

THE GENUS *CREPIDOTUS* (FR.) STAUDE IN EUROPE

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The genus *Crepidotus* in Europe is considered. After an examination of 550 collections seventeen species and eight varieties are recognized. Two keys are supplied; all taxa accepted are typified.

Morphological, ecological and chorological characters are critically evaluated. Descriptive statistics are used for basidiospore size. An infrageneric classification is proposed based on phenetic relationships using different cluster methods. The new combinations *C. calolepis* var. *squamulosus* and *C. cesatii* var. *subsphaerosporus* are introduced. The spore ornamentation as seen in the scanning electron microscope provides the best character for species delimitation and classification.

## INTRODUCTION

Fries (1821: 272) established *Agaricus* series *Derminus* tribus *Crepidotus* for more or less pleurotoid species with ferruginous or pale argillaceous spores and an ephemeral, fibrillose veil (!). His fourteen species include such taxa as *Paxillus atrotomentosus*, *Lentinellus vulpinus*, *Panellus violaceo-fulvus* and *Entoloma depluens* which nowadays are placed in quite different genera and families. Only three of Fries' species belong to the genus *Crepidotus* as conceived now. This demonstrates the importance of microscopic characters, neglected by Fries, for the circumscription of species and genera.

Staudé (1857) raised the tribus *Crepidotus* to generic rank with *C. mollis* as the sole species. Hesler & Smith (1965) dealt with the history of the genus *Crepidotus* in more detail.

In recent years several regional floras have been published, e.g. Ortega & Buendia (1989) for Spain, Watling & Gregory (1989) for the British Isles and Norstein (1990) for Norway. None of these includes critical revisions of type collections.

Pilát (1948) provided the first European monograph. Since then six new species have been described and new techniques and methods have been developed, e.g. the study of ultrastructures and numerical taxonomy, which allow a critical reassessment of the taxonomy in this genus.

## ACKNOWLEDGMENTS

I owe my best thanks to Kees Bas for many discussions and to Marijke Nauta and Leo Jalink for their kind hospitality during my stays in Leiden. I thank Thomas Kuyper (Wijster) for his comments on nomenclature, Irene Bisang (Zürich) and Stein Norstein (Oslo) for helpful discussions, Lucia Wick (Bern) for preparing the SEM-pictures, Norbert Arnold (Regensburg) for chemical tests, Margrit Kummer for inking of text-figures, and the directors and curators of the various herbaria for loans, as well as all persons who provided me with fresh or dried material. Also I would like to express my appreciation to my husband, Roland, for help in writing several computer programs.

## A. GENERAL PART

## 1. MATERIAL AND METHODS

The microscopic structures were mainly observed in dried material. Fragments of lamellae were mounted in Congo red, heated and examined in 5% KOH. The structure of the pileipellis was examined in 10% ammonia or 5% KOH. The ornamentation and the colour of the spores were studied in 5% KOH.

The spore sizes are given with an approximation of 0.5  $\mu\text{m}$ ; they are based on 20 spores measurements per collection. Spores measured were taken from the surface of the pileus. Q is the length-width ratio of spores.

For basidia and cystidia the arithmetic mean of the smallest and the largest object per collection, with 10 measurements in each case, is given. Unusually extreme sizes are added in parentheses. The bar equals 1  $\mu\text{m}$  in the SEM pictures, 10  $\mu\text{m}$  in the drawings of microscopic characters, and 1 cm in the drawings of fruit-bodies.

Colours are compared with Munsell Soil Colour Charts (abbreviated M) and named with Ridgway (1912) or with Kornerup & Wanscher (1978, abbreviated K & W).

The SEM investigations were carried out with a JEOL JSM-T 300 using accelerating voltages between 10 and 15 kV. Air-dried spores were coated with gold for 3 minutes. The nuclei were observed using DAPI staining and fluorescence or by staining with aceto-carminic acid.

Material from the following herbaria has been investigated: B, BERN, BRNM, C, G, GDAC, IB, K, L, LAU, M, NMLU, NY, SOM, SZU, TAA, UPS, W, WAG-W, WU (abbreviations in accordance with Index Herbariorum), La Laguna (Tenerife), Lugano and from private herbaria: F. Bellu, M. Bon, E. Chételat, H. Engel, H. Hallgrímsson, M. Jossierand, N. Luschka, J. Mornand, J. Prongué, A.F.M. Reijnders, A. Runge, J.A. Schmitt, F. Tjallingii, W. Winterhoff.

The nomenclature of mentioned vascular plants follows Ehrendorfer (1973). Pieces of wood were determined with Schweingruber (1978).

Collections marked with an asterisk (\*) in the list of collections examined are those in which the number of nuclei in mature spores has been counted (see 2.6).

## 2. NOTES ON CHARACTERS

## 2.1. Shape of fruit-body — Fig. 1

The fruit-bodies of all European *Crepidotus* species are pleurotoid, i. e. when seen from above, semicircular, rounded flabelliform, reniform, more rarely spathuliform, when seen from the side plano-convex, appanate, convex, more rarely campanulate. They are dorsally or laterally, more rarely centrally attached to the substratum. Fully developed, they reach 10–30 (100) mm across.

Some species have characteristic shapes: 1) younger fruit-bodies are often unguiculate in the *C. cesatii* aggr. and in *C. luteolus*; 2) old fruit-bodies are often crenate at the margin and furrowed in *C. variabilis* and *C. lundellii*; 3) convex caps with a low umbo are typical for *C. mollis*; 4) caps are mostly spathuliform to flabelliform in the terrestrial *C. autochthonus* and occasionally in large fruit-bodies of *C. applanatus* on logs.

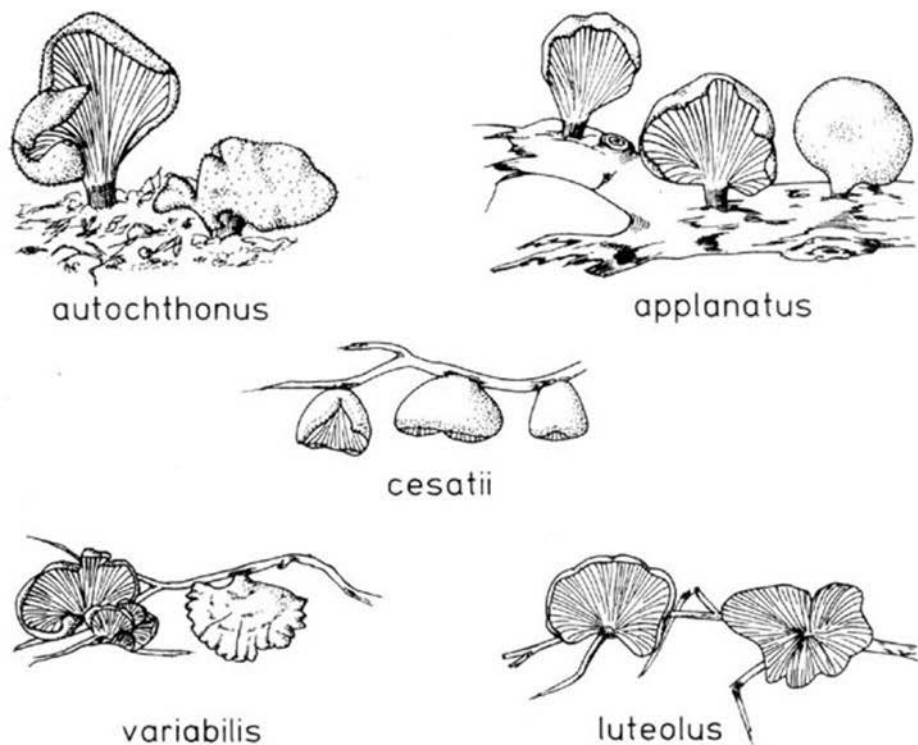


Fig. 1. Fruit-body shapes.

The pileus surface of all species with the exception of the *C. mollis*-group is tomentose to felted. The degree in which this characteristic surface texture expresses itself may vary according to age, weather conditions and probably type of habitat. While the central part of the pileus surface becomes adpressed-felted to almost smooth, the pileus margin often remains distinctly tomentose. Scales that can be observed macroscopically are to be found in *C. crocophyllus* and *C. calolepis*.

## 2.2. Lamellae

The shape and the spacing of the lamellae is rather uniform: subventricose, more rarely ventricose, or arcuate, usually crowded, distant only in *Crepidotus cesatii*. The young lamellae in all species observed were decurrent at first. Only after expansion of the cap they become adnexed or almost free. In most species the lamellae are white to very pallid at first, turning ochraceous-tawny, cinnamon, sayal-brown or snuff-brown with age, with pinkish tinges mainly in *C. cesatii* and occasionally in *C. variabilis* and *C. epibryus*. Aberrant are *C. roseornatus* and *C. cinnabarinus* with orange-pink or salmon-red, *C. crocophyllus* and *C. ehrendorferi* with pale orange to cinnamon, and *C. sambuci* sensu Orton with yellow lamellae; in *C. luteolus* they are only very pale yellowish.

In all species the edge of the lamellae is finely fimbriate, floccose only in very young stages, becoming even. In *Crepidotus cinnabarinus* it is strikingly red because of the presence of cystidia with coloured contents.

### 2.3. Fruit-body development — Figs. 26, 28

In many collections early stages of the fruit-body development are to be seen. They all show the same stipitocarpous development. However, the earliest stages of tissue differentiation have not been observed, therefore an arrangement in Reijnders' classification (1963) must remain tentative. Primordia can be seen as small, hemispherical warts on the surface of the substratum without any extended basal mycelium. Very early centrally stipitate fruit-bodies develop a strongly involute pileus densely covered with erect hyphae (see Figs. 25, 27). Plate no. 321 in Sowerby (1803) illustrates this development stage. No velum was observed. The stipe consists of a densely packed trama with parallel hyphae. At about the height of 1–2 mm the stipe stops growing, the pileus develops excentrically away from the substratum. The stipe is soon hidden by the young lamellae and the fleshy parts of the cap; in mature stages of development it is normally obliterated.

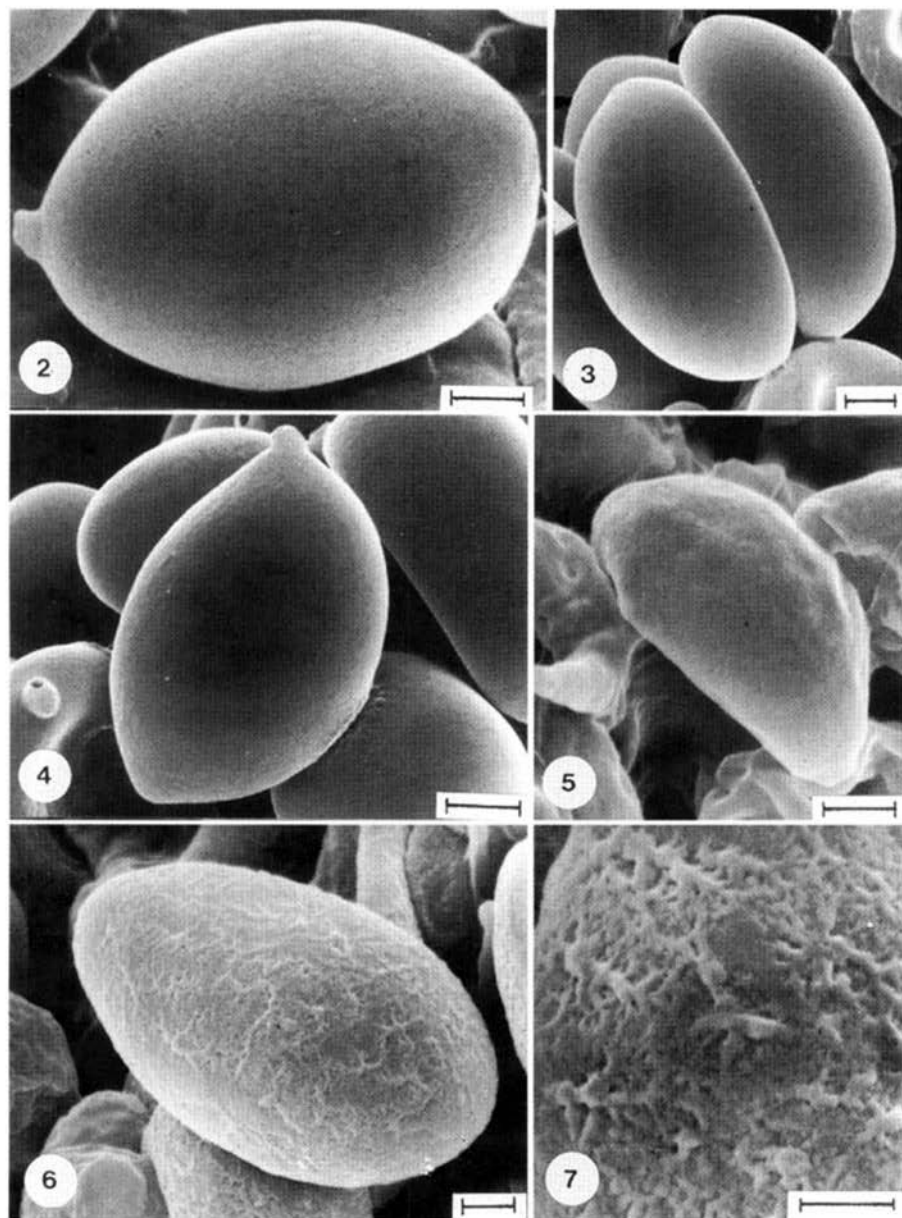
The *Crepidotus mollis*-group and sometimes *C. applanatus* develop short and thick stipes: the stipe grows longer than in the other species, becomes thicker and coalesces with part of the pileus, but remains visible only from below.

### 2.4. Basidiospores — Figs. 2–25

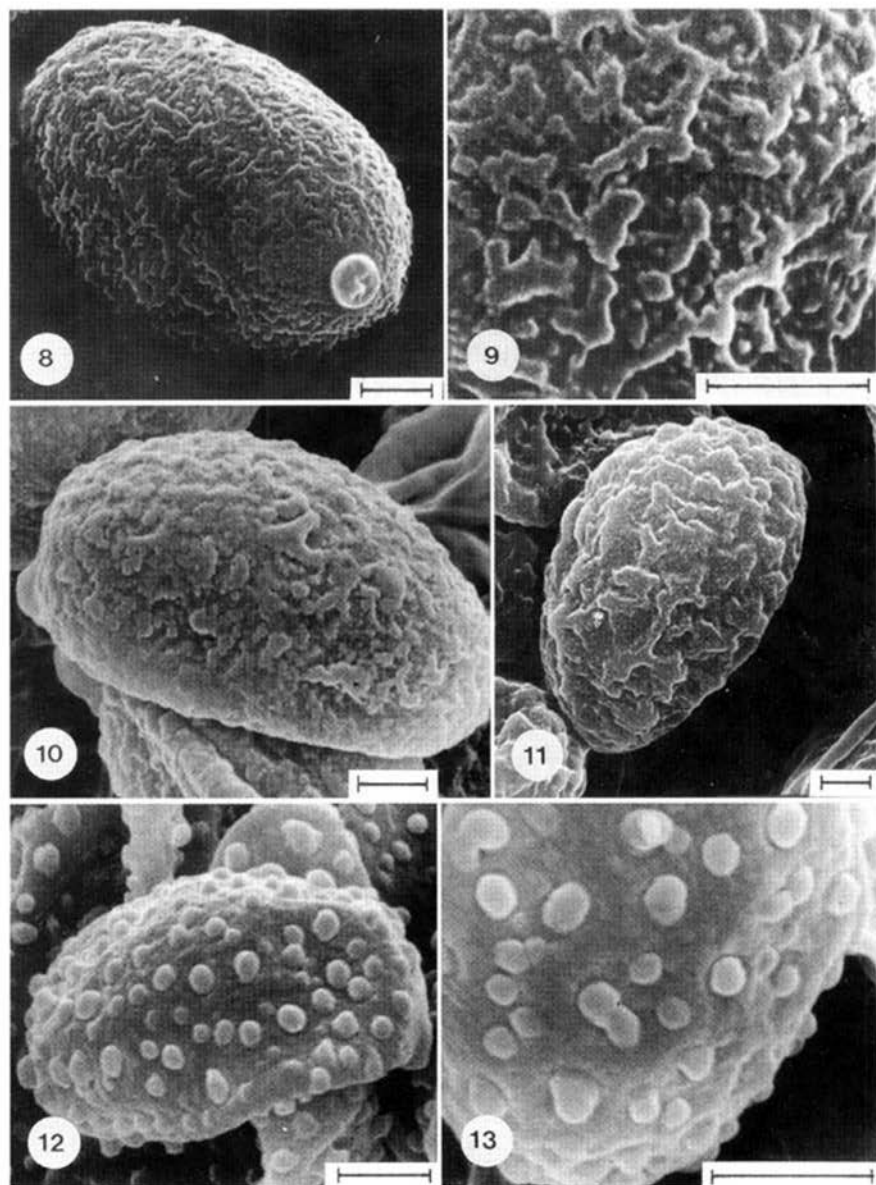
Characters of the spores are taxonomically the most important ones in the genus *Crepidotus*. I agree with Hesler & Smith (1965) that spore shape and ornamentation are of prime importance and that spore size is a diagnostic feature mainly used at species level. Important is also the colour of the spore deposit and of the spore wall under the light microscope. A difficulty in establishing spore deposit colour is that a good spore deposit is not always readily obtained and that the colour changes with age in the herbarium, which hampers a synoptical comparison of various collections at the same time. As differences between many species are modest – but probably very constant – the practical use of this character in identification work is negligible. Under the light microscope three categories may be discerned (Norstein, 1990): spore wall faintly, moderately and strongly coloured.

The colour of the spore print once played an important role at generic level. Patouillard (1887) separated *Crepidotus* with ochraceous to rust-brown spores from the genus *Dochmiopus*, with *C. variabilis* as type, on account of its pink spores. Pilát (1948) rejected this separation on generic level, added the pinkish colour of young lamellae and a verruculose or echinulate spore ornamentation as further characters of *Dochmiopus* reduced to subgeneric rank. Hesler & Smith (1965) finally characterized their enlarged subgenus *Dochmiopus* by the shape of the spores and the presence of clamp-connections. Pinkish or reddish colours do not play a part in their definition of subgenus *Dochmiopus*. Kühner (1980) agrees with the rejection of spore colours as the decisive character for *Dochmiopus*.

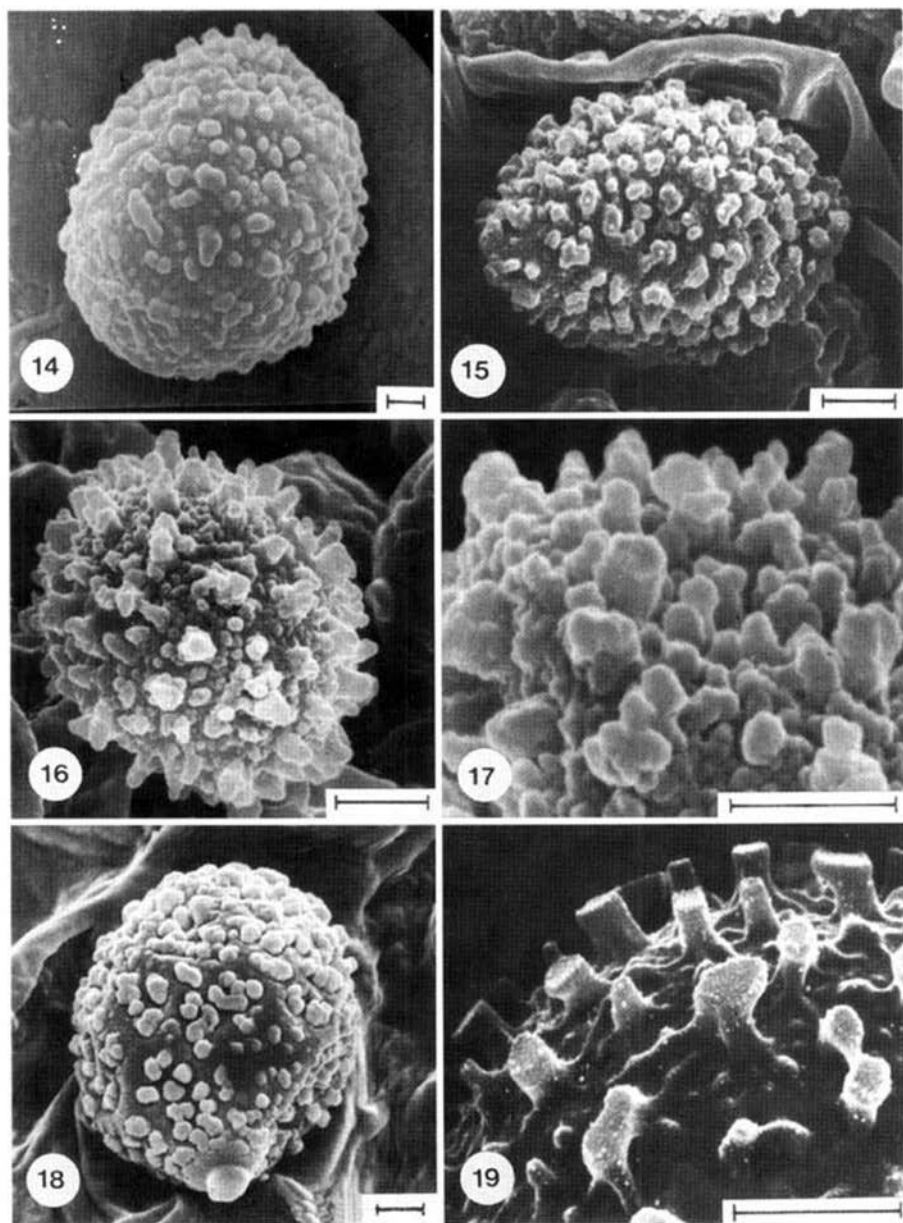
Under the light microscope the spores of several species, especially in section *Dochmiopus* show granular refractive contents, which are missing in subgenus *Crepidotus*, but usually also in *C. autochthonus* and *C. epibryus* belonging to subgenus *Dochmiopus*.



