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THE GENUS PSILOCYBE IN KERALA STATE, INDIA

K. Agretious Thomas, P. Manimohan

Department of Botany, University of Calicut, Kerala, 673 635, India

Gastón Guzmán, Fidel Tapia & Florencia Ramírez-Guillén

Instituto de Ecología, Apartado Postal 63, Xalapa, Veracruz 91000, Mexico

Abstract: Eight species of *Psilocybe* from Kerala State, India, are considered. *Psilocybe keralensis* sp. nov. and *P. wayanadensis* sp. nov. are described. *Psilocybe pegleriana, P. subaeruginascens*, and *P. subcubensis* are recorded for the first time from India. *Psilocybe argentina, P. coprophila*, and *P. cubensis* are new records for Kerala.

Key Words: Basidiomycota, Agaricales, Strophariaceae, new species, new records

INTRODUCTION

Information on the species of *Psilocybe* (Fr.) Kumm. (Strophariaceae, Agaricales, Basidiomycota) occurring in India is rather sketchy with only a few sporadic reports available. Pegler (1977) reported *P. goniospora* (Berk. & Broome) Singer. From Kerala State, Sathe & J.T. Daniel (1980) described *P. indica* Sathe & Daniel, a poorly known species whose type seems lost (Guzmán, 1995). Manjula (1983) listed five species of *Psilocybe* viz., *P. tristis* P. Henn., *P. coprophila* (Bull.: Fr.) P. Kumm., *P. merdaria* (Fr.) Ricken, *P. caespitosa* (Berk.) Sacc., and *P. montana* (Pers.: Fr.) P. Kumm. of which *P. tristis* and *P. caespitosa* are doubtful species according to Guzmán (1983). *Psilocybe pseudoaztecorum* Natarajan & Raman (first recorded as *P. aztecorum* Heim emend. Guzmán var. *aztecorum), P. cubensis* (Earle) Singer, *P. natarajanii* Guzmán (first recorded as *P. aztecorum var. bonetii* (Guzman) Guzman), *P. crobula* (Fr.) M. Lange ex Singer, *P. muscorum* (Orton) Moser, *P. argentina* (Speg.) Singer, and *P. sabulosa* Peck (as *P. squarrosipes* Singer) were subsequently recorded from India (Natarajan & Raman, 1983; Natarajan & Raman, 1985; Guzmán, 1995). *Psilocybe kashmiriensis* Abraham was described from Kashmir Valley (Abraham, 1995); however, this species seems to belong to *Agrocybe* owing to the hymeniform pileipellis described. *Psilocybe semilanceata* (Fr.) P.Kumm. was reported from India by Stamets (1996) without any discussion; it is necessary to check this record.

While studying the agaric flora of Kerala State, India, two of us (KAT & PM) collected materials belonging to eight species of *Psilocybe* that are discussed here.

MATERIALS & METHODS

Microscopic sections were mounted in 5% aqueous KOH. Colour codes refer to Kornerup & Wanscher (1978). All collections cited are deposited at XAL with part of each one at L.

DESCRIPTION OF NEW SPECIES

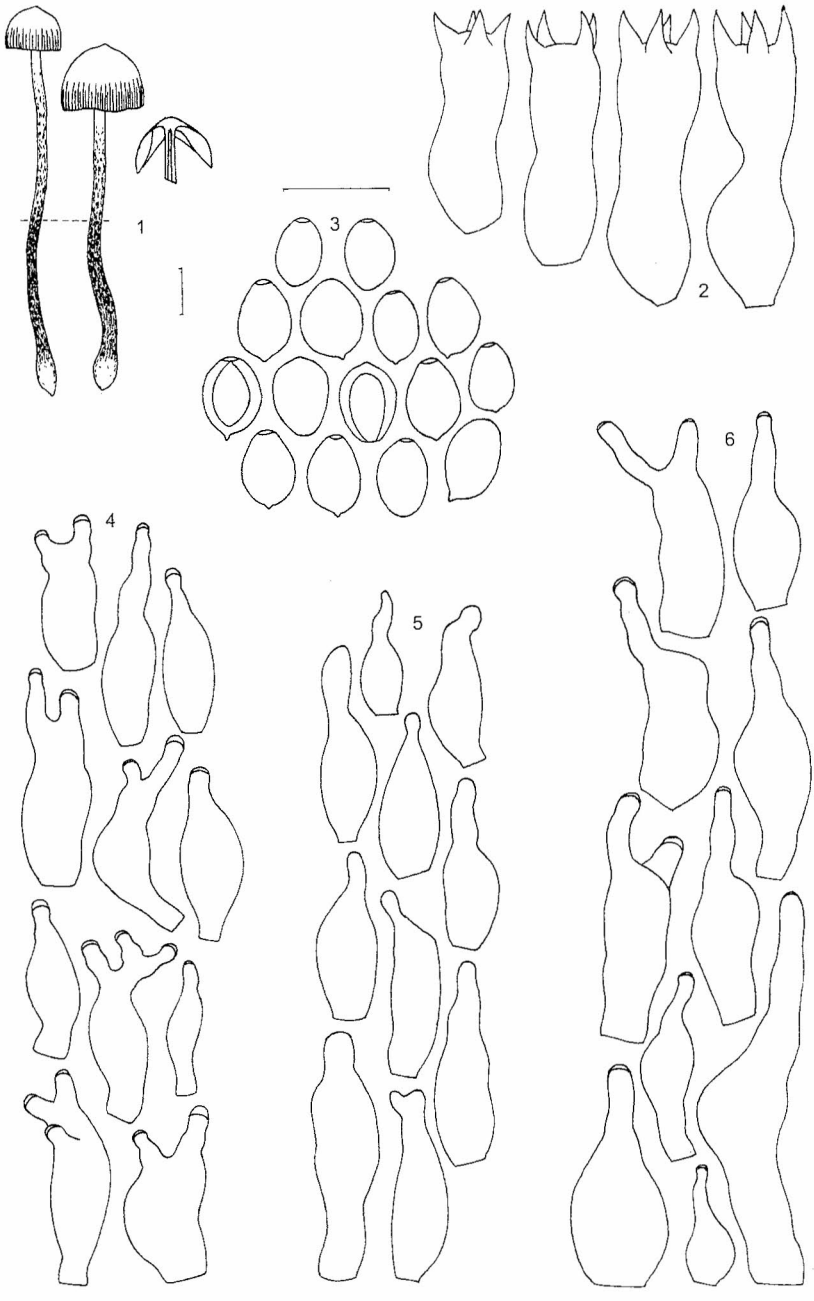
Psilocybe keralensis K. A.Thomas, Manim. & Guzmán sp. nov. Figs. 1-6.

