

BOLETES FROM SOUTH & EAST CENTRAL AFRICA – I

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Fifteen boletes (Basidiomycotina) distributed in the following genera: *Afroboletus* (1), *Aureoboletus* (1), *Boletellus* (1), *Gyroporus* (2), *Phlebopus* (1), *Phylloporus* (1), *Pulveroboletus* (5), *Suillus* (1) *Tuboseta* (1), and *Veloporphyrellus* (1) are recorded from Zambia. Four of these collections cannot be assigned to any formerly documented stirps. Two new combinations are proposed and full descriptions of the other collections are given. *Afroboletus azureotinctus* and *Veloporphyrellus africanus* are described as new; *Tuboseta brunneosetosa* var. *retipes* is recorded from Cameroon & Zimbabwe in addition to Zambia.

INTRODUCTION

For some time now Dr Graham D. Pearce has paid attention to the larger fungi of Central Africa and accumulated an impressive collection of dried material. The specimens collected by him in the Copperbelt of Zambia in collaboration with M.H. Ivory during 1974 & 1975 are the basis of this and a subsequent paper (the second dealing with the tylopileoid and xerocomoid taxa). These collections are supplemented with information from a limited number of fresh specimens and from notes on additional dried material deposited at the Forest Pathology Herbarium, Riverside Laboratories, Kitwe, which it was possible to examine whilst one of us (RW) was in Zambia. The herbarium and laboratories are part of the former Northern Rhodesia Forestry Department, Ndola NDO with collections prefixed by FP – Forest Pathology. All Ivory's collections (abbreviated *Ivory*) are in E with duplicate or part collections in NDO. Miombo woodland is considered to be an example of an ectomycorrhizal plant-association (Högberg & Pearce, 1986; Högberg, 1986); this forest type is found over wide areas of Eastern and Central Africa and is dominated by the leguminous genera *Brachystegia*, *Isoberlinia* and *Julbernardia* and the dipterocarp *Marquesia macroura* Gilg. The miombo woodland is open forest with a canopy of less than 20 m and an understorey of dense tall grasses. It occurs in the savanna climatic area and covers an estimated 80% of Zambia. The boletes described herein are from this community and may represent the ectomycorrhizal partners. Their identification is particularly pertinent, as an intensive study of mycorrhizal and nutrient-cycling is underway in transects close to the collecting areas at Kitwe (I. Alexander, pers. comm.). Incorporated in this study are a few taxa from Zimbabwe. Fourteen species of bolete are described from East Africa (Pegler, 1977) and 83 from Zaire and neighbouring areas (Heinemann, 1954, 1964 & 1966; Heinemann & Rammeloo, 1980 & 1983) although this number will undoubtedly increase (Rammeloo, pers. comm.). No single account is available for Zambia although from notes available this is a rich area for larger fungi, particularly the miombo woodland (Ryvarden, pers. comm.). This is confirmed by the present study, and the large number of collections for which specific names cannot be found indicates much has still to be done.

The authors have adopted a similar arrangement of genera to that in Watling & Hollands (1990) in order to allow direct comparison, and avoid the necessity to make placements in families with often minimal field information. All herbarium material has been deposited in E with duplicates in NDO, unless otherwise stated.

TAXONOMIC ACCOUNT

AFROBOLETUS Pegler & Young

Afroboletus azureotinctus Watl. sp. nov., Fig. 1A & B, Fig. 3I–K.

Pileus 50–100mm, convexus dein planus, siccus, stramineus verrucis atomurinis et marginibus appendiculatis. *Stipes* 40–90 x 10–20mm, annulatus, infra squamis atomurinis provisi. *Pori* albi, ubi contusi hinnulei. *Caro* alba, caerulescens. *Basidiospore* ellipsoideae, 13–15 x 9–10 μ m, projecturae aliformes prominentes provisae.

Type: Riverside, Kitwe, 27 xii 1974, FP 335/7 (holo. E).

Pileus 50–100 mm, convex then plane, dry, straw-coloured throughout with many dark mouse-grey warts, and prominent, thick, straw-coloured appendiculate margin with dark grey scales especially when young. *Stipe* 40–90 x 10–20 mm, solid, covered in dark mouse-grey scales except at apex where they are replaced by a prominent similarly coloured ring. *Tubes* sinuate, white; pores white bruising fawn-colour, angular, compound. *Flesh* white becoming indigo.

Basidiospores broadly ellipsoid with large prominent wing-like projecting ridges spiralling downwards, dark tawny brown in ammoniacal solutions and umber fuscous in mass, (13–)14.5–16.5 x (9)11–11.5(–12) μ m. *Basidia* 4-spored, hyaline, broadly clavate, prominent in hymenium, 25–30 x 14–16 μ m with sterigmata 4–4.5 μ m long. *Pleurocystidia* prominent, umber to dark tawny brown, ampullaceous with or without a faint swelling at apex, or cucurbitiform with short or long neck (4.5–11 μ m), smooth, scattered, numerous, 35–52 x 8–13 μ m, apex 2.5–4.5 μ m, *cheilocystidia* forming a strongly developed fringe, mixture of elongate-ellipsoid to flexuous cylindrical and ampullaceous cells, 20–35 x 5.5–7.5 μ m broad, with tawny orange inclusions, more brightly coloured than pleurocystidia. *Hymenophoral trama* divergent; highly gelatinized with hyaline, lateral strata and a darker more compacted medio-stratum containing dark tawny brown relatively short, laticiferous hyphae; hymenium tawny orange. *Pileipellis* probably radially arranged, of a suprapellis consisting of concentrations of loosely arranged, non-gelatinized, dull tawny orange to tawny brown, shortly cylindrical or dumb-bell shaped hyphae 6.5–13 μ m broad with similar short-cylindrical or knee-like branches, non-clamped and only slightly constricted at the prominent septa, not obviously disarticulating, but end-cells rounded and slightly torpedo-shaped; between concentrations of usually narrower (<5 μ m broad), similarly coloured, irregularly flexuous hyphae stretched out over pale mediopellis and in places adhering into skeins and drawn off into narrow ends; mediopellis seated on a subpellis of similarly short-cylindrical, hyaline, intertwined hyphae which become compacted downwards and pass into context on which are short dull tawny brown laticiferous hyphae, similar or even connected to those in hymenophoral trama.

