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Paxilloid Agaricales in Australasia

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Summary. Review of the described Australasian representatives of *Paxillus* and *Hygrophoropsis*. Description and illustration of two new species of *Paxillus*, viz. *P. minutesquamulosus* sp. n. (Papua New Guinea) and *P. chalybaeus* sp. n. (New Caledonia). First record of the genus *Ripartites*, *R. helomorphus* (Fr.) Karsten, in New Zealand and *Hygrophoropsis*, *H. kivuensis* Heinemann, in Papua New Guinea. Two new synonyms are proposed: *Hygrophoropsis coacta* McNabb 1969 (= *H. aurantiaca* (Fr.) Schroeter 1899) and *Paxillus infundibuliformis* Cleland 1927 (= *Paxillus mülleri* (Berk.) Sacc. 1887).

Introduction

Compared to the large geographic area of the Australasian region rather few agaricoid species have been published which belong to one of the four genera (*Paxillus*, *Hygrophoropsis*, *Neopaxillus*, *Ripartites*) allotted to the family of Paxillaceae (Singer 1975: 685).

Neopaxillus Singer, a genus of 1—2 species only, is restricted to South America and there is no indication yet about its potential occurrence in Australasia.

To date *Ripartites* consists of 5 to 6 taxa whose area of distribution (except *R. amparae* Singer (Singer & Digilio 1952) from subtropical Argentina) is confined to the temperate zone of the northern hemisphere. However, two of these species occur also in temperate forests South of the equator viz. *R. tricholoma* (Fr.) Karsten in Argentinian Patagonia and *R. helomorphus* (Fr.) Karsten under *Nothofagus* in New Zealand (see below).

Regarding *Paxillus* and *Hygrophoropsis*, the two remaining genera of Paxillaceae, some information about Australasian records is found in the literature. About 10 species of *Paxillus* are reported from Australia. The search for type material was not very successful for authentic material could be traced for 4 taxa only. Furthermore the exsiccata of these species are in bad condition and the extraction of microdata proved difficult or was impossible at all. By comparison the New Zealand species of *Paxillus* have been carefully studied by McNabb (1969). During my stay in New Zealand I recollected the 3 native representatives reported and I can confirm the accurate observations published in McNabb's monograph.

Regarding *Hygrophoropsis* McNabb (1969) also gave a full description of the two New Zealand taxa hitherto known. In addition the occurrence of *H. aurantiaca* (Fr.) Maire in Australia is mentioned

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in CORNER (1966). Beside these two sources of information no further reports about *Hygrophoropsis* in Australasia can be discovered in the literature.

Paxilloid fungi are not only poorly known from Australasia but this group of agarics was also rarely collected in neighboring countries. *Paxillus cantharelloides* HENNINGS (1899) is reported from Celebes. Unfortunately the type material is lost and hence nothing can be said about the actual taxonomic position of this species. Finally CORNER (1970) published recently on two *Paxilli* which occur in the tropical forests of Singapore and Malaysia respectively.

Acknowledgements

I have to thank the authorities of the Department of Forests both in New Zealand (FRES, then Rangiora) and Papua New Guinea (FRC, Bulolo) for all the facilities offered during my sojourn in these countries. A travelling grant received from the Swiss Society of Natural Sciences gave me the opportunity to visit New Caledonia (1977) whose interesting mycoflora is still largely unexplored. I am also indebted to the Curators in ADW, K, PDD and S for the loan of type material.

If not otherwise stated the magnifications of the figures are: carpophores (nat. size), spores (×2000), basidia and cystidia (×1000), cuticle of pileus (×500, vertical section). Type material of the new species is kept in ZT, Herbarium Horak.

PAXILLUS FR. 1835
Fl. scan., 339

A. Australia

1. *Paxillus involutus* (FR.) FR. 1835, Fl. scan., 339

The occurrence of this species is reported by CLELAND (1918: 101; 1934: 176, with illustration). The collection (ADW 12867) — grown under *Larix* sp. — agrees in all essential details with European specimens. It is likely that this fungus accidentally was brought to Australia together with its mycorrhizal host plant.

2. *Paxillus mülleri* (BERKELEY) SACCARDO 1887: Syll. Fung. 5: 986

Bas. *Agaricus mülleri* BERKELEY 1873: J. Linn. Soc. Bot. 13: 159.

