

## Keys for the identification of the species of Agaricales I.

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While in the first edition of my "Agaricales in modern taxonomy" keys to the species of the genera treated there were attached to each genus after the general treatment of the genus, such keys were omitted in the second and third edition of this work in spite of the fact that many mycologists would have liked to have them at their disposal. It was then decided to edit these keys in a separate series. The first instalment on this project is to be found below. It is planned to proceed in alphabetical order. However, for practical reasons, it may not always be possible to include all valid genera in this order.

It must be emphasized that the mycoflora of the world is still rather unevenly known. Even in Europe, new or misunderstood species are still being discovered at a rate basically corresponding to the introduction of more and more useful characters, neglected in older works. Furthermore, the user of the keys may find that even some validly published species are often omitted, i. e. they will not key out in the keys given below for one of the following reasons: Either the species is unknown to the author and it appeared hazardous to include it in the keys because certain characteristics were not or not sufficiently studied, or else the characters known do not sufficiently separate the species from similar well known species; or, finally, the species omitted can be better identified by using other sources in the available literature (and these sources will then be indicated). Consequently, the reader should not be disappointed if a given specimen cannot be named in any key. Furthermore, as in all keys, there will be cases where the full variability of a species is not sufficiently known — since it has been collected sparingly — and therefore some of the diagnostic characters leading to that species as indicated in the keys will not completely cover the full breadth of variability, especially in colors and measurements. In this case, only the good judgement and experience of the user will lead to the desired result.

In most cases, the supraspecific but infrageneric taxa are not keyed out. It is assumed that the third edition of "Agaricales in modern taxonomy" (1975 \*) is at hand, and that the subgenus, section etc.

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\*) SINGER, ROLF (1975, April). The Agaricales in modern Taxonomy. 812 pp, 70 pls Verlag J. Cramer. Vaduz.

has been identified using this book. Where the infrageneric taxa have been identified by some other procedure, the species may key out in another section than expected.

Some species may not have been described fully and correctly in the available literature. Where this is the case, and where the description of a species serves some useful purpose, such a redescription is given after the key. If, however, some imperfection of the existing published descriptions can be corrected merely by the wording of the key, the characters given in the key should be considered the ones corresponding to this author's opinion and data.

As in the enumeration of the species in "Agaricales in modern taxonomy", the species keyed out here are not necessarily all "good" species. It may turn out, after further monographic work, that some exceptional species keyed out here are better considered formae, varietates, or subspecies of others, whereby the decision depends on future additional information e. gr. on distribution or host range or, more often, on the definition of what an author considers a species, a subspecies, or a variety. On the other hand, not all published varieties and formae are taken into consideration.

Climatic-geographic races, usually with limited interfertility are considered as subspecies. Races based on host or substratum (mycoecotypes) are likewise considered as subspecies. In both cases, morphological or chemical characters must be present and constant (except in cases where interfertility leads to intermediate forms where both subspecies occur); if there are no such differences we have "formae speciales" (few known in Agaricales). If a taxon is considered infraspecific, but either only temporarily so, or with overlapping areas and/or hosts or area specialisation so that we cannot, at present, decide whether we have a microspecies, a race, or a forma (with unknown sexuality or with characters not hereditary), we use the varietas-level.

With respect to those genera for which no key is offered in this series — for example *Amanita* — partial monographs (for one section only or for a single region) do exist and are easily available; since the present author cannot essentially contribute to a significant extension or correction of the keys published in these monographs and does not have sufficient data to supplement them, or else is aware of the fact that a complete monograph of the respective genus is in preparation, the respective genus has been omitted at present. This has been done without prejudice of a future supplement containing keys to the species of such genera.

In some genera it was necessary to substitute distribution for other diagnostic characteristics. This was done only reluctantly, merely because no other way could be found at present to make the key dependable for the user. One of the purposes of the publication of this

I. Basidia mixed 2—4-spored or all 4-spored.

M. On inland dunes as well as on lake and sea-shore dunes, deeply inserted in the sand with a somewhat thickened and sometimes pseudorrhiza-like base and with often root-like rhizomorphic strands; spores mostly about  $12.5-15.5 \times 7.5-9.5 \mu$ . *A. arenicola* (BERK.) SING.

M. Not on dunes

N. Spores  $(10.7)-14.3-18.3-(20) \times (7.5)-9-10.7-(12) \mu$ ; average size  $14-15 \times 10.2 \mu$ ; pileus umbonate. *A. subpediades* (MURR.) SING. [Probably = *pediades* var. *macrospora* SING., and possibly only a variety of the following species. If the spores have rusty-fulvous internal pigment bodies cf. *A. insignis* SING. — a species from the Caucasus which requires additional research.]

N. Spores  $(10.5)-11-15 \times 7-10.5 \mu$ , average size  $12-14 \times 8.3-9.2 \mu$ ; pileus obtuse<sup>2)</sup>

*A. pediades* (PERS. ex FR.) FAYOD ex aut.

2. Key to *Agrocybe*, section *Agrocybe*

- A. Spores up to  $10.5 \mu$  long; growing on wood or woody humus or on humus in dense woods or forests in the north-temperate zone or in the subtropics or tropics.
- B. Taste farinaceous and more or less bitterish; annulus well formed and persistent or obsolete and veil adhering to the margin of the pileus. (*Pholiota fulvella* (BULL.) ex BRES. sensu BRES. =) *A. sphaleromorpha* (BULL. ex FR.) FAYOD. ex aut. sensu ROMAGNESI, FAVRE (vix sensu RICKEN, vix sensu BRES., the latter perhaps *A. praecox* var.).
- B. Taste not farinaceous or, if farinaceous, not bitterish; annulus usually well formed except in a tropical species.
- C. Tropical species (Cuba), growing on rotten wood; pileus not rugose; cystidia more than  $55 \mu$  long; annulus fugacious or obsolete. *A. underwoodii* (MURR.) SING.
- C. Temperate species of North America; pileus often rugose; cystidia up to  $55 \mu$  long; annulus persistent.
- D. Taste more or less distinctly farinaceous; spores  $5-5.3-(6) \mu$  broad; lamellae subclose to close; pileus smooth or rugose; cystidia often with amorphous internal body,  $15-20.5 \mu$  broad. *A. acericola* (PECK) SING.
- D. Taste not farinaceous; spores  $(5)-6-6.5 \mu$  broad;

<sup>2)</sup> If spores even smaller and pileus rather large cf. *A. bokotensis* (BEELI) WATLING described from tropical Africa.

lamellae close to crowded; pileus rugose; cystidia without an internal body, and more variable in diameter

*A. alachuana* (MURR.) SING.

A. Spores larger, or habitat in fields, meadows, steppes etc. outside the woods or in the shade of scattered trees or in gardens, never lignicolous.

E. Annular veil constantly absent; young pilei with a marginal veil

F. Tropical species (see "N" below).

F. Temperate species (if spores smaller than 9.5  $\mu$ , see sect. *Microspora*).

G. Habit of *A. pediades* or *semiorbicularis*; spore print fuliginous brown without a rusty tinge.

*A. arenaria* (PECK) SING.

G. Habit of *A. praecox* or *dura*; spore print tobacco brown with a slight rusty tinge

*A. hortensis* (BURT) SING.

E. Annular veil persistent or fugacious, exceptionally absent.

H. Cystidia of the sides of the lamellae mostly broadly rounded and not mucronate or ampullaceous; spores 10.2—13.8  $\times$  6.8—8.3—(9)  $\mu$ .

I. South American species (African species: *A. carneobrunnea* WATLING which is probably = *A. platensis*).

J. Lamellae free; pileus mostly rugose. *A. perfecta* (RICK) SING.

J. Lamellae adnexed; pileus smooth (if pileus white cf. *A. dura*, below, which may be introduced in South America).

*A. platensis* (SPEG.) SING.

I. North-temperate species. Pileus rarely and weakly rugulose; lamellae not free but rounded-adnexed to adnate, sometimes with decurrent tooth; cystidia often with an amorphous internal body.

"*A. dura*" (BOLT. ex FR.) SING. <sup>3</sup>)

H. Cystidia with a distinct mucro or ampullaceous, at least in their majority; spores as above or different (if bitter — cystidia both mucronate and evenly rounded).

K. Spores 8.5—12.5—(14.5)  $\times$  5—7.3  $\mu$ ; basidia 2-spored or mostly 4-spored; taste mild (though farinaceous).

I. Growing in open places among grasses.

*A. praecox* (PERS. ex FR.) FAYOD ex aut.

[(If pileus tending to crack and whitish, spores slightly larger cf. var. *cutifracta* (LANGE)].

<sup>3</sup>) This species is known in Europe under this name (but BOLTON's illustration is not convincing at all!) and in North America as *Pholiota vermiflua* (PECK) SACC. The correct name of this species should be: *Agrocybe molesta* (LASCH) SING. comb. nov. (*Agaricus molestus* LASCH, Linnaea 5: 421. 1828).

2. More collybioid, in swampy places *A. paludosa* (LGE)  
KÜHN. & ROM.

K. Spores larger or taste bitter.

L. Taste bitterish or bitter; spores variable (in authentic material  $7.5-10.3 \times 5.3-6 \mu$ ; in Singer's collection from Massachusetts  $11-14.3 \times 6.5-8.2 \mu$ ), many tending to be somewhat rhombic in facial view; basidia 4-spored. (Possibly not homogeneous species in this delimitation). *A. howeana* (PECK) SING.

L. Taste mild (but more or less farinaceous), or, if unknown — basidia 2-spored. South American and other subtropical or tropical species.

M. Pileus with veil patches reminding one of *Amanita*, viscid. Annulus rather fugacious; spores  $13.5-17 \times 9-12 \mu$ , mostly about  $14 \times 10 \mu$ ; frequently many 2-3-spored basidia present; size and shape of *A. praecox* *A. viscosa* SING.

M. Pileus without veil patches, subviscid or not viscid. Annulus obsolete, fugacious or well developed and persistent; spores as above or smaller; carpophores as above or smaller.

N. Annulus persistent; pileus 30-50 mm broad; basidia (2)-4-spored.

*A. puiggarii* (SPEG.) SING.

N. Annulus fugacious or obsolete; pileus 10-35 mm broad; pileus with an epicutis which is sometimes intermittent, i. e. hymeniform arrangement sometimes not continuous or becoming discontinuous.

O. Basidia (1)-2-(3)-spored.

P. Pileus 16-23 mm; spores  $11.5-17.8 \times 8-11-(12.8) \mu$ .

Southern South America.

*A. paradoxa* SING.

P. Pileus to 30 mm; spores to  $12.5 \mu$ .  
West Indies.

O. Basidia (2)-4-spored.

*A. earlei* (MURR.) DENNIS ex SING.

Q. Spores  $13-15.3 \times 7-8.5 \mu$ ; pileus white to cream or olive yellow.

*A. broadwayi* (MURR.) DENNIS

Q. Spores  $10-13.2 \times 7-8.8 \mu$ ; pileus ochraceous with brownish to chestnut brown center (see sect. *Pediadeae*, "E").

3. Key to the species of subgenus *Agrocybe*,  
section *Microsporae* SING.

- A. Spores large: (11)—13.7—14.4—(16.5) × (7.5)—8.5—9.5—(11)  $\mu$  or 9.5—14.2 × 6—8  $\mu$ .
- B. Pileus 70—150 mm broad. Op sawdust. *A. procera* SING.
- B. Pileus up to 68 mm broad, often much smaller. On dung or on earth.
- C. On earth, mostly in open places; pileus always in some part or entirely strongly venose-rugose-reticulate or scrobiculate. North and South America, thermophilous.  
*A. retigera* (SPEG.) SING.
- C. On dung or on earth, mostly in shaded places; pileus smooth or only margin eventually rugose-folded or transparently striate.
- D. African or South American species.
- E. On earth under *Manihot* in Africa.  
*A. manihotis* PEGLER
- E. On dung in South America (if on earth in tropical America see also under 2 "O" above: *A. broadwayi*).  
*A. neocoprophila* SING.
- D. European species on garden beds (see "I" below).
- A. Spores smaller, only up to 12.5  $\mu$  long.
- F. Pileus and stipe whitish, watery white or milk white. American species.
- G. Spores >9.2  $\mu$  long; taste mild.  
*A. collybiiformis* (MURR.) SING.
- G. Spores <9.2  $\mu$  long; taste bitter. *A. microspora* SING.
- F. Pileus and/or stipe distinctly pigmented.
- H. Cystidia with finger-like appendages; sclerotia present.  
*A. arvalis* (FR.) SING.
- H. Cystidia only exceptionally with finger-like appendages; sclerotia not known; taste farinaceous and typically more or less bitterish.
- I. Apex of many cystidia incrustated by calcium oxalate crystals, others with yellow refractive contents; spores 10—15.5 × 5—8.5  $\mu$ . On seeds of Rosaceae and on straw in garden beds and compost heaps in Europe.  
*A. putaminum* (MAIRE) SING.
- I. Cystidia, if incrustated, with a mucous or resinous, not crystalline incrustation; spores somewhat shorter.  
*A. sororia* (PECK) SING.
- J. Pileus 30—50 mm broad; lamellae broad or rather broad; spores 9—12 × 6—8  $\mu$ ; on garden beds and manure heaps in Eastern North America.  
var. *amara* (MURR.) SING.

- J. Pileus as above or either smaller or larger; lamellae rather narrow to medium broad; spores  $8-12 \times 5-8.5 \mu$ ; on the ground in woods and on vegetable compost.
- K. Pileus 20—40 mm broad. Japan. var. *farinacea* (HONGO) SING.
- K. Pileus 45—100 mm broad. North America and Europe. var. *sororia*

4. *Agrocybe* subgenus *Agrocybe* sect. *Allocystides* SING.:  
Only one species, *A. allocystis* SING.

5. Key to the species of *Agrocybe*, subgenus *Agrocybe*, section *Evelatae* SING.

A. Cystidia absent on the sides of the lamellae; cheilocystidia (23)— $31-50 \times 5-10 \mu$ , with narrow neck (2.2—3.5  $\mu$ ); dermatocystidia present in a continuous hymeniform epicutis. In mesophytic grassy places in the temperate zone of the Northern hemisphere.

*A. vervacti* (FR.) ROMAGNESI

A. Pleurocystidia present although sometimes in form of inconspicuous cystidiolae.

B. Cystidia on the sides of the lamellae cystidiolae-like or only up to  $10 \mu$  broad and then like the cheilocystidia, or scattered and rare.

C. Xerophytic species of South America. Epicutis continuous, with dermatocystidia; cheilocystidia not making the edge of the lamellae heteromorphous,  $24.7-29.5 \times 3.3-7.3 \mu$ , with obtuse or acute narrow apex which sometimes bears an inconspicuous crystalline incrustation at the tip; pileus 8—20 mm broad.

*A. xerophytica* SING.

C. Mesophytic to hygrophilous species; epicutis as above or different; cheilocystidia making the edge heteromorphous or, if not, broader than indicated above; pileus as above or larger.

D. Pleurocystidia inconspicuous and versiform, of the size of the basidia; epicutis of the somewhat rivulose-cracked pileus loosely arranged and discontinuous and often not sharply separated from the elements of the hypodermium; an incrusting pigment present in the elements of the cuticle. Mexico.

*A. xuchilensis* (MURR.) SING.

D. Pleurocystidia conspicuous, larger than the basidia; epicutis with  $\pm$  continuous hymeniform arrangement and well differentiated from the hypodermium which is pigment-incrustated or not (see "E" below).

B. Cystidia on the sides of the lamellae well differentiated and broader than  $10 \mu$ .

- E. Stipe broader than 2 mm; pileus not yellow, but brown. On the ground in wooded areas, sometimes on small pieces of wood.
- F. Dermatocystidia present on pileus and stipe. Temperate zones of the Northern hemisphere *A. firma* (PECK) SING. [cf. also closely related American forms: *A. illicita* (PECK), *A. pruinatipes* (PECK)].
- F. Dermatocystidia numerous on the surface of the stipe but absent or very scarce on the pileus. Subtropical zone of South America, On forest humus. Spores  $6.5-9.3 \times 4.5-6 \mu$ .  
(*A. firma* var. *tucumana* SING. =) *A. tucumana* SING.
- E. Stipe less than 2 mm broad; pileus "Naples yellow". On culms of Gramineae in Europe. *A. pusiola* (FR.) HEIM

6. Key to the species of *Agrocyste*, subgenus *Aporpus* section *Velatae*  
SING.

- A. All basidia 2-spored; clamp connections absent. *A. erebia* (FR.) KÜHN.
- A. Either basidia both 2- and 4-spored or clamp connections present.
- B. Spores over  $10 \mu$  long.
- C. Clamp connections absent; basidia 2-4-spored. *A. apepla* SING. ined.
- C. Clamp connections present. ?*A. ombrophila* (FR.)  
[Several American species belong to the group *A. erebia*—*A. ombrophila* which need further studies regarding their anatomical characters (clamp connections, number of sterigmata, etc.): *A. aggericola* (PECK) SING.; *Pholiota indecens* PECK, *P. washingtoniensis* MURR.; *P. subnigra* MURR.].
- B. Spores  $7-8.5 \times 4-5.5 \mu$ ; basidia 4-spored; clamp connection present. *A. lazoi* SING.

7. Subgenus *Aporus* SING. section *Aporus*: Only *A. aegea* (BRIG.) SING. [Possibly a collective species, very variable with regard to shape of cystidia, number of sterigmata, smoothness or unevenness of pileus surface]. Widespread in warm-temperate, oceanic and subtropical climates, on living trees and dead trunks especially Salicaceae, Aceraceae, *Brussonettia*, *Maytenus*, Myrtaceae, *Allophylus*, and *Quercus*]

Descriptive notes and transfers

*A. cubensis* (MURR.) SING. comb. nov. — *Hebeloma cubense* MURR., North Am. Fl. 10: 227. 1924). This was described by DENNIS as



*Agrocybe sacchari* (MURR.) DENNIS Bull. Soc. Myc. Fr. 69: 180. 1953.  
Known from Cuba south to Northeastern Argentina.

*A. coprophila* SING. Description see Trudy Bot. Inst. Akad. Nauk II  
6: 459. 1950.

*A. subpediades* (MURR.) SING. comb. nov. = *Naucoria subpediades*  
MURR, Lloydia 5: 150. 1942. This species was described by SINGER as  
*A. arenaria* (PECK) SING. in Beih. Nova Hedwigia 29: 227. 1969. But  
the type of *Naucoria arenaria* PECK (NY) seems to agree better with  
the species here keyed out under *A. arenaria* (PECK) SING., section  
*Agrocybe*.

*Agrocybe hortensis* (BURT) SING. comb. nov. = *Hebeloma hortense*  
BURT, Ann. Miss. Bot. Gard. 6: 171. 1919.

*A. howeana* (PECK) SING.

Pileus argillaceous-whitish, then ivory with light wood brown  
shades, especially in the more brownish center, smooth, eventually  
sometimes irregularly radially rimose-cracked, vaguely shiny to almost  
opaque, not distinctly viscid, mostly naked, campanulate-umbonate  
or convex-subumbonate, later more repand to applanate or slightly  
concave with the center obtuse or more often subumbonate, rarely  
obtusely umbonate, 32—113 mm broad. — Lamellae argillaceous-  
whitish then argillaceous and eventually brown from the spores,  
rather broad, 5—8 mm broad but not or scarcely ventricose, close to  
almost crowded, sinuate or not and adnexed to adnate, with a long-  
decurrent tooth. — Stipe white, smooth, glabrous but appearing  
innately silky, under a lens very finely white-silky, with a strictly apical  
annulus (exceptionally, if annulus fragmentary or absent — some veil  
patches pendulous on rim of margin of pileus), equal or subequal,  
i. e. with slightly widened apex and/or with very slightly and gradually  
enlarged lower portion, rarely slightly ventricose, 46—135 × 5—16  $\mu$ ;  
annulus membranous and persistent, smooth, eventually sulcate in  
upper-inner half, dirty white, whitish, repand-horizontal to pendulous;  
mycelium at base pure white, white rhizomorphs also more or less  
developed; in old specimens and by handling stipe surface showing the  
brown context. — Context white, unchanging on exposure but  
eventually becoming brown in the stipe starting from the base. Odor  
weakly farinaceous; taste farinaceous and with a bitter or bitterish,  
disagreeable aftertaste. — Spores 7.5—10.3—(11) × 5.5—6—(7.5)  $\mu$ ,  
ochraceous, ovate to ellipsoid, in frontal view tending to be rounded-  
rhombic but by far not all spores so, but all smooth, with complex wall,  
with broad truncate germ pore. — Hymenium: Basidia 16—25 × 6.5—  
7.5  $\mu$ , 4-spored. Cystidia on both edges and sides 30—49 × 12—22  $\mu$ ,  
some ventricose-subvesiculose with eventually rounded-obtuse apex,  
others ventricose to ventricose-subampullaceous or with a low broad  
obtuse mucro (mucro about 7—8  $\mu$  broad), the former type more  
numerous at the edges and there rather crowded, the latter on the sides

and moderately numerous, all cystidia thin-walled, hyaline, without enclosure, — Hyphae of the pileus trama hyaline, filamentous to strongly inflated, interwoven; hymenophoral trama regular; clamp connections present. — Cortical layers: Epicutis of pileus hymeniform, consisting of hyaline vesiculose, rarely broadly ventricose cells which are  $21-36 \times 9.5-20 \mu$ , thin-walled, few thick-walled, not mucronate; dermatocystidia not differentiated; some velar hyphae often present and at times obscuring the epicutis so that the hymenium becomes obsolete in places in young specimens; hypodermium — a cutis of pale ochraceous to ochraceous yellow hyphae with intraparietal pigment. Covering of stipe (silky fibrils) mainly hyphous, but numerous dermatocystidia present above the annulus, these much like the broadly and evenly rounded type of hymenial cystidia or the elements of the epicutis; below the annulus dermatocystidia scattered and in shape like either of the types of cystidia present in the hymenium, but smaller:  $19-27 \times 8.5-11 \mu$ .

On the ground in shady places under trees and bushes, among litter, mulch, moss, or among grass, almost fasciculate or singly, fruiting from May until summer.

Material studied: USA: N. Y., TYPUS, leg. PECK (NY, FH); Floodwood, det. PECK (FH). — Chio, Cleveland, 26. V. 1975, SINGER N 7518 (F).

The above description excludes large-spored specimens from Massachusetts (FH) which are not identical but belong to some other species.

*Agrocybe praecox* var. *cutifracta* (LANGE) SING. comb. nov. (*Pholiota praecox* var. *cutifracta* LANGE, Dansk Bot. Ark. 2 (11): 6. 1921) differs from *A. howeana* in spore size  $(6.5)-9-12.5-(13.5) \times (5.5)-6.5-7.5-(8) \mu$ , and mild taste (although farinaceous), but can be distinguished from *A. dura* = *molesta* by the cystidia which are not vesiculose-ventricose and obtusely broadly rounded above, but rather ventricose-mucronate to ampullaceous or even constricted underneath a subcapitate apex, without internal bodies,  $35-40 \times 12-21 \mu$ , much like in *A. praecox*. *A. praecox* var. *cutifracta* SING. sensu SING. & DIGILIO with smaller spores and bitterish taste, described from Tierra del Fuego material is obviously *A. howeana*. Thus *A. howeana* occurs in the temperate zone of both North and South America.

*A. paradoxa* SING., Sydowia Beiheft 7: 76. 1973.