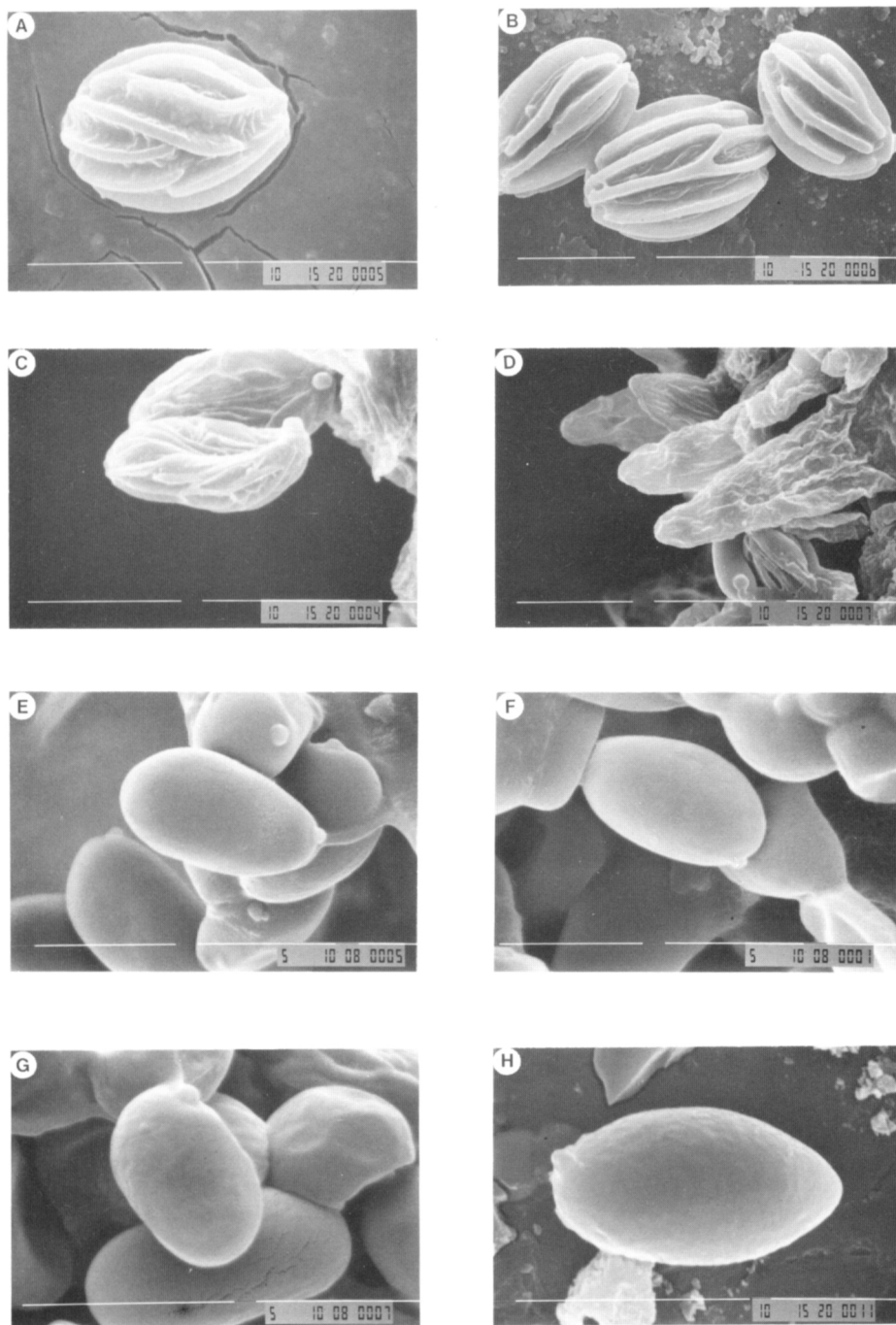


FIG 1. A & B, *Afroboletus azureotinctus*, holotype, FP 335/7; C & D, *Boletellus pustulatus*, FP 176/45; E, *Aureoboletus* sp., FP 380/1; F, *Pulveroboletus* aff. *shoreae*, FP 338/12; G, *Gyroporus microsporus* var. *congolensis*, Watling 22687; H, *Pulveroboletus* aff. *ravenelii*, FP 338/6; A, B, C–H, Basidiospores; D, Pleurocystidia.

Habitat: Scattered on soil under light to moderate shade in relic miombo woodland.

Material examined: Kitwe, 27 xii 1974, FP 335/7 (holotype, E), Ivory 1.

According to Ivory (pers. comm.) this taxon has appeared from December–March at the same site. He has also collected it in January in miombo woodland in Misaka Forest Reserve and under trees, Riverside both near Kitwe. Further collections in Forest Pathology Herbarium, Riverside Lab. (NDO): FP 176/68; 335/7 & 338/4.

This species has no counterpart in the genus; the blueing flesh, the prominent annulus and appendiculate veil, and straw-colour beneath the mouse-grey warts are very distinctive. The basidiospores are more narrow than those of previously described species.

The genus *Afroboletus* was proposed by Pegler & Young (1981) and they gave two species, *A. pterosporus* (Singer) Pegler & Young (generic type) and *A. luteolus* (Heinem.) Pegler & Young. Undoubtedly *Strobilomyces costatisporus* (Beeli) Gilbert and *S. lepidellus* Gilbert ex Heinem. also belong here and the appropriate combinations are made.

***Afroboletus costatisporus* (Beeli) Watling comb. nov.**

Basionym: *Boletus costatisporus* (as '*costatisporae*') Beeli in Bull. Soc. Roy. Bot. Belg. 59: 162 (1927).

***Afroboletus lepidellus* (Gilbert ex Heinem.) Watling comb. nov.**

Basionym: *Strobilomyces lepidellus* Gilbert ex Heinem. in Bull. Jard. Bot. État Brux. 21: 340, 1951.

AUREOBOLETUS Pouzar

***Aureoboletus* sp. 1, Fig. 1E.**

Pileus 40 mm (not fully expanded), convex, somewhat irregular, smooth, dry, vinaceous/bay/blood; **stipe** 45 x 15 mm, tapering upwards, solid vinaceous/bay, yellow near tubes, darkening towards base, centre pale-yellow, the top half rapidly bruising indigo. **Context** pure yellow, firm 14 mm thick at disc, bruising indigo near tubes which then fades. **Tubes** adnate pure yellow (chrome) 7 mm long; **pores** small, angular pure-yellow. **Taste** not distinctive.

Basidiospores in mass olivaceous, 9.6–10.1(–10.5) x 5.2–5.7 μm , ellipsoid-subfusiform to slightly amygdaliform. **Basidia** 4-spored, hyaline, 9–11 x 25–27.5 μm , often quite prominent as vesiculose elements. **Pleurocystidia** fairly numerous, scattered, lageniform to cucurbitiform, 25–35 x 6–7.5 μm , with obtuse sometimes swollen apex (3–3.5 μm broad), neck tapered, variable, 2–11 μm long, either distinctly or hardly proud of the hymenial surface; **cheilocystidia** similar, clustered forming a distinct sterile edge. **Hymenophoral trama** of distinctly gelatinized, silvery lateral stratum of hyaline hyphae divergent from a slightly darker more compacted mediostatum. **Pileipellis** of highly tangled and intertwined hyaline or honey-coloured, smooth, slightly thick-walled hyphae, 4.4–6.5 μm broad, hardly constricted at the septa and collapsing to give an irregular pinkish, gelatinized suprapellis in NH_4OH ; subpellis of radially arranged hyphae which become compacted downwards into rather dense hyaline or honey-coloured context, exuding a yellow fluid in mounts.

Habitat: In relic miombo woodland on soil at side of trench in small cluster and partly sun dried.

Material examined: Kitwe, 7 iv 1975, FP 380/1, *Ivory* 31. Also FP 389, Kitwe in Forest Pathology Herbarium, Riverside Lab., Kitwe (NDO).

