

## A revision of the genera *Antromycopsis*, *Sclerostilbum*, and *Tilachlidiopsis* (Hyphomycetes)

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The anamorphic genera *Antromycopsis*, *Sclerostilbum*, and *Tilachlidiopsis* are revised. Three anamorph species with basidiomycetous affinities are accepted in *Antromycopsis*: *A. macrocarpa* (Ellis & Everh.) comb.nov. (basionym *Stilbum macrocarpum*), previously known as *A. broussonetiae* (teleomorph: *Pleurotus cystidiosus*), *A. angustata* sp.nov. for the presumed anamorph of *Pleurotus angustatus*, and *A. guzmanii* sp.nov. (teleomorph *Pleurotus smithii*). A description and illustration are presented of the type species of *Tilachlidiopsis*, *T. racemosa*, the anamorph of *Collybia racemosa*. *Sclerostilbum* is considered a taxonomic synonym of *Tilachlidiopsis*. *Nothoclavulina ditopa*, the anamorph of *Arthrosporella ditopa*, is illustrated and briefly discussed.

**Key words:** anamorph–teleomorph connections, *Antromycopsis*, *Sclerostilbum*, *Pleurotus*, *Collybia*, nematophagous fungi.

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Les genres anamorphes *Antromycopsis*, *Sclerostilbum* et *Tilachlidiopsis* sont révisés. Trois espèces anamorphes ayant des affinités avec les basidiomycètes sont acceptées dans *Antromycopsis*: *A. macrocarpa* (Ellis & Everh.) comb.nov. (basionyme *Stylbum macrocarpum*) connu antérieurement comme *A. broussonetiae* (téléomorphe: *Pleurotus cystidiosus*), *A. angustata* sp.nov. comme présumé anamorphe du *Pleurotus angustatus*, et *A. guzmanii* sp.nov. (téléomorphe *Pleurotus smithii*). Une description avec illustrations de l'espèce type du *Tilachlidiopsis*, *T. racemosa*, l'anamorphe du *Collybia racemosa*, est donnée. Le *Sclerostilbum* est considéré comme synonyme taxonomique du *Tilachlidiopsis*. Le *Nothoclavulina ditopa*, l'anamorphe de l'*Arthrosporella ditopa*, est illustré et brièvement discuté.

**Mots clés :** relations anamorphe–téléomorphe, *Antromycopsis*, *Sclerostilbum*, *Pleurotus*, *Collybia*, champignons nématophages.

[Traduit par la Rédaction]

### Introduction

The synnematus Hyphomycete genera *Antromycopsis* Pat. & Trabut, *Sclerostilbum* Povah, and *Tilachlidiopsis* Keissler have teleomorphs in the Agaricales. *Antromycopsis* was described and illustrated by Patouillard (1897) with a single species, *A. broussonetiae* Pat. & Trabut, based on material collected on wood of *Broussonetia* in Algeria. Pollack and Miller (1967) associated the type species with its teleomorph, *Pleurotus cystidiosus* O. K. Miller. Nine additional taxa have been described in *Antromycopsis*, four of them with putative *Pleurotus* teleomorphs. The genus is characterized by the production of determinate synnemata consisting of parallel hyphae, more or less globose blastoconidia produced on denticles along the stipe and arthroconidia formed in a terminal slime droplet. The arthroconidia are at first hyaline, but become dark brown to black when mature, and develop basipetally from the divergent hyphae of the capitulum. Patouillard (1897) observed the basipetal conidiogenesis and recognized the beaklike projections on young conidia as remnants of clamp connections.

*Sclerostilbum septentrionale* Povah was shown to be the anamorph of *Collybia racemosa* (Pers.) Quélet by Watling and Kendrick (1977). The synnemata of this species are produced on the stipe of the basidiome, but the pileus often is not formed. Blastoconidia are not produced. The arthroconidia develop in a manner similar to those of *Antromycopsis*, but remain hyaline. Based on our studies of herbarium specimens and a freshly

isolated culture, *Tilachlidiopsis racemosa* Keissler was found to be an earlier name for *S. septentrionale*. A revision of other described species of *Tilachlidiopsis* will be the subject of a second paper (R. A. Samson, K. A. Seifert, and J. A. Stalpers, in preparation).

Originally, we had intended to combine *Antromycopsis* and *Tilachlidiopsis* because of the similarities in arthroconidial development. However, we believe that the differences in the classification of the teleomorphs, *Pleurotus* in the Polyporaceae for *Antromycopsis* and *Collybia* in the Tricholomataceae for *Tilachlidiopsis* (following Hawksworth *et al.* 1983), support the maintenance of distinct anamorph genera. The differences in conidial pigmentation and the production of blastoconidia by species of *Antromycopsis* are characters that allow the two genera to be distinguished easily.

### Materials and methods

Isolates were grown in 9 cm diameter polystyrene Petri dishes on neutralized 2% malt extract agar (MEA) and cherry decoction agar (ChA, pH 4–5) at room temperature in diffuse daylight. Some isolates were also grown on YPG (20 g glucose, 10 g bactopectone, 5 g yeast extract, 15 g agar, 1 L water) and on Modess agar (Gams *et al.* 1987). Drop tests for laccase and tyrosinase were performed as described by Käärik (1965) and Stalpers (1978). Preparations for scanning electron microscopy were made according to Samson *et al.* (1979). Observations of nuclei were performed with a Leitz Dialux 20EB microscope with Ploemopak fluorescence device and a 50 W mercury lamp. Fluorochromes were a 1:1 mixture of (i) 5 mg mitramycin and 125 mg MgCl<sub>2</sub> in 100 mL 12.5% ethanol and (ii) 2.5 mg ethidium bromide, 1.2 g Tris buffer, and 0.6 g NaCl in 100 mL H<sub>2</sub>O with filter G or I2. Sections of synnemata were prepared using a Damon IEC CTF

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Microtome Cryostat as described by Seifert (1985). Measurements are based on fresh mounts in 2% KOH for herbarium material, or 90% lactic acid for living material.

### Taxonomy

*Antromycopsis* Pat. & Trabut apud Pat., Bull. Soc. Mycol. Fr. 13: 215. 1897.

TYPE SPECIES: *A. broussonetiae* Pat. & Trabut

Conidiomata synnematos, determinate, with white to straw-coloured stipes, colour unchanged in 2% KOH or lactic acid, and divergent, brown to black capitula. Hyphae of stipe hyaline, thin- to slightly thick-walled, with clamp connections at all primary septa; parallel throughout most of the length of the stipe, forming a *textura porrecta* or a *textura prismatica*. Conidia of two kinds: blastoconidia hyaline, globose, produced on denticles on the stipe and on the aerial mycelium, and arthroconidia dark brown to black, broadly ellipsoidal to cylindrical, produced in the capitulum. The arthroconidia are generally connected by clamp connections that leave beaklike remnants after secession. Hyphal cells and conidia binucleate.

Reaction for laccase positive, for tyrosinase negative.

TELEOMORPH WHEN KNOWN: *Pleurotus*.

HABITAT: Lignicolous and nematophagous.

