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FULL PAPER

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# Type studies of *Pleurotus* reported from Japan

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**Abstract** Eight type specimens of *Pleurotus* reported from Japan were examined. Four new combinations, *Marasmius alopecius*, *Omphalotus guepiniformis*, *Marasmiellus leiophyllus*, and *Hohenbuehelia squamula*, are proposed. *Pleurotus cyatheae* is accepted in the original genus. The following species are synonyms: *Pleurotus harmandii*, a synonym of *Omphalotus guepiniformis*; *P. minutoniger*, a synonym of *Resupinatus striatulus*; and *P. pulchellus*, a synonym of *Hohenbuehelia tremula*. *Omphalotus japonicus* (= *Lampteromyces japonicus*) is a synonum of *O. guepiniformis.*

**Key words** Japan · *Lampteromyces* · *Omphalotus* · *Pleurotus* · Type specimens

## Introduction

Many species treated as *Pleurotus* have been reported from Japan. Ito (1959), who wrote *Mycological flora of Japan*, listed 40 names of *Pleurotus* in the index. He accepted three names as the correct names of *Pleurotus* species, 25 names as synonyms, and 12 names as doubtful species. Ten of the doubtful species were reported originally from Japan, and only 2 species were determined among them. Pegler (1975) regarded *Pleurotus russaticeps* (Berk.) Sacc. (=*Agaricus russaticeps* Berk.) as a synonym of *Lentinula edodes* (Berk.) Pegler. Neda and Doi (2000) placed *Pleurotus lividulus* (Berk. & M.A. Curtis) Sacc. (=*Agaricus lividulus* Berk. & M.A. Curtis) in *Hohenbuehelia* and proposed a new combination *H. lividula*. I examined the eight type specimens that had not been reexamined.

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## Materials and methods

The microscopic features were observed in 5% KOH solution, Melzer's reagent, and crezyl blue by using a Nikon microscope (Optiphot). Abbreviations of herbaria are referred to Holmgren et al. (1990). Abbreviations of author's names are referred to Kirk and Ansell (1992).

## Descriptions and identification

1. ***Agaricus alopecius*** Berk. & M.A. Curtis in Proc. Amer. Acad. Arts 4: 115, 1860 Figs. 1,2
=*Pleurotus alopecius* (Berk. & M.A. Curtis) Sacc. in Syll. Fung. 5: 345. 1887.

Pileus reniform to flabelliform, 4–18 mm long, 7–21 mm broad, brownish-yellow to brown, glabrous, striate. Gills crowded, yellow to brown. Stipe eccentric, 2–6 mm long, 0.5–1 mm broad, insititious, equal, smooth. Spores oblong, 7.5–10 × 4–5 μm, with thin and smooth walls, hyaline to light yellow. Pleurocystidia abundant, clavate, 24–50 × 6–13 μm, with thin and smooth walls, light yellow to yellow. Basidia clavate 17–24 × 5–7 μm, with four sterigmata. Hymenial trama parallel, dextrinoid. Pileus cuticle parallel, not differentiated. Hyphal system monomitic. Clamp connections present.

Specimens examined: On decayed logs, Bonin Islands, Oct. 27, 1854, collected by C. Wright (FH, Herbarium of the U.S. North Pacific Exploring Expedition under Commanders Ringgold and Rogers, 1853–56, 67 [31], type); on the dead wood in woods, Sekimonzan, Hahajima, Bonin Is., Nov. 20, 1936, collected by S. Ito and S. Imai, TMI 5505.

Remarks: The marasmioid fruit body, striate pileus margin, eccentric stipe, non-hymeniform pileus cuticle, dextrinoid pileal trama, and clavate pleurocystidia show close relationship to *Marasmius* sect. *Fusicystides*. This species differs from the species of sect. *Fusicystides*, however, by its nonencrusted cystidia and pale-colored pileus. Therefore, a new combination is made here: ***Marasmius***

