
Revision of *Amanita* collections made from Hainan, Southern China

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A critical re-examination of *Amanita* specimens collected from Hainan, Southern China, indicated that many of the collections had been misidentified. Fourteen taxa, including two new to science, three new to China, and several new to Hainan, are reported in this account. The new taxa are *A. sinensis* var. *subglobispora* and *A. zangii*, while the new records for China are *A. orientogemmata*, *A. princeps* and *A. vestita*.

Key words: Agaricales, *Amanita*, *Amanita sinensis* var. *subglobispora*, *Amanita zangii*, Basidiomycetes, taxonomy.

Introduction

Presently, about twenty-five taxa of the genus *Amanita* Pers. have been reported from Hainan, a region of tropical climate and the southernmost province of China (Teng, 1963; Tai 1979; Gong, 1991; Teng, 1996; Bi *et al.*, 1997). Specimens of the genus *Amanita* collected from Hainan Island were re-examined. Unfortunately, critical re-examinations indicate that many collections were misidentified. It was found that two taxa are new to science, and a few taxa have not previously been recorded from China or from the province. The new findings are published here. The vouchers are deposited in the Herbarium of the Institute of Microbiology, Chinese Academy of Sciences (HMAS) and the Herbarium of Guangdong Institute of Microbiology (HMIGD). Additional specimens made by X.L. Wu, M.Q. Gong and M.S. Yuan are kept in the Herbarium of Cryptogams, Kunming Institute of Botany of the Chinese Academy of Sciences (HKAS). For several taxa treated, detailed descriptions can be found in other publications, therefore, only vital information on those taxa will be provided here.

In descriptions of marginal striations of the pileus, the abbreviation *nR* is used, where *n* is the ratio of striation length to the radius of the pileus (*R*). The abbreviation [*n/m/p*] shall mean *n* spores measured from *m* basidiocarps of *p*

collections. Dimensions for spores are given using a notation of the form (a - b - c ($-d$)). The range b - c contains a minimum of 90% of the measured values. Extreme values, i.e. a or d , are given in parentheses. Q is used to mean "length/width ratio" of a spore in side view; Q means average Q of all spores measured for a given taxon \pm sample standard deviation. Colour codes of the form "6F1" are from Kornerup and Wanscher (1981); colour names with first letters capitalised are from Ridgway (1912).

Taxonomy

1. *Amanita avellaneosquamosa* (S. Imai) S. Imai in Ito, Mycological Flora of Japan 2: 250 (1959)

Pileus convex to almost applanate, whitish, dirty white to brownish, covered with floccose to felty, brownish to brown, volval remnants; margin distinctly striate (0.3-0.4R). *Lamellae* brownish to greyish brown when dried; lamellulae truncate to nearly truncate. *Stipe* totally elongating; bulb absent; annulus fugacious. *Volva* saccate, 1-2 \times 1-1.5 cm, outer surface whitish. *Spores* [40/2/1] (8-)8.5-10.5(-12.5) \times (5-)5.5-7(-7.5) μ m [$Q = (1.31-)$ 1.35-1.75(-1.80), $Q = 1.54 \pm 0.11$], ellipsoid to elongate, colourless, hyaline, thin-walled, amyloid. *Basidia* 4-spored, rarely 2-spored. *Clamp-connexions* absent.

Material examined: CHINA, Hainan Province, Changjiang County, Bawangling, on soil in forest, 23 August 1988, Q. Chen *s.n.* (HMIGD 15018, as *Amanita phalloides* var. *striatula* in Bi *et al.*, 1997).

The collection cited above is regarded as *A. avellaneosquamosa* due to its dirty white to brownish, striate pileus covered with floccose to felty, brownish to brown, volval remnants, the darkening lamellae with truncate lamellulae, the elongating stipe with a fugacious annulus but without a bulb, and the size and form of the spores. *Amanita phalloides* var. *striatula* Peck, a poorly known taxon originally described from the United States, has a basal bulb on the stipe, a persistent annulus, and globose spores (Peck, 1902). *Amanita phalloides* var. *striatula* probably belongs in section *Phalloideae* (Fr.) Quél., while *A. avellaneosquamosa* belongs in section *Amidella* (E.J. Gilbert) Konrad and Maubl. According to Tulloss (unpublished data), Peck's taxon has attenuate lamellulae, no floccose remnants of volva on the pileus, 2-spored basidia, and wider spores measuring (8-)9-10 \times (7.5-)8-9.5 μ m. For a detailed description of *A. avellaneosquamosa* see Yang (1997).

2. *Amanita chepangiana* Tulloss and Bhandary, Mycotaxon 43: 25, Figs. 1-3 (1992)

Pileus 3.5-10 cm in diam., convex to applanate, centre without an umbo or sometimes slightly umbonate, glabrous, pale yellowish to cream-coloured on disc, white to milk white elsewhere; margin striate (0.2-0.4R). *Stipe* 5-15 × 0.5-2 cm, white; bulb absent; annulus present. *Volva* saccate, membranous, white. *Spores* [70/3/3] 8.5-10.5(-12) × (7-)8-10(-11) μm [Q = (1-)1.02-1.17(-1.19), Q = 1.10 ± 0.05], subglobose, sometimes globose or broadly ellipsoid, colourless, hyaline, thin-walled, inamyloid. *Clamp-connexions* common.

Material examined: CHINA, Hainan Province, Changjiang County, Bawangling, on soil in forest, 15 June 1987, Q. Chen *s.n.* (HMIGD 15217, as *Amanita virosa* in Bi *et al.*, 1997); same location, on soil in forest, 21 June 1987, Q. Chen *s.n.* (HMIGD 12114, as *Amanita muscaria* var. *alba* in Bi *et al.*, 1997). Ledong County, Jianfengling, on soil in forest, 15 May 1987, Q. Chen *s.n.* (HMIGD 14402, as *Amanita caesarea* var. *alba* in Bi *et al.*, 1997).