The clavate cells on the stipes of the synnemata of *Antromycopsis* species have been called cystidia or distorted cystidia, depending on the presence or absence of one to four swollen structures on denticles. Such structures are also produced on reduced lamellae and stipes of several species of *Pleurotus*, such as *P. cornucopiae* (Paulet) Rolland, *P. eryngii* (DC.:Fr.) Quélet, and *P. ostreatus* (Jacq.:Fr.) Kummer (Hilber 1982). All possible intermediates can be found between typical basidia with four ballistospores, clavate cells with four obovoid to glo-

bose blastoconidia that are not actively discharged (i.e., statismospores), clavate cells with single apical or lateral conidia and sessile lateral conidia on undifferentiated hyphae of the stipe. As soon as the spores are statismospores, slime caps may be found around them, as illustrated by Hilber for *Pleurotus abalonus* Han, Chen & Cheng, *P. cornucopiae*, *P. eryngii*, and *P. ostreatus*. We concur with Hilber that the propagules should be called conidia when they are clearly statismosporic, although there is no evidence at what point the transition from meiotic to mitotic division occurs.

The slime-covered structures and blastoconidia resemble the predatory adhesive nobs and blastoconidia produced by species of the genus *Nematoctonus* (Barron and Thorn 1986). This helps confirm the relationship of *Pleurotus* with *Hohenbuehelia*. We were unable to identify any of the *Pleurotus* anamorphs described below with described species of *Nematoctonus* (Thorn and Barron 1986).

Moore (1984) discussed the identity of the seven species attributed to *Antromycopsis* at that time. To his comments we can add that *A. alpina* Höhnelt, a species of uncertain disposition according to Moore, can be considered a taxonomic synonym of *Pycnostysanus azaleae* (Peck) Mason, based on our examination of the holotype in FH.

As noted by Watling and Kendrick (1977), the anamorph of *Pleurotus dryinus* (Pers.) Kummer (Figs. 14–16), is very similar to *Antromycopsis*, but no synnemata are produced. Instead, the brown arthroconidia are produced directly in the aerial mycelium, and no slime is formed. The anamorph is clearly allied to *Antromycopsis*, and differs mainly by the absence of synnemata. J. A. Stalpers (unpublished) has demonstrated that three strains of *P. dryinus* (CBS 481.72, 449.77, and 724.83) are capable of killing nematodes.

### Key to the species

1. Arthroconidia large, 15–40 × 6–10 μm; blastoconidia on stipe, 4.5–7.5 μm diameter ..... *A. angustata*
1. Arthroconidia smaller, 11–23 × 5–8 μm; blastoconidia on stipe, 1.5–3.0 μm diameter ..... 2
2. Growth rate on MEA 14–20 mm radius in 2 weeks ..... *A. macrocarpa*
2. Growth rate on MEA 5–7 mm radius in 2 weeks ..... *A. guzmanii*

*Antromycopsis macrocarpa* (Ellis & Everh.) Stalpers, Seifert & Samson, comb.nov. (Figs. 1–11)

= *Stilbum macrocarpum* Ellis & Everh., J. Mycol. 2: 103. 1886.

= *Antromycopsis broussonetiae* Pat. & Trabut apud Pat., Bull. Soc. Mycol. Fr. 13: 215. 1897.

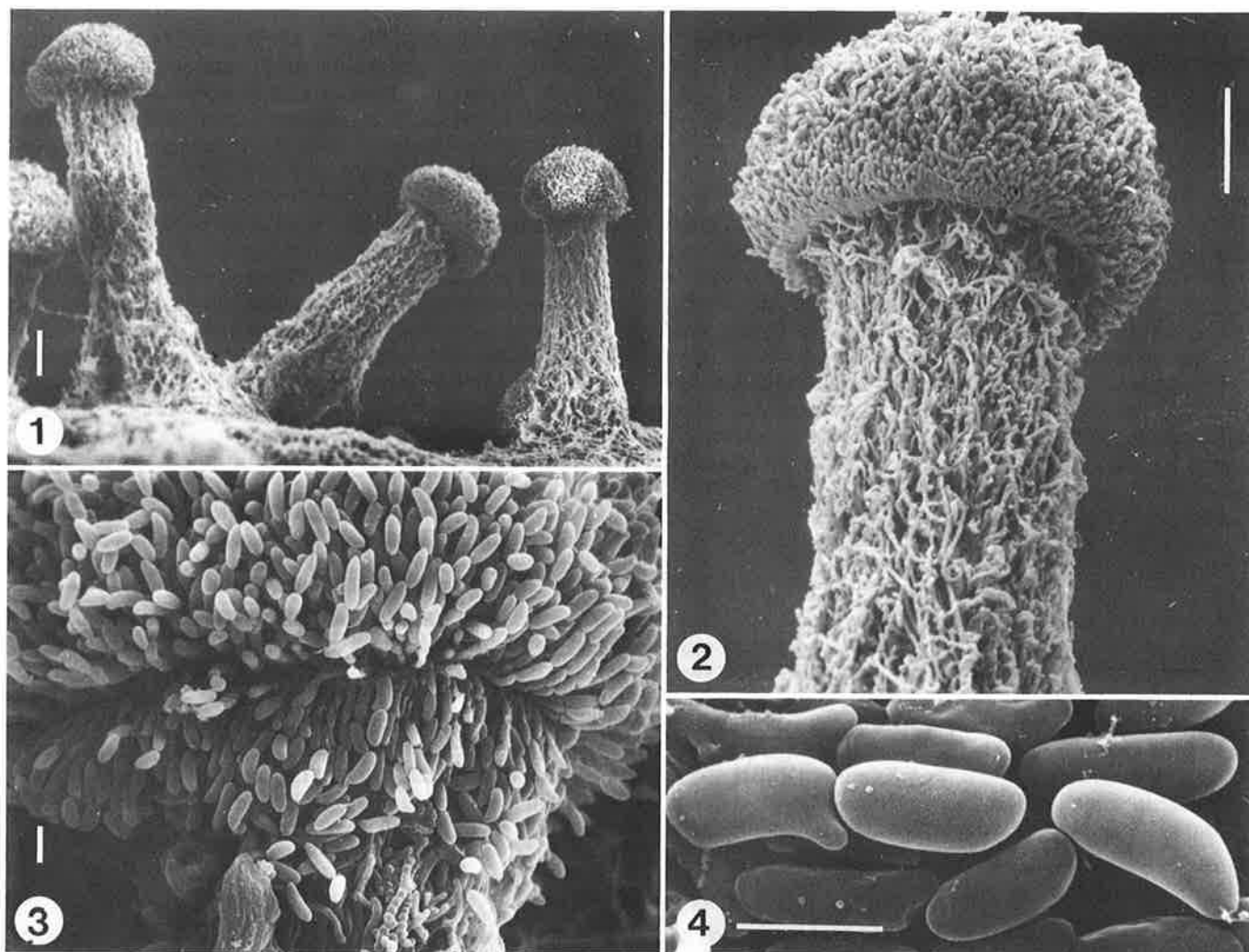
= *Antromycopsis broussonetiae* ssp. *minor* Penzig & Sacc., Malpighia 15: 254. 1902 = *Antromycopsis broussonetiae* var. *minor* Sacc., Syll. Fung. 18: 652. 1906.

TELEOMORPH: *Pleurotus cystidiosus* O. K. Miller, Mycologia 61: 889.