**Fig. 1.** Type specimen of *Agaricus alopecius* Berk. & M.A. Curtis (FH). *Bar* 10 mm

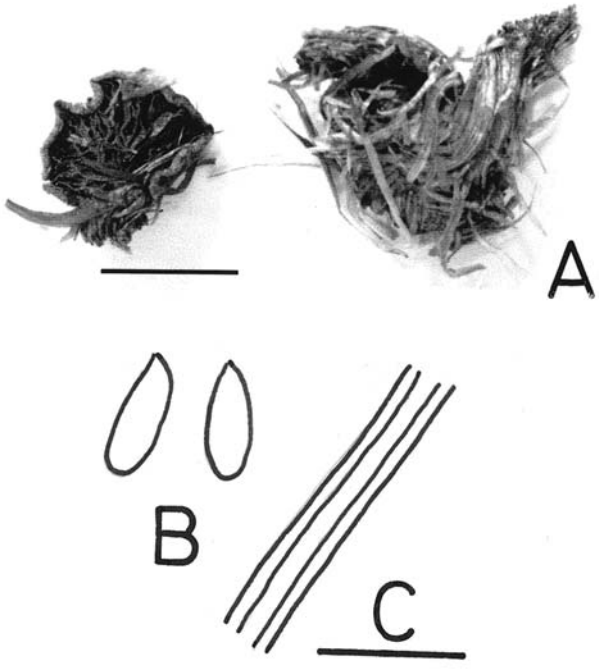


**Fig. 3.** **A** Type specimen of *Pleurotus cyatheae* S. Ito & S. Imai (TMI 5507). **B** Basidiospores. **C** Tramal hypha. *Bars* **A** 10 mm; **C** 10 μm

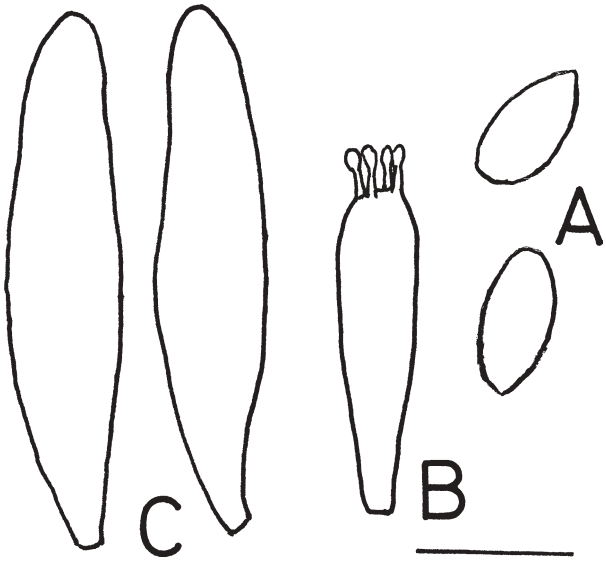


**Fig. 2.** *Agaricus alopecius* (type). **A** Basidiospores. **B** Basidium. **C** Pleurocystidia. *Bar* 10 μm

***alopecius*** (Berk. & M.A. Curtis) Neda, comb. nov. Ito and Imai (1939) also collected this species from Bonin Islands.

Japanese name: Munin-hime-hiratake (Ito and Imai 1939).

2. ***Pleurotus cyatheae*** S. Ito & S. Imai in Trans. Sapporo Nat. Hist. Soc. 16: 13. 1939. Fig. 3

Pileus flabelliform, 10 mm long, 13 mm broad, brown, smooth. Gills crowded, thin, decurrent, dark brown. Stipe none. Spores cylindrical, 7.5–8 × 2.5–3 μm, smooth, hyaline (TMI 5507). Skeletal hyphae present, 2–4 μm wide. Clamp connection present (SAPA 31).

Specimens examined: On living trunks of *Cyathea boninsimensis* Copel. (Hego) and *Alsophila mertensiana* Kunze (Maruhachi), Asahiyama, Chichi-jima, Bonin Island, Nov. 12, 1936, collected by S. Ito and S. Imai (TMI 5507, type); Fukurozawamura-Kobikidani, Chichi-jima, Bonin Island, Nov. 15, 1936, collected by S. Ito and S. Imai (SAPA 31, type).

Remarks: Pleurotoid fruit body, dimitic hyphal system, and cylindrical spores indicate this species belongs to *Pleurotus*. I accepted this species as a dimitic species of *Pleurotus. Pleurotus cyatheicolus* Corner is close to *P. cyatheae*, but has smaller spores (Corner 1983). *Pleurotus cyatheicolus* also grows on *Cyathea* in Solomon Islands.

Japanese name: Hego-shiro-kataha (Ito and Imai 1939).

3. ***Agaricus guepiniformis*** Berk. [as "*guepiniiformis*"] in Linn. Soc. Journ. Bot. 16: 50, 1878. Fig. 4

=*Pleurotus guepiniformis* (Berk.) Sacc. in Syll. Fung. 5: 382, 1887.

Fruit body spathulate or flabelliform, 20–30 mm long, 20 mm broad, brown to dark brown. Gills brown, decurrent, narrow, close. Stipe lacks the base. Spores globose, 11–13.5 μm in diameter, thick walled (~1 μm thick), hyaline, smooth, inamyloid. Basidia not observed. Pileal trama monomitic, weakly gelatinized. Hymenial trama regular. Subhymenium gelatinized. Clamp connections present.

