determinate, or percurrently proliferating through the apex of the conidiophores with new conidiogenous cell production. Conidial ontogeny holoblastic by apical wall building. Conidial maturation presumably synchronous with conidial ontogeny. Conidial secession rhexolytic by fracture of a separating cell. Conidia spherical, triangular, subglobose, broadly ellipsoid or obovate, acrogenous, smooth, dry, pale brown to dark brown, aseptate.

Balaniopsis africana (Kiffer) P.M. Kirk, Mycotaxon **23**:309, 1985 (not P.M. Kirk 1587). Figs. 1–8 = ***Balanium africanum*** Kiffer, Nat. Can. **100**:261, 1973.

Conidiophores 5–5.5 µm wide, up to 110 µm long, cylindrical, unbranched, with a distinctive light–dark–light pigmentation pattern; cells of the conidiophores readily separate at the septa. Conidiogenous cells 11–12.5 µm long, 8.5–11 µm wide at the widest point, slightly inflated, somewhat triangular, dark brown to black, producing 3–4 pale brown denticles; basal cell pale brown, broadly conical, easily detached from the conidiophore. Conidia 9–11 µm long, 7–9 µm wide at the widest point, triangular, brown to pale brown, with a small, narrow portion of the separating cell remaining.

Habitat: Soil and decaying plant parts of *Pandanus* sp., *P. seychellarum*.

Distribution: Brunei Darussalam (current specimen), Seychelles (current specimen), Zaire (Kiffer 1973).

Specimens examined: Brunei Darussalam, Temburong, Batu Apoi Forest Reserve, Kuala Belalong Field Studies Centre, Ashton Track, on decaying leaves of *Pandanus* sp., 24 October 1996, S.R. Whitton (HKU(M) 5095). Seychelles,

Mont Blanc, on decaying leaves of *P. seychellarum*, 1 August 1996, K.D. Hyde (HKU(M) 5096).

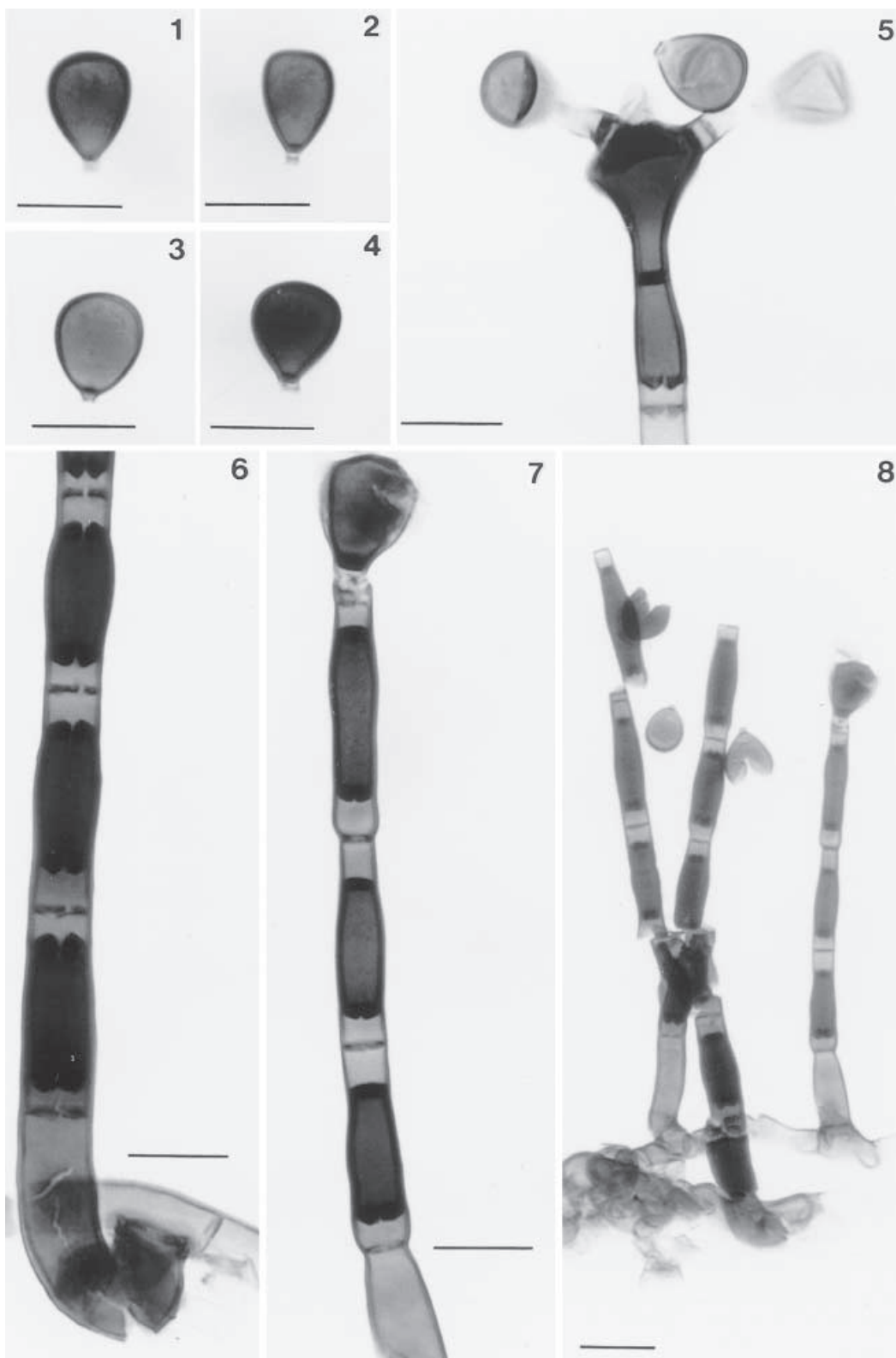
Notes: Both specimens found on decaying leaves of *Pandanus* show the distinctive conidiophore characteristics described and illustrated by Kiffer (1973).