For detailed descriptions of *A. chepangiana* see Tulloss and Bhandary (1992), and Yang (1997). This species is a member of section *Caesareae* Singer ex Singer, and was often regarded as *Amanita caesarea* var. *alba* Gillet in the Chinese literature. However, *A. caesarea* var. *alba*, originally described from Europe, has shorter marginal striations on the pileus, a shorter stipe, and ellipsoid spores (Yang, 1997). *Amanita muscaria* var. *alba* Peck, known from North America, belonging in section *Amanita*, usually has warts on the pileus, a basal bulb on the stipe, and larger, broad ellipsoid to elongate spores (Jenkins, 1986: 34). *Amanita virosa* Bertillon from Europe, belonging in section *Phalloideae*, has a smooth pileal margin, a basal bulb on the stipe, no clamp-connexions, and amyloid spores (Breitenbach and Kränzlin, 1995: 156). In HMIGD 12114, a basidiocarp of the genus *Strobilomyces* is intermixed.

3. *Amanita farinosa* Schwein., Schriften Naturforschende Gesellschaft zu Leipzig 1: 79 (1822)

Spores [20/1/1] 6.5-7.5(-8) × 5.5-6.5(-7) μm [Q = 1.07-1.21(-1.28), Q = 1.16 ± 0.05], subglobose to broadly ellipsoid, colourless, hyaline, thin-walled, inamyloid. *Basidia* 30-40 × 8.5-10 μm, 4-spored. *Clamp-connexions* absent.

Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, on soil in forest, 3 September 1999, X.L. Wu 6 (HKAS 34096).

For a detailed description of *A. farinosa* see Yang (1997: 38).

4. *Amanita fritillaria* (Berk.) Sacc., Sylloge Fungorum 9: 2 (1891)

Pileus ca. 6 cm in diam., pale brown, covered with grey to dark grey, floccose volval remnants. Upper part of the bulbous base of the stipe covered with dark grey volval remnants in 2-4 rings. *Spores* [50/3/3] 7-9 × (5-)6-7.5(-8.5) μm [Q = (1-)1.08-1.36(-1.40), Q = 1.22 ± 0.09], broadly ellipsoid, occasionally subglobose or ellipsoid, rarely globose, colourless, hyaline, thin-walled, amyloid. *Clamp-connexions* absent.

Material examined: CHINA, Hainan Province, Changjiang County, Bawangling, on soil in forest, 24 May 1988, G.Y. Zheng *s. n.* (HMIGD 14591, as *Amanita spissacea* in Bi *et al.*, 1997). Ledong County, Jianfengling, on soil in forest, 3 September 1999, X.L. Wu 11 (HKAS 34101); same location, on soil in forest, 20 August 1999, M.S. Yuan 4354 (HKAS 34563).

Although *A. fritillaria*, which was originally described from India, is quite common throughout East Asia, it was not well known until publication of the work of Corner and Bas (1962). The species was recorded from Yunnan, China as early as 1948 (Chiu, 1948), but has been almost completely forgotten since that period. *Amanita spissacea* S. Imai, originally described from Japan, may be conspecific with *A. fritillaria* (Yang, 1997: 201).

5. *Amanita ? japonica* Bas, Persoonia 5: 399, Figs. 107–110, 1969

Pileus 6–7 cm in diam., greyish, covered with small, grey (to dark grey) volval remnants, 0.5–1.5 mm in height. *Spores* [28/1/1] 7-9(-9.5) × 5.5-7(-7.5) μm [$Q = (1.16-)$ 1.25-1.43(-1.55), $Q = 1.32 \pm 0.08$], broadly ellipsoid to ellipsoid, colourless, hyaline, thin-walled, amyloid. *Basidia* 40-48 × 10-12 μm , 4-spored; basal septa often with clamp-connexions.

Material examined: CHINA, Hainan Province, Changjiang County, Bawangling, on soil in forest, 26 May 1988, G.Y. Zheng and J.P. Lai *s.n.* (HMIGD 14172, as *Amanita strobiliformis* in Bi *et al.*, 1997).

The specimen studied is imperfect due to the lack of stipe, and similar to *A. japonica*, but the latter has somewhat longer spores (Bas, 1969; Yang, 1997). *Amanita strobiliformis* (Paulet ex Vittad.) Bertillon, originally described from Europe, has significantly larger spores and lacks clamp-connexions (Bas, 1969: 520; Breitenbach and Kränzlin, 1995: 154).

6. *Amanita orientogemmata* Z.L. Yang and Yoshim. Doi, Bulletin of the National Science Museum, Tokyo, Series B, 25: 107, Figs. 1–4 (1999)

Pileus ca. 4 cm in diam., applanate, yellowish to ochraceous, darker at centre, glabrous (volval remnants probably washed away by rain); margin long striate (0.35R). *Stipe* imperfect. *Annulus* pendant from ca. 1 cm below apex of stipe. *Spores* [25/1/1] (7-)8-10(-10.5) × (5.5-)6-7(-7.5) μm [$Q = (1.08-)$ 1.18-1.50(-1.55), $Q = 1.36 \pm 0.11$], broadly ellipsoid to ellipsoid, rarely subglobose, colourless, hyaline, thin-walled, inamyloid. *Basidia* 26-34 × 10-12 μm , clavate, 4-spored, rarely 1- or 2-spored; basal septa often with clamp-connexions.

Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, on soil in forest, 26 September 1987, T.H. Li *s.n.* (HMIGD 12446a, as *Amanita bingensis* in Bi *et al.*, 1997).

HMIGD 12446 consists of two basidiocarps, each of which represents a separate taxon. HMIGD12446a is *A. orientogemmata* (Yang and Doi, 1999), a

species new to China, while HMIGD 12446b is *A. sychonopyramis* f. *subannulata* (see below). *Amanita bingensis* (Beeli) R. Heim, originally described from Africa, has differently coloured basidiocarps, no annulus, and smaller spores (Heim, 1940; Gilbert, 1940–41). Chiu (1948) first reported *A. bingensis* from China, but the voucher specimen turned out to represent *A. rubrovolvata* S. Imai (Yang, 1997: 44).

7. *Amanita ovalispora* Boedijn, Sydowia 5: 320 (1951)

Spores [50/4/2] (8-)8.5-10.5(-11) × (6.5-)7-8.5(-9) μm [Q = (1.08-)1.11-1.37(-1.46), Q = 1.24 ± 0.09], subglobose to broadly ellipsoid, occasionally ellipsoid, thin-walled, colourless, hyaline, inamyloid. *Basidia* 4-spored, rarely 2-spored. *Clamp-connexions* absent.

Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, on soil in forest, 3 September 1999, X.L. Wu 19 (HKAS 34109); same location, on soil in forest, 2 September 1999, X.L. Wu 20 (HKAS 34110).

The lamellae of the specimens cited are greyish to brownish when dried, which is a typical feature for *A. ovalispora* (see Yang, 1997: 92).

8. *Amanita princeps* Corner and Bas, Persoonia 2: 297, Plate 10; Fig. 51 (1962)

Pileus 7–20 cm in diam., convex to appanate, sometimes concave, centre without an umbo or sometimes only slightly umbonate, yellowish brown to ochraceous, paler towards a striate margin (0.25-0.4R). *Stipe* 9-20 × 1-2 cm, tapering slightly upwards; annulus present or torn from stipe during expansion of pileus, superior to subapical and pendant from 0.5-2 cm below apex of stipe when present. *Volva* saccate, 4-12 × 4-6 cm, membranous; outer surface whitish, greyish to dirty brownish, often cracking into thin patches. *Spores* [130/8/7] (8.5-)9-11.5(-12) × (7.5-)8.5-10.5(-11) μm [Q = (1-)1.05-1.16(-1.21), Q = 1.09 ± 0.04], subglobose, sometimes broadly ellipsoid, rarely globose, thin-walled, colourless, hyaline, inamyloid, mostly smooth, occasionally finely verruculose; apiculus prominent, up to 2 μm long. *Basidia* 40-60 × 12-15 μm, clavate, 4-spored; basal septa often with clamp-connexions. *Volva* on stipe base composed primarily of filamentous hyphae, 3-7 μm wide, colourless hyaline, thin-walled; inflated cells rare to scattered, subglobose to ovoid (75-100 × 50-80 μm) to ellipsoid or fusiform (100-150 × 30-70 μm). *Clamp-connexions* common.

Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, on soil in forest, 22 May 1981, M.Q. Gong 60058 (HKAS 22370); same location, on soil in forest, 3 September 1999, X.L. Wu 16 (HKAS 34106); same location, on soil in forest, 16 August 1999, M.S. Yuan 4295 (HKAS 34561), 4293 (HKAS 34562) and 4291 (HKAS 34560). Changjiang County, Bawangling, on soil in forest, 17 August 1988, G.Y. Zheng *s.n.* (HMIGD 14274, as *Amanita caesarea* in Bi *et al.*, 1997). Tongshen Municipality, Wuzhishan, on soil in

forest, 30 August 1960, J.H. Yu and R. Liu 2227 (HMAS 31007, as *Amanitopsis vaginata* in Teng, 1963 and 1996, as *Amanita vaginata* in Tai, 1979).

Amanita princeps is a new record for China. In the protologue of *A. princeps* the spores are described as densely and minutely verruculose (Corner and Bas, 1969: 298). Spores of the collections cited above are mostly smooth, and only occasionally finely verruculose. The cracking of the outer layer of the volva of *A. princeps* calls to mind *A. zambiana* Pegler and Pearce, recently reported to be a synonym of *A. loosii* Beeli (Buyck, 1994), but the mushrooms under the latter two names have a differently coloured pileus with relatively shorter striations and longer spores (Gilbert, 1940-41; Pegler and Pearce, 1980; Pegler and Shah-Smith, 1997). *Amanita caesarea* (Scop.: Fr.) Pers. from Europe has a shorter stipe, shorter marginal striations on the pileus, and ellipsoid spores (Breitenbach and Kränzlin, 1995: 146). It is generally accepted that *Amanita vaginata* (Bull.: Fr.) Lam. [= *Amanitopsis vaginata* (Bull.: Fr.) Roze] has a different habit with differently coloured pileus, exannulate stipe, globose to subglobose spores and no clamp-connexions (Yang, 1997, 2000). HKAS 22409 was immature when dried. For a detailed description of *A. princeps*, see Corner and Bas (1962).

9. *Amanita pseudoporphyria* Hongo, Journal of Japanese Botany 32: 141, Fig. 2/a-c (1957)

Pileus ca. 5 cm in diam., greyish brown, glabrous; margin smooth. *Stipe* 5 × 0.6-1 cm, with a clavate base; annulus apical, white, friable. *Volva* limbate, 2.5-3 × 1-1.5 cm, white, but upper limb often with a greyish tinge. Spores [30/1/1] 7-8 × 5-6(-6.5) μm [Q = (1.23-)1.27-1.50(-1.59), Q = 1.38 ± 0.08], ellipsoid, sometimes broadly ellipsoid, colourless, hyaline, thin-walled, amyloid. *Basidia* 38-47 × 8.5-10 μm, 4-spored. *Clamp-connexions* absent.

Material examined: CHINA, Hainan Province, Lingshui County, Diaoluoshan, on soil in forest, 26 May 1988, T.H. Li *s.n.* (HMIGD 14029, as *Amanita phalloides* in Bi *et al.*, 1997).

The collection cited above is identified as *A. pseudoporphyria* for its greyish brown pileus, the apical friable annulus on the stipe with a clavate base, and small ellipsoid spores. *Amanita pseudoporphyria* has wrongly been regarded as *A. phalloides* (Fr.) Link in the Chinese literature (Yang, 2000). However, the latter has usually a yellowish green pileus, a lower and stronger annulus, an enlarged stipe base, and larger spores (Breitenbach and Kränzlin, 1995: 152; Yang, 1997: 174). The phylogenetic relationship between *A. pseudoporphyria* and *A. phalloides* seems not to be very close (Weiß *et al.*, 1998).

10. *Amanita sinensis* var. *subglobispora* Z.L. Yang, T.H. Li and X.L. Wu, var. nov. (Figs. 1-3)

A typo recedit spora brevioris. **Holotype:** M.S. Yuan 4329 (HKAS 34568), 18 October 1999, Jianfengling, Ledong, Hainan, China.

Etymology: *subglobispora*, on account of the subglobose spores.