Specimen examined: Japan, collected by F.V. Dickens, 749 [K (M): 115062, type].

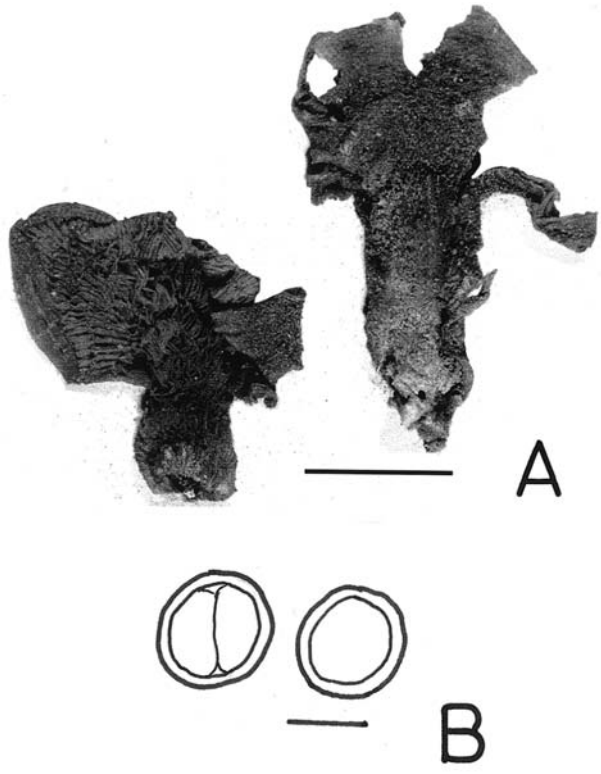


**Fig. 4. A** Type specimen of *Agaricus guepiniformis* Berk. (K(M): 115062). **B** Basidiospores. *Bars* **A** 10 mm; **B** 10 μm

Remarks: The pleurotoid fruit body, large thick-walled globose spores, and weakly gelatinized trama are similar to the characters of *Lampteromyces japonicus* (Kawam.) Singer (=*Pleurotus japonicus* Kawam.). However, the fruit body is rather smaller than the average of *L. japonicus*. I could not confirm the presence of a veil on the stipe because the base of the stipe was lacking. The veil is a key character of *L. japonicus*. According to the original description, the upper layer is gelatinous and bright-colored saffron yellow. A small and young fruit body of *L. japonicus* has such a color of pileus. Although the type is not intact, all features show this species is identical to *L. japonicus*.

At first this species was named as *Plerutous noctilucens* Inoko (Inoko 1889), but this name is invalid because the combination *P. noctilucens* was already occupied by *P. noctilucens* (Lév.) Sacc., 1887. Kawamura (1915) described this species and gave a new name, *Pleurotus japonicus*. Imai (1938) moved this species to *Armillaria*. Singer (1947) proposed a new genus, *Lampteromyces*, for this species and proposed the combination *L. japonicus*. This name has been adopted for a long time, but *A. guepiniforimis* was published 37 years before *P. japonicus*. Therefore, *A. guepiniforimis* is a prior name to *P. japonicus*.

Moncalvo et al. (2002) analyzed the phylogenetic relationship among 877 homobasidiomycete taxa by comparing their sequences of 1000 nucleotides at the 5′-end of the nuclear large ribosomal subunit gene (nLSU). The lowest clade "*omphalotus*" consists of two genera, *Omphalotus* and *Lampteromyces*. Moncalvo et al. mentioned that the tree topology suggested these two generic names were possibly synonymous. Furthermore, Kirkmair et al. (2002) examined chemotaxonomic and morphological features in *Omphalotus* and *Lampteromyces*. According to them, "In all *Omphalotus* and *Lampteromyces* species typical Boletales pigments of the pulvinic acid type as well as sesquiterpenes of the illudane type were found. The combination of these two features is highly characteristic for *Omphalotus* and *Lampteromyces* and cannot be found in any other mushroom group." They regarded *Lampteromyces* as a synonym of *Omphalotus* and proposed a new combination, *Omphalotus japonicus* (Kawam.) Kirchmair & O.K. Mill. I agree with their conclusion.

I propose ***Omphalotus guepiniforimis*** (Berk.) Neda comb. nov. for this species. This species is known in Japan as a luminescent and poisonous fungus growing on beech wood.

Japanese name: Tsukiyotake.

4. ***Pleurotus harmandii*** Har. & Pat. [as "*Harmandi*"] in Bull. Mus. Hist. Nat. 2: 131, 1902. Fig. 5

Pileus reniform, 13.5 mm long, 13 mm broad, surface brown. Gills decurrent, close, dark brown. Stipe lateral, short, clavate, 7 mm long, 10 mm broad, with annulus, same color as pileus. Spores globose, 8–9.5(–16) μm in diameter, hyaline, smooth. Basidia clavate, 35–45 × 7.5–10 μm, with 2 or 4 sterigmata. Hymenophoral trama regular, weakly gelatinized. Clamp connection present.