This collection closely approaches the N American *Boletus innixus* Frost, which Singer (1986) placed in *Pulveroboletus* considering it to represent his earlier concept of *B. caespitosus* Peck (Singer, 1947). This latter species has been much confused especially as 1. the epithet has been used on other occasions for quite unrelated fungi, and 2. was for some time considered a synonym of *B. auriporus* Peck, another N American bolete – although recently collected in Europe (Kuyper, pers. comm.). The epithet 'caespitosus' was used by Masee (1892 under subgenus *Gyrodon*) for a bolete close, if not identical, to *Boletus pulverulentus* Opat., indeed the same fungus to which the true *B. caespitosus* Peck is related. A third '*B. caespitosus*' was described by Cleland (1924), again unrelated to *B. innixus* and the Zambian bolete, which he later transferred to *Gyroporus* (see Watling & Gregory, 1988). *Boletus caespitosus* Peck is a true member of the genus *Boletus*.

The present collection (FP 380/1), despite its similar colouring to *Rubinoboletus virescens* (Heinem.) Heinem. & Rammeloo (Gyrodontoideae), possesses a hymenophoral trama of the '*Boletus*' subtype (Singer, 1951) in common with the genus *Pulveroboletus* and the genus *Boletus* both of which belong in the Boletoidae. In the Kitwe material, this is supported by the short basidiospores which are boletoid and not phaseoliform or ellipsoid as in the Gyrodontoideae.

BOLETELLUS Murrill

Boletellus pustulatus (Beeli) Gilbert, *Les Bolets*, 107 (1931). Fig. 1C & D, Fig 3 G & H.

Pileus 20 mm, convex, velvety, rust-colour. *Stipe* 40 x 5 mm, fulvous-vinaceous, solid. *Tubes* amber-colour bruising blue-green; *pores* amber-colour, small. *Flesh* white becoming blue.

Basidiospores 12–13 x 6.5–7.7(–8)µm, rather broadly boletoid with some apical differentiation, longitudinal striae distinct although forming only very shallow furrows; no cross striae. *Basidia* 4-spored, hyaline or becoming pigmented, clavate. *Pleurocystidia* prominent, sepia honey, ventricose-rostrate with broad, obtuse apex; *cheilocystidia* similar, forming a sterile edge to tube, 30–35 x 10–13µm with tapered apex 6.5µm broad. *Hymenophoral trama* divergent from a darker central strand. *Pileipellis* an epithelium of vesiculose ellipsoid to broadly papillate cells, 12–22µm broad, closely bound into a pale amber palisade arising from similar cells of a mediopellis which become crushed and distorted-rounded downwards; subpellis of broad cylindrical hyphae arranged radially and somewhat open, and seated directly on a rather compacted context. Habitat: In relic miombo woodland, solitary on side of shallow trench under light shade. Material examined: Kitwe, 17 xii 1973, FP 176/45, *Ivory* 13. Also F176/73 (i iv 1974) from the same site Kitwe in Forest Pathology Herbarium, Riverside Lab. (NDO). It is now known to occur from March to April in addition to appearing in December.

The bolete was originally described from Eala, Central Africa occurring on dead wood in inundated forest, but in parallel to many larger fungi described from this area it could be expected to extend into Zambia.

GYROPORUS Quélet

1. *Gyroporus castaneus* (Bull.: Fr.) Quélet, *Ench. Fung.*: 161 (1886).

This has been recorded by Heinemann & Rammeloo (1983: 181) from Zambia (FP 176/65 – see below), although the original collectors consider this rather surprising (Pearce, pers. comm.). *G. castaneus* is usually associated with Fagaceae especially *Quercus* in Britain, continental Europe and N America although var. *ammophilus* Castro & Freire is known from under *Pinus* in sand-dunes (Watling 21615, E). Var. *castaneus* has, however, been found in the absence of any possible commonly considered ectomycorrhizal trees, e.g. *Olearia* (Compositae) in Guernsey (Watling 20827, E). This observation is significant in the finding of *G. microporus* with Malvaceae; also generally not considered ectomycorrhizal – see below. Material from Zimbabwe associated with *Isoberlinia* has been examined (Wilson 5, E).

Our observations suggest that the Zambian collection above is in fact *G. microporus* var. *congolensis* (Heinem.) Heinem. & Rammeloo, as conceded by these authors in Heinemann & Rammeloo (1983: 184)

2. *G. microporus* var. *congolensis* (Heinem.) Heinem. & Rammeloo in *Bull. Jard. Bot. Nat. Belg.* 49: 446 (1979).

Pileus 30–50mm, plane, tomentose, umber at disc ochraceous towards margin. *Stipe* 20–30 x 7–10mm umber, tomentose, brittle with loose spongy interior. *Tubes* free, adnexed, up to 5mm long, straw-coloured; *pores* small, straw-coloured. *Flesh* hard-fleshy, white.

Basidiospores 7–7.5(–8) x 5µm, slightly elongate ellipsoid, smooth, hardly thickened with slight honey-coloured tinge in ammoniacal solutions and straw-coloured in mass. *Clamp-connections* absent.

Habitat: In small clusters in light shade in relic miombo woodland, Riverside, Kitwe, 19 ii 1975, FP 360/1, Ivory 3.

Additional material in Forest Pathology Herbarium, Riverside Lab. (NDO) examined: FP 335/12, 355/3, 369, 370/8 and 374/6.

G. castaneus var. *congolensis* is known from the Riverside site from December until March and has been found at the base of *Hibiscus rosa-sinensis* L. (Malvaceae) in a Kitwe garden. This variety is rather widespread in the Misaka Forest Reserve near Kitwe in *Brachystegia/Marquesia* stands (Watling 22687 [Fig. 1G] & 22688, E).

A further collection with slightly smaller basidiospores has also been found at Riverside and a brief description is offered:

Pileus 25–65mm, convex then plane, fulvous with white upturned margin, dry, smooth. *Stipe* 25 x 10mm, tapering upwards, suddenly constricted near base fulvous, brittle, solid with spongy context. *Tubes* 5mm long, free, white, appearing gelatinous; *pores* white, very small. *Flesh* white, spongy, 10mm thick.

Basidiospores ellipsoid, smooth, hardly thickened, cyanophilic, 5–7 x 4.5µm. *Clamp-connections* absent.

Habitat: In groups in shade in relic miombo woodland.

Material examined: Riverside, Kitwe, xii 1973, FP 176/61, Ivory 8..

The spore-size of this collection comes very close to var. *microsporus* (Singer & Grinl.) Heinem. & Rammeloo but we agree with Heinemann & Rammeloo (1983) that this material is better placed under var. *congolensis*. The gelatinous nature of the tubes is probably because the basidiomes were immature.

PHLEBOPUS (Heim) Singer

Phlebopus brunneoruber (Beeli) Heinem. & Rammeloo in Mycotaxon 15: 390 (1982). Fig. 2G.

Pileus 120mm (–150mm) diam., irregularly plane then depressed, dry, rough, isabelline to umber with rusty patches; margin incurved. *Stipe* 75 x 150mm, irregular, cavernous, rusty brown. *Flesh* firm, straw rapidly becoming glaucous-blue-green, 30mm thick. *Tubes* yellow, 4.5mm long, adnate/adnexed; *pores* small, yellow. *Spore-print* isabelline. *Spores* (4.8–)5.2–5.7 x (3.5–)3.9µm. *Cheilo-* and *pleurocystidia* well differentiated, hyaline lageniform to cylindrical with slightly swollen to subcapitate head.