Pileus 10-15 cm in diam., convex to almost applanate, whitish to brownish, densely covered with dark grey to smoky grey [6F1-3; Fuscous-Black], sometimes grey, subconical (2-5 mm wide, 1-4 mm high), towards the pileal margin scale-like to fibrillose, volval remnants; margin striate (*ca.* 0.2R). *Stipe* 15-20 × 1-2.5 cm, white to whitish, densely covered with grey to dark grey, farinose to tomentose squamules; bulb subfusiform, occasionally elongate, 1.5-3 cm wide, upper part covered with greyish to grey, granular to floccose, volval remnants. *Annulus* fugacious. *Lamellar trama* bilateral; mediostratum 30-50 µm wide, consisting of long ellipsoid to fusiform cells, 10-30 µm wide, mixed with abundant, branching hyphae, 3-7 µm wide; vascular hyphae rare. Lateral stratum consisting of long clavate to ellipsoid or fusiform cells, 10-25 µm wide, mixed with fairly abundant hyphae, 3-7 µm wide, diverging at an angle of 30°-45° to the central stratum; septa often with clamp-connexions. *Subhymenium* (Fig. 1) 30-40 µm thick, with 2-3(-4) layers of subglobose, ovoid or ellipsoid cells (10-30 × 8-16 µm), sometimes mixed with a few hardly inflated, hyphal segments. *Basidia* (Fig. 1) 45-60 × 10-14 µm, clavate, 4-spored; sterigmata 5-6 µm long; basal septa often with clamp-connexions. *Spores* (Fig. 2) [85/4/3] (7.5-)8.5-10.5(-11) × (6.5-)7.5-9(-10) µm [*Q* = (1.05-) 1.06-1.21(-1.26), *Q* = 1.13 ± 0.05], subglobose to broadly ellipsoid, colourless, hyaline, thin-walled, inamyloid. *Lamellar edge* a sterile, somewhat gelatinised strip, 50-150 µm wide in side view, made up of filamentous hyphae, 2-6 µm wide, running ± parallel to the lamellar edge, mixed with scattered to abundant, pyriform (15-20 × 12-17 µm) to ovoid or subglobose (13-22 × 12-18 µm) inflated cells, single and terminal or in chains of 2-3, thin-walled, colourless, hyaline. *Pileipellis* hardly differentiated, made up of ± radially arranged and compacted hyphae, 2-7(-10) µm wide, often with fine granular incrustations and brownish, vacuolar pigmentation; clamp-connexions rare. *Volval remnants* on pileus (Fig. 3) composed of ± vertically arranged elements on disc, to irregularly arranged elements towards the pileus margin; elements composed primarily of inflated cells, long ellipsoid to subfusiform or subcylindric (40-110 × 10-20 µm), rarely ellipsoid (30-40 × 15-22 µm), thin- to slightly thick-walled (≤ 0.5µm), subhyaline or with brownish to brown, vacuolar pigmentation; mixed with scattered to fairly abundant filamentous hyphae, 2-7 µm wide, thin-walled, hyaline, colourless or sometimes with brownish, vacuolar pigmentation; septa rarely with clamp-connexions; vascular hyphae rare to scattered, 3-8 µm wide. Volval remnants on upper bulb similar to those on pileus, but elements irregularly arranged. *Stipe trama* composed primarily of longitudinally arranged, long clavate,

terminal cells, 200-380 × 20-40 μm, mixed with scattered (in interior) to abundant (on stipe surface) filamentous hyphae, 2-8 μm wide; vascular hyphae rare, 2-8(-15) μm wide.

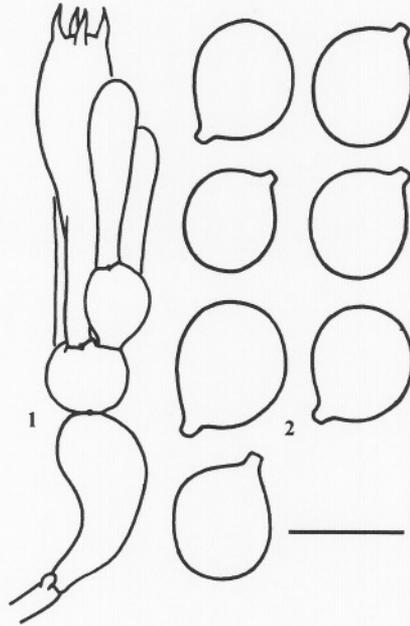
Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, alt. 900 m, on soil in forest, 18 August 1999, M.S. Yuan 4329 (HKAS 34568, holotype!); same location, on soil in forest, 2 September 1999, X.L. Wu 17 (HKAS 34107); same location, alt. 800 m, on soil in forest, 22 April 1960, J.H. Yu and R. Liu 1103 (HMAS 30834, as *Amanitopsis strangulata* in Teng, 1963 and 1996; as *Amanita inaurata* in Tai, 1979).

Amanita sinensis var. *subglobispora* appears to be common in Hainan. It mainly differs from *A. sinensis* var. *sinensis* by its proportionally shorter, and somewhat wider spores. The ranges of Q for the two varieties are disjunct. In addition, the colour of the volval remnants on the pileus of var. *subglobispora* is usually darker than that of var. *sinensis*; consequently the inflated cells of the volval remnants of var. *subglobispora* are darker than those of var. *sinensis* under the microscope (see Yang, 1997; Oda, Tanaka and Tsuda, 2000). *Amanita ceciliae* (Berk. and Broome) Bas (= *Amanita inaurata* Secr. ex Gillet) has completely elongated stipe, globose to subglobose spores, and no clamp-connexions. The latter belongs in sect. *Vaginatae* (Fr.) Quél., while the former belongs in sect. *Amanita* (Yang, 1997). *Amanitopsis strangulata* (Fr.) Roze (≡ *Agaricus strangulatus* Fr.) is an unknown species (Bas, 1984).

11. *Amanita sychnopyramis* f. *subannulata* Hongo, Memoirs. Faculty of Liberal Arts. Shiga University, Natural Science 21: 63, Fig. 31/3-5 (1971)

Pileus 3-5 cm in diam., convex to applanate, dark brown at disc, becoming yellowish to ochraceous towards the striate margin (0.24-0.47R), covered with dirty white, brownish to brown, small, conical to subconical, volval remnants, occasionally glabrous. *Stipe* 4-8 × 0.3-1 cm; bulb subclavate to subglobose, upper part covered with dirty white, greyish, grey-brown to brown, small, granular to floccose, volval remnants. *Annulus* almost medial, sometimes torn from stipe. *Spores* [170/13/7] (6-)6.5-8(-10) × (5.5-)6-7.5(-9) μm [Q = 1-1.16(-1.33), Q = 1.09 ± 0.06], globose to subglobose, occasionally broadly ellipsoid, rarely ellipsoid, colourless, hyaline, thin-walled, inamyloid. *Basidia* (25-)30-45 × 9-12 μm, clavate, 4-spored. *Clamp-connexions* absent.

Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, on soil in broad-leaved forest, 20 April 1960, J.H. Yu and R. Liu 1107 (HMAS 27959, as *Amanita pantherina* in Teng 1963, 1996, and in Tai, 1979); same location, on soil in forest, 23 May 1988, G.Y. Zheng s.n. (HMIGD 14558, as *Amanita aspera* in Bi *et al.*, 1997); same location, on soil in forest, 26 September 1987, T.H. Li s.n. (HMIGD 12446b, as *Amanita bingensis* in



Figs. 1-2. *Amanita sinensis* var. *subglobispora* (HKAS 34568, holotype). 1. Basidia and subhymenium. 2. Spores. Bars: 1 = 20 μm ; 2 = 10 μm .

Bi *et al.*, 1997); same location, on soil in forest, 18 May 1988, H.Q. Chen *s.n.* (HMIGD 14478, as *Amanita kwangsiensis* in Bi *et al.*, 1997); same location, on soil in forest, 23 May 1981, M.Q. Gong 815016 (HKAS 22400); same location, on soil in forest, September 1999, X.L. Wu 5 (HKAS 34095). Tongshen Municipality, Wuzhishan, on soil in forest, 17 May 1988, T.H. Li *s.n.* (HMIGD 13814, as *Amanita albocreata* in Bi *et al.*, 1997).

Amanita pantherina has a different habit, and significantly larger, ellipsoid spores (Breitenbach and Kränzlin, 1995: 150; Yang, 1997: 47). *Amanita franchetii* (Boud.) Fayod (= *A. aspera sensu auct.*) of Europe, assignable to section *Validae* (Fr.) Quél., has differently coloured basidiocarps, a smooth pileal margin, and larger, ellipsoid, amyloid spores (Breitenbach and Kränzlin, 1995: 148). HMIGD 12446 consists of two basidiocarps, each of which represents a separate taxon. HMIGD12446a is *A. orientogemmata* (see above). *Amanita bingensis*, known from Africa, has differently coloured basidiocarps, no annulus, and ellipsoid to broadly ellipsoid to ovoid spores (Heim, 1940; Gilbert, 1940-41). *Amanita albocreata* (G.F. Atk.) E.J. Gilbert, known from North America, has a lighter coloured pileus, a cothurnate to ocreate volva on the stipe base, no annulus, and larger spores (Jenkins, 1977 and 1986; Tulloss and Jenkins, 1986). *Amanita kwangsiensis* Y.C. Wang is a

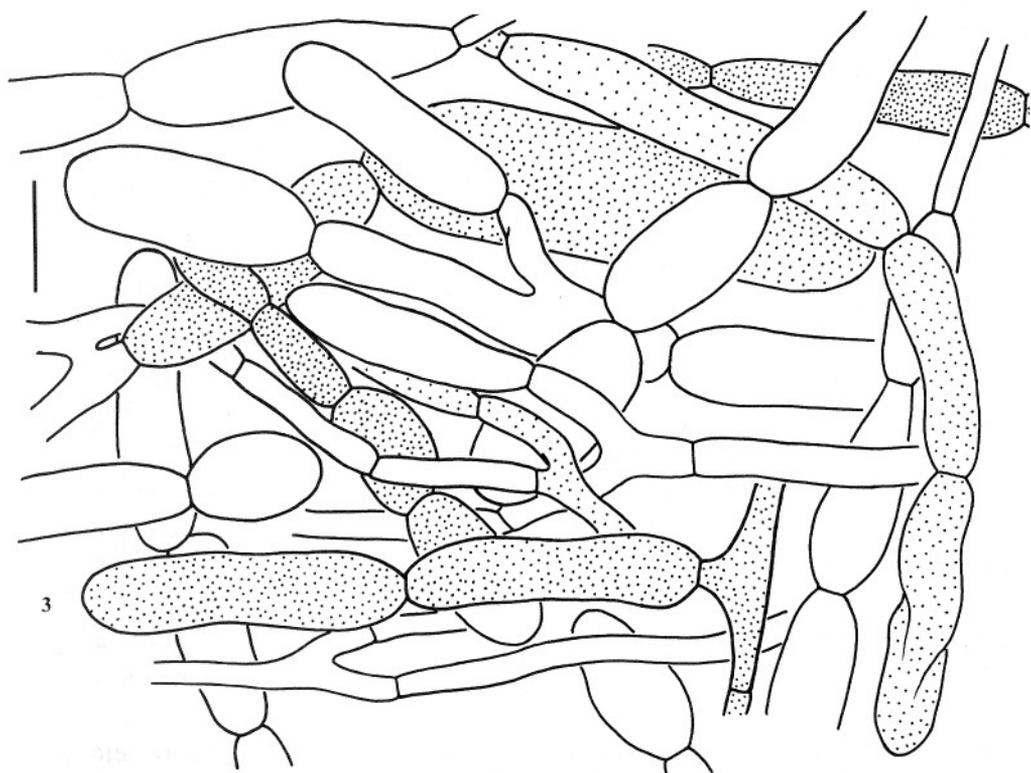


Fig. 3. Crushed volval remnants from pileus of *A. sinensis* var. *subglobispora* (HKAS 34568, holotype). Bar = 20 μ m.

synonym of *A. sychnopyramis* f. *subannulata* Hongo (Yang, 1997: 32). For a detailed description of this taxon see Yang (1997).