Pileus "Mellow glow" to "Inca gold" (Maerz & Paul) or more pallid on margin, sometimes a rather deep fulvous, neither distinctly viscid nor distinctly hygrophanous, smooth, glabrous, convex, obtuse, with incurved margin which is appendiculate by a very scanty, pallid-ochraceous veil which is flocculose and interrupted and disappears soon, 10–17 mm broad. — Lamellae argillaceous-gray to argillaceous-fuscous, eventually tobacco brown from the spores, broad, moderately

distant to medium close, with pallid edges, adnexed to rounded-  
 adnate. — Stipe concolorous with the pileus and at first with a white  
 apex on a whitish base, glabrous but often with a fibrillose roughened  
 surface or with flocculose from a fugacious veil which may even form  
 a thin, smooth, narrow annulus but eventually becoming quite naked,  
 equal or slightly tapering downwards, sometimes with a subbulbous  
 base,  $20-37 \times 1.5-3.5$  mm, base  $2-2.3$  mm broad. No conspicuous  
 white rhizomorphs present. — Context white; odor weak or nil;  
 taste farinaceous, not bitter. — Spores  $11.5-17.8 \times 8-11-(12.8)$   $\mu$ ,  
 ellipsoid but Q very variable, some abnormally triangular or broad-sau-  
 sage-shaped (and then with two germ pores), with thick compound wall,  
 smooth, with a broad, truncate apical germ pore, brownish ochraceous  
 to ochraceous brown. — Hymenium: Basidia (1)–2–(3)-spored,  
 $25-32 \times 7.7-10$   $\mu$ . Cheilocystidia very numerous, but often intermixed  
 with small pseudoparaphysoid cells,  $24-42 \times 6-12.5$   $\mu$ , ventricose in  
 lower portion, with narrowed acute or subcapitate to capitate (capitulum  
 $2-6$   $\mu$  diam.) apex, hyaline, or some ochraceous, thin-walled. Cystidia  
 on the sides of the lamellae scanty to moderately numerous, of two  
 types, (1) only near edge and much like the cheilocystidia,  $45-55 \times$   
 $15-16.5$   $\mu$ , with one or two (one above the other) capitella  $6-8.2$   $\mu$   
 broad, constriction underneath  $3-6$   $\mu$  across, hyaline or ochraceous,  
 thin-walled or wall up to  $0.5$   $\mu$  thick, (2)  $28-41-(70) \times 7.5-14$   $\mu$ ,  
 more irregular ventricose or ampullaceous, some with one or two  
 apical obtuse prongs or finger-like appendages, sometimes almost  
 cylindrical, thin-walled and hyaline. — Hyphae hyaline, with clamp  
 connections; hymenophoral trama regular. — Epicutis subhymeniform,  
 in places hymeniform, consisting of vesiculose or ventricose hyaline or  
 brownish elements which pass over into the pseudoparaphysoid elements  
 of the edge of the lamellae,  $12-33 \times 6-14$   $\mu$ , rarely more broadly  
 cylindrical, and frequently pedicellate, in places intermittent, and  
 overgrown by a velar layer consisting of appressed hyaline non-  
 gelatinized or slightly gelatinized hyphae; dermatocystidia not seen.  
 Covering of the stipe at apex consisting of rather numerous dermatocystidia  
 which are like the cheilocystidia. Pigment in the covering  
 layers intracellular or incrusting, pale stramineous to light brownish  
 ochraceous, also intracellular, but many elements hyaline.

On the soil in tropical and subtropical mountain slopes, often  
 among grasses or herbs, not in dense forests, at up to 2600 m elevation.  
 Andes from Argentina to Ecuador.

At higher altitudes, many species form smaller carpophores with  
 larger spores. It is therefore thought that the form described above is  
 only a mountain form or race of *A. earlei* the type of which is  $20-30$  mm  
 broad and has spores not larger than  $13 \times 7.5$   $\mu$ .

Material studied: Ecuador: Pichincha, 2600 m alt., near Rio  
 Machángara, 20. V. 1973, SINGER B 7542 (F). — Argentina: Tucumán,

Road from Infernillo to Tafi d. Valle at 2500 m alt., 29. I. 1962, SINGER T 3767 (BAFC).

*A. earlei* (MURR.) DENNIS ex SING. comb. nov. = *Naucoria earlei* MURR., Mycologia 4: 77. 1912.

*A. necrophila* SING. was first described and illustrated by RICK, Broteria 6: 79. 1907, as *Hebeloma*. RICK's type was analysed by SINGER, Lilloa 26: 95. 1953. SINGER & DIGILIO's redescription (as *A. coprophila* (RICK) SING. non *A. coprophila* SING., Not. Syst. e Sect. Crypt. Inst. Bot. Acad. Sc. URSS 5 (7-9): 99. 1937.) is ambiguous because some Argentine material not belonging to this species had been included although SINGER T 966 from Argentina (Tucumán: Anta Muerta, in subtropical forest on and around cow dung, 16 IV 1950 (LIL)) seems to be a small-spored form of the type form; here the basidia are all 4-spored whereas in the type 2-3-spored ones are mixed in.

*Agrocybe microspora* SING. spec. nov.

Pileo eburneo vel flavido-albo, margine anguste subappendiculato; stipite albo, exannulato; sporis  $7.5-9.2 \times 4-5.3 \mu$ , poro apicali truncato; basidiis tetrasporis; cystidiis numerosis; epicute hymeniformi. Sapore amarulo. — Ad terram in prato, Illinois, America borealis. Typus in F conservatur.

Pileus ivory, yellowish white, glabrous, smooth, slightly shiny but not more than subviscid, with initially incurved margin, convex, obtuse, 23-41 mm broad; veil in the very young at times thin-membranous, appendiculate, whitish, but inconstant and very fugacious. — Lamellae argillaceous, broad, ventricose, close, almost crowded, here and there thinly pallid-fringed, sinuate and narrowly adnexed. Spore print fuscous. — Stipe white, glabrous but at apex under a lens minutely white pruinose, naked, equal but in apical third gradually widened towards the tip, smooth, hollow,  $70-75 \times 4-5$  mm; annulus and veil rests none; base of stipe white mycelioid. — Context white taste bitterish. — Spores  $7.5-9.2-(10) \times 4-5.3-(6) \mu$ , mostly  $8-8.5 \times 4.5-4.8 \mu$ , with complex ochraceous wall, ellipsoid-subamygdaloid or ovoid, smooth, with broad, truncate germ pore. — Hymenium: Basidia 4-spored,  $13-18 \times 7-7.5 \mu$ . Cystidia on edges and sides of lamellae rather numerous,  $36-51 \times 12-22$  mm saccate with a broad obtuse mucro  $5-9 \mu$  broad, with thin, hyaline wall (wall  $0.3-0.7 \mu$  thick; mostly about  $0.3 \mu$ ), some melleous or ochraceous-yellow, many with amorphous hyaline contents body (but not chryso-cystidioid); cheilocystidia not differentiated from the cystidia of the sides of the lamellae. — Hyphae with clamp connections; hymenophoral trama hyaline, regular, not gelatinized. — Epicutis hymeniform, monostromatic, elements  $20-30 \times 12-32 \mu$ , vesiculose to broadly clavate, hyaline, mostly pedicellate; dermatocystidia few, inconspicuous,

20—25 × 8.5—9  $\mu$ , cylindric, narrowly clavate or ventricose, hyaline or melleous-yellow, not projecting.

On the ground in a meadow, Arnold Arboretum, Illinois, USA, 16. V. 1970, SINGER N 2100 (F), Typus.

*A. sororia* (PECK) SING. comb. nov. = *Naucoria sororia* PECK, Bull. Torr. Bot. Cl. 34; 101. 1907.

*A. sororia* var. *amara* (MURR.) SING. comb. nov. = *Naucoria amara* MURR., North Am. Fl. 10: 176. 1917. = *Agrocybe amara* (MURR.) SING., Llyodia 5: 134. 1942.

*A. sororia* var. *farinacea* (HONGO) SING. comb. nov. = *Agrocybe farinacea* HONGO, Journ. Jap. Bot. 32: 143. 1957.

*A. xuchilensis* (MURR.) SING. Redescription see Sydowia 11: 361. 1957.

*A. apepla* ad int.

Pileus near "New bronze" Maerz & Paul, but center reaching much deeper, margin much paler shades, not viscid, not striate, not hygrophanous, convex, 37 mm broad. — Lamellae "New bronze", inserted, some inversely forked, close, adnate, 3.5 mm broad. — Stipe umber, concolorous with the pileus at the apex, with innately silky striae, coarsely fibrillose-squamose below, 65 × 4.5 mm; annulus early fragmented and fugacious. — Context paler to pallid, inodorous. — Spores (9)—13.15.5 × (4.5)—5—6  $\mu$ , fusoid, often with an apical callus or mucro, without a germ pore, brownish ochraceous, the endosporium pale ocher, the episporium darker brown, smooth. — Hymenium: Basidia 2-spored, but many 3—4-spored basidia present. Cystidia on sides and edges of the lamellae, versiform, often ventricose to ampullaceous or with a constriction underneath a claviculate or subcapitate apex, hyaline, thin-walled, often opaque, 38—48 × 9—14  $\mu$ . — Hyphae without clamp connections. Hymenophoral trama regular, of parallel hyphae 2—3  $\mu$  broad, often inflated to 15  $\mu$ , stramineous-hyaline. — Epicutis consisting of a hymeniform layer of dermatocystidia; hypodermium intermixed, of pigment-incrustated cells.

On the ground in humus under mixed coniferous and frondose trees. Maple River, Emmet Co., Michigan, USA, 27. VII. 1953, SINGER N 855 (F).

This species is proposed ad interim since it is not fully clear what its relations with regard to other taxa of the *Erebia*-stirps are as long as some of the species described are not fully revised. It is possible that *A. apepla* is merely a form or race of *A. erebia* with intermixed 2-, 3-, and 4-spored basidia.

#### *Alnicola* KÜHNER (Cortinariaceae)

1. Key to the species of section *Submelinoideae* SING.

A. On the ground in leafmold, litter, sometimes deep moss or *Carex*, or in burned places.

- B. Pileus not viscidulous; hyphae of the pileus epicutis not loosely arranged.
- C. Hyphae with clamp connections.
- D. Basidia 4-spored. *A. submelionoides* KÜHNER
- D. Basidia 2-spored.
- E. Stipe white or pallid, pallid-cream; spores 7.2—9  $\mu$  broad. Under Salicales, in Southern South America. *A. devia* SING.
- E. Stipe more pigmented (brown); spores 6.5—7.5  $\mu$  broad. Under *Alnus*, perhaps also *Salix*; in the northern hemisphere. *A. inculta* (PECK) SING.
- C. Hyphae without clamp connections.
- F. Cheilocystidia not over 8  $\mu$  broad; basidia 2-spored. *A. bohémica* (VELEN.) SING. sensu ORTON
- F. Cheilocystidia over 8  $\mu$  broad or basidia 4-spored.
- G. Basidia 4-spored. *A. langei* (KÜHN. in KÜHN & ROMAGN.) SING. (*Naucoria langei* KÜHN. in KÜHN. & ROMAG. Bull. Soc. Nat. Oyonnax 10—11 suppl.: 9. 1957.
- G. Basidia 2-spored.
- H. Under *Alnus* in bogs in North America. *A. mirabilis* (ATK.) SING.
- H. Under *Salix* in Europe and Atlantic islands; *N. salicis* ORTON (possibly a variety of *A. mirabilis*)
- B. Pileus subviscid; hyphae of epicutis gelatinized and loosely arranged; always with clamp connections and basidia 4-spored [Group intermediate between *Alnicola* and *Hebeloma* and at present of somewhat doubtful generic position].
- I. On burned places; context bitter; spores 4.5—6.2  $\mu$  broad. *A. pseudoamarescens* KÜHNER & ROMAGN.
- I. On swampy places; spores 6—7.2  $\mu$  broad. *A. clavuligera* ROMAGNESI
- A. On wood of *Picea* in Central Asia. [Generic position uncertain, possibly rather *Gymnopilus*]. *A. lignicola* SING.
2. Key to section *Alnicola*.
- A. On charcoal; taste bitter. Europe and America. *A. amarescens* (QUÉL.) ROMAGN.
- A. Not on charcoal or not bitter (or neither).
- B. Pileus pale ochraceous under a whitish fibrillose covering; taste bitter; veil relatively strongly developed; lamellae with distinct yellowish tinge. *A. luteofibrillosa* KÜHNER
- B. Pileus and lamellae differently colored; pileus as above or

granular-squamulose, velutinous-tomentose, silky-fibrillose or glabrous to glabrescent; veil strongly developed or not.

C. Odor weakly but distinctly aromatic-fuity like *Inocybe piriadora*; spores  $8-10 \times 4.5-5 \mu$ .

*A. suavis* (BRES.) KÜHNER

C. Odor none or different.

D. Spores small, only up to  $10.5 \mu$  long.

E. Spores very weakly and sometimes faintly ornamented. European species growing in Sphagnetum (fide Orton). cf. "*Naucoria*" *sphagneti* ORTON

E. Spores more distinctly punctate-verruculose to verrucose outline rough.

F. Spores broadly fusiform:  $7.8-10.5 \times 5.2-6.5 \mu$ ; pileus velvety-tomentose, pale brownish, with non-striate margin. *A. velutina* (MURR.) SING.

F. Spores relatively more elongated or pileus not velvety-tomentose (or both characters at the same time); margin often transparently striate (see "G" below).

D. Spores, at least many of them, at maturity over  $10 \mu$  long.

G. Pileus ochraceous-melleous, brownish ochraceous, dull stramineous-chamois, only young caps or center often more brown.

H. South American species with many cheilocystidia which are not effilate or subacute mixed with others typical, in shape, of this section. In South American montane woods under *Alnus jorullensis*.

*A. diplocystis* SING.

H. North-temperate zone, common under *Alnus* (other than *A. jorullensis*); nearly all cheilocystidia ventricose below and narrowly effilate and/or subacute above.

I. Center of pileus more brown, margin more ochraceous-stramineous, transparently striate over one third or more of the radius; stipe at first with fine scattered yellowish flocculi which soon disappear taste mild; spores  $4.5-5.3-(6.3) \mu$  broad.

*A. paludosa* (PECK) SING.<sup>4)</sup>

I. Center of pileus even in center with distinct ochraceous (ochraceous brown) tinge and margin short-striate to smooth; stipe without any rests of a flocculose veil; spores broader:

<sup>4)</sup> Not to be confused with *Naucoria paludosa* VELEN. which is *Alnicola scolecina*.

5.3—7—(7.3)  $\mu$ ; terminal cells of epicuticular elements mostly subisodiametric, some transformed into dermatocystidia.

*A. melinoides* (FR.) KÜHNER

[This and preceding species often difficult to distinguish and possibly the latter a variety of the former].

G. Pileus a much deeper brown, chestnut etc., the margin not ochraceous.

J. Stipe with a rather distinct squamulose or zonate sordid-brownish or pale ochraceous veil; taste mild or almost so; cheilocystidia as typical in this section but some with a broader subcapitate apex.

*A. subconspersa* KÜHNER ex ORTON<sup>5)</sup>

J. Veil indistinct, appressedly silky and hyaline, soon disappearing; or becoming brown and fibrillose, never squamulose; taste variable; cheilocystidia all typical for the section.

K. Spores not over 10.3  $\mu$  long (mostly 8—10.3  $\times$  4.5—5.3  $\mu$ ); pileus obtuse or with a small, low umbo or subumbonate; taste mild or very slightly bitterish. Under *Alnus jorullensis* in the Americas and other alders in the North. Hemisphere *A. scolecina* (FR.) ROMAGN. var. *scolecina*

K. Spores, at least many of them when quite mature, reaching more than 10.3  $\mu$  (often up to 14  $\mu$  long); pileus mostly umbonate; taste mild to bitter.

L. With *Alnus* and *Betula* in bogs; taste bitter; stipe brownfibrillose (cf. *N. fellea* (FAVRE) MOSER? = *A. scolecina* sensu ROMAGNESI, Bull. Soc. Myc. Fr. 58: 121. 1942).

L. Growing under *Alnus*; taste mild; stipe not distinctly brown-fibrillose (if under dwarf *Salix* in alpine zone — see *Naucoria tantilla* FAVRE which probably does not belong in *Alnicola*).

*A. scolecina* (FR.) ROMAGNESI var. *umbrina* SING.

<sup>5)</sup> *Naucora urticacea* VELEN., type collection, is a mixture of *Alnicola* cf. *subconspersa* (PR 154404) and *Psilocybe* cf. *crochula* (PR 154426). Since the description is also a mixture of these two elements, we may consider it a *nomen confusum*.



## Descriptive notes and transfers

*Alnicola paludosa* (PECK) SING. comb. nov. = *Naucoria paludosa* PECK, Ann. Rep. N. Y. State Museum 41: 68. 1888. — *Naucoria striatula* ORTON, Trans. Brit. Myc. Soc. 43: 322. 1960 is apparently the same species.

*Alnicola scolecina* (FR.) ROMAGNESI. — A description of this species was given by Singer, Sydowia 4: 154. 1950, but this description is in need of a correction as far as the spore size is concerned. The spore size given l. c. includes specimens of var. *umbrina* SING. as is explained in the last paragraph (p. 155). Several other specimens both of var. *scolecina* and var. *umbrina* have been found in the Alneta of the pre-Andine montane zone but the former always had spores under  $10.3 \mu$  long and under  $5.7 \mu$  broad. The short-spored form, var. *scolecina*, was also collected by me on the Högnen Peninsula near Femsjö in Sweden under alder 21. VIII. 1964, no. C 4176 (BAFC) with precisely the characters of the Argentine specimens. This, and the fact that Fries does not indicate bitter taste causes me to consider the shortspored form as the type form of *A. scolecinus* FR. The taste is quite mild to rarely vaguely bitterish in both forms. Var. *umbrina* SING. var. nov. (an vere *Tubaria umbrina* MAIRE, Bull. Soc. Mycl. Fr. 44: 48. 1928, Orton dubitante) a typo differt sporis majoribus  $10.3-12 \times 6-6.7 \mu$ . Typus: Chile, Salto de Laja near San Antonio under *Alnus* (planted), 2. IV. 1967, SINGER M 6540 (BAFC).

The bitter tasting species or form described by ROMAGNESI seems to be identical with *N. fellea* (FAVRE) MOSER but I lack experience with regard to the bitter form which I have collected only once. Consequently, I am not certain whether this is an additional variety or form (perhaps, as Romagnesi suggests, f. *gracillima* LANGE) or as Moser seems to believe, another species. The form of lamellae-attachment to the stipe is extremely variable and does not seem to be of much help when the three forms are compared.

In the key, I have taken care to key out the separate forms which does not mean that they are specifically different although they may be.

*Amanita* PERS. ex HOOKER (Amanitaceae)

A key to the species of *Amanita* is not provided in this series. Several good regional keys (e. gr. MOSER 1967), a world-wide illustrated treatment (GILBERT in BRESADOLA 1940—1941) and a world monograph of section *Lepidellae* (BAS 1969) are available. C. BAS is completing his monograph of *Amanita* at present so that this author does not feel that a new — still incomplete — key should be added now.

*Amyloflagellula* SING. (Tricholomataceae)

Only two, easily distinguishable species are known at present.

*Anellaria* KARST. (Coprinoaceae)

Only two easily distinguishable species are known at present.

*Anthracophyllum* CES. (Tricholomataceae)

- A. Tropical, subtropical species.
- B. Neotropical species.
  - C. Spores more than 10  $\mu$  long; stipe minute.
    - A. lateritium* (BERK. & CURT.) SING.
  - C. Spores less than 10  $\mu$  long; stipe conspicuous.
    - A. paxilloides* SING.
- B. Paleotropical species.
  - A. nigrita* (LÉV.) KALCHBR.
- A. Temperate species of the southern hemisphere.
  - C. Spores 8.5—10.8  $\times$  3.8—5.3  $\mu$ ; lamellae intervenose. Australia.
    - A. proximum* (BERK. & BR.) REID
  - C. Spores relatively broader; lamellae not intervenose.
    - D. Spores reaching up to 12.5  $\mu$  in length and 7.5  $\mu$  in breadth. Tasmania.
      - A. archeri* (BERK.) PEGLER
    - D. Spores slightly smaller. South American species.
      - E. Basidia with 2—3—4 spores 8—11.3  $\times$  4.7—6.5  $\mu$ ; trough-lamellae about seventeen.
        - A. berteroi* (MONT.) SING.
      - E. Basidia all 4-spored; spores 7.5—9  $\times$  (4)—5—5.5—(6.8)  $\mu$ ; trough-lamellae six to eleven.
        - A. discolor* (MONT.) SING.

*Aphyllotus* SING. (Tricholomataceae)

Only one species known.

*Armillaria* KUMMER (Tricholomataceae)

Only two species well known; others doubtful.

*Armillariella* KARST. (Tricholomataceae)

- 1. Key to the species with distinct annular veil.
- A. Species of the temperate zones.
- B. Species of Europe.
  - C. Growing on frondose wood (rarely passing onto roots of other dicotyledonous plants, exceptionally on pine).
  - D. Pileus distinctly pigmented but — aside from the scales which are sometimes somewhat olive tinged — without olive or greenish tinge.
  - E. Annulus membranous, with yellow flocculi on the lower surface; stipe relatively elongated and not strongly bulbous below; a distinct styptic after-taste

always noticeable in fresh material. Infraparietal pigment scarcely developed.

F. Fruiting rarely from August, usually from September until November or December, most commonly in dense subfascicular clusters or numerous individual carpophores; a slight odor of camembert cheese usually noticeable in fresh material; spore print when quite fresh pale cream (Romagnesi, *Russula chart* I b, becoming deeper cream dehydrated).

*A. mellea* (VAHL ex FR. KARST.

F. Fruiting in June and July, usually in somewhat looser, smaller groups; odor none; spore print pure white when quite fresh but becoming pale cream on drying.

*A. praecox* (VELEN.) SING.

E. Either annulus more cortiniform and without yellow flocculi on its lower side or one of these characteristics present; stipe often relatively shorter and/or bulbous; odor not of camembert and taste mild and remaining so, or with a styptic after-taste. Infraparietal pigment usually visible.

G. Young stipe beset with bister floccons or scales.

*A. ostroyae* ROMAGN.

G. Bister floccons or scales absent or very inconspicuous and fugacious.

H. Annulus soft, membranous and not thin, cortiniform; spore print at least I b (Romagnesi, *Russula chart*) when quite fresh, becoming deeper cream after dehydration; mature spores  $6.8-9.2 \times (4.3)-4.5-6.3-$   
(8)  $\mu$ , mostly  $7.2-8.8 \times 5-6.3 \mu$ .

*A. polymyces* (PERS. ex S. F. GRAY) SING. &  
CLÉM.

H. Annulus soft and thin and cortiniform; spore print varying from pure white to between I a and I b (Romagnesi, *Russula chart*), not reaching I b unless by dehydration; spores  $7.5-8.5 \times 4-5 \mu$ .

*A. bulbosa* (BARLA) ROMAGN.

D. Pileus white or whitish or with olive or greenish tinge.

I. Pileus white or whitish without olive tinge (*A. spec.* discovered by Poelt in Berlin, not fully studied).

I. Pileus with olive or greenish tinge *A. montagnei* SING.  
[Cf. also an *A. spec.*, possibly *A. mellea* var. *viridiflava*

(BARLA), not uncommon along the Southern fringe of the Alps, but not fully studied].

- C. Growing on coniferous wood.
- J. Pileus 7—10 mm broad. In the plains of Eastern Europe.  
*A. saviczii* SING.
- J. Pileus 40—110 mm broad; on its surface flocculose-squarrulose scales at first all over, in the center rather persistent, dark brown; mostly on and around stumps of *Picea* but apparently also on other conifers most frequently in the boreal and montane zone [if with olive tinge, cf. also "I" above]. *A. obscura* (SECR.) ROMAGN.
- B. Species of Northern Asia and North America and of the south-temperate zone.
- K. Species of the south-temperate zone (South Chile, Patagonia and temperate Australia and New Zealand).
- L. Pileus pigmented but without green tinges underneath the scales.
- M. Pileus entirely bright yellow. *A. limonia* STEVENSON
- M. Pileus not entirely yellow.
- N. Pileus rather deep umber brown, mostly on *Austrocedrus*, *Fitzroya* and other Southern conifers (see "J" above).
- N. Pileus cream to melleous or fuscous gray to cinereous.
- O. Pileus cream-melleous reaching often yellowish pallid near the margin, the center often reaching brownish melleous or almost chestnut, without any gray shades, tending to be viscid; taste quite mild lateral stratum of the hymenophoral trama strongly gelatinized and curving outwards (trama strongly bilateral); spores rather large (7.3)—7.5—10.7—(12) × (4.5)—4.7—7.3  $\mu$ . On various deciduous trees.  
*A. sparrei* var. *sparrei* SING.
- O. Pileus cinereous to fuscous gray.
- P. Taste strongly styptic; lamellae light cinnamon salmon color or cinnamon; mostly on Aextoxacaceae in South Chile.  
*A. griseomellea* SING.
- P. Taste mild or very slightly styptic after long mastication, at times persistently mild; lamellae at first white to cream-white; mostly on Salicaceae, Myrtaceae and other frondose trees, not on *Aextoxicum* (see key II "C").

- L. Pileus with a green to olive tinge. Always on frondose trees, mainly in the *Nothofagus* zone, or on myrtaceous wood.
  - Q. Pileus viscid when wet; taste mild.
    - R. Spores up to 7  $\mu$  broad and up to 9.7  $\mu$  long.  
*A. sparrei* SING. var. *elaeodes* SING.
    - R. Spores up to 5—(5.8)  $\mu$  broad and up to 8—(9)  $\mu$  long.  
*A. novaezelandiae* STEVENSON
  - Q. Pileus not viscid; taste strongly styptic (see "I" above).
- K. Species of Northern Asia, East-Asia and North America.
  - S. On frondose wood.
    - T. Species combining the following characteristics: Context mild and remaining so; spore print almost white (between I a and I b of Romagnesi *Russula* chart); spores 7.5—10.3  $\times$  4.5—6  $\mu$ ; fibrils of the covering of both pileus and stipe distinctly yellow.  
*A. sparrei* var. *xantha* SING.
    - T. With another combination of characters.
      - U. Species with the characteristics of *A. mellea* (this key "F"), see *A. mellea*.
      - U. With other character combinations [the species of Asia and North America have not been analyzed sufficiently; forms not yet described may occur. At any rate cf. "D" and "L" above and key II].
  - S. On coniferous wood.
    - V. Species combining the characters of *A. obscura* (this key "J"), see *A. obscura*. (Cf. also *A. solidipes* PECK, 1900).
    - V. With other character combinations [the species of Asia and North America have not been analyzed sufficiently; forms not yet described may occur. At any rate compare "J" above].
- A. Tropical and subtropical species (see key II).

