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Five polypores (Basidiomycota) new to Taiwan and their cultural characteristics

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Abstract. Five polypores (Basidiomycota), all new to Taiwan, are described and illustrated. These are *Amylosporus campbellii* (Berk.) Ryvarden, *Grifola frondosa* (Dicks : Fr.) S. F. Gray, *Nigrofomes melanoporus* (Mont.) Murrill, *Phellinus pachyphloeus* (Pat.) Pat. and *Tyromyces cerifluus* (Berk. & M. A. Curtis) Murrill. The genera *Amylosporus, Grifola* and *Nigrofomes* are new to fungiflora of Taiwan. Cultural characteristics are described for the five species. Cultural characters of *N. melanoporus* and *T. cerifluus* are reported for the first time. *Amylosporus campbellii* is a brown rot fungus while the others have a white rot.

Keywords: Cultural characteristics; Polypores; Taiwan.

Introduction

During the survey on the aphyllophoralean fungi in Taiwan, we collected five interesting wood-inhabiting polypores new to Taiwan. In this report, they are described and illustrated. In addition, their cultural characteristics were also studied.

Materials and Methods

Descriptions of basidiocarp characters were based on fresh and dried specimens. Free-hand thin sections for basidiocarps were mounted in two reagents for microscopic studies. KOH (3%) was used for observations and measurements of microscopic characters and to ensure rehydration. Melzer's reagent (IKI) was used to detect amyloidity and dextrinoidity. The methods used for examination of basidiocarps have been described in a previous paper (Chang, 1993). Indentification was based on Gilbertson and Ryvarden (1986) and on Nunez and Ryvarden (2000, 2001).

The methods of Stalpers (1978) were used to study the cultural characteristics. The cultures were isolated from basidiocarps, and grown at 25°C on 2% malt extract agar (MEA) and potato dextrose agar (PDA). The response to temperature was determined by measuring the linear growth of colonies on agar plate incubated at temperatures of 12, 16, 20, 24, 28, 32 and 36°C for 14 days, respectively. Petri dishes (85 mm internal diameter, containing 20-25 ml agar) were inoculated with a piece of mycelium at the center, kept at 25°C, and macroscopically examined after 2 and 6 weeks of incubation. Separate slides were prepared from various parts of the colony and mounted in KOH (3%) for light microscopic observation. The culture code of these fungi followed Stalpers (1978). The methods of cultural study have been detailed by Chang and Fu (1998).

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Taxonomy and Cultural Descriptions

Amylosporus campbellii (Berk.) Ryvarden. Norw. J. Bot. 24: 217. 1977. (Figure 1)

Basidiomata annual, pileate, laterally stipitate or sessile to dimidiate, single to clustered, up to 20 cm wide and 7 cm thick at the base, soft when fresh, light and fragile when dry, with margin entire, obtuse; upper surface first finely tomentose becoming glabrous with age, whitish to creamy when fresh, becoming light buff to light ochraceous-buff with darker spots to cinnamon-brown when dry. Pores angular to round, 2-4 per mm, pore surface concolorous with upper surface. Context fibrous, homogeneous, whitish when fresh, creamy to buff when dry, up to 3 cm thick. Odor of specimens becoming malodorous like rotten vegetables. Hyphal system dimitic; generative hyphae hyaline, thin-walled, readily collapsed, with simple septa but occasional with single, double or multiple clamps, 4-12 μm wide, skeletal hyphae hyaline, thick-walled, aseptate, unbranched to irregular branched and contorted, 3-7.5 μm wide, gloeoplerous hyphae persent, thin-walled and filled with refractive contents, sinuous to contorted, 3-9 μm wide. Basidia broadly clavate, 4-sterigmate, 15-20 × 6-8 μm, simple-septate at the base. Basidiospores oblong ellipsoid to broadly ellipsoid, hyaline, smooth to finely asperulate, 4.5-5.5 × 2.5-4 μm, amyloid.

Specimens examined. **TAIWAN.** Kaohsiung County: Fengshan, plain, on roots of *Michelia alba* DC, leg. S. F. Tsay, August 2002, TFRI 1059; Taichung City, plain, leg. Jun 2002, W. N. Chou, *CWN 5474*.