Balaniopsis dendroidea Whitton, McKenzie & K.D. Hyde, sp. nov. Figs. 9–20

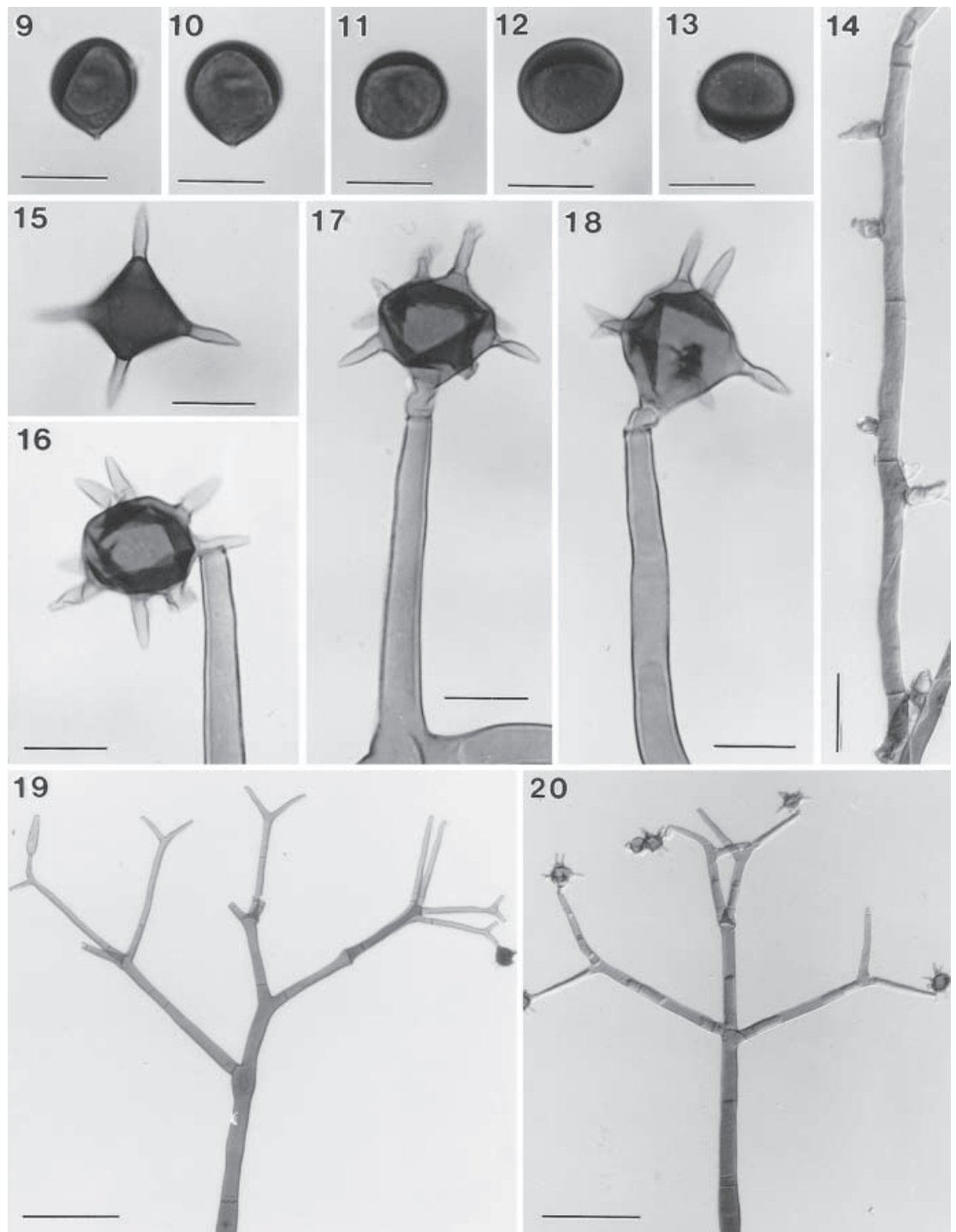
Coloniae in substratum naturale effusae, brunneae. Mycelium superficiale, laeve, septatum, ramosum, brunneum vel pallide brunneum, 5–14 µm diameter. Hyphopodia 0–3 septatis, 10–40 × 5.5–9.5 µm. Conidiophora macronematosa, mononematosa, cylindrica vel attenuata, apice di- vel trichotome 2–3(–4) ramosa, erecta, recta vel flexuosa, laevia, brunnea, ad apicem pallidiora, 360–750 µm longa, ad basim 11–14 µm crassa. Cellulae conidiogenae holoblasticae, polyblasticae, in conidiophoris incorporatae, laeves; cellula basalis cylindrica, pallide brunnea, circa 3 × 2–3 µm; cellula apicalis atrobunnea vel nigra, obovata, 12–19 × 10–15 µm, 4–9-denticulata; denticuli pallide brunnei, anguste conici, 4–6.8 × 1.5–2 µm. Conidia singula, sicca, subglobose, laevia, aseptata, brunnea vel pallide brunnea, crassitunicata, 8.5–13 µm diameter.