## Key II.

- A. Neotropical species.
  - B. Pileus olive; taste astringent-styptic or bitter (if mild see key I "Q").  
*A. olivacea* (RICK) SING.
  - B. Pileus not olive.
    - C. Pileus at first light gray, cinereous or fuscous gray; lamellae at first white to cream white; taste mild or with a very slight styptic after-taste.  
*A. procera* (SPEG.) SING.
    - C. Pileus not gray when fresh.
      - D. Annulus membranous and persistent.

- E. Lamellae with a distinct pinkish or salmon tinge; margin of pileus said to be pinkish when fresh; scales of pileus apparently easily disappearing; spores  $8-9 \times 4.5-6.3 \mu$  (with exact data on taste and spore print color of fresh specimens missing). Gulf area.  
*A. melleorubens* (BERK. & CURT.) SING.
- E. Lamellae whitish to cinnamon pallid when young; margin of pileus not pinkish; spores (7.3)—8—11—(12)  $\times$  (3.7)—5.3—7.3  $\mu$ , with thin to thick wall; taste mild (rarely with a very slight styptic after-taste; spore print pure white when quite fresh).
- F. Taste persistently mild; pileus 11—34 mm broad.  
South America.  
*A. puiggarii* (SPEG.) SING. ssp. *puiggarii*
- F. Taste submild (after long mastication slightly styptic); pileus 27—127—(175) mm broad. In gallerie forest in subtropical to warm-temperate South America, Atlantic coast.  
*A. puiggarii* ssp. *tigrensii* SING.
- D. Annulus fibrillose, thin, loose, cortiniform; taste always mild; spore print always pure white.
- G. Lamellae with a salmon tinge when young and fresh; center of pileus dark brown. *A. yungensis* SING.
- G. Lamellae whitish to cinnamon white when young; center of pileus light colored, only the scales reaching a medium deep cinnamon fuscous (see "F" above).
- A. Paletropical species [Probably not all species known, cf. also "B" above].
- H. Lamellae white or pallid. Tropical Asia *A. fuscipes* (PETCH) and *A. mellea* var. *javanica* (HENN.). — Tropical Africa: *A. camerunensis* HENN. (with spores  $7 \times 4.8 \mu$ , longitudinally striate).
- H. Lamellae whitish pink or salmon.
- I. Himalayan species with thick-membranous annular veil and spores  $9-10 \times 5-6.5 \mu$ . *A. omnituens* (BERK.) SING.
- I. Species from New Guinea and species from Africa.
- J. African species with spores  $6.8-10 \times 4.5-5.6 \mu$ , many spores assuming thick (1.3  $\mu$ ) triple walls; scales of pileus greenish. *A. spec. aff. elegans* HEIM
- J. New Guinean species with spores  $7-8.4 \times 5-5.8 \mu$  (i. e. broader than above); scales of the pileus maroon brown. *A. elegans* HEIM

## 2. Key to the exannulate species.

- A. Pileus and stipe at first white or whitish with fuliginous or black innate fibrils. Boreal-alpine species. *A. nigropunctata* (SECR.) SING.

A. Pileus different.

- B. Stipe 10—20 mm broad with large reflexed scales; spores 4.5—5.5  $\mu$  broad; odor of anise. Florida.

*A. watsonii* (MURR.) SING.

- B. Stipe generally somewhat narrower; fibrils of stipe appressed (if any); spores 4.5—6  $\mu$  broad; odor agreeable, of *Clitopilus prunulus*, or very slight to nil, not of anise.

- C. Spores 6—7.5  $\times$  4.5—5.5  $\mu$ ; hyphae of epicutis with incrusting pigment; growing cespitose on sandy soil.

*A. compressipes* (MURR.) SING.

- C. Spores 7.5—9  $\times$  5—6  $\mu$ ; pigment not incrusting; carpophores growing cespitosely or not, not on sandy soil.

- D. Epicuticular hyphae not forming scales like those of *A. mellea* but merely radially appressed fibrils consisting of hyphae with colorless walls. Europe, among *Sphagnum* and *Carex* in bogs.

*A. ectypa* (FR.) SING.

- D. Pileus fibrillose-squamulose-squarrollose, the scales consisting of hyphae with intraparietal pigment. Widespread, often on and around dead wood, but also pathogenic on forest trees as well as on various plants in plantations.

*A. tabescens* (SCOP. ex FR.) SING.

*Arrhenia* FR. (Tricholomataceae)

Only one species is well known.

*Arthrosporella* SING. (Tricholomataceae)

Only one species is known.

*Bolbitius* FR. (Bolbitiaceae)

- A. Growing on wood.

- B. Tropical, Asiatic. Pileus dirty bluish purple. *B. glaucopurpureus* (BERK. & BR.) KÜHN.

- B. Temperate-neotropical. Pileus pearl gray, lilac gray, fuscous gray, fuscous-violet.

- C. Pileus reticulate-venose, mostly fuscous violet, 30—60 mm broad; stipe not tending to yellow at base; spores about half as broad as long or slightly broader. Temperate, mostly European species. *B. reticulatus* (PERS. ex FR.) RICKEN

- C. Pileus only radially grooved when mature, less violet, often smaller; spores as above or broader. Gulf region from Vera Cruz in Mexico to Venezuela or widespread in temperate regions.

- D. Widespread in the temperate zone of Southern South

America and in the northern temperate zone; stipe not tending to yellow; spores  $8-11 \times 4-5.6 \mu$ .

*B. aleuriatus* (FR.) SING.

- D. Tropical zone of Mexico from Vera Cruz to Venezuela; spores relatively broader:  $8-9 \times 4.5-5 \mu$  (Murrill),  $9-11 \times 6-7 \mu$  (Dennis); stipe yellow at base according to Dennis (cf. also "O" below).

*B. mexicanus* (MURR.) MURR.

- A. Growing on dung, more rarely on rotting vegetable matter, fabrics, etc., or on the earth in open grassy places, not on wood, perhaps sometimes on the earth in woods.

- E. Pileus entirely white, at least at first; stipe also entirely white.

F. American species with spores  $9 \times 6 \mu$ , or  $12-16 \times 8-10 \mu$  (not studied by the author).

G. Spores  $12-16 \times 8-10 \mu$ . cf. *B. glatfelteri* PECK

G. Spores  $9 \times 6 \mu$ . cf. *B. sordidus* LLOYD

F. European species with spores  $10.5-11.5 \times 6-6.3 \mu$  or South American species with spores  $11.5-14.8 \times 6.8-8.5 \mu$ .

H. European species with spores  $10.5-11.5 \times 6-6.3 \mu$ ; pileus more than 5 mm broad. *B. lacteus* LANGE

H. South American species with spores  $11.5-14.8 \times 6.8-8.5 \mu$ , or pileus very small.

I. South American species; pileus  $> 10$  mm.

*B. albiceps* SPEG.

I. European species; pileus 1-2 mm broad.

*B. exiguus* SING.

- E. Pileus not entirely white; stipe white or colored.

J. Base of stipe blue ("Arno blue" Maerz & Paul) or hyphae with clamp connections. *B. gloiocyaneus* ATK.

J. Base of stipe white, pink, yellow; hyphae generally without clamp connections (known to lack clamps in *B. brunneidiscus*, *B. tucumanensis*, *B. vitellinus*, *B. demangei*).

K. Stipe pink; Europe, Asia, North and South America.

*B. demangei* (QUÉL.) SACC. & SACC.

K. Stipe white or yellow

L. Spores more than  $9 \mu$  long or more than  $5 \mu$  broad.

M. Pileus bright yellow-brown, egg yellow, sometimes with olive shades; stipe white or more often at least partly yellow (and then the whiteness of the apical portion of the stipe depending on the abundance of pallid pruina); if pileus not yellow — at least stipe in part bright yellow.

N. Pileus entirely yellow, only margin often pallid to rarely slightly grayish. On dung and



- manured lawns and meadows, common and widespread. *B. vitellinus* (PERS. ex FR.) FR.
- N. Pileus not entirely yellow.
- O. Pileus at first sulphur yellow on the margin, otherwise tinged with cinereous-ochraceous or greenish or with pink hues; North America cf. *B. expansus* (PECK) var. *terrestris* (PECK)
- O. Pileus smoky olive to fuliginous; stipe at first yellow and ochraceous. On manured lawns, rotting straw and sawdust in North America and East Asia.
- B. variicolor* ATK.
- M. Pileus and stipe both without bright yellow colors, but pinkish gray, brown, pale yellow with red tinge on the disc or with olive shades; stipe white or more rarely pale ochraceous; context never bright yellow in any part.
- P. Spores  $18-20.7 \times 7-7.8 \mu$ . Dung-inhabiting species of South America; lamellae subfree.
- B. tucumanensis* SING.
- P. Spores somewhat or much smaller. North or Central American and European species; lamellae free to adnate.
- Q. European species with pileus 1-2 mm broad (see "I" above).
- Q. American and Asiatic species (not all restudied by the author).
- R. Pileus pale yellow, the disc tinged with red; spores unknown; "in woods". cf. *B. nobilis* PECK
- R. Pileus differently colored.
- S. Spores  $12.5-16 \times >7.5 \mu$ .
- T. Pileus pinkish gray or light pinkish cinnamon, becoming whitish; spores indicated as  $12.5-15 \times 7.5 \mu$  (MURRILL),  $10-13 \times 6-8 \mu$  (IMAI). On dung. *B. coprophilus* (PECK) HONGO
- T. Pileus gray-stramineous, fuscescent to the margin; spores indicated as  $13-16 \times 10-12 \mu$ . "On stercorate leaves".
- B. glutinosus* (CLEMENTS)  
[Possibly an old *B. variicolor* ?]

S. Spores up to  $11\ \mu$  long. On the ground in rich soil. Jamaica; Argentina *B. brunneidiscus* (MURR.) SACC. & TROTT.

L. Spores  $7.5-9.3 \times 4.5-5\ \mu$ ; stipe lemon- to chrome-yellow. Tropical species on sugar cane, with or without admixture of dung. *B. mesosporus* SING.

#### Descriptive notes and transfers

*B. demangei* (QUÉL.) SACC. & SACC.

This species has been described fully by Singer (Lilloa 25: 318. 1952).

*B. vitellinus* (PERS. ex FR.) FR.

This common species apparently exists in all continents (excepting Antarctica) and is very variable. Moser distinguishes as varieties two forms with more lemon yellow rather than egg yellow pileus and yellowish white to yellow stipe. These are var. *titubans* with spores  $13-15 \times 7-9\ \mu$  and pileus sulcate to disc, and var. *fragilis* with spores  $9-12 \times 7-9\ \mu$  and pileus striate only on margin.

*B. expansus* (PECK) var. *terrestris* (PECK). This is the species described by KAUFFMAN as *Pluteolus expansus* (PECK) KAUFFMAN and thought to be the same as PECK's var. *terrestris*. Since *Galera expansa* var. *expansa* was originally described by PECK as occurring on decayed wood, a transfer to *Bolbitius* is at present postponed.

*B. mesosporus* SING. spec. nov.

Pileo chromeo-flavo, 30—60 mm lato; lamellis flavis dein ochraceis, liberis; stipite citrino,  $73-76 \times 1.5-6$  mm. Sporis  $7.5-9.3 \times 4.5-5\ \mu$ . Ad culmos Sacchari in Aequatoria, typus in F conservatus est.

Pileus bright chrome yellow, viscid, pectinate over more than half the radius, glabrous, at first barrel shaped or obovate, then convex with depressed center, sometimes umbonate and then sometimes umbo umbilicate, 30—60 mm broad. — Lamellae yellow, then ochraceous, close, free. — Stipe lemon yellow, with pruinose apex, white floccose below, hollow, equal, slightly tapering upwards or tapering from a ventricose base (so often when young),  $73-76 \times 1.5-6$  mm. — Spores  $7.5-9.3 \times 4.5-5\ \mu$ , ellipsoid to almond shaped, rusty ochraceous, smooth, with apical germ pore, complex but moderately thick walled. — Hymenium: Basidia  $15-18 \times 8-8.5\ \mu$ , mixed 2—4-spored but predominantly 4-spored; pseudoparaphyses  $15 \times 11\ \mu$ , hyaline, broadly ventricose; cheilocystidia  $31-37 \times 7-15\ \mu$ , narrowly clavate to ampullaceous-subventricose, hyaline, numerous. True cystidia none. — Hyphae elongated but often very broad-inflated, hyaline, inamyloid, without clamp connections; hymenophoral trama regular,

hyaline. — Epicutis of pileus hymeniform. Covering of stipe consisting of hyaline hyphal ends which are little differentiated, e. gr.  $23-28 \times 8 \mu$ .

On stalks of *Saccharum* with or without admixture of dung, gregarious.

Material studied: Ecuador: Tungurahua, Baños, 27. IV. 1973, SINGER B 7148 (F), Typus.

*B. brunneidiscus* (MURR.) SACC. & TROTTER

Bos.: *Mycena brunneidisca* MURRILL, North Am. Flora 10: 192. 1917.

Pileus brownish isabelline to fuscous gray, on disc even almost fuliginous at times, glutinous, glabrous, smooth, long-striate and subpectinate in age, smooth on the disc, campanulate-conic, then mostly repand or even at times somewhat depressed, at first often subumbonate but soon obtuse, about 12 mm broad. — Lamellae ferrugineous with pallid edge, rather broad, close, almost crowded, adnexed. — Stipe entirely white, equal or slightly attenuated towards the apex, smooth, macro- and microscopically glabrous or nearly so,  $53-60 \times 1.5-2$  mm. — Contextwhite, very thin, inodorous. — Spores  $9.5-11-(12.5) \times 7-8.3-(8.5) \mu$  (according to Murrill  $8-9 \times 5-7 \mu$ ), elliptical in frontal view, slightly lentiform and only  $5.5-6.5 \mu$  broad in lateral view, with a broad truncate germ pore, smooth, ferrugineous as in *Conocybe*, with thick complex wall. — Hymenium: Basidia  $18 \times 11 \mu$ , 4-spored, often a few 3-spored ones mixed in; pseudoparaphyses  $24-32 \times 10-15 \mu$ , thin-walled and hyaline, ventricose-subvesiculose; cheilocystidia  $33-38 \times 7.5-8 \mu$ , versiform but usually mostly fusoid-subamullaceous, ventricose in lower half thinner  $4.5-5 \mu$  diam., sometimes the latter constricted ( $1.5-4 \mu$ ) underneath a clavulate to subcapitate ( $4-5 \mu$  across) apex; true cystidia none. — Hyphae subhyaline to hyaline, inamyloid, strongly elongated, thin-walled, parallel in the stipe, no clamp connections observed. — Epicutis of pileus hymeniform, consisting of vesiculose elements  $15-18.5 \times 11-15 \mu$ , also some clavate to cylindrical and  $11-12 \times 5-7 \mu$ , with some gelatinized hyphae breaking through the hymenium and occasionally even covering it. Covering of the stipe consisting of small ventricose to subvesiculose bodies like those of *Conocybe lactea*, but no elongated hyphous hairs present, but in bunches intermixed with these small elements, there are also basidia, basidioles, and dermatocystidia, the latter very versiform, mostly subfusoid-ampullaceous, ventricose below and with tapering neck ( $2.5 \mu$  across), all thin-walled and hyaline,  $30-33 \times 9.5-11 \mu$ .

On rich soil and dung, in gardens and open grassy places.

Material studied: Jamaica: between Port Antonio and Manchioneal, 17. XII. 1908, Murrill 223 (NY), typus. — Argentina: Tucumán, Ciudad Universitaria on San Javier, 1100 m alt., March 1957, SINGER T 3031 (F).

*Boletellus* (Strobilomycetaceae)

1. Section *Boletellus*

A. Spores longitudinally winged and the wings cross-striate (striation visible under a good oil immersion lens).

B. American species south to Colombia. Pileus some tinge of red, conspicuously large-squamose much like *Strobilomyces floccopus*, but with a widely projecting membranous veil-like margin which rings the apex of the stipe at first (if not combining all these characters, see sect. *Chrysenteroidei*).

*B. ananas* (CURTIS) MURR.

B. Not observed in the Western Hemisphere, or else occurring in the South Pacific.

C. Species occurring in Australia and the South Pacific.

*B. pallescens* COOKE & MASS. = *B. ligulatus* COOKE (both as *Strobilomyces*).

[This species may be a geographical race of *B. ananas*].

C. Species occurring in Asia and Africa.

D. Pileus chestnut; spores  $21-23 \times 10.3 \mu$ . Sikkim.

*B. verrucarius* (BERK.) SING.

D. Pileus with red or purple colors when quite fresh or spores significantly smaller.

E. Spores  $13-17.5 \times 8-10 \mu$ .

F. Spores  $9-10 \mu$  broad; Asiatic species.

*B. squamatus* (BERK.) SING.

F. Spores  $6-8 \mu$  broad; African species (see "P" below).

E. Spores larger.

G. Pileus umber, densely irregularly verrucose; spores  $18.2-21.2 \times 8 \mu$ .

*B. paradoxus* (MASS. as *Strobilomyces*)

G. Pileus differently colored *B. emodensis* (BERK.) SING. and closely allied species or forms, probably specifically identical, viz. *B. floriformis* IMAZEKI from Japan; *Strobilomyces annamiticus* PAT. from Vietnam; *B. porphyrius* (PAT. & BAKER) Gilbert from Malaya. [Compare also "Q" below where spore data have not been checked by the present author].

A. Spores longitudinally winged but the wings decidedly smooth under a good oil immersion lens.

H. Australian species.

I. Pileus reddish brown medium sized scales.

*B. rufescens* (COOKE & MASS.) SING.

I. Pileus whitish with obtuse, large scales.

*B. ananaeiceps* (BERK.) SING.

H. Species from the South Pacific Islands, New Guinea etc., Asia, Africa or the Americas.

J. Species with red pileus, with squamose covering and with spores not over  $15 \mu$  long and not over  $6.2 \mu$  broad (see sect. *Chrysenteroidei*).

J. Species with red or purple pileus — and then spores larger — or with other colors.

K. American species (Gulf region or Northern South America).

L. Spores  $18-22.5 \times 7.5-10 \mu$ , with rather low longitudinal ridges; margin of pileus not appendiculate; pileus cow red or red, dry often more brown.

M. Pileus said to be glabrous, red; stipe furfuraceous; on rotten wood.

*B. lignatilis* (BERK. & CURT. as *Boletus*)

[Possibly identical with *B. cubensis*].

M. Pileus distinctly fibrillose to squamulose, cow red (see here also if dried pileus brown); on the ground in forests.

*B. cubensis* (BERK. & CURT.) SING.

L. Spores  $14-19 \times 6.5-8.5 \mu$ , with longitudinal low striae; margin of pileus appendiculate.

*B. guadelupensis* (PAT. as *Boletus*)

[Possibly identical with *B. cubensis*].

K. Species not occurring in tropical America.

N. African species.

O. Spores  $17-22.7 \times 5.3-8 \mu$  (see "S" below).

O. Spores smaller.

P. Spores  $(12.5)-13.3-16.8-(18) \times 6-7.2-(8) \mu$ ; margin with a sterile veil-like sleeve like that of *B. emodensis*. Madagascar.

*B. immutabilis* (BOURIQUET) PERREAU

P. Spores  $12-16.2 \times 5.3-10.8$ ; margin not conspicuously appendiculate (see sect. *Chrysenteroidei*).

N. Asiatic species. Pileus always with a red to vinaceous tinge or with a veil-like appendiculation projecting from the margin and often clasping the apex of the stipe at first.

Q. Tomentum of the pileus 0.2 mm thick, the surface cracking into large flat scales; spores  $14-16 \times 5.7-7 \mu$ . *B. dissiliens* (CORNER as *Boletus*)

Q. Pileus different; spores reaching larger size.

R. Pileus 25—45 mm broad; context bluing;  
pores at first pinkish orange.

*B. fallax* (CORNER as *Boletus*)

R. Pileus often larger or smaller; context not bluing.

S. Pileus about 10 mm broad.

*B. ridiculus* (CORNER as *Boletus*)

S. Pileus much larger.

T. Pileus carmine red, not appendiculate.

*B. obscurecoccineus* (HÖHN.) SING.

T. Pileus pale fuscous tan, with a veil-like  
appendiculation like that of *B. ananas*—

cf. *B. ananas* sensu CORNER

## 2. Section *Mirabiles* SING.:

A. Pileus granular-roughened to coarsely tomentose; mostly on rotting  
coniferous wood in the Western United States but east to the upper  
Peninsula of Michigan. *B. mirabilis* (MURR.) SING.

A. Pileus only subtomentose when young. Under *Pinus* from Michigan  
to North Carolina. *B. projectellus* (MURR.) SING.

## 3. Section *Retispori* Sing.:

A. Pileus more or less viscid to glutinous.

B. Pores crimson to orange red. Malaya, Borneo.

*B. mandarinus* (CORNER as *Heimiella*)

B. Pores yellow. New Guinea.

*B. rubropunctus* (HONGO as *Heimiella*)

A. Pileus dry.

C. Pileus rugose-reticulate to subcerebriform.

D. Pileus up to 120 mm broad, bright fawn-ochraceous; spores  
to 18  $\mu$  long. Borneo.

*B. kinabaluensis* (CORNER as *Heimiella*)

D. Pileus smaller, dark brown; spores more than 18  $\mu$  long.  
New Guinea. *B. anguiformis* (HEIM as *Heimiella*)

C. Pileus smooth.

E. Spores 11—13  $\mu$  long and relatively short.

F. Yünnan (China).

cf. *B. glabripes* (CHIU as *Strobilomyces*)

F. Malaya, Singapore, Borneo.

*B. retisporus* (PAT. & BAKER) SING.

E. Spores more elongated.

G. Spores up to 15  $\times$  8  $\mu$ . Japan.

*B. japonicus* (HONGO as *Heimiella*)

G. Spores 16  $\mu$  long or longer.

*B. subretisporus* (CORNER as *Heimiella*)

4. Section *Chrysenteroidei* SING.:

A. African species.

B. Spores 9  $\mu$  or more broad, said to be brown under the microscope.

C. Pores concolorous with the tubes.

*B. lepidosporus* GILBERT ex Heinemann

C. Pores at first carmine red; tubes yellow.

D. Pileus dark carmine red.

*B. rubroviolaceus* HEINEMANN & GOOS.

D. Pileus yellow.

*B. linderi* SING.

B. Spores 8.5  $\mu$  or less broad; said to be yellow under the microscope.

E. Stipe whitish towards the base, brown, scarcely pink at apex,  
50—70 mm long.

*B. pustulatus* (BEELI) GILBERT

E. Stipe with yellow basal mycelium, orange yellow at apex,  
otherwise purple red, 70—90 mm long.

*B. longipes* HEINEMANN

A. Species not observed in Africa.

F. American and European species.

G. Spores with easily discernible ridges at least 0.5  $\mu$  projecting.

H. Temperate North American species with spores showing  
an ornamentation with intervenose ridges; pileus never  
red.

*B. chrysenteroides* (SNELL) SNELL

H. Spores longitudinally ridged or winged, the ridges or  
wings sometimes forked but not intervenose and/or  
pileus red, rose red.

I. Pileus dark rose red ("Pompeian red" Ridgway); pores  
not red.

*B. subchrysenteroides* SM. & THIERS

I. Pileus not so colored; pores sometimes discolorous,  
red.

*B. pictiformis* (MURR.) SING.

G. Spores with very low longitudinal veins, these often barely  
recognizable in ammonia mounts under a good oil immersion  
lens, macroscopically having the aspect of *Xerocomus*  
*chrysenteron* or *X. truncatus*.

