

## MACROMYCETES FROM THE STATE OF PARANÁ, BRAZIL

### 5. Poroid and lamellate boletes

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Nine species of tubulate and two species of lamellate boletes are recognized in the mycota of Paraná State, Brazil, of which five are considered introduced.

*Gloeocantharellus corneri* and a further genus of boletes are noted, the latter based on immature material. These records are new to South America, Brazil or Paraná State. Three new combinations are made in the genus *Boletinellus* for species previously placed in *Gyrodon*: *Boletinellus exiguus*, *B. monticola* and *B. rompelii*.

*Keywords.* *Austroboletus*, boletinoid, ecology, *Gloeocantharellus*, paxilloid, *Phlebopus*, suilloid, xerocomoid.

### INTRODUCTION

Brazil is an enormous country covering over 8,500,000 square kilometres and hosting many kinds of vegetation from tropical rainforest to grasslands and savannah communities. Paraná State is situated in the southern part of Brazil and particular attention has been paid by the junior author to the fungi found along the coastal strip from the Atlantic seaboard to the hills and mountains of the Serra do Mar, in the metropolitan area of Curitiba, and along the River Iguaçú. The main vegetation of this region includes dense ombrophilous forest, mixed ombrophilous forest with *Araucaria angustifolia* (Bert.) Kuntze, seasonal deciduous alluvial, regularly flooded forest, forest on marine sands ('restinga'), and plantations of introduced *Pinus* and *Eucalyptus*. These vegetational types are defined by Veloso & Goés-Filho (1982) and have been used in earlier mycological studies by Rajchenberg & Meijer (1990), and Watling (1992).

### MATERIALS AND COLOUR TERMINOLOGY

The two- or three-letter code in front of the number of the herbarium exsiccata refers to the main collection sites which are discussed in detail by Meijer (1992). These are all situated in Paraná State and are the following:

- COB = Colombo (municipality), Parque Castelo Branco
- CUa = Curitiba, quarter Uberaba, Reserva Biológica Cambui
- CUB = Curitiba, Parque Barigui

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CUe = Curitiba, quarter Jardim das Américas, Hospital Erasto Gaertner  
 GC = General Carneiro, Fazenda São Pedro  
 MA = Marumbi Parque (situated in several municipalities)  
 MANa = Mandirituba, forest near graveyard and Diamante river  
 PAa = Paranaguá, Ilha do Mel  
 PAb = Paranaguá, Pontal do Sul  
 PIb = Piraquara, forest along street to Borda do Campo  
 SJa = Sao José dos Pinhais, quarter Boneca do Iguaçú, forest at Harry Feeken Street

All collections cited under 'Material examined' are deposited in E. The colour codes in the descriptions follow *Methuen's Handbook* (Kornerup & Wanscher, 1978). 'R' in the descriptions refers to the pileus radius.

## TAXONOMIC ACCOUNT

### *Boletes with tubulate hymenophore*

**1. *Austroboletus festivus*** (Singer) Wolfe, *Biblioth. Mycol.* 69: 92 (1979). **Fig. 1A, B; Fig. 2.**

Pileus 33–80mm broad, fleshy (5–7mm thick at  $\frac{1}{2}$ R; 8–13mm thick at centre), strongly convex, margin entire, with areolate surface especially towards centre, dry, matt, glabrous, brown (6E4) on pale pinkish background, becoming evenly yellowish brown (5CD5), appressed squamulose on yellowish ground (4A2), squamules <1mm, azonate, lacking veil. *Hymenophore* adnexed, depressed near stipe; *tubes* 5–22mm long, white becoming greyish yellow (4C4); *pores* somewhat angular, mostly isodiametric 0.8–1.5(–2)mm diam., white becoming sometimes greyish yellow (4C4), finally light brown (5D4). *Stipe* 65–95 × 10–16mm, cylindrical, straight or bent, slightly tapering upwards, solid, smooth towards base and at apex, brown furfuraceous in upper third, very humid or slightly viscid in wet weather, drying quickly, white at apex, elsewhere yellowish (4A3), base orange-white (6A2) to greyish red (7B4). *Context* in pileus remaining pure white; in stipe white at apex and in cortex, dark bluish green in centre on cutting, dark ruby (12F4) to purplish brown at very base or merely brownish grey (8C2); *smell* fungoid; *taste* mild. Ammonia on pileus immediately producing intense or light blue ring but fading, and on stipe either negative or leaving a permanent dull green ring (26E4).

*Basidiospores* in mass brown (5CD4) without any olive flush, 15–17 × 5–5.7µm, cylindrical-fusiform to navicular, shallowly punctate with obscure meanderings and reticulate ridges. *Basidia* 4-spored, broadly clavate, 27.5–32.5 × 11–15µm. *Pleurocystidia* 45–80 × 13–20µm, thin-walled, fusoid-ventricose, golden yellow in Melzer's reagent; *cheilocystidia* hyaline or similarly coloured to pleurocystidia, elongate clavate, 35–60 × 5–7.5µm. *Pileipellis* of parallel, cylindrical, non-encrusted hyphae 40–90 × 6–11µm. *Clamp-connections* absent.