Distribution. Widely distributed in the subtropical and tropical zone.

Cultural descriptions. Colonies on PDA and MEA media at 25°C growing slowly, 0.8-1.2 mm/d, appressed to raised, cottony to woolly, mat white at first, acquiring pinkish tint and finally pale pinkish-brown. Advancing zone even, with dense marginal hyphae. Reverse uncolored, remaining unchanged after 6 wk. Generative hyphae hyaline, with frequent simple septa and occasional single, double or multiple clamps, up to 4 μm wide. Skeletal hyphae unbranched to rarely branched, thick-walled, up to 3.5 μm wide. Hymenophores not developed within 6 wk. Diffusion zones absent on gallic and tannic acid medium tests (Davidson et al., 1938); laccase, peroxidase and tyrosinase not produced. Optimal temperature range for growth 24-28°C; minimal temperature 12°C and maximal temperature 36°C. Species code (Stalpers, 1978): 9, 12, (13), 21, 22, 30, 33, (39), (40), (42), 45, 46 (52), (53), (67), 83, 89.

Remarks. The specimens are very malodorous like rotten vegetables if the basidiomata are not dried out imme-

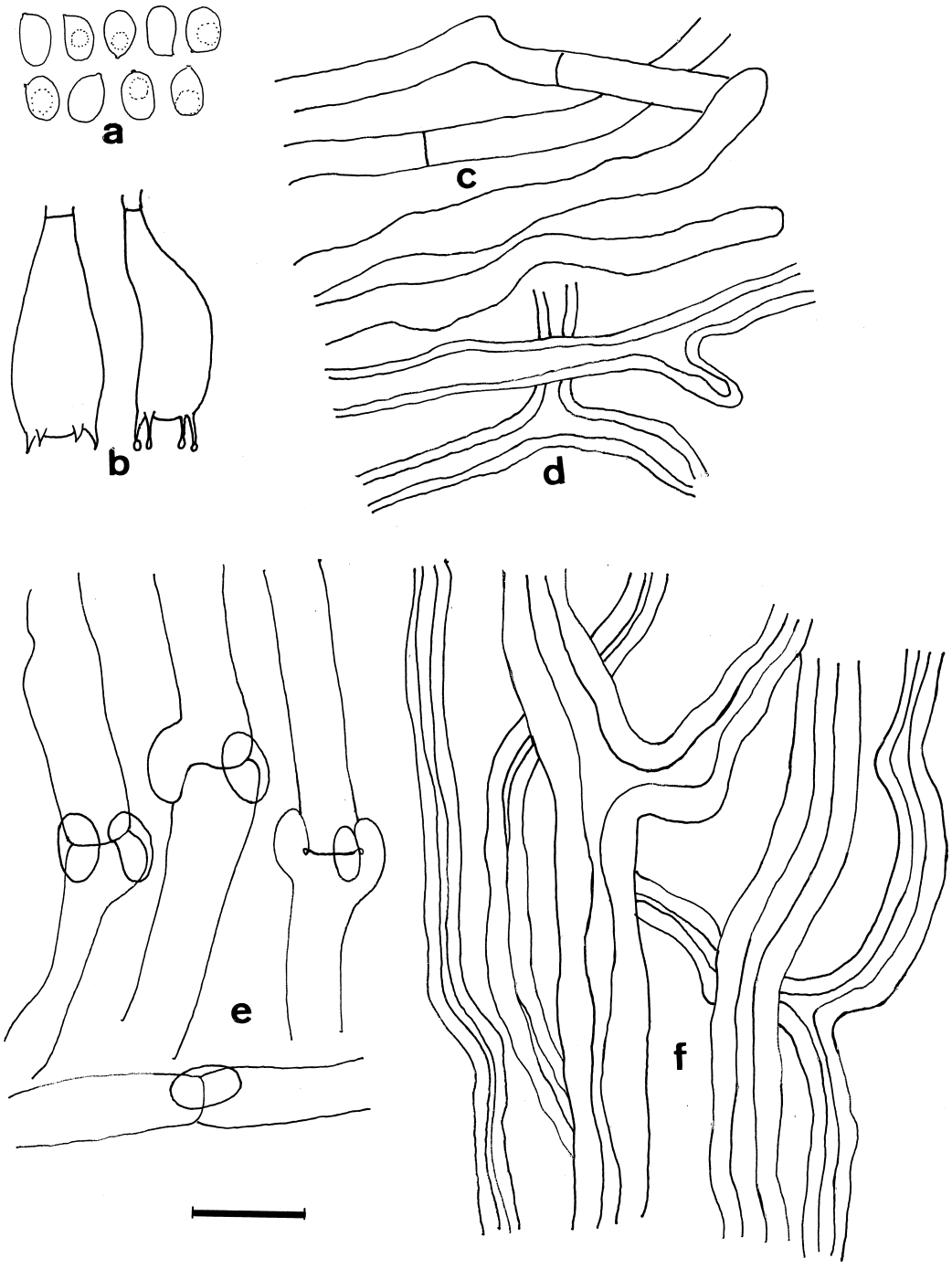

Figure 1. *Amylosporus campbellii.* a, Basidiospores; b, Basidia; c & e, Generative hyphae; d & f, Skeletal hyphae. Bar = 10 μm.

diately after collection. The occurrence of double and multiple clamps, an unusual character in polypores, characterizes this species.

Grifola frondosa (Dicks.: Fr.) S. F. Gray. Nat. Arr. Brit. Plants 1: 643. 1821. (Figure 2)

Basidiomata annual, stipitate, stipe branched from a major base, forming numbers of imbricate, petaloid or flabelliform pilei, up to 4 cm wide and 1 cm thick in individual pileus, upper surface pale olive-buff at first, becoming wood brown to buffy brown when dry, azonate, very finely tomentose to glabrous, smooth, margin thin, curved downwards when dry. Pores angular to elongate, 2-4 per mm, with thin, often lacerate dissepiments, pore surface cream to