Pileus 6-30mm latus, conico-convexus vel convexus, umbonatus, hygrophanus, primo pallide brunneus, postea pallide aurantius, glaber, ad marginem pellucido-striatus. Lamellae adnatae, griseobrunneae, subconfertae. Stipes 30-90 x 2-5mm, radicans, ad apicem pallide luteus, ad basim griseoaurantius, caerulescens. Sporae (6.5-) 7-8 x (5-) 5.5-6 (-6.5) x (4-) 5-5.5 (-6) µm, in cumulo atrobrunneae, leniter lentiformes, subrhomboideae vel ellipsoideae, violaceobrunneae, crassitunicatae, truncato poro germinativo praeditae. Basidia (19-) 22-28 (-32) x 6.5 -7.5 (9) µm, 4- vel 2-sporigera. Pleurocystidia (11.5-) 12-20 (-27) x (3-) 4-6.5 (-7.5) µm, versiformia, hyalina. Cheilocystidia pleurocystidiis similia. Hyphae cuticulae pilei repentes, 1.5-7µm latae, hyalinae. Caulocystidia cheilocystidiis similia. Hyphae omnes fibulatae. Ad terrum. India, Kerala, Wayanad, Ponkuzhy, Thomas T-319a holotypus (XAL).

Pileus 6–30 mm diam., convex, conico-convex or subcampanulate, with a small umbo, smooth, glabrous, moist, finely translucent striate towards margin when moist, golden brown (5D7) to light brown (6D7), paler or whitish or sometimes with a tint of light orange (5A4) towards margin, hygrophanous and becoming entirely pale orange (5A3); margin decurved, entire when young, sometimes becoming wavy or eroded. Context up to 1.5 mm thick at the center, light yellow (4A4) or light orange (5A4), bluing. Lamellae adnate, greyish brown (8E3, 9E3) or brownish grey (11D2), subcrowded to close, up to 5 mm wide; edge pale, entire. Stipe 30–90 x 2–5 mm, central, terete, almost equal, fistulose; pale yellow (4A3) towards upper part, greyish orange (5B3) or brownish orange (5C3, 6C4) towards base, bluing, finely and inconspicuously floccose especially towards base, frequently radicating. Odour not distinctive. Spore-print brown (7E4) to dark brown (7F4) or greyish brown (8E3).

Spores (6.5-) 7-8 x (5-) 5.5-6 (-6.5) x (4-) 5-5.5 (-6) µm, slightly lenticular, ovo-ellipsoid to subrhomboid in face-view, ellipsoid in side-view, yellowish-brown or pale violet-brown, smooth, thick-walled, apically truncated by a germ-pore. Basidia (19-) 22-28 (-32) x 6.5-7.5 (-9) µm, subventricose or almost cylindrical with a median constriction, hyaline, 4-spored, rarely 2-spored; sterigmata up to 4.5 µm long. Pleurocystidia (11.5-) 12-20 (-27) x (3-) 4-6.5 (-7.5) µm, hyaline,