12. *Amanita* cf. *vaginata* (Bull.: Fr.) Lam., Encyclopédie Méthodique Botanique 1: 109 (1783)

Pileus ca. 5 cm in diam., convex, brownish grey, becoming grey towards the striate margin (0.3-0.4R). *Stipe* 6 \times 0.5-0.8 cm, whitish. *Volva* saccate, 2 \times 1 cm, membranous, white. *Spores* [20/1/1] 8.5-11 \times 8-10.5 μ m [Q = (1-)1.05-1.11(-1.13), Q = 1.08 \pm 0.03], subglobose, rarely globose, colourless, hyaline, thin-walled, inamyloid. *Basidia* 55-65 \times 12-14 μ m, clavate, 4-spored. *Clamp-connexions* absent. *Volval remnants* on stipe base made up of \pm irregularly arranged elements, composed primarily of filamentous hyphae, 3-8(-12) μ m wide, hyaline, thin-walled, interwoven; inflated cells scattered (to locally abundant), more abundant towards the inner surface of volva, subglobose to

ovoid, 60-80 × 40-70 μm, hyaline, thin-walled. Outer surface consisting primarily of filamentous hyphae, 3-7 μm wide; inflated cells not seen. Inner surface gelatinised.

Material examined: CHINA, Hainan Province, Changjiang County, Bawangling, on soil in forest, 18 May 1988, H.Q. Chen *s.n.* (HMIGD 14480, as *Amanita vaginata* in Bi *et al.*, 1997).

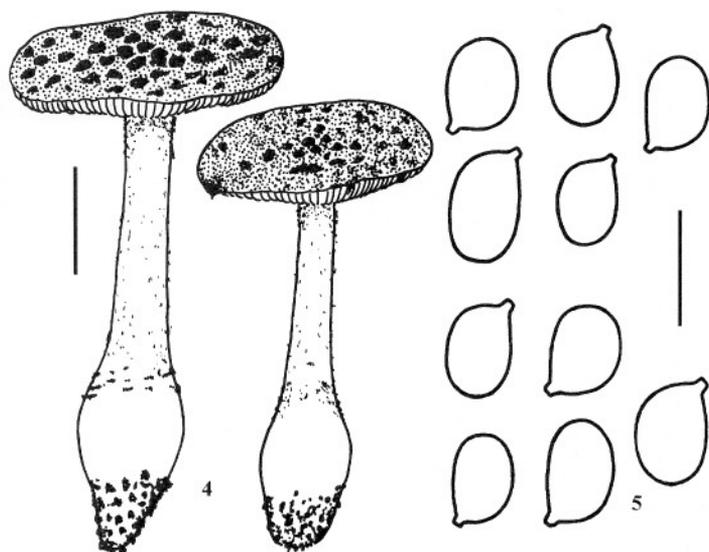
Although the name *A. vaginata* (Bull.: Fr.) Lam. is widely used, the true concept of the species remains unclear (Yang, 2000). The material here treated as *A. cf. vaginata* probably represents a different taxon from that reported by Yang (2000: 127).

13. *Amanita vestita* Corner and Bas, *Persoonia* 2: 252, Fig. 5, Plate 1b (1962)
(Figs. 4-6)

Pileus (Fig. 4) 4-5 cm in diam., convex to applanate, densely covered with cream-buff to brownish, floccose-felted patches, sometimes with subconical, clay-coloured warts over disc; margin smooth, appendiculate. *Stipe* 4-6 × 0.5-1 cm, subcylindrical, covered with floccose to fibrillose squamules, farinose at apex of stipe; bulb ventricose to subfusiform, 1.5-2 cm wide, ± radicating, upper part covered with farinose volval remnants. *Annulus* fugacious. *Basidia* 40-48 × 8-10 μm, 4-spored; basal septa without clamp-connexions. *Spores* (Fig. 5) [40/2/1] 7.5-9.5(-11) × (5-)5.5-6.5(-7) μm [Q = (1.29-)1.33-1.58(-1.66), Q = 1.45 ± 0.09], ellipsoid, rarely broadly ellipsoid or elongate, colourless, hyaline, thin-walled, amyloid. *Volval remnants* on pileus (Fig. 6) made up of irregularly arranged elements, the majority of which are inflated cells, ovoid to subglobose (25-45 × 20-40 μm) or sphaeropedunculate to pyriform (35-80 × 20-35 μm), sometimes ellipsoid or subfusiform (50-60 × 20-25 μm), nearly colourless hyaline or with brownish vacuolar pigmentation, single and terminal or in chains of 2-3 and not easily broken; filamentous hyphae scattered (to locally fairly abundant), 2-5 μm wide; vascular hyphae rare. *Volval remnants* on stipe base similar to those on pileus, but inflated cells usually single and terminal; filamentous hyphae more abundant.

Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, alt. 800 m, on soil in forest, 22 August 1999, M.S. Yuan 4441 (HKAS 34573).

Amanita vestita is new report for China. The present collection has somewhat paler coloured volval remnants on the pileus than is described by Corner and Bas (1962) and Bas (1969). As suggested by Corner and Bas (1962), and Bas (1969), *A. vestita* is closely related to *A. griseofarinosa* Hongo; the latter mainly differing by its longer and proportionally wider spores (see Yang and Doi, 1999: 118). Moreover, recent observations on the type and additional material of *A. griseofarinosa* made from Japan and China show that *A. griseofarinosa* tends to have more grey coloured volval remnants



Figs. 4, 5. *Amanita vestita* (HKAS 34573). 4. Basidiocarps. 5. Spores. Bars 4 = 2 cm; 5 = 10 μ m.

on the pileus than *A. vestita*. The volval remnants of *A. griseofarinosa* are primarily made up of longer but more easily breaking chains of \pm globose cells, mixed with fewer filamentous hyphae as compared with those of *A. vestita* (unpublished data of Z.L. Yang).

14. *Amanita zangii* Z.L. Yang, T.H. Li and X.L. Wu, sp. nov. (Figs. 7-10)

Pileus 5-6 cm latus, convexus vel applanatus, albus, albidus vel cremeus, reliquiis volvae subconicis vel plano-verrucosis, tomentosus vel subfibrillosus, adnatis, subfuscis, atrogriseis vel subnigeris, ornatus, margine appendiculata, non striata. *Lamellae* liberae, albae, confertae, lamellulis attenuatis. *Stipes* 6-8 \times 0.8-1.2 cm, subcylindricus, albidus vel cremeus, annulatus; *Bulbus* subclavatus vel subglobosus, 1.5-2 cm latus, reliquiis volvae griseis vel inconspicuis. *Annulus* albus vel albidus, apicalis vel subapicalis, fragilis. *Caro* alba. *Basidia* 4-sporigera. *Sporae* (7.5-)8.5-11.5(-12) \times 6.5-8(-9) μ m, ellipsoideae, amyloideae. *Fragmenta pilei* a volvae cellulis elongatis catenulatis composita. *Fibulae* absentes.

