# *Psathyrella* (Agaricales) with Ornamented Spores in the Malay Peninsula.

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## Abstract

Five species are described as new and illustrated. Two have a thin exospore and two have not. The fifth species, *P. flavidifolia,* is apparently rare and needs fuller investigation. Sporograph-analysis reveals the smooth spore, general in *Psathyrella,* as an endospore.

## Introduction

In describing *Psathyrella nigeriensis* from Africa, Pegler and Young (1992) have reviewed the position in the genus of the few known species with verrucose or rugulose spores. I, now, add five, four of which are common in Malayan forest. The fifth, *P. flavidifolia,* is imperfectly known from one collection and is included in order that it may be rediscovered. The robust stature of several, especially *P. splendens,* suggests that they should be placed in *Lacrymaria* Pat. but they do not have the chief qualification of the spores of that genus nor the inaequihymenium which gives a mottling to the gill-surface. The spores of *Lacrymaria* are black or very dark in the mass (Pegler and Young 1971 and 1992, Smith 1972, Singer 1975, Watling 1979). Those of the Malayan species are fuscous purple or vinaceous brown. Then the spores of *Lacrymaria* have an apical germ-pore which is figured by Pegler and Young (1971) as a hole, though it is probably the thin apical wall without the ornamentation as in the Malayan species. Pegler and Young (1992) give, also, aggregated pleurocystidia and capitate cheilocysytidia for *Lacrymaria. P. verrucispore,* here described, has scattered pleurocystidia and the cheilocystidia of *P. malayana* may be more or less capitate. Perhaps the most remarkable point is the thick veil of *P. splendens* which forms such a conspicuous annulus on the stem as to suggest *Stropharia.* It adds a new feature to *Psathyrella,* the concept of which has been based on temperate species.

The occurrence of ornamented spores in a genus regarded as smooth-spored is part of a wide problem among homobasidiomycetes. In my work on *Amauroderma-Ganoderma* (Corner 1983) and the *Boletus-spore* (Corner 1972) I gave reasons for regarding the bitunicate spore as the more primitive state leading to the common and advanced unitunicate and smoothspore; even theamyloid reactionmaybeamanifestation (Corner 1989). Thus the ornamented spore turns up in various genera such as *Coprinus* (Pegler and Young 1992).

The illustrations of spores, given in this article, are enlargements from *camera lucida* drawings in order to show as clearly as possible what seems to be their manner of ornamentation.

## Key to Malayan *Psathyrella* with Ornamented Spores

### On macroscopic characters

1. Pileus 5-15 cm wide, fulvous bay, subtomentose then appressedly scaly. Stem 7-18 cm x 5-18 mm, base bulbous fusiform. Ring pronounced at first, thick, woolly, white..... *P. splendens*

1. Pileus not scaly. Ring indistinct or none.

   2. Gills pale egg-yellow then vinaceous drab, subdecurrent, crowded, 2-3 mm wide. Pileus -10 cm wide, pale ochraceous tan with brown disc. Stem 6.5-14 mm wide. Ring as a floccose zone. ..... *P. flavidifolia*

   2. Gills white then dark brown to purplish fuscous.

      3. Gills adnate, not or scarcely crowded, 21-30 primaries 5-9 wide. Smell strong of radish and fenugreek..... *P. verrucispora*

      3. Gills adnexed, crowded, 40-60 (-80) primaries 2-5 mm wide. Smell faint of mushroom, or none.

         4. Pileus ochraceous with ferruginous disc..... *P. retispora*

         4. Pileus umber with date-brown disc..... *P. malayana*

### On microscopic characters

1. Pileus hymenioderm with a palisade of clavate cells. Pleurocystidia none. Spores with a smooth adaxial patch, without a hyaline exospore.

   2. Spores 9-10.5 x 5-6 |im (overall), reticulately marked with wide adaxial patch. Cheilocystidia mostly clavate..... *P. retispora*

   2. Spores 7-9 x 6-6.5 µm (overall), with short irregular flanges and small or no adaxial patch. Cheilocystidia variable, often ventricose..... *P. malayana*

1. Pileus not hymenioderm, the surface pseudoparenchymatous (? *P. flavidifolia).* Spores with hyaline exospore covering the warts, without adaxial patch.

   3. Pleurocystidia present. Spores 9.5-12 x 6.5-8 |im..... *P. verrucispora*

   3. Pleurocystidia absent (? P. flavidifolia).

      4. Spores 6.5-7.5 x 5-6 µm..... *P. splendens*

      4. Spores 10-12 x 6-7 µrn..... *P. flavidifolia*

1. **Psathyrella flavidifblia.sp.n.**

**Pileus 5-10.5cm latus, convexus dein planus, centro aliquando depresso, glaber rugulosus subhygrophanus subochraceus, disco cinnamomeo-brunneo; margine veli pannis paucis ornato. Stipes 6-11.5 cm x 6.5-14 mm apicem versus, 5-8 mm basim saepe attenuatum versus, sed apice basique plus minus dilatato, fistulosus, pallide brunneolus, zona floccosa deformi alba 15-20 mm sub apice, deorsum furfuraceus, sine annulo. Lamellae subdecurrentes confertissimae angustae, 70-90 primariae 2-3 mm latae, ordinibus 4-6, pallide vitellinae dein sordide vinaceae. Caro 3-6 mm crassa in pllei centro, firma subhygrophana brunneolo-albida. Sporae 10-12 x 6-7 µm, in cumulo vinacei-cinnamomeae, verruculosae amygdallformes. Ad terram in silva montana. Malaya, Pahang, Fraser's Hill, *Corner s.n.* 25 Nov 1930; typus, herb. Corner.**

*Pileus* 5-10.5 cm wide, convex to campanulate then plane, disc sometimes depressed, subhygrophanous, glabrous, irregularly and shallowly rugulose to the smooth disc, pallid ochraceous tan with the disc rather cinnamon brown; margin strongly incurved at first, minutely subvillous, with a few evanescent cottony patches as the remains of the veil. *Stem* 6-11.6 cm x 6.5-14 mm above, 5-8mm below, cylindric or attenuate downwards, apex and base more or less dilated, stout, hollow, pallid tan with a narrow ill-defined whitish floccose zone 15-20 mm below the stem-apex as the remains of the ring, no ring, subpruinose above the zone, coarsely scurfy fibrous below, base with short white mycelial strands. *Gills* subdecurrent, very crowded, narrow, thin, 79-90 primaries 2-3 mm wide, 4-6 ranks, pale egg-yellow then vinaceous drab or subfuscous, edge entire. *Flesh* 3-6 mm thick in the centre of the pileus, 1-2 mm halfway to the margin, subhygrophanous, firm, pallid tan-white.