ivory white. Context ivory white, up to 6 mm thick. Tube layer decurrent on the stipe, up to 4 mm thick, odor pleasant. Hyphal system dimitic; generative hyphae hyaline, thin-walled, with clamps, up to 5 µm wide, skeletal hyphae thick-walled, aseptate, unbranched to infrequently branched, up to 6 µm wide. Basidia clavate, 4-sterigmate, 20-25 × 7-8 µm, with a basal clamp. Basidiospores ovoid to ellipsoid, hyaline, smooth, 6-7 × 4-5 µm, IKI$^-$.

Specimen examined. **TAIWAN.** Nantou County: Tsuifeng, 2,350 m alt., on rotten hardwood, leg. Aug 2002, W. N. Chou, *CWN 5839*.

Distribution. Widely distributed in the temperate zone.

Cultural descriptions. Colonies on PDA and MEA media at 25°C growing 1.8-3.2 mm/d, appressed, woolly to felty, mat white to cream. Advancing zone even, with marginal hyphal tips widely apart. Reverse uncolored, remaining unchanged after 6 wk. Odor none. Hymenophores not developed within 6 wk. Generative hyphae hyaline, thin- to thick-walled, clamped but inconstant at all septa and absent in the margin, branched, up to 4 µm wide. Chlamydospores globose to broadly ellipsoid, up to 12 µm in diam. White rot decay type, observed both on rotting wood and on the basis of tannic and gallic acid medium tests (Davidson et al., 1938). Laccase and peroxidase produced but not tyrosinase. Optimal temperature range for growth 24-28°C; minimal temperature 12°C and maximal temperature 32°C. Species code (Stalpers, 1978): 1, 3, 4, (7), (8), 11, 13, 14, 22, (25), 30, 31, (35), (38), (39), 40, (42), 45, (47), 48, (50), (51), 52, 53, (82), 83, 85, 89.

Remarks. The profusely branched basidiomata with many petaloid pilei characterize the fungus. *Polyporus umbellatus* Pers: Fr. and *Meripilus giganteus* (Fr.) P. Karst. share the character of profusely branched basidiomata with *G. frondosa.* However, *P. umbellatus* has cylindric basidiospores while *M. giganteus* has simple-septate generative hyphae.