Syn. *Paxillus infundibuliformis* CLELAND 1927: Trans. Proc. Roy. Soc. S. Australia 51: 304 (syn. nov.).

The type material proper is not kept (PEGLER 1965: 340) but there are two further collections ("Albert Range, BERKELEY 1544" and "Victoria, MÜLLER") under that name in K which fit the original description. The spores are fusoid, 10.5—15×5—6 µm, yellow-brown. Cystidia absent. Cuticle a trichoderm or palisade with cylindric to subfusoid terminal cells, yellow-brown plasmatic pigment present. Clamp connections not observed.

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In the BRESADOLA-Herbarium (S) exsiccata are lodged under "*Paxillus mülleri* BERK.; Gracemore, Australia, leg. v. MÜLLER". The revision revealed that — due to the conspicuous cystidia (60—85 × 12—20 μm) and the ellipsoid to subfusoid yellow-brown spores (11.5—14 × 6—7 μm) — these fungi undoubtedly represent a species of *Phylloporus* QUÉLET.

As pointed out above *P. infundibuliformis* CLELAND (1927) is considered a synonym of *P. mülleri* (BERK.). The microdates found on the type collection (ADW 12876) support in every respect that transfer. Based upon my observations, however, there is no indication that this species should be classified under *Phylloporus* as proposed by SINGER (1945: 284) and REID (1955: 645).

3. *Paxillus veluticeps* (SACCARDO) SINGER 1955: Sydowia 9: 418

Bas. *Flammula veluticeps* SACCARDO 1895: Syll. Fung. 11: 56 (= *Ag. veluticeps* COOKE & MASSEE 1891: Grevillea 19: 89).

The microscopic characters (spore morphology, structure of the cuticle) found on the type material ("Omeo, Victoria, Australia, leg. v. MÜLLER", K) are reminiscent of *P. mülleri* (BERK.). However, the septa of the hyphae consistently bear conspicuous clamp connections. For further discussion consult SINGER (1955: 418) and PEGLER (1965: 347).

Species of uncertain taxonomic position — no type material in K or ADW:

4. *Paxillus aureus* LLOYD 1916: Myc. Not. 43: 595

? *Paxillus olivaceoflavidus* (COOKE & MASSEE) REID (1955: 644)

This fungus is reported to resemble *P. panuoides* FR. (see below).

5. *Paxillus crassus* FR. 1871: Hym. europ., 404

According to COOKE (1892: 73) collected in Queensland.

6. *Paxillus eucalyptorum* BERKELEY 1845: J. Linn. Soc. Bot. 4: 49

Supposed to be a large yellow fungus growing under *Eucalyptus* in Western Australia.

7. *Paxillus hirtulus* F. MÜLLER in KALCHBRENNER 1884: Proc. Linn. Soc. N. S. Wales, 175

Reported from tropical Queensland (Daintree River, N of Cairns).

8. *Paxillus panuoides* (FR.) FR. 1835, Fl. scan., 339

This European species is mentioned in COOKE (1892: 73) found growing in cellars and on saw dust (Victoria). Cp. also REID (1955: 645).

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9. *Paxillus psammophilus* CLELAND 1933: Trans. Roy. Soc. S. Australia 57: 187 (as "*P. psammiphila*" in CLELAND 1934: 177)

A rather large brown species collected in sand, South Australia.

B. New Zealand

1. *Paxillus aurantiacus* MCNABB 1969: N. Z. J. Bot. 7: 357 — Fig. 1, A

Additional material. — NEW ZEALAND: South Island: Canterbury: Thompson River, Waimakarere River, under *Nothofagus solandri* var. *cliffortioides*, 26. III. 1968, leg. BAKER (ZT 68/219). — Craigieburn, near Base Camp, 1000 m, under *Nothofagus solandri* var. *cliffortioides*, 19. IV. 1968, leg. BAKER (ZT 68/275). — Nelson: Lake Rotoiti, Westbay, under *Nothofagus solandri* var. *cliffortioides*, 3. V. 1968, leg. HORAK (ZT 68/355).

2. *Paxillus involutus* (FR.) FR. 1835, Fl. scan. 339

Adventitious under *Betula* and *Corylus* in Auckland and various localities in Canterbury (MCNABB 1969: 352).