J. Spores 4.8—6.5  $\mu$  broad. In mixed coniferous woods in  
Western North America.

*B. zelleri* (MURR.) SING., SNELL & DICK

J. Spores 4—5  $\mu$  broad. In frondose woods (*Quercus*).

*B. intermedius* SM. & THIERS

F. Asiatic species.

K. Spores up to 18  $\mu$  long, vaguely striate longitudinally.

*B. phaeocephalus* sensu CORNER (= ? *Boletus umbrinellus*  
PAT. & BAKER, non *B. phaeocephalus* PAT. & BAKER)

K. Spores reaching more than 18  $\mu$  in length (see section  
*Boletellus* "D").





obtuse and 3—6  $\mu$  wide, thin-walled. — Hyphae inamyloid, with clamp connections, but some (secondary?) septa clamp-less. Hymenophoral trama now almost regular, its very long hyphal cells hyaline, many of them near context of pileus rather broad (6—15  $\mu$ ) and with opalescent contents, the clamps often of the medallion type. — Cortical layer (fibrils) made up of ascendant hyphae with pale brownish intracellular pigment, 3—20  $\mu$  broad, forming a trichodermium, not gelatinized. — In tropical forest on the ground.

Material studied: Venezuela: Dpto Federal, Trail from Quebrada Mariperez to ca. 1 km below Hotel Humboldt, 27. VII. 1972, DUMONT et al. VE 6201 (NY).

*Boletus ananas* Curtis sensu CORNER, *Boletus* in Malaysia p 95, 1972.

This species differs from the American *B. ananas* in pale fuscous tan pileus, spores with lower wings (whether striate or not is not indicated) and shorter tubes, perhaps also other characters.

*Boletus phaeocephalus* PAT. & BAKER sensu CORNER l. c. p. 125 (non CORNER 1947 which = *Tylophilus funerarius* (MASS.) SING.).

The type of *B. phaeocephalus* PAT. & BAKER was not studied by CORNER who attributes to it characters which do not correspond to those found in the type specimens (cf. SINGER, Amer. Midl. Nat. 37: 20. 1947) and states that the spores are "faintly striate longitudinally". If so, at least part of the specimens determined *B. phaeocephalus* belong in *Boletellus* and are not conspecific with *Boletus phaeocephalus* sensu PAT. & BAKER. They are, however, probably identical with *Boletus umbrinellus* PAT. & BAKER, indicated by CORNER as a synonym of his *B. phaeocephalus*. The type of *B. umbrinellus* (FH) has remarkably variable spores (9)—12—14—(16.5)  $\times$  4—5  $\mu$  which are short to long fusoid and pale yellowish brown. I have not seen longitudinal striations with any certainty but it may well be that the spores measured were young and did not show the ornamentation. The epicutis of the pileus consists of a trichodermial palisade whose terminal cells are cystidiform and ampullaceous with the neck 3—7  $\mu$  wide and sometimes separated from the ventricose portion (8—18  $\mu$  broad) by one to three cross septa without clamp connections. The pileus is macroscopically subvelutinous. The apex of the stipe (the upper 15 mm) is reticulate.

Note: The transfer of those species which are here quoted as *Boletelli* published as *Boletus*, *Strobilomyces*, or *Heimiella* is here postponed, inasmuch as some of them may be forms or subspecies of validly published species or are not fully described (since specimens have not been revised by the present author); their valid transfer to *Boletellus* or a corresponding *nomen novum* should be made in a monographic study.



often with leather brown areas and rarely with a slight olive or reddish chocolate tone mixed in, white underneath the cuticle; stipe with a brown to cinnamon brown reticulation on palest cinnamon ochraceous or pale brownish ground; spores  $10-17 \times 4.5-6 \mu$ . In warmer parts of Europe rather common.

*B. aereus* BULL. ex FR.

[If if pileus deep, even blackish brown but stipe with white reticulum cf. *B. variicolor* var. *fagicola* SMITH & THIERS].

- E. Pileus differently colored, generally tending to liver brown, deep purple brown, often near "Verona br." M & P, sometimes dull red at the margin or with some ochraceous hues at the margin; reticulation at least in upper part of the stipe, white and otherwise not deeper colored than the ground color; spores  $9.5-16 \times 3-5 \mu$  or slightly smaller. North America and south to Mexico, probably also in East Asia.

*B. nobilis* PECK

[If pileus and stipe or tubes more yellowish or context tending to yellow, see section *Appendiculati* (below); if European cf. "K" below].

- B. Epicutis of pileus — a trichodermium (sometimes rather deep and eventually depressed to appear as a cutis-like structure, or else rather shallow and elements curved, crooked or intermixed).

F. Species connected with hardwood mycorrhiza (especially with *Quercus*, *Castanea*, *Fagus*, *Carpinus*, *Corylus*, more rarely *Betula* or *Populus*).

G. Pileus dark purple "blue violet" (Ridgway), sometimes fading to dark maroon purple"; stipe concolorous or paler. Under *Quercus* in East Asia.

*B. violaceofuscus* CHIU

G. Pileus and stipe differently colored.

H. Pileus predominantly purple lilac to purple red ("roan" to "Pompeian r." M & P with some occasional pallid or red-brown areas, sometimes becoming brown in age; some of the same colors on the stipe. In *Quercus-Castaneawoods* in Eastern North America.

*B. separans* PECK

H. Pileus without purple-lilac or purple red colors; if with reddish colors — drying yellow.

I. Pileus without yellow tinge even on the margin or in age or on drying; if under *Betula* — pileus pallid.

J. Pileus pallid, whitish, gray, cinereous; mycorrhiza with *Betula* or *Salix* or *Carpinus*.

- K. Reticulation of the stipe brown; pileus pallid, dirty whitish. Mycorrhiza with *Betula* *B. betulicola* (VASILKOV) PILÁT
- K. Reticulation of the stipe white or pallid; pileus  $\pm$  grayish; mycorrhiza with *Carpinus*. *B. carpinaceus* VELEN.  
[If associated with SALIX and carpophores small — cf. *B. edulis* var. *arcticus* VASILKOV].
- J. Pileus neither pallid or whitish nor gray (if pileus grayish brown, stipe not white or mycorrhiza with *Quercus*).
- L. Color of pileus like that of *Russula mustelina* or paler or more umber; stipe white with white reticulation, rather long; surface of pileus usually found entire. Under *Quercus*.  
*B. quercicola* (VASILKOV) SING.
- L. Color of pileus duller leather brownish or even grayish brown or dull ocher brown (e. gr. "Arizona" M & P); stipe with a white or whitish reticulation on light brown ground; surface of pileus eventually tending to become cracked-rimose or areolate in dry weather conditions. Frequent in Europe under *Quercus*, *Fagus*, *Carpinus*, *Corylus*, rarely *Betula*, *Ostrya*. Dried carpophores with a strong cumarinous odor. (Compare also notes — under *B. aestivalis* — on *B. variipes*) *B. aestivalis* (PAUL. ex) FR.
- I. Species with some ochraceous or yellow tones, especially towards the margin or when dried or old; often found under *Populus* or *Betula* in mixed stands (see "N" below).
- F. Species connected with conifer mycorrhiza.
- M. Pileus from whitish (in very young specimens) becoming dark brown, even fuliginous-brown (without reddish or yellowish tones) and without a reddish zone underneath the cuticle; stipe very pale: a white reticulation in the upper portion of the stipe on white, later brownish-pallid ground; almost exclusively under *Picea*, very rarely under *Abies*, *Pinus* or other conifers.

*B. edulis* BULL. ex FR.

M. Pileus differently colored.

N. Pileus, at least when moist, with a narrow reddish (pink to pale wine color) zone underneath the cuticle, surface red-brown, vinaceous brown, chestnut in the center; cuticle tending to contain some  $\pm$  diverticulate terminal cells or hyphae.

O. Margin of pileus yellowish or ochraceous or with yellow or ochre blotches or entirely ochraceous (var. *ochraceus* SMITH & THIERS); pores  $\pm$  staining brown when injured; tubes white, then yellow before assuming an olive tone; under *Betula* and *Populus* but often in mixed stands (*B. edulis* v. *pinicola* aut. <sup>8)</sup>

*B. edulis* var. *clavipes* PECK sensu SMITH & THIERS

O. Margin not tending to yellow or ochraceous; pores not staining or merely staining ochraceous when bruised, but at times rust-spangled in age; tubes cream color, then olive yellow to olive; under conifers generally (*B. edulis* var. *fuscioruber* FORQU. apud QUÉL. ).

*B. pinophilus* PILÁT & DERMEK

N. Pileus without a reddish zone, but sometimes with a gold brown zone underneath the cuticle.

P. Pores soon becoming yellowish, staining yellowish olive or vinaceous cinnamon when bruised; pileus in some stage brick red or rusty-red ferruginous, even orange red when young at times; spores reaching more than  $15 \times 4.5 \mu$  but not larger than  $17 \times 7 \mu$ .

Q. Pileus rusty-red ferruginous, sometimes even orange red when young and fresh; pores staining yellow-olive when bruised.

*B. edulis* var. *aurantioruber* DICK & SNELL

Q. Pileus pale lemon yellow splashed with ferruginous to vinaceous tawny, finally brick red overall or margin remaining pale yellow; pores staining vinaceous cinnamon when bruised.

cf. *B. chippewaensis* SMITH & THIERS

P. Pores yellow or passing through a yellow stage but not staining when bruised or merely becoming slowly yellowish brown (if pores and tubes never yellow in any stage cf. "O" above); pileus not

<sup>8)</sup> See annotations below, under *B. pinophilus*, p 000.

colored as indicated above; spores as above or smaller.

R. Spores up to  $15 \times 4.5 \mu$  or many spores larger than  $17 \times 5.5 \mu$ . (see "E" above).

R. Spores  $13-17 \times 4-5.8 \mu$ .

*B. clavipes* (PECK) PILÁT & DERMAK

## 2. Species of section *Grisei* (SING.) SING.

A. Reticulation of stipe strongly projecting and raised

B. Stipe bright yellow (see sect. *Calopodes*, below).

B. Stipe sordid pallid or grayish *B. griseus* FROST in PECK

C. Spores  $8-13.5 \times 3.5-5 \mu$ ; in hardwood forest.

*B. griseus* ssp. *griseus*

C. Spores  $12-15.5 \times 4.5-5 \mu$ ; under pines.

*B. griseus* ssp. *pinicaribaeae* SING.

A. Reticulation of stipe fine, pallid. *B. fumosiceps* (MURR.) MURR.

## 3. Species of section *Calopodes* FR.

A. Stipe white, sometimes yellowish above or dirty brownish streaked below in age, reticulate only in the apical region or not at all; taste submild to slightly bitter; pileus light colored. American species growing under hardwood trees. *B. pallidus* FROST

A. Stipe different; taste usually more decidedly bitter.

B. Pileus usually breaking into large frustulae or scales, or soon rimose; stipe reticulate almost over its entire length. Growing in coniferous woods in Western North America.

cf. *B. frustosus* SNELL & DICK

B. Pileus different or stipe less reticulate (or both).

C. Pileus only subviscid in very rainy weather; epicutis not an ixotrichodermium; spores (at least many of them) more than  $10 \mu$  long.

D. Pileus not pink; tubes bluing when bruised.

E. Stipe with a fine yellow reticulation, often only at the apex, and without red colors excepting a reddish or reddish-brownish color zone in form of a ring (but this zone not constant); spores  $11-16 \times 3.3-6 \mu$ ; hyphae inamyloid. *B. radicans* PERS. ex FR.

E. Stipe either without any reticulation, or, if reticulated, — and then reticulation sometimes very strong — with distinct red tinge at least in the lower or median zone; spores as above or slightly smaller or larger; hyphae of the base of the stipe often amyloid or amylaceous.

F. Spores  $9-15.3 \times 3.3-5.3 \mu$ ; hyphae somewhat amyloid, with very little amylaceous incrustation,

none in the cuticle of the pileus; mycorrhiza with various hardwood trees, in North America and East Asia.

*B. subclavatisporus* SNELL

G. Spores  $9-14 \times 3-4.5 \mu$ , rarely as broad as  $5 \mu$  or as long as  $15 \mu$ , often clavate or irregular, very variable; stipe rather elongated, 8-20 mm broad. Northeastern and Mid-Western North American species also occurring in East Asia.

*B. subclavatisporus* ssp. *subclavatisporus*

G. Spores  $10-15.3 \times 3.5-5.3 \mu$ , mostly fusoid-oblong; stipe 15-25 mm broad. Southeastern (from South Carolina to Florida) North American species.

*B. subclavatisporus* ssp. *inedulis* (MURR.) SING.

F. Spores small ( $9.5-11 \times 3.5-4 \mu$ ) or reaching more than  $15.3 \mu$  in length.

H. Mycorrhiza with conifers, more rarely with *Fagus*; stipe reticulated.

I. Stipe without red colors; growing under conifers in Western North America.

cf. *B. coniferarum* SNELL & DICK

I. Stipe usually with strong red colors ("peony", 6-L-7, M & P, or even darker), more rarely only somewhat reddish pink in the middle portion; spores  $10.2-18 \times 4-5.8 \mu$ ; hyphae even in epicutis with a strong amylaceous incrustation. Common in the whole North-temperate zone.

*B. calopus* FR.

H. Mycorrhiza relationship not established; stipe without any reticulation.

J. Spores  $12.5-17.6 \times 4-5 \mu$ . Californian species with red stipe.

cf. *B. rubripes* THIERS

J. Spores  $9.5-11 \times 3.5-4 \mu$ . European species of the Atlantic Coast of France, with deep bright yellow stipe in the upper portion and mostly reddish pink in the middle, brown below.

*B. fragrans* VITT.

sensu aut. nonn. gall.  
non VITTADINI nec SING. <sup>9)</sup>

<sup>9)</sup> See LECLAIR & ESSETTE pl. 38. — No new name is proposed here since this species is incompletely known (although undoubtedly different from other European species).

D. Pileus pink (eventually and on drying bleached), or else context not bluing at all when bruised.

K. Tubes and context not bluing when bruised; stipe with a strongly raised or at least strong reticulation which is yellow on yellow ground, running down the stipe over almost its entire length; pileus not pink. American species.

*B. ornatipes* PECK  
[Eastern Asiatic species: cf. (*B. ornatipes* sensu CHIU =) *B. kauffmanii* LOHWAG].

K. Tubes bluing on bruising; pileus pink, in age and on drying often discolored. *B. peckii* FROST in PECK

C. Pileus viscid; epicutis an ixotrichodermium; spores 8—9—(10) × 4—4.5—(5) μ; American species.

cf. *B. calvinii* SMITH & THIERS

#### 4. Species of Section *Appendiculati* KONR. & MAUBLANC

A. Context and tubes bluing on exposure.

B. Pileus and stipe yellow; in Piceetum in Europe.

*B. glabretae* PILÁT

B. Pileus not or only partly yellow; mostly in frondose woods (except *B. odaiensis*).

C. Pileus when mature and fresh melleous brown, reddish brown, ochraceous brown or even deeper brown; stipe without yellow tinges; under Fagales in general.

*B. appendiculatus* SCHAEFF. ex (FR.) SECR.

C. Pileus and stipe not so colored.

D. Pileus black-brown like *B. aereus*, but tubes, pores, stipe, and context yellow cf. *B. aereus* BULL. ex KROMBH. (sensu KROMBH. non FR.), a rare and insufficiently known European species.

D. Pileus much paler.

E. Pileus pallid or pale greyish cream.

*B. fechtneri* VELEN.

E. Pileus pileus pink, red, yellow ocher, reddish golden.

F. Pileus pink or red; forming mycorrhiza with Fagales.

G. Context weakly bluing when bruised, sometimes not bluing at all.

H. Spores 11—17 × 4—5 μ; pileus pink, Europe and Asia.

*B. regius* KROMBH.

H. Spores 9—11 × 3—4.5 μ; pileus persistently deep pinkish red (“Pompeyan red” R.) in center; North America.

cf. *B. rubissimus* A. H. SMITH



G. Context distinctly and strongly bluing when bruised; spores  $9-14 \times 3-4.5 \mu$ ; pileus brownish red to blood red, pinkish red. European and North American species, possibly also in Asia.

I. Epicutis — a trichodermium.

*B. speciosus* FROST in PECK

I. Epicutis — a cutis of cylindric or filamentous repent and interwoven hyphae which are flexuous and  $3-5-(7) \mu$  broad; end cells not enlarged. North American species.

cf. *B. pseudopeckii* SMITH & THIERS

F. Pileus yellow-ocher to reddish golden, growing under *Abies* in Japan. cf. *B. odaiensis* HONGO

A. Context unchanging or at least never bluing (cf. also Calopodes key, "K").

J. Context of pileus yellow; spores  $12-13.7 \times 3.7-4.8 \mu$ ; odor strong and agreeable, fruity when dried; under *Quercus* in Eastern North America, south to Florida. *B. auripes* PECK

J. Context mostly white, only occasionally partly (above tubes) yellowish; spores slightly or considerably larger or at least reaching up to  $15 \mu$  in length; odor weak or none. Occurring in the Northeastern states of North America west to Michigan, and perhaps in China.

[The following species are unknown to the author and may possibly belong in section *Boletus*; *B. insuetus*, with scattered clamp connections, is of uncertain position.]

K. Spores  $12-15 \times 3.8-4.5 \mu$ ; apex of stipe pallid to avel-laneous; pileus  $30-80$  mm broad.

*B. insuetus* SMITH & THIERS

K. Spores  $10-17 \times 3.8-4.5 \mu$  (according to Snell) but accompanied by numerous giant spores up to  $25 \times 12 \mu$  (according to SMITH & THIERS); apex of stipe yellow and reticulate, otherwise not reticulate and white. *B. gertrudiae* PECK

##### 5. Species of Section *Subpruinosi* FR.

[Note: Species with a fresh pileus staining blue in ammonia and with  $\text{NH}_3$  vapors and/or having a hymenophoral trama of the *Phylloporus*-type belong in the genus *Xerocomus*. Some species which are, according to the descriptions available (specimens unknown to the author) intermediate between sect. *Subpruinosi* and sect. *Luridi* as far as the characteristics of the hymenophore and the shape of the stipe are concerned are keyed out in both sections, but it is generally recommended to compare also sect. *Luridi* if the *Subpruinosi* key does not give the expected result.]

A. Epicutis of pileus — an epithelium or consisting mainly of subisodiametric elements arranged in chains and forming a trichodermium or trichodermial palisade whereby the cells tend to dissociate (if only few short cells are present see alternative "A" below).

B. Tropical Asiatic species.

[There are apparently several species belonging in this section in Tropical Asia; most of these are not known to the author. They are best identified using CORNER, Boletus in Malaysia (1972), keys on p. 107 and p 205. Cf. especially *B. formosus* CORNER].

B. Species not occurring in tropical Asia.

C. Tropical African species.

cf. *Xerocomus spinulosus* HEINEMANN & GOOS.

C. Species occurring in Europe, temperate Asia and the Americas, Australia or New Zealand.

D. Species occurring in Australia and New Zealand.

[There are apparently several species belonging in this section; most of these are not known to the author. They are best identified by the keys published by MCNABB, New Zealand Journal of Botany 6 (2): 169. 1968 (but characteristics of the structure of the epicutis not given)].

D. Species occurring in Europe and North and South America.

E. Species of Patagonia and South Chile (see sect. *Luridi*).

E. European and North American species.

F. European species with apricot color basal mycelium; pileus up to 100 mm broad.

*B. pruinatus* FR. (sensu PEARSON, vix Fr.) — [if basal mycelium not apricot cf. also "H" below].

F. North American species; basal mycelium not apricot color; pileus up to 80 mm broad.

G. Cells of the epicutis of the pileus with amyloid inclusions; mycelium yellow-ocher.

cf. *B. flavorubellus* SMITH & THIERS

G. Epicutis cells without amyloid inclusions; color of basal mycelium unknown; pileus mostly not over 50 mm broad.

cf. *B. harrisonii* SMITH & THIERS

[cf. also "H" below].

A. Epicutis different (mostly a trichodermium or trichodermial palisade with the majority of the elements strictly elongated).

H. Pileus pink or red when young.

I. Species of the tropics or the South temperate zone.

- J. Tropical species of Asia.
  - cf. *B. oksapminensis* HONGO and see also "B" above and key II "CC"
- J. Species of other regions.
- K. Tropical African species.
  - cf. *Pulveroboletus carminoporus* HEINEMANN
- K. Species of other regions.
- L. South temperate species (cf. "D" above, but most species seem to be referable to sect. *Luridi*, see there).
- L. Species not known to occur in Patagonia and South Chile.
- M. Neotropical species with spores short (6)—7.5—8.5—(9) × 3.3—5.3—(6)  $\mu$ ; context not bluing. *B. guadelupae* FIARD & SING.
- M. Not combining the characters indicated above or not neotropical see key II below.
- I. Species growing in other regions see key II below.
- H. Pileus neither red nor pink in any stage see key II below.

#### Key II.

- AA. Pileus red or pink at least when young.
- BB. KOH not causing a bright yellow color to appear in the terminal cells of the cuticle of the pileus; pores 1 mm wide or wider, angular; basal mycelium cream white or partly yellowish white, partly white, often scanty; spores 12—16 × 5—6.5  $\mu$ . (*B. rubellus* ssp. *bicoloroides* SING. =)
  - B. fraternus* PECK
  - [cf. also *B. parvus* PECK which, however, may belong in the genus *Chalciporus* rather than *Boletus*].
- BB. Not combining the above characteristics: Epicutis usually bright yellow in KOH mounts; pores usually only up to 1 mm wide; spores often smaller and/or basal mycelium more distinctly yellow.
- CC. Lower surface of hymenophore arcuate-decurrent. Himalayan species. *B. fragicolor* BERK.
  - [This is possibly a *Pulveroboletus* rather than *Boletus sensu stricto*].
- CC. Lower surface of hymenophore ventricose-convex or at least flat at maturity.
- DD. Basal mycelium white; spores only (3)—3.3—4  $\mu$  broad. *B. rubeus* FROST
- DD. Basal mycelium yellow; spores reaching 5 or 6 (7)  $\mu$  in breadth.

EE. Spores  $12-16 \times 4-5.5 \mu$ ; epicutis subhymeniform; spores said to be amyloid with a small apical pore.

cf. *B. bicoloroides* SMITH & THIERS

EE. Spores usually not over  $14 \mu$  long; epicutis not subhymeniform; spores not amyloid and without germ pore.

FF. Stipe  $10-35$  mm broad; spores  $8.2-11.8 \times 3-4.2-(5) \mu$ ; basal mycelium yellow-white to buff; pileus apple red.

*B. bicolor* PECK

[If spores larger and pileus less pink or red, cf. *B. smithii* THIERS from California].

FF. Stipe  $3-20$  mm broad, mostly not over  $13$  mm; spores reaching at least  $13$ , sometimes  $16 \mu$  in length and more than  $4.3 \mu$  in breadth unless the stipe is particularly long and thin (decidedly less than  $10$  mm in diameter).

GG. Pores concolorous with the tubes or more golden yellow, not reddish in age. Widespread in Europe, Asia, and America.

*B. rubellus* KROMBH.

GG. Pores at first concolorous with the tubes, at maturity discolorous ("cinamon rufous" to "hazel" Ridgway).

*B. subfraternus* COKER & BEERS

AA. Pileus red-brown, brown, fuscous, olive or fuliginous, or fulvous, dull ochraceous and never, even before bleaching or discoloring) with pink or red colors.

HH. Pores red. Florida.

*B. weberi* SING.

HH. Pores not discolorous or at any rate never red.

II. Pileus deep fuliginous, almost black, velutinotomentose becoming squarrose; stipe surface like that of the pileus; growing in mycorrhizal relationship with *Quercus* in Colombia.

*B. fuliginotomentosus* SING.

II. Pileus some other color.

JJ. Tropical Asiatic species (see key I "B").

JJ. Species not occurring in (or known from) Tropical Asia.

KK Tropical African species.

cf. *Pulveroboletus aberrans*

HEINEMANN & GOOS.

KK. Temperate species and American subtropical species.

- LL. Taste of carpophore partly or weakly bitter (see sect. *Calopodes*).
- LL. Taste mild or slightly acidulous.
- MM. South temperate species (see key I, "L").
- MM. North temperate and subtropical species.
- NN. Context usually strongly and deeply bluing in less than a second after bruising (at least when quite fresh); pores about "wax yellow" (Ridgway); spores  $11-14.7 \times 4-6 \mu$ . Usually under Fagales, often *Quercus* in woods and mesophytic hammocks. Common species, widespread.
  - B. pulverulentus* OPAT.
- NN. Context weakly and slowly bluing (or spores different) or context not bluing at all <sup>10</sup>).
- OO. American thermophilous species, often mycorrhizal with *Coccolobis*, but also sometimes with *Quercus*.
  - PP. Basal mycelium yellow and conspicuous; epicutis at margin of pileus hymeniform.
    - B. subsolitarius* SING.
  - PP. Basal mycelium sordid pallid or whitish to white; epicutis — a trichodermial palisade throughout.
    - B. granuloseiceps* SING.
- OO. North American non-thermophilous species and European species, usually under hardwoods (not *Coccolobis*).