On the ground in montane forest. Malaya, Pahang, Fraser's Hill 1,200 m alt. November 1930.

*Spores* 10-12 x 6-7 µm, vinaceous cinnamon in the mass, dark brown s.m., verruculose appearing punctate-rough, amygdaliform.

I describe this fungus, even though my notes on microscopic details are so imperfect, because it indicates an ally of P. *splendens*. It may be rare because I found it but once and, then, it puzzled me and became *Hebeloma* in my notes. Possibly *P. rugocephala* (Atk.) A. H. Smith (1972) may be related but the Malayan fungus differs in the yellow gills and and paler spores.

2. **Psathyrella malayana** *sp. n* Figure 1, Plate 1

**Pileus 1-9 latus, centro ruguloso, saepeumbonatus, glaber striatus, primo badlobrunneus dein pallldior rufus, ultimo umbrlnus centro brunneo. Stipes 4-13.5 cm x 2.5-8 mm ad apicem, 5-11 mm as basim albivillosum, fistulosus fragilis, saepe obtortus, pruinsovillosus, albus dein brunneolus. Velum album tenuslssimum evanescens. Lamellae adnexae, saepe dente subdecurrentes, ultimo iiberae, confertissimae angustae, 40-80 primariae 1.5-5mm latae, ordinibus 4-6, pallide albae dein umbrino-chocolatae vel obscure brunneae, acie alba serrulata. Caro in pile! centro 1-3.5 mm crassa, hygrophana fragilis. Odor fungosus levis. Sporae 7-9 x 6-6.5µm, in cumulo obscure purpureibrunneae, ellipsoideae, verrucis purpureibrunneis saepe elongatis irregularibus ornatae, apicibus Icyibus. Cheilocystidia 20-65 x 8-16 µm, clavata vel ventricosa, etiam apice subcapitato 6-9 µm lato, ut lamellae acie sterili. Pleurocystidia nulla. Caulocystidia -70 x 4-7|xm, cyiindrica subclavata flexuosa. Superficies piiei cellulis clavatis 30-80 X 12-25 µm hymeniodermls. Ad terram vel lignum in silva, etlam In locis graminosis. Peninsula Malayana. Typus, *Corner s.n.* 23 Oct. 1934, Singapore.**

*Pileus* 1-9 cm wide, conico-convex then plane or repand with more or less sinuous margin, often umbonate, hygrophanous, striate, smooth but with rugulose centre or occasionally entirely and strongly rugulose, at first deep bay-brown then paler and rufous, becoming watery livid umber with date-brown disc, drying pale rufous tan or pinkish tan with fulvous ochraceous to subferruginous disc and minutely atomate; margin incurved at first. *Stem* 4-13.5 cm x 2.5-8 mm at the apex, 5-8 mm at the white villous base, attenuate upwards, stout but very brittle, often twisted, hollow, innately brownish fibrillose, wholly minutely pruinose villous, pallid white to pale tan. *Veil* white, very thin, evanescent. *Gills* adnexed, often decurrent with a tooth, separating free, very crowded, rather narrow, 40-80 primaries 1.5-5 mm wide, 4-6 ranks, at first drab white or clay-white then chocolate umber or fuscous date-brown, sometimes persistendy pale brownish umber or pale brownish white for a long time, edge white and serrulate. *Flesh* 1-3.5 mm thick in the centre of the pileus, 0.7-1.5 mm halfway to the margin, thin, hygrophanous, brittle, concolorous, drying pallid white but brownish beneath the surface of the pileus. *Smell* like mushrooms *(Agaricus)* or gravy, not strong.

On the ground (? from roots), on wood and on lawns. Malay Peninsula, rather common.

*Spores* 7-9 x 6-6.5 µm, dark purple brown in the mass, opaque purple brown under the microscope, ellipsoid, verrucose from irregular and often flange-like purple brown thickenings of the spore-wall, the ends of the spore smooth, adaxial patch small or none. *Basidia* dimorphic, long basidia c. 33 x 11.7 µm, short basidia c. 25 x 11.4 µm, clavate-stipitate; sterigmata 4, 3µ,m long. *Cheilocystidia* 20-65 x 8-16 urn, very variable in shape, cylindric and often flexuous, clavate to more or less ventricose and then often with subcapitate apex 6-9 µm wide, with transitions to sterile basidia, thin-walled, colourless, smooth, as a sterile gill-edge. *Pleurocystidia* none. *Caulocystidia* -70 x 4-7 urn, cylindric to subclavate, flexuous, thin-walled, smooth, colourless. *Pileus* covered with a palisade of thin-walled, smooth, clavate cells 30-80 x 12-25 µrn, the subterminal 1-2 cells also more or less inflated. *Hyphae* of the pileus 8-25 u,m wide, the hypodermal hyphae with thin, pale brown, subannular, placque-like incrustation. Hyphae of the stem 8-25 µm wide, 3-6 µm at the surface.

*Note*. This common Malayan fungus develops fruit-bodies at all times of the year after heavy rain-storms. I had always assumed it to be *P. trechispora* Petch but, on studying the recent accounts of that fungus by Pegler (1986) and by Pegler and Young (1992), I have decided to describe it as a new species rather than as a variety. The main distinction lies in the spores which, in *P. malayana,* do not have the wrinkled exospore (myxospore) of P. *trechispora; the* warts of P. *malayana* are thickenings of the endospore and coloured in the same way. Then, the cheilocystidia arid clavate cells of the pileus are much larger in *P. malayana,* and the cheilocystidia are much more variable inform. The colour of the pileus in *P. trechispora* is like that of P. *retispora* (here described). Certainly the fruit-bodies of the three species are very similar and

microscopic study is needed to distinguish them.

In October 1930 1 watched the development of some 20 fruit-bodies in the Singapore Gardens Jungle. The pileus began to open in the morning and was not fully expanded (5-7 cm wide) until next morning. They remained like this for *2½* - 3 days before collapsing.