3. *Paxillus nothofagi* MCNABB 1969: N. Z. J. Bot. 7: 354 — Fig. 1, B

Additional material. — NEW ZEALAND: South Island: Westcoast, Taylorville, Mt. Sewell, under *Nothofagus solandri* var. *cliffortioides*, 1. IV. 1968, leg. HORAK (ZT 68/244).

The elliptic spores distinctly separate *P. nothofagi* from the two other native New Zealand species of *Paxillus*. Size and shape of the spores remind of those in *P. involutus* (FR.) which, however, is readily distinguished by the presence of large cystidia.

4. *Paxillus squarrosus* MCNABB 1969: N. Z. J. Bot. 7: 355 — Fig. 1, C

Additional material. — NEW ZEALAND: South Island: Nelson, Lake Rotoiti, Mt. Robert, under *Nothofagus solandri* var. *cliffortioides*, 3. V. 1968, leg. HORAK (ZT 68/356).

This species is closely related to *P. statuum* (SPEGAZZINI) HORAK, a very common fungus in the *Nothofagus* forests of Chile and Argentina (HORAK 1980).

C. New Caledonia

1. *Paxillus chalybaeus* HORAK sp. n. Fig. 2

Pileus — 75 mm, subumbonato-planus dein concavus vel infundibuliformis, involutus, fuligineus vel nigrus, marginem versus azureogriseus, tomentoso-velutinus, vetustate minute squamulosus. Lamellae decurrentes, dichotomiter furcatae, argillaceae dein subferrugineae. Stipes —45×—8 mm, cylindricus, centralis, pileo concolor vel pallidior, apicaliter azureus, velutinus vel subsquamulosus. Caro rubescens dein aurantiaca. Sporae 9.5—11.5×5—6 µm, ellipticae, aureobrunneae, crasse tunicatae, leves. Cystidia nulla. Hyphae fibuligerae. Ad terram in silvis nothofagineis. Nova Caledonia. Typus ZT 77/24.

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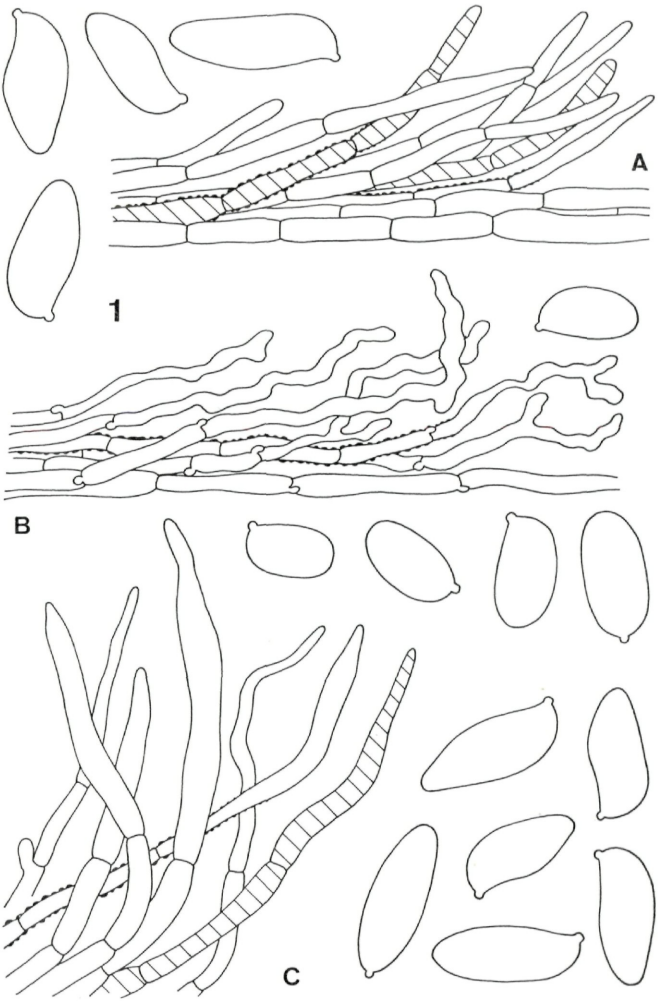

Fig. 1. A. *Paxillus aurantiacus* McNabb (ZT 68/275): spores, cuticle. — B. *Paxillus nothofagi* McNabb (ZT 68/244): spores, cuticle. — C. *Paxillus squarrosus* McNabb (ZT 68/356): spores, cuticle