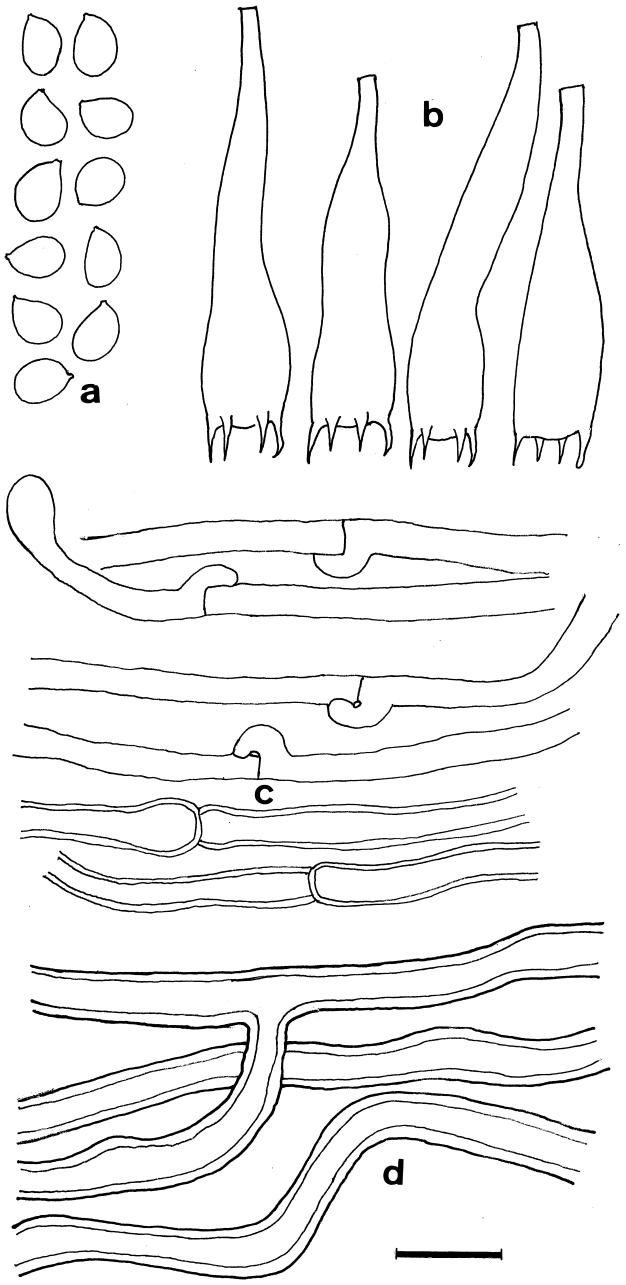

Figure 2. *Grifola frondosa.* a, Basidiospores; b, Basidia; c, Generative hyphae; d, Skeletal hyphae. Bar = 10 µm.

Nigrofomes melanoporus (Mont.) Murrill. Bull. Torrey Bot. Club 31: 425. 1904. (Figure 3)

Basidiomata annual, pileate, applanate, sessile to dimidiate, up to 15 cm wide and 3 cm thick, very hard; upper surface first finely velutinate and dark brown, then glabrous and purplish black, with sulcate zone; margin obtuse, curved downwards when dry. Pores round to isodiametric, 6-10 per mm, surface dark brown to purplish black; tubes concolorous with pore surface, up to 0.5 cm deep. Context concolorous with pore surface, hard, up to 2.5 cm thick. Hyphal system dimitic; generative hyphae thin- to thick-walled, with simple septa, up to 4 µm wide, skeletal hyphae hyaline to slightly brown, thick-walled, aseptate, unbranched, up to 5 µm wide. Cystidia present, but rare, ventricose, thick-walled, brown, 12-32 × 6-10 µm. Basidia not found. Basidiospores hyaline, broadly ellipsoid to subglobose, 5-6 × 3.5-4.5 µm, IKI$^-$.