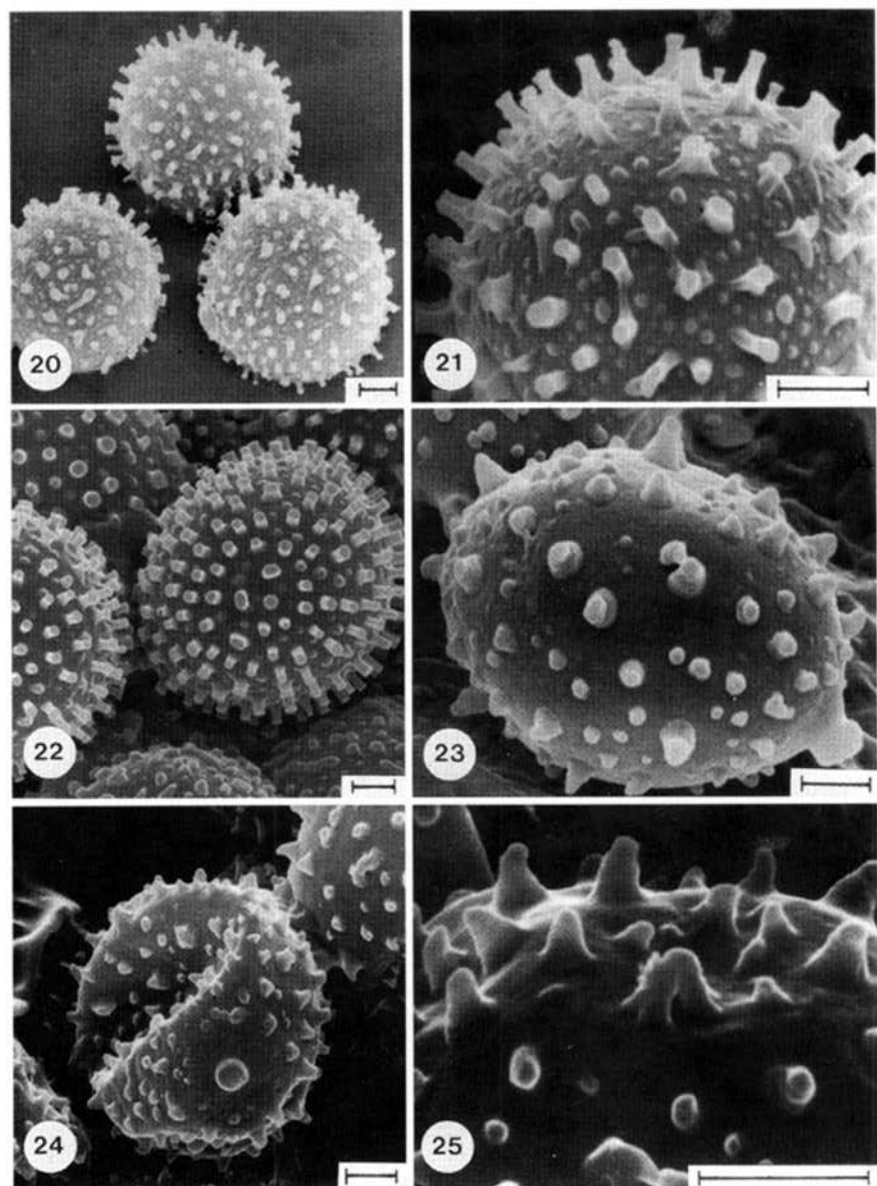
Figs. 2-7. SEM pictures of spores. - 2. *Crepidotus mollis* (coll. 89/135 BERN). - 3. *C. calolepis* var. *squamulosus* (coll. 89/9, BERN). - 4. *C. autochthonus* (coll. 88/485, BERN). - 5. *C. epibryus* (coll. 90/4, BERN). - 6. *C. versutus* (coll. Lugano). - 7. *C. versutus* (detail).



Figs. 8–13. SEM pictures of spores. – 8. *Crepidotus lundellii* (coll. 88/462, BERN). – 9. *C. lundellii* (detail). – 10. *C. luteolus* (coll. 5144, WAG-W). – 11. *C. subverrucisporus* (coll. 13810, G). – 12. *C. variabilis* (coll. ECH 21, BERN). – 13. *C. variabilis* (detail).

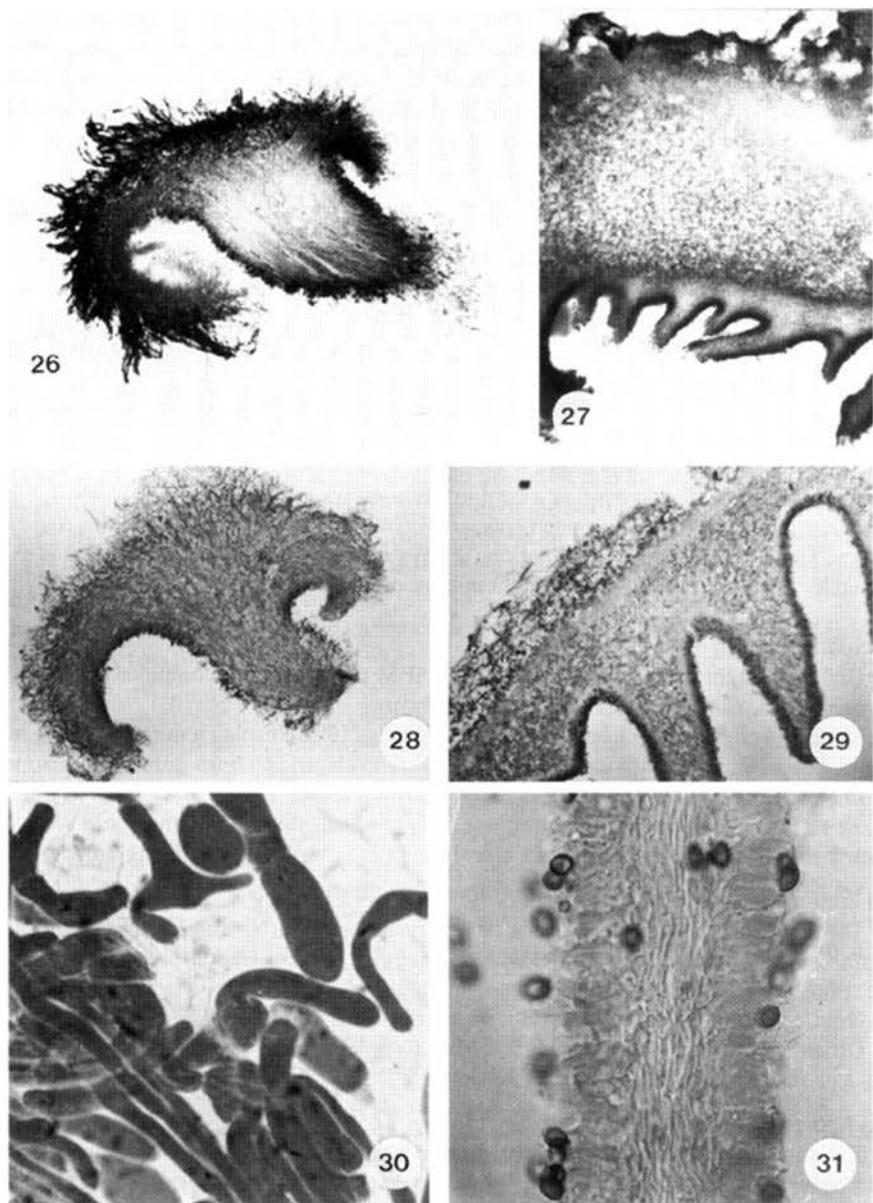


Figs. 14–19. SEM pictures of spores. – 14. *Crepidotus cinnabarinus* (coll. 960.110-176, L). – 15. *C. roseornatus* (type). – 16. *C. carpaticus* (coll. herb. Bon). – 17. *C. carpaticus* (detail). – 18. *C. macedonicus* (coll. ZT 63/230). – 19. *C. applanatus* (coll. 13806, G).



Figs. 20–25. SEM pictures of spores. – 20. *Crepidotus crocophyllus* (coll. 313035, BRNM). – 21. *C. crocophyllus* (detail). – 22. *C. ehrendorferi* (type). – 23. *C. cesatii* var. *subphaerosporus* (coll. 89/240, BERN). – 24. *C. cesatii* var. *cesatii* (coll. IB 76/11). – 25. *C. cesatii* var. *cesatii* (detail).





Figs. 26–31. Anatomical details. – 26. Young fruit-body of *Crepidotus calolepis* (coll. TAA no. 72404); diameter of the pileus: 0.8 mm. – 27. Gelatinous layer in younger fruit-bodies of *C. calolepis* (coll. TAA no. 72404). – 28. Young fruit-body of *C. luteolus* (coll. BERN 89/243). – 29. Pileus of *C. cesatii* var. *cesatii* (coll. BERN 87/274) with distinct subpellis. – 30. Old hymenophoral trama of *C. epibryus* (coll. Lugano 3178). – 31. Lamellae of *C. autochthonus* (coll. Tjallingii).

At the level of SEM analyses, the spore surface reveals the most striking variation of ornamentation types within the agarics. SEM pictures of *Crepidotus* have been published by Pegler & Young (1972), Cléménçon (1977), Strid (1975), Bigelow (1980), Luther & Redhead (1981) and Moreno et al. (1984). All data published by these authors refute Singer's hypothesis (1947) of the heterogeneous spore wall showing immersed short and thin columns (see especially Cléménçon, 1977).

The only published TEM pictures known are of *Crepidotus cesatii* and *C. appianatus* (Pegler & Young, 1972; Cléménçon, 1977). The eusporium, i.e. the inner tegument of the spore wall, is composed of a thick coriotunica; a pure corium is absent. The myxosporium, i.e. the outer layer of the spore wall, is composed of a heterogeneous epitunica, which contributes to the ornamentation of the spores. The spines in *Crepidotus cesatii* are hollow. Cléménçon (1977) discusses the relationships in ultrastructural details between *Crepidotus* and the *Cortinariaceae*. According to this author the arrangement of the spore wall layers resembles *Tubaria* more than *Cortinarius*, but affinities to *Cortinarius* exist, e.g. in the presence of a cerostratum. The most important differences are to be found in the fine layers of the epitunica: hollow spines are unknown in *Cortinarius* and the podostratum, present in *Cortinarius*, is absent in *Crepidotus*.

The ornamentation of European species of *Crepidotus* may be classified in five categories. The height of the ornamentations always measures less than 1  $\mu\text{m}$ , which is at the boundary of perceptibility with the light microscope.

#### (i) Spores smooth

Under the light microscope as well as in SEM the spores are completely smooth: *C. autochthonus*, *C. mollis*, *C. calolepis*, *C. epibryus*.

The SEM pictures published by Pegler & Young (1972) display a minutely warty surface in *C. mollis*. I interpret this as an artefact due to electric charges during pretreatment.

In SEM analyses *C. mollis* and *C. calolepis* often reveal a small apical depression (see arrow in Fig. 2) which may be interpreted as an apical thinning of the spore wall. Yet neither a truncate spore apex nor an apical thinning is visible under the light microscope.

#### (ii) Spores rugulose-verruculose

The spore ornamentation consists of low ridges and warts, which may be confluent, forming at times a rudimentary net with an irregular pattern. Under the light microscope the spore surface is seen as spotted-granulated.

Ornamentation up to 0.5  $\mu\text{m}$ : *C. subverrucisporus*.

Ornamentation 0.2–0.35  $\mu\text{m}$ : *C. luteolus*, *C. lundellii*.

Ornamentation 0.1–0.25  $\mu\text{m}$ : *C. lundellii*.

#### (iii) Spores verruculose

The spore wall forms isolated warts. In type 1 these warts are isolated hemispherical in side view and round when seen from above. In type 2 these warts are irregular in all views, often consisting of 2–3 confluent warts and at times decorated by small outgrowths. Under the light microscope the spores appear punctate; it is therefore not possible to distinguish between these verruculose types and the baculate type of ornamentation.

Ornamentation 0.2–0.4  $\mu\text{m}$ , verruculose, type 1: *C. variabilis*, *C. cinnabarinus*.

Ornamentation 0.2–0.4  $\mu\text{m}$ , verruculose, type 2: *C. carpaticus*, *C. roseornatus*, *C. macedonicus*.

(iv) Spores baculate

The spore wall forms truncate, rod-shaped warts or cylindrical processes which are round as seen from above and which under the light microscope are hardly visible in optical section, otherwise the spores appear punctate with thick spore walls.

Ornamentation 0.3–0.8  $\mu\text{m}$ : *C. applanatus*, *C. crocophyllus*, *C. ehrendorferi*.

(v) Spores echinulate

The ornamentation consists of isolated spines. Under the light microscope these spines are readily seen in optical section. The surface of the spores appears punctate.

Ornamentation 0.3–0.7  $\mu\text{m}$ : *C. cesatii* s.l.

### 2.5. Basidia

All European species exhibit four-spored basidia of the common normal cylindrical type in agarics. In some collections two-spored basidia and four-spored basidia occur together. This always affects the variability of spore size and is interpreted as a result of disturbed fruit-body development (coldness, drought).

In older fruit-bodies basidia with sterigmata are often lacking. It seems that in those cases the sterigmata are dissolved and the remnants of the basidia have changed their shape towards short, broadly cylindrical to almost globose elements, which stain deep red in Congo red or phloxine. Connected with this ageing process is a swelling of the hyphae in subhymenium and hymenophoral trama.

Basidia with thickened walls, so-called crassobasidia (Watling & Chandra, 1983) were observed only two times.

### 2.6. Nuclei

The nuclei in mature spores from at least two collections per species (marked with \* in the list of collections examined) were counted after special treatment. For all species, two nuclei were found. These results are in accordance with those of Kühner (1980).

### 2.7. Cystidia

The lamella edge of all species examined is completely sterile, i.e. cheilocystidia are always present and basidia are absent. Only old damaged exsiccata or old fruit-bodies may lack cheilocystidia (e.g. *C. applanatus*, *C. epibryus*), in which case they have probably been rubbed off or disintegrated.

No pleurocystidia have been observed in any European collection.

Although the shape of the cheilocystidia within one species or even on the segment of one individual lamella edge varies considerably, there are still characteristic patterns to be found (see Table I).

### 2.8. Trama

The hymenophoral trama of *Crepidotus* in general can be described as regular to sub-regular. Detailed studies, however, reveal two subtypes: one found exclusively in subgenus *Crepidotus*, the other in subgenus *Dochmiopus*. In the latter, the narrow, 2–4  $\mu\text{m}$  wide, medium long, cylindrical hyphae first run parallel forming at the time of spore maturation bundles of slightly undulating hyphae, which later partially swell up to 30  $\mu\text{m}$  and branch during the ageing process. These swollen elements (see Fig. 3) have rounded tips and are often somewhat constricted.

Table I. Patterns of shapes of cheilocystidia.

	lageniform, narrowly utriform	clavate	cylindrical, flexuous	fusoid	whip-like
never branched	<i>mollis</i> <i>calolepis</i> <i>autochthonus</i> <i>subverrucisporus</i> <i>cinnabarinus</i>	<i>applanatus</i> <i>autochthonus</i>	<i>versutus</i> <i>applanatus</i>	<i>cinnabarinus</i>	
sometimes branched	<i>lundellii</i>	<i>applanatus</i> <i>crocophyllus</i>	<i>luteolus</i> <i>ehrendorferi</i>		<i>epibryus</i>
always branched	<i>cesatii</i> <i>variabilis</i> <i>carpaticus</i> <i>roseornatus</i> <i>macedonicus</i>		<i>luteolus</i>		

In subgenus *Crepidotus* the hyphae are from the beginning short-celled and distinctly wider. Often a well differentiated gelatinous subhymenium develops (see Fig. 26), which is thickest near the lamella edge. An excellent description of the trama of subgenus *Crepidotus* is given by Singer (1973: 447).

In the pileus trama the same two types exist: subgenus *Crepidotus* has its characteristic gelatinous layer with thin hyphae loosely embedded in a hyaline gelatinous mass. The inferior part of the pileus trama consists of short-celled, branched hyphae which are like a jigsaw puzzle. In all other groups the pileus trama is composed of one single type without special differentiations. In some collections the uppermost layer may consist of more densely packed hyphae (see Fig. 28). The taxonomic importance of that character is doubtful and is not used for species delimitation.

Some species of *Crepidotus* exhibit refractive vascular hyphae in the pellis and the uppermost layers of the pileitrama.

### 2.9. *Pileipellis*

Two main types exist, i.e. a simple cutis in subtypes and a trichoderm. Each of these two types can be divided into two subtypes: the cutis with (e.g. *Crepidotus calolepis*) or without distinct squamules (e.g. *C. mollis*) and the trichoderm in a subtype with more or less differentiated terminal cells (e.g. *C. subverrucisporus*) and a subtype with loosely interwoven, narrowly cylindrical hyphae without differentiated terminal cells (e.g. *C. variabilis*). Pileocystidia more or less in the shape of cheilocystidia are present in *Crepidotus applanatus* and *C. cinnabarinus*. In subgenus *Dochmiopus* a trichoderm is characteristic, however, a fully developed trichoderm may be found only in very young specimens or at the margin in older carpophores, because the pileipellis turns into a cutis in transitional stages. In many species of subgenus *Dochmiopus* the pileipellis hyphae may be coiled in various degrees. In opposition to Hesler & Smith (1965) but in accordance with Norstein (1990) I do not believe in the reliability of that character for taxo-

onomic purposes, because intermediate forms are very frequent. In most fully developed fruit-bodies with an intact not yet eroded pileus surface, such coiled hyphae can be found at the margin. At the point of attachment of the fruit-body, however, the hyphae are always very straight and most often arranged in bundles, forming a rather stiff, strigose tomentum.

### 2.10. Pigments

Nothing is known about the chemical compounds of the various red, yellow and brown pigments in *Crepidotus*.

Mr. N. Arnold (Regensburg) kindly tried to analyse two small fragments of *C. cinnabarinus* with HPLC. The red pigments proved to be hardly soluble and instable in acid solutions. They show an intensive blue fluorescence at 366 nm. This means that a close relationship of the *C. cinnabarinus* pigments with anthrachinons, styrylpyrons, terphenylquinons, and derivatives of pulvinic acid can be excluded. After some days the dissolved soluble red pigments turned to yellow.

## 3. ECOLOGY

All *Crepidotus* species are probably saprophytes of wood or woody substrates, mainly of semi-decomposed twigs or bark of branches and stems, sometimes on culms of herbaceous plants. In all woody substrates signs of white rot were observed. In all cases studied no other lignicolous agaric was fruiting in the immediate vicinity during the fruiting period of the concerning species of *Crepidotus*, nor were there more fruit-bodies of more than one *Crepidotus* species present on the substrate.

One species, *Crepidotus autochthonus*, fruits almost exclusively and a second, *C. versutus*, frequently on soil, most probably, however, always in connection with forest litter or wood. Two other species (*C. luteolus*, *C. epibryus*) occur mainly on dead culms of phanerogams (*Urtica*, *Rumex*, *Solidago*, *Gramineae*, *Equisetum*, among others).

Table II gives a survey of all registered substrates. As several different substrates can be present in one collection, the number of substrates is higher than the number of collections.

About 70% of all collections occur on deciduous wood, 11% on coniferous wood, 11% on culms of different phanerogams and 4% on mosses and litter (of hardwood). Almost each species can grow on hardwood, but several do not occur on coniferous wood. In relation to their presence in European forests *Salix*, *Fraxinus*, and probably also *Alnus* are over-represented, indicating a habitat preference of many *Crepidotus* species for moist alluvial forests or montane ravine forests.

Specific literature on the sociology of *Crepidotus* species is still very scarce. According to the few articles, *Crepidotus* species never form the dominant element in any European vegetation unit. Nevertheless, one mycosociological unit has been named after a *Crepidotus* species: *Crepidotus calolepis* is described by Jahn (1966) as being the most important species of the *Crepidotetum calolepidis*, a saprophytic association on decayed wood of *Populus tremula* in Sweden. Out of four distinct degradation stages, *C. calolepis* is the characteristic species of stage three, the optimal phase for basidiomycetes.

Table II. Substrates of European species of *Crepidotus*.

no. of coll.	as	cs	au	mc	ap	cr	ep	ca	li	cc	mo	lu	su	va	ve	ci	ms	ma	er	ro	vt
coniferous wood:																					
<i>Picea</i>	7	16	-	-	-	-	2	1	2	-	-	5	-	2	-	-	-	-	-	-	-
<i>Pinus</i>	4	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
conifers <sup>1</sup>	-	2	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Abies</i>	-	5	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
various substrates:																					
litter <sup>2</sup>	-	-	-	-	-	-	9	-	-	-	-	-	2	4	-	-	-	-	-	-	-
soil	-	-	8	-	-	-	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-
mosses <sup>3</sup>	-	1	-	-	-	-	7	-	1	-	-	2	-	-	-	-	-	-	-	-	-
herbs <sup>4</sup>	-	-	-	-	-	-	16	-	3	-	-	18	1	6	-	-	-	-	-	-	-
deciduous trees and shrubs:																					
hardwood <sup>1</sup>	-	-	2	3	8	2	2	2	7	14	3	5	6	8	1	2	3	-	-	-	1
<i>Fraxinus</i>	-	-	-	1	2	1	2	1	6	10	2	3	2	2	-	-	-	-	-	-	-
<i>Fagus</i>	-	-	-	-	9	1	4	-	5	10	8	1	-	1	2	-	-	1	1	-	-
<i>Quercus</i>	-	-	-	-	-	-	1	1	1	4	1	3	2	7	1	-	-	-	-	-	-
<i>Alnus</i>	-	-	-	-	-	-	-	1	2	1	1	3	6	2	2	-	-	-	-	-	-
<i>Salix</i>	-	-	-	1	-	-	-	-	11	13	2	2	2	1	1	-	-	-	-	-	-
<i>Populus</i>	-	-	-	5	-	-	-	-	1	1	5	-	1	1	-	-	-	-	-	-	-
<i>Ulmus</i>	-	-	-	-	-	3	-	-	2	1	-	1	-	1	1	-	-	-	-	-	-
<i>Betula</i>	-	-	-	1	-	-	1	-	1	-	-	-	-	2	8	-	-	-	-	-	-
<i>Acer</i>	-	-	-	-	1	-	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-
<i>Carpinus</i>	-	-	-	-	-	1	1	-	-	-	-	1	2	1	-	-	-	-	-	-	-
<i>Tilia</i>	-	-	-	-	-	-	-	-	1	1	-	1	-	1	-	1	-	-	-	-	-
<i>Robinia</i>	-	-	-	-	-	-	1	-	-	-	-	3	2	-	-	-	-	-	-	1	-
<i>Eucalyptus</i>	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-
<i>Frangula</i>	-	-	-	-	-	-	3	-	1	1	-	-	-	-	-	-	-	-	-	-	-
<i>Ulex</i>	-	-	-	-	-	-	1	-	-	-	-	-	1	2	-	-	-	-	-	-	-

Various mycocoenological investigations give indications about the most frequent and easily recognisable species:

*Crepidotus mollis* is reported from a hygrophilous birchwood on peat (*Betuletum pubescentis*) in Poland (Bujakiewicz, 1986), from alluvial forests on calcareous grounds near Leipzig (Buch & Kreisel, 1957) and Colmar (Carbiener, 1981), from mesophilous beech forests (*Mercuriali-Fagetum*) in Poland (Lisiewska, 1974) as well as from more dry, acidophilous oak-hornbeam forests (*Galio-Carpinetum*) near Munich (Einhellinger, 1964) and near Geneva (Horak & Röllin, 1988). My own collections mainly origin from alluvial forest types.