Figs. 1-6. *Psilocybe keralensis*, 1: basidiomata; 2: basidia; 3: spores; 4: cheilocystidia; 5: pleurocystidia; 6: caulocystidia; scale = 10 mm for basidiomata and 10 µm for microstructures.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ventricose-fusoid, sublageniform or utriform, rarely irregularly branching, with a short or long neck, scattered, thin-walled. Cheilocystidia (10.5-) 13-28 (-32) x (3-) 5-7 (-8) µm, hyaline, subventricose, ventricose-fusoid or sublageniform, frequently with irregular branches at the top, thin-walled, with a subgelatinous secretion at the apex. Hymenophoral trama subregular, hyaline, often with scattered conducting elements having dark turquoise blue contents; hyphae 2–21.5 µm wide, thin-walled. Context in the pileus interwoven; hyphae 2–26.5 µm wide, inflated, pale brownish, thin-walled, without encrustations. Context in the stipe composed of 2-20 µm wide, thin-walled, brownish hyphae. Pileipellis a cutis with repent, hyaline hyphae, 1.5–7 µm wide, thin-walled. Hypodermium a distinct band of brown-encrusted tramal hyphae. Stipitipellis a repent cutis, with pale brown hyphae, 1.5–7 µm wide, thin-walled. Caulocystidia 10.5–40 x 3–11.5 µm, similar to cheilocystidia in shape, hyaline, sometimes branched, occurring towards the upper part of the stipe, either in clusters or scattered, thin-walled, with a subgelatinous secretion at the apex. Clamp-connexions present on all hyphae.

On the ground, scattered, July-October. Known only from the type locality.

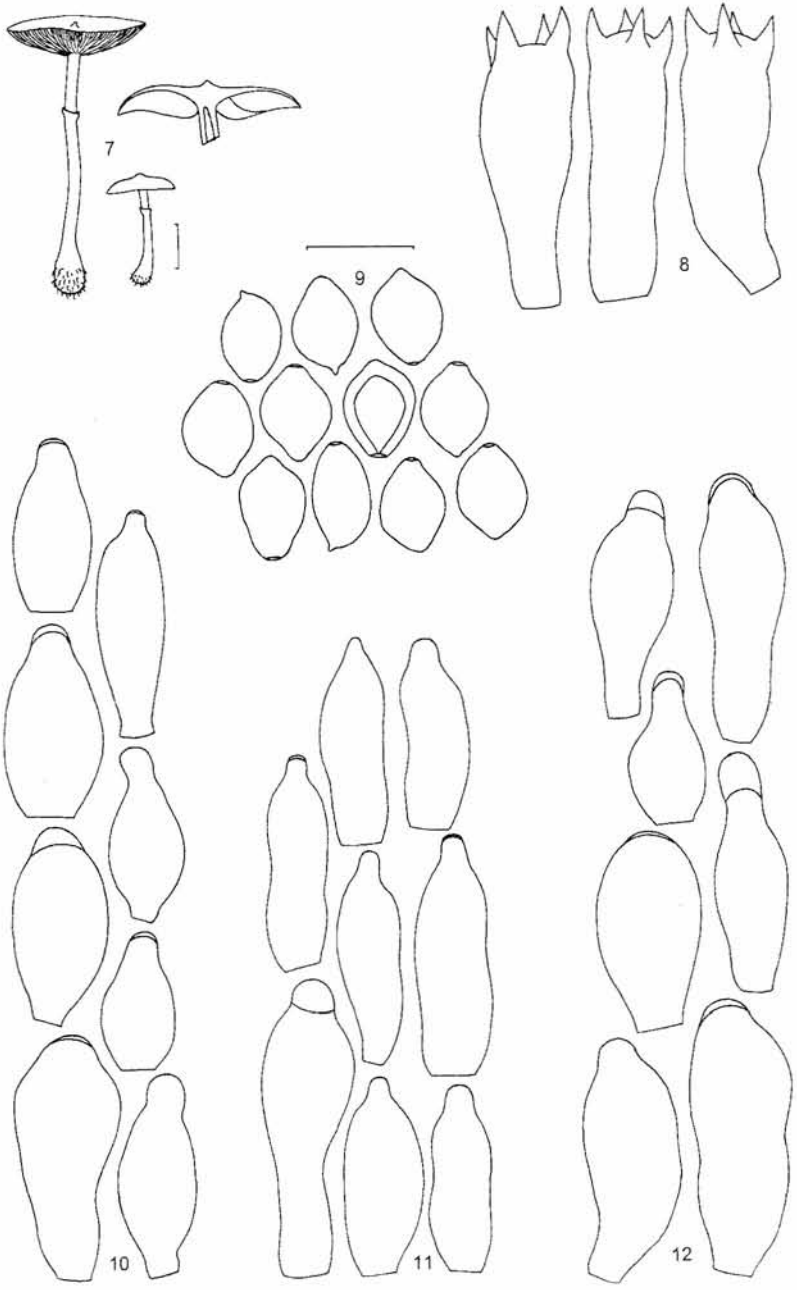
Specimens examined: India, Kerala State, Wayanad District, Ponkuzhy, 21 July 1999, *Thomas T-319a* (holotype, XAL; isotype, L); 25 July 1999, *Thomas T-319b* (XAL, L); 1 August 1999, *Thomas T-319c* (XAL, L); 17 October 1999, *Thomas T-319d* (XAL, L); 28 October 1999, *Thomas T-319e* (XAL, L).