Holotype: M.S. Yuan 4346 (HKAS 34570), 20 August 1999, Jianfengling, Ledong, Hainan, China.

Etymology: *zangii* is named in honour of Prof. Mu Zang on the occasion of his 70th birthday.

Pileus (Fig. 7) 5-6 cm in diam., convex to applanate, white, whitish to cream-coloured [1A1-1A2; Cream Colour], covered with adnate, brownish grey, dark grey to blackish [8E2, 8F2; Blackish Brown, Fuscous-Black], small to rather coarse, subconical (2-5 mm wide) to flat verrucose (5-10 mm wide),

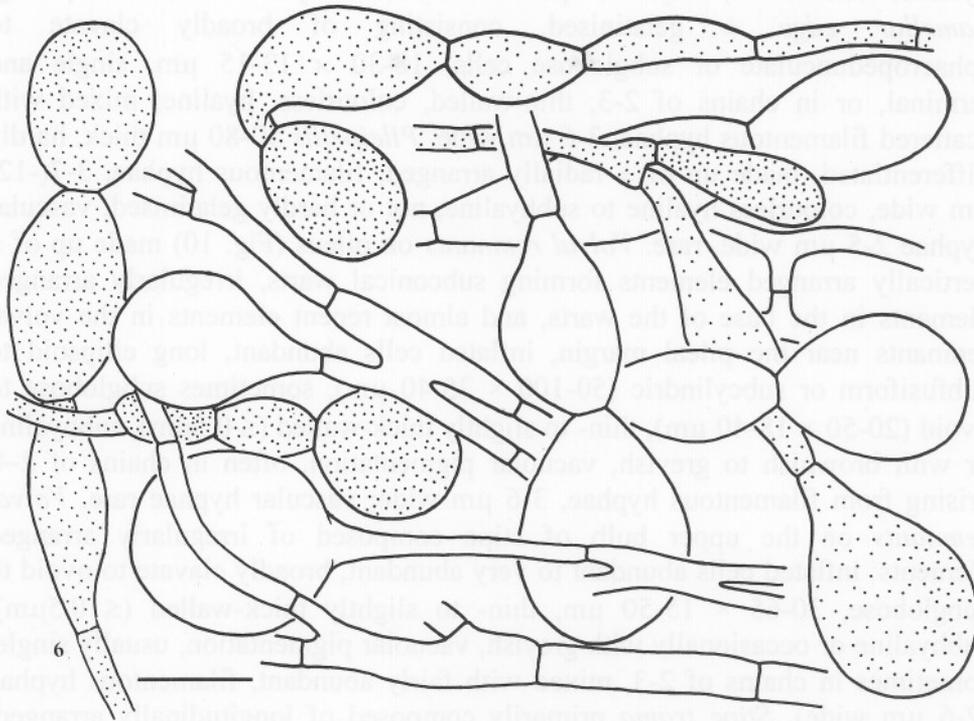


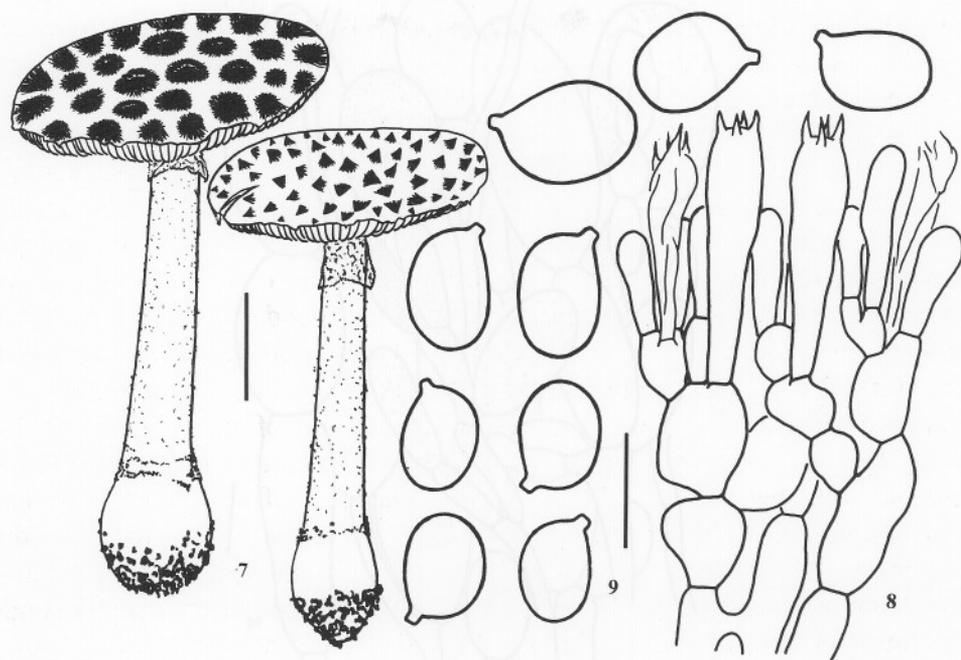
Fig. 6. Crushed volval remnants of *Amanita vestita* (HKAS 34573). Bar = 20 μ m.

felty to subfibrillose volval remnants; margin smooth, appendiculate; context white. *Lamellae* free, white, crowded; lamellulae attenuate. *Stipe* 6-8 \times 0.8-1.2 cm, subcylindric, annulate, surface whitish to cream-coloured, context white; bulb subclavate to subglobose, 1.5-2 cm wide, upper part covered with inconspicuous, whitish to greyish, farinose to floccose, volval remnants. *Annulus* apical to subapical, white to whitish, friable. *Lamellar trama* bilateral; mediostratum 30-40 μ m wide, made up of long ellipsoid to fusiform cells (40-100 \times 15-30 μ m), mixed with fairly abundant, branching, filamentous hyphae, 2-7 μ m wide; vascular hyphae rare. Lateral stratum made up of long clavate to ellipsoid cells (45-75 \times 10-18 μ m), mixed with fairly abundant to abundant, filamentous hyphae, 3-7 μ m wide, diverging at an angle of 30°-45° to the central stratum; clamp-connexions absent. *Subhymenium* (Fig. 8) 30-40(-50) μ m thick, with 2-3(-4) layers of subglobose, ovoid to broadly ellipsoid cells, 15-28 \times 10-20 μ m. *Basidia* (Fig. 8) 30-50 \times 9.5-12 μ m, clavate, 4-spored; sterigmata 3-4 μ m long; basal septa without clamp-connexions. *Spores* (Fig. 9) [50/2/1] (7.5-)8.5-11.5(-12) \times 6.5-8(-9) μ m [Q = (1.25-)1.29-1.57(-1.69), Q = 1.41 \pm 0.09], ellipsoid, rarely broadly ellipsoid or elongate, colourless,