Synnemata (Figs. 1–3) 800–2500(–9000) μm tall, unbranched, or sometimes with lateral or terminal branches or proliferations, with a white to straw-coloured stipe, 150–400(–3000) μm wide. Hyphae of stipe 2.5–4(–5) μm wide, hyaline, thin-walled, becoming slightly brown and slightly thick-walled with age, clamped, parallel through most of the length, sometimes intermixed with crystals. Arthroconidial mass forming within an initially hyaline slime drop that becomes black and dries as the conidia mature, usually black but sometimes orange when dry, 300–1000(–2500) μm in diameter; drops often coalescing to form a continuous slimy

mass over parts of the culture. Arthroconidia (Figs. 4–8) formed on divergent hyphae in the capitulum, maturing basipetally, at first hyaline with beaklike basal clamp remnants, when mature brownish to black, smooth in outline, slightly thick-walled, sometimes with granular contents; apical conidia narrowly ellipsoidal to cylindrical, 14–18 × 6–7.5 μm; intercalary conidia ellipsoidal to ovoid, 10–15(–18) × 6.5–7.5(–8) μm; basal conidia cylindrical to narrowly cylindrical, sometimes curved, 16–24 × 3.5–5(–5.5) μm. Blastoconidia (Figs. 9–11) globose to broadly ovoid, 1.5–3 μm in diameter, often remaining attached to the conidiogenous denticles, which emerge from the stipe hyphae, or from clavate marginal cells, or produced directly from stipe hyphae on the lower part of the stipe.

Growth rate on MEA: 14–20 mm radius in 2 weeks, and 8–12 mm on ChA. Colonies appressed, hyaline but becoming locally downy to farinaceous, white. Margin even to slightly gnawed; marginal hyphae appressed to submerged, distant, hyaline, thin-walled, 1.5–3.5 μm in diameter, with clamp connections at all primary septa; clamp diameter sometimes equal to that of supporting hyphae, but often narrower; some hyphae with short, irregular branches or short protuberances; crystals absent. Synnemata formed within 1 week on the inoc-



Figs. 1–4. *Antromycopsis macrocarpa* CBS 297.35. Fig. 1. Synnemata. Fig. 2. Synnema. Fig. 3. Arthroconidia on synnema. Fig. 4. Arthroconidia. Bars for Figs. 1 and 2 = 100  $\mu\text{m}$ , Figs. 3 and 4 = 10  $\mu\text{m}$ .

ulum block, older cultures sometimes with a second generation of synnemata on the stipes and rarely even on the capitula; on YPG, the capitula sometimes remaining ochraceous or pale brownish. Reverse unchanged. Odour insignificant. Aerial hyphae hyaline, thin- to slightly thick-walled, 1.5–5  $\mu\text{m}$  wide, with clamp connections, sometimes encrusted with small crystals. Denticles (Figs. 9–11) 3–5  $\times$  0.5–1  $\mu\text{m}$ , found in older cultures on the aerial hyphae (Fig. 9) and at the base of the synnema stipes (Fig. 10), sometimes with a terminal swelling up to 2  $\mu\text{m}$  wide surrounded by a cyanophilous drop, 2–7.5  $\mu\text{m}$  in diameter. Crystals present in the medium, rhomboid or prismatic. All cells and nearly all conidia are binucleate.

Reaction for laccase positive, for tyrosinase negative.

Cardinal temperatures for growth: minimum 8°C, optimum 28–30°C, maximum 33–35°C.

Species Code (Nobles 1965): 2, 3, 7, 33, 35, 36, 38, 45–47, (48), 54, 60.

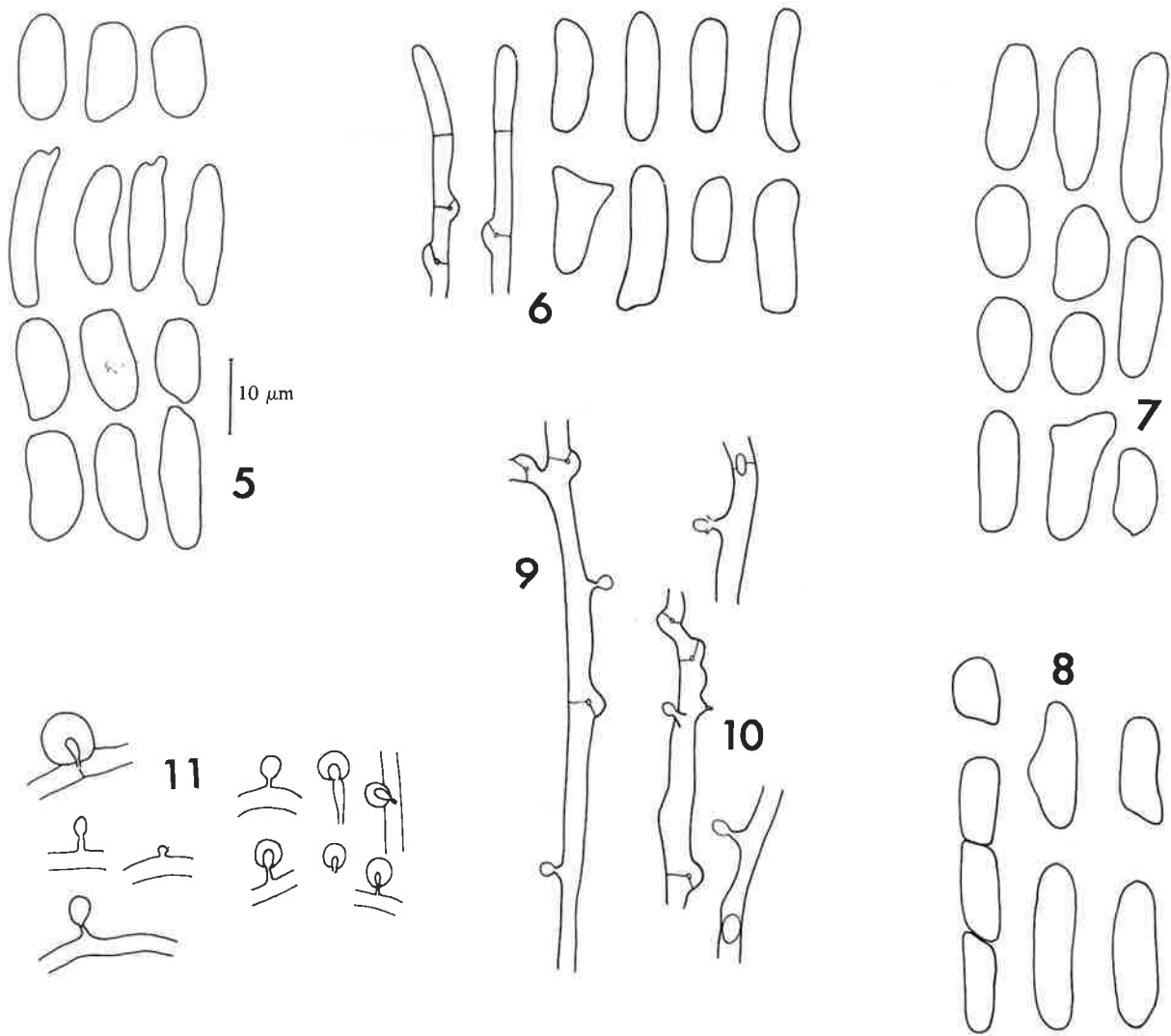
Species Code (Stalpers 1978): 1, (9), 13, 14, (16), 17, 18, 30, 39, (44), (45), 48, 52, 53, (54), (59), 82, 84, 86, 87, (88), 89, 94, 95.