This species belongs to Sect. *Cordispora* Guzmán (Guzmán, 1983), owing to the following combination of characters: bluing reaction, spores that are thick-walled, subrhombic in face view, and not longer than 9 µm, and absence of annulus. The radicating stipe brings it close to *Psilocybe harrerae* Guzmán, *P. fagicola* Heim, and *P. wassoniorum* Guzmán & Pollock that are known only from Mexico (Guzmán, 1983), but they differ in cystidial morphology and spore-size. *Psilocybe wassoniorum* has no pleurocystidia. *Psilocybe subtropicalis* Guzmán, also from Mexico as well as from Guatemala (Guzmán, 1995), is similar to *P. keralensis* in most of the microscopic features, but that species has smaller spores and a non-radicating, subbulbous, and hollow stipe-base.

Psilocybe wayanadensis K. A. Thomas, Manim. & Guzmán sp. nov. Figs.7-12.

Pileus 10-55 mm latus, convexus vel applanatus, acute papillatus, hygrophanus, primo brunneogriseus, postea griseobrunneus, caerulescens, glaber, subviscidus, ad marginem pellucido-striatus. Lamellae adnexae vel sinuatae, griseobrunneae vel brunneae. Stipes 20-80 x 2-10 mm, cylindricus, albidus, aurantioalbidus vel griseoluteus, caerulescens, glaber, annulatus. Odor fortis, ingratus. Sporae 8-9.5 (-11) x 6.5-7 (-8) x (5-) 5.5-6 (-6.5) µm, in cumulo atrobrunneae, lentiformes, subrhomboideae vel ellipsoideae, violaceobrunneae, laeves, crassitunicatae, truncato poro germinativo praeditae. Basidia (21.5-) 26-28 (-34) x 7-9 (-10) µm,

Figs. 7-12. *Psilocybe wayanadensis*, 7: basidiomata; 8: basidia; 9: spores; 10: cheilocystidia; 11: pleurocystidia; 12: caulocystidia; scale = 10 mm for basidiomata and 10 µm for microstructures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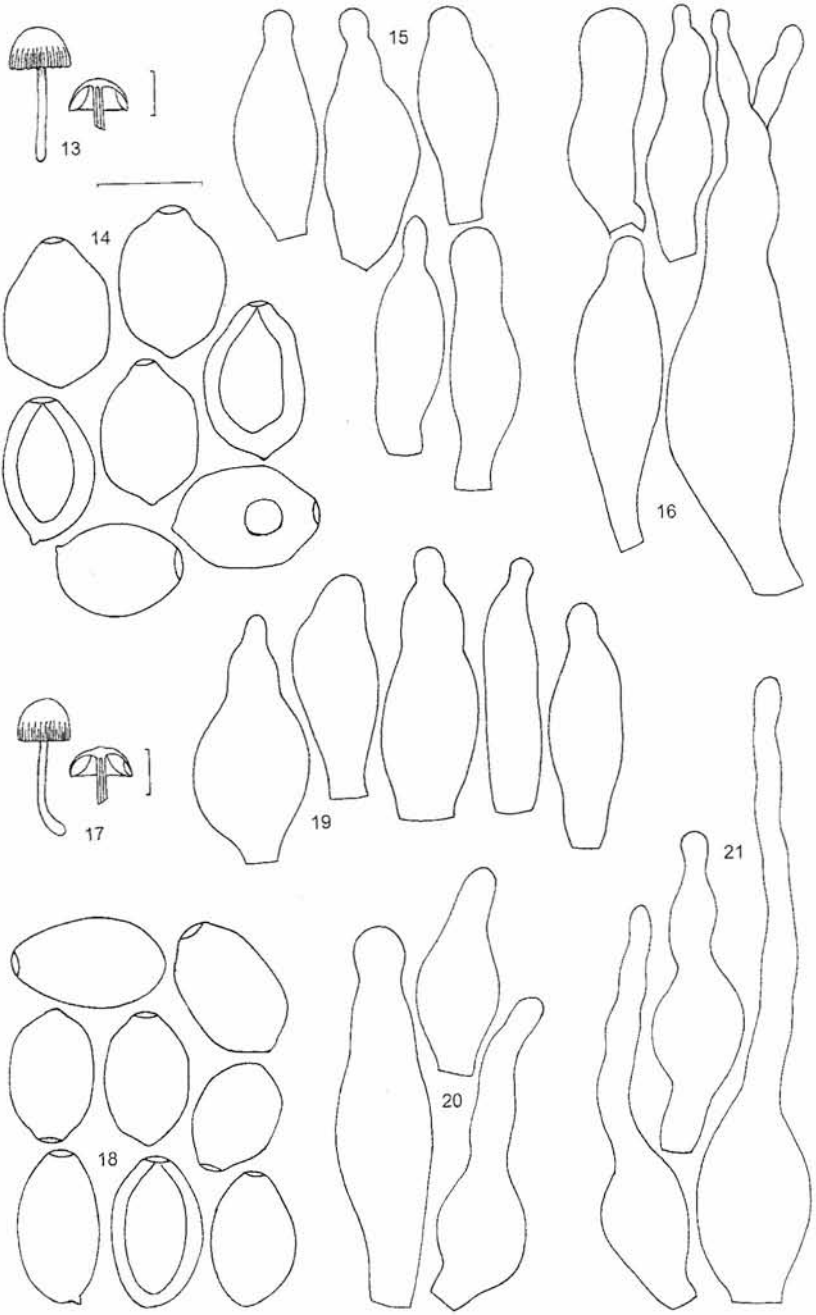
4-sporigera. Pleurocystidia (16-) 18-30 (-34) x (7-) 9-12 (-14.5) µm, ventricoso-fusoidea, lageniformia vel utriformia, tenuitunicata, raro ad apicem crassitunicata. Cheilocystidia pleurocystidiis similia. Epicutis gelatinosus. Caulocystidia 15-30 x 6.5-12.5 µm, cheilocystidiis similia. Hyphae omnes fibulatae. Ad terrum. India, Kerala, Wayanad, Muthanga, Thomas T-320a, holotypus (XAL).