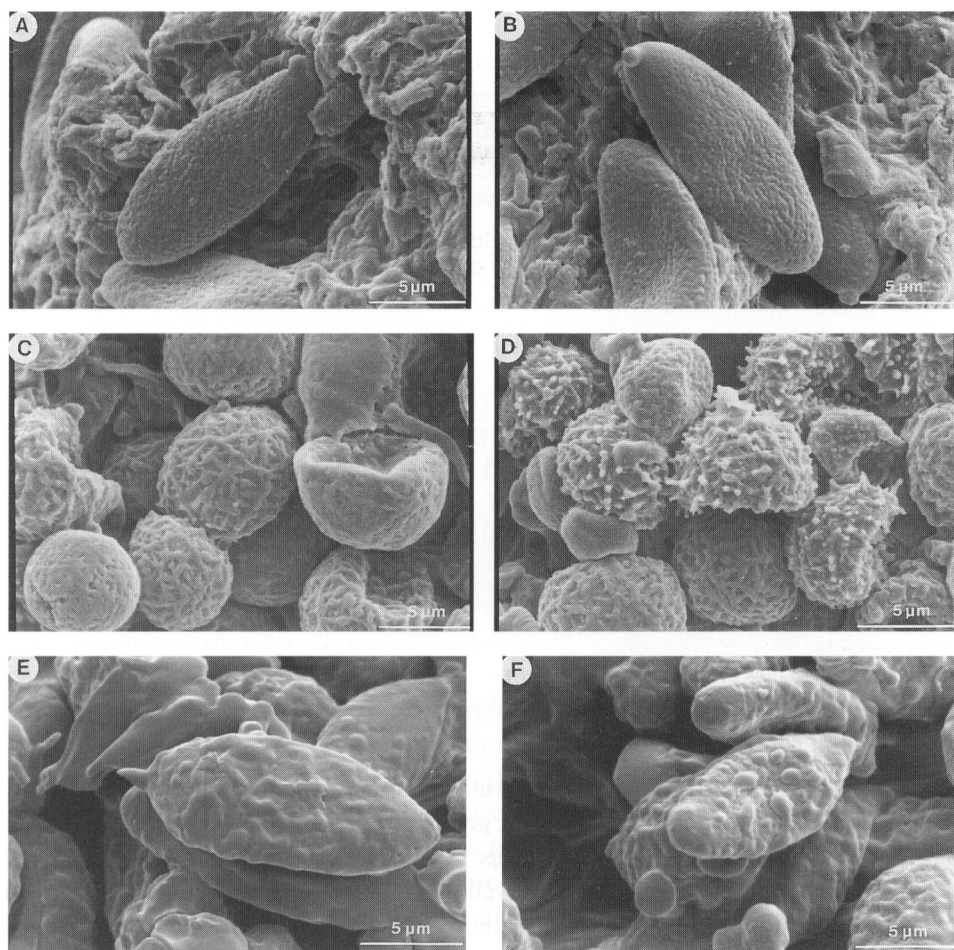


FIG. 1. Basidiospores. A & B, *Austroboletus festivus* (Meijer 1205). C & D, *Neopaxillus echinosporus* (Meijer 1690): C, immature basidiospores; D, mature basidiospores showing spines. E & F, *Gloeocantharellus corneri* (Meijer 2949).

MATERIAL EXAMINED. Paranaguá, PAa, in 'restinga' forest, 18 iii 1989, Meijer 1205; *ibid.*, 6 v 1989, Meijer 1228. A more recent collection (26 iv 1996) has been made by the second author in moss in restinga forest at Fazenda Sambaqui, Garanguaçu (Paranaguá).

This species, originally described from Pernambuco in northern Brazil (13 viii 1960; Singer, 1961) is apparently not rare and is found singly or in pairs in the native forests on coastal sands along the Atlantic coast of Paraná State. One collection (Meijer 1228) grew close to *Ocotea pulchella* Martius (Lauraceae).

**2. *Chalciporus piperatus*** (Bull.: Fr.) Bataille in Bull. Soc. Hist. Nat. Doubs 15: 19 (1908).

Pileus 17–30mm broad, hemispherical, expanding only slightly, not hygrophanous,

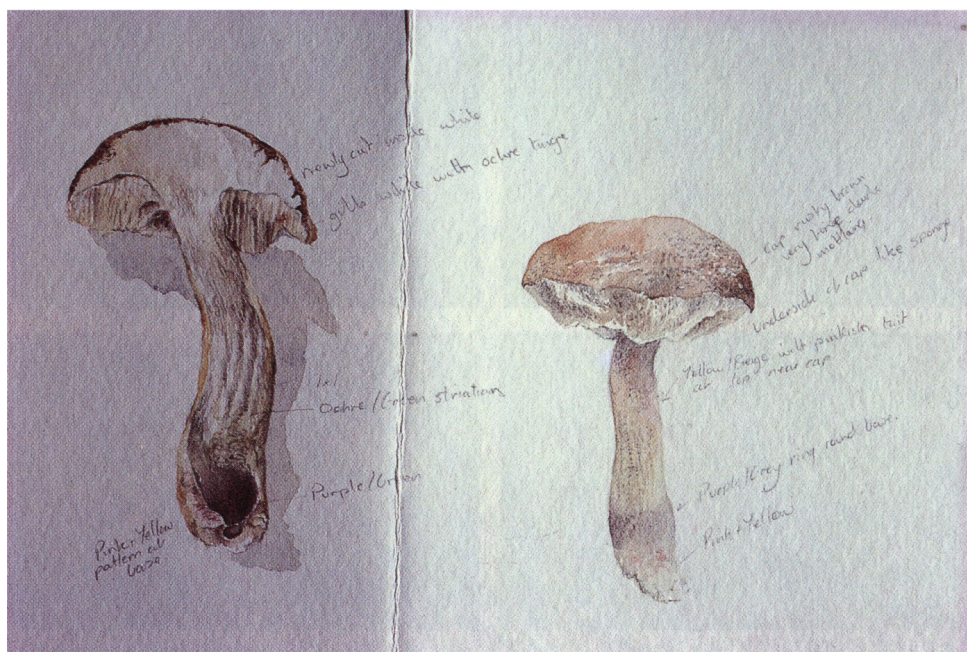


FIG. 2. *Austroboletus festivus* (field aquarelle).

brownish orange (5C6), viscid when wet, smooth, glabrous, rather thick-fleshy. *Hymenophore* adnate; *tubes* <4mm long, greyish yellow (3–3.5C4); *pores* not isodiametrical, 1 × 0.5mm, brown (6D7). *Stipe* 15–50 × 2.5–11mm, mostly cylindrical, sometimes broadest in lower half, solid, yellow (3A7), yellow intermixed with brown towards apex, smooth, dry, basal mycelium pale citrine yellow. *Context* in pileus pale yellow (2–3A3), in stipe bright citrine yellow (2A8); *taste* very sharp. No colour change with ammoniacal solutions. *Spore-print* brown (6E5).

The microscopic characters show no variation from those of European material (Watling, 1969a), viz. basidiospores subfusiform to ellipsoid, pale straw-colour in ammoniacal solutions, 8–10(–11) × 3–4(–4.5) μm and cheilo- and pleurocystidia fusiform to lageniform, hyaline to straw-colour in ammoniacal solutions but many covered in a mucilaginous deposit which in some hardens to a darker layer. The pleurocystidia are scattered and increase in number towards the tube orifices where they pass imperceptibly into cheilocystidia of similar morphology; they are never fasciculate as in *Suillus*. The pileipellis is a poorly developed ixotrichoderm with the elements suberect, but in most specimens this has collapsed to be almost repent. The stipitipellis consists of parallel or subparallel hyphae overlaid in the apical area with scattered fragments of caulohymenium.

MATERIAL EXAMINED. Curitiba, CUe, under planted *Pinus* sp., 7 v 1988, Meijer 1122. The collection agrees in all ways with European material (see Watling, 1969a). It

has probably been introduced to Brazil with exotic plantings where it grows exclusively under *Pinus elliottii* Engel. and *P. taeda* L. with which it is probably ectomycorrhizal. Records exist (T. May, pers. comm.) for this fungus having been introduced in a similar way into Australia (see Watling & Gregory, 1989).

*Chalciporus piperatus* is characterized by its (1) cinnamon, humid to viscid pileus which becomes ochre and generally dries rather shiny; (2) cinnamon to brick-coloured, rather angular, decurrent tubes; (3) red-carmine line in the flesh above the tubes; and (4) bright citrine yellow flesh in the stipe-base; the flesh is very hot to taste.

**3. *Phlebopus beniensis*** (Singer & Digilio) Heinemann & Rammeloo in Mycotaxon 15: 390 (1982).

Pileus 60–150mm broad, convex, fleshy (10–20mm thick at halfway from margin but <22mm thick near stipe) smooth, dry, yellowish brown (5D6), lacking all olivaceous tints; margin entire. *Hymenophore* narrowly adnexed, not depressed about the stipe, never decurrent; *tubes* <7mm long, olive-brown (4D5); *pores* <0.5mm broad but sometimes <1mm long, small, somewhat angular, olive-brown (4D5) when mature with darker spots. *Stipe* 50–110 × 15–50mm, clavate, solid, dry, smooth, yellow at apex, elsewhere dark reddish brown, finally becoming dark purple or very dark brown. *Context* pale yellow (3A2–3) in both pileus and stipe, becoming darker (3A7) on drying in pileus and stipe-medulla, brownish yellow under stipe-cortex and in base, not or only very slightly blueing; *smell* fungoid. Ammoniacal solution negative on pileus, pale pinkish in stipe, blue and pinkish blue in pileus flesh.