Habitat: In relic miombo woodland, under light shade.

Material examined: Kitwe, 27 xii 1974, FP 335/5, Ivory 11; 392 & 388/2, all in Forest Pathology Herbarium, Riverside Lab. (NDO). Ivory (pers. comm.) reports he has also found this species in similar habitats at Misaka Forest Reserve.

This species is known from Zaire as a variety of *Boletus braunii* Bres. and has been made into an autonomous species because of the uncertainty surrounding Bresadola's taxon (Bresadola, 1890), originally described from Cameroon. Heinemann & Rammeloo (1982a) have demonstrated that material from Liberia named 'braunii' by Singer is a distinct taxon (viz. *P. harleyi* Heinem. & Rammeloo). *P. brunneoruber* is characterized by the lack of clamp-connections, particularly small basidiospores, and by the brown cystidia. A collection of this same species has been found recently in Cameroon at the base of an old emergent leguminous tree (*Watling* 22357, E).

The closely related *P. silvaticus* Heinem. has been collected at the Maresi station (Sesheke, 7 ii 1983, FP 746/3 in Forest Pathology Herbarium, Riverside Lab. (NDO)). *P. braunii* differs markedly from *P. silvaticus* in the presence of well-differentiated cystidia. The latter species is also much larger in its general facies.

PHYLLOPORUS Quélet

Phylloporus albocarnosus Heinemann, Bull. Jard. Bot. État Brux 25: 177 (1955).

Fig. 2H.

Pileus 30–65mm, convex then plane, dry, smooth, white to straw-colour with pinkish patches. *Stipe* 20–30 x 5–8mm, tapering to base, solid, white then straw. *Gills* citrine yellow. *Flesh* spongy white to straw colour.

Basidiospores hazel in mass, ellipsoid, only slightly boletoid, 7–8 x 3–4µm.

Habitat: In moderate shade in relic miombo woodland.

Material examined: Riverside, Kitwe, growing together on soil at top of trench, 27 xii 1974, FP 335/14, Ivory 2.

This collection agrees with recent material documented by Heinemann & Rammeloo (1987) under the same accession number in NDO.

Some species of *Phylloporus* have very slightly ornamented basidiospores when seen under the scanning electron microscope. *P. albocarnosus* is a member of this group.

PULVEROBOLETUS Murrill

Ivory and Pearce's collections in the Forest Pathology Herbarium and personal field collections by one of us (RW) indicate that in Central Africa this is a very complex group of species of which three groups are documented below.

Pulveroboletus sp.1, Fig. 1H.

Pileus 30–40mm, convex, humid, sulphur yellow to amber-colour. *Stipe* 35–40 x 3–5mm, solid viscid, yellow to luteous. *Tubes* adnate, mm long violaceous buff. *Pores* angular, small vinaceous buff. *Flesh* thin, straw-colour.

Basidiospores ellipsoid-boletoid, 11–12 x (6–)6.5–7 μ m with slightly thickened wall, slightly rugulose under scanning electron microscope, faintly honey-coloured in ammoniacal solutions, dark brick-colour in mass. *Cheilo-* and *pleurocystidia* cylindrical-lageniform, hyaline, scattered.

Habitat: Solitary or grouped in moderate shade in miombo woodland.

Material examined: Misaka Forest Reserve, Kitwe, 3 i 1975, FP 338/6, Ivory 23.

The bright yellow, pulverulent stipe-base would place this in *Pulveroboletus*, close to *P. ravenelii* (Berk. & Br.) Murrill which has been recently recorded from W Africa (Thoen & Ducouso, 1989); *P. ravenelii* however, has smaller basidiospores. The viscid stipe is in parallel to *P. curtisii* (Berk.) Singer, although in the present fungus the tubes are more in keeping with those of *Tylopilus* (Watling, in ed.). It is unfortunate that more detailed field-notes are not available as this collection indicates that the pulverulent velar material may have evolved in unrelated taxa; this material would be placed in the Strobilomycetaceae as outlined by Pegler & Young (1981) whereas *Pulveroboletus* s. stricto is placed in the Boletaceae. This taxon is under further investigation.

Pulveroboletus spp. 2 & 3

Two collections, one from Misaka (FP 338/12) and another from Chati (FP 367/1) come within Singer's circumscription of this genus (Singer, 1947).

Although they have some characteristics in common they represent two different taxa, the first with ellipsoid to elongate-ovoid basidiospores and scattered ventricose cystidia with irregular neck and red-brown hymenium in Melzer's reagent, and the second with narrower, boletoid basidiospores, numerous ventricose cystidia with distinct erect neck and paler hymenium in Melzer's reagent supported by a highly gelatinized almost hyaline hymenophoral trama. The first comes close to *P. shoreae* Singer & Singh from Uttar Pradesh, Dehra Dun, India and the second has some similarities with *P. umbilicatus* (Masse) Singer; the differences are discussed in full under each entry.

Pulveroboletus sp. 2 aff. *shoreae* Singer & Singh in Mycopath. Mycol. Appl. 43: 28 (1971). Fig. 1F.

Pileus 90mm, plane, viscid, pale luteous/fulvous with small cracks. *Stipe* 70 x 15mm tapers to base and apex solid viscid, white/ochraceous with a yellowish base. Context

straw bruising slightly indigo. *Tubes* adnexed 7mm long, amber rapidly bruising indigo; *pores* small amber/orange.

Basidiospores olivaceous in mass, 8.3–9.6 x (4.4–)4.8–5.2 μ m, ellipsoid to elongate ovoid, pale honey-coloured, smooth, slightly broader towards apex, no apical differentiation. *Basidia* 4-spored, clavate, hyaline. *Cheilocystidia* ventricose, hyaline scattered. *Pileipellis* a cutis of filamentous, gelatinized, hyaline hyphae with some upturned elements. *Clamp-connections* absent.

Habitat: On soil under-moderate shade in miombo woodland.

Material examined: Misaka Forest Reserve, 3 i 1975, FP 338/12, *Ivory* 16.

This collection differs from *P. shoreae* in that the stipe is viscid and the pileus less pitted. Indeed, FP 376/1 described below is more in keeping in this character with the original description. The pileipellis in the present collection is a cutis of gelatinized, filamentous hyphae with a few upturned groups of hyphae adhering together to form small tufts.

Pulveroboletus sp. 3

Pileus 15–30mm, convex, viscid/glutinous, luteous with bay squamules, margin with remnants of veil. *Stipe* 25–40 x 5–6mm narrowing to apex, yellow, floccose, centre yellow. *Context* firm, yellow, rapidly bruising indigo. *Tubes* adnexed/free sulphur-yellow; *pores* small, round, sulphur-yellow with globules of yellow liquid.