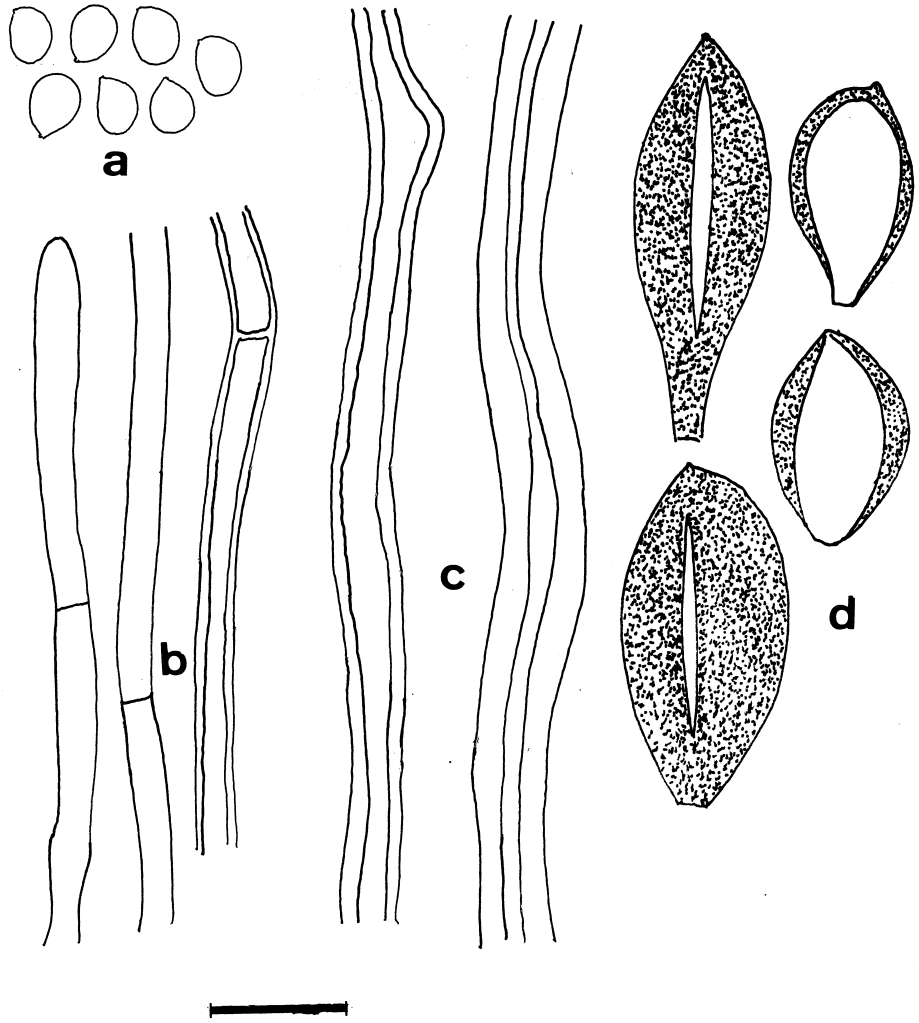

Figure 3. *Nigrofomes melanoporus.* a, Basidiospores; b, Generative hyphae; c, Skeletal hyphae; d, Cystidia. Bar = 10 μm.

Specimen examined. **TAIWAN.** Ilan County: Fushan, 650 m alt., on rotten hardwood, leg. Jul 2002, T.T. Chang, *TFRI 1050*.

Distribution. Widely distributed in the tropics.

Cultural descriptions. Colonies on PDA and MEA media at 25°C growing 1.0-1.8 mm/d, with plates coverd in 6 wk, appressed to raised, floccose, cottony to woolly, mat hyaline, cream to ochraceous. Advancing zone even, with marginal hyphal tips widely apart. Reverse uncolored, remaining unchanged after 6 wk. Hymenophores not developed within 6 wk. Generative hyphae simple septate, branched, thin-walled, hyaline to brownish yellow, up to 4.0 μm wide. Skeletal hyphae aseptate, unbranched, thick-walled, hyaline to brownish yellow, up to 5 μm wide. Crystals present on the mycelium. White decay type, observed both on rotten wood and on the basis of tannic and gallic acid medium tests. Laccase produced but not peroxidase and tyrosinase. Optimal temperature range for growth 20-28°C; minimal temperature 12°C and maximal temperature 28°C. Species code (Stalpers, 1978): 1, 9, 12, 13, 14, 19, 21, 22, 30, 31, 35, 46, 52, 53, (57), (67), 82, 83, 89.

Remarks. The very hard and purplish black basidiomata, and the cystidia in the hymenium charaterize the species. Cultural characters of the fungus have previously not been reported.