*Basidiospores* ellipsoid 6–7 × 5.5(–6)µm. *Basidia* 4-spored, 25 × 10µm. *Cheilocystidia* 30–45 × 10–15µm, ventricose-clavate, hyaline or with brownish detritus; *pleurocystidia* absent. *Pileipellis* a trichodermium of interwoven, filamentous hyphae 4–7.5µm broad giving rise to swollen, hyaline, thin-walled, lageniform or clavate erect terminal cells. *Clamp-connections* abundant.

MATERIAL EXAMINED. Paranaguá, PAb, Centro de Estudos do Mar, in mangrove vegetation, gregarious on sandy, muddy soil, 7 ii 1991, legit Cesário dos Santos & Nilva Brandini, *Meijer* 1883. Vera Cruz do Oeste, Paraná State, in native forest, i 1990, legit O. Riepenbach, *Meijer* 1529.

Our collection (*Meijer* 1883) was found with native woody plants: *Laguncularia racemosa* Gaertn.f. (Combretaceae) and *Hibiscus tiliaceus* L. (Malvaceae) were close by and no exotic trees occurred in the vicinity of the material.

This bolete was originally placed in *Phaeogyroporus* by Singer & Digilio (1960) although Heinemann & Rammeloo (1982) have shown that it is best accommodated in *Phlebopus*. This genus has representatives in Australia (Watling & Gregory, 1988) and New Zealand (McNabb, 1968), Sri Lanka (Pegler, 1986), Africa (Pegler, 1971; Heinemann & Rammeloo, 1982, 1983) and Lesser Antilles (Pegler, 1983), in addition to the three species described from South America (Brazil and Argentina). *P. beniensis* differs from one of these, *P. brasiliensis* Singer, in the blueing flesh, larger size, and particularly in the swollen tips to the end-cells of the pileipellis hyphae. Heinemann & Rammeloo (1982) placed *P. beniensis* in a distinct subgenus but this

would appear to be unnecessary judging from the other differences between the constituent taxa. It differs from *P. tropicus* (Rick) Singer, the third South American member, particularly in the wide, subgyrose to boletinoid pores.

**4. *Suillus cothurnatus*** Singer in Farlowia 2: 201 (1945).

Pileus <70mm broad, greyish orange (5B4) at first, finally light brown (5D4), smooth, very shiny, non-innately fibrillose, slimy in wet weather, lacking velar remnants. *Hymenophore* pale yellow, darkening with age; *pores* 2–3 per mm, light yellow (3.5 A4) at first then greyish yellow (4B4) and finally greyish yellow/orange (4.5 B5), unchanged by ammoniacal solutions. *Stipe* ≤10mm, thick, with glandular-like dots (caulohymenium) obscured by thick, baggy, white ring, which is shiny in wet weather, and often flares away from stipe at both top and bottom, at most becoming pale purplish when old; basal mycelium white, hardly darkening even with age. *Context* in pileus and stipe pale orange darkening on drying and greyish orange (5B3) to pale yellow (4A3) when fully dry; *taste* mild; *odour* not recorded.

The microscopic characters are characteristic of a member of subsection *Angustiporini* Singer of which *S. granulatus* is considered to be the type. The surface of the stipitipellis of *S. cothurnatus* resembles *S. luteus* although obliterated because of the remnants of the collapsing hyphae of the velar remnants. The masking of the caulohymenium with its distinctive paraphyses is even more developed than in *S. luteus*, although it can still be found over the entire stipe when the ring is removed. The basidiospores are subfusiform-ellipsoid, smooth, pale straw-colour in ammoniacal solutions, 8–8.5(–9) × 2.7–3(–3.5) μm, and the cheilo- and pleurocystidia are elongate-clavate to broadly clavate or fusiform and distinctly encrusted in dark amorphous material. The pileipellis is an ixocutis composed of narrow, filamentous hyphae embedded in gelatinous material and elements not erect towards the margin.

MATERIAL EXAMINED. Paraná, COB, under *Pinus elliottii*, 6 iv 1991, Meijer 1908.

By virtue of the yellow flesh and very striking sheathing ring, Singer (1945) considered collections such as that above sufficiently distant from *S. luteus* (L.: Fr.) S.F. Gray (see below) to be considered a separate species. He therefore introduced *S. cothurnatus* with two subspecies, the first (subsp. *aestivalis* Singer, termed the type subspecies – Singer, 1945) on bare or mossy ground and on mossy trunks in low and high hammocks in the neighbourhood of *Pinus palustris* Miller and *P. taeda* in southern N America, although sometimes as far as 11m from the nearest tree. Singer rarely found it in flat woods and scrub and records it as being scattered in small groups from May until September in N Florida and until October in C Florida.

The second (subsp. *hiemalis* Singer) he found on soil from October or November to January and from Florida to N Carolina. Although occurring with the same pines it was also recorded with *P. australis* Mich., considered by some to be synonymous with *P. palustris*.

Singer (1945) considers these two subspecies to be seasonal, dimorphic races of a single taxon differing in the length of the stipe and reaction of their context with

ammonia, i.e. carrot-red in the low temperature race and purple in the summer temperature race, analogous characters apparently having been seen by him in other taxa. He believes this is a 'biformity' (Singer, 1945: 264) with slight differences also in stipe width and pileus colour, i.e. stipe 4–7mm wide and pileus colour ochraceous yellow to cinnamon-buff in subsp. *aestivalis* and stipe 9–11(–13)mm and pileus browner in subsp. *hiemalis*. The latter also has a light salmon-orange stipe-base, more cinnamon-coloured than yellow stipe and slightly larger basidiospores ( $7.8\text{--}9.8 \times 2.7\text{--}3.2\mu\text{m}$ , as opposed to  $7.5\text{--}9.8(–12.3)\mu\text{m} \times 2.7\text{--}3.5(–5)\mu\text{m}$  fide Singer, 1945). The differences exhibited are well within the variation found in other species in this section of the genus, e.g. *S. granulatus* in which no subspecies are presently recognized, although considerable genetic variation is recorded (see below).

The baggy ring, pallid to brownish stipe with brown, resinous, glandular-like dots, fragrant odour and caulohymenium lacking paraphyses on the stipe of *S. cothurnatus* are distinctive. It is related to *S. subluteus* (Peck) Snell ex Snell & Slipp with which it can be confused; indeed Smith (1958) called the last taxon '*cothurnatus*' in his *Mushroom Hunter's Field Guide*. This mix-up was undoubtedly because Singer had previously recognized his *cothurnatus* in Northern Michigan (Smith, pers. comm.). The description of *S. cothurnatus* in Snell et al. (1959) refers to this same bolete, which was later considered to be *S. subluteus* by Smith & Thiers (1964). *S. subluteus* grows with *P. banksiana* Lamb.; it lacks the paraphyses in the caulohymenium. Snell & Dick (1970) have interpreted the data differently, separating and associating *S. subluteus* with *P. strobus* L., one 'northern form' of *S. cothurnatus* with *Pinus resinosa* Aiton (generally with red-brown dark pileus) and another with *P. banksiana* (generally with whitish background). *S. cothurnatus* s.str. must be retained for a southern bolete with typification based on the fact that Singer elsewhere indicated '*aestivalis*' as 'type subspecies' (Singer, 1945), automatically typifying the name *cothurnatus* and making '*aestivalis*' superfluous. Smith & Thiers (1964) unnecessarily selected subsp. *aestivalis* as var. *cothurnatus*, although they also changed the rank. For further discussion see Singer et al. (1983).