Specimen examined: Forest, Chuizuipi, collected by M. le D'Harmand, Sept. 1890 (FH, type).

Remarks: Singer (1951) recognized *P. harmandii* as *Hohenbuehelia* from the published diagnoses. In fact, the type specimen has neither the metuloid nor strongly gelatinized trama that are typical of *Hohenbuehelia*. The macroscopic features and the shape of spores indicate this species is *Omphalotus guepiniforimis* (=*Lampteromyces japonicus*). This type specimen was collected by M. le D'Harmand, the minister of France, in Tokyo, Japan. Hariot and Patouillard (1902) mentioned the collector's note "chair jaune-noirâtre au milieu." The blackish tint in the center of the flesh is one of the important features of *O. guepiniforimis*. However, most spores of the type specimen I observed are smaller than those of *O. guepiniforimis*. According to Hariot and Patouillard (1902), this type specimen was preserved in alcohol at first and dried later. I observed spores of a dried specimen of *O. guepiniforimis* (TFM-M-K696, collected on Nov. 22, 2002) after soaking it in ethanol for 3 months. The spores of the treated specimen (TFM-M-K696) were the same size as those of the type specimen of *P. harmandii*. Therefore, I conclude these two species are identical. *Pleurotus harmandii* is a synonym of *Omphalotus guepiniforimis*.

The following names are synonyms of *Omphalotus guepiniforimis*:

*Agaricus guepiniformis* Berk. in Linn. Soc. Journ. Bot. 16: 50, 1878.

*Pleurotus guepiniformis* (Berk.) Sacc. in Syll. Fung. 5: 382, 1887.

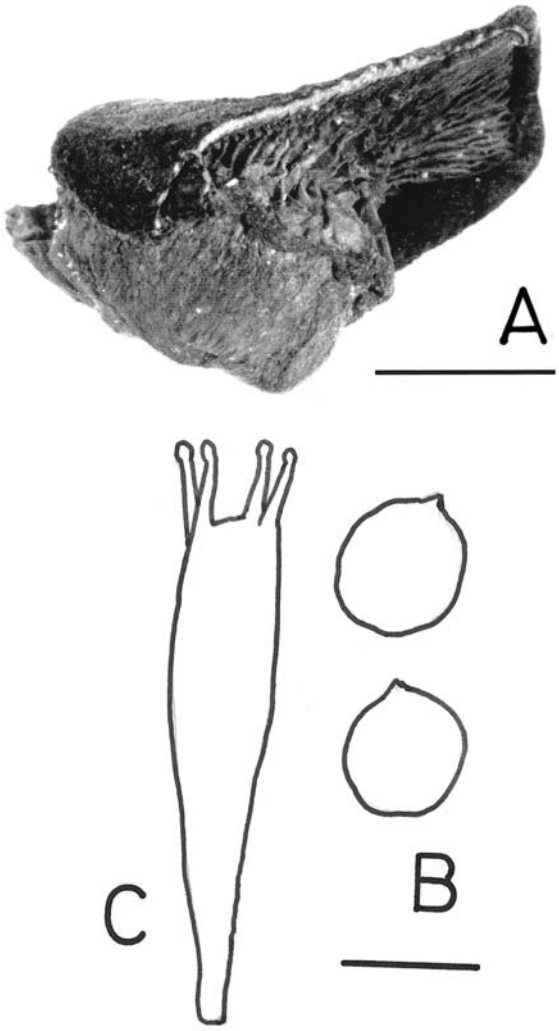


**Fig. 5. A** Type specimen of *Pleurotus harmandii* Har. & Pat. (FH). **B** Basidiospores. **C** Basidium. *Bars* **A** 5 mm; **B** 10 μm