Holotypus: in foliis mortuis pandanacearum *Pandanus monticola*, Australia, north Queensland, alongside the road between Baybinda and Cairns, 17 June 1996, S.R. Whitton (HKU(M) 5098).

Colonies on natural substrate effuse, brown, consisting of scattered solitary conidiophores. Mycelium superficial, smooth, septate, cylindrical, infrequently branched, brown to pale brown, giving rise to short hyphopodial branches and aerial conidiophores, 5–14 µm diameter. Hyphopodia (1–)2(–4) celled, typically with one large basal cell and one small apical cell, 10–40 µm long, 5.5–9.5 µm wide at the widest point, 1–2 hyphopodia produced from most cells of the superficial hyphae. Conidiophores macronematous, mononematous, cylindrical or slightly tapering from the base, 2–3(–4)-branching toward the apex, erect, straight, curved or slightly flexuous, smooth, brown toward the base, fading to pale brown toward the apices of the branches, 360–750 µm long, 11–14 µm wide at base, 2.5–3.2 µm wide at apices of the branches, 3–9-septate and 210–525 µm long from base to first branch; end branches typically 1(–2)-celled and 10–69 µm long; apices of each branch truncate with a single denticulate conidiogenous cell. Conidiogenous cells holoblastic, polyblastic, integrated, smooth; basal portion pale brown, cylindrical or slightly conical, about 3 µm long, 2–3 µm wide at point of attachment, acting as a separating cell from the conidiophore; apical part initially pale



Figs. 1–8. *Balaniopsis africana* (HKU(M) 5095). **1–4** Conidia: note the persistent portion of the conidiogenous cell at the base. **5** Conidiogenous cell and conidia. **6–8** Conidiophores: note the light–dark–light pattern of pigmentation. *Bars 1–8* 10 μ m



Figs. 9–20. *Balaniopsis dendroidea* (HKU(M) 5098, holotype). **9–13** Conidia: note short portion of the conidiogenous cell at base. **14** Superficial hyphae with hyphopodia. **15** Conidiogenous cell from

above. **16–18** Conidiogenous cell with denticles. **19, 20.** Branching conidiophores. Bars 9–13, 15–18 10 μ m; 14, 19, 20 40 μ m