Basidiospores olivaceous in mass, 8.3–8.7 x 3.9(–4.4) μ m, smooth, honey-coloured in ammoniacal solutions, without apical differentiation. *Basidia* 4-spored, clavate, hyaline. *Cheilo-* and *pleurocystidia* numerous, ventricose with long neck with obtuse apex, hyaline. *Hymenophoral trama* characteristically boletoid, gelatinized, hyaline, lateral stratum of broadly spaced hyphae divergent from a slightly darker compacted centre strand. *Pileipellis* a cutis with groups of upturned elements of gelatinized, flexuous, disarticulating, cylindrical hyphae with slightly asperulate inner and/or outer surfaces, some brownish yellow in folds of the scrobiculae and seated on similar but more compacted, hyaline hyphae. *Clamp connections* absent.

Habitat: In miombo woodland, clustered on soil at base of two trees.

Material examined: Chati Forest Reserve, 4 iii 1975, FP 367/1, *Ivory* 16a.

This material agrees in general facies with the black and white photograph of *P. shoreae* given by Singer & Singh (1971) and a coloured illustration given by Bakshi (1974) especially in respect to the raised ribs or reticulations and smudges of reddish brown on a yellow background. In keying out this fungus the reader is always led to the *Boletus umbilicatus*-group, because of the glutinous pileus, but the present fungus stains indigo blue on bruising whereas *B. umbilicatus* Masee is only faintly dull pinkish rufescent. Singer (1947) places Masee's fungus in *Pulveroboletus*. *Boletopsis corrugatus* Pat. & Baker is considered a synonym of *P. umbilicatus*. On the younger of the two specimens available, although some sulphur yellow floccose fragments were found, it is not possible to directly connect them with the velar appendiculate margin. Horak (1980) has suggested that *P. shoreae* might well be a synonym of *P. ravenelii*; the present collection suggests that this should be explored further. Formal descriptions are not proposed as more field information is required on these undoubtedly new taxa.

Pulveroboletus spp. 4 & 5

The two collections described below possibly represent a single taxon.

Pulveroboletus sp. 4

Pileus velvety, cinnamon becoming dry, salmon ochraceous with age and in exsiccata broken up into small carmine fibrillose scales giving the surface the appearance of some forms of *Tricholomopsis rutilans* (Schaeff.: Fr.) Singer & Smith (Agaricales) i.e. *Tricholoma variegatum* (Scop.: Fr.) Gillet. *Tubes* and *pores* sulphur yellow in young basidiome but when dried with unusual isabelline colour similar to *P. ravenelii* (Berk. & Curt.) Murr. *Spore-print* olivaceous.

Basidiospores (10.5–)11–12.5 x 4.5–5.5µm, pale honey-colour, smooth without apical differentiation, shortly boletoid. *Basidia* 4-spored, pale honey-coloured, clavate. *Hymenophoral trama* hardly differentiated into median- and lateral strata, slightly divergent from central strand hyaline, non-gelatinized. *Hymenium* producing a yellow exudate in ammoniacal solutions. *Cheilocystidia* hyaline, scattered, ventricose-rostrate, sometimes intermixed with more clavate cells, 6.5–8.5µm broad; *pleurocystidia* scattered but very prominent, whole surface covered by basidiospores adhering in groups in mucilaginous material, elongate-cylindric, slightly tapered to obtuse, hyaline or slightly honey-coloured in ammoniacal solutions, 45–78 x 11–13µm; apex 6.5–10µm. *Pileipellis* of collapsed, disrupted, intertwined, honey-coloured often short-cylindric, smooth to slightly roughened hyphae, 6.5–13µm with obtuse slightly tapered end-cells, seated on a core of hyaline filamentous, intertwined hyphae which becomes more compact and more orientated radially above the tubes; many acicular crystals found scattered in the tissue.

Habitat: In relic miombo woodland

Material examined: Riverside, Kitwe, 19 ii 1975, clustered on soil at side of a deep trench under light shade, FP 360/2, *Ivory* 17a.

Further collections by Pearce indicate that this bolete occurs at both the Misaka and Chati Forest Reserves and fruits from December until February.

The collector also indicated some external resemblance to material from Misaka (FP 338/16) but in detail this bolete is slightly different, particularly in the former's more prominent pleurocystidia. The development of pleurocystidia may not be significant by itself as has been demonstrated in collections of *P. ravenelii* from N America (Watling, unpubl. data).

Pulveroboletus sp. 5

Pileus 45–55mm, convex/plane, dry, velvety, ochraceous. *Stipe* 30–40 x 10–12mm, solid, pale luteous with long tufts and streaks. *Context* spongy, white, unchanging. *Tubes* adnexed, 8mm long, amber; *pores* small, angular amber.

Basidiospores ochraceous buff in mass, (10–5)11–11.8(–12.2) x 4.8–5µm, subhyaline to pale honey-colour, smooth, boletoid, lacking apical differentiation. *Basidia* 4-spored, pale honey-coloured. *Cheilocystidia* utriform to broadly lageniform, 17.5–20 x 12.5–14µm, broad with broad obtuse apex. *Hymenophoral trama* of broad, distinctly septate, hyaline cells distinctly divergent from the mediostratum of similar or yellow hyphae, some components accentuated by a clear yellowish honey-coloured fluid. *Pileipellis* a

turf of broad hyphae many agglutinated together to form a firm trichodermium with some end-cells swollen to form an irregular surface.

The basidiome is similarly coloured superficially to the above but differs in the pileus which does not crack up into small carmine scales and short stipe rather abruptly tapered to the base as in the European *Boletus tumidus* Pelt.

Material examined: in miombo woodland, Riverside, Kitwe, 3 i 1975, FP 338/16, Ivory 17.

The mature specimen of F 338/16 is accompanied by two primordia which are covered as the stipe with similar cells to those on the pore orifice.

FP 338/16 & 360/20 differ from *Boletus cutifractus* Corner in the adnexed not adnato-decurrent tubes, stipe lacking hints of yellow and pallid cinnamon pores.

STROBILOMYCES Berk.

Members of the genus *Strobilomyces* have been mentioned under the closely related *Afroboletus* (q.v). One other member, the type of the genus, viz. *S. strobilaceus* (Scop.: Fr.) Berk. (= *S. floccopus* (Vahl: Fr.) Karsten) has been listed for Zambia (Angus, 1966; also Doidge, 1950). Both these entries are based on a record by Cheesman (1909) from a rain forest community at Victoria Falls. As the record is not supported by descriptive data, fresh collections are required to confirm the record. The record is considered by Pearce (comm. in Forest Pathology Herb., Riverside Lab) as close to *Strobilomyces lepidellus* Gilbert. This must be the material named in this contribution as *Afroboletus azureotinctus* Watling.

SUILLUS Micheli ex S.F. Gray

Suillus granulatus (Fries) O. Kuntze, Revis. Gen. Pl. 3(2) 535 (1898).

Under *Pinus michoacana* Martinez, Riverside, Kitwe, 3 April 1991, Watling 22685 (E). This is a widespread bolete in Zambia having become established in plantations of exotic pines. There are many collections in the Forest Pathology Herb Riverside, Kitwe. Pearce has many accession numbers including cultures on which he based his account of this bolete (Pearce, 1979); it occurs from November until May.

Material examined includes FP 466; FP 453 and FP 715/8 (NDO).