(Table II continued)

no. of coll.	as	cs	au	mc	ap	cr	ep	ca	li	cc	mo	lu	su	va	ve	ci	ms	ma	er	ro	vt
	11	26	10	14	22	8	54	8	46	76	25	60	34	42	19	4	4	1	1	1	1
	deciduous trees and shrubs (contd):																				
<i>Castanea</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Viburnum</i>	-	-	-	-	-	-	-	-	1	4	-	-	1	-	-	-	-	-	-	-	-
<i>Sambucus</i>	-	-	-	-	-	-	-	-	3	-	-	3	1	-	-	-	-	-	-	-	-
<i>Crataegus</i>	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
<i>Platanus</i>	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
<i>Lonicera</i>	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-
<i>Corylus</i>	-	-	-	-	-	-	-	-	-	4	-	-	1	-	-	-	-	-	-	-	-
<i>Rosa</i>	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	-	-	-	-	-
<i>Sarothamnus</i>	-	-	-	-	-	-	-	-	1	-	1	-	-	-	2	-	-	-	-	-	-
<i>Cornus</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Spiraea</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>rope</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Vitis</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Pyrus</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Rubus</i>	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
<i>Clematis</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Prunus</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Berberis</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-

1) unidentified; 2) litter of deciduous trees (*Fagus*, *Quercus*, *Castanea*, among others); 3) *Plagiomnium affine*, *Hypnum spec.*, *Rhytidiadelphus triqueter*, and *Pseudoscleropodium purum*; 4) *Urtica*, *Solidago*, *Rumex*, *Filimendula*, *Poaceae*.

ap = *applanatus* var. *applanatus*, as = *applanatus* var. *subglobigera*, au = *autochthonus*, ca = *carpaticus*, cc = *cesatii* var. *cesatii*, ci = *cinnabarinus*, cr = *crocophyllus*, cs = *cesatii* var. *subsphaerosporus*, ep = *epibryus*, er = *ehrendorferi*, li = *lundellii*, lu = *luteolus*, ma = *macedonicus*, mc = *calolepis* var. *calolepis*, mo = *mollis*, ms = *calolepis* var. *squamulosus*, ro = *roseornatus*, su = *subverrucisporus*, va = *variabilis* var. *variabilis*, ve = *versutus*, vt = *variabilis* var. *trichocystis*.

*Crepidotus variabilis* was observed in vegetation units which differ significantly in their ecological claims: mesophilous beech forests (*Mercuriali-Fagetum*, *Melico-Fagetum*) in Poland (Lisiewska, 1963, 1974), moist alder forests (*Carici elongatae-Alnetum*) in Berlin (Gerhardt, 1978), moist heathland (*Arnico-Genistetum anglicae*) in the Netherlands (Arnolds, 1982), acid oakwoods (*Dicrano-Quercetum*, *Quercu-Betuletum*) in the Netherlands (Jansen, 1984) and acid oak-hornbeam forests (*Galio-Carpinetum*) near Geneva (Horak & Röllin, 1988).

As opposed to *Crepidotus variabilis* which is obviously more frequently reported from woods on acid soils, *C. cesatii* var. *cesatii* prefers woods on more basic soils. *Crepidotus cesatii* is reported from alluvial forest in Alsace (Carbiener, 1981) and from a thermophilous beech forest (*Carici-Fagetum*) in Switzerland (Brunner, 1987). Own observations confirm a coherence with *Fagion* and *Alno-Padion* associations, i.e. beech forests and alluvial forests.

#### 4. CHOROLOGY

An accurate assessment of European or holarctic distribution patterns exhibited by fugitive organisms such as small agarics which need a time-consuming microscopic examination, will likely remain an impossible task still for many years. Nevertheless, thanks to several regional floras published in recent years (Hallgrímsson, 1973; Ortega & Buendia, 1989; Watling & Gregory, 1989; Norstein, 1990; Senn-Irlet, 1992a) our knowledge on distribution patterns has increased. On the one hand northern boundaries of *Crepidotus* species in Norway are rather well known (Norstein, 1990). Expeditions to Greenland gave further information on the few species which extend in subarctic and arctic areas (Senn-Irlet, 1992b). On the other hand the southern boundaries are imperfectly known. While some information exists from the western mediterranean region including the Canary Islands (Malençon & Bertault, 1975; Bañares-Baudet et al., 1986; Ortega & Buendia, 1989), almost no records are known from the eastern mediterranean region.

Despite these problems I have tentatively assigned the *Crepidotus* species treated to some general distribution types, based, however, exclusively on specimens examined by myself. The distribution types are based on the north-south zonation proposed by Meusel et al. (1965) and mainly characterized by a temperature gradient.

In addition to this gradient in latitude Meusel et al. (1965) distinguish a gradient in longitude. This west-east gradient in Europe, i.e. the degree of continentality in the terminology of these authors, is mainly determined by precipitation. As almost all agarics need humid conditions to develop fruit-bodies, the presence of *Crepidotus* species in dry areas with cold winter must be restricted to local habitats with more humid conditions which cannot find expression in diagrams of the macroclimate. Without a better knowledge of *Crepidotus* habitats in eastern Europe possible differences in distribution related to longitude gradients cannot be discussed.

- 1) meridional – submeridional  
*C. calolepis* var. *squamulosus*
- 2) meridional – submeridional – temperate  
*C. calolepis* var. *calolepis*
- 3) meridional – submeridional – temperate – boreal  
*C. variabilis* var. *variabilis*, *C. epibryus*
- 4) submeridional  
*C. variabilis* var. *trichocystis*, *C. roseornatus*, *C. macedonicus* (single collections!)
- 5) submeridional – temperate  
*C. applanatus* var. *applanatus*, *C. applanatus* var. *subglobigera*, *C. cesatii* var. *cesatii*, *C. cinnabarinus*, *C. crocophyllus*, *C. luteolus*, *C. mollis*



- 6) submeridional – temperate – boreal  
*C. subverrucisporus*, *C. lundellii*
- 7) temperate  
*C. autochthonus*, *C. carpaticus*, *C. ehrendorferi*
- 8) temperate – boreal  
*C. cesatii* var. *subsphaerosporus*
- 9) temperate – boreal – arctic  
*C. versutus*

The distribution areas of most European species of *Crepidotus* seem to be continuous. Exceptions are *C. carpaticus* occurring at some isolated spots from Great Britain to the Vosges (France), Alps (Switzerland) and Carpathes (Ucrainia), *C. cesatii* var. *subsphaerosporus* with records from the boreal region and the montane zone of the temperate regions (Alps) and probably occurring elsewhere in spruce forests or plantations, and *C. calolepis* var. *calolepis*, which seems to have a genuine disjunct distribution: numerous records prove the presence of a southern area in the mediterranean region and a northern one in Scandinavia and the Baltic. The isolated European localities of the very conspicuous *C. cinnabarinus* suggest introduction by man from North America.

## 5. RESULTS OF STATISTICAL ANALYSES

### 5.1. Descriptive statistics of basidiospore size

As stated before the basidiospores exhibit the most important taxonomic characters in *Crepidotus*. In addition to the spore ornamentation the size and shape, the latter expressed with the length-width ratio  $Q$ , provide unique dimensions for each species.

Based on a random sample of 20 measured spores per collection (usually one fruit-body), the 95% population limits ( $p = sd \times t$ ;  $sd =$  standard deviation with population parameter 'n-1',  $t =$  tolerance limit according to Wissenschaftliche Tabellen Geigy 1980) of the spore size can be calculated to gain some information about the range of each collection and furthermore, by computing the limits with the mean values of each collection, about the totality of the collections that are grouped in one species (Table III). Figs. 32 and 33 visualize the frequency distribution of my measurements.

On the strength of one parameter alone (spore length, width or volume) not all species can be separated. But combinations of at least two of these characters allow for an individual characterization as can be seen in Fig. 34.

### 5.2. Special problems

In species complexes, where several taxa may be involved, a statistical approach seems suitable. In all cases the spores are concerned.

#### 5.2.1. *Crepidotus mollis*-group — Fig. 35; Table IV

In European literature *C. calolepis* and its var. *squamulosus* have often been treated as varieties of *C. mollis*. According to a widely accepted morphological species concept (see Kuyper, 1988) a good species differs in at least two interdependent morphological characters. Spore size in combination with features of the pileipellis fulfil this claim.

Table III. Spore size measurements.

(Spore size: range of calculated population limits. Maximum, minimum: absolute measurements.)							
species	Q = 1/w	max.	max.	min.	min.	n./coll.	
spore size		l	w	l	w		
1. <i>applanatus</i> var. <i>applanatus</i> 4.7–6.5 × 4.4–6.4	0.99–1.11	6.9	6.2	4.5	4.0	298/14	
2. <i>applanatus</i> var. <i>subglobigera</i> 5.0–7.1 × 4.8–6.8	1.00–1.09	8.6	7.2	4.5	4.5	208/11	
3. <i>autochthonus</i> 6.7–9.1 × 4.7–6.0	1.33–1.63	8.7	6.1	6.8	4.7	240/13	
4. <i>calolepis</i> var. <i>calolepis</i> 7.5–10.3 × 5.4–6.7	1.35–1.59	12.5	7.2	7.0	5.0	403/19	
5. <i>calolepis</i> var. <i>squamulosus</i> 8.6–11.5 × 6.5–7.2	1.28–1.66	11.3	8.0	8.0	6.0	79/4	
6. <i>carpaticus</i> 4.9–6.6 × 4.1–6.3	1.02–1.18	6.5	6.0	4.5	4.0	62/4	
7. <i>cesatii</i> var. <i>cesatii</i> 6.9–8.6 × 5.7–7.3	1.09–1.30	8.9	7.7	7.0	5.6	1062/53	
8. <i>cesatii</i> var. <i>subphaerosporus</i> 6.6–8.5 × 4.9–6.6	1.19–1.46	8.5	7.0	7.0	5.2	453/21	
9. <i>cinnabarinus</i> 6.7–8.0 × 5.6–6.1	1.16–1.36	8.5	6.6	6.0	5.0	76/4	
10. <i>crocophyllus</i> 6.1–6.9 × 6.0–6.7	1.00–1.04	8.0	7.5	5.4	5.4	188/8	
11. <i>ehrendorferi</i> 5.6–7.2 × 5.5–7.1	0.97–1.07	7.0	7.0	5.5	5.5	20/1	
12. <i>epibryus</i> 6.9–9.1 × 2.7–3.2	2.32–3.09	10.0	4.5	6.0	2.2	431/23	
13. <i>lundellii</i> 6.5–9.1 × 4.5–5.8	1.32–1.71	11.0	7.0	5.4	3.7	990/50	
14. <i>luteolus</i> 8.1–9.9 × 4.2–5.1	1.79–2.07	11.0	5.8	6.9	3.6	1013/50	
15. <i>macedonicus</i> 6.2–7.9 × 4.6–5.8	1.20–1.54	8.0	5.8	6.0	4.8	20/1	
16. <i>mollis</i> 7.3–9.8 × 4.9–6.3	1.40–1.67	11.0	6.7	6.5	4.6	605/29	
17. <i>roseomatus</i> 5.8–7.8 × 3.9–5.9	1.21–1.59	8.0	6.0	6.0	4.2	22/1	
18. <i>subverrucisporus</i> 7.7–10.7 × 4.8–6.6	1.38–1.74	11.5	8.0	7.0	4.5	892/43	
19. <i>variabilis</i> var. <i>variabilis</i> 6.0–6.8 × 3.0–3.6	1.73–2.14	8.1	4.3	5.2	2.5	614/30	
20. <i>variabilis</i> var. <i>trichocystis</i> 6.4–8.8 × 3.4–4.4	1.62–2.25	9.0	4.5	6.2	3.2	61/1	
21. <i>versutus</i> 9.5–11.4 × 5.1–5.9	1.76–2.05	13.0	6.5	8.2	4.0	514/29	

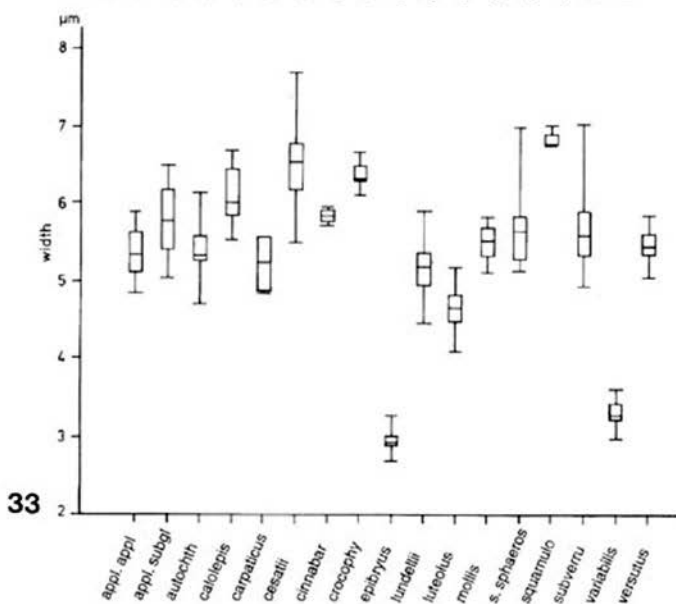
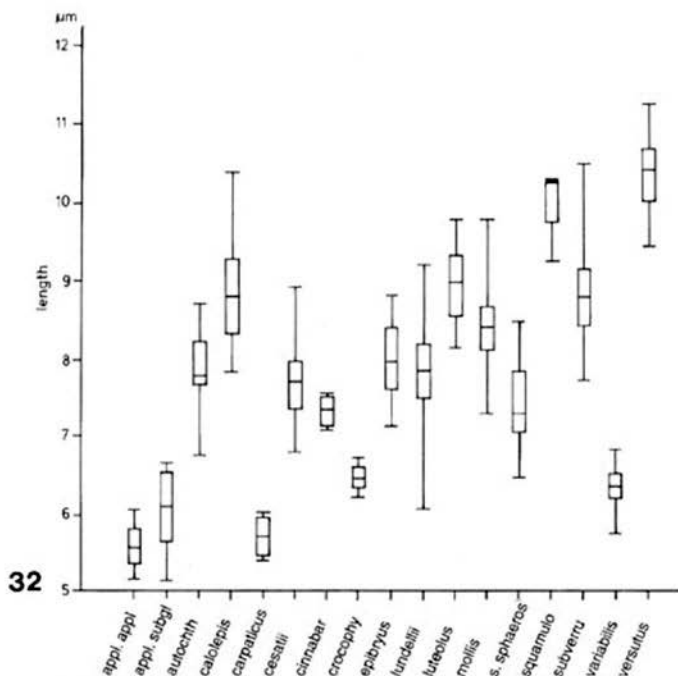


Fig. 32. Box- and Whisker-Plots for spore lengths. — Fig. 33. Box- and Whisker-Plots for spore widths. — The rectangle (= box) for each species covers the middle 50% of the measurements of the length of the spores. The horizontal line in the box indicates the median value. The length of the vertical bars connects the absolute (measured) minimum with maximum length.

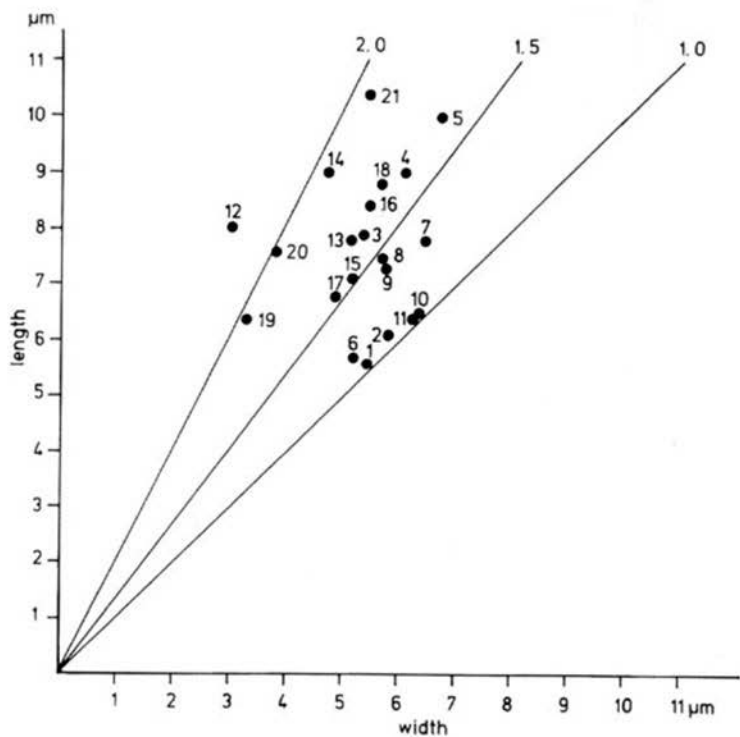


Fig. 34. Scatter diagram of the mean values of the length vs width of European *Crepidotus* species; the numbers refer to Table III.

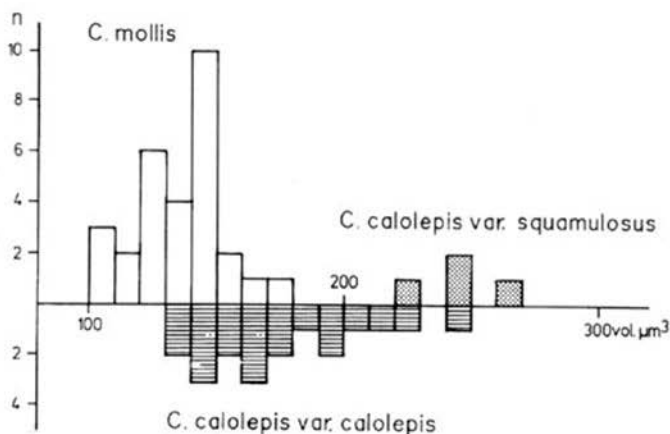


Fig. 35. *Crepidotus mollis*-group: histogram of spore volumes, grouped according to presence or absence of scales (*Crepidotus mollis* vs *Crepidotus calolepis*) and width of pilicellis hyphae (*Crepidotus calolepis* var. *calolepis* vs var. *squamulosus*).

Table IV. *Crepidotus mollis* s.l.: Data on spore volumes, calculated for an ellipsoid.

Spore volumes in $\mu\text{m}^3$ , sd = standard deviation, n = number of collections						
species	mean	sd	median	max.	min.	n
<i>C. mollis</i>	134	17	137	175	102	29
<i>C. calolepis</i>						
var. <i>calolepis</i>	174	31	167	242	129	19
var. <i>squamulosus</i>	246	18	247	265	221	4

Table V. *Crepidotus applanatus* s.l.: Data on spore volumes.

Spore volumes in $\mu\text{m}^3$ , sd = standard deviation, n = number of collections						
species	mean	sd	median	max.	min.	n
<i>C. applanatus</i>						
var. <i>applanatus</i>	85	14	82	109	64	16
var. <i>subglobigera</i>	111	31	113	194	48	11
<i>C. crocophyllus</i>	139	25	135	156	121	8

Recently Norstein (1990) used descriptive and inductive statistics in the *C. mollis*-group. He proved that collections with a scaly pileus grow most frequently on *Fraxinus* whereas those with a glabrous pileus are more frequent on *Populus*. Moreover, the width of the spores is highly correlated with the scaliness of the pileus.

In Fig. 35 a histogram displays the frequency distribution for spore sizes, expressed as the volume, grouped on the basis of independent morphological characters, viz. the presence or absence of scales on the pileus and the diameter of the hyphae of the scales. The scales are formed by hyphae which are brown incrustated with intra- and extracellular pigments. It is obvious that three distinct groups exist. The Wilcoxon-Mann-Whitney test, which does not require a normal distribution of the data, as well as the t-test performed with values transformed into normal logarithms showed highly significant differences at a 0.01 level.

### 5.2.2 *Crepidotus applanatus*-group — Fig. 36; Table V

In the group of *C. applanatus* the differences in spore size are less obvious than in the *C. mollis*-group. Yet, a grouping of the spores (volumes) with regard to their substrate (hardwood versus coniferous wood) in Fig. 36 shows clear tendencies towards a small-spored taxon on hardwood and a large-spored taxon on coniferous wood. However, two collections from hardwood exhibit spore volumes which are almost double as large as the mean of the small-spored group. These collections are omitted in Table V as they may represent an undescribed taxon from Eastern Europe. Once more the Wilcoxon-Mann-Whitney test and the t-test, again performed with transformed values, proved the presence of two significantly different populations within *C. applanatus*.

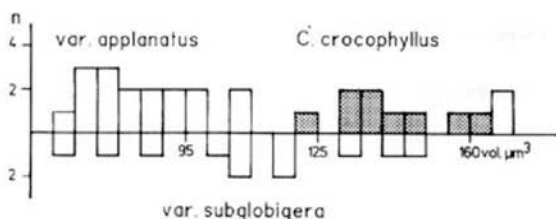


Fig. 36. *Crepidotus applanatus* s.l.: histogram of spore volumes according to substrate (upper half: hardwood, lower half: coniferous wood) and squamulose pileus (*Crepidotus applanatus* vs *C. crocophyllus*).

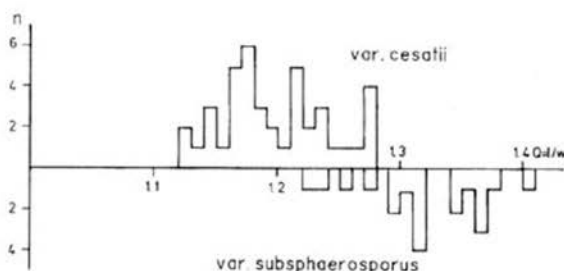


Fig. 37. *Crepidotus cesatii* s.l.: histogram of length/width-ratio (= Q) of collections with a known substrate (upper half: hardwood, lower half: coniferous wood).

*Crepidotus crocophyllus*, a closely related species, has spore sizes which as seen as a population are distinctly and significantly larger than those of var. *subglobigera*. One sample, however, i.e. one collection may well have spores of which the sizes cannot be separated from those of a large-spored collection of var. *subglobigera*. But for identification *C. crocophyllus* is characterized by several other morphological characters (see below).

### 5.2.3. *Crepidotus cesatii*-group — Fig. 37; Table VI

Within the *C. cesatii*-group the spore size varies considerably, which probably indicates a genetic polymorphism. But a clear correlation of spore volumes with other characters could not be found.