The Brazilian material agrees with the type of *S. cothurnatus* by virtue of its pileus colour, velar characteristics, hymenophore colour and basidiospore size. In Paraná State it is encountered under *Pinus elliottii* and *P. patula* and has undoubtedly been introduced with exotic trees. Under these conditions it is not unknown for an ectomycorrhizal associate to 'jump' hosts both in the nursery and in plantings, especially in the absence of the normally found associate (see Watling & Gregory, 1989). We believe this has happened in the above example; *P. elliottii* is native to S Carolina and Florida westward to Louisiana whereas *P. patula* is native to the warm temperate altitudes of central eastern Mexico.

*Suillus pinorigidus* Snell & Dick is closely related; it occurs with *Pinus rigida* Miller but differs in its olive tints to the pileus and orange-buff hymenophore characters absent from the Brazilian collection of *S. cothurnatus*. In *S. cothurnatus* the flesh darkens rather quickly when exposed and takes on shades of orange-grey when fully dry. However, Palm (1983) considers *S. pinorigidus* and *S. salmonicolor* (Frost) Halling synonymous, the last being the earlier name.

**5. *Suillus granulatus* (L.: Fr.) Kuntze, Rev. Gen. Pl. 3(2): 535 (1898).**

The macroscopic and microscopic characters agree in all ways with European collections of this species (see Watling, 1969a). The basidiospores are subfusiform-ellipsoid,  $8-10 \times 2.5-3 \mu\text{m}$ , and pale straw-colour in ammoniacal solutions, and cheilo- and pleurocystidia occur in obvious bundles in a well-developed hymenium obscured with dark, amorphous encrusting material. The pileipellis is an ixocutis of gelatinized narrow hyphae  $3-5(-7) \mu\text{m}$  broad and the stiptipellis is composed of cylindrical hyphae ornamented with bundles of caulocystidia, similar in all ways to the cheilocystidia.

This species has undoubtedly been introduced to Brazil with the introduction of pines. In the present study *S. granulatus* was found under *Pinus elliottii*, *P. patula* and *P. taeda*. It is known to be associated with a whole range of members of the genus *Pinus* in Australia (Watling & Gregory, 1989), in Africa (Watling & Turnbull, 1994) and in the Philippines with *P. kesiya* Royle ex Gord. (Watling, pers. obs.: Watling 25615). It is probably the most common and widespread bolete with introduced pines all over the world; see *S. luteus* below. *S. granulatus* is also known in very strange circumstances in the absence of Coniferae in Peninsular Malaysia (Corner, 1972). In the light of recent molecular studies Kretzer et al. (1995) indicate that *S. granulatus* from N America and from Europe and Asia differ fundamentally and may have different origins; similar work using Malaysian and S American populations would be of great interest.

MATERIAL EXAMINED. Paraná, COB, under *P. elliottii*, 6 iv 1991, Meijer 1909.

**6. *S. luteus* (L.: Fr.) S.F. Gray, Nat. Arrang. Brit. Pl. 1: 646 (1821).**

As with *S. granulatus* our material agrees in all ways macroscopically and microscopically with European material (see Watling, 1969a) and it too has been found in exotic plantings. *S. luteus* is included in *Mycoflora Australis* (Singer, 1969).

MATERIAL EXAMINED. Paraná, COB, under *P. elliottii*, 6 iv 1991, Meijer 1910.

*S. luteus* differs from *S. cothurnatus* in the less baggy ring which usually commences with a lilaceous or vinaceous flush and then takes on a distinct purple-brown coloration when mature; the ring does not flare out from the lower contact point with the stipe, all the ring tissue hugging the stipe and concealing the caulohymenium below. In addition, *S. cothurnatus* has a more slender stipe and slightly smaller, less thick-fleshed, paler pileus, which is never innately fibrillose. *S. salmonicolor*, which Palm (1983) considers the same as *S. subluteus* Smith & Thiers, is more slender and less robust than both *S. luteus* and *S. cothurnatus*, although it possesses the baggy veil of the latter. It differs from both in the lack of a distinctive caulohymenium on the stipe, and the salmon-coloured pore-mouths.

After the examination of many collections it would appear that *S. granulatus*, although lacking a ring, is more closely related to *S. luteus* than *S. cothurnatus* is to either (even *S. luteus* with which it shares the character of a well-formed ring). Both *S. granulatus* and *S. luteus* possess white flesh that yellows on drying, whereas the



flesh of *S. cothurnatus* is pale orange, darkens when exposed and darkens even further on drying. The first two species when they decay often show pinkish red colours whereas *S. cothurnatus* in contrast becomes greyish green when decaying. In addition, *S. cothurnatus* has a much thinner pileus-pellicle and consequently the context becomes much more quickly water-soaked after rain than either *S. granulatus* or *S. luteus*. These field observations would support Singer's deposition of *S. granulatus* and *S. luteus* in sect. *Angustiporini* (Singer, 1986) instead of dispersing them in different sections, e.g. Thiers (1975).

*S. luteus* has been found in many places in the world where members of the genus *Pinus* have been introduced; in this it parallels *S. granulatus*. It is known in Africa (Heinemann & Rammeloo, 1989), New Zealand (McNabb, 1968) and Australia (Watling & Gregory, 1989). Both this species and *S. granulatus* (q.v.) are collected for commercial purposes in Brazil on a very limited scale.

**7. *Xerocomus* cf. *coccolobae* Pegler in Kew Bull. Add. Series 9: 576 (1983).**

Pileus 30–50mm broad, convex then flattened, rather thick-fleshed, smooth, dry, glabrous, yellowish brown (5E4), olive- to hair-brown (4.5 E4), innately squamulose on yellowish white background, not pinkish between cracks, lacking veil. *Hymenophore* narrowly adnexed to narrowly adnate; *tubes* 3–4.5mm long, olive (3–4D5); *pores* c.2–3 per mm concolorous with tubes, somewhat angular, c.0.3–0.7mm wide. *Stipe* 35–60 × 4.5–9mm, cylindric, bent, solid, pale yellow (2A2.5) to yellowish white (3A2) with lower third yellowish brown (5E5) or with pale reddish brown striae, smooth, dry and in lower third pale reddish brown. *Context* in pileus and upper stipe pale yellow (2A2.5) to yellowish white (3A2), not blueing when cut except faintly so after prolonged pressure, reddish brown in stipe-base; *smell* fungoid or none; *taste* mild. Ammoniacal solutions on all tissues negative.

*Basidiospores* olive-brown (4D4) in mass, (8–)9–10.5(–10.8)µm × 3–3.8µm. *Basidia* 4-spored, 22 × 8µm. *Cheilocystidia* 45–55 × 5–10µm, narrowly fusiform, hyaline, thin-walled. *Pileipellis* a well-differentiated trichodermium of erect chains of short cylindric cells, the terminal fusiform, 35–50 × 5–10µm; *pleurocystidia* absent. *Clamp-connections* absent. *Caulocystidia* apparently absent.