S. granulatus has been found in Zambia associated with:

Pinus leiophylla Schlecht. & Cham. (subtropical Mexico and Southern United States); *P. kesiya* Royle ex Gordon (N. Burma & Philippines); *P. merkusii* Jungh & de Vriese (S.E. Asia); *P. michoacana* Martinez (Mexico); *P. montezumae* Lambert (Mexico); *P. oocarpa* Schiede (C. America); *P. ponderosa* Douglas (W. North America); *P. strobus* L. (Canada & N. United States); *P. tabulaeformis* Carrière (South East N. America). It has been recorded from Chati Forest Reserve, Dola Hill; Itinpi; Riverside, Kitwe and Samfya. To this list Heinemann & Rammeloo (1989) have added, often under synonyms, *P. caribaea* Morelet (C. America & West Indies), *P. patula* Schlecht. & Chamisso (Mexico), & *P. radiata* D. Don (California) planted in other Central African states.

Heinemann & Rammeloo (1989) record *S. granulatus* from Zaire, Rwanda, Burundi, Cameroon, Uganda, Zambia, Zimbabwe, Malawi, Tanzania & Kenya, with introduced *Pinus* spp. except for a collection from Nairobi under *Cupressus* (ex East African Herb. 14115, K).

It is very interesting to note that of all the species of *Suillus* which grow with a wide range of *Pinus* spp. only *S. granulatus* has taken advantage of the change in environment because there is no doubt this species has been introduced to Africa south of the equator. *S. granulatus* has also become the dominant species of *Suillus* in plantations of exotic conifers in Australia, often occurring in troops of many hundreds. For example, Australian Capital Territory: Urairra Forest, under *Pinus radiata* Don (planted 1947), Watling 10516 (E), Cowan Nat. Forest, under *Pinus ponderosa* (planted 1940), Watling 10467 (E) (Watling & Gregory, 1989).

Suillus granulatus, although not considered of high quality, is still eaten throughout continental Europe. Although the fungus has been given its own common name in Bemba ('Boara') one of the native tongues of the Copperbelt it has not been possible to persuade the indigenous population to use it for supplementing their diet. This is strange as they avidly collect chanterelles, species of *Termitomyces* and *Lactarius kabansus* Pegler & Pearce for food.

TUBOSETA Horak

Tuboseta brunneosetosa* var. *retipes Heinem. & Rammeloo, Bull. Jard. Bot. Belg. 58: 266 (1988). Fig. 2, A–D.

Pileus (28–)50–150mm, convex to plane, dry, velvety or plush red to blood-red or scarlet with faint peach-coloured tinge becoming washed out and cracked and finally brownish with age. *Stipe* 30–60(–80) x 10–25mm (base 5–10mm) cylindric tapering to base, pale luteous to straw at apex, buff to lemon-yellow at base, with rust-colour to blood-red or carmine punctae on raised ridges in upper 2/3rds or forming a reddish purpuraceous belt at -way. *Context* straw-colour to whitish in pileus except for reddish or purplish zone under pileus-cuticle, lemon-yellow in stipe slowly blueing especially in pileus. *Tubes* adnate, straw-colour, greenish glaucous; *pores* angular, compound, luteous with orange orifice, margins citrine/ochraceous to fulvous.

Basidia 4-spored, clavate-elongate, hyaline or pale honey-colour.

Basidiospores pale honey-colour, smooth (very faintly rugulose under scanning electron microscope), (9.2–9.6)10.1–10.9(–11.4) x 4.8–5.2(–5.7) μ m, isabelline in mass. *Cheilo-* and *pleurocystidia*, setuloid lanceolate with a long pointed apex, hyaline below, rust-brown at very tip 80–110 x 10–12 (tip 1–3 μ m). *Hyphae* in stipe-base sordid amyloid.

Habitat: Solitary or in groups under light shade in miombo woodland.

Material examined: Miombo woodland Misaka Forest Reserve, 3 i 75, FP 338/11, Ivory 7; ditto, 3 iv 1991, Wat. 22691; Chati Forest Reserve, under *Uapaca kirkiana* Mull., Wat. 22689, E.

Additional collections in Forest Pathology Herbarium, Riverside Lab. (NDO): FP 176/52; 339/1; 355/4; 358/5, 362, 370/1 and 377/1.

This fungus is said to occur from December until March in miombo with *Brachystegia* spp. & *Marquesia* at Chati, Misaka and Riverside; fresh material was also collected in April indicating it has a very wide fruiting period. Heinemann (1954) records *T. brunneosetosa* (as *T. calocystis*) with *Gilbertiodendron dewevrei* (de Wild.) J. Léonard as an ectomycorrhizal associate and Pegler (1977) records it from Kenya and Tanzania, with *Paramacrolobium*. Heinemann & Rammeloo (1989) also add *Brachystegia* to the