3. **Psathyrella retispora** *sp. n.* Figure 1, Plate 2

**Pileus 2-8 cm latus, conico-convexus dein planus, umbonatus ruguloso-reticulatus, badiobrunneus vel badio-subferrugineus, deln ochraceus disco ferrugineo-brunneo; margine glabro. Stipes 3-9 cm x 4-8 mm, cylindricus fistulosus fragilis, vix fibrillosus, albus. Lamellae adnexae confertae angustae, 42-55 primariae 2.5-4.5 mm latae, ordinibus 4-5, albae dein pallide brunneo-ochraceae, ultimo fuscibrunneae. Sporae 9-10.5 x 5-6 |.im. in cumulo fusci-chocolatae, amygdaliformes reticulatae, apice laevi protruso, macula adaxiali bene distincta. Cheilocystidia 40-58 xlO-18 µm, plerumque clavata. Pleurocystidia nulla. Superficies pilei cellulis clavatis instructa. Ad terrain solitaria, gregaria vel subcaespitosa. Peninsula Malayana. Typus, *Corner s.n.* 13 April. 1941, Johore (alc.form.).**

*Pileus* 2-8 cm wide, conico-convex then plane or concave, umbonate, hygrophanous, smooth or more or less reticulate towards the disc, not striate or slightly near the margin, bay brown or dark rich ferruginous bay becoming paler on expansion and ochraceous with ferruginous brown centre, livid towards the margin; margin incurved at first, entire, glabrous. *Stem* 3-9 cm x 4-8 mm, cylindric, stout, fibrous, easily snapping, hollow, white. *Veil* fibrillose, very thin, white, evanescent. *Gills* adnexed, not ventricose, crowded, narrow, 42-55 primaries 2.5-4.5 mm wide, 4-5 ranks, white then pale brownish ochraceous, finally date-brown fuscous, paler to the whitish edge. *Flesh* rather thick, firm in the pileus, brittle in the stem, white.

On bare ground in forest or plantations, solitary, gregarious or several fruit-bodies connate at the base. Malay Peninsula.

*Spores* 9-10.5 x5-6 µm (overall), fuscous chocolate in the mass, amygdaliform, irregularly reticulate with superficial coloured meshes 0.2-0.5 urn high, with smooth adaxial patch and smooth subacute end. *Basidia* dimorphic; long basidia 36-43 x 11.3-12.3 µn, short basidia 29-35 x 10.3-11.9 µrn; 4-spored. *Cheilocystidia* 40-58 x 10-18 µm, mostly clavate, obtuse to almost subtruncate, occasionally subvent ricose, thin-walled, smooth, colourless, contents fairly dense, as a sterile gill-edge. *Pleurocystidia* none. Surface of pileus with a palisade of clavate hyphal ends. *Collections* - Singapore, Gardens Jungle, *Corner s.n.* 1 March 1944; Johore, Sungei Pendas Rubber Estate, *Corner s.n.* 13 April 1941.

*Note.* Macroscopically this is almost indistinguishable from *P. malayana* and is surely overlooked in consequence but the stem is usually attenuate upwards in *P. malayana.*

; 4. **Psathyrella splendens** *sp. n.* Figure 1, Plate 3

**Pileus 5-15 cm latus, convexus deln fere planus, siccus, primo badiofulvus, minute subtomentosus, dein**

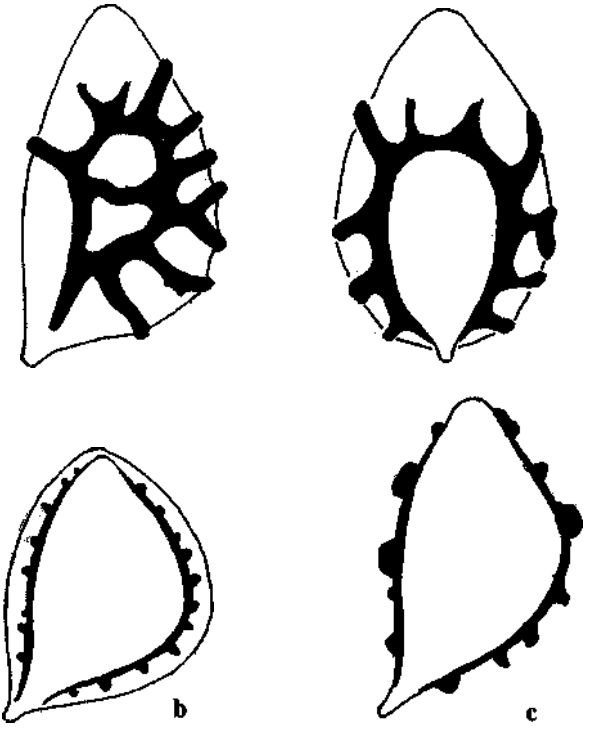


Figure 1. Spores of *Psathyrella retispora* (a), *P. splendens* (b) and *P. malayana* (c); x5000.

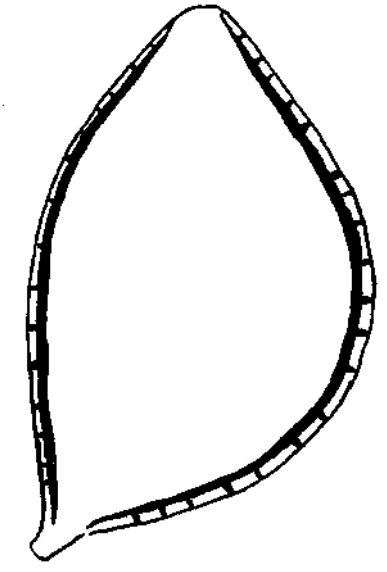

Figure 2. Spore of *Psathyrella verrucispora;* x5000.

**pallide ochraceifulvus, appresse squamulosus, veil pannis fuscis vel pallidis sparsis in zonis concentricis obtectus, disco castaneo-umbrino subtomentoso. Stipes 7-18 cm x 5-18 mm ad apicem, 6-25 mm ad basim fusiformi-bulbosum, flrmus, solidus vel in aetate flstulosus, albus dein subochraceus vel brunneolus, sub annulum veil pannis subfuscis peronatus, superne albipruinosus. Annulus crassus lanneus albus, 5-12 mm sub stipitis apice. Lamellae brevlter decurrentes, raro sinuatoadnatae, confertae, 70-100 primariae 3.5-8 mm latae, ordinibus 4(-5), albae dein subincarnatae, ultimo vinacei-brunneae, acie lacrymanti. Caro 5-11 mm crassa In pile! centro, firma alba. Odor fragrans, haud fortis. Sporae 6.5-8 x5-7 (im, in cumulo alte vlnaceibrummeae, ovoideae verruculosae, verrucis 0.2-0.3 |im altis in exosporio inclusis, sine macula adaxiall. Cheilocystidia 35-70 x 7-14 *im,* clavata, ut lamellae acie sterili. Pleurocystidia nulla. Superficies pilei pseudoparenchymatlca. Ad terram in silva solitaria vel gregaria. Peninsula Malayana, Borneo. Typus, *Corner s.n.* 9 Mar 1930, Singapore.**