However, spore shape expressed by means of the length-width ratio allows the distinction of two populations: one on hardwood and one on coniferous wood. Norstein (1990) was the first to pay attention to this fact, which he was able to prove statistically on the basis of Norwegian material. He even found a significant correlation with a morphological character, viz. the degree of coiling of the hyphae of the pileipellis.

Table VI: *Crepidotus cesatii* s.l.: data on length-width ratio of spores.

species	sd = standard deviation, n = number of collections					
	mean	sd	median	max.	min.	n
on coniferous wood	1.311	0.051	1.30	1.22	1.40	19
on hardwood	1.192	0.043	1.13	1.12	1.27	41

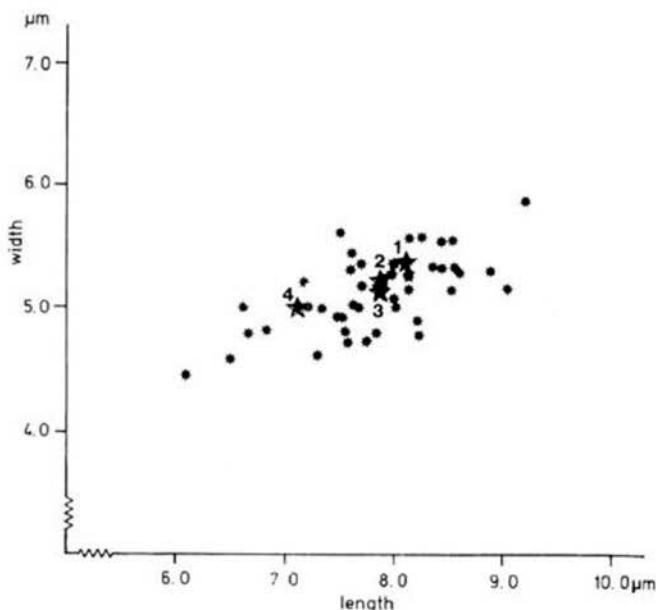


Fig. 38. *Crepidotus lundellii*: scatter diagram of basidiospore sizes (means per sample). 1 = *C. lundellii* (type), 2 = *C. subtilis* (type), 3 = *C. amygdalosporus* (type), 4 = *C. lundellii* var. *subglobisporus* (type).

Fig. 37 illustrates the differences in spore shape between collections from hardwood and from coniferous wood. Statistical tests (Wilcoxon-Mann-Whitney test, t-test) underline this observation. However, I failed to prove a close correlation between spore shape and the presence or absence of coiled hyphae in the pileipellis; I observed but a faint tendency to such a correlation.

#### 5.2.4. *Crepidotus lundellii*-group — Fig. 38

With *C. amygdalosporus*, *C. subtilis* and *C. lundellii* var. *subglobisporus* taxa are described, that in many respects come very close to *C. lundellii* var. *lundellii*. In these cases spore size has often been considered conclusive, but the original descriptions give the spore sizes as follows:

<i>C. lundellii</i>	6.5–8 × 4–5 µm
<i>C. lundellii</i> var. <i>subglobisporus</i>	6–7.5 × 4.5 µm
<i>C. amygdalosporus</i>	7–9 × 4.5–5 µm
<i>C. subtilis</i>	7–10 × 5–6 µm

In Fig. 38 the mean values of the lengths and widths of the samples of all collections of this species complex examined are displayed. From a statistical point of view it is obvious that it is impossible to distinguish more than one population within the cluster of spots produced. In fact, even the four collections with the smallest spores, which stand somewhat isolated, cannot be separated on spore size alone. As in most *Crepidotus* species a positive linear correlation between length and width exists.

### 5.3. Infrageneric classification

#### 5.3.1. Infrageneric classifications proposed so far

There are two valuable propositions for an infrageneric classification, viz. by Singer (1947) and by Hesler & Smith (1965).

Singer (1947) gave the following synopsis:

Sect. *Echinosporeae* Pilát (1929) – Spores ornamented.

Subsect. *Porphophorini* Sing. (1947) – Clamp-connections present.

Subsect. *Aporpini* Sing. (1947) – Clamp-connections absent.

Sect. *Laevisporae* Pilát (1929) – Spores smooth.

Subsect. *Fibulatini* Sing. (1947) – Clamp-connections present.

Subsect. *Defibulatini* Sing. (1947) – Clamp-connections absent.

Also in the latest edition of his 'Agaricales in Modern Taxonomy' (Singer, 1986) this classification is maintained, but in 1962 for nomenclatural reasons Singer changed section *Laevisporae* to section *Crepidotus*.

Hesler & Smith (1965) proposed a different classification, introducing the presence or absence of clamp-connections in combination with the shape of the spores as the most important characters on subgeneric level.

Subg. *Crepidotus* – Clamp-connections absent.

Sect. *Cinnabarini* Hesler & Smith (1 species also present in Europe).

Sect. *Tubariopsis* Hesler & Smith (1 species also present in Europe).

Sect. *Stratosi* Hesler & Smith – not in Europe.

Sect. *Parvuli* Hesler & Smith – not in Europe.

Sect. *Crepidotus* (9 species / 2 in Europe).

Sect. *Versuti* Hesler & Smith (4 species / 2 in Europe).

Subg. *Sphaerula* Hesler & Smith – Spores globose to subglobose, clamp-connections present.

Sect. *Nyssicolae* (Sing.) Hesler & Smith – not in Europe

Sect. *Sphaerula* (41 species / 2 in Europe).

Subsect. *Sphaeruli* (18 species / 1 in Europe).

Subsect. *Colorantes* Hesler & Smith – not in Europe.

Subsect. *Fulvofibrillosi* Hesler & Smith (8 species / 1 in Europe).

Subg. *Dochmiopus* (Pat.) Pilát – Spores typically longer than broad, clamp-connections present.

Sect. *Cystidiosi* Hesler & Smith (7 species / 2 in Europe).

Sect. *Fulvidi* Hesler & Smith – not in Europe.

Sect. *Phaseoli* Hesler & Smith – not in Europe.

Sect. *Fusisporae* Hesler & Smith – not in Europe (but represented on Greenland, see Senn-Irlet 1992b).

Sect. *Betulae* Hesler & Smith – (10 species / 1 in Europe).

Sect. *Dochmiopus* (Pat.) Pilát (3 species / 2 in Europe).

Sect. *Crepidotellae* Hesler & Smith (32 species / 6 in Europe).



## 5.3.2. Phenetic classification based on taxometrics

Numerical taxonomy offers new methods of organizing data and obtaining from them a classification, which were unknown until the 1960's and gained much attention with the increasing use of computers. Aims and principles are to be found in Sneath & Sokal (1973).

In order to arrive at a phenetic classification of *Crepidotus* with every character a priori equally weighted, the following characters for species separation were chosen for the data-matrix (OTU) in Table VII:

- a. Presence of clamp-connections (1 = present, 0 = absent).
- b. Scales on the pileus (1 = present, 0 = absent).
- c. Gelatinous layer in the pileus (1 = present, 0 = absent).
- d. Lower part of pileitrama short-celled and interwoven (resembling a jigsaw puzzle) (1 = this type of tissue present, 0 = this type absent).
- e. Cap hygrophanous (1), sometimes hygrophanous ( $1/2$ ) or not (0).
- f-h. Cap colour white (f), yellow or brownish (g), red (h),  $1/2$  = pigment not in all collections present.
- i-k. Spore shape globose,  $Q = 1.0-1.25$  (i); ellipsoid,  $Q = 1.3-2.0$  (j); cylindric,  $Q > 2.1$  (k).
- l-o. Spore ornamentation absent (l), rugulose (m), baculate/verruculose (n), echinulate (o).
- p. Coloration of spore wall (1 = very weakly coloured, 0 = distinctly coloured).

The analyses were computed using the statistical packages SYSTAT (Wilkinson, 1990) and a program written by H. Clémenton after Sneath & Sokal (1973).

Table VII. Data-matrix for 15 European species of *Crepidotus*.

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
<i>applanatus</i>	1	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0
<i>autochthonus</i>	1	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0
<i>calolepis</i>	0	1	1	1	0	0	1	0	0	1	0	1	0	0	0	0
<i>carpaticus</i>	1	0	0	0	0	1	$1/2$	0	1	0	0	0	0	1	0	0
<i>cesatii</i>	1	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0
<i>cinnabarinus</i>	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
<i>crocophyllus</i>	1	1	0	0	0	0	1	0	1	0	0	0	0	1	0	0
<i>epibryus</i>	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1
<i>lundellii</i>	1	0	0	0	0	1	$1/2$	0	0	1	0	0	1	0	0	1
<i>luteolus</i>	1	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0
<i>mollis</i>	0	0	1	1	$1/2$	1	$1/2$	0	0	1	0	1	0	0	0	0
<i>roseornatus</i>	1	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0
<i>subverrucisporus</i>	1	0	0	0	0	1	$1/2$	0	0	1	0	0	1	0	0	0
<i>variabilis</i>	1	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
<i>versutus</i>	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	1

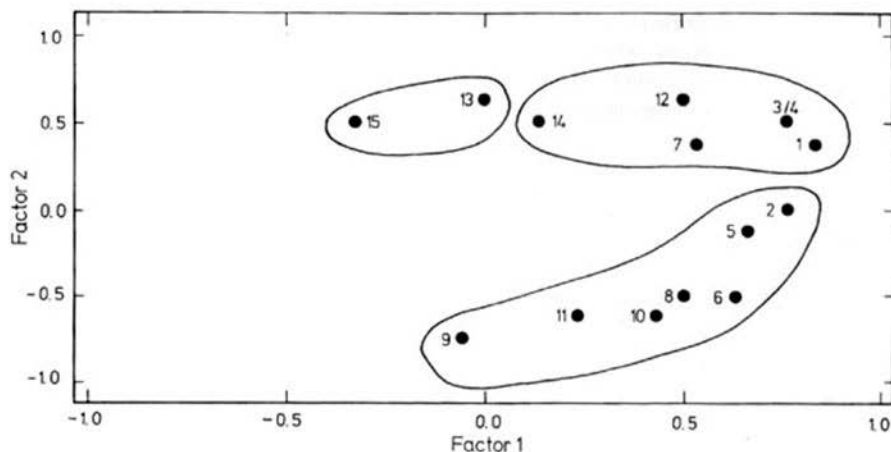


Fig. 39. Ordination diagram from principle component analysis. The diagram shows the position of the species on the first two axes (factors). 1 = *subverrucisporus*, 2 = *variabilis*, 3 = *lundellii*, 4 = *luteolus*, 5 = *cesatii*, 6 = *carpaticus*, 7 = *autochthonus*, 8 = *applanatus*, 9 = *cinnabarinus*, 10 = *roseornatus*, 11 = *crocophyllus*, 12 = *versutus*, 13 = *mollis*, 14 = *epibryus*, 15 = *calolepis*.

Figure 39, displaying an ordination diagram from principle component analysis, gives a good impression of a possible delimitation of three distinct groups within the genus *Crepidotus*.

Figs. 40 and 41 display the two main phenogram types obtained by other methods, i.e. 1-Pearson, Euclidean, Gower, and Canberra as distance metrics and Average Linkage, Single Linkage, Complete Linkage, UPGMA (unweighted pair group method using arithmetic averages, see Sneath & Sokal, 1973), sums of squares as cluster algorithms. They all indicate the same important results as also Fig. 39: the genus can be divided into three main groups as the phenograms clearly display the following subdivisions:

(i) the group with a gelatinous layer, and a short-celled trama: *Crepidotus mollis*-group (subgenus *Crepidotus* sensu Hesler & Smith);

(ii) the group with ellipsoid, smooth or rugulose spores (subgenus *Dochmiopus* sensu Hesler & Smith);

(iii) the group with globose, baculate or echinulate spores (subgenus *Sphaerula* Hesler & Smith).

Broadly outlined the phenogram of Fig. 40 reflects the divisions proposed by Hesler & Smith (1965). In detail, however, it reveals some important differences. While Hesler & Smith accentuate one single character – the missing clamp-connections – as the main reason for separating subgenus *Crepidotus*, the phenogram based on an overall similarity of chosen characters, distinguishes this subgenus on a combination of various characters. For the group around *C. mollis* at least two characters unique within the genus are observed: it is the gelatinous upper layer and the type of structure of the lower trama of the pileus. The other members of subgenus *Crepidotus* sensu Hesler & Smith should therefore be placed in other subgenera, which means that the absence or presence of clamp-connections is not a very important character in *Crepidotus*.

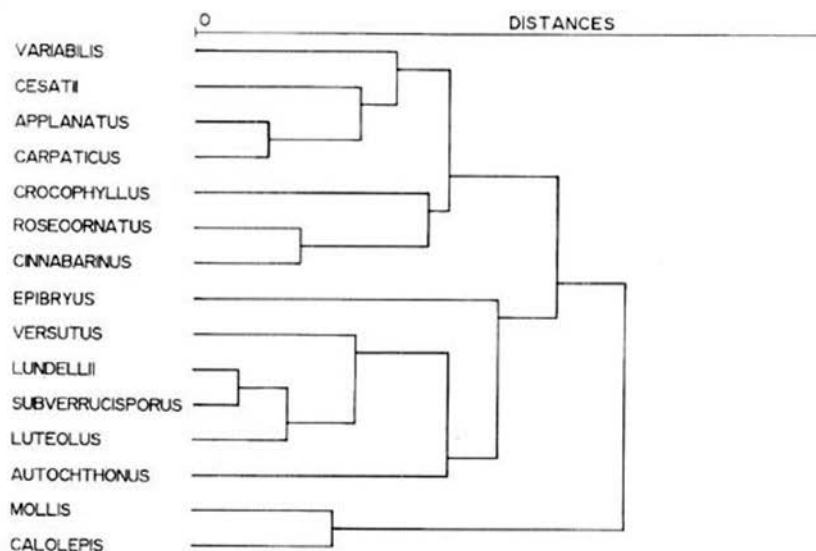


Fig. 40. Phenogram of an Average Linkage clustering based on 1-Pearson correlation coefficient for 15 *Crepidotus* species.

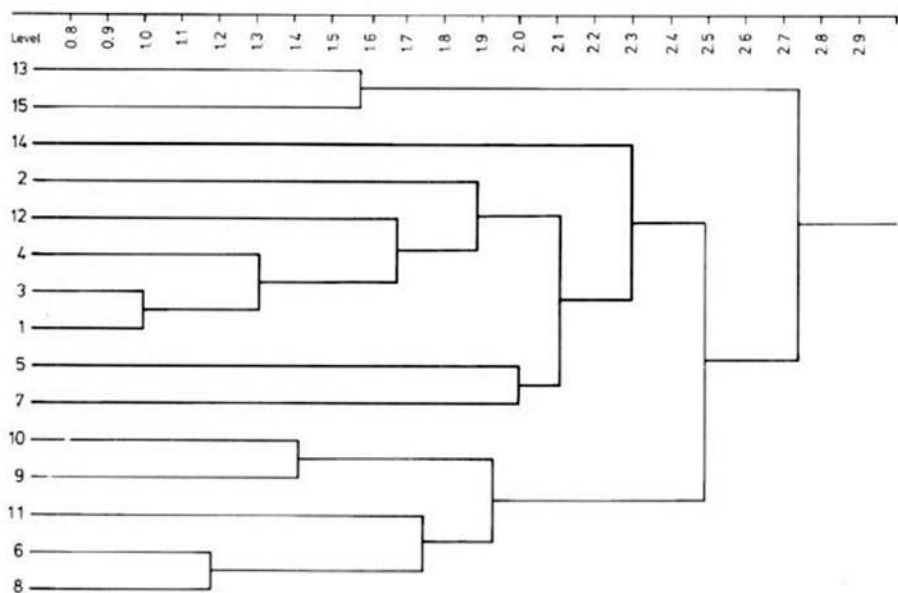


Fig. 41. Phenogram of an UPGMA clustering based on Euclidean distances for 15 *Crepidotus* species (co-phenetic correlation coefficient: 0.820; degree of freedom D.F. = 103). Numbers refer to those in Fig. 39.

The taxonomic importance of clamp-connections has been discussed before. Horak (1964) attaches no importance at all to this feature in *Crepidotus*.

Important characters for an infrageneric classification of *Crepidotus* apparently are the shape and the ornamentation of the spores. Both Singer (1947) and Hesler & Smith (1965) used these characters but in different ways: Singer considered the character of the spore ornamentation as more important than the shape, whereas Hesler & Smith found the latter character more important. In the phenograms presented here the subdivision is based on a combination of these characters.

Analysing the differences in the various phenograms obtained, of which in Figs. 40 and 41 two are shown, one can observe that two species, i.e. *Crepidotus variabilis* and *C. cesatii* change their position within the three large groups. On the one hand these species are attached in all UPGMA clustering to the group with *C. lundellii* and *C. luteolus*, on the other hand they are put together with *C. applanatus* and *C. crocophyllus* in Fig. 40 using Pearson's correlation coefficient. In other words the positions of these species are weak and the final attachment to one group remains to a certain degree a personal decision of the taxonomist, as at least two solutions are supported by numerical analyses.

I conclude that, based on European species, the genus *Crepidotus* is best divided into two subgenera, i.e. subgenus *Crepidotus* and subgenus *Dochmiopus*, and the latter subgenus into two sections (section *Dochmiopus* and section *Crepidotellae*). Mainly judging from the literature, I am convinced that this infrageneric classification will hold out when extra-European species are taken into consideration and will turn out to have predictive value.

## B. SPECIAL PART

## CREPIDOTUS (Fr.: Fr.) Staude

*Agaricus* tribus *Crepidotus* Fr., Syst. mycol. 1 (1821) 272. — *Crepidotus* (Fr.) Staude, Schwämme Mitteldeutschl. 25 (1857) 71. — Lectotype (Earle, 1909): *Agaricus mollis* Fr., Syst. mycol. 1 (1821) 274.

*Phialocybe* P. Karst., Bidr. Känn. Finl. Nat. Folk 32 (1879) xxii, 415. — Lectotype (Earle, 1909): *Crepidotus epibryus* (Fr.: Fr.) Quél.

*Dochmiopus* Pat., Hymenomyc. Eur. (1887) 113. — Lectotype (Earle, 1909): *Agaricus variabilis* Pers.: Fr.

*Pleurotellus* Fayod, Ann. Sci. nat. (Bot.) VII, 9 (1889) 339. — Type: *Pleurotellus hypnophilus* (Berk.) Fayod.

*Tremellopsis* Pat., Enum. Champ. Guadeloupe (1903) 13. — *Tremellastrum* Clem., Gen. Fungi (1909) 105 (superfluous name change). — Type: *Tremellopsis antillarum* Pat.

*Conchomyces* Over. in Heyne, Bull. Jard. bot. Buitenzorg III, 9 (1927) 19. — Type: *Conchomyces verrucisporus* Over.

Etymology: krepis (Greek): slipper, ous (Greek): ear.

Fruit-bodies pleurotoid, usually lignicolous, more rarely on dead plant debris (culms, leaves, litter), mosses or on soil; pileus white to coloured, fibrillose, tomentose or more or less glabrous; lamellae radiating from a lateral or strongly eccentric point of attachment; spores in deposit brown, clay-colour, snuff-brown, cinnamon; spore wall single and thin or double and thick, smooth or ornamented and then the ornamentation consisting (1) very short rods, warts or spines or (2) structures caused by a wrinkling, rugulose to verruculose exosporium, globose, subglobose or ellipsoid to elongate, without germ-spore; cheilocystidia present and often branched; pileocystidia present in some species. Trama of the pileus subregular, sometimes with a gelatinous layer. Hyphae of the pileipellis either slightly or not at all differentiated, in species with a somewhat tomentose pileus mostly curved to coiled, or sharply differentiated and then repent and sometimes incrustated with brownish ring-like pigments; clamp-connections present or more rarely absent and in the latter case lacking from all tissues. Stipe only visible in young fruit-bodies, short and eccentric, lacking in older fruit-bodies and these sometimes forming a remarkable short and thick stump. Veil none.

Some species, such as *Clitopilus hobsonii*, *Cheimonophyllum candidissimum*, and species of *Panellus*, *Hohenbuehelia* and *Pleuroflammula* have often been mistaken for *Crepidotus* species. Of these only the representatives of the last genus have brown coloured spores, which, however, are ferruginous-fulvous and distinctly more strongly coloured than those in any *Crepidotus*. For further characters of the genus *Pleuroflammula* see Horak (1978). The rest have hyaline spores, when seen under the light microscope. Spores of *Clitopilus* are recognized by their longitudinal ribs and are angular in polar view.

*Crepidotus haustellaris* sensu Pilát is not a member of the genus *Crepidotus*. It is much better placed in *Simocybe* on account of the colour of its spore print with distinct olivaceous tints, the shape of the spores, the presence of a germ-pore and the structure of the pileipellis which is a turf of pileocystidia and exudations.

## KEY TO THE EUROPEAN SPECIES

(Note: excellent optical equipment is crucial for identification!)