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<sup>10</sup>) Olive-discolored pilei occur in species related to *B. rubellus* (aside from those keyed out under "OO" here); cp. therefore data given below under *B. rubellus* "Descriptive notes and transfers". Brown pilei with an olive tinge can also be observed in species with very finely ornamented spores (under light microscope) which may be misinterpreted as being smooth; in this case cf. *Boletellus*.

QQ. Context and pores bluing when injured; spores (9)—10—13 × 3—4  $\mu$  (SNELL & DICK), 10—13 × 4—5  $\mu$  or 8—11 × 5—7  $\mu$  (SMITH & THIERS). North America.  
*B. glabellus* PECK

QQ. If context and pores bluing, spores 9.5—11 × 3.5—4  $\mu$  (LECLAIR & ESSETTE) and growing in the Atlantic Coast region of France.

RR. Context bluing. European species (see key to sect. *Calopodes*).

RR. Context not bluing; spores 10—15—(16) × 3.2—4.5  $\mu$ , mostly 11—12 ×  $\pm 4$   $\mu$ . cf. *B. fulvus* PECK sensu SNELL & DICK

### 6. Species of section *Luridi*

A. Tropical species (including species from Southern China) of the Eastern Hemisphere.

B. Species from South China (Yünnan), New Guinea and Malaysia.

C. Stipe not or scarcely reticulated.

D. Pores not discolorous or, if discolorous, brown, not red

E. Yünnan. *B. brunneissimus* CHIU  
[Compare also *B. subsplendidus* CHIU].

E. Borneo and New Guinea. *B. kumaeus* HEIM  
[Compare also *B. jocosus* CORNER].

D. Pores red or deep orange.

F. Pileus red.

G. Yünnan *B. magnificus* CHIU  
G. Malaysia *B. craspedius* MASS.

F. Pileus deep brown or bay-orange.

H. Context weakly greening on exposure; pore orange. *B. rufoaureus* MASS.

H. Context immediately strongly bluing; pores red.

I. Spores  $9.5-16 \times 4-6 \mu$  (*B. queletii* sensu CHIU = ?).

*B. erythropus* var. *novoguineensis* HONGO

I. Spores  $10-12.5-(13) \times 4.3-5.5 \mu$ .

*B. reayi* HEIM

C. Stipe reticulated.

J. Pileus "garnet brown", fibrillose-scaly. China.

*B. sinicus* CHIU

J. Pileus not garnet brown, not or not strongly fibrillose-scaly.

K. Pileus whitish or grayish, e. gr. "pale olive buff".

L. Spores  $10-12.5 \times 4.3-5.5 \mu$ ; taste bitter. New Guinea.

*B. manicus* HEIM

L. Spores smaller. China.

*B. taianus* CHIU

K. Pileus carmine red; pores yellow.

*B. havilandii* CORNER

B. Species from tropical Africa.

*B. loosii* HEINEMANN

A. Extratropical species and species of subtropical America.

M. Pores concolorous with the tubes (yellow or yellowish, eventually more brownish or olive-green), even in age not discolorous brown to orange or red; stipe not or very little reticulated (at the extreme apex only).

N. Pileus pale ocher, dull orange brown, light isabelline or leather pallid to buff-whitish, rarely with a pale salmoneous flush, later sometimes brownish or fulvous; context unchanging or very rarely very slightly bluing in the area above the hymenophore. European species. *B. impolitus* FR. — Species of the stirps Subglabripes of *Leccinum* should not be confused. A species of the Atlantic Coast region of France, growing on sandy soil and fruiting late (November) with very large spores  $14-22-(25) \times 5-7 \mu$  and context becoming pinkish on bruising, pileus essentially brown at first showing a narrow yellowish marginal zone — cf. *B. lepidus* BOUCHET which seems to be closer to *Leccinum subglabripes* and *L. rugulosiceps*].

N. Pileus colored as above or more commonly of some other color; context bluing on injury at least in fresh young material.

O. Pileus pale grayish brownish to almost olive gray or light umber brown to umber-olive ("sombbrero", "maple", "yellow beige", "powdered gold" M & P), tomentose. European species.

[American species of *Leccinum* should be compared carefully].

*B. fragrans* VITT.

O. Pileus differently colored (see key II below).

M. Pores discolorous; stipe reticulated or not (see key III below).

### Key II

AA. Pileus predominantly and rather bright yellow.

BB. Spores (4.5)—5—6  $\mu$  broad. *B. junquilleus* (QUÉL.) BOUD.

BB. Spores 3.5—5—(5.5)  $\mu$  broad. Florida

*B. flavissimus* (MURR.) MURR.

AA. Pileus sometimes with some yellow, but predominantly pink, red, or brown.

CC. Pileus some shade of brown.

DD. Spores 9.4—12.5  $\times$  3.6—5  $\mu$ . South American species growing in connection with *Nothofagus*-mycorrhiza (see key III below).

DD. Spores as above or narrower (9—12  $\times$  3—3.5  $\mu$ ) or longer (to 15  $\mu$ ), not associated with *Nothofagus*. North American species.

EE. Apex of stipe reticulated in a narrow zone; base of stipe carmine red (see key III below).

EE. Apex of stipe not reticulated.

FF. Base of stipe amber brown. Florida.

*B. oliveisporus* (MURR.) MURR.

FF. Base of stipe carmine red cf. *B. carminipes* SMITH & THIERS [cf. also key to species of section *Subpruinosi* II, "QQ"].

CC. Pileus some tinge of pink or red, at least when quite fresh (often discolored in age and then often partly yellowish or olive).

GG. Pileus distinctly viscid; spores 5—6.3  $\mu$  broad.

*B. dichrous* ELLIS

GG. Pileus not strongly viscid when wet (but may be somewhat viscidulous after prolonged rains).

HH. Forming mycorrhiza with *Nothofagus alpina* and perhaps other species of *Nothofagus* in Southern Chile; pileus and stipe beautifully red, the latter bulbous.

*B. loyo* PHIL. ex SPEG.

HH. Forming mycorrhiza with other trees, in the northern hemisphere.

II. Forming mycorrhiza with *Pinus* in Southern Florida, growing on calcareous soil; spores (9.5)—10—14.2—(14.5)  $\times$  4.2—6.5  $\mu$ , mostly 11—11.7  $\times$  5  $\mu$ , rarely (f. *serotinus* SING.) 10—16.3  $\times$  4.5—6.8  $\mu$ , mostly 12.5  $\times$  6.8  $\mu$ ; habit much like *B. bicolor*; pores 0.7—1.5 mm with tubes adnate but often somewhat depressed



around the stipe; often forming carpophoroids.

*B. caribaeus* (SING.) SING.

JJ. Epicuticular cells thin- or firm-walled, dry pileus without or with very little olive shades. *B. caribaeus* var. *caribaeus*

JJ. Epicutis-cells thick-walled; dry pileus olive or with distinct olive areas.

*B. caribaeus* var. *crassotunicatus* SING.

II. Forming mycorrhiza in hardwood forest or in mixed stands of hardwoods and pine; spores and habit as above or different; pores only up to 1 mm wide; tubes often at first adnate but mostly becoming deeply depressed in fully mature material; not forming carpophorids as far as known.

KK. Spores  $6.5-9 \times 4.5-5.5 \mu$ .

*B. tennesseensis* SNELL & SMITH

KK. Spores larger.

LL. Spores reaching more than  $14 \mu$  in length,  $4.8-7.7 \mu$  broad. Florida.

*B. rubricitrinus* (MURR.) MURR.

LL. Spores smaller or at least narrower.

MM. Spores reaching  $16-(17) \mu$  in length; odor not distinctive.

cf. *B. miniatopallescens*

SMITH & THIERS

MM. Spores reaching  $14-(15) \mu$  in length; odor often like that of

*B. satanas*.

*B. miniatoolivaceus* FROST

(sensu lato)

[If cystidia, as in Peck's type are vesiculose to utriform  $26-38 \times 12-18 \mu$  (SMITH & THIERS), this would be *B. miniatoolivaceus*, typus. If not, but with many wide short cells in the epicutis of the pileus, this is *B. pseudo-sensibilis* SMITH & THIERS = *B. miniatoolivaceus* sensu SING., except that the latter differs from *B. pseudo-sensibilis* in having a disagreeable odor of onion or garlic much like *B. satanas*. If the epicutis has few or no short cells this would be *B. sensibilis* PECK sensu SMITH & THIERS].

Key III (with discolorous pores)

AAA. Stipe not reticulate or with a scarce incomplete network or reticulation only at the extreme apex.

BBB. Pores yellow-brown to reddish brown and thus contrasting with the color of the tube interior, at least at maturity; spores  $9-13.5 \times 4-6 \mu$ .

CCC. Pileus grayish brown, red-brown, becoming cinnamonaceous. North American species.

*B. vermiculosus* PECK (sensu lato)

[If spores small (up to  $12 \times 3.5 \mu$ ) and epicutis cutis-like cf. *B. vermiculosoides* SMITH & THIERS; if odor of dried specimens characteristic "of burned urine" cf. *B. subgraveolens* SMITH & THIERS].

CCC. Pileus vinaceous red, purple red, at least at margin. Near East. cf. *B. reichertii*

AVIZ.-HERSCH & BENJAMINI

BBB. Pores orange to bright rose red or carmine to deep red, if somewhat brownish — spores large (to  $17.8 \mu$ ).

DDD. Context not changing to blue (or green) when bruised, not even in the hymenophore or above it, but often changing to salmon pink when cut. American species.

EEE. Spores  $10.5-15 \times 3.5-5.5 \mu$ ; stipe at apex not reticulate; pores rufous or orange near stipe; pileus not dull orange brown drying crust brown but showing some olive or yellow at least near the margin.

*B. morrisii* PECK

EEE. Spores less than  $12 \mu$  long or up to  $12 \mu$ .

FFF. Pileus dull orange brown drying crust brown.

cf. *B. eberwhitei* SMITH & THIERS

FFF. Pileus red fibrillose.

cf. *B. rubropictus* SMITH & THIERS

DDD. Context bluing when bruised.

GGG. Reticulation of stipe weak at apex down to only about 10 mm from the tubes, below that indistinct, fragmentary or lacking (see key IV below).

GGG. Stipe without any reticulum.

HHH. Base of stipe with a conspicuous velvety, strigose or pilose dense

covering, this rust brown, olive or brown-red to red, not yellow.

III. Basal strigosity "Isabella color" to "buffy citrine" (olive); pileus "vinaceous brown" on margin, "Sorghum brown" on disc (Ridgway); spores  $9.5-12.5 \times 4.2-5.5 \mu$ . Under *Quercus* in Florida. *B. austrinus* SING.

III. Colors different.

JJJ. Pileus umber, yellowish brown, reddish brown or red; basal tomentum red, rusty red, rarely absent or indistinct.

KKK. Spores  $9.2-13.8 \times 5.5-6 \mu$ . *B. tomentipes* EARLE

KKK. Spores longer or broader.

LLL. Pileus brown; spores  $13-16 \times 4.8-5.5 \mu$ ; basal tomentum said to be absent.

*B. erythropus* (FR. ex FR.)

KROMBH. sensu

THIERS non al.

LLL. Pileus red; spores  $11.2-16 \times 5.2-8 \mu$ ; basal tomentum red.

*B. puniceus* THIERS

JJJ. Pileus either deep brown to fuliginous-sepia or becoming so (after having been some shade of yellow at first) on drying and in age, rarely red; basal tomentum ferruginousbrown, olive brown, never red.

*B. erythropus*

(FR. ex FR.) KROMBH.

MMM. Pileus when young and quite fresh with more or less extensive yellow or ochraceous areas, especially on margin but sometimes all over, growing in hardwoods (*Quercus*, *Car-*

*pinus, Tilia*) in somewhat thermophilous vegetation.

*B. erythropus* ssp.

*discolor* (QUÉL.) DERMEK

MMM. Pileus never with yellow or ochraceous tinge; mycorrhiza with *Fagus* or conifers, preferring non-thermophilous stations, often in montane woods.

*B. erythropus*

ssp. *erythropus*

HHH. Base of stipe not with a brown, olive, or red velvety or strigose or pilose covering (see key IV below)

AAA. Stipe reticulate at least at the apex of the stipe and 10 or more mm downwards. (see key V below)

#### Key IV

- a. Pileus pink or red when fresh.
- b. Context with a weak fetid odor of spoiled onions or spoiled meat (like *B. satanas*) spores extremely variable:  $8.5-14 \times 3.5-6 \mu$ , sometimes some giant spores up to  $17.7 \mu$  long (*B. luridellus* (MURR.) MURR. = ?) *B. underwoodii* PECK
- b. Context inodorous or with a slight agreeable acidulous or fruity odor when fresh, inodorous or with a cumarinous odor when drying or dried.
- c. Pileus distinctly viscid when wet; spores  $14-15 \times 5-7 \mu$ ; under hardwoods in Europe; hyphae of stipe inamyloid. *B. dupainii* BOUD.
- c. Pileus not or slightly viscid in wet weather, not combining the spore size with inamyloid hyphae unless extra-European.
- d. Spores  $12.5-18.8-(19.7) \times (4.5)-4.8-7.7 \mu$ , most frequently about  $15 \times 5-5.5 \mu$ ; under *Quercus virginiana* in Florida. *B. fairchildianus* (SING.) SING.
- d. Spores smaller or not under *Quercus* in Florida.
- e. Basal mycelium pale yellow; pores for a long time concolorous with the tubes, then orange red; spores  $8-15 \times (4.2)-5.2-7 \mu$ , rarely some up to  $18 \times 9 \mu$ , relatively short (Q between 1.6 and 2.5); stipe finely punctate; hyphae of stipe strongly and distinctly amyloid. Mostly under oak in Europe, North Africa, Near East, perhaps also in North America (see "o" below).
- e. Basal mycelium more indistinct or more decidedly

sulphur yellow; pores early flame scarlet to carmine or darker red, sometimes maroon red in young specimens; spores as above or relatively narrower; stipe pruinose to finely flocculose-pustulate rose colored to organe-cinnamon or brown, or else stipe yellow except at base and pruinose-furfuraceous overall; hyphae amyloid or inamyloid. Under Fagales in North America.

f. Dermatocystidia of the covering of the stipe not over 30  $\mu$  long.

cf. *B. bicolor* var. *borealis* SMITH & THIERS

f. Many dermatocystidia of the stipe in the middle zone of the stipe or above strongly elongated, reaching more than 30  $\mu$  in length, sometimes up to 200  $\mu$  long.

g. Context pallid when fresh; pileus dark rose color, rose red.

cf. *B. roseobadius* SMITH & THIERS

g. Context yellow. Eastern and Mid-Western species (if Californian, see also key III, "LLL").

h. Hyphae of the epicutis of the pileus red in Melzer's reagent; spores 11–15  $\times$  4–5  $\mu$ ; pileus "vermillion red" or "bay" (Ridgway).

cf. *B. subluridellus* SMITH & THIERS

h. Hyphae of the epicutis rusty brown to reddish in Melzer's reagent; spores 14–17  $\times$  4.5–6.5  $\mu$ ; pileus dull brick red "Sanford's brown" when young, in age becoming "sayal brown" (Ridgway).

cf. *B. rufocinnamomeus* SMITH & THIERS

a. Pileus in no stage or area pink or red when fresh.

i. Pileus somehow brown without olive shades; spores 8.5–13  $\times$  3.5–5.5  $\mu$ . American species.

j. Pores "dragon blood red" (RIDGWAY); stipe up to 30 mm broad; spores 3.5–5  $\mu$  broad; epicutis of pileus — a trichodermium of 3–7  $\mu$  broad hyphae, these not incrustated; dermatocystidia of the stipe 30–50  $\times$  8–14  $\mu$  (SMITH & THIERS) (*B. spraguei* Frost non Berk. & Curt. =).

cf. *B. hypohaematicus* SING. nom. nov.

j. Pores "hydrangea red" to "mineral red" (Ridgway); stipe reaching more than 30 mm in diameter; spores 3.5–3.8  $\mu$  broad; epicutis — a trichodermium with the hyphae incrustated by a melleous brown resinous incrustation; dermatocystidia of the stipe 22–30  $\times$  5–8.5  $\mu$ .

*B. hypocarycinus* SING.

- i. Pileus brown or some other color; if brown, spores larger than  $8.5-13 \times 3.5-5.5 \mu$  or Eastern Hemisphere species.
- k. Pileus never golden yellow; dermatocystidia of stipe longer than  $38 \mu$  (see "h" above).
- k. Not combining the two characters indicated above, i. e. dermatocystidia not or exceptionally longer than  $30 \mu$  or pileus yellow.
- l. Pileus "light brownish olive" (RIDGWAY) to "Isabella color" and yellowish to olive yellow when dried. American species growing under hardwoods.

cf. *B. pseudoolivaceus* SMITH & THIERS

- l. Pileus not olive becoming yellowish on drying.
- m. Pileus never yellowish or stipe more than 10 mm in Diameter; spores more than  $8 \mu$  long.
- n. Taste mild.
  - o. Hyphae of stipe inamyloid (see key III, "LLL").
  - o. Hyphae of stipe distinctly amyloid; basal mycelium pale yellow; pores for some time yellow, then orange red; spores  $8-15 \times (4.2)-5.2-7 \mu$ , rarely some up to  $18 \times 9 \mu$ , relatively short (Q between 1.6 and 2.5); stipe finely punctate; Under *Quercus*, more rarely other hardwoods in Europe, North Africa, Near East, perhaps also in North America.

*B. queletii* SCHULZ.

- n. Taste bitter; pileus cracking, grayish avellaneous becoming brownish; under *Abies* in North-East Asia. cf. *B. tomentososquamulosus* VASSILIEVA
- m. Pileus golden yellow to yellowish tan or bright yellow or spores less than  $8 \mu$  long.
  - p. Stipe up to 10 mm broad; spores longer than  $8 \mu$  (see key V, "ee").
  - p. Stipe 20—50 mm broad; spores  $5.5-6.4 \times 3-4 \mu$ . California (possibly adventitious).

*B. orovillus* THIERS & KOWALSKI

[Perhaps belonging to another genus]

#### Key V (stipe reticulate)

- aa. Context and tubes not bluing when bruised.
  - bb. Stipe finely but distinctly reticulated with a red network of veins; pileus red, purple red ("Prussian red" RIDGWAY); spores  $11-14 \times 5-7 \mu$ . *B. holoroseus* SMITH & THIERS
  - bb. Stipe reticulated only at the apex; pileus orange brown or duller colored.

cc. Spores  $9-12 \times 3.8-4.5 \mu$  (see key III, "EEE").

cc. Spores  $10-22 \times 4.5-9 \mu$  (SNELL & DICK).

cf. *B. magnisporus* FROST

aa. Fresh context of young specimens at least in or above hymenophore distinctly bluing when bruised.

dd. Lower surface of pileus context reddish after removal of the hymenophore; hyphae of the context of the stipe distinctly to strongly amyloid; stipe with a strong reticulation; odor agreeable or none; reticulation with spaces between veins strongly vertically elongated. Widespread in the North-temperate zone under both conifers and hardwoods.

*B. luridus* SCHAEFFER ex FR.

dd. Not combining these characters and not so widely distributed.

ee. Pores yellow, then brown, red-brown, and sometimes fading to orange in age or, if more reddish, pileus with a distinct grayish tone; stipe yellow or ochraceous when young excepting often the base (which may be red); odor none. American species.

ff. Pileus with bright yellow margin, otherwise brown; spores  $(9)-11-14-(15) \times 3.5-5 \mu$ .

*B. fagicola* SMITH & THIERS

ff. Pileus dingy grayish brown or dingy and paler gray towards the margin; spores  $9-12-(15) \times 3.5-5 \mu$  (i. e. more elongated than those of *B. fagicola*).

*B. firmus* FROST

ee. Pores almost from the beginning some shade of red or slowly becoming orange to orange-red, red, or purple red, not brown; if pileus has yellow or red tinge, the ground color of the stipe is at least partially red or pink; odor none or agreeable or fetid. American, European and Asiatic species, often also in North Africa.

gg. Reticulation of the stipe made up of strongly raised, almost lamellar veins or ridges.

hh. Pileus glabrous to tomentose and glabrescent, after moistening becoming viscid.

*B. frostii* RUSSEL ap. FROST

hh. Pileus tomentose to velutinous, decidedly red from the beginning and stipe likewise red; spores  $10-14 \times 4-5 \mu$ .

cf. *B. rubroflammeus* SMITH & THIERS

gg. Reticulation of stipe fine and low although distinct, consisting of veins.

ii. Under conifers from Nova Scotia to Pennsylvania; pileus red.

cf. *B. flammans* DICK & SNELL

- ii. Under *Quercus* and other Fagales; pileus red or some other color.
- jj. Spores  $13.2-16.7-(18) \times (4)-4.5-5.3 \mu$ . Florida; pileus pinkish red to red.  
*B. floridanus* (SING.) SING
- jj. Spores different or pileus not red (see "KK" below).
- kk. Pileus pink, red, or purple red; spores  $9-14.7 \times 4-6.5 \mu$  often of two types (a short and broad one,  $9-14.5 \times 4-6.5 \mu$ , and a more elongated one,  $11-14.7 \times 4-5 \mu$ , the latter often scarce or even absent.
- ll. Pileus 150—200 mm broad; stipe cylindrical; odor fetid like that of *B. satanas*. Mexico. *B. michoacanus* SING.
- ll. Pileus 50—150 mm broad; stipe mostly bulbous-ventricose and odor agreeable or none. Europe.  
*B. rhodopurpureus* SMOTLACHA
- kk. Pileus some other color when young and fresh, or merely with a pinkish margin or with strawberry red spots, only after reaching maturity often becoming predominantly red.
- mm. Pileus dingy ochraceous brown becoming olive to olivaceous brown in age and about this color when dried; spores  $9.5-12.5 \times 5.5-6 \mu$ . Under *Quercus* in North America.  
cf. *B. vinaceobasis* SMITH & THIERS
- mm. Either the pileus is differently colored, or the spores are larger when mature (reaching 15 and more  $\mu$  when mature) or narrower than indicated above.
- nn. Odor disagreeable at least after a while (before drying). European species, also occurring in the Near East or in North Africa, perhaps in East Asia (?).
- oo. Reticulation of the stipe present only in the upper 10 mm of the stipe, otherwise more fragmentary or absent; pileus in age mostly strongly red spotted or zoned; odor acidulous, reminding one of acetylene and, when bruised, of *Lepiota cristata*; spores  $12-16 \times 5-6 \mu$ . *B. lupinus* FR. (sensu ROMAGNESI)
- oo. Reticulation of stipe complete and reaching beyond the apical zone; pileus without any red, very rarely margin slightly pinkish; odor of rotten meat or rotting onions; spores  $11-15-(16) \times (4)-5-7 \mu$ .  
*B. satanas* LENZ  
[For misinterpretations see also below, "ss" & "vv"].
- nn. Odor none, or slight and agreeable, fruity or acidulous, on drying sometimes cumarinous.



- pp. Stipe in the upper fifth to two thirds dirty reddish reticulate in pinkish ground, later cinnamon-pallid to ocher-pallid on concolorous ground, below this zone strongly pustulose-flocculose-furfuraceous like *B. erythropus*, at the base with a rather strongly developed deep red or olivaceous strigose tomentum, with pale yellowish basal tomentum; pileus light grayish brown, grayish yellow, also with some reddish areas, thinly tomentose and not viscid when wet; hyphae of stipe inamyloid; stipe not broadly ventricose-bulbous but attenuate towards the base or constricted between two ventricose portions. In mixed woods (*Fagus* and *Abies*) on non-calcareous soil in Europe and Caucasus. *B. caucasicus* SING.
- pp. Surface, covering, and colors of stipe different; color of pileus as above, or different; shape of stipe as above or different; hyphae amyloid or not.
- qq. European species, some also occurring in the Near or Far East in Asia; stipe usually rather strongly ventricose-bulbous, more rarely very broadly cylindrical; pileus color frequently more distinctly red in age or else pileus at first pallid or whitish with or without some slight pinkish tinge.
- rr. Mycorrhiza with conifers, mostly in montane vegetation; pileus neither sticky nor without a distinct red color appearing after maturity. *B. splendidus* Martin  
ssp. *moseri* SING. & KUTHAN
- rr. Mycorrhiza with Fagales, also with *Tilia europaea*.
- ss. Surface of pileus gradually becoming red or developing red areas as a reddish zone underneath the uppermost covering of the pileus is gradually exposed, often in cracks, not sticky (not adhering to tissue paper).
- tt. Surfaces of carpophore (pileus and stipe) not or scarcely bluing when pressed or touched (but context and tubes bluing readily although moderately); context not extraordinarily heavy; pores and stipe surface not remaining yellow for a

long time before red portions appear; young pileus with grayish bister or brownish bister tones.