MATERIAL EXAMINED: Herbarium specimens: *Stilbum macrocarpum*, HOLOTYPE, UNITED STATES OF AMERICA, LOUISIANA, New Orleans, on rotten *Salix*, leg. A. B. Langlois

no. 465, 28 April 1886 (NY). *Antromycopsis broussonetiae*, HOLOTYPE, ALGERIA, on trunk of *Broussonetia*, leg. N. Patouillard, 18 Aug. 1880 (FH). *Antromycopsis broussonetiae* ssp. *minor*, HOLOTYPE, INDONESIA, JAVA, Bogor, on wood of *Cecropia schiedeana*, leg. O. Penzig, no. 316, 9 Dec. 1896 (BO 2587). Living cultures: CBS 297.35, F. Kaufert, U.S.A., isol. ex *Liquidambar styraciflua*. CBS 298.35 = ATCC 36499, F. Kaufert, U.S.A., isol. ex *Quercus nuttallii*. CBS 756.79, F. F. Lombard, U.S.A. CBS 615.80, K. Natarajan, India, from *Pleurotus* sp., sent by R. T. Moore. ATCC 28787, J.-T. Peng TA-2.

*Pleurotus abalonus* Han, Chen & Cheng was considered a synonym of *P. cystidiosus* by Jong and Peng (1975) and by Sasek *et al.* (1986). Hilber (1982) considered *Pleurotus abalonus* a distinct microspecies ('Kleinart') despite the fact that 54.5% of the interspecific matings were positive. Neda and Furukawa (1987) also considered *P. abalonus* a distinct species. We will not enter into the discussion on microspecies, but we concur with Sasek *et al.* (1986) that the anamorphs of *P. cystidiosus* and *P. abalonus* are identical. The description of *A. macrocarpa* above also covers the anamorph of *P. abalonus*.

Nair and Kaul (1980) considered *A. broussonetiae* ssp. *minor* the anamorph of *Pleurotus gemmellarii* (Inzeng.) Sacc.



FIGS. 5–11. *Antromycopsis macrocarpa*. Fig. 5. Arthroconidia (type of *A. broussonetiae*). Fig. 6. Arthroconidia (type of *Stilbum macrocarpon*). Fig. 7. Arthroconidia (CBS 297.35). Fig. 8. Arthroconidia (type of *A. broussonetiae* ssp. *minor*). Fig. 9. Blastoconidia developing in aerial mycelium (ATCC 28787). Fig. 10. Blastoconidia developing on basal part of synnema (ATCC 28787). Fig. 11. Blastoconidia and secretory cells (CBS 298.35).

Their description of the anamorph of *P. gemmellarii* conforms with our concept of *A. macrocarpa*. If Nair and Kaul (1980) were correct in their identification of the basidiocarps as *P. gemmellarii* and if *P. gemmellarii* is not conspecific with *P. cystidiosus*, then *A. macrocarpa* is a species aggregate. If *P. gemmellarii* is conspecific with *P. cystidiosus*, it is the correct name of the species.

Thorn and Barron (1984), Saikawa and Wada (1986), and Barron and Thorn (1987) reported that several species of *Pleurotus*, including *P. cystidiosus*, are capable of attacking nematodes. Our own experiments (J. A. Stalpers, unpublished) confirmed this. The four strains of *P. cystidiosus* tested were able to kill the nematodes *Panagrellis redivivus*, *Tubatrix aceti*, and *Rhabditis* sp.

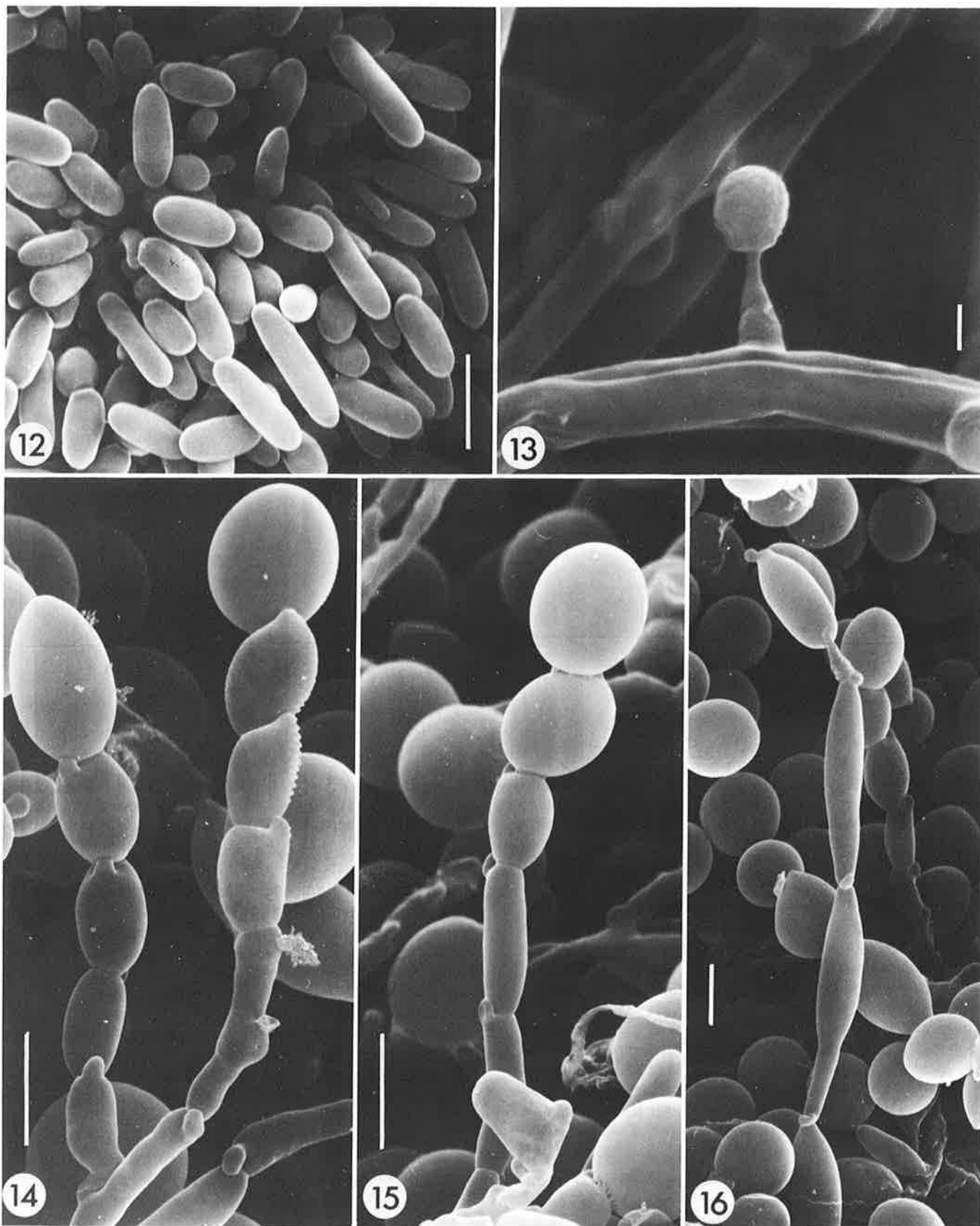
***Antromycopsis angustata*** Stalpers, Seifert & Samson anam. sp. nov. (Figs. 17, 18, 29)

TELEOMORPH: *Pleurotus angustatus* (Berk. & Br.) Sacc., Syll. Fung. 5: 353. 1887.