Pileus 10–55 mm diam., convex, becoming applanate to slightly depressed, with a small acute umbo at the centre, smooth, glabrous, slightly sticky when moist, translucent-striate towards margin, initially brownish grey (5C2), brownish orange (5C3) or greyish brown (5D3), uniformly turning to greyish brown (6E3, 7E3, 7D3) with brownish grey umbo (5F2, 6F2), sometimes greyish yellow (4C3), greyish orange (5B4), brownish orange (5C5), or light brown (5D6) towards centre, pale yellow (4A3) or greyish yellow (4B3) towards margin with olive brownish grey (4F2) umbo, hygrophanous; margin decurved, becoming plane, entire, sometimes becoming eroded or fissile. Context up to 4 mm thick, whitish or concolorous with the pileus surface. Lamellae adnexed to sinuate, initially greyish yellow (4B3), orange grey (5B2) or brownish orange (5C3), becoming greyish brown (6D3) to brown (6E4, 7E4), close, up to 7 mm wide; edge pale, entire. Stipe 20–80 x 2–10 mm, central, terete, hollow, orange white (4A2) or greyish yellow (4B3), smooth, with a superior, membranous, white annulus; base enlarged, with strigose basal mycelium. Stipe and pileus turning blue on bruising or aging. Odour sharp and unpleasant when mature. Spore-print dark brown (8F4, 8F5).

Spores 8-9.5 (-11) x 6.5-7 (-8) x (5-) 5.5-6 (-6.5) µm, lenticular, subrhomboidal in face-view, ellipsoid in side-view, pale brownish or pale violet-brown, smooth, thick-walled, apically truncated by a germ-pore. Basidia (21.5-) 26-28 (-34) x 7-9 (-10) µm, subventricose or cylindric to clavate, hyaline, 4-spored; sterigmata up to 4 µm long. Pleurocystidia (16-) 18-30 (-34) x (7-) 9-12 (-14.5) µm, hyaline, thin-walled, subventricose, with an acute apex and narrow base, often with a subgelatinous secretion at the apex. Cheilocystidia (11-) 13-21 (-26.5) x (5-) 6-9 (-12) µm, subventricose, ventricose-fusoid or sublageniform, thin-walled, hyaline, with an acute or obtuse apex, often with a subgelatinous secretion at the apex. Hymenophoral trama regular to subregular; hyphae 2–20 µm wide, thin-walled or wall up to 1 µm thick, hyaline to pale brownish. Context in the pileus interwoven, pale brownish, with 2–24 µm wide, hyaline hyphae, thin-walled or wall up to 1.5 µm thick. Context in the stipe composed of 2-22 µm wide, thin-walled, hyaline or faintly bluish hyphae. Pileipellis an ixocutis; hyphae 2–12.5 µm wide, thin-walled, with faint hyaline encrustations. Stipitipellis a repent cutis, with 1.5–14.5 µm wide, thin-walled, hyaline or bluish hyphae. Caulocystidia 15-30 x 6.5–12.5 µm, similar to cheilocystidia in shape, restricted to the extreme tip of the stipe, either in clusters or scattered, often with a subgelatinous secretion at the apex.

Figs.13-21. *Psilocybe argentina* and *P. coprophila*. 13-16: *Psilocybe argentina*, 13: basidiomata; 14: spores; 15: cheilocystidia; 16: pleurocystidia; 17-21: *Psilocybe coprophila*, 17: basidiomata; 18: spores; 19: cheilocystidia; 20: pleurocystidia; 21: caulocystidia; scale = 10 mm for basidiomata and 10 µm for microstructures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Clamp-connexions present.