*Pileus* 5-15 cm wide, convex then nearly plane, dry, at first deep fulvous bay or auburn and wholly minutely appressedly subtomentose, becoming paler ochraceous fulvous with the surface breaking up into small appressed scales with large thin fuscous or pallid patches of the veil scattered in concentric zones towards the margin, the disc persistently chestnut umber and subtomentose, no separable pellicle; margin strongly incurved at first. *Stem* 7-18 cm x 5-18 mm at the apex, 6-25 mm at the usually bulbous fusiform base, white discolouring pale ochraceous or brownish, appressedly peronate with subfuscous fragments of the veil up to the ring, white pruinose scurfy above the ring, stout, firm, fibrillose, solid then hollowing in age. *Ring* well-marked, white then fuscous purplish or vinaceous from the spores, thick and woolly at first but soon collapsing and membranous, placed 5-12 mm below the stem-apex. *Gills* shortly decurrent, rarely sinuato-adnate with a decurrent tooth, crowded, thin, c. 70-100 primaries 3.5-8 mm wide, 4(-5) ranks, white then pinkish, finally vinaceous brown; edge white, sinuate, serrulate, exuding liquid drops (as the stem-spex) when young and fresh. *Flesh* 5-11 mm thick in the centre of the pileus, 1 -4 mm halfway to the margin, firm, rather thick, white. *Smell* faint, somewhat of almond and caramel, pleasant.

On the ground in forest, singly or in troops, less often subcaespitose, shortly rooting. Malay Peninsula, Borneo, frequent.

*Spores* 6.5-8 x 5-7 µm, commonly 7.5-6.7 x 6.3 µm, deep vinaceous brown or russet vinaceous in the mass (not purplish), fuscous purplish under the microscope, broadly ellipsoid, subacute, punctate verruculose, wholly surrounded with a hyaline, not gelatinous, exospore c. 0.5 µm thick enclosing the warts 0.2-0.3 |xm high, without adaxial patch. *Basidia* dimorphic; long basidia 35-43 x 7.3-9 |im, short basidia 28-34 x 7-9 µm; sterigmata 4,3 µm long; paraphyses none. *Cheilocystidia* 35-70 x 7-14 µm above, 3-4 µm at the base, clavate with flexuous stalk, thin-walled, smooth, with cloudy vacuolate contents, colourless, as a sterile gill-edge. *Pleurocystidia* none. *Caulocystidia* clustered on the stem-apex above the ring, as the cheilocystidia but shorter and ofter cylindric. *Hyphae* of the pileus colourless, thin-walled, interwoven-radiating with abundant air-spaces, the cells 50-150 x 5 -20 µm, forming a compact pseudoparenchyma at the surface with short irregular cells 5-20 µm wide, this layer 150-180 µm thick over the centre of the pileus and thinning off in the peripheral part of the limb to radial and slightly compacted hyphae with short cells 20-50 x 10-20 µm; outer hyphae of the

pseudoparenchyma rather narrow with brownish walls giving off the loosely entangled brown-walled hyphae of the veil 3-8 urn wide; flesh over the gills with cells 20-50 x 10-30 µm, compacted into a turgid pseudoparenchyma. *Hyphae* of the stem longitudinal, compact, 8-25 µm wide with long cells, 3-6 Jim wide at the surface andmostly collapsed with yellowish walls. Gill-trama with descending hyphae 3-12 Jim wide, long-celled, 3-4 )µm wide and interwoven in the subhymenium, 12-20 µm wide with short cells in the intermediate layer c. hyphae thick. All septa with clamps.

*Collections* - Singapore Gardens' Jungle Sing. *F. N. 5946; Corner s.n.* Sept. 1929, Sept. 1930; Bukit Timah, *Corner s.n.* Sept. Oct. 1929,1930; Reservoir Jungle, *Corner s.n.* 9 Feb. 1930.- Johore, Gunong Panti, *Corner s.n.* March 1930.- Borneo, Mt. Kinabalu, *RSNB 8152.*

*Note.* Among the paintings of Ridley's collections of fungi from Singapore *n. 29,* 20 Sept. 1907, is undoubtely *P. splendens* but the species seems not to have been taken up by Massee. On this painting Chipp has written '= 5946' which is Sing. *F.N. 5946* collected by F. Flippance. Then Chipp (1921) placed this number under *Stropharia umbonata* Mass., typified by *Ridley n.36J,* which is a different species from *P. splendens* and with smooth spores may belong in *Stropharia.* The third collection cited by Chipp, namely *Flippance 6178,* seems also to be 5. *umbonata.*

*Development of the fruit-body.* In October 1930,I watched the development of 8 fruit-bodies in the Singapore Gardens Jungle. The pileus expanded and ruptured the veil during the night. On the previous day the fruit-bodies were 7-11 cm high with unopened pilei 3.5-5.3 cm wide. On the following night the pilei expanded to full size, 4.5-11.5 cm wide, and lasted for a further 3-4 days. My observations began on 2 October and the fruit-bodies had evidently developed after the heavy rain which began on 24 September. The unexpanded fruit-bodies could not have been more then 7 days old. Hence the life of the fruit-body appears to be 13-14 days with nocturnal rupture of the veil on the 8th night.

5. **Psathyrella verrucispora** *sp. n.* Figure 2, Plates 4 and 5

**Pileus 1.5-8 cm latus, campanulatus dein convexo-planus, centro subdepresso, glaber hygrophanus rivuloso-rugosus, primo badilrufus dein umbrinobruneiis; margin primo fibrilloso rachnoideo. Stipes 2.5-11 cm x 1.5-6 mm ad apicem, 2-10 mm ad basim, albiviliosus fragilis, aibidus dein fuscibrunneus, deorsum ad medium fibrilloso-subzonatus. Velum arachnoideum evanescens. Lamellae adnatae vel sinuato-adnatae, vix confertae, latae, 21-30 primariae 5-9 mm latae, ordinibus 3-4, albidae dein pallide purpureofuscae vel vinaceo-cinnamomeae, acie serrulata albida. Caro 1-1.5 mm crassa in pilei centro, hygrophana. Odor raphanaceus vel ut foenum-graecum. Sporae 9.5-12 x 6.5-8 µm, in cumulo fuscipurpureae, amygdaliformes verruculosae, apice hyalino laevi, sine macula adaxiali. Cheilocystidia 20-35 x 8-14 µm, clavata vel ventricosa cum apice subacute elongate. Pleurocystidia 38-78 x 13-17|im, ventricosa, tenuiter tunicata, laevia, etiam apice elongate. Superficies pilei cellulis irregulariter clavatis 30-70 x 20-60 |im, tunicis ochraceibrunneis laevibus, plus minus hymeniodermia. In humo in silva, gregaria vel subcaespitosa. Peninsula Malayana. Typus, *Corner s.n.* Aug. 1929, Johore.**