Phellinus pachyphloeus (Pat.) Pat. Essai Taxon. Hymenom. P. 97. 1900. (Figure 4)

Basidiomata perennial, ungulate to applanate, dimidiate to sessile, broadly attached, solitary, woody hard, up to 50 cm wide and 12 cm thick at the base; upper surface pale fulvous to dull brown, dark brown, grayish or blackish from the base, first finely velvety, soon glabrous, sulcate to rugulose in concentric zones, irregularly rimose when dry, with a dark brown to black resinous hard cuticular, up to 2 mm thick, margin entire, thick and obtuse. Pores round, 8-10 per mm, concolorous with upper surface, up to 10 cm long, pore surface concolorous with upper surface. Context concolorous with upper surface, up to 3 cm thick, woody hard. Hyphal system dimitic; generative hyphae hyaline to pale yellow, simple-septate, thin-walled, up to 4 μm wide, skeletal hyphae yellow to pale brown, thick-

walled, up to 6 wide. Setal hyphae dark brown, acute, in the dissepiments up to 800 × 30 µm. Hymenial setae pale brown to dark brown, acute, thick-walled, straight or slightly curved on the top, often basally swollen, 12-35 × 5-10 µm. Basidia not found. Basidiospores hyaline to slightly pale yellow, broadly ellipsoid to globose, thin-walled, smooth, 3.5-5 × 4-5.5 µm, IKI-.

Specimens examined. **TAIWAN.** Taoyuan County: Shimen, plain, on rotten hardwood, leg. Apr 2001, T.T. Chang, *TFRI 962*; Tainan County, plain, leg. Jul 2001, T. T. Chang, *TFRI 983*; Tainan County, plain, on basal stem of a declining *Zizyphus jujuba* (L.) Lam., leg. Dece 2001, S. F. Tsay, *TFRI 1030*; Taichung City, plain. On rotten hardwood, leg. Jul 2002, W. N. Chou, *CWN 5456*.

Distribution. Widespread in tropical and subtropical Asia, Australia and Africa.

Cultural descriptions. Colonies on PDA and MEA media at 25°C growing 1-2 mm/d, with plates covered in 4 wk,