- 1a. All hyphae of fruit-body without clamp-connections ..... 2  
 b. All hyphae of fruit-body with clamp-connections ..... 6
- 2a. Spores ornamented (sometimes very faintly; oil immersion!) ..... 3  
 b. Spores absolutely smooth, never ornamented ..... 4
- 3a. Spores globose to broadly ellipsoid ( $Q = 1.0-1.3$ ), minutely warty, punctate under the light microscope,  $6-8 \times 5.5-6.5 \mu\text{m}$ , with moderately coloured walls; fruit-body red ..... 8. *C. cinnabarinus*  
 b. Spores ellipsoid to oblong-subcylindrical ( $Q = 1.6-2.1$ ), minutely rugulose to almost smooth,  $8.5-12 \times 5-6.5 \mu\text{m}$ , with faintly coloured walls; fruit-body white  
 17. *C. versutus*
- 4a. Spores broadly ellipsoid to ellipsoid ( $Q < 1.7$ ),  $7-10 \times 5-7 \mu\text{m}$ , in side view often amygdaliform, with strongly coloured walls; trama of pileus with gelatinous layer; cheilocystidia narrowly utriform to cylindrical ..... 5  
 b. Spores cylindrical, fusoid to pip-shaped ( $Q = 2.1-3.2$ ),  $6.5-9.5 \times 2.5-3.5 \mu\text{m}$ , with weakly coloured walls; trama of pileus without gelatinous layer; cheilocystidia whip-like, filiform ..... 16. *C. epibryus*
- 5a. Fruit-body with macroscopically recognizable ferruginous scales; spores  $7-10 \times 5-7 \mu\text{m}$  ( $Q = 1.3-1.7$ ) ..... 2. *C. calolepis*  
 b. Fruit-body without macroscopically recognizable scales, cream, yellowish, pale brown; spores  $7-10 \times 5-6.5 \mu\text{m}$  ( $Q = 1.3-1.7$ ) ..... 1. *C. mollis*
- 6a. Spores globose to broadly ellipsoid (mean  $Q < 1.35$ ), echinulate, spiny or punctate under the light microscope ..... 7  
 b. Spores ellipsoid, in side view sometimes amygdaliform (mean  $Q > 1.4$ ), never echinulate but verruculose or rugulose, warty or smooth under the light microscope .. 13
- 7a. Cheilocystidia with short finger-like protuberances, small,  $< 30 \mu\text{m}$  long ..... 8  
 b. Cheilocystidia without finger-like protuberances,  $> 30 \mu\text{m}$  long ..... 9
- 8a. Spores  $6-8 \times 5-7 \mu\text{m}$  ( $Q = 1.2-1.5$ ), fruit-body pinkish red .. 7. *C. roseornatus*  
 b. Spores  $5-6.5 \times 4.5-6 \mu\text{m}$  ( $Q = 1-1.2$ ), fruit-body white or yellow when young  
 6. *C. carpaticus*
- 9a. Spores  $4.5-7.5 \times 5-7 \mu\text{m}$ , distinctly punctate-warty, baculate, moderately thick-walled; cheilocystidia never exclusively antler-like, mostly clavate or cylindrical, flexuous and often branched; lamellae never pink, crowded ..... 11  
 b. Spores  $6-9 \times 4.5-7.5 \mu\text{m}$ , minutely spiny, echinulate, or punctate-warty, rather thin-walled; cheilocystidia narrowly lageniform, rarely clavate, branched and often antler-like; lamellae sometimes pinkish, fairly crowded to distant ..... 10
- 10a. Spores  $6-9 \times 5.5-7.5 \mu\text{m}$  ( $Q = 1.1-1.35$ ), echinulate; fruit-body  $< 30 \text{ mm}$ , thin; young lamellae often pinkish, subdistant to distant ..... 10. *C. cesatii*  
 b. Spores  $6-8 \times 4.5-6 \mu\text{m}$  ( $Q = 1.25-1.5$ ), punctate-warty; fruit-body  $> 30 \text{ mm}$ , fleshy; lamellae crowded, never pinkish ..... 9. *C. macedonicus*
- 11a. Pileus densely covered with orange-fulvous scales, never distinctly hygrophanous  
 4. *C. crocophyllus*  
 b. Pileus without scales, often distinctly hygrophanous ..... 12

- 12a. Cheilocystidia cylindrical, flexuous, often branched; pileipellis a true trichoderm; pileus rounded flabelliform, semicircular, light orange to melon-yellow; young lamellae pale orange ..... 5. *C. ehrendorferi*
- b. Cheilocystidia clavate or lageniform, never flexuous, very rarely mixed with some apically branched ones; pileipellis a cutis with scattered clusters of pileocystidia; pileus often spatuliform, cream to greyish brown; young lamellae cream to clay  
3. *C. applanatus*
- 13a. Spores faintly rugulose or completely smooth; lamellae never pink ..... 14
- b. Spores distinctly rugulose or verruculose; lamellae occasionally pinkish or yellow when young ..... 15
- 14a. Spores completely smooth, 7–9 × 5–6 μm (Q = 1.3–1.7), with strongly coloured, thick walls; fruit-body often fan-shaped, terrestrial ..... 15. *C. autochthonus*
- b. Spores faintly rugulose, 6.5–9.5 × 4.5–6 μm (Q = 1.4–1.7), with moderately to faintly coloured walls; fruit-body semicircular, lignicolous ..... 12. *C. lundellii*
- 15a. Spores ellipsoid to amygdaliform, rugulose, 7.5–10.5 × 5–6.5 μm (Q = 1.4–1.7); cheilocystidia narrowly lageniform ..... 14. *C. subverrucisporus*
- b. Spores elongate to cylindrical (mean Q > 1.7); cheilocystidia cylindrical, flexuous or clavate, obpyriform, sometimes branched ..... 16
- 16a. Spores subcylindrical, fusiform, 8–10 × 4–5 μm (Q = 1.8–2.1); cheilocystidia narrowly cylindrical, flexuous, sometimes branched; fruit-body either fresh or dried lemon-yellow, rarely cream-white, margin rarely lobed ..... 13. *C. luteolus*
- b. Spores cylindrical, 6–9 × 3–4.5 μm (Q = 1.6–2.2); fruit-body white, margin often lobed to crenate ..... 11. *C. variabilis*

### **Crepidotus** subgenus **Crepidotus**

Type: *C. mollis* (Schaeff.: Fr.) Staude.

*Crepidotus* subg. *Gelocutis* Pilát, Atl. Champ. Eur. 6 (1948) 11 (not val., no Lat.).

*Crepidotus* sect. *Laevisporae* Pilát, Hedwigia 69 (1929) 143.

*Crepidotus* subsect. *Defibulati* Sing., Lilloa 13 (1947) 94.

Spores smooth; trama of pileus made up of multi-branched, short-celled hyphae and a gelatinous layer; clamp-connections lacking.

#### 1. **Crepidotus mollis** (Schaeff.: Fr.) Staude — Fig. 42, Plate 1a, b

*Agaricus mollis* Schaeff., Fung. Bavar. Palat. nasc. 4 (1774) 49. — *Agaricus mollis* Schaeff.: Fr., Syst. mycol. 1 (1821) 274. — *Crepidotus mollis* (Schaeff.: Fr.) Staude, Schwämme Mitteldeutschl. 25 (1857) 71. — *Dermisium mollis* (Schaeff.: Fr.) J. Schroet., Pilze Schlesiens (1889) 578. — Neotype (designated here): Netherlands, prov. Noord-Holland, Vogelenzang, 8.XI.1954, on dead *Populus*, *Maas Geesteranus* 10225 (L. 954.292-024).

*Agaricus alveolus* Lasch, Linnaea 4 (1829) 547 (no type). — *Crepidotus alveolus* (Lasch) P. Karst., Ryssl., Finl. Skand. Halföns Hattsvamp. (1879) 414.

*Agaricus chimonophilus* B. & Br., Outl. Brit. Fungol. (1860) 164 (fide Pilát, 1948; type: K).

*Agaricus (Crepidotus) ralsii* B. & Br., Ann. Mag. nat. Hist. 5 (1893) 12 (fide Pilát, 1948; type: K).

*Crepidotus alabamensis* Murr., N. Amer. Fl. 10 (1917) 150 (type: NY).

*Crepidotus fraxinicola* Murr., N. Amer. Fl. 10 (1917) 150 (type: NY).

Table VIII. Main differences between the taxa studied.

	aut	cal	car	ces	cin	cro	epi	ehr	lun	lut	mac	mol	ros	sub	var	ver
app	ef	abc defg	fh	f	adf	bdf	aef h	dh	fg (d)	dfg h	gh	ace g	dfh	fg	fgh	afg
aut	-	abc	eg h(d)	eg h	ade g	bde g	a h	deg h	e (d)	ed h	eh	acf	deg h	e	e h	ae
cal	-	abc deh	abc deh	bcd eg	ace g	bcd h	abc dehg	abc de	abc deh	cde h	bdf	abc degh	abc de	abc eh	abc cde	
car	-	(d)	ad h	bd h	aeg	f	g h	dg	g	ace fgh	d	g h	g	ag h		
ces	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
cin	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
cin	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
cro	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
cro	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
epi	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
epi	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
ehr	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
ehr	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
lun	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
lun	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
lut	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
lut	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
mac	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
mac	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
mol	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
mol	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
ros	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
ros	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
sub	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
sub	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
var	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		
var	-	(d)	adh	bdh	aeg	df	gh (d)	dg	(g)	ace fg	d	gh	g	agh		

Characters: a = clamp-connections, b = scales, c = gelatinous layer, d = pileus colour, e = smooth spores, f = pileus hygrophanous, g = spores globose to broadly ellipsoid (Q = 1-1.3), h = cheilocystidia branched. Species: app = *applanatus*, aut = *autochthonus*, cal = *calolepis*; car = *carpaticus*, ces = *cesatii*, cin = *cinabarinus*, cro = *crocophyllus*, epi = *epibryus*, ehr = *ehrendorferi*, lun = *lundellii*, lut = *luteolus*; mac = *macedonicus*, mol = *mollis*, ros = *roseornatus*, sub = *subverrucisporus*, var = *variabilis*, ver = *versutus*.



*Excluded. Crepidotus mollis* var. *mollis* sensu Hesler & Smith, N. Amer. Spec. Crepidotus (1965) 31.  
*Selected icones.* Sow., Col. Figs. Engl. Fungi 1 (1797) pl. 98; Konr. & M., Ic. sel. Fung: pl. 303. 1.  
*Selected description.* Horak, Syn. Gen. Agar. (1968) 194.

Pileus 3–50(–80) mm, semicircular, rounded flabelliform, reniform or spatuliform, young campanulate to unguulate, later convex to plano-convex, sometimes with low umbo around point of attachment, with inflexed margin, becoming straight and striatulate with age, hygrophanous only in very old fruit-bodies, smooth, glabrous or with scattered innate fibrils sometimes forming indistinct pale scales towards centre, at first not viscid, at maturity distinctly viscid, cream, pale orange-yellow, buff-yellow, ochraceous-buff or pale honey (M 7.5 YR 4/4, 5/6–5/8, 10 YR 4/4, 5/6, 7/4–7/8), at point of attachment often whitish cream, villose; in dried specimens surface wrinkled. Lamellae L = 12–28, l = 1–4, crowded, narrow, up to 4 mm broad, subventricose to linear, narrowly adnexed to free, whitish cream, chamois to snuff-brown (M 7.5 YR 5/6); edge even, sometimes paler. Stipe often none; sometimes present as an eccentric, short, white, tomentose, thick stump. Flesh moderately thick at point of attachment, elastic, olive-buff, cream; gelatinous layer in the upper part thin to rather thick, ratio to the non-gelatinous layer from 1 : 1 to 1 : 13; taste mild or bitterish, odour none. Spore print snuff-brown (M 7.5 YR 4/4).

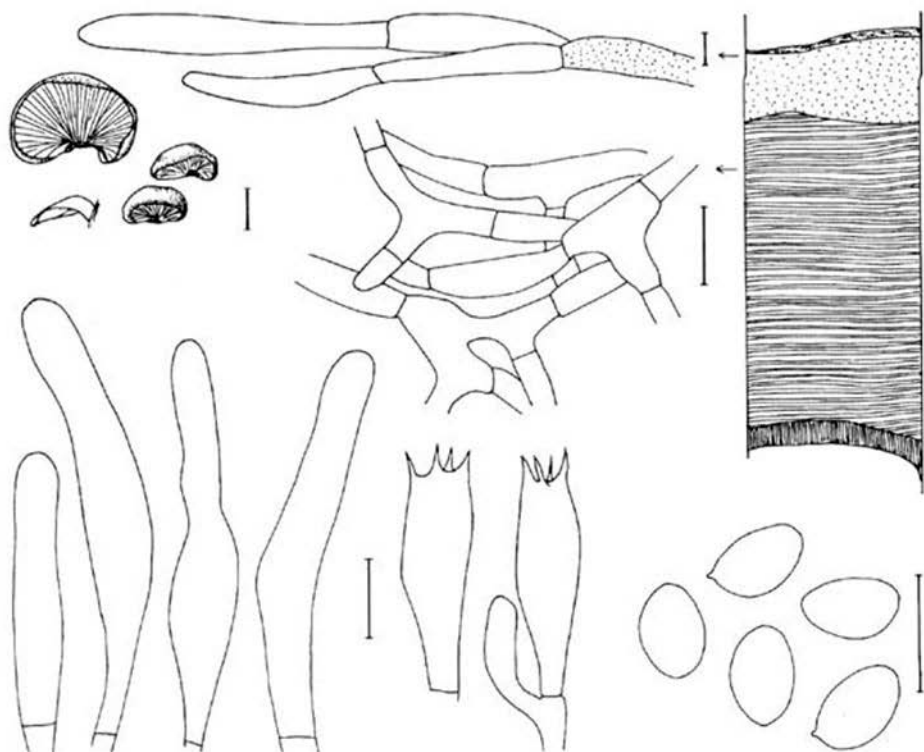


Fig. 42. *Crepidotus mollis*: fruit-body, pileitrama, cheilocystidia, basidia, spores.

Spores 7–10 × 5–6.5 µm, Q = 1.3–1.7, mean volume 134 µm<sup>3</sup>, ellipsoid, slightly inequilateral in side view, smooth; walls strongly coloured, thick. Basidia 18–30 × 6–9 µm, four-spored, clampless. Cheilocystidia 22–55(–74) × 4–10 µm, narrowly utriform, lageniform, cylindrical, hymenial and tramal. Pileipellis a cutis of radially arranged, 4–10 µm wide, sometimes minutely incrustated hyphae; terminal cells undifferentiated. Pileitrama of short-celled, multibranching, hyaline, 6–14 µm wide hyphae; gelatinous layer of 3–5 µm wide, filiform hyphae, 200–400 µm wide. Pigment absent. Clamp-connections absent from all tissues.

**Habitat & Distribution** — On logs or trunks of various hardwood or in cracks of living frondose trees (*Fraxinus*, *Fagus*), rarely on worked wood, from the lowlands up to the montane zone (uppermost record 1030 m). Widespread and frequent. June–December.

*Collections examined.* AUSTRIA: Niederösterreich, Kranichberg, Syhrnlucke, 9 Dec. 1977, *Passauer* (W 06244); Hainburg, 4 May 1980, *Hausknecht* (WU 0235). — BULGARIA: Silistra, Alfatar, Kora-kuz, 12 Nov. 1957, *Hinkova* (SOM 344). — ESTONIA: Tallinn, 21 Aug. 1989, *Senn-Irlet 89/135* (BERN). — FRANCE: dpt Maine-et-Loire, Chauffond, Layon, 25 May 1980, *Mornand 8015B1* (herb. Mornand); dpt Pas-de-Calais, Forêt de Guines, 13 Oct. 1991, *Senn-Irlet 91/216* (BERN); Bois de Boulogne, 15 Oct. 1991, *Senn-Irlet 91/229* (BERN). — GERMANY: Baden-Württemberg, Friedrichshafen, 19 Aug. 1970, *Winterhoff* (herb. Winterhoff). — GREAT BRITAIN: England, Clanton heath, Surrey, 18 Oct. 1953, *Deche-rain* (L). — JUGOSLAVIA: Neuhaus, Aug. 1937, *Porsch 8169* (W). — NETHERLANDS: prov. Noord-Holland, Vogelenzang, 8 Nov. 1954, *Maas Geesteranus 10225* (L); prov. Utrecht, Linschoten, 15 Nov. 1951, *van der Voo* (L). — LICHTENSTEIN: Balzers, May 1989, *Prongué 8931* (herb. Prongué). — SWITZERLAND: Kt. Bern, bei Bern, Oct. 1849, *Trog* (BERN); Bern-Bremgartenwald, 19 Dec. 1982, *Irlet 80/352* (BERN); Bern-Dählhölzli, 13 June 1982, *Irlet 82/32* (BERN); Bremgarten, Oct. 1853, *Fischer* (BERN); Thun, an der Zug, June 1850, *Trog* (BERN); Brienz, Birchetal, 25 Sept. 1991, *Senn-Irlet 91/149* (BERN); Brienz, Giessbach, 21 June 1992, *Senn-Irlet 92/157* (BERN); ct. Jura: Develier, La Vache, 28 Sept. 1989, *Senn-Irlet 89/200, 89/195\** (BERN); Kt. Luzern: Horw, Birregwald, 12 Sept. 1976, *Richoz 1209-76-R* (NMLU); Sins, 10 June 1973, *Bächler 1006-73-BA9* (NMLU); Hasle, Sandboden, 30 Sept. 1988, *Senn-Irlet 88/421* (BERN); Kt. Schwyz: Steinen, 2 Oct. 1991, *Senn-Irlet 91/165* (BERN); ct. Vaud, Lausanne, Stade de Vidy, 15 Nov. 1972, *Cléménçon 72/1127* (LAU); Kt. St. Gallen, Quinten, 29 June 1988, *Bächler 2006-88-Ba3* (NMLU); ct. Ticino, Someo, 17 Sept. 1989, *Senn-Irlet 89/176* (BERN); Dalpe, 20 Aug. 1981, *Riva* (Lugano 1778); Meride, Murgala, 3 Oct. 1981, *Lucchini* (Lugano 1958).

Due to its gelatinous layer, which makes the whole fruit-body elastic, *Crepidotus mollis* is easily identified. It seems to be the only species fruiting in cracks of living trees and therefore probably has parasitic capacities.

There exist forms with some coloured innate fibrils or even scale-like fibrils, which may be confounded with *Crepidotus calolepis*. In such cases the spore forms have to be examined carefully, *C. mollis* is characterized by narrower spores and hyphae of the pileipellis which are never heavily incrustated.

## 2. *Crepidotus calolepis* (Fr.) P. Karst. — Fig. 43

*Agaricus calolepis* Fr., Öfvers. K. Vetensk.-Akad. Förh. 30 (5) (1873) 5. — *Crepidotus calolepis* (Fr.) P. Karst. in Bidr. Känn. Finl. Nat. Folk 32 (1879) 414. — *Crepidotus mollis* var. *calolepis* (Fr.) Pilát, Acta Mus. nat. Prag. 2B (1940) 74. — *Crepidotus mollis* subsp. *calolepis* (Fr.) Norstein, Syn. Fung. 2 (1990) 67.

— *Crepidotus fulvotomentosus* Peck, Annu. Rep. N.Y. State Mus. nat. Hist. 26 (1874) 57 (fide Singer 1947, type: NY).

*Crepidotus calolepidoides* Murr., Mycologia 5 (1917) 30 (type: NY).

## KEY TO THE VARIETIES

- 1a. Spores 7–10  $\mu\text{m}$  long, scale-forming hyphae up to 15  $\mu\text{m}$  wide . . . . a. var. *calolepis*  
 b. Spores larger, 8–12  $\mu\text{m}$  long, scale-forming hyphae up to 22  $\mu\text{m}$  wide  
 b. var. *squamulosus*

2a. *Crepidotus calolepis* var. *calolepis*

*Agaricus calolepis* Fr. — *Crepidotus calolepis* (Fr.) P. Karst. — Neotype (designated here): Estonia, Kothla-Järve, in deciduous forest on bark, 5.VIII.1961, *Kalamees* (TAA 72403, isotype: L).

*Misapplied name.* *Crepidotus mollis* (Fr.) Staude var. *mollis* sensu Hesler & Smith, 1965.

*Selected icones.* Fries, Ic. sel. Hymenomyc. 2 (1878) pl. 129, fig. 4; Ryman & Holmåsén, Svampar (1984) 468.

Pileus 16–55(–100) mm, semicircular, reniform, orbicular, rounded flabelliform, young campanulate, later convex to plano-convex, with margin initially distinctly inflexed, sessile, mostly laterally attached, on sordid or pallid ground densely tomentose at first, later appressed fibrillose-scaly, with tomentum and the scales sayal-brown, ochraceous-ferruginous, ochraceous-tawny (M 5 YR 4/6, 5/8, 10 YR 5/6–5/8), later pigmented layer often partly washed off and the pileus becoming hygrophanous, sticky and pale ochraceous to light ochraceous-tawny; at point of attachment sometimes tomentose-villose, white to cream. Lamellae L = 14–18, l = 2–3, fairly crowded, narrow, up to 3 mm wide, arcuate to subventricose, narrowly adnexed, cream, light buff, light ochraceous-buff to cinnamon; edge minutely fimbriate, whitish, later even. Stipe only recognizable in very young fruit-bodies, central at first, later eccentric, lateral and reduced. Flesh moderately thick below point of attachment, elastic, cream to olive-buff; gelatinous

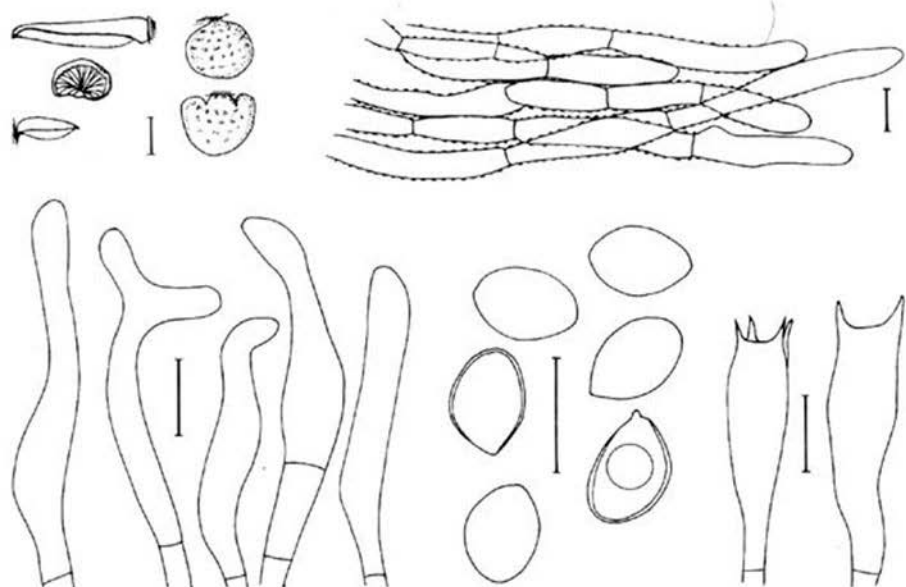


Fig. 43. *Crepidotus calolepis*: fruit-bodies, pileipellis, cheilocystidia, basidia, spores.

layer narrow to broad, occupying 1/4 to 1/10 of the pileus-trama; taste mild or bitterish; odour none. In dried specimen pigmented scales remaining clearly recognizable.

Spores 7.5–10 × 5–7 µm, Q = 1.3–1.7, mean volume 173 µm<sup>3</sup> ellipsoid, slightly inequilateral to amygdaliform in side view, smooth, strongly coloured, walls moderately thick. Basidia 22–37 × 6–10 µm, four-spored, rarely mixed with two-spored, clampless. Cheilocystidia (26–)32–52(–76) × 5–8 µm, cylindrical, narrowly utriform, lageniform, rarely clavate and septate, hyaline, arising from trama as well as from hymenium. Pileipellis a cutis of radially arranged, 3–5 µm wide hyphae. Scales formed by bundles of 6–14 µm wide hyphae composed of botuliform short cells; terminal cells often slightly thick-walled, undifferentiated. Oleiferous hyphae sometimes present in upper pileitrama. Pigment brown, incrusting scale-forming cells of pileipellis. Clamp-connections absent from all tissues.

Habitat & Distribution — On hardwood, mainly *Populus* (Norstein, 1990) in boreal Europe, southwards already very rare in Denmark (J. Lange, 1938), on hardwood of various kinds in the mediterranean region, lacking (or very rare?) in temperate Europe. Frequent in greater parts of its area of distribution. June–February.