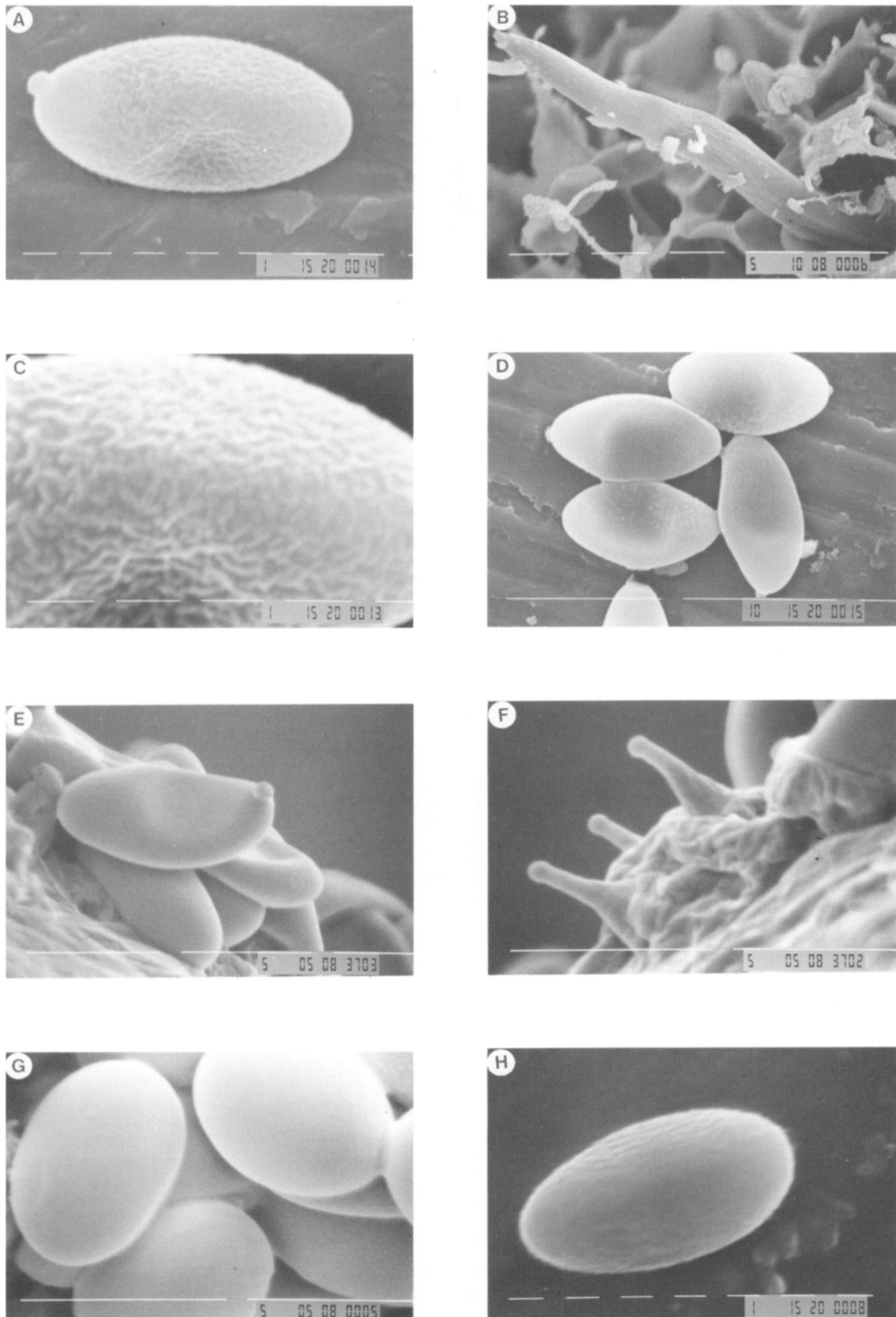


FIG 2. A–D, *Tuboseta brunneosetosa* var. *retipes*, FP 338/11; E & F, *Veloporphyrellus africanus*, holotype, FP 370/3; G, *Phlebopus brunneoruber*, FP 335/5; H, *Phylloporus albocarnosus* FP 335/14; A, C–E, G, & H, Basidiospores, B, & F, Pleurocystidia.

host list based on material from Burundi, and Thoen & Ducouso (1989), add *Uapaca quineensis* Müll. Arg. Other hosts are *Julbernardia globiliflora* (Benth.) Troupin, *Isoberlinia angolensis* (Welw. ex Benth.) Hoyle & Brenan, (Leguminosae) in Tanzania, and *Marquesia macroura* from Zaire.

However, unlike *T. calocystis* in its original sense (Heinemann, 1954) all our collections possess not carmine but red-brown coloured setuloid cystidia. Even when the hymenium becomes carmine to purple-red in sulphovanillin the cystidia remain brown. In this way our collections agree with *T. brunneosetosa* (Singer) Horak which Heinemann & Rammeloo (1989) consider conspecific. The present material differs from *T. brunneosetosa* in its original sense in the blueing yellow flesh but this is not considered to be a definitive character; from *T. goossensii* (Heinm.) Horak it differs in the smaller basidiospores, non-blackening pileus, the non-gelatinizing pileipellis and in the sturdier stature and overall colours.

It must be noted that in Heinemann (1954) the legend to the coloured plate is reversed; thus Plate XI 2 is *T. calocystis* and Plate XI 3 is *T. goossensii*. Pegler (1977) also compounds this confusion by indicating Plate IX, 3 for *T. calocystis*, instead of Plate XI, 2.

In all our collections the flesh blues and the pileipellis is composed of a tight turf of rather short almost ellipsoid terminal and penultimate cells. The variation in spore-size comes within the concept of *T. calocystis* as outlined by Heinemann (1954). In the field var. *retipes* can be recognized by the raised red ribs or rather open network to reticulation on the stipe.

Immature material of *T. brunneosetosa* has been examined from Zimbabwe (Shawanae: 13 ii 1961, legit K. Wilson, *Watling* 22358, E); the characteristic setuliform cystidia are prominent and the hymenial elements turn firstly carmine and then after five minutes violet in freshly prepared solutions of sulphovanillin. *T. brunneosetosa* var. *retipes* has been found under similar conditions in Cameroon (Korup rain forest legit J. Rother, Spring 1989, *Watling* 22423, E).

Much discussion has raged around the significance of the thick-walled cystidia (see Corner, 1972) but the consensus of opinion is that there are three distinct genera with setiform cystidia, viz. *Boletochaete* Singer, *Setogyroporus* Heinem. & Rammeloo and *Tuboseta* Horak (Heinemann & Rammeloo, 1982b). The last genus was recognized by Horak (1967) based on those species of *Boletochaete* described by Singer (1944) with boletoid basidiospores. At present *Tuboseta* contains two taxa excluding var. *retipes* and one described by Heim (1938) associated with termite mounds in Madagascar, as yet unnamed; the genus is apparently confined to Africa. *Setogyroporus* is also African and based on a single species from the Congo (Heinemann & Rammeloo, 1982b) although there is evidence of a second species in Cameroon (Watling, unpubl. data). Singer (1986) considers *Setogyroporus* a synonym of *Tuboseta*. *Setogyroporus* is placed along with the preceding in the *Gyrodontoideae*. *Boletochaete* is now restricted to *Boletus spinifer* Pat. & Baker and its relatives, although Corner (1972) strongly argues it is purely an extension of the tropical group he places in *Boletus* subgen. *Tylopilus*. He points out that the cystidia are filled with a conspicuous brown material but are not

thick-walled. Corner (1972) describes several species of bolete with thick-walled, acute or hour-glass shaped cystidia. It would appear that thickened cystidioid walls have occurred in several species consortia.

In the case of *Tuboseta* we believe it to be ectomycorrhizal and the association with termites noted by Heim (1938) secondary. It is well known that there are both changes in soil structure and concentrations of nutrients at the base for around termite workings and nests; these attract tree-roots and it would seem reasonable to think that suspected ectomycorrhizal fungi would fruit there too, even using the termite structures to raise the fruit-bodies above the forest floor.

Such a phenomenon has been observed in the Australian rain forest where *Boletellus emodensis* (Berk.) Singer has been found fruiting at shoulder height on a stringy barked Myrtaceous tree, the mycelium permeating the soft, open bark.

VELOPORPHYRELLUS Gomez & Singer

Veloporphyrellus africanus Watling, sp. nov., Fig. 2E & F, Fig. 3 D–F

Pileus 35–50(–100)mm, convexus, testaceus rimis bubalinis, siccus, margine albo laciniis magnis triangularibus formanti. *Stipes* 40–50(–100) x 7–8mm, avellaneus ad apicem livido-virescentes, ubi contusi azurei. *Pori* olivacei. *Caro* alba, caerulescens. *Basidiosporae* elongato-subfusiformes, (11.8–)12.7–13(–14.2) μm x 4.4–4.8(–5.2) μm .

Type: Zambia, Riverside, Kitwe, 5 iii 1975, FP 370/3 (E).

Pileus 35–50(–100)mm, convex, brick with buff cracks, dry, margin a white prominent marginal fringe which later forms large triangular flaps. *Stipe* 40–50(–100) x 7–8mm, buff-hazel becoming livid vinaceous at apex, bruising blue or livid vinaceous and then blue, whitish bruising ochraceous towards centre, stuffed. *Tubes* free, hazel then olivaceous mm long; *pores* small, angular, olivaceous. *Flesh* spongy, white becoming blue on exposure to air.