*Pileus* 1.5-8 cm wide, campanulate then convexo-plane, centre slightly depressed,

rivulose-rugose from the disc almost to the margin, at first bay-brown rufous then date-brown umber, drying rufous fawn to pale fawn tan with bay-brown umber, drying rufous fawn to pale fawn tan with bay-brown and minutely cracked disc; margin incurved at first and arachnoid with silky white fibrils (remains of veil). *Stem* 2.5-11 cm x 1.5-6 mm at the apex, 2-10 mm at the white villous bases, attenuate upwards, brittle, stuffed then hollow, fibrillose and often with faint zones in the lower two thirds, whitish to dingy brownish ageing fuscous. *Veil* cortinate, at first rather thick, evanescent, not forming a ring. *Gills* sinuate-adnate to broadly adnate, not or scarcely crowded, broad, thin, 21-30 primaries 5-9 mm wide, 3-4 ranks, pallid white then pale purplish fuscous or pale vinaceous cinnamon, edge whitish and serrulate. *Flesh* 1-1.5 mm thick in the centre of the pileus, less than 0.5 mm over the limb, hygrophanous, drying whitish and rather spongy, pale dingy yellowish fawn in the stem. *Smell* rather strong and peculiar, of radish and fenugreek.

In forest humus, gregarious or subcaespitose. Malay Peninsula.

*Spores* 9.5-12 x 6.5-8 am (overall), fuscous purple in the mass, amygdaliform, verrucose with conico-truncate coloured warts within the thin mucilaginous exospore 0.2-0.3 am thick, without adaxial patch. *Basidia* dimorphic; long basidia 32-38 x 9-10 am, short basidia 23-29 x 7-9 am; sterigmata 4, 4 am long. *Paraphyses* none. *Cheilocystidia* 20-35 x 8-14 am, clavate or ovoid, or ventricose and prolonged -60 am with subacute apex 3-4 am wide, thin-walled, colourless, as a sterile gill-edge. *Pleurocystidia* 38-78 x 13-17 am, ventricose, thin-walled, colourless, smooth, some lanceolate with prolonged narrow apex 50-100 x 9-12 am with apex 1-2.5 am wide. *Hyphae* of pileus 3-15 am wide, loosely interwoven but short-celled -35 am wide and pseudopamenchymatous in the subhymenium. *Hyphae* of the stem 10-20 am wide, 3-5 am at the surface, longitudinal, without distinct caulocystidia. Surface of pileus with a palisade of irregularly clavate cells 30-70 x 20-60 am with smooth yellowish brown walls, very compact and almost pseudoparenchymatous as if cemented together.

*Collections* - Singapore, Gardens Jungle, *Corner s.n.* July and September 1929,10 Sept. 1940,28 March 1943; Reservoir Jungle, *Corner s.n.* Oct. 1929; Mandai Road, *Corner s.n.* Aug. 1929.

var. **minima** v. *nov.*

**Differt receptaculis minimis, piieo 4-8 mm lato, stipite 15-20 x 1 mm, iamellis primariis 15-20, -2.5 mm latis, ordinibus 2-3. Ad terrain, solitaria, Singapore. Typus, *Corner s.n.* 3 Sept. 1934.**

*Pileus* smooth, persistently convex, pale fawn tan, disc subrufous, whitish towards the margin. *Cheilocystidia* 15-40 x 8-17 am, mostly clavate or subcylindric, some ventricose-lanceolate. *Pleurocystidia* 40-80 x 12-20 am, ventricose-lanceolate with prolonged subacute to obtuse process, thin-walled smooth, colourless.

*Note.* Superficially this species is so like *P. malayana* and *P. retispora* that one must

look at the wide gills and test the smell. Microscopically the spores and pleurocystidia are distinctive. At one time I thought this species might be *Hypholoma elatum* Mass. (Kew Bull. 1908, 5), described from Singapore with *Ridley n. 83E* as the type. The painting of this collection shows a strongly and acutely umbonate pileus with extensively and closely cutifract squamulose limb and dark fuliginous grey to blackish gills. Though the gills are broad, the painting cannot represent the fungus which I describe; it does not fit any fungus know to me.

Var. *minima,* with typical spores of V. *verrucispora,* shows the diminution of fruit-body which occurs in some agarics, perhaps related to the circumstances of mycelial growth.

## The Basidium-unit in *Psathyrella* with Ornamented Spores

This investigation was undertaken in 1944 at the Singapore Botanic Gardens when Kwan Koriba was the director. It was one of the many ways by which we passed the time during the anxious years of the Occupation. The results confirm the general theory of basidium-geometry (Corner 1972, Wasser and Berger 1980,1983). There are some discrepancies but it must be remembered that any close agreement between observed and theoretical results is remarkable because there is no explanation why this should be except that of the geometry of the unit based on spore-spacing, the sporograph, the basidiograph and the ampoule effect. These matters are eschewed by textbooks. The main points for the four Malayan species which I studied in detail are the following.

The basidia are dimorphic. The difference in length between long and short basidia is, roughly, that of spore-length. Thus, taking the averages that I obtained (not the mean values):-

| | Difference in basidium length (μm) | Spore length (μm) |
|---|---|---|
| *P. verrucispora* | 9.0 | 10.6 |
| *P. malayana* | 8.0 | 8.0 |
| *P. retispora* | 7.0 | 9.5 |
| *P. splendens* | 6.9 | 7.0 -- 7.25 |

Concerning differences in the width (w) of long and short basidia, I am doubtful if such as I found have any significance. Thus :-

| | long basidia (µm) | short basidia (Mm) |
|---|---|---|
| *P. malayana* | 11.8 | 11.4 |
| *P. retispora* | 11.6 | 11.0 |
| *P. verrucispora* | 9.7 | 8.0 |
| *P. splendens* | 8.1 | 8.1 |

The point is that the values for this comparison cannot be made on the same undisturbed fruit-body. The long basidia mostly shed their spores and begin to collapse before the short basidia are fully grown, and there are commonly slight differences in the size of the basidia and the spores in different fruit-bodies of the same species. The best way of measuring basidium-width is by means of the mature basidium-circles as seen in apical view of the basidia. Lateral compression may render the basidium-circle into an ellipse with long and short diameters which cannot de detected in lengthwise view, though the mean of the two diameters gives generally much the same result.