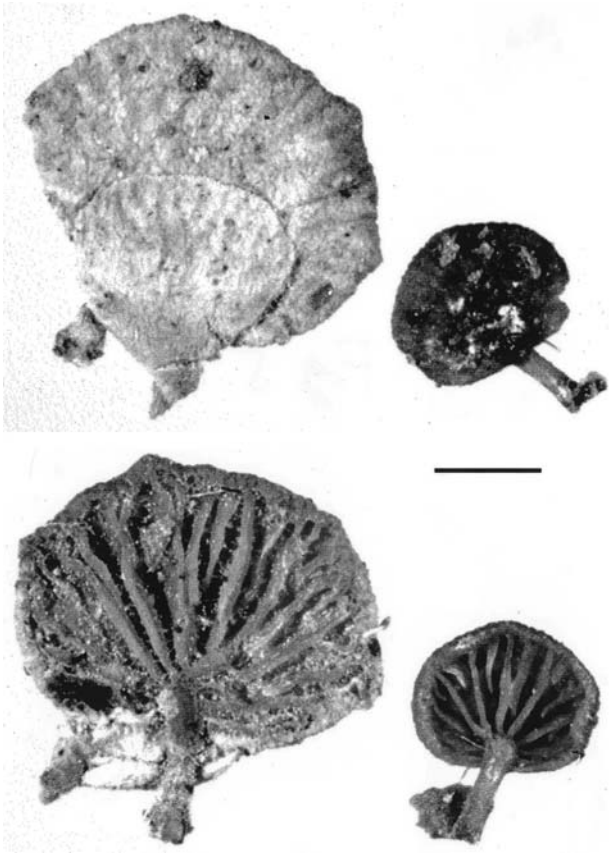

**Fig. 6.** Type specimen of *Agaricus leiophyllus* Berk. & M.A. Curtis (FH). *Bar* 1 mm

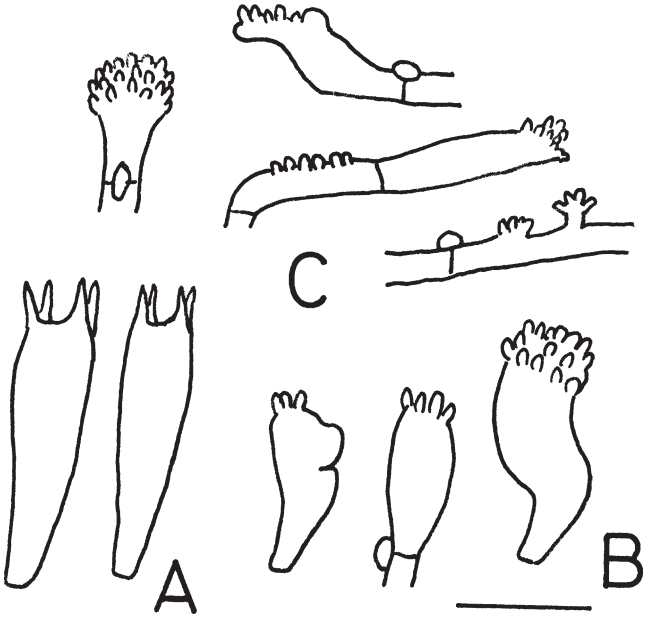


**Fig. 7.** *Agaricus leiophyllus* (type). **A** Basidia. **B** Cheilocystidia. **C** Hyphae of pileipellis. *Bar* 10 μm

*Pleurotus harmandii* Har. & Pat. in Bull. Mus. Hist. Nat. 2: 131, 1902.
*Acanthocystis harmandii* (Har. & Pat.) Singer in Ann. Mycol. 41: 148, 1943.
*Hohenbuhelia harmandii* (Har. & Pat.) Singer in Lilloa 22: 255, 1951.
*Pleurotus japonicus* Kawam. in Journ. Coll. Sci. Imp. Univ. Tokyo 35: 2, 1915.
*Armillaria japonica* (Kawam.) S. Imai in Journ. Facul. Agr. Hokkaido Imp. Univ. Sapporo 43: 52, 1938.
*Lampteromyces japonicus* (Kawam.) Singer in Mycologia 39: 80, 1947.
*Omphalotus japonicus* (Kawam.) Kirchmair & O.K.Mill. in Persoonia 17: 597, 2002.

5. ***Agaricus leiophyllus*** Berk. & M.A. Curtis in Proc. Amer. Acad. Arts 4: 115, 1860. Figs. 6, 7
=*Pleurotus leiophyllus* (Berk. & M.A. Curtis) Sacc. in Syll. Fung. 5: 371, 1887.

Pileus orbicular to reniform, 1.5–5.5 mm long, 2–7 mm broad, pale yellow to pale brown, smooth. Gills adnate, subdistant. Stipe eccentric, short, clavate, 1–1.4 mm long, 0.2–0.4 mm broad, light brown to brown. Spores not observed. Basidia clavate 16–20 × 4.5–6 μm, 4-spored, hyaline, thin walled. Ceilocystidia clavate 10–20 × 7–10 μm, hyaline,