On soil rich with wood chips, gregarious to scattered, July-October. Known only from the type locality.

Specimens examined: India, Kerala State, Wayanad District, Muthanga, 21 July 1999, *Thomas T-320a* (holotype, XAL; isotype, L); 25 July 1999, *Thomas T-320b* (XAL, L); 27 July 1999, *Thomas T-320c* (XAL, L); 31 October 1999, *Thomas T-320d* (XAL, L).

The annulus, the subrhomboid, thick-walled spores, and the bluing reaction place this new species in Sect. *Stuntzii* Guzmán (Guzmán, 1983). It is different from *P. stuntzii* Guzmán & Ott from the USA in the presence of pleurocystidia and in the shape of the cheilocystidia. *Psilocybe subaeruginascens* Hohnel from Java and southern Japan is a close species, but the spores are (8-) 9-10 (-13) x 7-8 (-8.5) x 5-7 µm and the cheilocystidia are (16-) 18-23 (-33) x (4.5-) 5.5-9 µm (Guzmán, 1983). *Psilocybe septentrionalis* (Guzmán) Guzmán (Guzmán, 1995), known only from northern Japan, is also a very close species, but differs in the size and shape of pleurocystidia (14-23 x 9-10 µm) and cheilocystidia (16-25 x 5.5-7.5 µm).

NEW RECORDS

Psilocybe argentina (Speg.) Singer, *Beih. Nov. Hedwigia* 29:241, 1969. Figs. 13-16

The Kerala collections agree remarkably well with the description of this species given by Guzmán (1983). *Psilocybe argentina* has already been recorded from southern India (Natarajan and Raman, 1983). The Kerala collections were found growing on cow dung and the spores measured 12-17 x 9-12 x 8.5-10.5 µm.

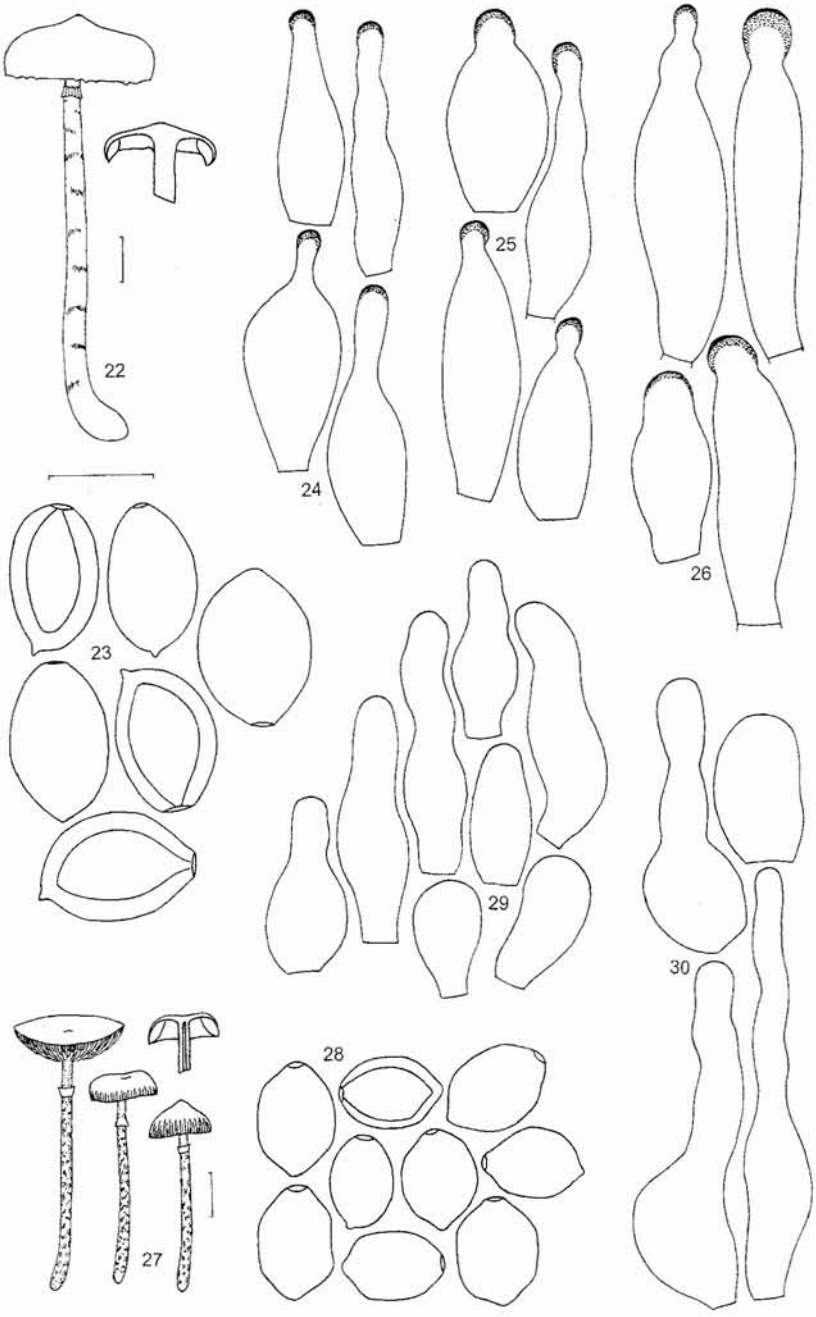
Specimens examined: India, Kerala State, Idukki District, Munnar, 28 August 1997, *Thomas T-150b* (XAL; L).