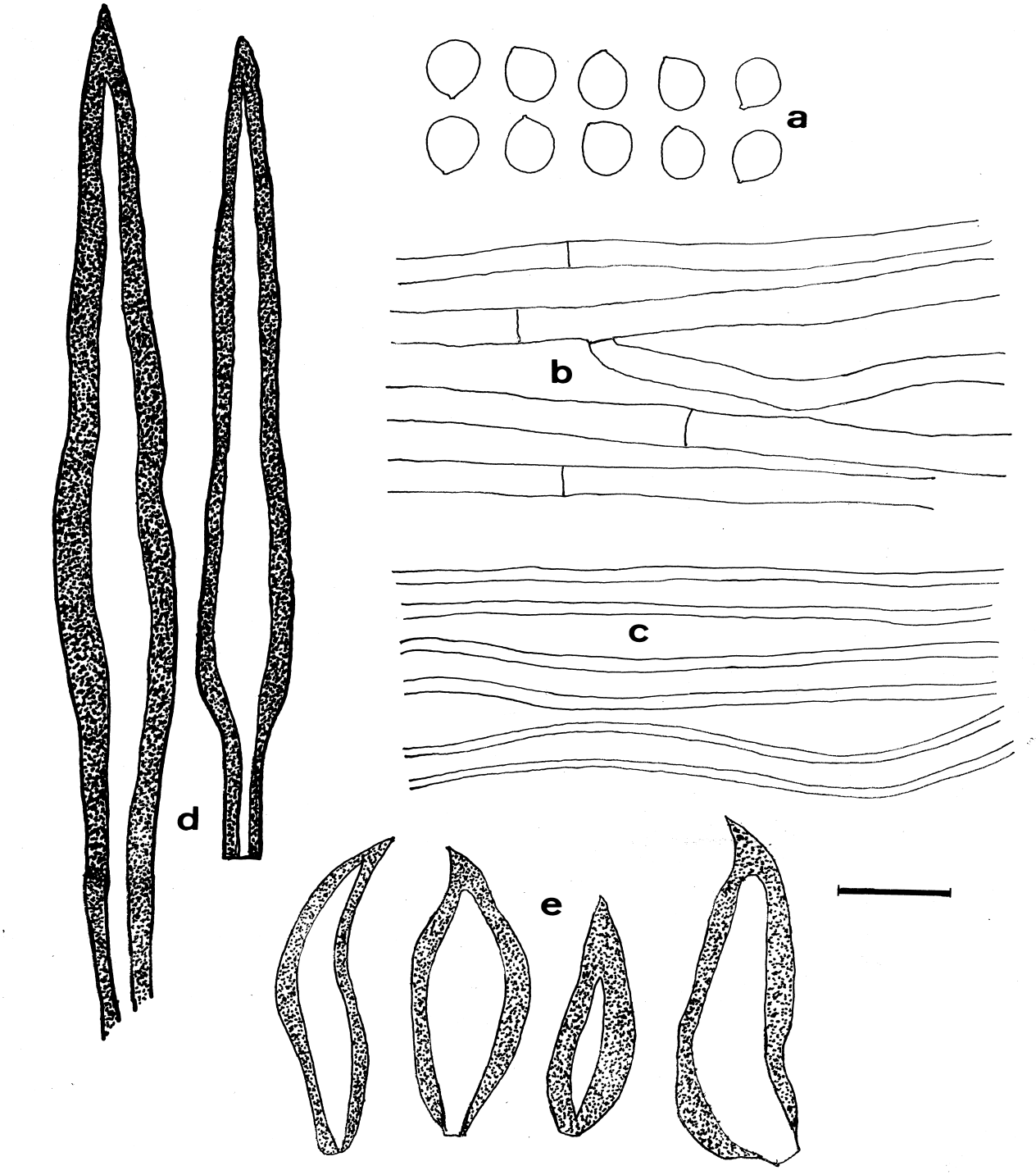

Figure 4. *Phellinus pachyphloeus*. a, Basidiospores; b, Generative hyphae; c, Skeletal hyphae; d, Setal hyphae; e, Setae. Bar = 10 µm.

appressed to raised, cottony, woolly to felty, mat cream, ocher to honey yellow, to mustard yellow. Advancing zone even, with dense marginal hyphae. Reverse darkened. Generative hyphae thin- to thick-walled, hyaline first, then become yellowish brown, with simple septa, up to 5.5 μm wide. Skeletal hyphae thick-walled, up to 6.0 μm wide. Setae 30-55 × 4.5-8 μm, often with basal swelling. Hymenophores not developed within 6 wk. White decay type, observed both on rotten wood and on the basis of tannic and gallic acid medium tests. Laccase and peroxidase produced but not tyrosinase. Optimal temperature range for growth 24-32°C; minimal temperature 12°C and maximal temperature 36°C. Species code (Stalpers, 1978): 1, 3, 4, (8), (9), (11), (12), (13), (14), 21, 22, (25), 28, 31, 35, 38, 48, 50, 52, 53, 54, 64, 67, 70, 83, 89.

Remarks. The acute and wide setal hyphae, and abundant hymenial setae characterize the species. *Phellinus pachyphloeus* was usually found on the basal stem of declining trees indicating that it probably had pathogenicity to the hosts.

Tyromyces cerifluus (Berk. & M. A. Curtis) Murrill. North Am. Flora 9: 33. 1907. (Figure 5)