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Pileus 15—75 mm, plano-convex soon becoming expanded, centre depressed, concave or infundibuliform, margin strongly inrolled (also in mature specimens); dark brown to black, margin distinctly grey-blue in young carpophores; felty to velutinous becoming coarsely fibrillose or subsquamulose, often concentrically cracking and exposing white subcutis, dry, margin not striate. Lamellae very crowded, decurrent-arcuate, 1—4 dichotomously forked, up to 4 mm wide;

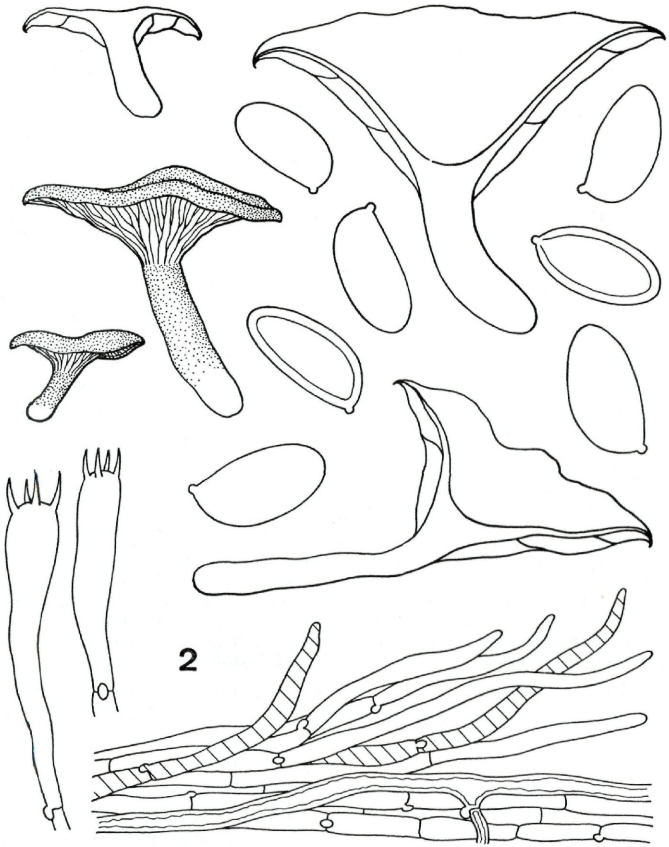

Fig. 2. *Paxillus chalybaeus* Horak (type): carpophores, spores, basidia, cuticle

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pale argillaceous turning cinnamon or pale brown with reddish tint, pale rust brown in mature specimens; edge concolorous, rather broad and rounded. Stipe —45×—8 mm, cylindric to subclavate, central, rather slender; concolorous with pileus, blue to grey-blue at apex, base often brown to orange-brown; glabrous to minutely velutinous, becoming fibrillose to flaky with age; dry, solid, veil remnants absent, single and cespitose. Context reddening, discolouring to orange-yellow (base of stipe) or brown-black (context of pileus). Odour and taste not distinctive. Chemical reactions on pileus: KOH — negative. Spore print pale rust brown.

Spores 9.5—11.5×5—6 µm, elliptic, yellow-brown, membrane thickwalled, smooth, germ pore none. Basidia 35—55×8—10 µm, 4-spored. Cystidia absent. Cuticle a cutis or trichoderm of cylindric hyphae (5—10 µm diam.), terminal cells conically tapering, brown to lilac-brown (KOH) plasmatic and encrusting pigment present, oleiferous hyphae occasionally observed. Clamp connections numerous.

Habitat. — On soil under *Nothofagus* spp. — New Caledonia.

Material. — New Caledonia: Paita, Mt. Mou, 1150 m, 20. II. 1977, leg. Horak (ZT 77/24, holotype). — Same locality, 1200 m, 20. II. 1977, leg. Horak (ZT 77/13).

The most distinct macroscopic features of this remarkable species are the blue colour along the margin of the pileus and on the upper portion of the stipe, and the reddening context. Microscopically noticeable are the rather large, elliptic and yellow-brown spores whose membranes can reach about 1 µm in diameter. Cystidia are absent. The pigment stains lilac-brown to pale brick red in KOH and is observed both in the plasma and on the surface of the cuticular hyphae.