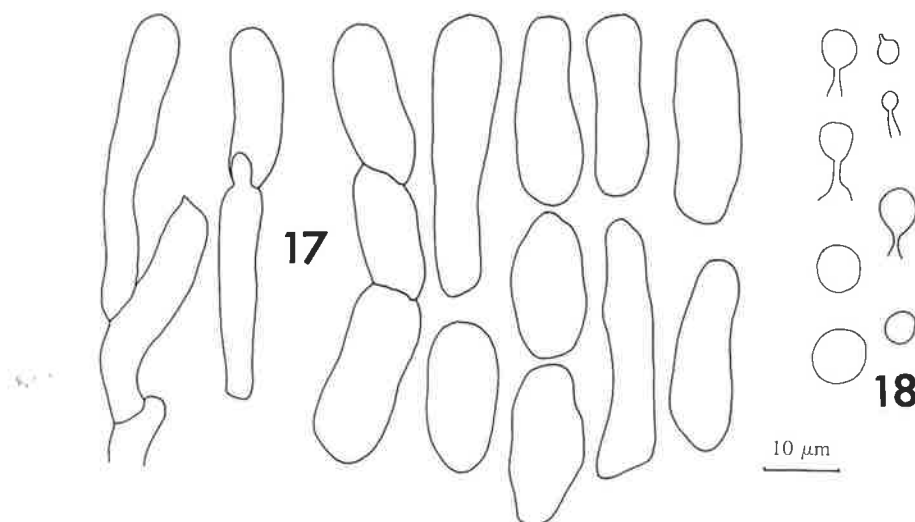
Synnemata gregaria vel solitaria ad stipites et partes basiales lamellarum basidiomatum decurrentium, 800–1200 ×

50–350 μm, capitula usque ad 800 μm diam. Arthroconidia in capitulis successione basipetali, tenui- vel crassi-tunicata, primum hyalina, deinde atrobrunnea vel atra, ellipsoidea vel cylindrica, 25–40 × (5–)6–8(–9) μm. Blastoconidia globosa, (2–)4.5–7.5 μm diam, ad denticulos secundum stipitem formata. TYPUS (BO) Java, Cibodas, Gunung Gedeh.

Synnemata (Fig. 29) densely aggregated on the stipe and sometimes solitary on the basal part of the decurrent lamellae of the teleomorph, the stipes brownish, presumably white when young, 800–1200 μm long, 50–200 μm wide, cylindrical or expanding to 200–350 μm below the capitulum. Capitula dark brown to black, 0.2–0.8 mm in diameter, sometimes forming a continuous crust. Hyphae of stipe 3–4.5(–5) μm wide, hyaline, thin-walled, clamped, parallel. Arthroconidia (Fig. 17) forming from divergent hyphae in the capitulum, maturing basipetally, hyaline and thin-walled when young, when mature brownish black to black and slightly thick-walled, typically with basal beaklike clamp remnants and granular contents; terminal conidia ellipsoidal to cylindrical, 15–28 × (7–)8–10 μm, lower and basal conidia narrowly cylindrical, 25–40



FIGS. 12 and 13. *Antromycopsis guzmanii*. Fig. 12. Arthroconidia. Fig. 13. Blastoconidium. FIGS. 14–16. *Pleurotus dryinus* (CBS 724.83), conidial chains. Bars = 10  $\mu\text{m}$  for all Figs., except Fig. 13 = 1.0  $\mu\text{m}$ .



Figs. 17 and 18. *Antromycopsis angustata* (type). Fig. 17. Arthroconidia. Fig. 18. Blastoconidia.

$\times$  (5–)6–8(–9)  $\mu\text{m}$ . Blastoconidia (Fig. 18) globose, (2–)4.5–7.5  $\mu\text{m}$  in diameter, formed on denticles arising from clavate marginal hyphae or directly from stipe hyphae, often remaining attached.

Unknown in culture.

DISTRIBUTION: Indonesia.

MATERIAL EXAMINED: INDONESIA, JAVA, Cibodas, Gunung Gedeh, 1450 m, C. van Overeem, August 1922 (BO, HOLOTYPE).

*Antromycopsis angustata* closely resembles *A. sajor-caju* Nair and Kaul (1980) (nom. inval., Art. 37 ICBN), described as an anamorph of *Pleurotus sajor-caju* (Fr.) Singer. The only differences are in the sizes of the arthroconidia given as 17.7–26.6  $\times$  5.15–6.9  $\mu\text{m}$  in the text and 12.7–14.9  $\times$  6.7–9  $\mu\text{m}$  in the Latin diagnosis, making them in the first case too narrow and in the second case too narrow for *A. angustata*. The teleomorph of *A. sajor-caju* was identified as *Pleurotus sajor-caju* by Nair and Kaul (1980), but this name has a confused history. The available commercial strains belong either to *Pleurotus ostreatus* (Jacq.:Fr.) Kummer or to the closely related *P. pulmonarius* (Fr.) Quélet (Hilber 1982). The holotype of *P. sajor-caju* is trimitic and belongs to *Lentinus* Fr. (Pegler, 1983). The material of Nair and Kaul was unavailable, so we were unable to verify the identity of the teleomorph. The published photograph of their culture does not resemble a typical trimitic *Lentinus* strain and it appears likely that these authors were indeed dealing with a species of *Pleurotus*. Pegler (1983), who examined hundreds of specimens of *Lentinus*, never encountered an *Antromycopsis* anamorph in that genus.

*Antromycopsis guzmanii* anam. sp. nov.

(Figs. 12, 13, 19–21)

TELEOMORPH: *Pleurotus smithii* Guzmán, Beih. Nova Hedwigia 51: 100. 1975.

Synnemata 1400–4500  $\times$  300–1000(–1500)  $\mu\text{m}$ , capitula (500)–1000–3000  $\mu\text{m}$  diam. Arthroconidia in capitulis successione basipetali formata, tenui- vel crassi-tunicata, atrobrunnea vel atra, ellipsoidea vel cylindrica, 10–24(28)  $\times$  (4.5–)5.5–8(–9)  $\mu\text{m}$ . Blastoconidia globosa, 1.5–3  $\mu\text{m}$  diam, ad denticulos secundum stipitem formata. Incrementum in

MEA 5–7 mm post 14 dies. HOLOTYPE: CBS 680.82 (exsiccatus, herb. CBS).

Similar to *A. macrocarpa* with the following differences: synnemata 1500–4500  $\mu\text{m}$  tall, stipes 300–1000(–1500)  $\mu\text{m}$  wide, rarely branched. Hyphae of stipe 2.5–4.5(–8)  $\mu\text{m}$  wide, thin-walled, with frequent anastomoses, becoming brownish and slightly thick-walled with age. Arthroconidial mass (500–)1000–3000  $\mu\text{m}$  in diameter. Arthroconidia (Figs. 12, 20) maturing basipetally (Fig. 19), the terminal conidia narrowly ellipsoidal to cylindrical, 14–20  $\times$  6.5–8  $\mu\text{m}$ , intercalary conidia ellipsoidal to ovoid, 10–16  $\times$  6.5–8(–9)  $\mu\text{m}$  and the basal conidia cylindrical to narrowly cylindrical, sometimes curved, 16–24(–28)  $\times$  4.5–7  $\mu\text{m}$ . Blastoconidia (Figs. 13, 21) globose to broadly ovoid, often remaining attached, 1.5–3  $\mu\text{m}$  in diameter.

Growth rate on MEA: 5–7 mm radius in 2 weeks, and 2–4 mm on ChA. Aerial hyphae hyaline, thin- to slightly thick-walled, 1.5–5  $\mu\text{m}$  wide, sometimes encrusted with small crystals. Denticles protruding from aerial mycelium or synnema stipes especially in 4- to 8-week-old cultures, often with terminal swelling up to 2  $\mu\text{m}$  in diameter, and a cyanophilous drop up to 5(–7)  $\mu\text{m}$  in diameter. Crystals present in the medium, rhomboid or prismatic.