MATERIAL EXAMINED. MANa, near Diamante river, solitary in mixed ombrophilous secondary forest, 24 ii 1991, *Meijer* 1884; MA, Capivari, solitary on humus in dense ombrophilous forest, 24 iv 1991, *Meijer* 1956.

*Xerocomus coccolobae* was described from under *Coccoloba* (Polygonaceae) in the Lesser Antilles (Pegler, 1983) and approaches two other taxa recorded from S America and the southern United States, viz. *X. brasiliensis* Singer and *X. hypoxanthus* Singer. In addition to Brazil the latter is known from Florida and Georgia (Singer, 1945) and Martinique (Pegler, 1983). Although the present Paraná collections have certain features in common with both the last taxa they differ in pileus coloration. Furthermore, the basidiospores of *X. brasiliensis* are much larger and the flesh of the Paraná material is less cyanescent. The yellowish to olive-brown, tessellate

pileus and unchanging flesh characterize *X. coccolobae*, although our collections possess smaller basidiospores than the type material from the Lesser Antilles.

It has not been determined with what angiosperm our collections were associated. What is certain, however, is that the locality, although probably disturbed at some time, is of native trees and has not been planted with exotic taxa. An association with *Coccoloba* has been indicated by Pegler (1983) although evidence of a root sheath and associated details to substantiate its ectomycorrhizal role is lacking. A search should be made in the two areas for potential angiosperm hosts bearing in mind that *Polygonum viviparum* L. (Polygonaceae) in the arctic-alpine areas is associated with *Russula nana* Blytt (Watling, 1988), and Janos (1980) has recorded ectomycorrhiza in plants which are neither dipterocarps, nor fagaceous, caesalpinoid or pinaceous taxa, viz. Mimosaceae, Rubiaceae and Verbenaceae.

### 8. *Tylopilus* sp.

The present fungus has a non-reticulate stipe and dry, evenly dark brown pileus with the overall appearance in stature and colour of *Tylopilus tenuis* Heinemann, a bolete from Central Africa. The basidiospores are  $10\text{--}11 \times 4.2\text{--}5\mu\text{m}$ , pileipellis poorly differentiated, a strongly adhering, collapsed cutis of repent, smooth, narrow hyphae intermixed with broader, sometimes catenulate hyphae filled with pale dull tawny sap,  $7\text{--}10\mu\text{m}$  broad, and a hymenophoral trama typically boletoid but lacking pigmentation. The cystidia are hyaline and lageniform with an obtuse apex  $\leq 2.5\mu\text{m}$  broad and are scattered on both pore margin and face; the context is not dextrinoid.

*Tylopilus* is generally considered ectomycorrhizal, which may still be the case even though our material (Meijer 2945, 19 xi 1994) was at the base of a trunk of a living tree-fern (Cyatheaceae). A species of *Lactarius* sect. *Russulares* has been found fruiting on fallen Stag's Horn fern (*Platycaera*: Polypodiaceae) in Malaysia, and species of *Lactarius* sect. *Gymnocarpi* are commonly found on old logs in West African rainforest and other species in old stands of conifers in Pacific North West America (Watling, pers. obs.). It is possible that the basidiomes in Malaysia were actually attached to adjacent dipterocarp roots. This is not an uncommon phenomenon.

Unfortunately only a single, immature basidiome was found, something not uncommonly frustrating the agaricologist when working in rainforest communities. At least the presence of such a fungus emphasizes that our knowledge is still incomplete and that even after considerable monitoring new taxa still appear in the study plots. Singer et al. (1983) record several species of *Tylopilus* and the related *Fistulinella* from C America and Amazonia; the latter genus is especially characterized by long, pale-coloured basidiospores.

### *Boletes with lamellate hymenophore*

Several species of *Phylloporus* and *Paxillus* have been recorded for S America, some associated with *Nothofagus* communities and showing affinities to Australasian taxa, e.g. *Paxillus statuum* (Speg.) Horak and *P. defibulatus* Singer. In *Mycoflora Australis*

(Singer, 1969) five species are considered, and Garrido (1988) and Hahn (1996) have discussed several taxa with supporting figures. Horak (1983) has discussed their mycogeography. In the absence of suitable mycorrhizal hosts in the Brazilian communities studied herein it is not surprising that the paxilloid fungi are poorly represented in the mycota. Only two species have so far been collected, viz. *Neopaxillus echinospermus* (Speg.) Singer and *P. panuoides* Fr.: Fr., which is better placed in the genus *Tapinella* (see Redhead & Ginns, 1985; Watling & Gregory, 1991).

**9. *Neopaxillus echinospermus* (Speg.) Singer in Lilloa (1950) 23: 231 (1951).  
Fig. 1C, D.**

Pileus 12–40mm broad, centre depressed from beginning, slightly hygrophanous, non-striate when fresh, golden brown (5D7), brownish orange (5C5) when dry, smooth, dry, glabrous; margin often decurved, sometimes undulate. *Gills* strongly decurrent, distant, margin straight or concave,  $\leq 5.5$ mm broad, clay-brown (5D5) at first, dark brown (6F6) when fully mature, neither interveined, nor forked. *Stipe* 17–40  $\times$  3.5–7mm, cylindrical or slightly attenuated downward, solid, paler and more yellowish than pileus, minutely innately brown-striate, smooth, dry, basal mycelium white. *Context* in pileus when fresh yellowish brown (5DE5), drying pale ochraceous to white, in stipe drying white, but in stipe-base often becoming brown; *smell* fungoid or none.

*Basidiospores* 7–8(–8.5) $\mu$ m long, subglobose, strongly warty-echinulate, ornaments  $< 0.7\mu$ m high, non-amyloid. *Cheilo-* and *pleurocystidia* absent. *Pileipellis* composed of very irregular, rarely encrusted hyphae 5–7.5 $\mu$ m broad. *Clamp-connections* abundant.

**MATERIAL EXAMINED.** Paraná, GC, Fazenda São Pedro: solitary, in twos or loosely gregarious in mixed ombrophilous forest, in humus, 12 v 1990, *Meijer* 1690; *ibid*, 20 xii 1989, *Meijer* 1424.

The present material agrees with the studies by Singer (1948) and Singer (1964), the former under the later synonym *Neopaxillus echinosporus* Singer and the latter under *N. echinospermus* based on *Naucoria echinospermus* Speg. described from Apiiaí, Brazil in the state of São Paulo (*Puiggari* 2918 in LPS). The type locality of *N. echinosporus* is reported as Couto, in southern Brazil (*Rick* 1936), a site which although important in mycological terms for many fungi has been difficult to trace\*. *N. echinospermus* in addition to Brazil is recorded from Bolivia, Paraguay and Argentina (Singer & Digilio, 1952; Singer, 1964).