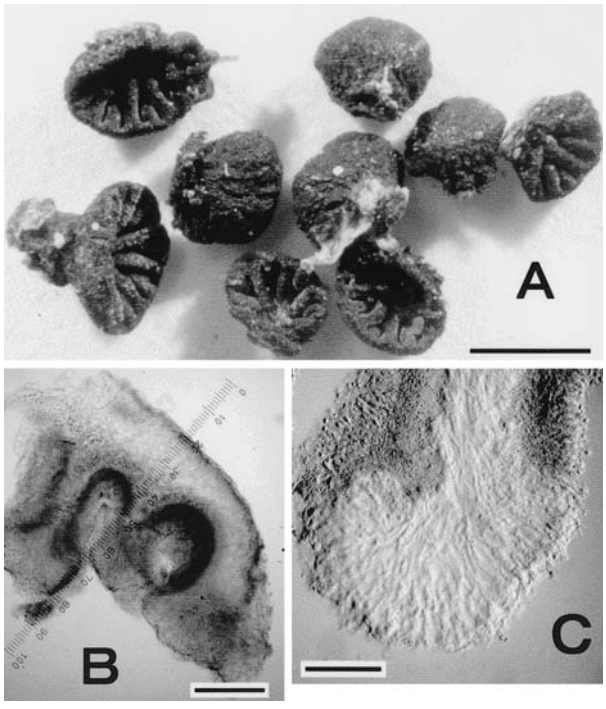


**Fig. 8.** Type specimen of *Pleurotus minutoniger* Lloyd (BPI 740193). **A** Fruit bodies. **B** Tangential section of the pileus. **C** Tangential section of gill edge. *Bars* **A** 1 mm; **B** 200 μm; **C** 50 μm

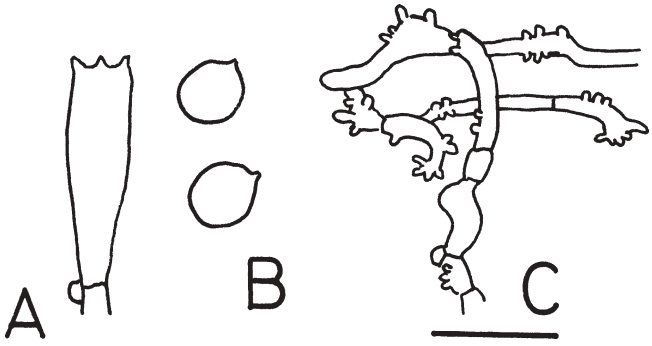


**Fig. 9.** *Pleurotus minutoniger* (type). **A** Basidium. **B** Basidiospores. **C** Hyphae of pileipellis. *Bar* 10 μm

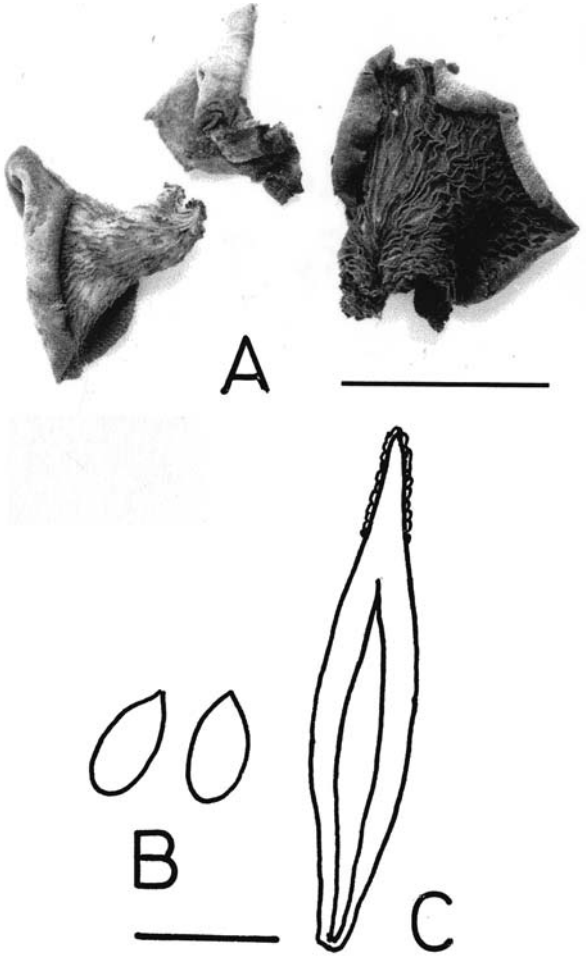


**Fig. 10.** **A** Type specimen of *Pleurotus pulchellus* S. Imai (TMI 5513). **B** Basidiospores. **C** Metuloid. *Bars* **A** 10 mm; **B** 10 μm

thin walled, apically ornamented. Hymenophoral trama subregular, hyaline, inamyloid, with hyphae similar to those of context. Pileipellis an epicutis of repent hyphae, 2.5–5 μm in diameter, with Rameales structure. Clamp connection present.