In *P. splendens* and *P. verrucispora,* both with thin exospore and without adaxial patch, there is no compression of the spore-circles. The ratio of spore-width (d) to basidium-width (w) is, respectively, d=0.63w and d=0.70w; that of the typical uncompressed basidium-unit is d=0.65w.

By contrast, in *P. malayana* and *P. retispore,* both without exospore but with an adaxial patch, there is compression as shown by their ratios, respectively, d=0.55w and d=0.51w.

I take this to imply, as with the *Boletus-spore,* that compression leads to loss or complete mucification of the exospore. The compression in this case would arise from interference of crowded basidium-units, not from incurvature of the hymenium as in *Boletus*. As proof, the spores are distinctly dilated tangentially in *P. retispora* with radial diameter 5.60µm and tangential 6.25 |im on average. I did not observe spore-compression in *P. malayana* and *P. verrucispora* but it occurs *P. splendens* with diameters 5.09 µm and 5.74 *µm* respectively. In *P. verrucispora* it seems that the short basidia produce narrower spores (? more compressed) than the long basidia.

In the following notes the intention has been to test the geometrical theory of the basidium-unit by comparison of actual measures with theoretical prediction. I have used the same symbols as in my account of the *Boletus-spore*. Thus :- D is spore-length, d is spore-width with dr and dt for radial and tangential diameters, w is basidium-width. S', S" and S"' are the diameters of the outer, the middle and the inner spore-circles. M is the diameter of the sterigmatic circle. 0 is the angle made by the long axis of the spore with that of the sterigma. All the measures are in microns.

Table 1. *Psathyrellyamalayana*

Observations in microns

| | Dor1 | d | w | SI | S" | S"' | M |
|---|---|---|---|---|---|---|---|
| Spore-print mean | 8.00 | 6.25 | | | | | |
| Basidium short mean • | 23.50 | | 11.00 | | | | |
| 11 long basidia average | 33.18 | | 11.7.6 | | | | |
| 21 short basidia average | 25.18 | | 11.39 | | | | |
| 22 spore-circles average exosp. | | 6.08 | 11.01 | 17.41 | 11.33 | 5.26 | |
| 22 spore-circles average endosp. | | 4.67 | 11.01 | 15.78 | 11.11 | 6.45 | |
| 20 sterigmatic circles, av. | | | 11.38 | | | | 8.25 |

Taking $d = \frac{S' S''}{S'''}$ then for the exospore w=8.08 µm; for the endospore w=9.16 µm

Both these figures are too low for the observed averages of 11.01 nm to 11.76 µn.

Taking M = S" - 0-7d then for the exospore M=7.07 µm; for the endospore M=7.84 (Xm.

While M for the endospore agrees moderately well with the observed value 8.25 µm, that for the exospore is too low.

For the exospore d=0.55 w., for the endospore d.=0.42w. These ratios indicate considerable compression of the spore-circles.

Table 2. *Psathyrella retispora*.

Observations in microns

| | D | dr | dt | w | s' | s'' | s''' | M |
|---|---|---|---|---|---|---|---|---|
| Spore-print mean | 9.75 | 5.50 | | | | | | |
| 22 spores, av. | 9.39 | 5.60 | | | | | | |
| 6 spores, av. | | | 6.25 | | | | | |
| 20 spore-circles average | | 5.72 | | | 16.83 | 11.11 | 5.39 | |
| 10 spore-circles average | | | | 10.46 | | | | |
| 11 sterigmatic circles, av. | | | | 11.51 | | | | 8.03 |
| 10 basidia average | | | | 11.31 | | | | |
| 5 long basidia average | | | | 11.63 | | | | |
| 5 short basidia average | | | | 11.00 | | | | |

Long basidia average 38.44µm long, short basidia 31.44µm

Taking the same equations as for *P. malayana,* then w=8.16 |im, which is clearly too small compared with the observed average values 10.46-11.62 µm. Then withS"=1111 Hmandd,=5.72µn,M=711µm which is also small compared with the observed average 8.03 µm.

Taking d=5.72 µm and w=11.2 µm (as the average of 5 values), then d,=0.51w., which shows considerable compression of the spore-circles as well as the spore.

If the usual relation for uncompressed values is taken then d,=7.28µm, which is clearly too high. If this value is taken for d, then S'" should be about 7.5 µm to satisfy w.=11.3µm, and this shows the compression of the spore-circles.

*

Table 3. *Psathyrella splendens.*

Observations in microns

| | Dor l | d | w | s' | S'' | S''' | M |
|---|---|---|---|---|---|---|---|
| Spore-print mean | 7.25<br>7.00 | 6.00<br>5.50 | | | | | |
| 43 spores average | 7.07 | 5.09 | | | | | |
| 12 long basidia average | 38.13 | | 8.08 | | | | |
| 19 short basidia average | 31.23 | | 8.08 | | | | |
| 32 spore-circles average | | 5.31 | 8.54 | 16.82 | 11.51 | 6.18 | |
| 22 sterigmatic circles, av. | | | 8.75 | | | | 7.41 |

dt is 5.74 µm on average.

Taking the same equations as for *P. malayana,* then w=9.03 µm and M=7.79 urn. These values are slightly higher than observed. If M=7.41 µrn, as observed, then d=5.86 urn, which is again but slightly higher than observed.

Taking the theoretical $d = \frac{S'' - M}{\sin \theta}$ and with S" as 11.51 µm and M as 7.41 µm, the spore-angle 9 is 45° and d. is 5.33 µm. Alternatively with d=5.31 µm, then 0 is 44° 28'.

I conclude that all these results are close enough to confirm the general theory of basidium-geometry.

Table 4. *Psathyrella verrucispora.*

Observations in microns

| | Dor l | d | w | Si | £1 | gn, | M |
|---|---|---|---|---|---|---|---|
| Spore-print mean | 10.75 | 7.25 | | | | | |
| 36 spores, average | 10.61 | 6.77 | | | | | |
| 10 spore-circles average * | | | | 17.10 | 10.65 | 4.20 | |
| 20 spore-circles long basidia, average | | 7.24 | | 20.62 | 13.38 | 6.15 | |
| 12 spore-circles short basidia, average | | 6.50 | | 18.25 | 11.77 | 5.30 | |
| 16 sterigmatic circles, long basidia, average | | | | | | | 9.23 |
| 12 sterigmatic circles, long basidia, average | | | | | | | 6.80 |
| 28 sterigmatic circles, mixed average | | | | | | | 8.84 |
| Sterigmatic circle direct measure average | | | | | | | 9.00 |
| 43 basidia, average | 30.58 | | 9.03 | | | | |
| 13 basidia, apical view, average | | | 9.90 | | | | |
| Long basidia, mean | 35.00 | | 9.50 | | | | |
| Short basidia, mean | 26.00 | | 8.00 | | | | |
| Both kinds, mean | | | 9.63 | | | | |

* including both long and short basidia.