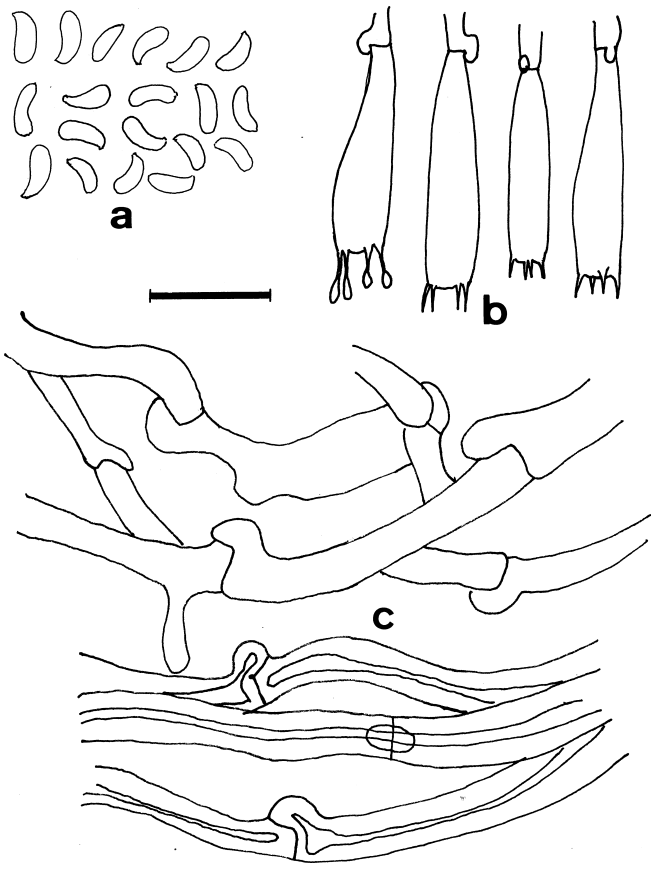

Figure 5. *Tyromyces cerifluus*. a, Basidiospores; b, Basidia; c, Generative hyphae. Bar = 10 μm.

Basidiomata annual, pendent to sessile, single to imbricated, attached by a dorsal contraction of the pileus, soft when fresh, fragile when dry, up to 3 cm wide and 3 mm thick, like soaked with a resinuous substance; upper surface white, cream to pale brown, velvety to glabrous. Pores angular to irregular, split and lacerate when dry, 2-4 per mm, pore surface sordid pale brown to pale straw, margin curved when dry. Context white to cream, up to 2 mm thick. Hyphal system monomitic; generative hyphae hyaline, clamped, up to 5 μm wide. Basidia clavate, 4-sterigmate, with a basal clamp, 15-25 × 5-6 μm. Basidiospores hyaline, cylindric to allantoid, 3-5 × 1.5-2 μm, IKI$^-$.

Specimen examined. **TAIWAN.** Nantou County: Tsuifeng, 2,350 m alt., on rotten hardwood, leg. W. N. Chou, Aug 2002, *CWN 5881*.

Distribution. Rarely distributed in Europe and North America, first recorded in Asia.

Cultural descriptions. Colonies on PDA and MEA media at 25°C growing 2-2.5 mm/d, with plates covered in 3 wk, appressed to raised, farinaceous, floccose, cottony, woolly to felty, mat white to cream, Advancing zone even, with dense to distant marginal hyphae. Reverse uncolored, remaining unchanged after 6 wk. Hymenophores not developed within 6 wk. Generative hyphae hyaline, branched, clamped, thin-walled, up to 4 μm wide. Chlamydospores subglobose to globose, up to 12 μm in diam. White decay type, observed both on rotten wood and on the basis of tannic and gallic acid medium tests. Laccase produced but not peroxidase and tyrosinase. Optimal temperature range for growth 24-28°C; minimal temperature 12°C and maximal temperature 32°C. Species code (Stalpers, 1978): 1, 8, (11), 12, 13, 18, 19, 21, 22, 25, 30, 31, 39, (44), (45), 48, 52, 53, 83, 85, 89.

Remarks. The pendent and like soaked with a resinuous substance basidiomata characterize the fungus. Cultural characters of the fungus have not been previously reported.

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五種台灣新紀錄之多孔菌及其培養特性

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本文報導五種台灣新紀錄之多孔菌：*Amylosporus campbellii* (Berk.) Ryvarden, *Grifola frondosa* (Dicks: Fr.) S. F. Gray, *Nigrofomes melanoporus* (Mont.) Murrill, *Phellinus pachyphloeus* (Pat.) Pat. and *Tyromyces cerifluus* (Berk. & M. A. Curtis) Murrill，其中 *Amylosporus*, *Grifola* 和 *Nigrofomes* 等三屬為台灣新紀錄菌屬。文內提供每種之描述，顯微特徵的描圖和純培養特性之研究。

關鍵詞：培養特性；多孔菌；台灣。