hyaline, thin-walled, amyloid; apiculus small, nearly truncate, not tapering. *Lamellar edge* \pm gelatinised, consisting of broadly clavate to sphaeropedunculate or subglobose cells, $18-30 \times 13-15 \mu\text{m}$, single and terminal, or in chains of 2-3, thin-walled, colourless, hyaline; mixed with scattered filamentous hyphae, $3-6 \mu\text{m}$ wide. *Pileipellis* $50-80 \mu\text{m}$ thick, hardly differentiated, made up of \pm radially arranged, filamentous hyphae, $3-7(-12) \mu\text{m}$ wide, colourless hyaline to subhyaline, not or hardly gelatinised; vascular hyphae $2-5 \mu\text{m}$ wide, rare. *Volval remnants* on pileus (Fig. 10) made up of \pm vertically arranged elements forming subconical warts, irregularly arranged elements in the base of the warts, and almost repent elements in the volval remnants near the pileal margin, inflated cells abundant, long ellipsoid to subfusiform or subcylindric ($50-100 \times 25-40 \mu\text{m}$), sometimes subglobose to ovoid ($20-50 \times 18-40 \mu\text{m}$), thin- to slightly thick-walled ($\leq 0.5 \mu\text{m}$), subhyaline or with brownish to greyish, vacuolar pigmentation, often in chains of 2-4, arising from filamentous hyphae, $3-6 \mu\text{m}$ wide; vascular hyphae rare. *Volval remnants* on the upper bulb of stipe composed of irregularly arranged elements: inflated cells abundant to very abundant, broadly clavate to ovoid to subglobose, $30-65 \times 15-50 \mu\text{m}$, thin- to slightly thick-walled ($\leq 0.5 \mu\text{m}$), subhyaline or occasionally with greyish, vacuolar pigmentation, usually single, sometimes in chains of 2-3, mixed with fairly abundant, filamentous hyphae ($2-6 \mu\text{m}$ wide). *Stipe trama* primarily composed of longitudinally arranged, long clavate, terminal cells ($220-350 \times 20-40 \mu\text{m}$), mixed with scattered (in interior) to fairly abundant (on stipe surface) filamentous hyphae, $2-5 \mu\text{m}$ wide; vascular hyphae rare. *Annulus* primarily composed of inflated cells, $20-40 \times 12-25 \mu\text{m}$, often in short chains; mixed with scattered filamentous hyphae, $2-5(-8) \mu\text{m}$ wide, thin-walled, colourless, hyaline.

Material examined: CHINA, Hainan Province, Ledong County, Jianfengling, alt. 900 m, on soil in forest, 20 August 1999, M.S. Yuan 4346 (HKAS 34570, **holotype!**).

Amanita zangii is characterised by its small to medium-sized basidiocarps with dark grey to blackish, felty to subfibrillose, adnate, volval remnants on the pileus, an appendiculate pileus margin, an apical to subapical, friable annulus in combination with many, long ellipsoid to subfusiform cells in the volval remnants on the pileus, ellipsoid spores, and the absence of clamp-connexions. It is very similar to *A. hesleri* Bas, originally described from the United States. However, it differs from the latter by its smaller basidiocarps, with volval remnants on the pileus with smaller inflated cells, and shorter, relatively wider spores. Moreover, *A. hesleri* tends to have scale-



Figs. 7-9. *Amanita zangii* (HKAS 34570, holotype). 7. Basidiocarps. 8. Basidia and subhymenium. 9. Spores. Bars: 7 = 2 cm; 8 = 20 μ m; 9 = 10 μ m.

like volval remnants towards the pileal margin (Bas, 1969: 370). *Amanita zangii* also looks like *A. inopinata* D.A. Reid and Bas, originally described from the UK (Reid, 1987); the latter differs however from *A. zangii* by its salmon-coloured lamellae, grey annulus, dirty salmon-coloured or bright tawny stipe, and the rather common presence of clamp-connexions. The cells in the volval remnants on the pileus of *A. inopinata* are relatively narrower, and more elongate than those of *A. zangii*. Considering the shape of the inflated cells composing the volval remnants on the pileus, and the clavate to subglobose stipe base, *Amanita zangii* may be another example of a taxon between subsection *Vittadiniae* Bas and subsection *Solitariae* Bas of section *Lepidella*.

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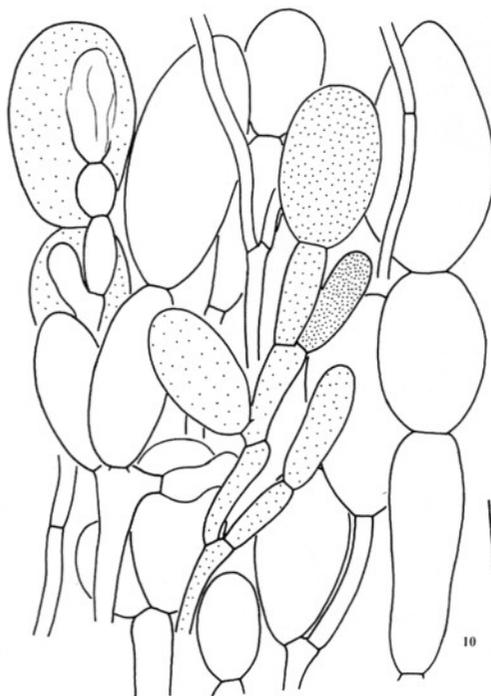


Fig. 10. Longitudinal section of a subconical volval remnant from pileus disc of *Amanita zangii* (HKAS 34570, holotype). Bar = 20 μ m.

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