Taking the same equations as with *P. malayana,* then

w=9.48 µm for long basidia: average observed value 9.5 µrn.

w.=8.23 µm for short basidia : average observed value 8.0 µm.

M=8.33 µrn for long basidia : average observed value 9.23 µrn.

M=7.20 µrn for short basidia: average observed value 6.8 µm.

w.=8.84 µrn as the observed average for both kinds of basidium.

Taking the equation for 9 (as with *P. splendens),* then with 9 as 45°, d=7.13 µm for long basidia and 6.43 µm for short basidia, and this compares favourably with the average value 6.77 µm for all the spore-measurements.

These results from living basidia agree closely with the theoretical. The slight discrepancy with M may be the effect of incipient collapse of the basidium with incurvature of the sterigmata.

## Sporograph of *Psathyrella*

In comparing spores I find it desirable to present the issue graphically by means of the sporograph. The data for the species with ornamented spores have been taken from Tables 1-4. The resulting sporograph is shown in Figure 3. It does not include the two species described by Pegler and Young because they excluded the myxosporium (exospore) in their measurements. The resulting figure was so uncertain that I decided to test it with a sporograph based on the European species with smooth spores described by Kits van Waveren (1985). I took the mean size of the overall spore-measures of the 96 species. The resulting sporograph is given with black circles in Figure 4. There is a remarkable scatter which shows, if vaguely, the usual tendency of the long spores to become relatively narrower. The scatter might become more orderly if this generic sporograph were itemised into the sectional categories used by Kits van Waveren. It is possible, also, that some species may have dimorphic basidia with slightly different spores, as I found in *P. verrucispora*. However, when the points for the species with ornamented spores are superimposed (as open circles) on this generic sporograph, it becomes clear that *P. malayana*, *P. splendens* and *P. verrucispora* have relatively wider spores on account of the presence of the exospore or ornamentation. Thus, the point for the endospore of *P. malayana* fits with the sporograph of the smooth spores. Then, if the points *for P. nigeriensis* and *P. trechispora* are added, they also fit with the smooth spores, being endospore measures. It is probable that my data *for P. retispora* were based on endospores. I take this generic sporograph as confirmation that the smooth spore, found generally in *Psathyrella*, is an endospore.

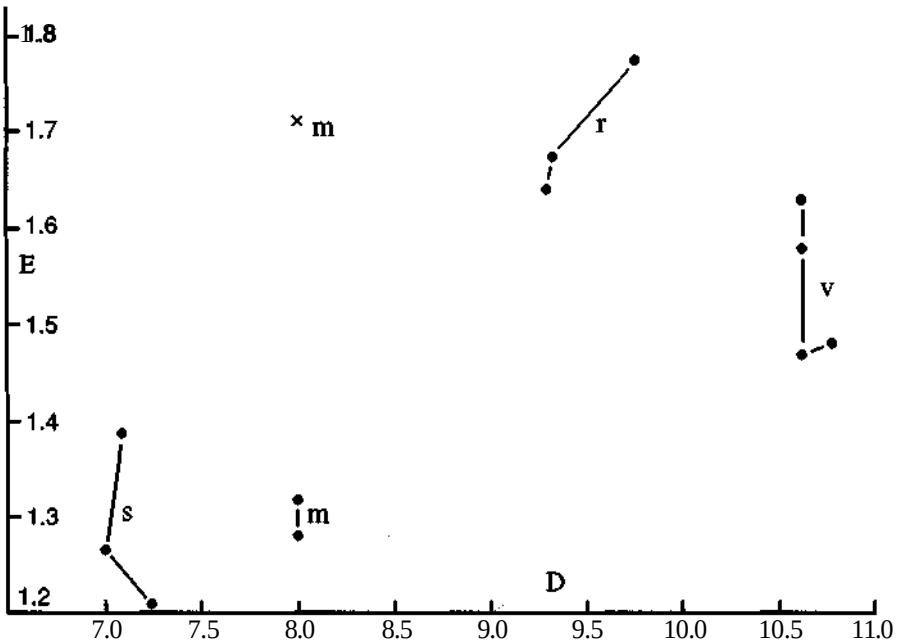


Figure 3. Sporograph for the Malayan species of *Psathyrella* with ornamented spores. *P. malayana* (m) with endospore at x, *P. retispora* (r), *P. splendens* (s) and *P. verrucispora* (v).

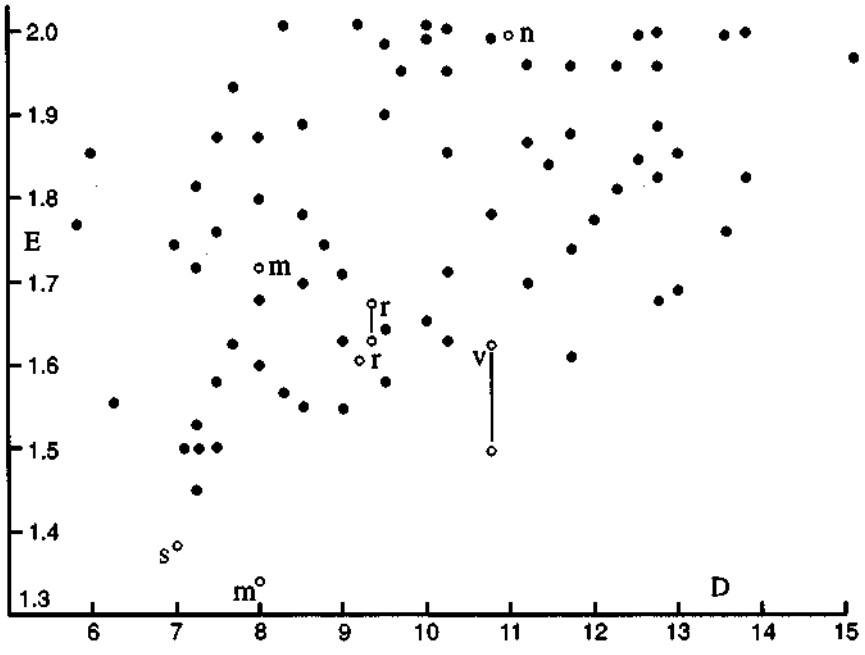


Figure 4. Sporograph for the 96 species of *Psathyrella* with smooth spores, descibed by Kits van Waveren (1985) with species-points as black circles. Open circles for the species with ornamented spores as *P. malayana* (m), *P. nigeriensis* (n), *P. retispora (r),P. splendens* (s), *P. trechispora* (t) and *P. verrucispora* (v).