\* In South America João Rick's collecting work was limited to the Brazilian state of Rio Grande do Sul, with only a few visits to the neighbouring state of Santa Catarina. There no longer exists a locality in southern Brazil with the name of Couto (in other parts of Brazil there are a few localities with this name). However, an ancient postal guide mentions a locality with this name for the state of Rio Grande do Sul. It describes its localization as follows (translated from the Portuguese): 'between the roads of the Rio Pardo and João Rodriguez at a distance of 39km from Vila Tereza, 3km from Rio Pardo and 22km from João Rodriguez'. (Reference: BRASIL (1930). *Guia Postal Geográfico da República dos Estados Unidos do Brasil*. Rio de Janeiro.)

There is some discussion as to whether this fungus is truly paxilloid. *N. echinospermus* undoubtedly has affinities to *Ripartites* but the senior author does not concede that this latter genus is a member of the Boletales.

**10. *Tapinella panuoides* (Fr.) Gilbert, Les Boletes 67 (1931).**

The available material of this taxon agrees in all ways with European material (see Watling, 1969a). It is too early to say whether the kind of variation exhibited by collections from Australia as outlined by Watling & Gregory (1991) will be found in Brazil from where Singer (1964) also records this fungus. It is very probable that, as hypothesized for Australia, it has been introduced to S America. Singer (1969) records this taxon in *Mycoflora Australis* from Argentina. The basidiospores of our material measured  $4.2\text{--}5 \times 3.2\text{--}3.7\mu\text{m}$ .

MATERIAL EXAMINED. São José dos Pinhais, SJa, on decayed boards, 8 × 1979, Meijer 171.

*Boletes with boletinoid hymenophore*

One of the more widespread genera of boletes in S America, and in the study area, is *Gyrodon* as circumscribed by Singer (1945, 1951 et subsq.). Examination of *G. exiguus* and *G. rompelii* from Paraná State and comparing them with collections from other parts of the world has led us to a better understanding of the relationships between the diverse taxa involved. With good collections of the above two taxa, fresh collections of *Uloporus lividus* (Bull.: Fr.) Sacc. (= *Gyrodon* sensu Singer) from Britain and Sweden, and a possible new taxon from Selangor, Malaysia (Watling 24559) resembling *G. exiguus* as illustrated by Singer (1986), a revision of the whole complex is considered necessary. Singer (1945) draws attention to a closely related fungus from Indonesia with slender, excentric stipe, thin pileus and short, ellipsoid basidiospores ( $7.8\text{--}10.2 \times 5.5\text{--}6.8\mu\text{m}$ ) which agrees with Watling 24559 and a collection housed in KEP as FP 124/8. The little-known *G. ledermanni* Kallenb., recorded from New Guinea, is a member of the same consortium. Many of the suggestions of Høiland (1987) from cladistic analysis are supported and radical changes to the delimitation of the genera are required.

Both the Paraná species based on anatomical characters are found to be cogenetic with *Boletinellus meruloides* (Schw.) Murrill, a North American fungus found with *Fraxinus amaricana* L. (Oleaceae) which has also recently been found in Japan, also with *Fraxinus*. *Boletinellus* is considered autonomous and only distantly related to *Uloporus*, the type of which is the European *U. lividus*. This fungus has now been recorded from California, N America (Haward & Theirs, 1984), under the incorrect name *Gyrodon lividus* (Bull.: Fr.) Quélet (Donk, 1955; Watling, 1964).

The authors believe that neither *Boletinellus* nor *Uloporus* are related to *Gyroporus*, for which there is no representative in S America, and nor are they related to *Phlebopus*. *Phlebopus*, which in an emended form includes *Phaeogyroporus* Singer, is as related to *Boletus* as *Paragyrodon* is to *Suillus* (Høiland, 1987; Watling, 1969b);

see above. Undoubtedly *Gyrodon monticola* Singer, originally described from Argentina, is also a member of this consortium and should be transferred to *Boletinelus* also. *G. monticola* has recently been recorded from Colombia by Halling (1989).

The following new combinations below are necessary:

**11. *Boletinelus exiguus* (Singer & Digilio) Watling, comb. nov.**

Basionym: *Gyrodon exiguus* Singer & Digilio in Lilloa 30: 154 (1960).

Pileus 10–70mm broad, 10–45mm wide, plano-convex, margin incurved to almost straight, reniform in circumference when seen from above, pale yellow (4A3), becoming yellowish brown (5E5), neither hygrophanous nor striate, non-zonate, fibrillose-glabrous to flocculose, matt, dry, medium fleshy; margin entire, regular to slightly wavy. *Hymenophore* lamellar-porose-anastomosed, subdecurrent; *tubes*  $\leq 4.5$ mm long; *pores*  $\leq 1$ mm broad, at first yellowish white (3A2), then light yellow (3A5), distinctly blueing when bruised, finally becoming reddish brown (8CD5). *Stipe* lateral, 5–15  $\times$  2.5–8mm, cylindrical or slightly attenuated upwards, not flattened, straight or bent, solid, blackish brown either only at base or all over, at apex often somewhat paler, viz. dark olivaceous brown or with reddish tinge; surface smooth, matt, dry, velvety. *Context* rather soft, white but when exposed immediately spotting reddish brown (9D5), becoming white on drying; *smell* fungoid; *taste* mild. Potash solution changing pileal surface immediately from yellow to olivaceous and pores from yellow to brownish with bluish green edge. *Spore-print* dark olivaceous brown.

*Basidia* 4(–2)-spored, clavate, hyaline or straw-colour, 25–30  $\times$  7.5–10 $\mu$ m. *Basidiospores* 7–9(–10)  $\times$  5.5–6(–6.5) $\mu$ m, ellipsoid, honey-coloured to pale brown in ammoniacal solutions, non-amyloid, smooth, lacking germ-pore. *Cheilo-* and *pleurocystidia* poorly differentiated, hyphoid, sparse and easily overlooked. *Pileipellis* a poorly developed cutis of repent, filamentous hyphae, 3–5 $\mu$ m, broad with both encrusting brown pigment and amorphous brown material between hyphal elements. *Clamp-connections* present.

MATERIAL EXAMINED. Paraná, MA, Estação Banhados, in troops on trunk of spiny tree-fern (Cyatheaceae), in dense ombrophilous forest, 23 i 1987, *Meijer* 731.

This fungus was originally described from the montane hygrophytic forests of Brazil although it is now known from Martinique (Pegler, 1983). It is rather pleurotoid in habit. Our material agrees well with the protologue although the basidiospores are rather more variable in size. This species is apparently common in small to medium troops in the Atlantic rainforest of the Serra do Mar. Singer et al. (1983) do not consider this taxon mycorrhizal.

**12. *Boletinelus rompelii* (Pat. & Rick in Rick) Watling, comb. nov.**

Basionym: *Phyllopus rompelii* Pat. & Rick in Rick, in Broteria 6: 81 (1907).

Syn.: *Gyrodon rompelii* (Pat. & Rick) Singer in Rev. Mycol. 3: 172 (1938).