Specimen examined: On dead sticks in shady ravines, Bonin Islands, Oct. 31, 1854 (FH, Herbarium of the U.S. North Pacific Exploring Expedition under Commanders Ringgold and Rogers, 1853–56, 69 [32], type).

Remarks: Pleurotoid habit, epicutis with a Rameales structure, and inamyloid trama with clamp connections indicate this species belongs *Marasmiellus* sect. *Marasmiellus.* Therefore, ***Marasmiellus leiophyllus*** (Berk. & M.A. Curtis) Neda, comb. nov., is proposed. This species is close to *M. epochnous* (Berk. & M.A. Curtis) Singer, as described by Pegler (1986), but has neither furcate nor interveined gills. The character of the spores has not been described, and I did not observe it. Further research is needed.

Japanese name: Munin-shirohoraitake (new name).

6. ***Pleurotus minutoniger*** Lloyd [as "*minutonigrus*"] in New Fung. Names Lloyd by Stevenson & Cash, 153, 1936 (Lloyd, Myc. Writ. 7: 1345, 1925). Figs. 8, 9

Fruit body minute, to 1 mm in diameter. Pileus cupulate, sessile, dorsally attached, black, glabrous. Gills radiating from point of attachment, thick, subdistant, dark brown. Spores globose, 4.5–5.5 μm in diameter, hyaline, smooth. Basidia clavate, with 4 sterigmata, 17–20 × 6–7 μm. Subhymenium brown to dark brown. Gill trama gelatinized, extending to gill edge, and gill edge lacks hymenium. Pileus trama gelatinized, 100–200 μm thick, consists of hyaline and brown cordlike hyphae, 1–4 μm in diameter. Pileus cuticle consists of irregular hyphae, 1.5–4 μm in diameter. Clamp connections present.

Specimen examined: Nikko, province Shimotsuke (=Tochigi Pref.), Aug. 12, 1923, collected by A. Yasuda [BPI 740193 (Lloyd 30176, A. Yasuda 718), type].