D. Papua New Guinea

1. *Paxillus minutesquamulosus* Horak sp. n. Fig. 3

Pileus —25 mm, convexus dein plano-depressus, primo involutus, albidus vel griseus, squamis brunneis dense obtectus, fragilis. Lamellae decurrentes, dichotomiter furcatae, pallide argillaceae dein subferrugineo-cinnamomeae. Stipes —15×—1.5 mm, cylindricus, centralis vel subexcentricus, albidus, minute fibrillosus. Caro albida. Sporae 10—12.5×6—7 µm, ellipticae, brunneae, leves, crasse tunicatae. Cystidia nulla. Hyphae fibuligerae. Ad lignum putridum in silvis nothofagineis. Nova Guinea. Typus ZT 73/233.

Pileus —25 mm, at first convex soon becoming expanded and depressed or subumbilicate at centre, margin strongly inrolled when young and often notched in aged specimens; whitish to grey, densely covered with appressed or suberect fibrillose squamules; dry, membranaceous, margin not striate. Lamellae moderately crowded, decurrent to arcuate, up to 2 mm wide, 1—2(—3) dichotomously forked; argillaceous to cinnamon when young turning pale rust brown, pale red-brown on bruising; edge rounded, concolorous. Stipe —15×

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—1.5 mm, cylindric, central or subeccentric, slender; white becoming pale brown with age; minutely fibrillose, dry, solid, single in groups. Context white slowly changing to pale brown. Odour sourish. Taste not distinctive. Chemical reactions on pileus: KOH, HCl and NH_3 — negative. Spore print brown.

Spores 10—12.5 × 6—7 μm, elliptic, brown, membrane smooth, thickwalled, germ pore absent. Basidia 30—40 × 9—11 μm, 4-spored.

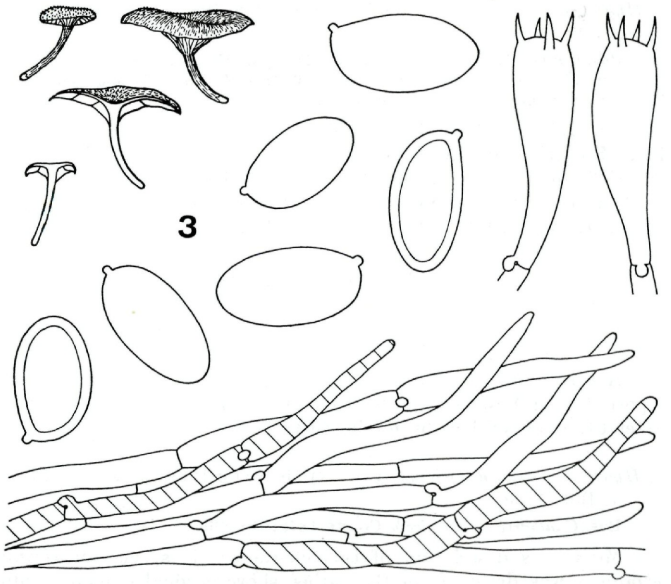

Fig. 3. *Paxillus minutesquamulosus* Horak (type): carpophores, spores, basidia, cuticle

Cystidia none. Cuticle a cutis or trichoderm of cylindric hyphae (5—12 μm diam.), terminal cells conic or cylindric, brown (KOH) pigment dissolved in plasma, membranes not gelatinized. Clamp connections present.

Habitat. — On rotten wood in *Nothofagus grandis*-forest. — Papua New Guinea.

Material. — Papua New Guinea: Morobe district, Wau, Mt. Kaindi, 2400 m, 17. V. 1973, leg. Horak (ZT 73/233, holotype).

This delicate fungus was found on wood under *Nothofagus grandis*

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(Fagaceae) and it is likely that *P. minutesquamulosus* enters ectrotrophic mycorrhiza with this tree. Morphologically this agaric reminds of a species belonging to *Hygrophoropsis*, however, the large, elliptic, brown, thick-walled and inamyloid spores relegate it to *Paxillus*.

HYGROPHOROPSIS (SCHROETER) MAIRE ap. MARTIN-SANS 1929 Empois. champ. 99

1. *Hygrophoropsis aurantiaca* (FR.) SCHROETER 1889: Krypt. Fl. Schles. 3: 511

Bas. *Cantharellus aurantiacus* FR. 1821: Syst. Myc. 1: 318.
Syn. *Hygrophoropsis coacta* MCNABB 1969: N. Z. J. Bot. 7: 358 (syn. nov.).
For further synonyms see CORNER (1966: 131).