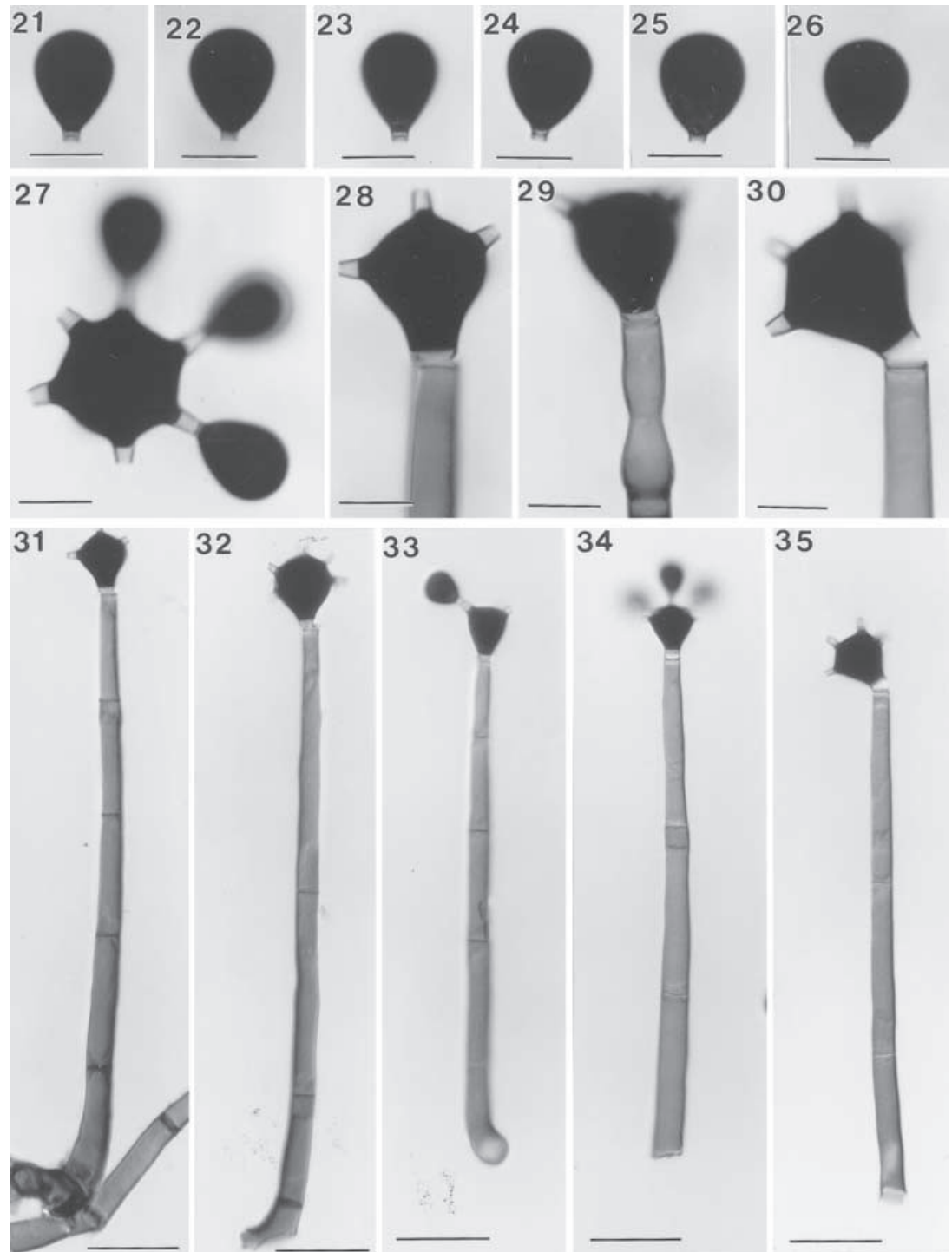
brown, becoming dark brown to black, obovate, 12–19 μ m long, 10–15 μ m wide at the widest point, 4–9-denticulate; denticles pale brown, narrowly conical, 4–6.8 μ m long, 1.5–2 μ m wide at the widest point, each gives rise to a single conidium and acts as a separating cell. Conidia solitary, dry, subglobose, smooth, aseptate, brown to pale brown, thick

walled, 8.5–13 μ m diameter, with a short portion of the separating cell persisting at the base.

Etymology: From the Greek *dendro*, meaning tree, referring to the branching conidiophores.

Habitat: Decaying leaves of *Pandanus monticola*.

Distribution: Australia.



Figs. 21–35. *Balaniopsis kirkii* (HKU(M) 5099, holotype). **21–26** Conidia: note persistent portion of the conidiogenous cell at the base. **27** Conidiogenous cell from above. **28–30** Conidiogenous cells with denticles. **31–35** Conidiophores. Bars **21–30** 10 μ m; **31–35** 30 μ m

Additional specimen examined: Australia, north Queensland, Lacy Creek State Forest Park, on decaying leaves of *P. monticola*, 17 June 1996, S.R. Whitton (HKU(M) 5097).