Psilocybe coprophila (Bull.: Fr.) P. Kumm., *Fuhr. Pilzk.*: 71, 1871. Figs. 17-21

This species has earlier been reported from India by Watling & Gregory (1980) and Natarajan & Raman (1983). The Kerala collections were found growing on elephant dung and the spores measured 10.5-15.5 x 7.5-9.5 x 7-9 µm.

Specimens examined: India, Kerala State, Idukki District, Munnar, 28 August 1997, *Thomas T-149* (XAL; L).

Figs.22-30. *Psilocybe cubensis* and *P. pegleriana*. 22-26: *Psilocybe cubensis*, 22: basidiomata; 23: spores; 24: cheilocystidia; 25: pleurocystidia; 26: caulocystidia; 27-30: *Psilocybe pegleriana*, 27: basidiomata; 28: spores; 29: cheilocystidia; 30: caulocystidia; scale = 10 mm for basidiomata and 10 µm for microstructures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Psilocybe cubensis (Earle) Singer, *Sydowia* 2: 37, 1948. Figs. 22-26

The Kerala collections of this species were found growing on soil with heavy traffic of cattle. The spores measured (11-) 14-16 (-17.5) x (8-) 9-9.5 (-10.5) x (7-) 8-9 µm. The basidia are 24-32 (-36) x 9-13 (-14) µm and 4-spored. The pleurocystidia are (20-) 22-32 (-36) x (7-) 9-11 (-13) µm, hyaline, and the cheilocystidia are (16-) 19-28 (-32) x (5.5-) 7-9.5 (-12) µm. Caulocystidia were observed. All our collections were found at elevations above 2000 m. Natarajan & Raman (1983) recorded it for the first time from India.

Specimens examined. India, Kerala State, Idukki District, Munnar, 29 August 1997, *Thomas T-156* (XAL; L); 30 August 1997, *Thomas T-156c* (XAL; L); Top Station: 30 August 1997, *Thomas T-156b* (XAL; L).

Psilocybe pegleriana Guzmán, *Doc. Mycol. 29 (116)*: 43, 2000. Figs.27-30

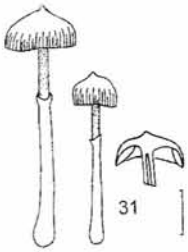
All the diagnostic features of *Psilocybe pegleriana* (Guzmán, 2000) such as the adnate to subdecurrent lamellae, the annulate stipe, the shape and size of spores, and the absence of pleurocystidia are shown by the Kerala collections. These collections grew on elephant dung and showed the following features: spores (8-) 8.5-10 (-12) x 6-7 (-8.5) x 5-6 (-7.5) µm; basidia 20-28 x 6.5-9.5 µm, 4-spored; and cheilocystidia (13-) 16-26 (-38) x (5-) 5.5-7 (-9) µm, hyaline. Caulocystidia were observed. This is the first Indian record of *P. pegleriana*, which hitherto was known from Mexico and Africa. *Psilocybe pseudobullacea* (Petch) Pegler from Sri Lanka (Pegler, 1986,1977) is very similar but has pleurocystidia, larger spores, and subcellular hypodermium as discussed by Guzmán (2000).

Specimens examined: India, Kerala State, Thrissur District, Guruvayoor, 11 June 1999, *Thomas T-311* (XAL; L); 17 June 1999, *Thomas T-311b* (XAL; L); 18 October 1999, *Thomas T-311e* (XAL; L); Palakkad District, Nelliyampathy, 30 August 1999, *Thomas T-311d* (XAL; L).

Psilocybe subaeruginascens Hohnel, *Sitzungsber. Kaiserl. Akad. Wissen. Wien 123(1)*: 78, 1914. Figs. 31-35

This species as discussed in *P. wayanadensis* is known from only Java (type locality) and southern Japan. The present specimens were found on elephant dung and presented the following features: spores (8-) 9-10 (-10.5) x (5.5-) 6-7 (-7.5) x 5-6.5 µm, subrhombic and thick-walled; basidia (20-) 23-28 (-30) x (6.5-) 7-9 µm, 4-spored, hyaline; pleurocystidia 12-26 (-32) x (4-) 5-9.5 µm, hyaline, sometimes rare and irregularly branched; and cheilocystidia (14-) 15-25 (-27) x (4-) 5-6.5 (-7.5) µm, hyaline, frequently irregularly branched. All these