Additional material. — NEW ZEALAND: South Island: Nelson, Lake Rotoiti, under *Nothofagus fusca*, *N. menziesii* and *N. solandri* var. *cliffortioides*, 30. IV. 1968, leg. HORAK (ZT 68/324). — Southland: Te Anau Downs, Denton Creek, under *Nothofagus solandri* var. *cliffortioides*, 1. IV. 1969, leg. HORAK (ZT 69/214).

Two well developed collections of *H. coacta* MCNABB have been made in New Zealand. All macro- and microcharacters observed indicate that this fungus is conspecific with *H. aurantiaca* (FR.) a wide spread species both in the northern hemisphere (BIGELOW 1975: 63) and in temperate South America (SINGER 1964: 98).

According to CORNER (1966: 132) *H. aurantiaca* (FR.) is already reported from Australia and for that reason the New Zealand records extend the area of distribution in Australasia.

2. *Hygrophoropsis umbriceps* (COOKE) MCNABB 1969: N. Z. J. Bot. 7: 360 Fig. 4

Bas. *Cantharellus umbriceps* COOKE 1879: Grevillea 8: 54.

MCNABB's description of this characteristic species of *Hygrophoropsis* was drawn from the rather short original diagnosis supplemented by microscopic data observed on the poorly preserved type material (compare also CORNER 1966: 75).

Under these circumstances my description of *H. umbriceps* (taken from fresh and well preserved fruitingbodies) is presented:

Pileus —65 mm, centre depressed, umbilicate or funnel-shaped from the beginning, margin strongly inrolled; dark brown to soot brown; velutinous to felty all over, surface cracking in aged specimens dry, margin not striate, veil remnants absent. Lamellae moderately crowded, decurrent, 4 dichotomously forked; whitish to cream becoming pale argillaceous with age; edge rounded, concolorous. Stipe —50×—6 mm, cylindric or tapering towards base, occasionally fusoid, central; pale brown, villous base white; glabrous, dry, solid,

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cespitose or single in groups. Context pale brown. Odour and taste not distinctive. Chemical reactions unknown. Spore print white.

Spores 5.5—7.5(—8)×3—4.5 µm, hyaline, membrane thin-walled, smooth, strongly dextrinoid. Basidia 30—45×5—7 µm, 4-spored. Cystidia absent. Cuticle a palisade of clavate to fusoid cells 35—80×5—15 µm), membrane thin-walled, not gelatinized, with

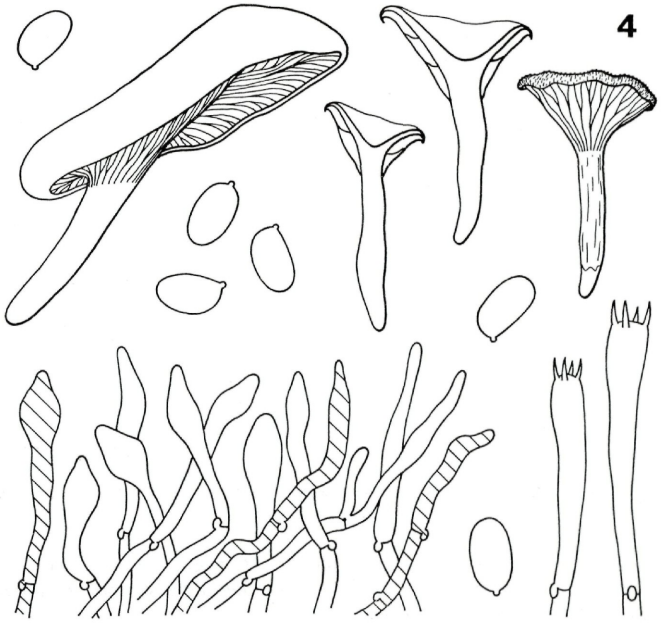

Fig. 4. *Hygrophoropsis umbriceps* (Cooke) McNabb (ZT 68/342): carpophores, spores, basidia, cuticle

dark brown vacuolar and plasmatic pigment. Clamp connections present.