*Collections examined.* ESTONIA: Haapsalu, Reserv. Matsalu, 4 Aug. 1979, *Kalamees* (TAA 120729); Valga, Lullemae, 24 Aug. 1982, *Veldre* (TAA 144861); Harju, Lahemaa National Park, 18 Oct. 1975, *Kalamees* (TAA 94708), 22 Aug. 1989, *Senn-Irlet 891136* (BERN), 18 Oct. 1975, *Kalamees* (TAA 94708); Pärnu: Surju, 27 Aug. 1989, *Kollom* (TAA 127668); Rakvere, Maasikarn, 12 Aug. 1958, *Kalamees* (TAA 71000); neotype (designated here): Kothla-Järve, in deciduous forest on bark, 5 Aug. 1961, *Kalamees* (TAA 72403) — PORTUGAL: June 1964 (K). — SPAIN: Cuenca, March 1975, *Moreno 478* (GDAC); Islas Canarias, Gomera, Meseta Vallehermoto, Feb. 1982, *Bañares 1998* (herb. La Laguna). — SWEDEN: Upland: Rasbo, Grän, 31 July 1990, *Gahne 90-30* (BERN).

ALGERIA: 25 Nov. 1932, *Kühner* (G 18444). — MAROCCO: Volubilis, 27 Nov. 1989, *Hausknecht* (WU-S/1925).

CANADA: prov. Alberta, Banff, 26 July 1990, *Senn-Irlet 901151, 901154* (BERN); prov. British Columbia, Yáhk, 5 Sept. 1989, *Vellinga* (L 984.303-073\*). — USA: California, San Mateo Co., San Francisco watershed, 22 Dec. 1963, *Thiers 11188* (NY as *C. fulvotomentosus*); Maine, Piscataquis Co., Boarstone Camp, 12–14 Sept. 1905, *Murrill 246* (NY); Massachusetts, Arlington, 5 Oct. 1907, *Piquet* (K, Reliquiae Farlowiana no. 319 as *C. fulvotomentosus* Peck); Michigan, Mount Morency, 4 Aug. 1967, *Cléménçon 670804* (LAU), Pellston Hills, 17 July 1961, *Reid* (K as *C. fulvotomentosus* Peck); New York, Ulster Co., Shandaken, 14 Oct. 1990, *Senn-Irlet 901108* (BERN).

Fries (1878) gives an excellent illustration of this species and despite his remark that *C. calolepis* lacks a gelatinous layer, I consider this illustration as a perfect presentation of his concept of it. An extended study of Scandinavian material (Norstein, 1990) as well as of Moroccan material (Malençon & Bertault, 1975) did not reveal any collection without a gelatinous layer, but this layer may be very thin and therefore may have escaped Fries' observation.

I agree with Singer (1973) that *C. calolepis* is very distinct from *C. mollis* on account of its brown scales, which form a dense brownish tomentum in young fruit-bodies never found in *C. mollis*.

Fig. 35 illustrates the differences in spore size between *C. calolepis* var. *calolepis*, *C. calolepis* var. *squamulosus* and *C. mollis*, respectively.

I am convinced that *C. calolepis* with its brown scales and its somewhat wider spores deserves autonomous status at species level.

*Crepidotus calolepis* seems to be very common in North America.

**2b. *Crepidotus calolepis* var. *squamulosus* (P. Coutinho), *comb. nov.***

*Basionym.* *Crepidotus mollis* var. *squamulosus* P. Coutinho, Bolm Soc. broteriana IX (1934) 211. — Neotype (designated here): Canary Islands, Tenerife, Vuelta de Taganana, macrophyllous evergreen forest, on fallen hardwood branch, III.1989, Lussi & Senn-Irlet 89/9 (G).

Pileus 5–45 mm, rounded flabelliform, semicircular, spatulate, convex with low umbro at point of attachment sessile, laterally attached, with initially broadly inflexed margin, young completely and densely villose, later appressedly fibrillose-scaly on sordid or pale yellow ground with tomentum or scales always more densely towards point of attachment, and sayal-brown, ochraceous-ferruginous, ochraceous-tawny (M 5 YR 4/8, 10 YR 7/8), becoming hygrophanous, at point of attachment cream tomentose, in dried specimen becoming ochre or remaining yellowish with scales remaining clearly recognizable. Lamellae  $L = 12-24$ ,  $l = 1-3$ , narrow, crowded, arcuate to subventricose, narrowly adnexed, cream, light buff, light ochraceous-buff to cinnamon, with minutely fimbriate, later even edge. Stipe only visible in very young fruit-bodies ( $< 1$  mm) first central, soon eccentric, later lateral, reduced or lacking. Flesh moderately thick, especially below point of attachment, elastic, whitish to cream; gelatinous layer thick, up to half as thick as pileus.

Spores  $8.5-12 \times 6-7.5 \mu\text{m}$ ,  $Q = 1.3-1.7$ , mean volume  $247 \mu\text{m}^3$ , ellipsoid, slightly inaequilateral to amygdaliform in side view, smooth, strongly coloured; walls moderately thick. Basidia  $25-33 \times 6-8 \mu\text{m}$ , four-spored, without clamps. Cheilocystidia  $31-87 \times 4-40 \mu\text{m}$ , cylindrical and flexuous, sometimes subcapitate or narrowly lageniform or septate, hyaline, rarely some with yellowish contents, arising from trama as well as from hymenium. Pileipellis a cutis of repent, radially arranged,  $2.5-5 \mu\text{m}$  wide, hyaline hyphae; scales formed by bundles of  $8-15(-22) \mu\text{m}$  wide, made up of botuliform, short cells. Pigment brown, heavily and densely incrusting scale-forming hyphae of pileipellis. Clamp-connections absent from all tissues.

**Habitat & Distribution** — On hardwood in meridional regions. Scattered. November–March.

*Collections examined.* ITALY: Sicily, Forte Campone, 17 Nov. 1988, Bellu 82/271 (herb. Bellu). — SPAIN: Islas Canarias, Tenerife, Mte Aguirre, Oct. 1979, Bañares 1668 (herb. La Laguna), Vuelta de Taganana, 15 March 1989, Lussi & Senn-Irlet 89/9\* (G).

USA: California, Berkeley University Campus, 20 Jan. 1978, Tavares 2528 (G).

As the spores of var. *squamulosus* are somewhat longer as well as somewhat wider than those of var. *calolepis*, the differences in spore size are best expressed in spore volumes (see Fig. 35). As these varieties occur sympatrically in southwestern mediterranean areas, this species complex seems favourable for investigations with molecular techniques to reveal the speciation process.

***Crepidotus* subgenus *Dochmiopus* (Pat.) Pilát**

*Dochmiopus* Pat., Hyménomyc. Eur. (1887) 113. — *Crepidotus* subg. *Dochmiopus* (Pat.) Pilát, Atl. Champ. Eur. 6 (1948) 12 (type: *C. variabilis* (Pers.: Fr.) Kumm.).

*Crepidotus* subg. *Sphaerocrepidotus* Pilát, Atl. Champ. Eur. 6 (1948) 11 (not val., no Lat.).

*Crepidotus* subg. *Geophila* Pilát, Atl. Champ. Eur. 6 (1948) 12 (not val., no Lat.).

*Crepidotus* subg. *Nebulosi* Pilát, Atl. Champ. Eur. 6 (1948) 12 (not val., no Lat.).

*Crepidotus* subg. *Muscicoli* Pilát, Atl. Champ. Eur. 6 (1948) 12 (not val., no Lat.).

*Crepidotus* subg. *Colorati* Pilát, Atl. Champ. Eur. 6 (1948) 12 (not val., no Lat.).

*Crepidotus* subg. *Sphaerula* Hesler & Smith, N. Amer. Spec. *Crepidotus* (1965) 38 (type: *C. applanatus* (Pers.) Kumm. sensu Joss.).

Trama without gelatinous layer, trama of pileus not made up of short-celled, multi-branched hyphae. Spores mostly ornamented, rarely smooth. Clamp-connections present or absent.

### Section *Dochmiopus*

Sect. *Sphaerula* Hesler & Smith, N. Amer. Spec. *Crepidotus* (1965) 40 (type: *C. applanatus* (Fr.) Kumm.).

Sect. *Cinnabarinini* Hesler & Smith, N. Amer. Spec. *Crepidotus* (1965) 20 (type: *C. cinnabarinus* Peck.).

Spores mainly globose or rarely oblong-ellipsoid, verruculose, tuberculose, baculate or echinulate, fruit-body white or red.

### 3. *Crepidotus applanatus* (Pers.) Kumm.

*Agaricus applanatus* Pers., Observ. mycol. 1 (1796) 8. — *Crepidotus applanatus* (Pers.) Kumm., Führ. Pilzk. (1871) 74. — Neotype (designated here): Scotland, Loch Lomond, on hardwood stump, 27.VIII. 1963, E. Kits van Waveren (L 986.062-019).

*Agaricus putrigenus* B. & C., Ann. Mag. nat. Hist., ser. 3, 4 (1859) 292 (type: K). — *Crepidotus putrigenus* (B. & C.) Sacc., Syll. Fung. 5 (1887) 883.

Misapplied name. *Crepidotus applanatus* var. *fulvifibrillosus* (Murr.) Pilát sensu Pilát, Atl. Champ. Eur. 6 (1948) 35.

#### KEY TO THE VARIETIES

- 1a. Cheilocystidia clavate, capitate; spores 4.5–7 µm long; mainly on hardwood  
a. var. *applanatus*
- b. Cheilocystidia cylindrical, lageniform; spores 5.0–7.5 µm long; on coniferous wood  
b. var. *subglobiger*

*Crepidotus applanatus* belongs to a species complex that is especially rich in North America, comprising almost all taxa described by Hesler & Smith (1965: 40, 71) in subsections *Sphaeruli* and *Fulvifibrillosi*, i. e. a total of at least 27 taxa. These taxa are distinguished mainly by spore size, nature of the covering of the pileus, and colour of the fruit-bodies.

Within *C. applanatus* two of the variants accepted by Hesler & Smith (1965) exist in Europe. As shown above (see Table V, Fig. 36) spore size is a separating character on population level but not always on sample level. However, a clear correlation exists between the shape of the cheilocystidia and the substrate which allows for taxonomic separation on an infraspecific level.

### 3a. *Crepidotus applanatus* var. *applanatus* — Figs. 19, 44a, Plate 3a

*Selected icon.* Mos. & Jül., Farbatl. Basidiomyc. 3 (1986) III *Crepidotus* I.

*Selected description.* Jossierand, Bull. trimest. Soc. mycol. Fr. 53 (1937) 219–222.

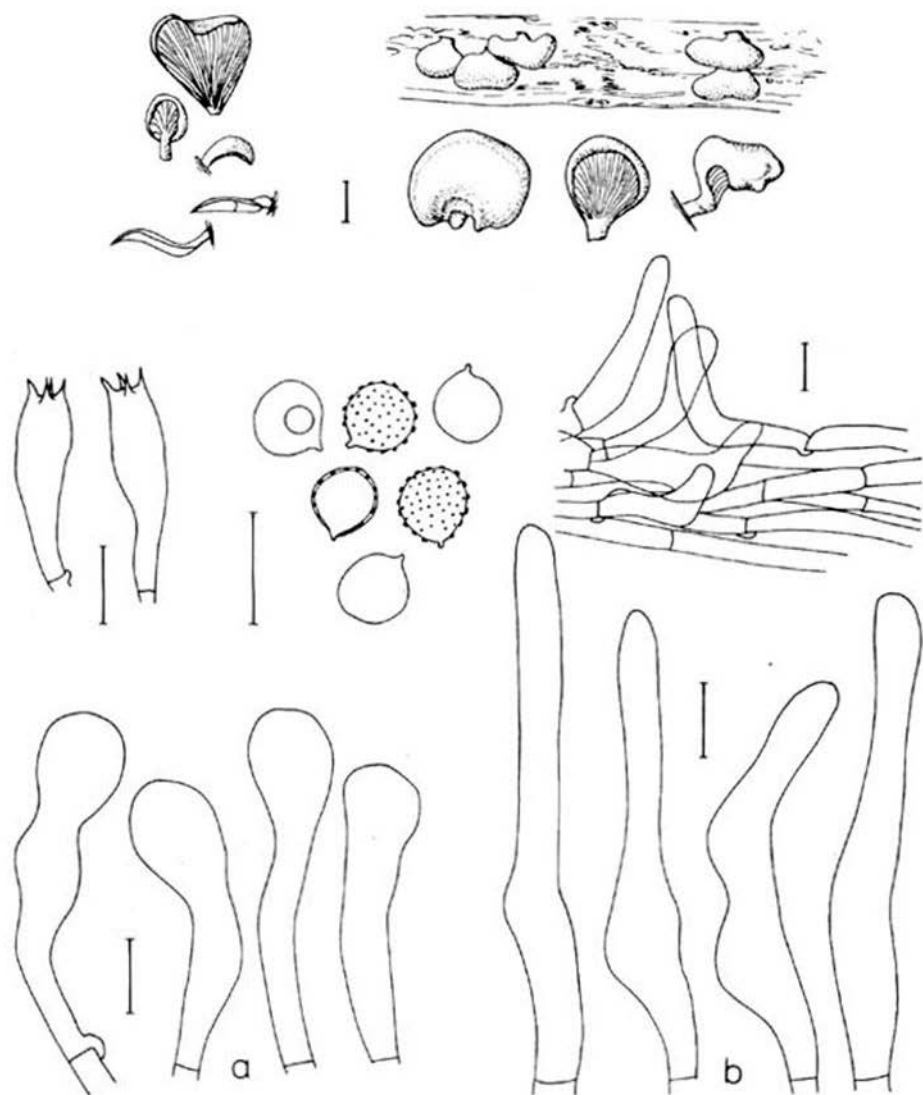


Fig. 44. *Crepidotus applanatus* s.l.: fruit-bodies, basidia, spores, pileipellis, cheilocystidia, (a) var. *applanatus*, (b) var. *subglobiger*.

Pileus 5–50 mm, spatuliform, petaloid, flabelliform, rounded flabelliform, semi-circular to circular, convex becoming plano-convex or applanate, with margin narrowly inflexed, soon becoming straight, hygrophanous, translucently striate at margin especially

when wet, smooth, white or pale grey, becoming whitish cream, dingy cream to avelanous (M 2.5 YR 8/3–7/3–7/6, 7.5 YR 6/4, 7.5 YR 7/4–7/6), in dried specimen ochreyellow or cream; point of attachment lateral or sometimes dorsal, felted or distinctly fibrillose-villose, white to cream. Lamellae, L = 12–18, l = 1–5, close to crowded, narrow, up to 2(–3) mm broad, arcuate, subventricose to linear, in younger stages distinctly decurrent, then narrowly adnate, white, later cinnamon, sayal-brown to snuff-brown (M 7.5 YR 5/6–5/8, 6/8, 7/8, 10 YR 6/8–7/8); edge even. A short and rather thick stipe at times present, white, tomentose. Flesh thin, white when faded, watery when fresh, not very fragile. Odour none. Taste mild. Spore print ochraceous-tawny to snuff-brown (M 7.5 YR 4/4, 10 YR 5/6).

Spores 4.5–7.0 × 4.5–6.5 μm, Q = 1.0–1.12, mean volume 96 μm<sup>3</sup>, globose to subglobose, contracted towards apiculus, warty-punctate, but almost smooth in optical section, with perispore, distinctly coloured. Basidia 18–29 × 5–9 μm, four-spored, clamped. Cheilocystidia 23–68 × 3–10 × 11–16 μm, clavate, capitate, more rarely flexuous, angled or slightly branched, hyaline. Pileipellis a cutis of repent 3.5–6(–10) μm wide, hyaline, cylindrical hyphae. Pileocystidia 30–65 × 5–9 μm, narrowly utriform, subcapitate, in clusters. Pigment lacking. Clamp-connections present in all tissues.

Habitat & Distribution — On logs and stumps of hardwood (*Fagus*, *Acer*, *Fraxinus*), exceptionally on coniferous wood. Submeridional to temperate. August–October.

*Collections examined.* AUSTRIA: Salzburg, Flachgau, bei Fürstenbrunn, 27 July 1990, *Rücker 96-90* (BERN). — BULGARIA: Zavoda, Rebarclza, 30 Aug. 1971, *Varev* (K). — CZECHOSLOVAKIA: Moravia, Ranspuk, 1 Aug. 1967, *Lazebnicek* (BRNM 313000); Zakova hora, 5 Sept. 1967, *Smardova* (BRNM 313044); Vihorlat, 2 Oct. 1967, *Konceroova & Kriz* (BRNM 266957). — FRANCE: dpt Vosges, Laxeuil, 8 July 1935, *Josserand* (herb. Josserand). — GERMANY: Bayern, Bayerischer Wald, Lärchenberg, 30 Sept. 1986, *Luschka 47* (herb. Luschka); Bayerischer Wald, Ruchelbachauer, 26 Sept. 1988, *Luschka 460* (herb. Luschka). — GREAT BRITAIN: Scotland, Loch Lomond, 27 Aug. 1963, *Kits van Waveren* (neotype: L 986.062-019); Wales, Lake Vyrnwy, 31 Aug. 1964, *Kits van Waveren* (L 985.109-096). — ITALY: prov. Vercelli, Fabell, 28 Sept. 1983, *Cavallera 83/572* (IB). — LATVIA: Talsi, reserv. Slitere, 22 Sept. 1982, *Kalamees* (TAA 122536). — NETHERLANDS: prov. Noord-Brabant, Oosterwijk, 20 Sept. 1962, *Donk* (L 962.24-019); prov. Gelderland, S. Hilversum, 1 Sept. 1951, *de Wit* (L 951.115-137); prov. Utrecht, Soest-Pijnenburgse bos, 19 Aug. 1972, *de Kleuver* (L 984.37-220). — RUSSIA: Krasnodar, Reservatum Caucasicum, Psekis, 9 Sept. 1975, *Kalamees* (TAA 94494), Guzeripl, 13 Aug. 1974, *Kalamees* (TAA 94031, 94041), Kraswaja-Poljawa, 27 Aug. 1974, *Kalamees* (TAA 94195). — SWITZERLAND: Ct. Jura, Bassecourt, La Caquerelle, 28 Sept. 1989, *Senn-Irlet 89/197\** (BERN); Boécourt, 26 Sept. 1989, *Chételat* (BERN); Kt. Luzern, Weggis-Lützelau, 5 Sept. 1981, *Müller 0509-81* (NMLU). — TURKEY: Bolu, Aug. 1979, *Sümer 126* (K).

*Crepidotus applanatus* unites several characteristic features, which makes it easy to recognize: pileus spatulate, distinctly hygrophanous, smooth; margin translucently striate; lamellae long remaining white; occurring on decayed logs; pileipellis a cutis with scattered but distinct pileocystidia. The spores are more globose, darker coloured and with a thicker spore-wall than in *C. cesatii*.

Two collections (TAA 122536, TAA 94195) exhibit very large spores (6.1–7.6 × 6.0–7.6 μm, see Fig. 36) which fall beyond the range of *C. applanatus* var. *subglobiger*, but on account of the shape of the cheilocystidia and the substrate they must be interpreted as a macrosporous (polyploid?) form of var. *applanatus* or an undescribed and badly known taxon from Eastern Europe.



3b. *Crepidotus applanatus* var. *subglobiger* Sing. — Fig. 44b

*Crepidotus applanatus* var. *subglobiger* Sing., Beih. Nova Hedwigia 44 (1973) 478. — Holotype: Mexico, Oaxaca, Singer M8400 (F, not seen).

Misapplied name. *Crepidotus applanatus* var. *globiger* (Berk.) Pilát sensu Pilát, Atl. Champ. Eur. 6 (1948) 36, sensu Hesler & Smith, N. Amer. Spec. Crepidotus (1965) 50.

Pileus 5–45 mm, spatuliform, petaloid, flabelliform, rounded flabelliform, semicircular to circular, convex becoming plano-convex or applanate, with margin narrowly inflexed, soon becoming straight, hygrophanous, translucently striate at margin especially when wet, smooth, white or pale grey, becoming whitish cream to dingy cream to avelanous (M 2.5 Y 8.3–7/3–7/6, 7.5 YR 6/4, 7.5 YR 7/6); point of attachment lateral or sometimes dorsal, white to cream felted or distinctly fibrillose-villose. Lamellae, L = 10–16, l = 1–3, close to crowded, narrow, up to 2–3 mm broad, arcuate, subventricose to linear, in younger stages distinctly decurrent, then narrowly adnate, white, later cinnamon, sayal-brown to snuff-brown (M 7.5 YR 4/6–5/6); edge even. A rather thick and short stipe at times present, white, tomentose. Flesh thin, white when faded, watery when fresh, not very fragile. Odour none. Taste mild. Spore print ochraceous-tawny to snuff-brown (M 7.5 YR 4/4, 10 YR 5/6).

Spores 5.0–7.5 × 5.0–7.0, Q = 1–1.2, mean volume 109 μm<sup>3</sup>, globose to subglobose, contracted towards apiculus, warty-punctate, almost smooth in optical section, baculate, with a perispore, distinctly coloured. Basidia 22–33 × 6–11 μm, four-spored, clamped. Cheilocystidia (20–)30–75(–90) × 5–10 μm, cylindrical, narrowly lageniform or narrowly utriform, mixed with some flexuous, angled or forked ones, rarely some subcapitate, hyaline. Pileipellis a cutis of repent, 4–9 μm, hyaline, cylindrical, sometimes minutely incrustated hyphae and scattered, narrowly lageniform pileocystidia, 35–67(–92) × 7.5–13 μm. Pigment lacking. Clamp-connections present in all tissues.

Habitat & Distribution — On logs and stumps of coniferous wood (*Picea*, *Pinus*). Submeridional to temperate. Mainly in mountainous regions, from the lowlands up to the subalpine zone (uppermost record 1550 m). Scattered to frequent. August–November.

Collections examined. CZECHOSLOVAKIA: Teleci, 27 Sept. 1963, *Hornicek* (BRNM 333 558). — FRANCE: dpt Maine-et-Loire, Forêt de Chaudelay, 2 Nov. 1976, *Mornand* 76192 (herb. Mornand); ex herb. Kühner sub nomen C. *subscalaris* (G 18434). — GERMANY: Bayern, Regensburg, Painter Forst, 13 Sept. 1972, *Cléménçon* 72168 (LAU). — ITALY: prov. Bolzano, Selva dei Molini, 26 Aug. 1986, *Bellu* 86/98\* (herb. Bellu). — NETHERLANDS: prov. Gelderland, Harderwijk, 27 Sept. 1988, *de Vries* 5282 (WAG-W). — SPAIN: Madrid, Rasafria, 11 Nov. 1975, *Rollan* (GDAC 473); Segovia, Boca del Amo, 13 Nov. 1978, *Soc. Mic. Cast.* (GDAC 5171). — SWITZERLAND: Kt. Graubünden, Zernez, Las Vallaines, 22 July 1942, *Favre* (G 13806); ct. Vaud, Pont de Nant, 26 Aug. 1976, *Cléménçon* 79170 (LAU).