Figs. 31-40. *Psilocybe subaeruginascens* and *P. subcubensis*. 31-35: *Psilocybe subaeruginascens*, 31: basidiomata; 32: spores; 33: cheilocystidia; 34: pleurocystidia; 35: caulocystidia; 36-40: *Psilocybe subcubensis*, 36: basidiomata; 37: spores; 38: cheilocystidia; 39: pleurocystidia; 40: caulocystidia; scale = 10 mm for basidiomata and 10 µm for microstructures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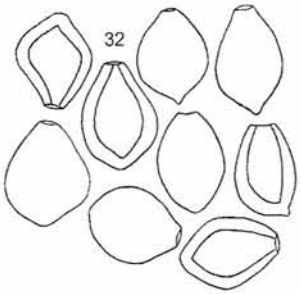
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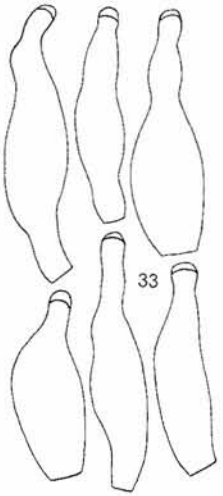
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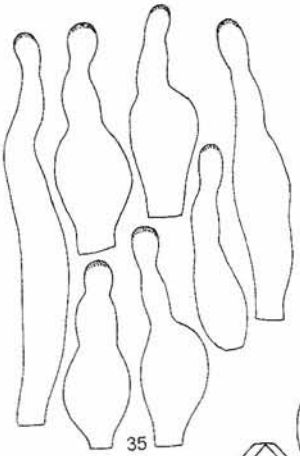
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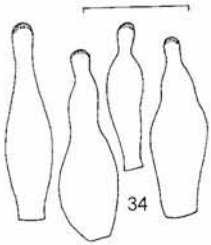
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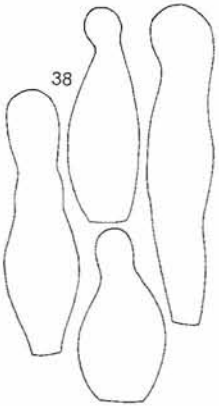
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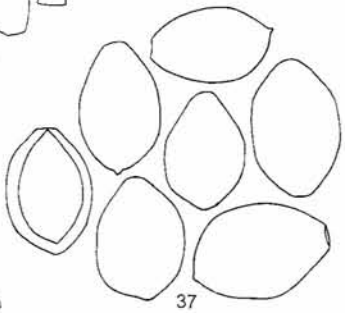
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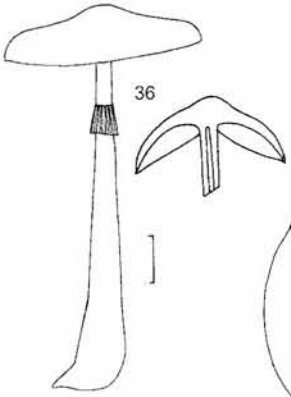
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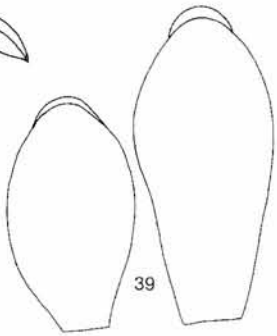
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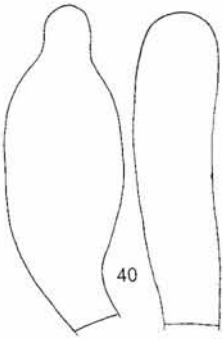
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observations agree more or less with those of Singer & Smith (1958) and Guzmán (1983), except for the caulocystidia and the branched pleuro- and cheilocystidia. Guzmán (1983) reported the following measurements: spores (7.7-) 8.8-10 (-12) (-13) x 6.6-7.7 (-8.5) x 5-6.6 µm, pleurocystidia (19-) 22-30 (-33) x (5-) 6-8 (-14) µm, and cheilocystidia (16-) 18-23 (-33) x (4.4-) 5.5-9 µm. Further studies of the type and more collections from the type locality are necessary to understand the variation of Hohnel's species.

Specimens examined: India, Kerala State, Calicut District, Vellarimala, 19 September 1999, *Thomas T-170* (XAL; L); 20 September 1997, *Thomas T-170b* (XAL; L); 8 November 1999, *Thomas T-170c* (XAL; L).

Psilocybe subcubensis Guzmán, *Mycotaxon 7:* 248, 1978. Figs. 36-40

The present collections were all from elephant dung and their spores are (9.5) 11-13 (-15) x (7.5-) 8-9 (-10.5) x (6-) 6.5-7.5 (-9) µm. This is the first Indian record of this pantropical species.

Specimens examined: India, Kerala State, Wayanad District, Muthanga, 17 June 1997, *Thomas T-76* (XAL; L); 25 June 1997, *Thomas T-76b* (XAL; L); 26 October 1997, *Thomas T-76f* (XAL; L); 25 May 1999, *Thomas T-76g* (XAL; L); 21 July 1999, *Thomas T-76h* (XAL; L).

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