Basidia 4-spored, hyaline, broadly clavate with granular contents 23–25 x 12.5–14mm. *Basidiospores* (11.8–)12.7–13(14.2) x 4.4–4.8(–5.2) μm , elongate, subfusiform (bole-toid), smooth, pale honey-colour in water and ammoniacal solutions, fawn in mass. *Pleurocystidia* hyaline, easily collapsing, cylindric-tapered or lageniform, 26–27.5 x 5–6.5 μm , apex 4.5–5 μm , scattered, not numerous, some with cytoplasmic granular material; *cheilocystidia* similar to pleurocystidia forming an irregular fringe, 19.5–26.5 x 5–6.5 μm (apex 3.5 μm). *Hymenophoral* trama, hardly differentiated into lateral and mediostrata, non-gelatinized, lacking laticiferous hyphae, not distinctly divergent. *Pileipellis* composed of a loose, collapsing suprapellis of hyaline to pale tawny brown, intertwined, asperulate to minutely, although distinctly verrucose, hyphae, 4.5–13 μm broad, some with granular contents, with rounded blunt-ended end-cells, collapsing onto a compacted subpellis composed of rather narrow hyphae (4.5–6 μm broad) demarcating it from open, hyaline intertwined smooth hyphae (17.5 μm broad) forming the floccose context which becomes slightly gelatinized and compacted immediately above the tube-zone. *Clamp-connections* absent.

Habitat: In clusters in moderate shade in relic miombo woodland.

Material examined: Riverside, Kitwe, 5 iii 1975 (holotype) FP 370/3, Ivory 25b and 850/1 ; further material in Forest Pathology Herbarium, Riverside Lab (NDO) FP 339/12

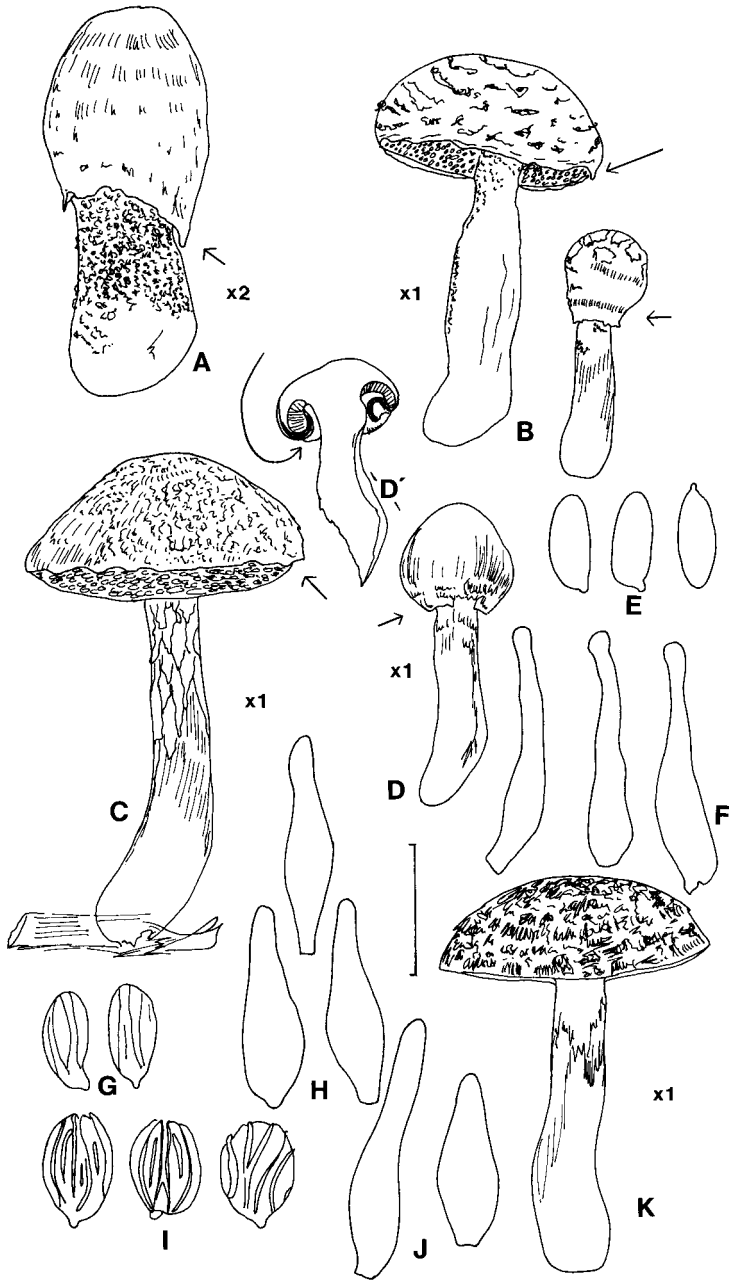


FIG 3. A, *Leccinum atrostipitatum*, Smith, Thiers & Watling. Wat. A 1546/C 1808; B, *Boletellus emodensis* (Berk.) Singer Wat. 10945; C, *Boletus projectellus* Murrill Watling 3373; D–F, *Veloporphyrellus africanus* Watl. holotype FP 370/3 & FP 338/17; (habit sketch). G & H *Boletellus pustulatus* (Beeli) Gilbert FP 176/45. I–K. *Afroboletus azureotinctus* Watl., holotype FP 335/7; A–D, & K, Habit sketches (D. Section). E, G, & I, Basidiospores. F, H & J, Pleurocystidia.

from Kitwe and 850/5. FP 338/17, *Ivory* 25 from Misaka Forest Reserve undoubtedly refers to this species but is immature.

Veloporphyrellus, based on *V. pantoleucus* Singer, was described originally for a collection from Costa Rica (Gomez & Singer, 1984) and our material agrees with the general facies. Unfortunately no possible mycorrhizal hosts are indicated by Gomez and Singer but undoubtedly the present material was connected with either *Brachystegia* or *Marquesia*. The African material differs markedly by the blueing flesh and narrower basidiospores.

The young material (FP 338/17, *Ivory* 25a) exhibits an elongate stipe with a slightly top-shaped pileus with enormous marginal flaps. The collar embraces the stipe in much the same way as *Boletellus emodensis* (Berk.) Singer, *B. ananiceps* (Berk.) Singer and *Boletus dissiliens* Corner. The tube-colour in the material indicates an affinity to the tylopiloid boletes.

It is particularly interesting that the marginal flaps have been exploited by members of several only slightly related genera: *Leccinum* as in *L. versipelle* (Fr. & Höh.) Snell, *L. atrostipitatum* Smith, Thiers & Watling etc., in *Boletus* as in *B. mirabilis* Murrill & *B. projectellus* Murrill in *Boletellus* (see Figs 3 A–C) and in some tylopiloid groups. It is to be expected that species of *Strobilomyces* have this structure and it does not seem out of place within the genus *Suillus* where non-velar and velar species are placed side by side in several classifications.

This raises the interesting question as to whether *Veloporphyrellus* is really worthy of generic rank especially when compared with *Boletellus*, where *B. emodensis* displays a frill and/or collar whereas *B. obscureococcineus* (Höhnelt) Singer lacks such tissue development.

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