*B. splendidus* MARTIN  
ssp. *splendidus*

tt. Surfaces of pileus and stipe readily bluing when touched, at least when fresh and young; context bluing very strongly, deeply and rapidly; remarkably heavy when young and when just reaching maturity; stipe and pores remaining without a red tinge for a long time; young pileus not gray or bister.

*B. torosus* FR. in FR. & HÖK.

ss. Surface of pileus argillaceous-pallid to yellowish-pallid, in age dirty brownish yellow, mostly pinkish along the margin, with a thin pinkish layer of context underneath the epicutis but this normally not reaching the surface which never becomes red in age (but becoming so under the influence of strong acids and occasionally when scratched), surface adhering to tissue paper as it is somewhat sticky in moist condition; stipe with a red reticulation on yellow ground, spaces between the low reticulating veins mostly angular-subisodiametric and small, only uppermost region of the network sometimes entirely yellow, only lowest sometimes entirely red.

*B. rhodoxanthus*  
(KROMBH. ex) KALLENBACH  
[see also footnote under "vv" below].

qq. Species of the Western hemisphere.

uu. Species occurring in California and perhaps limitrophous states, not under *Nothofagus*; spores reaching more than 12.5  $\mu$  in length.

vv. Reticulation of stipe weak and not extensive, or (according to Thiers) extensive and pileus brown to dark brown.  
cf. *B. eastwoodiae* MURR.

vv. Reticulation of stipe extensive or pileus not brown to

dark brown but pale gray to pale buff, eventually mostly pinkish, especially at the margin.

cf. *B. satanas* LENZ (sensu THIERS  
vix LENZ, cf. also "ss" above <sup>12</sup>)

uu. Species occurring either in southern Chile and then pileus brown and mycorrhiza with *Nothofagus*, or in Eastern North America and then spores up to 12.5  $\mu$ .

ww. Reticulation of stipe at the apex only and there consisting of pustules arranged in lines forming a network, this as well as the ground color "Begonia rose" or "buff yellow" with tints of red; base strigose with grayish hairs or tomentum; pileus at maturity "light pinkish cinnamon", "pinkish cinnamon" or "light grayish olive; pores "Brazil red" or near "dragon's blood red" (colors of Ridgway); forming mycorrhiza with hardwoods in North Carolina. cf. *B. piedmontensis* GRAND & SMITH

ww. Reticulation of veins which are very fine on the apical 15—20 mm of the stipe, ground color of apex yellow, lower part of stipe brown, pileus brown; pores more orange ("Titian gold" M & P); mycorrhiza with *Nothofagus* in South Chile. *B. chilensis* SING.

#### Descriptive notes and transfers

(in alphabetical order for all sections)

*Boletus aestivalis* (PAUL. ex) FR.

The species is common in Europe in the Fagetum and Querceto-Carpinetum and is correctly illustrated in SINGER (Röhrlinge II, pl. 3, fig. 1—3 as *B. edulis* ssp. *reticulatus*) and PILÁT & DERMEK (pl. 43). In North America, this species has not been recorded, except by mentioning the name without verifiable data, with the exception of one collection made at Arnold Arboretum, Mass., by me. The species may have been introduced with foreign plant material in this case.

On the other hand *B. variipes* PECK has been described and recorded only in America. This species is so close to *B. aestivalis* that it has been considered a synonym of the latter by PILÁT & DERMEK. When comparing the descriptions of both species, they can be distinguished only by what appears to be the sum of some minor characters. PILÁT & DERMEK's pl. 44 which is uncharacteristic for *B. aestivalis* compares well with the description and illustration of *B. variipes* PECK by SMITH & THIERS, The Boletes p. 369, pl. 145 where, in contrast to

<sup>12</sup>) A species with purplish violet lower portion of the stipe and elongated, larger spaces between the reticulating veins, with whitish pileus and generally more elongated stipe has been found in Japan and was there determined as *B. satanas* (sensu HONGO & IMAZEKI). This is probably a new species.

Peck, the stipe is said to have a reticulate surface "concolorous with or paler than the pileus". On the other hand, PECK describes the stipe of his species (and all three varieties) as "whitish or pallid". There may be other differences between *B. variipes* sensu SMITH & THIERS and *B. aestivalis* and the relation between the two deserves further studies, as does the relation between *B. variipes* sensu originali and sensu SMITH & THIERS. Their var. *fagicola* is certainly widely different from *B. aestivalis*.

From the data available at present, one might conclude that *B. variipes* PECK sensu SMITH & THIERS is doubtfully different from *B. aestivalis* especially by the deeper color of the stipe which may of course be a consequence of aging or reflect extremes of variation. If different, both forms seem to occur both in Europe and in America. As for *B. variipes* PECK, this differs from *B. aestivalis* in the color of the stipe and the discoloured (ochraceous) pores. The illustration given by SNELL & DICK strongly suggests *B. atkinsonii* PECK and this interpretation of PECK's species is entirely possible. However, the uncertainties remaining with the name cause me to prefer the better understood name *B. atkinsonii* even though *B. variipes* has priority. Since Peck himself thought *variipes* and *atkinsonii* different, the possibility exists that there is a third independent species, distinguishable from *B. variipes* sensu SMITH & THIERS as well as from *B. atkinsonii*.

*Boletus atkinsonii* PECK

Pileus grayish fuscous to grayish-fuscous-umber with olive grayish, dirty grayish or dirty pallescent margin and there in most specimens distinctly scrobiculate-rugose, at least when mature, with subacute margin, dried between "Bombey" and "burnt umber" in the middle and near 12 J 8 (Maerz & Paul) on the margin, i. e. on drying gradually losing the gray (and olive) tinges, unshining, finest pubescent-velvety to subglabrous, not viscid, pulvinate, obtuse, 65—116 mm broad. — Hymenophore tubulose, tubes long and nearly adnate to the stipe when young but soon removed and depressed, yellowish, then yellow to greenish yellow; pores yellowish to pale ochraceous or white and often remaining so when tubes have become darker, stuffed at first, small to minute, unchanging when bruised. — Stipe white reticulated on white ground, eventually ground color palest brownish and network macroscopically less visible, but always well developed with the areas between the reticulate veins elongated (more so below than above middle of stipe), only up to 11 mm from base, rarely further upwards, no reticulation visible and there surface smooth and persistently white or whitish, minutely (sub lente) white pubescent between the reticulating veins, equal or slightly widened at apex and/or at base, broad and rather long, solid, 100—200 × 15—30 mm; veil none; basal mycelium white. — Context white, unchanging, fleshy;

odor none; taste mild. — Spores  $9.5-13.7 \times 3-4.5 \mu$ , fusoid, with moderately thickish wall, pale melleous inamyloid, smooth. — Hymenium: Basidia  $16-26.5-(33) \times 8-8.5 \mu$ , 4-spored. Cystidia in tubes rare, sometimes none, if present very much like the dermatocystidia type (a) of the stipe; cheilocystidia like the pleurocystidia or more fusoid-ampullaceous, and then  $25-43 \times 3.5-7 \mu$ , hyaline. — Hyphae: Hymenophoral trama bilateral of the *Boletus*-type, quite hyaline and rather narrow in young material; all hyphae without clamp connections, inamyloid. — Cortical layers: Epicutis of pileus at first a trichodermial palisade of parallel or subparallel hyphal ends, these parallel to subparallel with each other, the cells cylindrical to slightly ventricose with broadly rounded tips,  $18-24 \times 5-10.5 \mu$  or cystidiform like the cheilocystidia, rarely subcapitate, and  $24-38 \times 6.5-10.5 \mu$ , hyaline to subhyaline in ammonia, in older dried specimens the members of the palisade becoming more or less entangled and elongated up to  $70 \mu$ , pale melleous ocher to subhyaline, and many becoming roughened above the somewhat gelatinizing outer wall-layer. On stipe surface (network-veins) a hymenium of basidiol-shaped but sterile elements  $16-22 \times 6.5-8.2 \mu$ , hyaline; there (and also forming the pubescence between veins) also dermatocystidia of two types (a) ampullaceous and rarely forked at the apex,  $58-100 \times 10-15 \mu$  (apex  $5.5-6 \mu$  diam.), hyaline, (b) more ventricose, fusoid-ventricose, obtuse,  $25-49 \times 8.5-12 \mu$ .

Chemical color reactions:  $\text{NH}_4\text{OH}$  on pileus (fresh): ferruginous.

In a mixed stand (with oaks) and generally apparently ectomycorrhizal with *Quercus* and perhas other hardwoods.

Material studied: New York: Port Jefferson, (NYS), Typus. — N. C., Cades Cove, 11. VIII. 1968, SINGER N 1690 (F).

*Boletus caribaeus* (SING.) SING. var. *caribaeus*

*Boletus rubellus* ssp. *caribaeus* SING., Mycologia 37: 798. 1945.

*Boletus caribaeus* var. *crassotunicatus* (SING.) SING. comb. nov.

*Boletus rubellus* f. *crassotunicatus* SING., Am. Midl. Nat. 37: 51. 1947.

Descriptions of these fungi may be found in Am. Midl. Nat. 37: 51, 1947.

*Boletus clavipes* (PECK) PILÁT & DERMEK, Hrib. Houb. p 97, 1974.

The original description by Peck permits, as in the case of *B. separans*, two interpretations, viz. that of SMITH & THIERS (Bol. Mich. p. 373—374, 1971) and that of SINGER (Am. Midl. Nat. 37: 25, 1947 and Pilze Mitt. 6: 26, 1967). The latter is here preferred because the respective form is common in Eastern North America particularly under conifers in upper New York State where the type of the variety was collected. In this interpretation, *B. clavipes* lacks a reddish zone underneath the cuticle. PILÁT & DERMEK as well as SNELL & DICK

(pl. 41 and pl. 32 respectively) seem to have combined both interpretations. *Boletus edulis* var. *clavipes* and var. *ochraceus* in the sense of Smith & Thiers are well described by these authors. I am not certain whether the fleeting "amyloid" reaction emphasized by these authors and the slight diverticulation of the epicutis elements are sufficiently diagnostic for any bolete of this group. The former is an often inconstant reaction with a pigment present in the cuticle and the latter has been occasionally observed by me in several species of this section (*Boletus*) e. gr. in otherwise typical *B. pinophilus*.

*Boletus fairchildianus* (SING.) SING. stat. nov.

*Boletus rubricitrinus* (MURR.) MURR. var. *fairchildianus* Sing., Mycologia 37: 798. 1945.

*Boletus floridanus* (SING.) SING. stat. nov.

*Boletus frostii* subsp. *floridanus* SING., Mycologia 37: 799. 1945.

*Boletus fragicolor* BERK.

This Himalayan species has the habit of a *Gyrodon* (according to the unpublished illustration by Hooker) but the hyphae of the type (K) are clampless. The spores are so short ( $9.5-10.2 \times 4.7-5.5 \mu$ ) and the hymenophore so arcuate that I believe that *B. fragrans* is rather related to *Pulveroboletus hemichrysus* although the habitat is definitely on earth. The epicutis structure is hyphous.

*Boletus frustosus* SNELL & DICK.

This species has been redescribed by SLIPP & SNELL (Lloydia 7: 56. 1944). The spore print color is indicated as ochraceous brown. Consequently the position of this species remains uncertain.

*Boletus guadelupae* FIARD & SING. Bull. Soc. Myc. Fr. 1977 (in print).

*Boletus loyo* PHIL. ex SPEGAZZINI

A full description has been given by SINGER (Nov. Hedw. 7: 125, pl. 11, fig. 5, 1964).

Aside from this species and *B. chilensis* SING., there is apparently another species in Chile which keys out in sect. *Subpruinosi*. This, however, was not fully described because of insufficient material but seems to differ from *B. loyo* and *B. chilensis* in wider pores, narrower stipe.

*Boletus nobilis* PECK

This is the same species as *Boletus separans* PECK sensu SMITH & THIERS, Bol. Mich. p. 363 (where it is well described) and the doubtful "*B. aereus*" from Mexico (cf. SINGER, Pilze Mitt. 6: 32). The latter identification should be disregarded because I lumped together several species under the name *B. aereus* in earlier work (cf. Am. Midl. Nat. 37: 22. 1947) which in view of newer revisions of this complex, including the true European *B. aereus*, was unjustified. As for the correct inter-

*Boletus michoacanus* SING. spec. nov.

Pileo carmineo-roseo, subtiliter rivuloso-subpunctulato, demum areolato, pulvinato, giganteo (120—250 mm lato). — Hymenophoro tubuloso, flavo, tubulis usque ad 20 mm longis, plus minusve depressis circum stipitem, poris venetiano-rubris, exiguis (0.5 mm); sporis in cumulo olivaceis. — Stipite rubro-reticulato supra fundum rubrum v. flavum, interdum arei atrocarmineis institutis, prope basin tantum levi, spatiis inter venas reticuli longitudinaliter elongatis, solido, late cylindraceo, 60—160 × 30—70 mm. — Carne flava, frequenter partim carminea, fracty caerulescente; sapore miti; odore Boleti lupini (eo Lepiotae clypeolariae simili) vel Boleti satanae (carnis bovinae vel cepae putridae), iniucundo. — Sporis auf 9—12 × 4.5—5 μ aut 11—14.5 × 5—6.5 μ, ellipsoideis vel fusoideis, brunneolis, levibus, haud truncatis nec porigeris, depressione suprahilari manifesta instructis, inamyloideis. — Hymenio: Basidiis 28 × 11—13 μ, (3)—4-sporis. Cystidiis ad poros sat numerosis, in tubulis raris, e. gr. 30 × 9 μ, ampullaceis, subhyalinis vel chromeis. — Hyphis defibulatis, prope poros saepe chromeis, in pileo stipiteque inamyloideis, tramate hymenophoralis bilateralis typi Boletorum. — Epicute pilei trichodermiali nec non in parte superiore saepe depressa ita ut cutem simulet, debiliter vel vix gelatinosa. Reticulo stipitis strato hymeniformi oblecto quod e basidiis 20—29 × 8—12 μ, dermatocystidiis 26—60 × 6—10 μ ampullaceis vel rarius ventricoso-clavatis, dematopseudo-paraphysibus 12—26 × 10—14 μ late ventricosis vel vesiculosis, interdum excrescentia sterigmatiformi ornatis efformatur.

Ad terram in silva pineo-quercina sub Quercu. Typus: Mexico: Michoacán, Parque Nacional prope Mirador, 3000 m alt. 9. VIII 1969, SINGER M 8998/II (F).

*Boletus ornatipes* PECK

CHIU (Mycologia 40: 226. 1948) and later SMITH & THIERS (Bol. Mich., p. 330, 1971) state that this species is not a synonym of *Pulveroboletus retipes* (BERK. & CURT.) SING. My description (1947) is indeed a mixture of the two species. The true *Boletus ornatipes* is a common species in North America and a good description can be found in Smith & Thiers l. c., a good illustration in SNELL & DICK (pl. 32).

In Asia, a similar fungus has been described from South China and Malaya, as *B. karffmannii* LOHWAG and *B. sinapicolor* CORNER, respectively. What CHIU describes from China is apparently *B. karffmannii*, but he uses the name *B. ornatipes*. Only the spore measurements differ slightly (LOHWAG 13—15 × 5—6 μ; CHIU 8—12 × 4—5 μ). CORNER and CHIU fail to indicate the taste of the context, but it may be

assumed that it is likewise bitter (as in the American *B. ornatipes*) because VASSILIEVA who apparently describes the same fungus as *B. retipes* indicates bitter taste. Whether *B. sinapicolor* is indeed conspecific with the Chinese fungus cannot be stated with confidence. Corner (Bol. Malayasia p. 124, 1972) suggests in his description a slight difference in color (tubes mustard yellow, stipe and basal mycelium likewise).

Similar American species with a yellow pulverulence on the pileus should be looked for in *Pulveroboletus*.

### *Boletus pinophilus* PILÁT & DERMEK

This species was described as *Boletus edulis* var. *pinicola* or *B. edulis* ssp. *pinicola* in most of the European literature. It is well described and illustrated by PILÁT & DERMEK (Hrib. Hub. p 100, pl. 46) who add with a question mark *Boletus edulis* var. *fuscuber* (FORQU. ap. QUÉL.) BAT. as a synonym. The identity of this latter form has been discussed at some length by me (Pilze Mitt. 6: 27—28. 1967) and it has now become clear that it is very close to *B. edulis* var. *clavipes* sensu SMITH & THIERS as far as the interpretation by MOSER (not that of the Swiss mycologists which call this form var. *pinicola*) is concerned. I do not know the typus of var. *fuscuber* and do not want to anticipate an interpretation but I believe that a form with yellow margin and otherwise redder pileus, vinaceous underneath the cuticle and coloring the boiling water yellow, with relatively soft context, actually exists and that this is the the var. *pinicola* of Walty (cf. pl. 4, fig. 4—5 of Pilze Mitt. 6) which is different from *B. pinophilus*. If such a form is constant and indeed identical with var. *clavipes* sensu SMITH & THIERS, it may deserve a specific name, but given the uncertainty about the interpretation of var. *clavipes* PECK and var. *fuscuber* FORQU., it should not at present be renamed.

### *Boletus quercicola* (VASILKOV) SING. comb. nov.

*Boletus edulis* f. *quercicola* VASILKOV, Biely grib p 13. 1966.

This species may account for occasional claims of *B. edulis* sensu stricto growing under hardwoods. I have collected and studied it in Southern England under *Quercus*. The glabrous pileus, white stipe with deeply decurrent-descending white reticulation, the rather elongated stipe and the colors differentiate it together with the association with *Quercus*. Vasilkov may have included *Boletus carpinaceus*, but the latter is here recognized as a separate species. The illustration by K. KALAMEES & LASTING, Eesti Puravikulised, plate 18, 1974 — even if it may have been drawn from a paler brown *B. edulis* — gives a good impression of the aspect of fresh *B. quercicola*.



*Boletus rubellus* KROMBH.

This species is common in the north temperate zone both in Europe and North America, Eastern Asia and North Africa. Some taxa, similar to this have in the past been considered to be conspecific with *B. rubellus*. SMITH & THIERS on the basis of type studies separate specifically *B. rubeus* FROST and *B. fraternus* PECK., a separation which we recognize as correct. As a consequence it is now necessary to consider *B. rubellus* ssp. *bicoloroides* SING. (Am. Midl. Nat. 37: 53, 1947) as a synonym of *B. fraternus*, and *B. rubellus* ssp. *fraternus* sensu SINGER (l. c. p. 47) as a misdetermination. The *B. rubellus* complex in Florida would then appear to be composed of the following forms (key below to replace the key l. c. p. 46):

- A. Stipe not pustulate to furfuraceous.
  - B. Pileus carmine purple to olive, often sepia on outer half; spores broad,  $9.2-11 \times 4.7-5.4 \mu$ . ssp. *consobrinus* SING.
  - B. Pileus pink to red; spores  $10-14.5 \times 4-5.5 \mu$ . ssp. "*fraternus*" ss. SING.
- A. Stipe pustulate-pruinose to furfuraceous.
  - C. Stipe yellow, brown-punctate, bluing distinctly and consistently. f. *subdumetorum* SING.
  - C. Stipe often with pinkish colors, with various punctations; context weakly or not bluing. ssp. *dumetorum* SING.

On the other hand, I have studied many specimens in Northern North America and cannot convince myself that the spore width permits a specific distinction between a broad-spored (*B. campestris* SMITH & THIERS) and a narrow-spored form since the European species has rather variable spores up to  $6 \mu$  broad.

Among the European forms, it seems that the red form of *Xerocomus chrysenteron* (or a closely allied "variety") has often been confused with *B. rubellus*. Judging from illustrations, one may suspect that PILÁT & DERMEK pl. 34, second figure from the left in middle row might represent a red *X. chrysenteron* rather than *B. rubellus*. Such cases may explain the fact that some European authors still prefer to include *B. rubellus* in *Xerocomus* in spite of the fact that typical *B. rubellus* has obviously Boletus-subtype hymenophoral trama and is closely related to other species of *Boletus* sect. *Subpruinosi*. *Xerocomus armeniacus* QUÉL. is often distinguished from *Boletus rubellus* because of its paler reddish, yellow-orangy color. The specimens I have seen are like those illustrated by PILÁT & DERMEK and include the specimens PILÁT has used for his description (Hrib. Hub. p. 87): Veverské Bityška 15. IX. 1952, KŘIŽ (PR 647653) as well as fresh collections, also from Moravia. Here the spores are  $9-12 \times 4.4-5 \mu$ ; basidia  $27 \times 7 \mu$ , 4-spored; cystidia fusoid to ventricose,  $30-68 \times 7.5-11 \mu$ ; hymenophoral trama distinctly of the Boletus subtype with the mediostratum brownish orange with hyphae  $1.2-2.3 \mu$  broad and paler yellowish

lateral stratum of curved and gelatinized hyphae 2.5—4.8  $\mu$  broad; epicutis almost cutis-like depressed, apparently a trichodermium with often ascendant terminal members of hyphal chains with elongated cells 5.5—11  $\mu$  broad, the terminal cells often clavate and broadly rounded at the tip, with oily-granular contents, with firm, even locally thickened wall, occasionally in strands of parallel hyphae, orange-gold-brown in Melzer's reagent, yellow to yellow-brownish in KOH; all hyphae without clamp connections. These data show that microscopically there is no tangible difference between *B. rubellus* and *X. armeniacus*, and the latter may be considered a color variant, perhaps a variety of *B. rubellus*.

*Boletus separans* PECK

PECK's description permits interpretations as different microscopically as that by SMITH & THIERS or that by SINGER (Pilz Mitt. 6: 28. 1967). SNELL & DICK describe and illustrate our species very well (pl. 31 below). In our sense, *B. separans* is apparently the same as a collection by AMMIRATI 2004 described by SMITH & THIERS as a variant (which "may represent a distinct species") of *B. edulis* var. *aurantioruber* DICK & SNELL. Since SMITH & THIERS's interpretation is undoubtedly the same as *B. nobilis* PECK, and PECK considered the latter as different from *B. separans*, describing the latter as brownish red to dull lilac on the pileus and the stipe as dull lilac, colors within the range of colors known in *B. separans* sensu SING., we maintain our *B. separans* as probably being identical with PECK's. At the same time, the problem of the correct naming of our *B. separans* vs. *B. nobilis* (= *B. separans* sensu SMITH & THIERS) requires additional studies. *B. separans* sensu SING. is well represented by specimens from Virginia (SINGER V 116, FH); this grew under *Quercus*, *Fagus* und *Castanea*, and the colors agree perfectly with those described for *Ammirati* 2004 mentioned above.

GRANT & SMITH (1971) distinguish from *B. separans* a third species, *B. pseudoseparans* GRANT & SMITH on the grounds that there are amyloid particles in some of the elements of the cuticle of the pileus and the wall of the dermatocystidia acquires a blue-green color in KOH mounts.

*Boletus splendidus* MARTIN

Both subspecies of this species are generally described together under the name *B. satanoides* SMOTLACHA. A detailed study on this complex will be found in a forthcoming paper (Česk. Mykol.) by SINGER & KUTHAN.

*Boletus subclavatiipes* Snell ssp. *inedulis* (MURR.) comb. nov.

*Ceromyces inedulius* MURR., *Mycologia* 30: 523. 1958.

*Boletus subfraternus* COKER & BEERS

The species as described by COKER & BEERS, Bol. N. Car. p. 61, 1942 has discolorous pores and therefore seems to be different from the species described under this name by SMITH & THIERS (Bol. Mich. p. 274); it has yellow cystidia which are pointed and about  $9.8 \mu$  thick with spores  $11-12.5 \times 3.8-4.5 \mu$ , and therefore appears to be different from the specimen received by me from the authors, see Am. Midl. Nat. 37: 49. 1947). SMITH & THIERS may be an undescribed species of *Boletus* whereas mine, formerly incorrectly included in *Boletellus*, is probably a *Gastroboletus*, provided it produces no spore print, a feature impossible to observe on dried material. It appears that COKER & BEERS included several, at least three, species in their concept of this species. Further observations at the type locality, and restudying the holotype might help to clear up this situation.

*Boletus underwoodii* PECK, Bull. Torr. Bot. Cl. 24: 145. 1897.

*Boletus subluridus* (MURR.) MURR., Mycologia 30: 525. 1938.

*Boletus miniatoolivaceus* var. *subluridus* (MURR.) SING., Mycologia 37: 798. 1945.

*Boletus miniatoolivaceus*, "Florida form" Singer, Am. Midl. Nat. 37: 61. 1947.