The shape of the cheilocystidia is a good distinctive character of var. *subglobiger*. In the examined annotated collections on or still attached to pieces of wood I found only coniferous wood, which leads me to the supposition that var. *subglobiger* may be an ecotype on coniferous wood.

As shown in Table V and Fig. 36 the spores of var. *subglobiger* are somewhat larger than in var. *applanatus* but have a very large range which hampers an identification based on spore size alone.

Two collections from *Pinus* (WAG-W 5283, GDAC 473) show finely incrustated hyphae in the pileipellis, which, however, do not form macroscopically recognizable scales. Yet,

Norstein (1990: 88) reports even macroscopically recognizable, brown, innate fibrils for some collections. These mostly colourless-incrusted hyphae can hardly be compared with the yellow-brown hyphae with thick-walled terminal cells forming the distinct scales in *C. crocophyllus*. But they may indicate a certain relationship between these two species.

#### 4. *Crepidotus crocophyllus* (Berk.) Sacc. — Figs. 20, 21, 45

*Agaricus crocophyllus* Berk., Lond. Bot. 6 (1847) 313. — *Crepidotus crocophyllus* (Berk.) Sacc., Syll. Fung. 5 (1887) 886. — Holotype: USA, Ohio, Waynesville, 4.IX.1844, *Lea* (K).

*Crepidotus appianatus* var. *crocophyllus* (Berk.) Pilát, Atl. Champ. Eur. 6 (1948) 35.

*Crepidotus fulvifibrillosus* Murr., N. Amer. Fl. 10 (1917) 153 (type: NYS, not seen). — *Crepidotus appianatus* var. *fulvifibrillosus* (Murr.) Pilát, Atl. Champ. Eur. 6 (1948) 35.

*Agaricus dorsalis* Peck, Ann. Rep. N.Y. St. Mus. 24 (1872) 69 (type: NY). — *Crepidotus dorsalis* (Peck) Sacc., Syll. Fung. 5 (1887) 883 (fide Singer, 1947, and Hesler & Smith, 1965).

*Selected icones*. Dermek, Fung. rar. Ic. col. 17 (1987) 19. — Mos. & Jül., Farbatl. Basidiomyc. 3 (1986) III *Crepidotus* 2. — Ricek, Z. Pilzk. 36 (1970) 207.

Pileus 10–35(–55) mm, first spatulate, later rounded-flabelliform, reniform to semi-circular, suborbicular, with inflexed, later straight, not-sulcate margin, young densely squamulose, later subsquamulose to fibrillose, with orange-rufous or ferruginous to chestnut scales (M 7.5 YR 5/6, 6/6–6/8) on pallid, yellowish to tawny ground; point of attachment lateral or dorsal, tomentose to villose, ferruginous or orange; when dried ferruginous and very brittle. Lamellae, L = 10–20, l = 1–3, crowded, more or less narrow, subventricose, narrowly adnate, capucine-yellow or salmon-orange to apricot-orange or orange-rufous to cinnamon (M 7.5 YR 5/6–5/8, 6/8); edge fimbriate, whitish. Stipe absent. Flesh thin, white. Odour none, Taste mild to bitterish. Spore print ochraceous-tawny to cinnamon (M 7.5 YR 5/6–10 YR 5/6).

Spores 5.5–7 × 5.5–7 μm, Q = 1–1.1, mean volume 138 μm<sup>3</sup>, globose to subglobose, contracted towards apiculus, warty-punctate, but almost smooth in optical section, baculate, with perispore, distinctly coloured. Basidia 26–36 × 5–8 μm, four-spored, clamped. Cheilocystidia 26–60 × 5–12(–15) μm, clavate, narrowly lageniform, sometimes almost cylindrical, (sub)capitate, flexuous, very rarely somewhat branched, often eroded. Pileipellis a cutis of repent, 4–6 μm wide, hyaline hyphae mixed with bundles of ascending 10–22 μm wide, finely incrusted, coloured hyphae; terminal cells of scale-forming hyphae conical or cylindrical, sometimes slightly flexuous, often thick-walled and without incrustations. Pigment yellow-brown in KOH, intracellular and incrusting in hyphae of squamules on pileus. Clamp-connections present in all tissues.

Habitat & Distribution — On hardwood (*Ulmus*, *Fraxinus*, *Fagus*, *Carpinus*). Submeridional to temperate. In Europe only known from central and southeastern parts. Rare. June–October.

*Collections examined*. AUSTRIA: Niederösterreich, Marchegg, March-Auen, 13 Sept. 1990, *Forstinger*\* (WU 8833); Oberösterreich, Molln, Inner-Breitenau, 21 Sept. 1986, *Forstinger* (WU 5628). — BULGARIA: Ropotamo, Sozopol, 16 June 1976 (L 978.330-130). — CZECHOSLOVAKIA: Moravia, Cahov, Lanzhot, 6 Oct. 1967, *Koncerova, Lazebnické & Vagner* (BRNM 313035, 313030); 9 Aug. 1968, *Stankovičová* (BRNM 266935). — RUSSIA: Caucasus, Saken, 1928, *Singer* (W); Umpor reserve, 11 Aug. 1976, *Varasma* (TAA 95084).

CANADA: Ontario, Bismarck, 24 Sept. 1984, *Moser 841236* (IB). — USA: Ohio, Waynesville, 4 Sept. 1844, *Lea* (K, type).

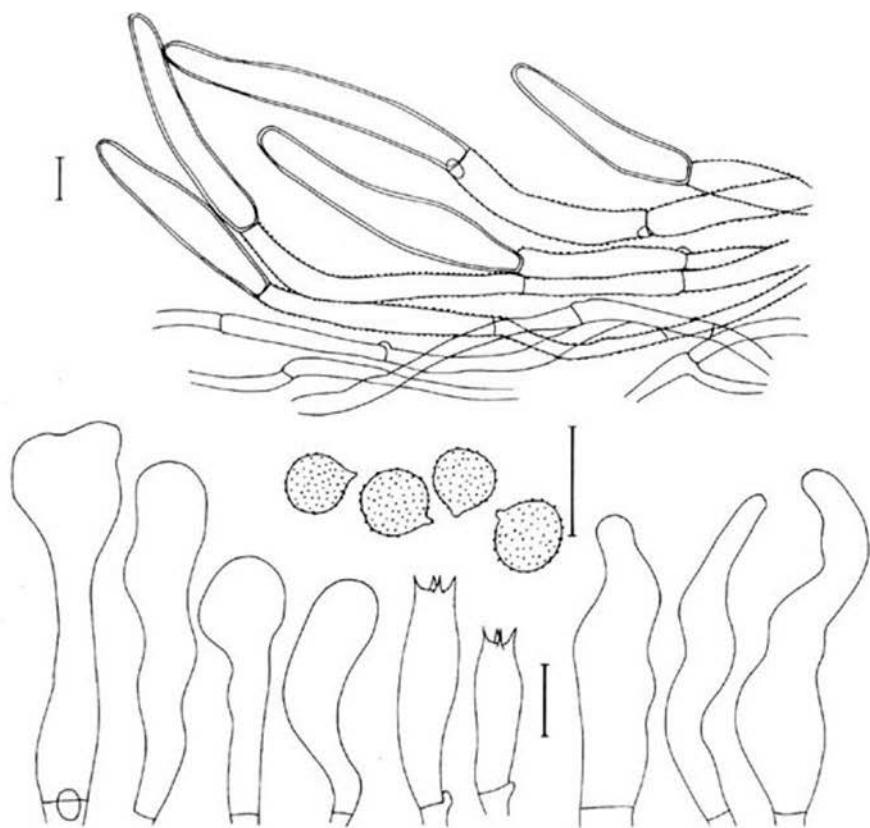


Fig. 45. *Crepidotus crocophyllus*: pileipellis, cheilocystidia (a) from coll. BRM 266935, (b) from coll. WU5628, basidia, spores.

Easily recognized because of the squamulose pileus, the salmon-orange lamellae, and the pileus which lacks any gelatinous layer. The spores, however, are in all features the same as in *C. applanatus* as can be seen in SEM: they exhibit the same type of ornamentation. Pilát (1948) has treated this species as a simple variety of *C. applanatus*, including also several other species described from North America.

I regard the presence of scales, the pigments and the spore size (see Table V, Fig. 36) as three independent characters and therefore I consider *C. crocophyllus* an autonomous species. The closely related American taxa need further critical investigation.

##### 5. *Crepidotus ehrendorferi* Hauskn. & Krisai — Figs. 22, 46

*Crepidotus ehrendorferi* Hauskn. & Krisai, Pl. Syst. Evol. 161 (1988) 183. — Holotype: Austria, Wien, Lainzer Tiergarten, 1.IX.1986, Mrazek (WU 6554).

*Selected icon.* Hauskn. & Krisai, Pl. Syst. Evol. 161 (1988) 184.

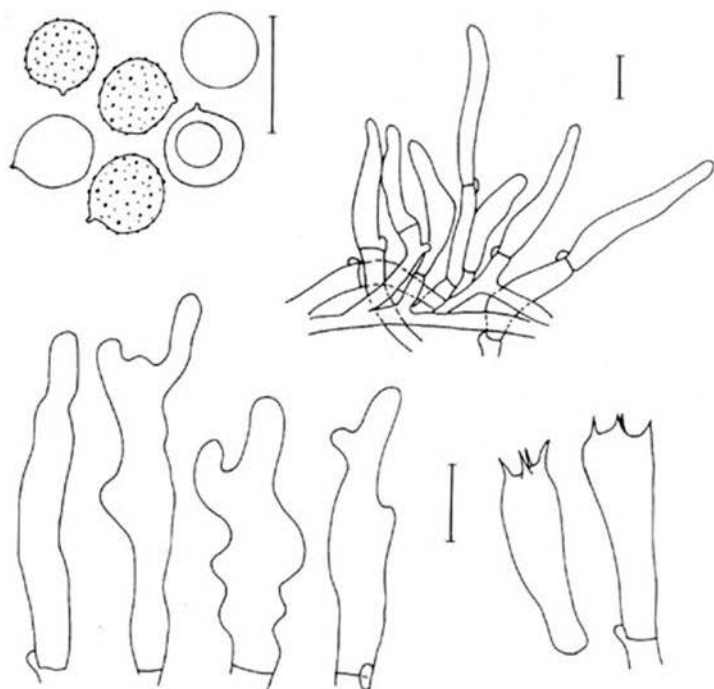


Fig. 46. *Crepidotus ehrendorferi*: spores, pileipellis, cheilocystidia, basidia.

Pileus 1.5–5.5 cm, semicircular, rounded flabelliform, soon irregularly conchate, young convex, later plano-convex, first with inflexed margin later becoming straight, indistinctly hygrophanous, tomentose, greyish orange to melon-yellow, light yellow with a distinct apricot hue when drying (M 7.5 YR 7/6-8/6), cream to pale orange when dried; strigose-fibrillose at point of attachment. Lamellae, L = 13–16, l = 2–3, crowded, sub-ventricose to ventricose, when young pale orange, later becoming darker orange, salmon-red, light yellow and finally clay to grey-brown (M 7.5 YR 6/8); edge fimbriate and whitish. Stipe visible only in very young fruit-bodies, up to 3 mm long, subcentral, later eccentric. Flesh thin, distinctly orange below point of attachment, otherwise whitish-hyaline with slightly greyish tinge. Taste somewhat bitter-adstringent, grating. Smell none. Spore print clay to grey-brown (K & W 5D4–5).

Spores  $5.5\text{--}7.0 \times 5.5\text{--}7.0 \mu\text{m}$ ,  $Q = 1\text{--}1.1$ , mean volume  $134 \mu\text{m}^3$ , globose, punctate-spiny; walls moderately coloured. Basidia  $25\text{--}35 \times 5.5\text{--}7 \mu\text{m}$ , four-spored, clamped. Cheilocystidia  $28\text{--}50 \times 5\text{--}11 \mu\text{m}$ , cylindrical, narrowly utriform, flexuous, many with branching uppermost part, hyaline, thin-walled. Pileipellis a distinct trichoderm of 4–6  $\mu\text{m}$  wide hyphae; terminal cells narrowly conical or cylindrical, occasionally branched or somewhat mucronate. Clamp-connections present in all tissues.

Habitat & Distribution — On hardwood (*Fagus*). Temperate. Only known from type locality in Austria. June–October.

Collection examined. AUSTRIA: Wien, Lainzer Tiergarten, 25 July 1981, Schnitz & Hausknecht\* (WU 6653, topotype material).

The macroscopic description has been mainly copied from the original description. *Crepidotus ehrendorferi* is in respect to several characters an intermediate between *C. applanatus* and *C. crocophyllus*: (i) It shares with both the type of spore ornamentation as seen in SEM (see Fig. 22). (ii) The pileus exhibits distinct orange colours, yet is paler than in *C. crocophyllus*. (iii) The shape of the terminal cells resembles that of those cells of *C. crocophyllus*. (iv) It was found in an area where both *C. applanatus* and *C. crocophyllus* occur.

The pileipellis consists of a striking turf of erect hyphae, which is found neither in *C. applanatus* nor in *C. crocophyllus*, and is a unique character of *C. ehrendorferi*.

### 6. *Crepidotus carpaticus* Pilát — Figs. 16, 17, 47

*Crepidotus carpaticus* Pilát, Hedwigia 69 (1929) 140. — Holotype: Ucraina, Corá Hora Mountains, Bogdan, VIII.1929, A. Pilát (PRM 23470).

*Crepidotus wakefieldiae* Pilát, Studia bot. cech. 10 (4) (1949) 152 (type: K).

*Crepidotus harperi* Sing., Mycologia 51 (1959, '1960') 586 (type: F).

Misapplied name. *Crepidotus larsenii* Pilát-sensu Mornand & Bon, Bull. soc. Et. sci. Anjou 12 (1986) 37–51.

Selected descriptions. Reid, Trans. Brit. mycol. Soc. 48 (1965) 515, 517–518 (as *C. wakefieldiae*). Joss., Bull. trimest. Soc. mycol. Fr. 81 (1965) 542–546 (as *C. wakefieldiae*). Sing., Beih. Nova Hedwigia 44 (1973) 477 (as *C. carpaticus*).

Pileus 2–8 mm, rounded flabelliform, semicircular, multi-angled shell-shaped, convex to applanate, with narrowly inflexed margin when young, later with straight margin, often lobed, mat, felted-tomentose, in old specimen fibrillose and furrowed, never distinctly hygrophanous, cream-buff to colonial-buff or pale yellowish (M 10 YR 8/4–8/6), when

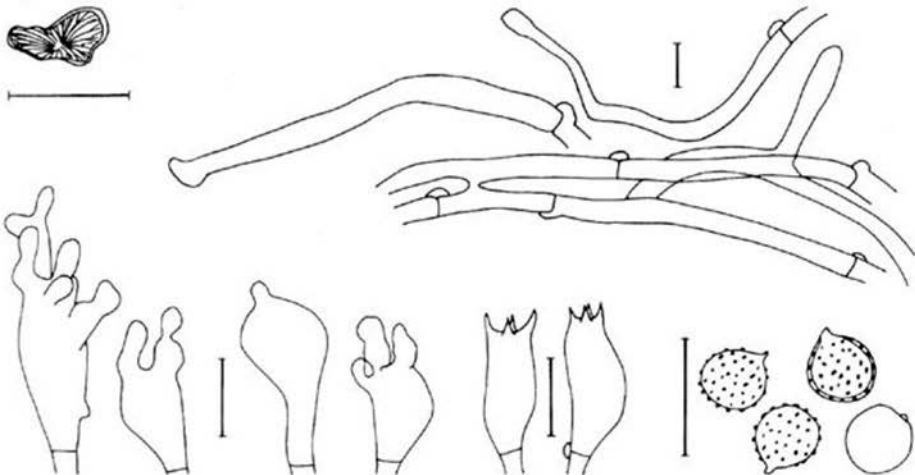


Fig. 47. *Crepidotus carpaticus*: fruit-body, pileipellis, cheilocystidia, basidia, spores.

dried cream to light ochraceous-buff; at point of attachment tomentose or villose. Lamellae,  $L = 8-16$ ,  $l = 1-3$ , moderately close to subdistant, arcuate to subventricose, young decurrent then narrowly adnate, ferruginous, chestnut (M 5 YR 4/6-5/6); edge fimbriate, whitish. Flesh thin, brittle, cream when dry. Taste and odour none.

Spores  $5-6.5 \times 4.5-6 \mu\text{m}$ ,  $Q = 1-1.2$ , mean volume  $85 \mu\text{m}^3$ , globose, distinctly punctate, indistinctly warty in optical section, with perispore, moderately coloured; in dried specimen always a certain amount of collapsed and broken spores present. Basidia  $17-26 \times 5-10 \mu\text{m}$ , four-spored, clamped. Cheilocystidia  $17-26 \times 6-10 \mu\text{m}$  (including outgrowths), clavate, narrowly utriform, with short finger-like up to  $3 \mu\text{m}$  wide protuberances, which may be branched, angled or flexuous. Pileipellis a transition between a trichoderm and a cutis with straight or slightly crooked to coiled,  $3-6 \mu\text{m}$  wide, hyaline hyphae, with terminal cells ascending, cylindrical, often angled; near pileus margin some pilocystidia present. Pigment absent. Clamp-connections present in all tissues.

A type study of this species has been recently published (Senn-Irlet, 1992c).

**Habitat & Distribution** — On hardly decomposed bark of different hardwoods (*Acer*, *Alnus*, *Fraxinus*, *Quercus*), according to literature also on stumps. Temperate. From lowlands up to subalpine zone. Rare. August–September.

*Collections examined.* FRANCE: dpt Vosges, Plombières, 22 Aug. 1939, *Josserand* (K); dpt Maine-et-Loire, Forêt de Longuenée, 3 Oct. 1981, *Mornand 8151B1* (herb. Mornand). — GREAT BRITAIN: Warwickshire, Moseley Bog, 13 Oct. 1985, *AWB 982* (K); Morayshire, Culbin, 9 Sept. 1963, *Reid* (L 982. 38-426). — IRELAND: Kylemore, West Galway, 13 Sept. 1985, *Scannell* (K). — SWITZERLAND: Kt. Bern, Brienz, Axalp, 9 Sept. 1972, *Candousseau* (herb. Bon). — UKRAINE: Corá Hora Mountains, Aug. 1928, *Pilát* (PRM 23470, holotype of *C. carpaticus*).

USA: Virginia, Bedford, May 1919, *Harper 1177* (F 1178, holotype of *C. harperi*).

The shape of the cheilocystidia makes *C. carpaticus* easy to distinguish from *C. applanatus*. It is interesting to note that young fruit-bodies may be yellow. Yellow pigments apparently occur in many different species of *Crepidotus* and are not restricted to *C. luteolus*.

This rare species is very well documented in literature (Pearson, 1952; Pilát, 1948; Reid, 1965; Josserand, 1965; Mornand & Bon, 1984 as *C. larsenii*).

Under the light microscope the spores of *C. carpaticus* do not differ from those of *C. applanatus*. SEM pictures, however, show differences in spore ornamentation. While *C. applanatus* always exhibits typical baculate spores, the ornamentation within *C. carpaticus* shows considerable variation, probably mainly dependent on the maturation process, as was demonstrated by Bigelow (1980) for *C. nyssicola* (Murr.) Sing. The spores of *C. carpaticus* are verruculose-truncate without or with small protuberances at the apex of warts. These protuberances were first observed by Pegler & Young (1972).

## 7. *Crepidotus roseornatus* Pöder & Ferrari — Fig. 48

*Crepidotus roseornatus* Pöder & Ferrari, Sydowia 37 (1984) 242. — Holotype: Italy, Novarra, Parco Naturale Lagoni di Mercurago, 30.VII.1983, *Ferrari* (IB 83/580).

*Selected icones.* Mos. & Jül., Farbatl. Basidiomyc. 3 (1986) III *Crepidotus* 4 (below).

Pileus 4–8 mm, semicircular, rounded flabelliform, convex, with strongly inflexed margin, tomentose, pale red, Venetian-red, pastel-red (K & W 10A3, 10A4); around point of attachment white tomentose-villose. Lamellae,  $L = 8-14$ ,  $l = 1-3$ , narrow, up to 1 mm,

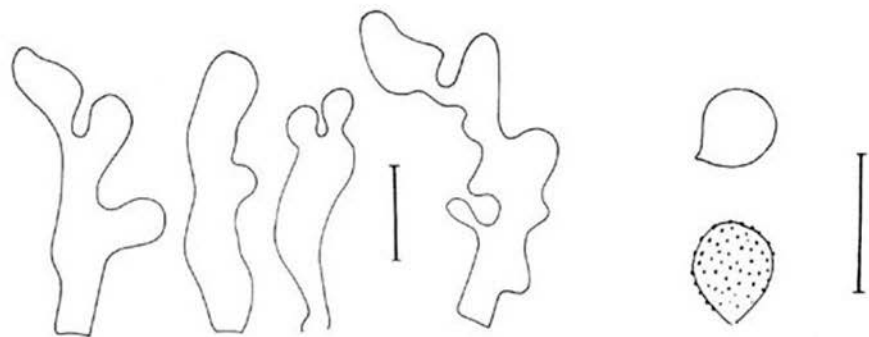


Fig. 48. *Crepidotus roseornatus*: spores, cheilocystidia.

thickish, arcuate to subventricose, rarely furcate, pink to pale red (M 5 YR 7/6), later brownish from spores; edge fimbriate. Stipe for a long time visible, up to 1.5 mm, curved, white tomentose. Flesh pinkish white, thin. Smell and taste not recorded.

Spores  $6-8 \times 4.5-6 \mu\text{m}$ ,  $Q = 1.2-1.5$ , mean volume  $87 \mu\text{m}^3$ , ellipsoid, sometimes broadly oblong, punctate, verruculose to baculate; walls medium coloured, thin. Basidia  $25-30 \times 6-7 \mu\text{m}$ , four-spored, clamped. Cheilocystidia  $20-38 \times 6-12 \mu\text{m}$ , clavate, cylindrical, flexuous, branched, with finger-like protuberances, sometimes septate. Pileipellis a trichoderm of erect,  $3.5-5 \mu\text{m}$  wide, filiform hyphae. Pigment reddish, intracellular, in basidia and young basidia, hymenophoral trama and pileus trama, sometimes as amorphous bodies.

Habitat & Distribution — On hardwood (*Robinia*) in submediterranean region. Known only from type locality in Italy. July.

Collection examined. ITALY: prov. Navarra, Parco Naturale Lagoni di Mercurago, 30 July 1983, Ferrari 83/580 (IB).