Pileus 20–220mm broad, strongly convex at first, at centre often becoming plane, but margin often remaining strongly incurved, circular when seen from above, not hygrophanous, not zonate, uniformly dark brown (6F4), after prolonged periods of rain sometimes fading to brown (6DE6) or yellowish brown to light brown (5E4–5), smooth, dry, but in wet weather becoming slightly viscid, glabrous to scurfy-glabrous, shining, surface peeling easily to half its diameter, rather thick fleshy; margin regular or more often undulate, subacute. *Hymenophore* broadly adnate to slightly decurrent, somewhat 'boletinoid'; *tubes* 2–8mm long, at first yellow (3A6), rarely yellowish white (4.5A2.5), becoming olive when old or bruised, except along pileus margin and on stipe which remain yellow; *pores* compound, concolorous with tubes. *Stipe* (10–)30–110 × (6–)13–30mm, slightly ventricose or cylindrical, solid, straight, uniformly dark brown (6F4), at extreme apex yellow, smooth, dry, subvelutinous. *Context* firm, when fresh whitish but just under stipe-surface very dark brown when cut, strongly blueing (23AB3), finally (at places where eaten by insects or slugs) becoming light orange (5A5); *smell* fungoid; *taste* completely mild. Ammoniacal and potash solutions changing context slowly to orange-white (6A2); ferrous sulphate reagent changing context and tubes to dark green (7E4).

*Basidiospores* olive-brown (4D4) in mass, ellipsoid, 8.5–10.5 × 5.5–6.8µm, smooth, slightly thick-walled, olivaceous brown. *Basidia* 4-spored, clavate, 9.5–10µm broad. *Cheilocystidia* and *pleurocystidia* not seen. *Pileipellis* a poorly developed cutis with suberect, slightly gelatinized hyphae which collapse to give tangled suprapellis. *Clamp-connections* abundant.

MATERIAL EXAMINED. Curitiba, CUa, in seasonal deciduous alluvial forest, 21 xii 1979, *Meijer* 308; *ibid.*, 22 xii 1979, *Meijer* 308b; Curitiba, CUb, growing in mixed ombrophilous forest near *Allophylus edulis* Radlk. (Sapindaceae) at forest edge, 15 i 1989, *Meijer* 1192; Curitiba, Praça Osório, public square, under planted native dicotyledonous trees and palm, 11 xi 1994, *Meijer* 2922.

This species is common, represented by solitary basidiomes, in native forest in the interior of the study area, although it has been found in man-made localities (*Meijer* 2919) dispersed or in small to large groups. The collections agree with the taxon as redefined by Singer (1945). Singer (1945) draws attention to a closely related fungus collected by von Höhnelt on a fern trunk in Indonesia (Tjibodas); it has characters in common with both *B. rompelii* and *B. merulioides*.

A synonym of *Boletinellus merulioides* is *Paxillus porosus* Berk., indicating the superficial similarity in hymenophore organization between *B. merulioides* and the paxilloid and phylloporoid agarics. Indeed, although placed in *Gyrodon* by Singer (1945) *P. rompelii* was originally assigned to *Phylloporus* by Patouillard and Rick (Rick, 1907) which in fact may be nearer to the truth than subsequent authors have accepted. Indeed, during the present survey, material (*Meijer* 2126) of an isolated collection was made which possessed a strongly lamellate hymenophore. A description of this collection is given:

Pileus 42–110mm broad, slightly convex or centre slightly depressed, neither hygro-

phanous, nor zonate, uniformly brown (7–8E7), dry, smooth, glabrous, thick-fleshed (to 7mm at half the radius, and to 12mm near stipe), lacking a veil. *Hymenophore* free, lanceolate or ventricose, boletinoid; *pores* mostly 1–1.5mm broad, not attached to stipe, yellowish brown (5E5); *tubes* similarly coloured to 5mm long. *Stipe* <60 × 5–10mm, ±cylindric or clavate at base, blackish brown except for yellowish apex, smooth, dry, glabrous. *Context* whitish in pileus, ochraceous in stipe, strongly blueing in all parts when cut; *smell* distinctly pleasant.

*Basidia* 4-spored, rarely 2-spored, clavate, hyaline or pale straw-colour, 25–40 × 7.5–10.5µm. *Basidiospores* 7.5–10 × 5.5–7µm, ellipsoid to ovoid, slightly reniform in some views, smooth, olivaceous honey-colour in ammoniacal solutions, wall slightly thickened, lacking germ-pore. *Cheilo-* and *pleurocystidia* poorly differentiated, filamentous to filamentous ventricose, often wavy towards the apex, hyaline, scattered, short and often overlooked, 12–20µm long (2.5–4.5µm at base). *Pileipellis* a rather poorly organized, very slightly gelatinized cutis seated on filamentous, pigmented, irregularly interwoven subpellis. *Clamp-connections* present.

MATERIAL EXAMINED. Paraná, PIB, dispersed on humus in mixed ombrophilous forest, 21 ii 1992, *Meijer* 2126.

***Boletinelus monticola*** (Singer) Watling, **comb. nov.**

Basionym: *Gyrodon monticola* Singer & Digilio in *Lilloa* 28: 256 (1957).

*Gloeocantharelloid taxon*

**13. *Gloeocantharellus corneri*** (Singer) Corner in *Nova Hedwigia* 18: 797 (1969). **Fig. 1E, F.**

A collection agreeing in all major features with *Linderomyces corneri* Singer, now placed in *Gloeocantharellus*, has been made and a description is offered. As Corner (1969) points out, *Gloeocantharellus* combines the characters of *Paxillus* and of *Gomphus*. Indeed, Petersen (1968) whilst re-interpreting the so-called coscinocystidia that originally delimited *Linderomyces* (Singer, 1947), merely considered *Gloeocantharellus* a section of *Gomphus*, although he later (Petersen, 1972) accepted its autonomy.

Pileus 50mm broad, convex with slightly incurved margin, greyish orange (6B6), smooth, slightly humid, glabrous, lacking veil, rather fleshy. *Gills* (L40; l 1–2) decurrent, distant, ≤4.5mm broad, pale yellow (4A3), not interveined, quite frequently bifurcate; margin concave, smooth. *Stipe* central, 70 × 10mm, cylindric, slightly attenuated towards base in lower quarter, solid, light yellow (4A4), smooth, dry, glabrous, matt lacking veil but with poorly developed pure white mycelial covering. *Context* white, 12mm thick near stipe; *smell* fungoid; *taste* mild; no change with alkaline solutions.

*Basidiospores* pale to light yellow (4A3.5(–4B4)) in mass, 9–14 × 6–7.5µm, ellipsoid, heavily warted with large apiculus but lacking plage, pale in water mounts but

brownish in Melzer's reagent. *Basidia* 4-spored,  $45 \times 10 \mu\text{m}$ , clavate; *sterigmata*  $< 7 \mu\text{m}$  long. *Cheilocystidia* absent; pleurocystidia replaced by abundant pseudocystidia,  $60\text{--}120 \times 7\text{--}10 \mu\text{m}$ , fusoid with long narrow base, densely filled with brown, granular sap. *Pileipellis* an ixocutis of non-encrusted, narrow, cylindrical hyphae  $1.5\text{--}2\text{--}(4) \mu\text{m}$  broad with pale granular, intracellular pigment. *Clamp-connections* present.

MATERIAL EXAMINED. Paraná, MA, solitary, on forest floor in dense ombrophilous forest, 19 xi 1994, Meijer 2949.

The collection was made in mixed forest with no exotic trees in the neighbourhood suggesting that it was native to the area. It is of interest to note that the related *Gomphus subclavaeformis* (Berk.) Corner, apparently not uncommon in parts of Brazil (Corner, 1968, 1969), has also been found in native forest in the study area. *G. subclavaeformis* was first collected by Spruce (Berkeley, 1856) in Panuré, on Rio Uaupés, near the currently named town of Uaruma.