A complete description was published by SINGER l. c. (1947). Some individuals show very little red at the pore mouths and these may be confused with species of the *B. miniatoolivaceus* complex. In Florida the basidia are usually all 4-spored or at least in their majority, but in Tennessee I have observed forms with 1-2-3-4-spored basidia. In the Tennessee form the spores are  $8.5-10 \times 4.2-6 \mu$  (N 1693, — F) and in Florida  $(8.5-11-13-(17.7) \times 3.5-4.2 \mu$ , i. e. the majority much more elongated. Whether the short-spored form bears shorter and broader spores regularly or merely produces often retarded spores, cannot be stated with confidence but I hesitate to believe that different species are involved since the type of *B. underwoodii* has spores  $9-12 \times (3)-3.5-4.5 \mu$  (SMITH & THIERS) and material from Virginia (Petersburg, 11. IX. 1934, LINDER & SMART, — FH) has spores  $9-12 \times 5 \mu$ , i. e. both collections have spores intermediate between the Tennessee and the Florida collections, and all collections known to me have the characteristic odor attributed to *B. miniatoolivaceus* by many authors. If the long-spored form from Florida were specifically distinguishable, its name would be *B. subluridus* (MURR.) MURR.

*Boletus variipes* PECK

See discusseon under *B. aestivalis*.

#### *Bondarzewia* SING.

A. Parasite on roots of conifers, mostly *Abies*, in Europe and Asia.  
*B. montana* (QUÉL.) SING.

- A. Parasite on frondose trees in Western Hemisphere, often strongly lactescent.  
B. On *Quercus* in North America. *B. berkeleyi* (FR.)  
BONDARZEW & SING.  
B. On *Nothofagus* in Southern South America.  
*B. guatecasensis* (HENN.) WRIGHT in SING.

*Callistosporium* SING.

- A. Spores reaching more than 7  $\mu$  in length, or at least many spores longer than 7  $\mu$ ; necro-pigment purple red to vinaceous pink (if of different color cf. genus *Tricholoma*).  
B. Growing on coniferous wood in Europe; spores 5.8—9.7  $\times$  2.8—4.5  $\mu$ . *C. favrei* SING.  
B. Growing on Mono- and Dicotyledones.  
C. Growing in Europe or Southern South America (see "J" below).  
C. Growing in Florida.  
D. Pileus brick color, 4—6 mm broad; spores 7.5—8.7  $\times$  4—5.2  $\mu$ , mostly 7.5—8  $\times$  4—4.5  $\mu$ ; taste farinaceous; on soil at the base of *Palmae*.  
*C. palmarum* (MURR.) SING.  
D. Pileus brown, about 20 mm broad; spores 7.2—7.7  $\times$  5—5.7  $\mu$ ; odor raphanaceous; on mosses in low hammock vegetation. *C. galerinoides* SING.  
A. Spores smaller, mostly not larger than 7  $\mu$ , often smaller than that  
E. Necro-pigment golden melleous; context bitter; on pine in Florida. *C. chrysophorum* SING.  
E. Necro-pigment some other color.  
F. Necro-pigment dark violet-lilac; spores 4—5.8  $\times$  3—3.3  $\mu$ ; lamellae subclose, narrowly adnexed; on dead wood of *Taxus baccata*. Coastal area of Black Sea.  
*C. heimii* (SING.) SING.  
F. Necro-pigment purple red to vinaceous pink.  
G. On roots of *Bambuseae* in South America; taste mild; pileus 8—15 mm broad; stipe 17—25  $\times$  1—1.5 mm; pileus clay color to fuscous (15 H 12 to 15 J 12, M & P), hygrophanous, fading to sordid ocher.  
*C. luteofuscum* SING.  
G. On rotten wood of various trees or on the ground, not combining the characters indicated above.  
H. Pileus when fresh not yellow, olive or brown; lamellae subclose to subdistant; subtropical and tropical species; mostly on naked earth or woody humus, sometimes among blue-green algae.

I. Pileus "Indian purple" to "tapestry r." (M & P) stiped-striate on sordid ground, with depressed center; lamellae pinkish gray, adnate-subdecurrent; spores  $3-4.5 \times 1.7-3.5$   $\mu$ . Amazonas.

*C. amazonicum* SING.

I. Pileus bright red, convex or umbonate, more rarely eventually depressed; lamellae at least in edge region bright red; narrowly adnexed to free; spores slightly larger, Andes and Pre-Andes.

*C. terrigenum* SING.

H. Pileus when fresh yellow-brown, yellow-ocher, chamois or olive, brown or red-brown; lamellae close to crowded, more rarely subclose to subdistant; generally on wood of coniferous or frondose trees in the temperate zones, only *C. luteoolivaceum* also in the neotropics.

J. Taste styptic or bitterish, disagreeable; lamellae rather narrow to medium broad; stipe equal or slightly tapering upwards, North America, south to the neotropics, rather common.

*C. luteoolivaceum* (BERK. & CURT.) SING.

J. Taste almost or quite mild; lamellae rather broad; stipe attenuated downwards or equal. Species of the temperate zones of the northern and the southern hemispheres.

K. Lamellae close to subclose; spores up to 6—(7)  $\mu$  long; on coniferous (and frondose wood?) of dead trunks and logs, in sawdust or woody humus, widely distributed ("*Collybia*" *exculpta* ("Fr.") sensu BRESADOLA =)

*C. majus* SING. nom. nov. (see below)

K. Lamellae subdistant; spores up to 7.5  $\mu$  long, but mostly  $6.5-7.2 \times 3.5-4-(4.5)$   $\mu$ ; on frondose wood in France.

cf. "*Tricholoma*" *elaedes* ROMAGNESI

*Callistosporium favrei* SING. spec. nov.

Pileo brunneo in siccis, minutissime fibrilloso, had viscoso, frequenter umbonato, margine primum incurvato, 10—30 mm lato. — Lamellis in siccis concoloribus, latis, subconfertis, adnexis vel adnatis. — Stipite concolori vel obscuriore, glabro, haud insititio, filis minutissimis albis mycelii ad basin ornato. — Carne tenui. — Sporibus  $5.8-9.7 \times 2.8-4.5$   $\mu$ , ellipsoideis, nonnullis ad latus interius leniter depressis sed sine depressione suprahilari, multis applanatione

suprahilari gaudentibus, levibus, hyalinis, multis in exsiccatis aut corpusculo hyalino aut necropigmento purpureorubro praeditis, parietibus tenuibus vel firmis instructis, debiliter cyanophilis, inamyloideis. — Hymenio: Basidiis  $24-26.3 \times 5.5-7 \mu$ , multis necropigmento purpureorubro praevisis, tetrasporis. Cystidiis nullis visis. — Hyphis pilei radiatim dispositis, tenuitunicatis, haud gelatinosis, inamyloideis, defibulatis. — Epicute pilei cutiformi, hyphis  $1.3-4.2 \mu$  latis, levibus, interdum fasciculatim ascendentibus vel conniventibus. — Ad lignum putridum Piceae. Typus a J. FAVRE in Helvetia, Bois de Chène pr. Nyon 18. X. 1942 lectus et in Herbario Favreano conservatus est.

This species was painted by FAVRE. Additional data on the fresh colors and size will be found on the unpublished plate. It seems to be closest to *Tricholoma elaeodes* ROMAGNESI, Bull. Soc. Nat. d'Oyonnax 8: 76. 1954 which differs in smaller size, habitat and smaller spores.

*Callistosporium amazonicum* SING. spec. nov.

Pileo purpureo ("Indian purple" vel "tapestry r", MAERZ & PAUL), pellucide striato per medium radium pilei supra fundum sordidum, glabro, convexo, centro depresso,  $17-23$  mm lato. — Lamellis grisello-arenicoloribus ("Polo tan" M & P), frequenter subpurpurascensibus, haud intervenosis, mediocriter latis ( $2.5$  mm), subconfertis vel subdistantibus, adnato-decurrentibus. — Stipite hepatico ("liver br" M & P), pruinato praesertim ad apicem, subaequali vel ad apicem vel ad basin leniter incrassato,  $14-17 \times 1.5-2.5$  mm; mycelio basali albo, sericeo. — Carne superficiebus subconcolori; odore farinaceo; sapore miti. — Sporis  $3-4.5 \times 1.7-3.5 \mu$ , ellipsoideis vel brevissime ellipsoideis, hyalinis, in siccis corpusculo purpureo-rubro interno ornatis ( $\text{NH}_4\text{OH}$ ), levibus. — Hymenio: Basidiis  $12.5-16.5 \times 4-4.2 \mu$ . — Hyphis in siccis saepe rubricatis ( $\text{NH}_4\text{OH}$ ), defibulatis. — Epicute ex hyphis tenuibus, repentibus, haud gelatinosis, levibus efformata. — Ad terram prope ripas torrentium sivistrium, locis umbrosis, inter Cyanophyta. Typus a R. SINGER in Brasilia, Guaporé, pr. Guajará mirim 10. III. 1956 lectus (BAFC).

This species appears to be closest to *C. terrigenum* SING. from which it differs in colors, shape of carpophores, and slightly smaller spores.

*Collybia exsculpta* "Fr." [sensu] BRESADOLA, Icon. Mycol. 5: 214. 1928, non Fr.

This species differs so slightly from the Chilean *Callistosporium luteofuscum* var. *major* (Beih. Nova Hedwigia 29: 53. 1969) that I am inclined to consider them conspecific. *C. majus* SING. is here proposed as a nomen novum for *Collybia exsculpta* as cited above. The Chilean form differs from *C. majus* in often (not always) reaching larger carpophore size, the pileus being either depressed or more or less umbonate in the center, the stipe not always being attenuate at the

base. While Bresadola's type was collected on conifer wood (*Pinus silvestris*), the South American fungus grew consistently on frondose trees (*Acacia*, *Aextoxicum*, *Eucryphia*). The manner of growth seems to influence the shape of the stipe base. It must be further investigated whether the European species occurs on frondose wood and whether larger specimens occur than those described by Bresadola.

*Calocybe* KÜHNER ex DONK

1. Species of the section *Calocybe*

A. Pileus lamellae and stipe essentially white. *C. gambosa* (FR.) SING.

A. Pileus more pigmented.

B. Pileus and other parts of the carpophore tending to straw color or yellow in youth, mostly somewhat pallescent in age.

*C. georgii* (CLUS. ex FR.) KÜHN.

B. Pileus and often other parts of carpophore dirty gray or grayish pallescent, grayish-cream, beige etc.

*C. graveolens* (PERS. ex FR.) SING.

2. Species of section *Echinosporae* (LANGE) SING.

A. With annulus.

*C. constricta* (FR.) KÜHN.

A. Without annulus.

*C. leucocephala* (FR.) SING. (sensu LANGE)

3. Species of the section *Pseudoflammulae* SING.

A. Without cellular epicutis; spores 3—5.5  $\mu$  long (variable according to species).

B. Temperate species growing mainly on herbaceous debris, coniferous and angiosperm-leaves etc.

C. Fungi growing under *Picea*, mostly on needle beds, perhaps also on *Fagus* leaves.

D. Lamellae bright lemon or sulphur yellow, close to crowded, mostly narrow. Spores ellipsoid or short ellipsoid.

*C. chrysesteron* (sensu lato)

D. Lamellae cream-isabelline; spores round.

*C. alpestris* (BRITZ.) (sensu HUIJSMAN)

C. Fungi growing on *Juncus* in wet places; context whitish

*C. juncicola* (HEIM) SING.

B. Subtropical and tropical species, with spores up to 3.5  $\mu$  long [if up to 8.5  $\mu$  long, see following section].

E. Pileus flesh-red with deeper colored center; lamellae crowded, narrow; growing in subtropical forests of Southern Brazil.

*C. rubra* RICK ex SING.

E. Pileus without any reddish tinge (cf. also *Lyophyllum fibrillosum*).

F. Pileus spadiceous; lamellae ochraceous, narrow, crowded; stipe ochraceous; on rotten wood in tropical forest.

*C. bipigmentata* SING.

F. Pileus light fulvous with fuscidulous center; lamellae yellow, close, subclose, rather broad; in montane-tropical Alnetum on woody and foliaceous débris.

*C. alneti* SING.

A. Epicutis cellular, subhymeniform.

G. Tropical species (cf. "E" above).

G. Temperate species with bright yellow lamellae and spores up to 4.8  $\mu$  long.

H. Pileus purple brown, the epicutis-cells often with reddish contents; stipe with a purplish tone at least at the apex.

*C. onychina* (FR.) KÜHN.

H. Pileus and stipe without purplish tinge.

*C. naucoria* (MURR.) SING. (sensu lato)

#### 4. Species of section *Carneoviolaceae* SING.

A. Epicutis not cellular.

B. Pileus blue, violet blue, obtuse. Florida.

C. Odor and taste farinaceous; lamellae white.

*C. cyanella* SING.

C. Odor none; taste pleasant; lamellae violet "*Gymnopus*" *atroviolaceus* MURR.

B. If pileus violet, it is not obtuse, or the species does not occur in Florida.

D. Temperate species; odor usually farinaceous or none; pileus not prominently papillate.

E. Odor farinaceous, taste also farinaceous.

F. Spores 5—6  $\times$  3—4  $\mu$ ; pileus predominantly violet, purple; lamellae white, tending to sulphur yellow.

*C. ionides* (BULL. ex FR.) KÜHN.

F. Spores more subglobose or narrower; pileus either sordid pinkishflesh to yellow with more ochreous center, or predominantly gray to fuscous and often with yellow-brown margin, more rarely slightly.

*C. fallax* (LASCH) SING.

G. Pileus sordid pinkish-flesh color to yellow (Séguy 202) with more ochreous center; spores subglobose, 3.4—4  $\times$  2.9—3.8  $\mu$  (HUIJSMAN) (see under "D" section 3: *C. alpestris* (BRITZ.)

HUIJSMAN sensu HUIJSMAN

G. Pileus predominantly gray to fuscous and often



with yellow-brown margin, more rarely slightly violet; spores  $5-6.8 \times 2.7-3.5 \mu$ .

*C. fallax* (LASCH) SING.

E. Odor none or almost none; taste not or not distinctly farinaceous.

H. Pileus flesh color, often with ocher-brownish tones; spores  $5-6.8 \times 2.7-3.5 \mu$ ; mostly solitary.

*C. carnea* (BULL. ex FR.) KÜHN.

H. Pileus violet rose color (e. gr. "Prolignac" M & P) with a central dark ("Castor" M & P) dot and otherwise gray (e. gr. "sea hawk"), sometimes a purer pink all over or with only fuscidulous center, stains "burnt umber" (M & P) with KOH; stipe mostly light grayish purple (5 A 8 M & P) in the middle zone; spores  $4.2-6.5 \times 2.5-3 \mu$ ; habit mostly subfascicular. (*C. obscurissima* (PEARSON) MOSER =)

*C. persicina* (FR.) SING.

D. Subtropical and tropical species.

I. Pileus with caesious or blue-gray margin and a fuliginous prominent papilla or pale violet with whitish margin and a strong but not discolorous papilla, or pale cream (10 D 2, M & P) with an acute papilla in the fuscidulous ("bamboo" M & P) center.

J. Spores  $6.2-6.8 \times 2.7-3 \mu$ ; tropical Afrikan species with pale violet pileus and whitish margin; odor strong, taste bitter.

*C. africana* SING.

J. Spores broader or smaller; Western hemisphere species.

K. Spores  $6.5-8.5 \times 4.5-5.8 \mu$ ; pileus pale cream with fuscidulous center.

*C. coniceps* SING.

K. Spores smaller; pileus blue-gray with fuliginous center.

*C. atropapillata* SING.

I. Pileus differently colored and/or without papilla (see "E" above)

A. Epicutis cellular, subhymeniform; neotropical species with blue or violet pileus (*Clitocybe cyanea* RICK =) *C. cyanea* SING.

#### Descriptive notes and transfers.

*Calocybe chrysenteron* (FR.) SING. (sensu QUÉL., KÜHNER & ROMAGNESI).

This binomial, sensu lato, includes several described forms which, at present, cannot be clearly separated from *C. chrysenteron* sensu KÜHNER & ROMAGNESI, for example *C. pseudoflammula* (LANGE) M. LANGE. Further studies will be necessary to establish whether this is a homogeneous species.

*Lyophyllum fibrilloseum* (SING.) SING. comb. nov.*Calocybe fibrillosa* SING., in SING. & DIGILIO, Lilloa 25: 19. 1952.

Since this species has in its brown parts hyphae incrustated by fuscous pigment, its place is in *Lyophyllum* rather than in *Calocybe* although it has the appearance of many species of the latter genus.

*Calocybe bipigmentata* SING. spec. nov.

Pileo atropadiceo, subglabro sed sub lente subtiliter punctato, sicco, levi, convexo papillatoque, cc. 7 mm lato. — Lamellis ochraceis, confertissimis, angustis, adnexas, secedentibus. — Stipite ochraceo, glabro, levi, aequali,  $17 \times 1.5$  mm; mycelio basali sordide pallido. — Sporis  $2.5-3 \times 2-2.5 \mu$ , subglobosis, hyalinis, levibus, inamyloideis. — Hymenio: Basidiis  $16-18 \times 3-5 \mu$ , granulatione siderophila repletis, (2)—4-sporis. Cystidiis nullis. Cheilocystidiis ex anguste fusoides vel hyphoideis basidiomorphis (et tunc e. gr.  $29 \times 7 \mu$ ) frequentius angustis et  $1.5-2 \mu$  latis, obtusis, raro subacutis, hyalinis. — Hyphis fibulatis, sed nonnullis septis secundariis defibulatis, tenui-tunicatis, inamyloideis. Tramate hymenophorali regulari, ex hyphis filamentosis parallelis haud gelatinosis, interdum usque ad  $7-9 \mu$  latitudine inflatis efformato. — Epicute pilei cutiformi, sed hyphis multiseptatis repentibus vel fasciculatim ascendentibus superimpositis, cellulis terminalibus anguste, rarius late ventricosis subcystidiformibus, obtusis,  $3-13 \mu$  latis, pigmento vacuolari saepe condensato ornatis, interdum filamentis cheilocystidiiformibus apicaliter appendiculatis, pigmento cellularum subiacentium intracellulari flavo abundante et in acie lamellarum quoque praesente.

Ad lignum putridum solitario in Brasilia, Pernambuco, Dois Irmãos, 13. VII. 1960 a R. SINGER lectum, specimen Typus in F conservatur.

*Calocybe alneti* SING. sp. nov.

Pileo fulvido, centro fuscidulo, subglabro, sub lente subtiliter tomentoso, punctato-maculato, levi, sicco, convexo, dein concavo, obtuso, cc. 10 mm lato. — Lamellis luteis, subconfertis vel confertis, in vetustis interdum distanter anastomosantibus, sat latis, adnexas. — Stipite fusco vel flavido-fusco, subglabro, sicco, basin versus attenuato vel ad basin nec non ad apicem angustato,  $22-29 \times 1-2.5$  mm; mycelio basali flabido. — Carne flavida vel pallide fulvidula vel pallida; odore subnullo. — Sporis  $2.5-3 \times 2-2.5 \mu$ , breviter ellipsoideis vel paene subglobosis, levibus, hyalinis, inamyloideis. — Hymenio: Basidiis  $12-20 \times 4-5.2 \mu$ , granulatione sidex rophila impletis, tetrasporis. Cystidiis et cheilocystidiis nullis. Tota praeparatione in ammoniaco et NaOH e pigmento diffuso flavescente. — Hyphis fibulatis, tenui-tunicatis, filamentosis, inamyloideis. — Epicute pilei

cutiformi, flava, nonnullis hyphis terminalibus recurvatis, e. gr.  $13 \times 4-6 \mu$ , sed haud umquam hymeniformi.

Ad quisquillas ligneas et ad folia dejecta in Alnetis in Argentina septentrionali, Jujuy, Lagunas de Yala, typus a R. SINGER in elevatione  $\pm 2300$  m, 14. II. 1966 lectus et in F conservatus.

*Calocybe africana* SING. sp. n.

Pileo pallide violaceo, albido marginem versus, in siccis "almond" (Maerz & Paul), subglabro, sub lente subtiliter tomentosio, convexo, dein repando, papillato,  $\pm 20$  mm lato. — Lamellis eburneis, confertis, haud intervenosis, angustis, adnexis. — Stipite violacelloc et basin versus brunneolo, subglabro vel glabro, cavo, aequali vel basin versus attenuato,  $\pm 35 \times 4$  mm; mycelio basali inconspicuo sed in paucis radicellis consensato. — Carne alba; odore forti; sapore amaro. — Sporis  $6.2-6.8 \times 2.7-3 \mu$ , cylindraceutis, hyalinis, levibus, inamyloideis. — Hymenio: Basidiis  $16-21 \times 5.8-6 \mu$ , granulatione siderophila repletis, tetrasporis. Cystidiis et cheilocystidiis nullis. — Hyphis fibulatis, inamyloides. — Epicute pilei cutiformi, ex hyphis filiformibus, tenuitunicatis, levibus, applicatis efformata.

Ad terram, solitario, in plantationibus; typus a GOOSSENS FONTANA 5334 in Zaire: Panzi Kivu lectus (BR). — Paratypi: Eiusdem loci no. 5465, 5483 Martio mense lecti.

Chemical characters indicated by the collector: Guaiak on stipe — rapidly blue; guaiacol on stipe — rapidly blue-green; phenol on stipe dark purple.  $\text{FeSO}_4$  — negative.  $\alpha$ -Naphthol, slow reaction to pinkish gray. A good illustration of the fungus is conserved at BR.

*Calocybe coniceps* SING. sp. n.

Pileo pallescente centro isabellino-fuscidulo, in siccis 10 D 2 ((Maerz & Paul) centroque "bamboo" (M & P), glabro, sed sub lente subtiliter radiatim innate fibrilloso-striato et hyalino-sericello, nudo, levi vel ruditer plicato ad marginem, convexo, papillato,  $13-15$  mm lato. — Lamellis albidis, in siccis subargillaceo-brunnescentibus, latis, ventricosis, mediocriter confertis vel subconfertis, adnexis. — Stipite: sordide pallido, glabro, sed ad apicem farinoso-pruinatulo, solido, aequali,  $20-21 \times 2$  mm; velo nullo. — Carne tenui, pallido. — Sporis  $6.5-8.5 \times 4.5-5.8 \mu$ , ellispoideis, levibus, hyalinis, inamyloideis. — Hymenio: Basidiis  $21-35 \times 6.8-8 \mu$ , utrififormibus vel clavatis, tetrasporis, hyalinis, granulis magnis pro ratione repletis. Cystidiis nullis. Cheilocystidiis sparsis,  $28-30 \times 7.5-9.5 \mu$ , tenuitunicatis, hyalinis, utrififormibus vel ampullaceis (apice  $6 \mu$  latis). — Hyphis fibulatis, inamyloides. Tramate hymenophorali regulari, haud gelatinoso, flavido-hyalino, vel hyalino, ex hyphis usquead  $27 \mu$  latis subparallelis, iodi ope intus aurantiaco-luteis efformato. —

Epicute pilei ex hyphis haud parallelis sed applicatis stratum sericellum formantibus efformata; hypodermio cutiformi in ammoniaco flavo, hyphis  $\pm 3 \mu$  latis.

Ad terram particulis carbonicis intermixtam. Typus a K. DUMONT et al. in Venezuela lectus, no. VE 6205, D. F.: Parque Nacional El Avila, 27. VII. 1972 (NY).

This species may be identical with *Gymnopus coniceps* Murr. *Lloydia* 5: 138. 1942.

*Calocybe atropapillata* SING. sp. n.

Pileo ad marginem ceasio ("cadet" vel "poilu" M & P) in vegetis sed in siccis centro fuligineo concolori, papillato (papilla prominente subacuta), ad marginem sulcato sed in siccis levi, subnitente, glabro, convexo, dein applanato sed papilla persistente, 13—18 mm lato. — Lamellis albis, dein carneo-albidis, mediocriter distantibus, spatiis interlamellaribus pileo concoloribus intermissis, mediocriter latis vel sat latis, angustato-subdecurrentibus. — Stipite fuligineo, glabro, subaequali vel aequali, 12—14 × 1—2 mm; mycelio basali radiato-fibrosos, bene evoluto, sordide pallido vel cupreo. — Carne tenui; odore nullo. — Sporis (paucis visis) 2.5—3.5 × 1.8—2  $\mu$ , ellipsoideis, levibus, hyalinis, inamyloideis. — Hymenio: Basidiis 13—17 × 3.5  $\mu$ , granulatione siderophila impletis, Cystidiis nullis visis. Cheilocystidiis 12—16 × 3—4  $\mu$ , inconspicuis, ad aciem haud heteromorpham sparsis, versiformibus, frequanter ampullaceo-rostratis vel subcapitatis (capitul 3  $\mu$  diam.). — Hyphis in tramate pilei hyalinis, saepe crassiuscule tunicatis (pariete 0.5—1  $\mu$ ), haud gelatinosis sed frequenter flexuosis, fibulatis, inamyloideis. — Epicute pilei ab hypodermio vix differente, cute e pigmento intracellulari dissoluto ochreo-grisello, hyphis omnibus levibus, parietibus tenuibus vel firmiusculis, haud gelatinosis.