Reaction for laccase positive, for tyrosinase negative.

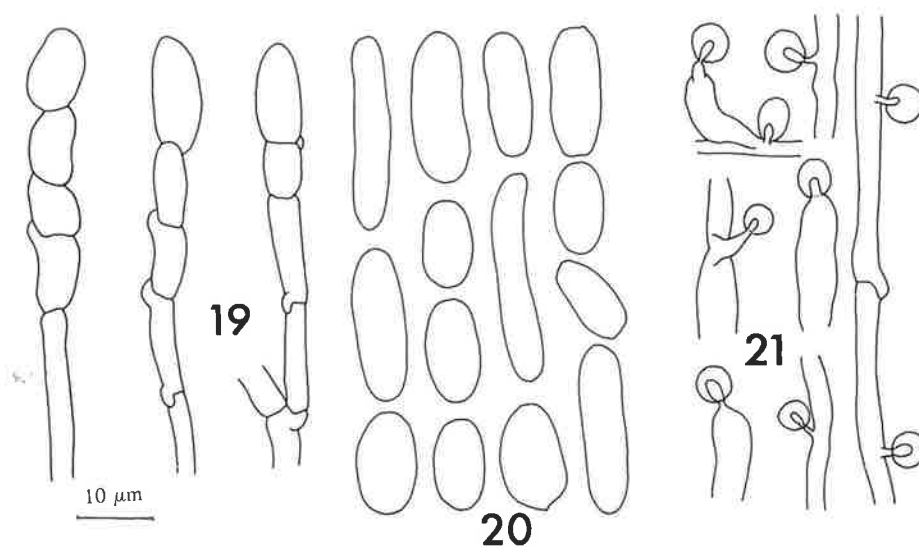
Cardinal temperatures for growth: minimum 8°C, optimum 24–25°C, maximum 29°C.

Species Code (Nobles 1965): 2, 3, 7, 33, 35, 36, 38, 47, (48), 54.

Species Code (Stalpers 1978): 1, (10), 11, 13, 14, (16), 17, 18, 30, 39, (44), (45), 48, 52, 53, (54), (59), 82, 84, 86, 87, (88), 89, 94, 95.

MATERIAL EXAMINED: Living culture: CBS 680.82, ex-type culture, G. Guzmán, Mexico, isol. ex *Populus alba*.

Guzmán and Valenzuela (in Guzmán *et al.* 1980) proposed the new combination *Antromycopsis smithii*, without mentioning an anamorphic basionym, but citing “estado imperfecto de *Pleurotus smithii* Guzmán, (in Guzmán 1975).” However, in that publication no anamorph was mentioned. The name is thus based on a teleomorph and must be considered a synonym of *Pleurotus smithii* Guzmán. The epithet is no longer available for the anamorph of this species, which consequently has been described as a new anamorph species above.



Figs. 19–21. *Antromycopsis guzmanii* (CBS 680.82). Fig. 19. Chains of arthroconidia. Fig. 20. Arthroconidia. Fig. 21. Developing blastoconidia.

*Antromycopsis guzmanii* is very similar to *A. macrocarpa*, differing in the slower growth rate, the more robust synnemata and possibly the more abundant occurrence of blastoconidia. The other differences mentioned by Guzmán *et al.* (1980) were inconsistent. When young, the stipe consists of parallel hyphae with unswollen or hardly swollen cells; they may become irregularly swollen in older synnemata of both species. Some, but not all, strains of *A. macrocarpa* display this character more clearly than the only available isolate of *A. guzmanii*. Cystidial and basidial structures are similar in the two species, and chlamydospores were not produced by *A. guzmanii* during our study.

*Antromycopsis guzmanii* does not kill nematodes as rapidly as *A. macrocarpa* (J. A. Stalpers, unpublished) but this may be directly related to its slower growth rate.

*Tilachlidiopsis* Keissler, Ann. Nat. Hist. Mus. Wien 37: 215. 1924.

Examination of the holotype of *Tilachlidiopsis*, *T. racemosa* Keissler, showed that it is the same fungus as *Sclerostilbum septentrionale* Povah, the anamorph of *Collybia racemosa*. The anamorph is redescribed below, based on herbarium specimens and cultures. The remaining species of *Tilachlidiopsis*, mainly entomogenous, will be reviewed by R. A. Samson, K. A. Seifert, and J. A. Stalpers (in preparation).

*Tilachlidiopsis racemosa* Keissler, Ann. Nat. Hist. Mus. Wien 37: 215. 1924. (Figs. 22–27)  
= *Sclerostilbum septentrionale* Povah, Mycologia 24: 242. 1932.

TELEOMORPH: *Collybia racemosa* (Pers.: Fr.) Quélet, Champ. Jura Vosges, ser. II(5): 342. 1873.

Conidiomata (Fig. 22) compound, consisting of a central indeterminate axis (a rudimentary basidiome stipe) and synnematus lateral branches. Axis up to 70 mm long, 200–400  $\mu\text{m}$  wide, greyish white when young, becoming brown to dark brown with age. Synnemata 250–1000  $\mu\text{m}$  tall, longest near the base of the axis, emerging in a racemose pattern from the axis, the stipes 50–100  $\mu\text{m}$  wide, dark brown at the base, light brown below the capitulum, cylindrical. Hyphae