## ECOLOGICAL RESULTS

### *Substrate types and organisms*

All the species recorded above are terrestrial, except *Tapinella panuoides* which was found on decayed, worked, unidentified wood (boards), the tylopiloid bolete which was found on a living tree-fern (Cyatheaceae) and *Boletinellus exiguus*, which was encountered on a wide variety of substrates, but always in native forest. *B. exiguus* is commonly found at low heights on trunks of both living dicotyledonous trees and tree-ferns (Cyatheaceae), on dead wood of dicotyledons and *Araucaria angustifolia*, on vertical earth banks and also on the vertical sides of eroded blocks of rock.

*Boletinellus rompelii* was several times (but not always) found in the close neighbourhood of *Allophylus edulis* (Sapindaceae), which is one of the trees mentioned by Singer et al. (1983) as an ectomycorrhizal partner of this fungus.

*Austroboletus festivus* was found on a small-sized coastal island from which an inventory of the phanerogam flora has been completed by local botanists. From the three or four tree species mentioned by Singer (1961) and Singer et al. (1983) as possible mycorrhizal partners of this fungus none occurs on the island (not even the respective genera). This means that, if *A. festivus* really forms ectomycorrhiza, at least in Paraná State its tree partner must be in another genus.

The vegetational communities, including plantations in which the boletes recorded above have been found, the periodicity of the appearance of basidiomes based on our records, and the altitudinal range of taxa are summarized in Tables 1 and 2.

## DISCUSSION

The Atlantic rainforest of Brazil is rather poor in boletes, which on first thoughts is rather surprising as Africa, with which it was linked in the not-so-distant past, is very rich. However, the reasons for the latter's richness is the presence there of a



TABLE 1. Species of Boletaceae and Paxillaceae of Paraná State, grouped by vegetation and substrate types.

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a.	Seasonal deciduous alluvial forest (in the present study: the forest in the floodplain area of the Iguaçu river): <i>Boletinellus rompelii</i>
b.	Seasonal semideciduous submontane and montane forests (insufficiently sampled): <i>Phlebopus beniensis</i>
c.	Mixed ombrophilous forest (=forest with <i>Araucaria angustifolia</i> ): <i>Boletinellus exiguus</i> (common) <i>Boletinellus rompelii</i> (common) <i>Neopaxillus echinospermus</i> (common) <i>Xerocomus</i> cf. <i>coccolobae</i> (found only once)
d.	Dense ombrophilous forest (in the present study: the dense ombrophilous forest of the Atlantic coast, known as 'Atlantic rain forest'): <i>Gloeocantharellus corneri</i> (found only once) <i>Boletinellus exiguus</i> (common) <i>Xerocomus</i> cf. <i>coccolobae</i> (found only once)
e.	Gallery forest in area of savanna: (no species of Boletaceae and Paxillaceae)
f.	'Restinga' forest (=forest on marine sands): <i>Austroboletus festivus</i> (not uncommon) <i>Phlebopus beniensis</i> (found only once)
g.	<i>Eucalyptus</i> plantations: (no species of Boletaceae and Paxillaceae)
h.	<i>Pinus</i> plantations: (In Paraná State these are planted almost exclusively with <i>Pinus elliottii</i> , <i>P. taeda</i> and <i>P. patula</i> , all three-needled pines originating from southern North America. Twenty-three small and large <i>Pinus</i> plantations have been mycologically investigated in Paraná State. For each mushroom species the number of plantations in which it was encountered is indicated). <i>Chalciporus piperatus</i> (under <i>P. elliottii</i> and <i>P. taeda</i> ) (common: found in 15 of the 23 plantations) <i>Suillus cothurnatus</i> (under <i>P. elliottii</i> and <i>P. patula</i> ) (very common: 23) <i>Suillus granulatus</i> (under <i>P. elliottii</i> , <i>P. taeda</i> and <i>P. patula</i> ) (common: 19) <i>Suillus luteus</i> (under <i>P. elliottii</i> ) (rather common: 9)

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whole series of ectomycorrhizal caesalpinoid legumes absent from Brazil. Further north in the Amazon Basin *Macrolobium*, *Intsia* etc. occur, but even there the number of boletes can be counted on one hand.

Apparently, *Phlebopus* forms a belt around the tropics, in parallel to *Fistulinella* (Guzmán, 1974) which has only recently been recorded from Brazil (Singer et al., 1983). The mycota of the present study area also includes members of the genera *Suillus* and *Chalciporus* which have undoubtedly been introduced into S America.

TABLE 2. Fruiting periodicity and range of vertical distribution of Boletaceae and Paxillaceae in Paraná State.

The altitude varies in Paraná State from sea level to 1922m (the top of the Paraná Peak, which is the highest spot in southern Brazil). Example: 08–09 = 800–900m. Fruiting periodicity: 3–7 = March–July; year = all year.

	Altitude	Periodicity
<b>Boletaceae</b>		
<i>Austroboletus festivus</i>	01	3–5
<i>Chalciporus piperatus</i> **	08–09	3–7
<i>Phlebopus beniensis</i>	01–06	1–2
<i>Suillus cothurnatus</i> **	01–10	year
<i>Suillus granulatus</i> **	01–10	year
<i>Suillus luteus</i> **	01–10	3–11
<i>Xerocomus</i> cf. <i>coccolobae</i>	09–11	2–5
<b>Paxillaceae</b>		
<i>Neopaxillus echinospermus</i>	08–09	12–5
<i>Tapinella panuoides</i>	09	9–10
<i>Boletinellus exiguus</i>	06–10	year
<i>Boletinellus rompellii</i>	08–15	11–15
<b>Gomphaceae</b>		
<i>Gloeocantharellus corneri</i>	10	10–11

\*\* Species marked with two asterisks occur exclusively under *Pinus*. In Paraná State *Pinus* has not been planted above 1000m altitude.

Such a phenomenon is not unknown elsewhere in S America. Thus Singer & Digilio (1960) identify both *Suillus* and *Leccinum* as introductions to the mycota associated with Pinaceae and Betulaceae respectively. Singer (1969) also records *Boletus loyo* Philippi ex Singer, *B. chilensis* Singer and a red form of *Boletus chrysenteron* Bull.: Fr. In continental S America, except for the Andean Arctic beech forests, there seems to be a dearth of boletes. Thus, Dennis (1970) records seven boletes, some introduced to Venezuela, and Pegler (1983) describes 18 taxa from the Lesser Antilles which have an apparently much richer regime.

#### ACKNOWLEDGEMENTS

The junior author expresses his sincere gratitude to Sandro M. Silva, Ricardo M. de Britez and Wagner e Silva de Souza for having made available unpublished data on the phanerogamic flora of the 'Ilha do Mel' (Honey Island). We both wish to acknowledge the help given by Evelyn Turnbull, especially in carrying out the scanning electron microscope observations and supplying micrographs, and Daniel Cole who made available his aquarelle of *Austroboletus festivus*. The Friends of the Royal Botanic Garden Edinburgh are gratefully acknowledged for making it possible to publish Cole's coloured illustration.

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*Received 19 June 1996; accepted with minor revision 12 August 1996*