Habitat. — On soil among litter under *Nothofagus* spp. — New Zealand.

Material. — New Zealand: Maungaroa, leg. Berggren, 138 (holotype, K). — South Island: Nelson, Lake Rotoiti, Mt. Robert, under *Nothofagus fusca*, leg. Horak (ZT 68/342).

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B. Papua New Guinea

1. *Hygrophoropsis kivuensis* HEINEMANN 1963: Bull. Jard. Bot. Bruxelles 33: 413 Fig. 5

Fig. 5 shows 4 carpophores and the most important microscopic characters (spores, basidia, cuticle) of *Hygrophoropsis kivuensis* HEINEMANN collected in Papua New Guinea. It can be seen that there is a good coincidence between the features described for the type collection (HEINEMANN 1963: l. c.; 1966: 292) from Zaire (Africa) and the specimens from Papua New Guinea.

Obviously *H. kivuensis* HEINEMANN is close to *H. flabelliformis*

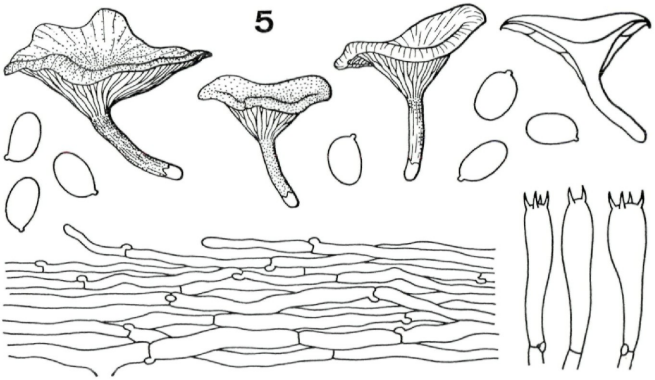

Fig. 5. *Hygrophoropsis kivuensis* HEINEMANN (ZT 72/594): carpophores, spores, basidia, cuticle

(BERKELEY & CURTIS) CORNER (1966) (= *H. tapinia* SINGER 1946, cp. BIGELOW 1975: 65) differs, however, by the slightly smaller spores and the lateral to absent stipe.

First record of the genus in Papua New Guinea.

RIPARTITES KARSTEN 1879
Bidr. Känn. Finl. Folk 32: XXIV, 477

A. New Zealand

1. *Ripartites helomorphus* (FR.) KARSTEN 1879: Bidr. Känn. Finl. Folk 32: XXIV, 477

Bas. *Agaricus helomorphus* FRIES 1821: Syst. Myc. 1: 270.

This species was well described by MÉTRODE (1946: 74) and

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HUIJSMAN (1960: 335), and the New Zealand collection agrees in lla taxonomically important details with European specimens.

The following description is taken from fresh carpophores collected in New Zealand:

Pileus —20 mm, convex at first soon umbonate-expanded, papillate centre sometimes depressed, margin inrolled in young specimens later becoming incurved and conspicuously notched, margin not striate; whitish to pale argillaceous; dry, smooth to appressedly fibrillose, veil remnants absent. Lamellae 10—16(—3) moderately crowded, broadly adnate to subdecurrent, up to 3 mm wide; argillaceous to cinnamon; edge concolorous, even. Stipe —30×—2.5 mm, cylindric to subclavate, central; at apex concolorous with pileus, reddish brown towards base, basal tomentum absent; glabrous or minutely fibrillose, dry, fistulose, single in groups. Context whitish. Odour and taste not distinctive. Chemical reactions on pileus: KOH-negative. Spore print pale brown.

Spores 4—5.5×3.5(—4) µm, subglobose to ovoid, pale brown, densely covered with hemispheric warts or short cylindric projections, membrane thin-walled, inamyloid. Basidia 30—35×6—7 µm, 4-spored. Cystidia absent. Cuticle a cutis of cylindric hyphae (3—6 µm diam.), membranes not gelatinized, encrusted with brown (KOH) pigment. Clamp connections present.

Habitat. — On soil among moss under *Nothofagus solandri* var. *cliffortioides* and *N. menziesii*. — New Zealand.

Material. — NEW ZEALAND: Fjordland: Lake Te Anau, Mt. Luxmore, 9. IV. 1969, leg. HORAK (ZT 69/330).

First record of the genus in New Zealand.

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