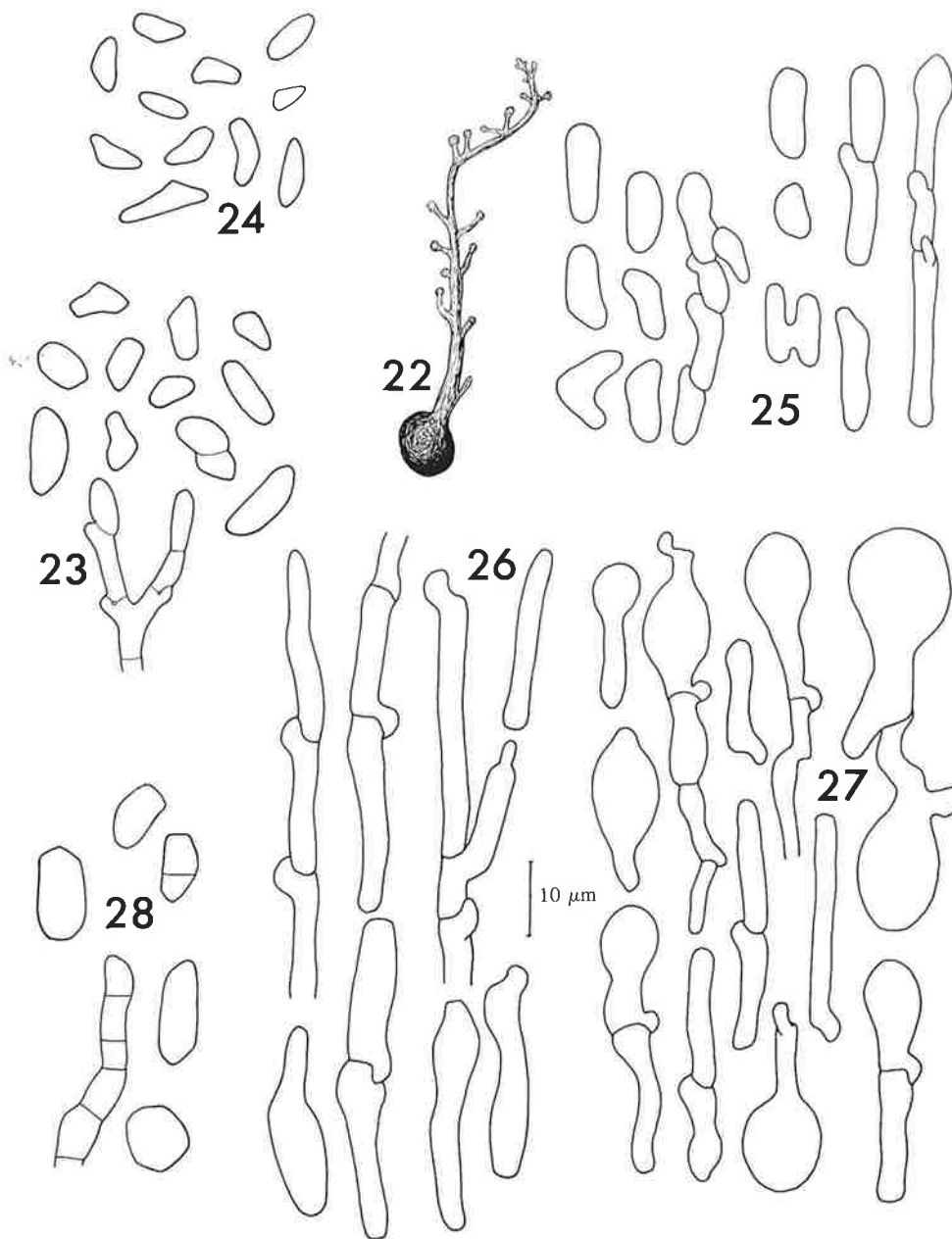
of the axis 2.5–4  $\mu\text{m}$  wide, hyaline, often containing oil droplets, parallel, with thin to slightly thickened walls, clamped. Arthroconidial mass 60–125  $\mu\text{m}$  in diameter, terminal on branches, initially hyaline or yellow, drying ochraceous, orange or brownish, hemispherical, slimy. Arthroconidia (Figs. 23–25) at first angular, becoming ellipsoidal to cylindrical, 6–13  $\times$  3–5  $\mu\text{m}$ , hyaline, thin-walled, formed from branching divergent hyphae in the capitulum that develop short cells with clamped septa or often with remnants of clamp connections.

Growth rate on MEA: 18 mm radius in 2 weeks, and 6 mm on ChA. Colony appressed, hyaline; after 4 weeks some scanty, white, downy, aerial mycelium may develop. Margin even on MEA, distinctly lobed on ChA; marginal hyphae (Fig. 27) hyaline, thin-walled, 2–3.5  $\mu\text{m}$  wide, appressed to submerged, rather dense, the cells rather short, up to 100  $\mu\text{m}$  in length, with clamp connections at all primary septa; hyphae often fragmenting into arthroconidia (Figs. 26, 27) up to 40  $\mu\text{m}$  long, often with a beaklike clamp remnants in young conidia, occasionally with two beaks, rounding off in older conidia; on ChA swollen cells frequent, mainly terminal, sometimes intercalary, hyaline, globose to ovoid or ellipsoidal, up to 16  $\mu\text{m}$  wide. Aerial hyphae hyaline, thin- to minutely thick-walled, of two types: broader hyphae hyaline, 2–5  $\mu\text{m}$  wide, with occasional swellings sometimes breaking into arthroconidia; narrower hyphae straight, little branched, 2–3  $\mu\text{m}$  wide, with slightly refractive contents. Conidiomata produced on Modess agar, the axis first evident as a positively phototropic fascicle, lax, occasionally touching the agar, with fertile branches emerging laterally. Sclerotia more or less globose, 1.5–4 mm in diameter, shiny black, developing after 3–5 weeks; in section with a cortex and a medulla; the cortex brownish black, amorphous; the medulla consisting of hyaline, gelatinized hyphae. All cells and nearly all conidia binucleate.

Reaction for laccase and tyrosinase negative.

Cardinal temperatures for growth: minimum 3°C, optimum 12–18°C, maximum 22°C.

Species Code (Nobles 1965): 1, 3, (7), (23), 33, 36, 38, 56.



FIGS. 22–28. *Tilachlidiopsis racemosa*. Figs. 22 and 23. Conidioma and conidia (type of *Sclerostilbum septentrionale*). Fig. 24. Conidia (type of *T. racemosa*). Fig. 25. Conidia. Fig. 26. Hyphae from the centre of the colony. Fig. 27. Hyphae from colony margin (Figs. 25–27 from CBS 687.84). Fig. 28. *Nothoclavulina* anamorph of *Arthrosporella ditopa*, conidia from stipe of basidiome (holotype of *A. ditopa*).

Species Code (Stalpers 1978): (9), (10), 13, (15), (16), (17), 30, 39, 44, (52), (53), (66), 80, (81), 84, 87, 91, 95.

MATERIAL EXAMINED: Herbarium specimens: *Tilachlidiopsis racemosa*, HOLOTYPE, AUSTRIA, on soil among decaying roots of *Abies* sp., leg. Keissler. BELGIUM, Oignies, on rotten mushrooms together with *Collybia tuberosa*, leg. J. A. Stalpers, 3 Oct. 1984, J.A.S. 1017 (CBS-H). *Sclerostilbum septentrionale*, HOLOTYPE, UNITED STATES OF AMERICA, MICHIGAN, Isle Royale, McCargoe Cove, among decaying leaves, A. H. Povah, 7 Nov. 1930 (MICH). Living culture: CBS 687.84, derived from J.A.S. 1017.

The synnemata of *Tilachlidiopsis racemosa* are always produced on the stipe of the basidiome. As the basidiome often has a reduced pileus or no pileus at all, it is not always rec-

ognized as such. In nature, it is always attached to a sclerotium, but in culture this is not always the case.

*Collybia racemosa* is one of four closely related species in *Collybia* section *Collybia* (Singer 1984), viz. *C. cirrhata* (Schum.: Fr.) Kummer, *C. cookei* (Bres.) J. D. Arnold, and the type species *C. tuberosa* (Bull.: Fr.) Quélet. *Collybia cirrhata*, the only species lacking sclerotia, always grows on rotten basidiomes of agarics, while the other species, in addition to this substrate, also occur on soil and mosses. However, remnants of basidiomata of agarics can generally be found between moss thalli or on the soil and it is likely that the substrate is always an agaric. Because sclerotia are produced first (except in *C. cirrhata*), the development of the basidiomes may be delayed until the original substrate is unrecognizable;