Notes: Based on the distinctive conidiogenous cell produced at the apex of each conidiophore branch, this

is undoubtedly a species of *Balaniopsis*. Because of conidiophore branching and the almost spherical nature of the conidia, this species cannot be accommodated in any known *Balaniopsis* species and, therefore, requires specific recognition.

Balaniopsis kirkii Whitton, McKenzie & K.D. Hyde, sp. nov. Figs. 21–35

Coloniae in substratum naturale effusae, brunneae vel atro-brunneae. Mycelium immersum et superficiale, laeve, septatum, ramosum, brunneum, 5–11 µm diameter. Hyphopodia 11.5–16 × 5.5–9 µm. Conidiophora macronematosa, mononematosa, cylindrica vel attenuata, erecta, recta vel flexuosa, laevia, brunnea vel atro-brunnea, ad apicem pallidiora, 3–6-septata, 155–265 µm longa, ad basim 8–12 µm crassa, apice 5–6.5 µm crassa et truncata. Cellulae conidiogenae holoblasticae, polyblasticae, in conidiophoris incorporatae, laeves; cellula basalis late cylindrica, pallide brunnea, 5.2–6.5 µm crassa; cellula apicalis atrobrunnea vel nigra, obovata, 17–23 × 13.5–18 µm, 4–10-denticulata; denticuli pallide brunnei, cylindrici vel subconici, 4–4.5 × 2–2.5 µm. Conidia singula, sicca, atrobrunnea vel nigra, laevia, aseptata, late obovata, 12.8–14.5 × 9.5–11 µm.

Holotypus: in foliis mortuis pandanacearum *Pandanus monticola*, Australia, north Queensland, off the track along side Lake Barrine, 17 June 1996, S.R. Whitton (HKU(M) 5099).

Colonies on natural substrate effuse, hairy, consisting of individual conidiophores scattered over the substrate surface, brown to dark brown. Mycelium 5–11 µm diameter, immersed and superficial; superficial hyphae brown, cylindrical, septate, infrequently branched, smooth, producing small hyphopodial outgrowths. Hyphopodia 11.5–16 µm long, 5.5–9 µm wide at the widest point. Conidiophores macronematous, mononematous, solitary, erect, straight or slightly curved, smooth, 3–6-septate, cylindrical or slightly tapered from the base to the apex, unbranched, brown to dark brown toward the base, fading slightly toward the apex, 155–265 µm long, 8–12 µm wide toward the base, 5–6.5 µm wide at the apex; basal cell more or less cylindrical; apex truncate and terminated by a single conidiogenous cell, infrequent percurrent proliferations present. Conidiogenous cells holoblastic, polyblastic, integrated into the apex of the conidiophores, smooth; basal portion 5.2–6.5 µm wide, pale brown, broadly cylindrical, acts as a separating cell from the conidiophore; apical part dark brown or black, somewhat triangular or broadly obovoid, 17–23 µm long, 13.5–18 µm wide at the widest part, 4–10-denticulate; denticles pale brown, cylindrical or slightly conical, 4–4.5 × 2–2.5 µm, each gives rise to a single conidium and acts as a separating cell. Conidia solitary, dry, dark brown to almost black, smooth, aseptate, broadly obovoid, apex broadly rounded, 12.8–14.5 µm long, 9.5–11 µm wide at the widest part, with a short portion of the separating cell persisting at the base.

Etymology: In reference to P.M. Kirk, the first person to collect, describe, and illustrate this fungus, and in recognition of his contributions to hyphomycete taxonomy and mycology.

Habitat: Decaying leaves of *Pandanus monticola* and rachis of *Cyathea* sp.

Distribution: Australia (current specimen), Kenya (Kirk 1985).

Notes: Because a fungus conspecific with *Balanium africanum* Kiffer (1973) has now been found on natural substrates, a new description for Kirk's fungus was needed. The current specimen, *Balaniopsis kirkii*, appears to be identical to that described and illustrated by Kirk (1985) as "*B. africana* (P.M. Kirk 1587)."

Key to species of *Balaniopsis*

1. Conidiophores typically 2–3(–4) times dichotomously branched, concolorous throughout; conidia brown to pale brown, more or less spherical, 8.5–13 µm diameter *B. dendroidea*
1. Conidiophores simple 2
2. Conidiophores with a distinctive light–dark–light pigmentation pattern; conidia brown to pale brown, more or less triangular in shape, 9–12 × 7–10 µm .. *B. africana*
2. Conidiophores concolorous throughout; conidia broadly obovoid, dark brown, 12.8–14.5 × 9.5–11 µm *B. kirkii*

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