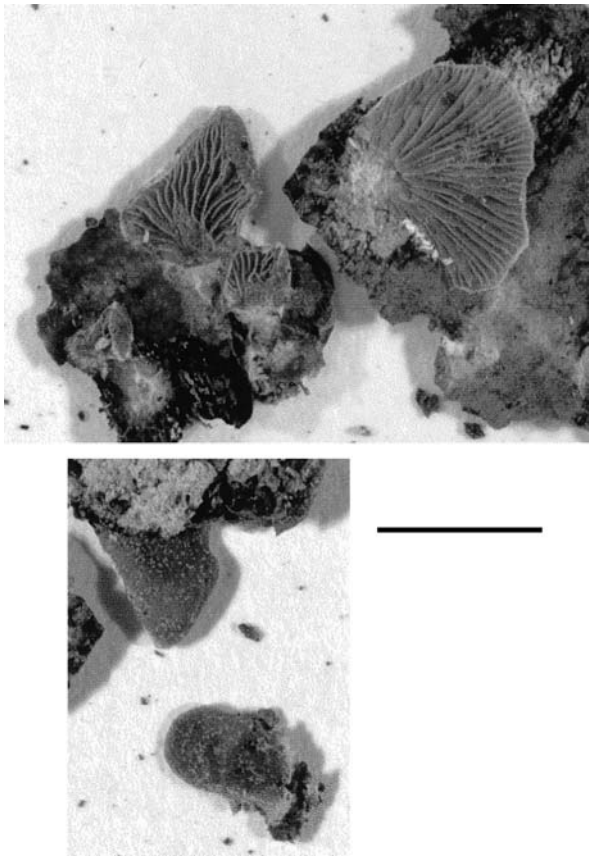

**Fig. 11.** Type specimen of *Agaricus squamula* Berk. & M.A. Curtis (FH). *Bar* 5 mm

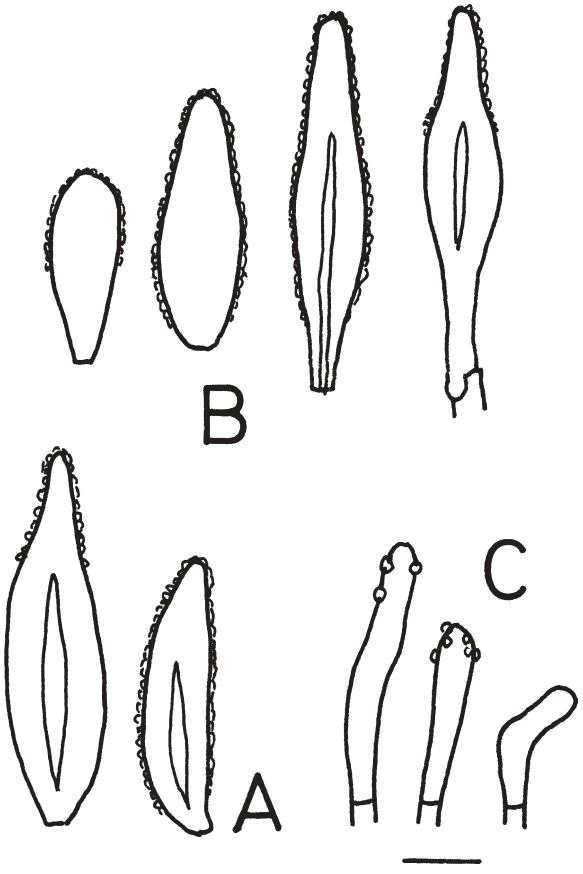


**Fig. 12.** *Agaricus squamula* (type). **A** Metuloids (pleurocystidia). **B** Metuloids (on pileipellis). **C** Gloeocystidia (on pileipellis). *Bar* 10 μm

Remarks: Small and sessile fruit body, gelatinized trama, and lack of metuloid show this species belongs to *Resupinatus*. In the protologue, the spore size was described as 2 μm in diameter. My measurements are larger than those given in the descriptions. All features I examined indicate this species is apparently conspecific with *Resupinatus striatulus* (Pers.: Fr.) Murrill sensu Thorn and G.L. Barron (1986), reported from United States and Europe. *Pleurotus minutoniger* is a synonym of *R. stiriatulus*.

Japanese name: Hime-shijimitake (new name).

7. ***Pleurotus pulchellus*** S. Imai in Bot. Mag. Tokyo 53: 395, 1939. Fig. 10

Pileus flabelliform, 12–17 mm long, 16–17 mm wide, brown, with white tomentum on surface. Gills crowded deccurent, same color as pileus. Spores elongate, 7–8 × 3–3.5 μm, hyaline, smooth. Metuloid present, 40–73 × 8.5–16 μm, crystal encrusted. Hairs on pileus 2–5 μm thick, hyaline. Pileus trama gelatinized.

Specimen examined: On decayed trunk, Sapporo, Hokkaido, Sept. 2, 1937, collected by S. Imai (TMI 5513, type).

Remarks: Due to the pleurotoid fruit body, metuloid in gill surface, and gelatinized pileus trama, this species should be placed in *Hohenbuehelia*. All features I examined indicate this is apparently conspecific with *Hohenbuehelia tremula* (Schaeff.: Fr.) Thorn & G.L. Barron. *Pleurotus pulchellus* is a synonym of *H. tremula.*

Japanese name: Kenpo-kataha (Ito and Imai 1939).

8. ***Agaricus squamula*** Berk. & M.A. Curtis in Proc. Amer. Acad. Arts 4: 115, 1860. Figs. 11, 12

=*Pleurotus squamula* (Berk. & M.A. Curtis) Sacc. in Syll. Fung. 5: 381, 1887.

Pileus sessile, flabelliform, 1.8–4.8 mm long, 1.8–6 mm broad, ocher to light brown, with white minute granules on the surface. Gills yellow-brown, decurrent. Stipe none. Spores not observed. Pilleipellis a densely interwoven layer, 5–10 μm thick, consisting of hyphae 1–5 μm in diameter with clamps. Metuloids abundant in hymenium, ventricose to lanceolate, 21–57 × 8–16 μm, with 4 to 8-μm-thick wall, hyaline to yellow, red-brown in Melzer's reagent. There are two types of pileocystidia: (1) thick walled and strongly encrusted metuloid, lanceolate or clavate, 20–46 × 7–11 μm, hyaline to yellow; (2) metachromatic gloeocystidia, thin walled, sometimes weakly encrusted, cylindrical, 15–42 × 3.5–4.5 μm.

Specimen examined: On decayed wood in shady ravines, Bonin Islands, Nov. 1, 1854, collected by C. Wright (FH, Herbarium of the U.S. North Pacific Exploring Expedition under Commanders Ringgold and Rogers, 1853–56, 72 [34], type).

Remarks: Metuloids in gill surface and gelatinous layer in pileus trama indicate this species is belonging to *Hohenbuehelia*. This species is close to *H. vermiculata* Corner, but differs from *H. vermiculata* in metachlomatic gloeocystidia in pileal cuticle. ***Hohenbuehelia squamula*** (Berk. & M.A. Curtis) Neda comb. nov. is proposed.

Japanese name: Tsubuge-himemukitake (new name).

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