Ad caules herbaceos ad marginem silvae tropicalis amazonicae. Typus a R. SINGER (B 7284) in Aequatoria: Napo, Lago Agrio 8. V. 1973 lectus et in F conservatus.

*Calyptella* QUÉL.

The numerous species belonging in this genus have not been monographed and few have been sufficiently studied to be included in the key. The following key takes into consideration only species studied by the present author. Keys by BOURDOT & GALZIN (reprint Lehre 1968), W. B. COOKE (Beih. Sydowia IV, 1961) should also be taken into consideration, but the generic position of the cyphellaceous fungi treated in these works is often uncertain. Compare also papers by REID (Kew Bull. 15: 261, 1961) and TALBOT (Bothalia 6: 480, 1956).

1. Subgenus *Calypptella*

- A. On living moss thallus; spores  $5.2-6 \times 3.5-5 \mu$ ; Carpophore whitish. *C. epibrya* SING.
- A. On Pteridophyta and phanerogamic plants.
- B. On Pteridophyta; spores  $6-7 \times 3-3.5-(4) \mu$ ; carpophores white, tending to cinerous when dried. Neotropics. *C. pteridophytorum* SING.
- B. On flowering plants.
- C. Carpophores white.
- D. Spores cylindric,  $9.5-12 \times 3.5-3.75 \mu$ . Neotropics. *C. cylindrospora* REID
- D. Spores different.
- E. On Monocotyledones: Palmae or Musaceae.
- F. On palm debris and dead fronds etc.; spores  $6-7 \times 3.5-4 \mu$ . Neotropical. Cf. *C. mauritiae*  
Cf. *C. mauritiae* (PAT. & GAILL.) SING.
- F. On grasses and herbaceous stems or on leaves and twigs of Monocotyledones (see "G" below and cf. "K" below).
- E. On Dicotyledones.
- G. Spores  $5-6 \mu$  broad. *C. capula* (HOLMSK. ex FR.) QUÉL. sensu DONK
- G. Spores narrower: Probably several species often determined as *C. capula* (sensu BOURDOT & GALZIN, REID, and, if spores only  $2.5-4 \mu$  broad. *C. gibbosa* (LÉV.) QUÉL.
- G. Carpophores distinctly pigmented when quite fresh.
- H. Carpophores yellow; on dicotyledonous plants.
- I. Spores  $8-12.5 \times 3.5-4.5 \mu$ . *C. flava* SING.
- I. Spores broader ( $7-9.5 \times 4-6 \mu$  according to W. B. Cooke). cf. *C. campanula* (NEES ex PERS.) W. B. COOKE (sensu COOKE)
- H. Carpophores light yellow or purplish, drying darker or pallescent, on monocotyledonous plants.
- K. Pale purple; spores  $5.5-8.6 \times 3.1-3.5 \mu$ . *C. musaecola* (BERK. & CURT.) SING.
- K. Pale yellow; spores  $7.5-9 \times 4-4.5 \mu$ . *C. musae* (JUNGH.) W. B. COOKE sensu PILÁT, DENNIS

Descriptive notes and transfers

*Calypptella flava* SING. sp. n.

Carpophoris elongate campanulatis pseudostipitatis pendulis, interdum nutantibus, subglabris, sed superficie externa cupulae sub lente pruinata et pseudostipitis nonnihil pubescente, laete flavis, siccis flavis, usque ad 5 mm altis; superficie hymeniali levi, concava,

flava; pseudostipite centrali, longitudine alturam cupulae adaequante vel paullum longiore, tenui ( $\pm 1$  mm diam in adultis), insititio vel subinsitio (i. e. saepe fibrillis minutissimis hyalinis radiatis brevissimis substrato appressis circumdato); tramate tenuissimo, flavida, inodora. — Sporis 8—12.5  $\times$  3.5—4.5  $\mu$ , oblongis vel cylindraceutis, hyalinis, levibus, inamyloideis. — Hymenio: Basidiis 25—27  $\times$  6.5—9.5  $\mu$ , tetrasporis; basidiolis plerumque vel ut minimum multis fusoideis. Cystidiis nullis. — Hyphis tramatis monimitici hyalinoflavidis pigmento intraparietali praeditis, pigmento granulati intracellulari vix manifesto praesente, fibulatis, inamyloideis, in cupula radiatim ascendentibus, in pseudostipite parallelis, 2—8  $\mu$  latis. — Tegumentis: Epicute cupulae tenuiter at manifeste structura Ramealium gaudente, diverticulis obtusis hyalinis hyphis composita, ad marginem cupulae cellulis terminalibus frequenter cystidiformibus, in medio inferiore integris et plus minusve 3  $\mu$  latis, in parte superiore ramoso-diverticulatis, plus minusve 15  $\mu$  altis, hyalinis. Tegumento pseudostipitis structura Ramealium haud manifesta, pilis hyphalibus plus minusve nodoso-diverticulatis filiformibus 9—90  $\times$  2.5—4.5  $\mu$ , dermatocystidiis ampullaceis, 4.5—8.5  $\mu$  latis, omnibus hyalinis et tenuitunicatis, erectis, numerosis.

Ad caules foliaque herbarum (*Digitalis*) dense gregario vel subcaespitose crescentes. Typus in Argentina: Jujuy, Lagunas de Yala a R. SINGER 9. II. 1965 lectus et in F conservatus.

This species differs from *C. campanula* (NEES ex PERS.) COOKE sensu COOKE in narrower spores. It differs from *C. musae* (JUNGH.) W. B. COOKE sensu PILÁT (1955) in longer spores and deeper and more persistently yellow carpophores and in the host (Dicotyledones instead of Monocotyledones).

## 2. Subgenus *Syncyphella*

- A. Fructifications as high as they are wide; generally 0.05 to 0.4 mm broad; in a mine in Chile. *C. spec.* (SGO)
- A. Fructifications larger and especially longer; on frondose woods in parks, Argentina. *C. bonaerensis* SING.  
[Compare also *Glabrocyphella ailanthis* W. B. COOKE which is small as *C. spec.* but occurs on bark of *Ailanthus altissimus* in New Jersey U. S. A.].

## *Camarophyllus* KUMMER

### 1. Sect. *Viscidi*

- A. Pileus fresh viscid; epicutis gelatinized: Series *Viscidi* HESL. & SM. [If spores smaller than 5  $\mu$ , see "S" below].
- B. Pileus pale or dark (olive-)brown; lamellae white or pallid. *C. recurvatus* (PECK) MURR.

- B. Differently colored.
- C. Pileus reddish brown or buff; lamellae at first "avellaneous" to "vinaceous buff" or "cartridge buff" to "pale pinkish buff" (Ridgway).
- D. Pileus "walnut brown" to "cinnamon brown" (Ridgw.).  
*C. colemannianus* (BLOX. ex FR.) RICKEN ss. HESL. & SM.
- D. Pileus "warm buff", fading "pinkish buff" (R.).  
 cf. *Hygrophorus burgdorfensis* HESL. & SM.
- C. Differently colored; lamellae more or less drab or gray colored, often pallescent.
- E. Taste bitter to subnauseous, finally somewhat acrid.
- F. Spores  $6-8.5 \times 4-6 \mu$ . *C. subviolaceus* (PECK) SING.
- F. Spores  $5-6 \times 4-5.5 \mu$ . *C. pallidus* (PECK) MURR.
- E. Taste mild or submild.
- G. Spores  $7-11 \times 4.5-5.5 \mu$   
 cf. *Hygrophorus nordmanensis* HESL. & SM.
- G. Spores  $5-6.5 \times 4-5.5 \mu$ .  
 cf. *Hygrophorus rainierensis* HESL. & SM.
- A. Pileus not distinctly viscid; epicutis not or scarcely gelatinized.
- H. Pileus und lamellae light purple drab; spores  $7-8.5 \times 4.5-5.5 \mu$ .  
*C. cinereus* (FR.) KARST.
- H. Differently colored or spores smaller.
- I. Spores longer than  $6 \mu$ .
- J. Temperate species of Europe
- K. Pileus with fuscous central dot or region; spores  $7-11 \times 4.5-6 \mu$ .  
*C. fuscescens* (BRES.) MOSER
- K. Pileus tawny brown, sometimes with a slight pinkish hue, gradually paler toward margin; spores  $8.5-9.5 \times 5-6.6 \mu$ .  
*C. subradiatus* (SCHUM. ex FR.)  
 WÜNSCHE
- J. Extra-European species.
- L. Temperate species from Patagonia; spores  $5-7.5 \times 4.8-6.8 \mu$ .  
*C. tehuelches* (SPEG.) SING.  
 [Species from New Zealand and North America, if spores than  $9 \mu$  long, see "N" below; if spores  $9-11 \times 5-6 \mu$ , see section Camaraophyllus (sect. 3, below].
- L. Tropical species. [If spores more than  $4.5 \mu$  broad cf. sect. 3].
- M. Taste acidulous and eventually somewhat acrid; stipe concolorous with the pileus (dark brown with violet reflexes) or slightly paler; spores  $6-8 \times 3.2-4 \mu$ . Palaeotropic species.  
*C. grinlingii* SING.

M. Taste mild; stipe pure white; spores  $6.2-7 \times 3.5-4.5 \mu$ . Neotropical species.

*C. hieronymi* SING.

I. Spores up to  $6.5 \mu$  long, or shorter.

N. Temperate species.

O. Lamellae gray; spores  $4-6.3 \times 4-4.8 \mu$ .

*C. canescens* (SM. & HESL.) SING.

O. Lamellae white or whitish at first or spores longer.

P. Lamellae broad; spores to  $4.5 \mu$ .

cf. *C. obconicus* (PECK) MURR.

P. Lamellae narrow; spores longer.

Q. Pileus grayish brown.

*C. albipes* (PECK) MURR.

Q. Pileus vinaceous buff, fading to a chalky white, or drab-gray.

R. Northern Hemisphere.

cf. *Hygrophorus silvaticus* HESL. & SM.

R. Southern Hemisphere. cf. *C. canus* HORAK

N. Tropical species. Mediostratum differentiated from lateral stratum.

S. Pileus about 50 mm broad; spores  $4.5-5.5 \times 4.5-4.7 \mu$ .

*C. umbrinus* (DENNIS) SING.

S. Pileus 6-8 mm broad; spores  $3.5-4 \times 3-3.2 \mu$ .

*C. paraiuboensis* SING.

## 2. Section *Virginei*

A. Species which turn glaucous in age or are pinkish when quite fresh

B. Species of the Northern hemisphere.

C. Lamellae white, turning pinkish orange when cut; stipe 4 mm broad. cf. *Hygrophorus borealis* f. *salmoneus* COKER

C. Lamellae "Maize color" M & P. or paler yellow; stipe 8-12 mm broad; epicutis — a trichodermium.

*C. cremicolor* (MURR.) MURR.

B. Species of the Southern Hemisphere.

D. Pileus umbonate, whitish turning blueish-greenish; spores  $5-6 \times 3.5-4.5 \mu$ .

*C. patinaecolor* HORAK

D. Pileus obtuse, salmon pink when fresh; spores  $6.8-8 \times 4.5-5.5 \mu$ .

*C. muritaensis* (STEVENSON) HORAK

A. Species without glaucous or pink tinges (sometimes pinkish red in parts from the action of a parasite).

E. Spores large:  $10-14 \times 7-9 \mu$ ; pileus dry.

*C. niveicolor* (MURR.) MURR.

E. Spores smaller unless basidia 2-spored and then with strong odor.

F. Odor strong of cedar wood or of Russian leather.



- G. Pileus, lamellae and stipe white; under conifers in Western North America. cf. *Hygrophorus lawrencei* HESLER & SM.
- G. Pileus cream whitish, ivory, or tending to ochre-grayish; on the earth in pastures and under shrubs in Europe; the bisporous form with spores  $10-13 \times 5.5-8 \mu$ .  
*C. russocoriaceus* (BERK. & BR.) LANGE
- F. Odor weak and not characteristic or none.
- H. Temperate species.
- I. Epicutis slightly to strongly gelatinized; pileus viscidulous to glutinous when wet.  
*C. niveus* (SCOP. ex FR.) KARST.  
[This is a complex containing moist-viscidulous forms and glutinous forms, forms with consistently 2-spored basidia and spores  $10-12 \times 5-6 \mu$ , consistently 4-spored forms with spores  $6-9 \times 3.5-5 \mu$ , and "mixed" forms with both 2- and 4-spored basidia. *C. borealis* (PECK) MURR. belongs to this group but all transitions between typical *C. niveus* and typical *C. borealis* can be found both in North America and in Europe and Asia. This complex needs further study; if there is a tendency to yellowish especially in the marginal zone of the pileus and spores  $8-10 \times 5.5 \mu$  with 4-spored basidia cf. "J" below].
- I. Epicutis not at all gelatinized; pileus not viscid, but often hygrophanous.
- J. Lamellae in the young and fresh specimens milk-white to cream colored; spores  $8-10 \times 5.5 \mu$  or  $6-8 \times 4-6 \mu$ .
- K. Spores  $6-8 \times 4-6 \mu$ ; lamellae subclose; pileus not or scarcely striate, not hygrophanous; among grasses.  
cf. *H. berkeleyi* ORTON
- K. Spores larger; lamellae distant; under *Picea* and *Abies* in North America, with conspicuously striate cap. *Hygrophorus berkeleyi* ORTON sensu HESLER & SMITH (vix ORTON)  
[Cf. note under *C. niveus* above; while ORTON's species is the same as *H. pratensis* var. *pallidus* COOKE and possibly belongs in section 3, HESLER & SMITH's fungus belongs in the *C. niveus* complex.].
- J. Lamellae when fresh and young white, later often somewhat yellowish; spores  $8-12 \times 5-7 \mu$  or

4.5—6.5 × 3.5—4.5 μ [if 6—8.5 × 4.2—5.5 μ see sect. 3].

L. Spores 8—12 × 5—7 μ *C. virgineus* (WULF. in JACQ. ex FR.) KUMMER (sensu SM. & HESL.)

L. Spores 4.5—6.5 × 3.5—4.5 μ.

*C. angustifolius* MURR.

H. Tropical species; pileus 0.5—1.5 mm broad, dry; spores 7—9 × 6—7 μ (*Hygrophorus buccinulus* (SPEG.) DENNIS ss. DENNIS =) *C. buccinulus* SING.

### 3. Section *Camarophyllus*

- A. Fresh lamellae “fawn color” to “wood brown” (Ridgway); spores 8—10 × 4—5.5 μ. North American species in cedar swamps and bogs. cf. *Hygrophorus uliginosus* HESL. & SM.
- A. Fresh lamellae white or some other color; spores as above or different.
- B. Spores 9—11 × 5—6 μ. American species, in deciduous woods. cf. *Hygrophorus fumosellus* SM. & HESL.
- B. Spores smaller, or not occurring in America (and then carpophores extremely small).
- C. Lamellae yellowish, ochraceous, pinkish cinnamon, salmon buff, not white or pallid when fresh.
- D. Pileus straw white to warm buff, light buff; spores 7.5—9.5 × 4.2—6 μ. Temperate and tropical South America and West Indies, south to temperate South America. *C. cremeus* (MURR.) SING.
- D. Either pileus more deeply or more orangy or brownish colored or spores smaller.
- E. Pileus very pale or pallid at times, never deeply colored; ethylchlorostannate turns context beautifully rose color. European species with spores ± 5—7 × 4—5.5 μ. cf. *Hygrophorus virgineus* ss. BAT. non al. (cf. *C. berkeleyi* ORTON)
- E. If pileus remarkably pale — different reaction with ethyl-chlorostannate or spores considerably larger, or American species.
- F. Spores 3.5—4.5 μ broad. American species (see sect. 1).
- F. Spores broader.
- G. Pileus remarkably pale (see sect. 2, but compare “J” below).
- G. Pileus well colored (pinkish cinnamon, buff-orange, etc.).
- H. Odor aromatic. cf. *Hygrophorus graveolens* SM. & HESLER

H. Odor weak and not aromatic, or none.

I. Pileus 20—60—(100) mm.

*C. pratensis* (FR.) KUMMER

I. Minute carpophores growing under dwarf-shrubs in the alpine zone; entire carpophore apricot ocher to egg yellow; spores 7—11 × 4—5.5  $\mu$ .

*C. alpinus* MOSER ined.

C. Lamellae white or pallid.

J. Pileus pallid to avellaneous-isabelline or light cinnamon, often only in the center pigmented, convex to appanate or turbinate, 30—42 mm broad. Subtropical to temperate species (Florida to Patagonia). *C. fulvosiformis* MURR.

J. Pileus avellaneous, or bright ferruginous, 17—30 mm broad, umbilicate or umbonate. Tropical species. [If temperate cf. also sect. 1].

K. Pileus avellaneous; spores 6—8 × 5—5.5  $\mu$ .

cf. *Hygrophorus bakeri* DENNIS

K. Pileus bright orange-ferruginous; spores 4.5—5.5—(6.2) × 3.5—4.5—(5)  $\mu$ .

*C. ferrugineoalba* (SING.) SING.

#### 4. Section *Adonidi*

A. Base of stipe yellow.

B. Lamellae gray or gray-violet. Europe *C. lacmus* (FR.) LANGE

B. Lamellae white, ivory, or violet. Extra-European species.

C. Pileus pale ecru drab, then paler, grayish; spores 5—7 × 4—5  $\mu$ . North American species.

cf. *Hygrophorus pseudopallidus* HESLER & SM.

C. Pileus more fuscous or more violet; spores larger, or narrower.

D. Pileus violet (55 A 11 or "Bishop's violet" MAERZ & PAUL), dried similarly colored; spores 7.5—9 × 5.5—6.8  $\mu$ .  
Tierra del Fuego. *C. adonis* SING.

D. Pileus dark fuscous brown with violet reflexes on yellowish ground; spores 6—7.5 × 3—4  $\mu$ . Tropical African species (see "E" below).

A. Base of stipe not yellow.

E. Pileus young and fresh "casserole" to "Piccadilly", lamellae 44 F 2 to 46 G 2 (MAERZ & PAUL); spores in four-spored form 7.5—9.5 × 4.1—5.8  $\mu$ , in two-spored form 8—11 × 4.8—6.8  $\mu$ . In tundra-like pastures in Tierra del Fuego.

*C. laccarioides* SING.

E. Colors different; spores much smaller, see section 1.

### 5. Section *Aeruginospora*

- A. Spores  $5.2-6.2 \times 3.8-5.2 \mu$ ; carpophore with rose or flesh color hues and tending to greenish especially in the lamellae. Tropical Asiatic species. *C. singularis* (HÖHN.) SING.
- A. Spores  $8-11.5 \times 4-5.5 \mu$ ; carpophore without pinkish or greenish tones; basidia often 2-spored. Patagonia. *C. patagonicus* SING.

#### Descriptive notes and transfers

*Camarophyllus grinlingii* SING., Beih. Sydowia 7: 2. 1973 (there a full description).

*Camarophyllus hieronymi* SING. spec. nov.

Pileo atrogriseo in vegetis, grisello-fusco vel fusco in siccis, marginem versus interdum plus minusve innate radiatim fibrilloso et rarius subrugoso, haud viscoso, nudo et glabro, in speciminibus juvenilibus levi vel sublevi nec striato sed margine pileorum tenuiorum pellucide striatulo maturitate. immo per pauca millimetra sulcolato, integro sed centro demum fisso-rupto nec non perforato, convexo et manifeste umbonato sed umbone demum frequenter evanescente, 15—55 mm lato. — Lamellis griseis, subconfertis vel subdistantibus, moderatim latis vel latis, rarius nonnullis furcatis, in speciminibus adultis intervenosis, anguste vel late adnexis, interdum a stipitis apice separatis, — Stipite candido, glabro, levi, sicco, nudo, farcto, dein cavo, apicem versus angustato, 53—80 mm longo, ad apicem 2.5—4 mm lato, ad basin 4—9 mm lato; mycelio basali albo. — Carne alba, immutabili, sapore miti; odore nullo. — Sporis  $6.2-7 \times 3.5-4.5 \mu$ , ellipsoideis, sed interius ad latus saepe applanatis, immo subdepressis, levibus, hyalinis, inamyloideis. — Hymenio: Basidiis  $23-38 \times 5-8.5 \mu$ , plerumque  $30-32 \times 6-7 \mu$ , (2)—4-sporis. Cystidiis et cheilocystidiis nullis, sed ad aciem interdum cystidiolis sparsis inconspicuis clavatis, interdum mucronatis,  $10-25 \times 7.5-10 \mu$  visis. — Hyphis filamentosis vel inflatis (usque ad  $16 \mu$  in tramate pilei), fibulatis, inamyloideis; tramate hymenophorali ex hyphis intertextis (nec non prope subhymenium paullum divergentibus) nec vero bilateralibus, filamentosis ( $2.5-7 \mu$  diam.) in mediostрати zona media magis subparallelis sed ibi vix clare differentiatas nec structura nec colore suis; subhymenio ex elementis exiguis brevissime filamentosis et intertextis, haud gelatinosis, hyalinis efformato. — Epicute pilei cutiformi, hypodermio pallidiore, sat densa, haud gelatinosa; hypodermio in ammoniaco melleo, pigmento intraparietali incrustanteque destituto. Tegumento stipitis subnullo sed hypharum terminationibus raris ascendentibus vel erectis cystidioideis notatis, his  $20-30 \times 4-5 \mu$ , integris, anguste ventricosis vel anguste clavatis, hyalinis, tenuitunicatis. —

Ad humum in umbrosis in silva tropicali-montana gregatim. Typus a R. SINGER B 968 in Bolivia: La Paz, Nor-Yungas, San Gerónimo 7. II. 1956 lectus et in F conservatus.

*Camarophyllus paraiboensis* SING. sp. nov.

Pileo griseo, non viscido, levi, opaco, convexo, frequenter subumbonato, 6—8 mm lato. — Lamellis griseolo-albis, siccis pallide alutaceis, distantibus vel subdistantibus, crassis, adnatis vel adnato-decurrentibus. — Stipite griseo-albo, ad basin albo, subtiliter appresse fibrillosulo ad apicem, solido, 10—15 × 1.5 mm. — Sporis 3.5—4 × 3—3.2  $\mu$ , subglobosis, paucis interdum leniter rotundato-angularibus, hyalinis, tenuitunicatis, inamyloideis, sed perpaucis granulis pseudoamyloideis praevisis. — Hymenio: Basidiis 18—31 × 4.5—5  $\mu$ , clavatis, tetrasporis. Cystidiis et cheilocystidia nullis. — Hyphis defibulatis, inamyloideis, perpaucis granulis sparsis pseudoamyloideis praevisis; tramate hymenophorali regulari sed ex hyphis quamquam axillariter dispositis tamen fortiter intertextis, filamentosis efformato, in mediostrato pallide fuscidulo, in strato laterali hyalino. — Epicute cutiformi tenuissimaque ex hyphis plerumque tenuissimis semperque filamentosis, haud vel vix gelatinosis efformata, hyalina; hypodermio ab epicute vix differente pigmento brunneo haud incrustante excepto.

Ad terram in silva tropicali pluviali Brasiliae: Paraibo, typus a SINGER B 3334 11. VII. 1960 prope João Pessôa lectus et in BAFC conservatus.

*Camarophyllus rainierensis* (HESLER & SMITH) SING. comb. nov.

*Hygrophorus rainierensis* HESLER & SMITH, North Amer. Spec. of Hygrophorus p. 64. 1963.

*Campanella* HENN.

Nearly all species of *Campanella* as far as they are fully known, can be determined using my Monograph "The Neotropical species of *Campanella* and *Aphyllotus* . . .", Nova Hedwigia 26: 847—896. 1975, and the data on *Campanella* in SINGER, Mycoflora Australis Beih. Nov. Hedwigia 29: 85—87. 1969. Compare also SINGER, Lloydia 8: 170—230. 1945 and 13: 249—258. 1950. There seems to be no need to combine these data now, but for North American species, a paper by S. A. REDHEAD, Mycologia 66: 183—187. 1974 should also be taken into consideration.

*Cantharellula* SING.

A. Pileus more or less gray, umbonate or papillate, among mosses (often *Polytrichum*); North-temperate species.

*C. umbonata* (GMEL. ex FR.) SING.

- A. Pileus differently colored or neither umbonate nor papillate, often on naked earth or with Gramineae (e. gr. *Chusquea*); species of the temperate zone of the Southern hemisphere.
- B. Hyphae of the cuticle of the pileus not incrustated by pigment.  
Patagonia. *C. infundibuliformis* SING.
- B. Hyphae of the cuticle of the pileus incrustated by brown pigment.  
cf. *C. waiporiensis* (STEVENSON) HORAK

(to be continued)

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