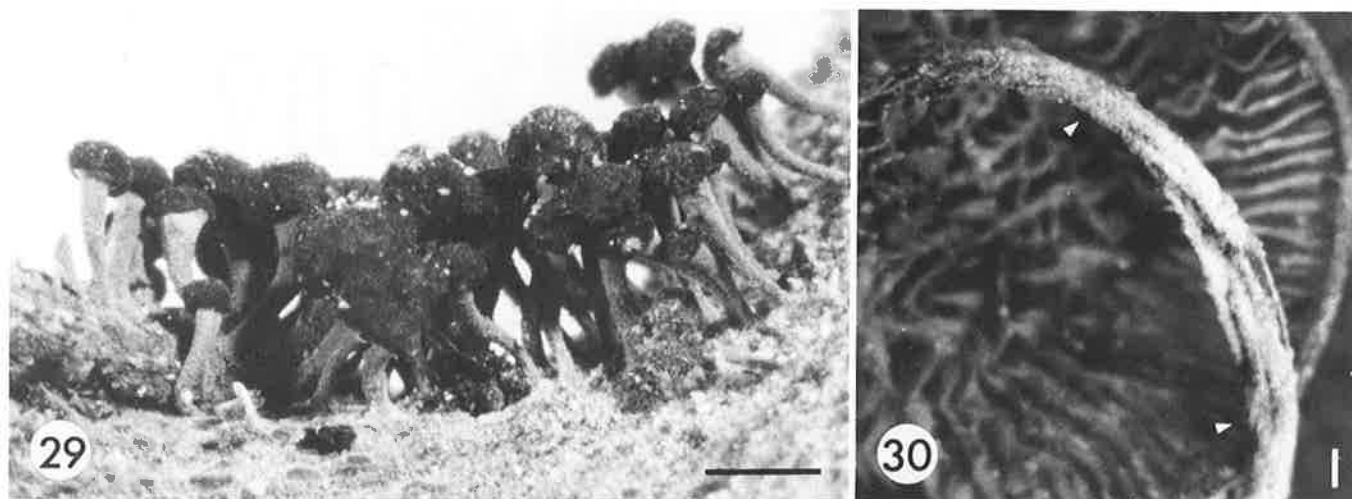


FIG. 29. *Antromycopsis angustata*, synnemata from holotype. Bar = 500  $\mu$ m. FIG. 30. *Arthrosporella ditopa*, portion of basidiome from holotype. Lamellae are out of focus in the background; the stipe (arrowheads) has a powdery appearance caused by conidia. Bar = 1 mm.

because of the sclerotia, the species is no longer dependent on the substrate for fruiting.

The temperature relationships of *C. racemosa* are remarkable. The maximum temperature is one of the lowest encountered in the Agaricales and within the broad optimum between 12 and 18°C, growth hardly varies on MEA or ChA. This behaviour may be connected with the substrate, fruit bodies of agarics, which are generally short-lived. Thus the mycelium of *Collybia racemosa* must develop quickly and a broad optimum temperature range enhances the chances for fruiting.

A similar anamorph genus with arthroconidia is *Nothoclavulina* Singer (1970), which also has a teleomorph in the Tricholomataceae. Although listed as producing synnemata by Carmichael *et al.* (1980), the arthroconidia of this species are in fact produced directly from the hyphae of the stipe of the basidiomes of *Arthrosporella ditopa* Singer, giving it a powdery to slightly pubescent appearance (Fig. 30). The conidia (Fig. 28) are angular and thus similar to those of *Tilachlidopsis racemosa*, but, unlike the latter, no clamp connections or clamp remnants are seen between the conidia.

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- BARRON, G. L., and THORN, R. G. 1987. Destruction of nematodes by species of *Pleurotus*. *Can. J. Bot.* **65**: 774–778.
- CARMICHAEL, J. W., KENDRICK, W. B., CONNERS, I. L., and SIGLER, L. 1980. *Genera of Hyphomycetes*. University of Alberta Press, Edmonton.
- GAMS, W., VAN DER AA, H. A., VAN DER PLAATS-NITERINK, A. J., SAMSON, R. A., and STALPERS, J. A. 1987. *CBS course of mycology*. 3rd ed. Centraalbureau voor Schimmelcultures, Baarn.
- GUZMÁN, G. 1975. New and interesting species of Agaricales of Mexico. *Beih. Nova Hedwigia*, **51**: 99–121.

- GUZMÁN, G., VALENZUELA, R., and CANALE, A. 1980. Primer registro de *Pleurotus smithii* de America del Sur y obtención de la fase asexual de la cepa Mexicana. *Bol. Soc. Mex. Micol.* **14**: 17–26.
- HAWKSWORTH, D. L., SUTTON, B. C., and AINSWORTH, G. C. 1983. *Ainsworth and Bisby's Dictionary of the Fungi*. 7th ed. Commonwealth Mycological Institute, Kew.
- HILBER, O. 1982. Die Gattung *Pleurotus*. *Bibl. Mycol.* **87**: 1–448.
- JONG, S. C., and PENG, J. T. 1975. Identity and cultivation of a new commercial mushroom in Taiwan. *Mycologia*, **67**: 1235–1238.
- KÄÄRIK, A. 1965. The identification of the mycelia of wood-decay fungi by their oxydation reactions with phenolic compounds. *Stud. For. Suec.* **31**: 1–80.
- MOORE, R. T. 1984. Deuteromycetes III. The other species of *Antromycopsis*. *Trans. Br. Mycol. Soc.* **82**: 377–380.
- NAIR, L. N., and KAUL, V. P. 1980. The anamorphs of *Pleurotus sajor-caju* (Fr.) Singer and *Pleurotus gemmellarii* (Inzeng.) Sacc. *Sydowia*, **33**: 221–224.
- NEDA, H., and FURUKAWA, H. 1987. *Pleurotus abalonus* Han, Chen et Cheng, a newly cultivated mushroom in Japan. *Trans. Mycol. Soc. Jpn.* **28**: 69–73.
- NOBLES, M. K. 1965. Identification of cultures of wood-inhabiting Hymenomycetes. *Can. J. Bot.* **43**: 1097–1139.
- PATOUILLARD, N. 1897. Additions au catalogue des champignons de la Tunisie. *Bull. Soc. Mycol. Fr.* **13**: 197–216.
- PEGLER, D. N. 1983. The genus *Lentinus*. *Kew Bull. Add. Ser.* **10**: 1–281.
- POLLACK, F. G., and MILLER, O. K. 1976. *Antromycopsis broussonetiae* found to be the name of the imperfect state of *Pleurotus cystidiosus*. *Mem. N.Y. Bot. Gard.* **28**: 174–178.
- SAIKAWA, M., and WADA, N. 1986. Adhesive knobs in *Pleurotus ostreatus* (the oyster mushroom) as trapping organs for nematodes. *Trans. Mycol. Soc. Jpn.* **27**: 113–118.
- SAMSON, R. A., STALPERS, J. A., and VERKERKE, W. 1979. A simplified technique to prepare fungal specimens for scanning electron microscopy. *Cytobios*, **24**: 7–11.
- SASEK, V., BUCHALO, A. S., and ZAKORDONEC, O. A. 1986. Confirmation of identity of *Pleurotus abalonus* with *Pleurotus cystidiosus* by scanning electron microscopy of anamorphs. *Folia Microbiol.* **31**: 309–311.
- SEIFERT, K. A. 1985. A monograph of *Stilbella* and some allied Hyphomycetes. *Stud. Mycol.* **27**: 1–235.
- SINGER, R. 1986. *The Agaricales in modern taxonomy*. 4th ed. Koeltz Scientific Books, Koenigstein.

- STALPERS, J. A. 1978. Identification of wood-inhabiting Aphyllophorales in pure culture. *Stud. Mycol.* **16**: 1-248.
- THORN, R. G., and BARRON, G. L. 1984. Carnivorous mushrooms. *Science* (Washington, D.C.), **224**: 76-78.
- 1986. *Nematoctonus* and the tribe Resupinateae in Ontario, Canada. *Mycotaxon*, **25**: 321-453.
- WAITLING, R., and KENDRICK, B. 1977. Dimorphism in *Collybia racemosa*. *Mich. Bot.* **16**: 65-72.