## Basidiograph

As the sporograph illuminates the nature of spores in an alliance, so the basidiograph displays that of the basidia. The basidiograph for the Malayan species with ornamented spores is shown in Figure 5. It indicates the same trend for both long and short basidia, but the data are too few to draw any definite conclusion. I refrain from comparing my results with the data of Kits van Waveren and Pegler and Young because their measures were taken from dried specimens and such, in my experience, are never sufficiently exact for the basidiograph. The pleurocystidium of *P. verrucispora* seems to fit its basidial locus rather than the steeper locus that one might derive for all four species. Again, there enters the problem of sectional distinction with separation of the species and their alignment, possibly, with smooth-spored species. It will be a huge undertaking but necessary for the understanding of *Psathyrella*.

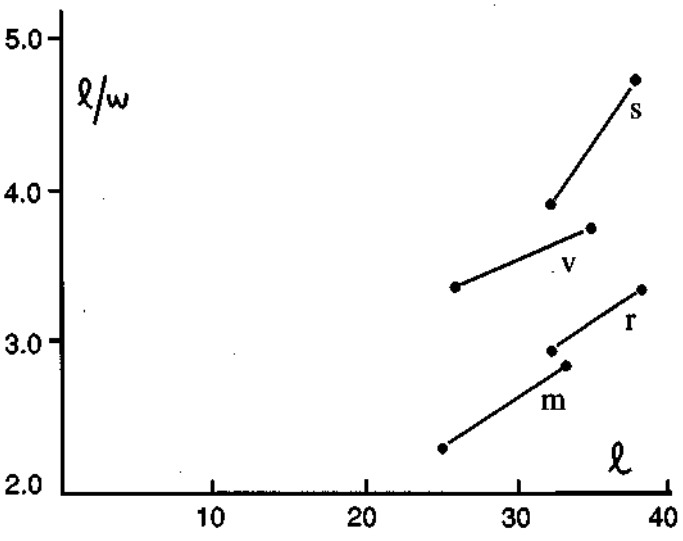


Figure 5. Basidiograph of the Malayan species *of Psathyrella* with ornamented spores. *P. malayana* (m), *P. retispora* (r), *P. splendens* (s) and *P. verrucispora* (v).

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Plate I. *Psathyrella malayana*, from Bukit Timah. Singapore, 7 April 1941.

Plate 2. *Psathyrella retispoau*, from Sungei Pendas, Johore, 3 April 1941.

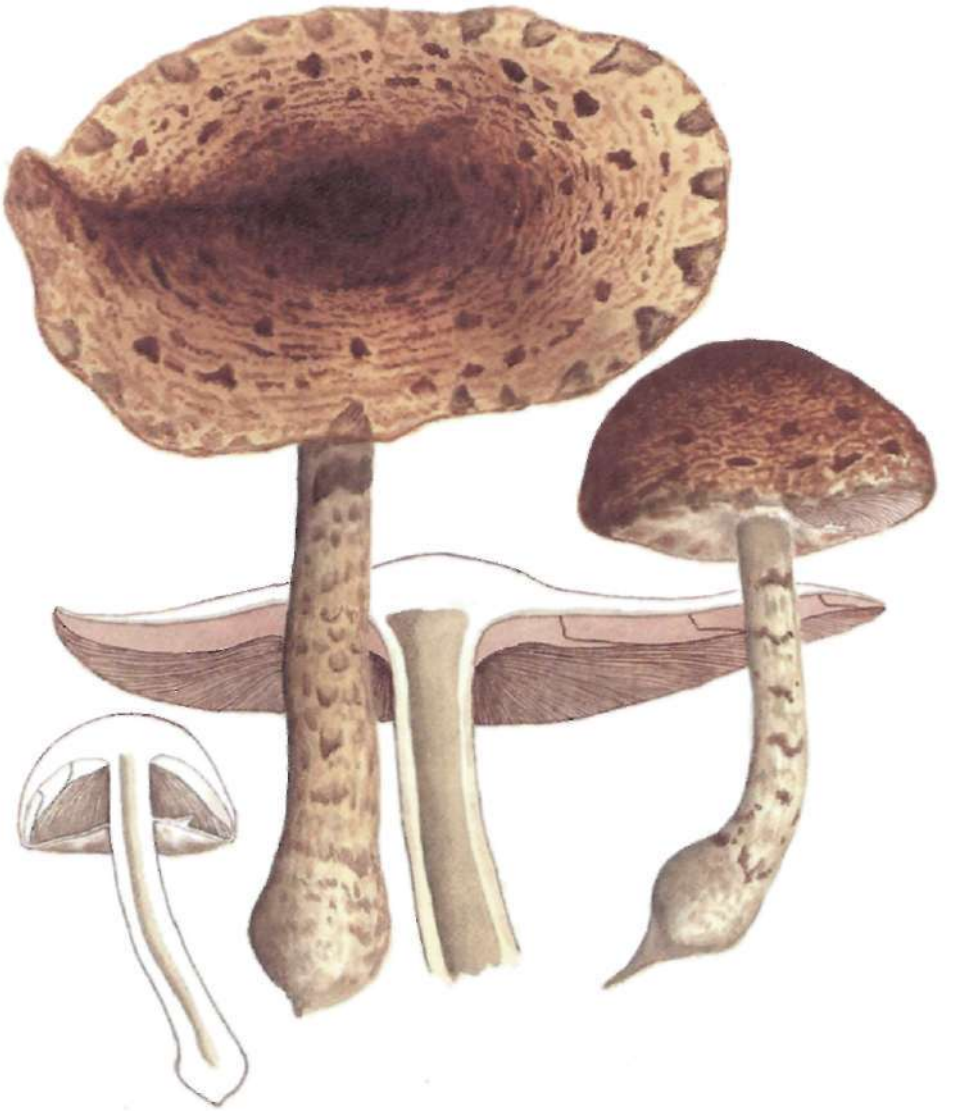

Plate 3. *Psathyrella splendens*, from Reservoir Jungle, Singapore 25 Aug. 1940.

Plate 4. *Psathyrella verrucispora*, from Gardens Jungle, Singapore 28 March 1943.

Plate 5. *Psathyrella verrucispora*, from Gardens Jungle, Singapore 10 Sept. 1940.