The macroscopic description has been copied from the original description. However, in the original description cylindrical, flexuous pleurocystidia,  $20-30 \times 3-7 \mu\text{m}$ , are mentioned. I could not find such elements. Judging by the description, it seems possible that these elements simply were young basidia.

The description of *Crepidotus roseolus* Sing. (1973: 350) fits *C. roseornatus* very well. Unfortunately, till now the type material could not be located (LIL, F) and consequently it could not be proved that *C. roseolus* is an older name for the present species.

## 8. *Crepidotus cinnabarinus* Peck — Figs. 14, 49

*Crepidotus cinnabarinus* Peck, Bull. Torrey bot. Club 22 (1895) 489. — Holotype: USA, Michigan, Ann Arbor, 24.IX.1894, Peck (NYS) (Not seen; studied by Singer, 1947: 68.) — *Crepidotus cinnabarinus* Møll. & Westerg., Friesia 3 (1945) 95 (nom. illeg.).

*Crepidotus decurrens* States, Bull. Torrey bot. Club 99 (1972) 250 (fide Luther & Redhead, 1981) (type: Northern Arizona University, not seen).

Selected icon. Svampe 11 (1985) 30.

Selected description. Luther & Redhead, Mycotaxon 12 (1981) 417-430.

Pileus 10–25 mm, rounded flabelliform, reniform, in younger specimen sometimes spatulate, convex to plano-convex, with inflexed margin only in younger specimen, mat, first tomentose-villose, later felted-tomentose, red to jasper-red or coral-red, remaining red in dried condition; at point of attachment sometimes red villose. Lamellae,  $l = 1-2$ , ventricose, adnexed, moderately crowded, pale brown to tawny (M 5 YR 6/8); edge serrulate, fimbriate, red. Stipe inconspicuous, eccentric, tomentose, red. Flesh thin, whitish. Smell and taste not recorded. Spore print cinnamon (M 7.5 YR 5/6).

Spores  $6-8 \times 5-6.5 \mu\text{m}$ ,  $Q = 1-1.3$ , mean volume  $133 \mu\text{m}^3$ , globose to broadly oblong, punctate, minutely warty in optical section, verruculose; walls faintly coloured. Basidia  $20-28 \times 5.5-11 \mu\text{m}$ , four-spored, clampless. Cheilocystidia  $60-77 \times 8-11 \mu\text{m}$ , conical, narrowly utriform, hyaline with reddish contents. Pileipellis mainly a trichoderm of loosely interwoven to erect,  $4-8 \mu\text{m}$  wide, filiform hyphae; terminal cells tapering, often mixed with lageniform pileocystidia. Pigment red, soluble in KOH, intracellular in cheilocystidia, pileipellis and stiptipellis. Clamp-connections absent.

Habitat & Distribution — On hardwood (*Tilia*, *Fagus*). Submeridional to temperate. Rare. June–October.

*Collections examined.* DENMARK: Bornholm, Døndalens, 12 Oct. 1964, *Donk* (L 964.281-299). — FRANCE: dpt Maine-et-Loire, Vauldenay, *Bon* (herb. Bon); dpt Var, Mt. Baume, 8 Oct. 1960, *Huijsman* (L 960.110-176).

USA: New York, Otsega Co., Cherry Valley, 27 Sept. 1970, *Rogerson* 986 and 228 (NY).

With its striking red colour, this species can hardly be confused with any other pleurotoid agaric. Because of the faint ornamentation, the spores have been described as smooth by Møller (1945) or "strongly punctate with heterogeneous wall" by Singer (1947). The SEM reveals the same type of ornamentation as is found in *C. variabilis* with isolated convex warts. The SEM pictures from the type specimen, published by Luther & Redhead (1981) agree perfectly with the material from southern France.

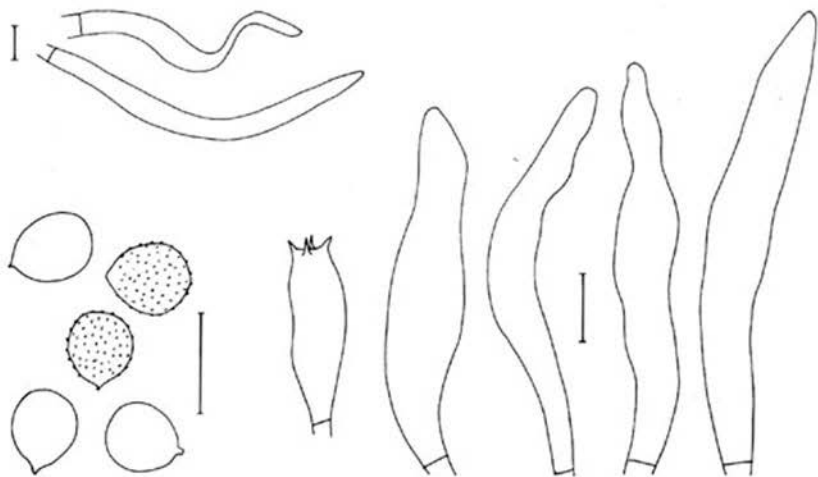


Fig. 49. *Crepidotus cinnabarinus*: pileocystidia, spores, basidium, cheilocystidia.



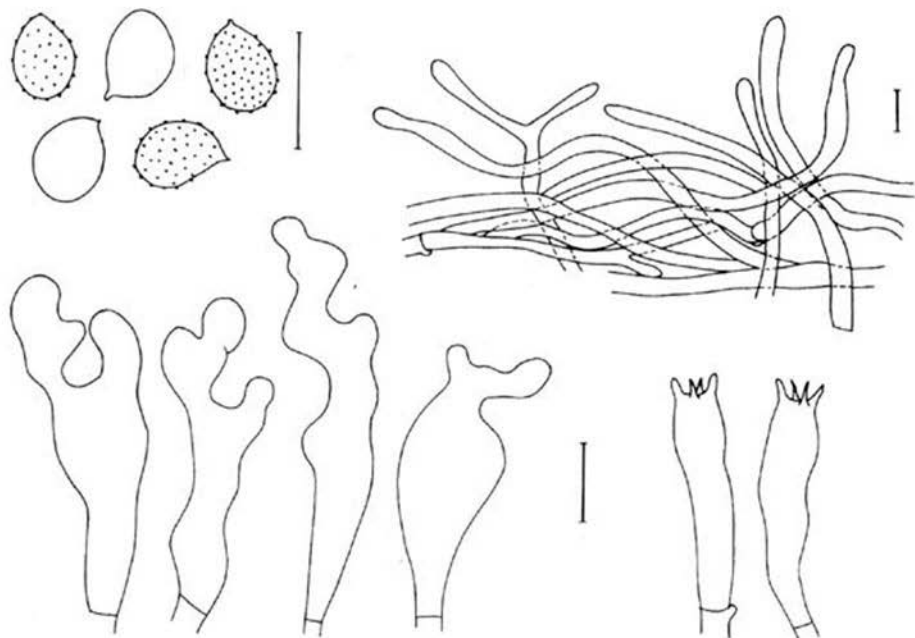


Fig. 50. *Crepidotus macedonicus*: spores, pileipellis, cheilocystidia, basidia.

### 9. *Crepidotus macedonicus* Pilát — Figs. 18, 50

*Crepidotus macedonicus* Pilát, *Studia bot. cech.* 10 (1949) 150. — Holotype: Macedonia, Sar Planina-Crni Kamen, VIII.1937, Lindtner (det. A. Pilát; PRM 489031; see Senn-Irlet, 1992c).

Pileus 40–70 mm, irregularly flabelliform, reniform with strongly inflexed, undulate margin, not striate, pallid to dirty cream (M 10 YR 7/4–8/4), at point of attachment tomentose. Lamellae crowded, up to 4 mm broad, ventricose, white later orange-rufous, ochraceous-tawny (M 7.5 YR 6/8, 10 YR 6/4); edge fimbriate, concolorous. Stipe not distinct, eccentric, villose-tomentose. Flesh in the pileus remarkably thick, up to 7 mm, whitish, without gelatinous layer. Smell none, taste mild. Spore print colour not recorded.

Spores 6–8 × 4.5–6 μm, Q = 1.2–1.55, mean volume 99 μm<sup>3</sup>, broadly oblong in frontal view, slightly inaequilateral in side view, punctate-warty, verruculose, walls moderately to strongly coloured. Basidia 26–33 × 6–7 μm, four-spored, clamped. Cheilocystidia 23–60 × 6–12 μm, narrowly utriform, clavate or cylindrical, in upper part branched, flexuous or angled, hyaline, thin-walled. Pileipellis a transition between a cutis and a trichoderm with 3–5 μm wide cylindrical hyphae; terminal cells straight or slightly bent or angled, undifferentiated. Pigment lacking; clamp-connections abundant.

Habitat & Distribution — On rotten wood of *Fagus* in the montane region. Submeridional. Only known from former Yugoslavia.

Collection examined. JUGOSLAVIA: Serbia, Mitrovatz, Tara Mountains, 11 Oct. 1960, Horak 63/230 (ZT).

The macroscopic description has been copied and translated from Horak (1964). The fleshy pileus is a striking character of this species. The cheilocystidia and the spores as seen in the light microscope resemble strongly *Crepidotus cesatii*. However, the verruculose type of ornamentation as seen in SEM, the straight terminal cells of the pileipellis and the large, fleshy carpophore form a unique combination of characters of a species, which is only known from its type region.

#### 10. *Crepidotus cesatii* (Rab.) Sacc.

*Agaricus cesatii* Rab., Flora 36 (1851) 564. — *Crepidotus cesatii* (Rab.) Sacc., *Michelia* 1 (1877) 2. — Holotype: Rabenhorst, herb. myc. no. 1506, Italy, Vercella, on *Platanus* (B).

*Agaricus* (*Claudopus*) *variabilis* var. *sphaerosporus* Pat., Tab. anal. Fung. (1884) 101. — *Crepidotus variabilis* var. *sphaerosporus* (Pat.) Quél., *Enchir. Fung.* (1886) 108 (lectotype: Roumeuguère-Fungi gallici exsiccati no. 4007 as *Agaricus* (*Claudopus*) *sphaerosporus* Pat. sp. nov. (K), chosen here). — *Claudopus sphaerosporus* (Pat.) Sacc., *Syll. Fung.* 5 (1887) 734. — *Dochmiopus sphaerosporus* (Pat.) Pat., *Hyménomyc. Eur.* (1887) 113. — *Crepidotus sphaerosporus* (Pat.) J. Lange, *Dansk bot. Ark.* 9 (6) (1938) 52. — *Crepidotus cesatii* var. *sphaerosporus* (Pat.) Ortega & Buendia, *Int. J. Myc. Lichenol.* 4 (1989) 96.

*Crepidotus variabilis* var. *sub-sphaerosporus* J. Lange, *Fl. agar. dan.* 5 (1940) IV. — *Crepidotus sub-sphaerosporus* (J. Lange) Kühn. & Romagn., *Fl. anal. Champ. sup.* (1953) 76 (not valid); ex Hesler & Smith, *N. Amer. Spec. Crepidotus* (1965) 121.

*Crepidotus kubickae* Pilát, *Studia bot. cech.* 10 (1949) 50 (type: PRM 665290, see Senn-Irlet, 1992c). *Crepidotus subepibryus* Pilát, *Studia bot. cech.* 10 (1949) 53 (type: PRM 14050, see Senn-Irlet, 1993).

#### KEY TO THE VARIETIES

- 1a. Spores broadly oblong,  $Q = 1.25-1.4$ ; on conifers; hyphae of pileipellis mostly straight . . . . . a. var. *sub-sphaerosporus*  
 b. Spores subglobose,  $Q = 1.1-1.25$ ; on hardwood; hyphae of pileipellis often coiled . . . . . b. var. *cesatii*

These two taxa are regarded as varieties of one species on account of their identical microscopical and macroscopical characters, except spore shape (see also Table VIII and Fig. 36).

#### 10a. *Crepidotus cesatii* var. *cesatii* — Figs. 24, 25, 51, Plate 1c, d

*Crepidotus cesatii* var. *gothoburgensis* Pilát, *Atl. Champ. Eur.* 6 (1949) 63 (type: Fungi exs. succ., no. 908, Sweden, Göteborg, on *Lonicera tatarica*, August 1937, T. Nathorst-Windahl, PRM 149095; see Senn-Irlet, 1992c).

*Agaricus* (*Claudopus*) *variabilis* var. *sphaerosporus* Pat., Tab. anal. Fung. (1884) 101.

*Crepidotus sphaerosporus* (Pat.) J. Lange. — *Crepidotus cesatii* var. *sphaerosporus* (Pat.) Ortega & Buendia, *Int. J. Mycol. Lichenol.* 4 (1989) 96.

*Selected descriptions.* Mal. & Bert., *Fl. Champ. sup. Maroc* 2 (1975) 471-472. Stangl et al., *Z. Mykol.* 57: 126-133 (as *C. cesatii* and *C. sphaerosporus*).

Pileus 6-21 mm, rounded flabelliform, reniform, semicircular, circular, young unguulate, later convex to plano-convex, with distinctly inflexed, rarely crenate margin, mat, felted-tomentose, in older specimen at least at margin tomentose, white, in dried specimen

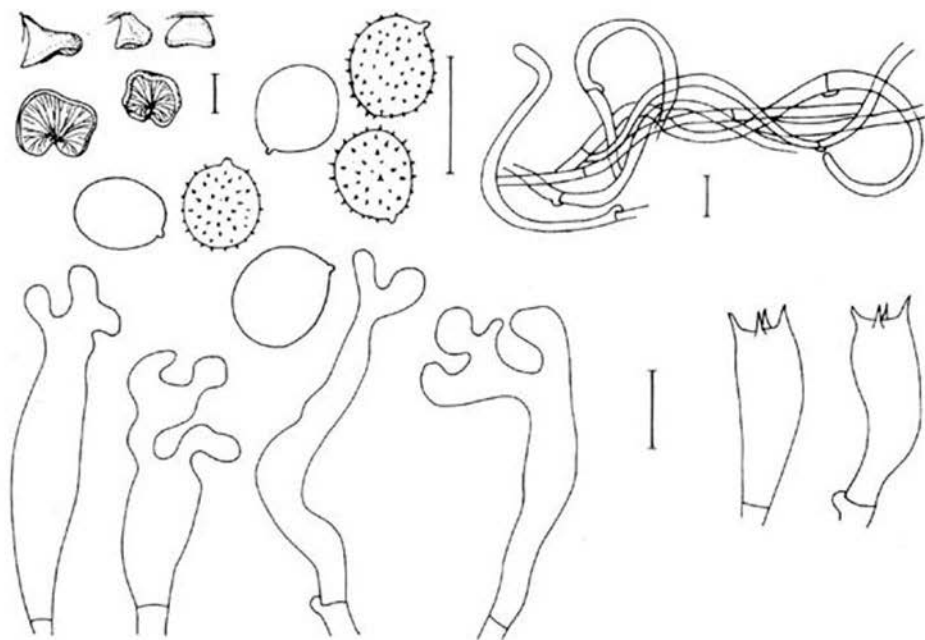


Fig. 51. *Crepidotus cesatii* var. *cesatii*: fruit-bodies, cheilocystidia, basidia, spores, pileipellis.

white to cream; at point of attachment often tomentose-villose. Lamellae,  $L = 8-14$ ,  $l = 1-2$ , ventricose to broadly ventricose, (sub)distal or rarely moderately crowded, narrowly adnate, young white, later cream to salmon or pinkish cinnamon (M 10 YR 8/3-7/4-7/6, 7.5 YR 7/4-7/6-6/6); edge fimbriate and whitish. Flesh thin, white. Smell none, taste bitterish. Spore print vinaceous-buff, pinkish cinnamon or ochraceous-tawny (M 7.5 YR 7/4-6/6).

Spores  $6.5-9 \times 5.5-7.5 \mu\text{m}$ ,  $Q = 1-1.3$ , mean volume  $177 \mu\text{m}^3$ , globose to subglobose, more rarely broadly oblong, punctate-spiny, echinulate, spines clearly visible in optical section; walls moderately to faintly coloured. Basidia  $20-30(-39) \times 6-10 \mu\text{m}$ , four-spored, sometimes mixed with two-spored, clamped. Cheilocystidia  $(18-24-50) \times 5-10(-15) \mu\text{m}$ , narrowly utriform, cylindrical or clavate, in the upper part mostly branched, often antler-like, sometimes flexuous or angled, rarely septate, hyaline, thin-walled. Pileipellis a transition between a trichoderm and a loose cutis with interwoven, crooked or coiled hyphae; terminal cells undifferentiated, mostly straight, more rarely coiled,  $2.5-6 \mu\text{m}$  wide; some collections with  $30-40 \mu\text{m}$  wide subpellis of very densely packed repent hyphae. Pigment absent. Clamp-connections present in all tissues.

Habitat & Distribution - On twigs of all kinds of hardwood, very rarely on coniferous wood, mosses, in many different vegetation types. Submeridional to temperate. From lowlands up to higher montane zone (uppermost record: 1000 m). Very common. Throughout the year, but mainly in October.

*Collections examined.* BULGARIA: Petric, Gabrene, 17 Dec. 1958, *Hinkova* (SOM 342). — DENMARK: Løvstrup, Skov, 30 Sept. 1984, *Læssøe & Elborne* (C). — FRANCE: dpt Hi-Rhin, Neuf-Brisach, Ile Vogelgrün, 25 Oct. 1988, *Wilhelm 881846* (BERN); dpt Maine-et-Loire, Parc de Moulévrier, 26 June 1983, *Mornand 8325B1* (herb. Mornand); dpt Paris, Bois de Vincennes, Nov. 1886, *Gaillard* (Roume guère — Fungi gallici exsiccati no. 4007 as *Agaricus (Claudopus) sphaerosporus* Pat. sp. nov.) (K); dpt Finistère, Crozon, Bronfoz, 20 Aug. 1980, *Mornand 8034B1* (herb. Mornand); Lanvéoc, Bois de Poulnic, 25 July 1983, *Mornand 8308B1* (herb. Mornand); ex herb. Kühner, sub nomen *Dochmiopus arboreus*, July 1927 (G 18418). — GERMANY: Baden-Württemberg, Kaiserstuhlgebiet, Wasenweiler Wald, 26 Oct. 1976, *A. F. M. Reijnders* (herb. Reijnders); Bayern, Herrsching/Ammernsee, 22 Sept. 1989, *Rücker 322-89* (SZU); Bad Mergentheim, 2 Jan. 1989, *Neeser*; Nordrhein-Westfalen, Minden-Porta Westfalica, 18 Oct. 1987, *Bock & Wollweber* (Münster). — ITALY: prov. Parma, Borgo Taro, Santa Donna, 26 Oct. 1982, *Moser 821470* (IB); Pisa, Nov. 1903, *Arcangeli* (Saccardo — Mycotheca italica, no 1406) (L); Appenino, Reggiano, SW of Felina, 18 June 1978, *Moser 78174* (IB); Vercella, c. 1855, *Cesati* (B, type). — LICHTENSTEIN: Rugel-lerriet, 8 May 1989, *Prongué 8933* (herb. Prongué); Mauren, 25 June 1989, *Prongué 8952* (herb. Prongué); Maurenberg, 11 July 1989, *Prongué 8981* (herb. Prongué); Ruggell, 29 Sept. 1989, *Prongué 89228* (herb. Prongué). — NETHERLANDS: prov. Flevoland, Oostelijk Flevoland, Abbert, 12 April 1989, *van Zanen* (BERN); Revebos, 6 Oct. 1981, *Bas* (L 982.103-188); prov. Gelderland, Nunspeet, Bloemkampen, 1 Oct. 1988, *Kuyper 2920* (WAG-W). — SPAIN: Madrid, 11 Dec. 1981, *Moreno 2275* (GDAC); Cadalso de los Vidrios, 6 Jan. 1982, *Moreno 2292* (GDAC); Los Santos de la Humosa, 12 March 1983, *Moreno 2505* (GDAC); Islas Canarias, Gran Canaria, Pinar de Tamadaba, 13 Jan. 1978, *Bañares 1172* (La Laguna); La Palma, Reserva Los Tiles, March 1989, *Bañares 4000* (La Laguna). — SWEDEN: Småland, Bringe tofta parish, Uddeberg, 12 Oct. 1947, *Lundell 2815* (Fungi Exsiccati suecici, praesertim Upsaliensis no. 2056, as *C. sphaerosporus*) (K). — SWITZERLAND: Kt. Aargau, Oberrüti, 5 April 1979; *Bächler 0504-79 Ba11* (MNLU); Tägerig, Pulvern, 11 Feb. 1990, *Gsell* (BERN); Kt. Bern, Bäriswil, Wolfstogel, 8 Sept. 1990, *Senn-Irlet 90162* (BERN); Bern, Bremgartenwald, 1 Oct. 1982, *Irlet 821391*; 12 Oct. 1987, *Senn-Irlet 871274* (BERN); Kappelen, Alte Aare, 10 Sept. 1988, *Senn-Irlet 881359*; 25 Oct. 1988, *Senn-Irlet 881458, 881463, 881464* (BERN); Köniz, Schwarzwassergraben, 21 Dec. 1982, *Irlet 821469* (BERN); La Neuveville, 21 Feb. 1988, *Senn-Irlet 88/18* (BERN); Oltigen, Niederriedstausee, 27 Feb. 1983, *Irlet 83/7* (BERN); Rubigen, Aaredamm, 11 Dec. 1988, *Senn-Irlet 881425, 881431* (BERN); Ettiswil, 27 Dec. 1985, *Bächler 2712-85 Ba1* (NMLU); ct. Neuchâtel, Creux du Van, Ferme Robert, 7 Oct. 1982, *Irlet 821396* (BERN); cte Ticino, Auressio, 1 Nov. 1981, *Zenone* (Lugano 2333); Someo, 18 Oct. 1982, *Irlet 821426* (BERN).

Based on macroscopical features alone, the pinkish tints of the young lamellae and the (sub)distant lamellae are characteristic. Microscopically the species is easily recognizable because of its antler-like cheilocystidia and the echinulate spores. *Crepidotus cesatii* var. *cesatii* is the most common European *Crepidotus* species.

I have seen several collections with small and very variable spores (< 6 µm). Each of these collections, however, had signs of a disturbed development, i.e., I found many two-spored basidia in collections in which the spore size and form varies considerably from 5–9 µm, from globose to oblong on the same lamella. In one collection (*Senn-Irlet 9012*) cystidioles (pleurocystidia sensu Hesler & Smith, 1965) were present on the surface of the lamella. I interpret these abnormalities as being induced by drought or low temperatures and therefore without any taxonomic significance. *Crepidotus cesatii* var. *cesatii*, fruiting throughout the year and several times on the very same substrate, seems to be especially susceptible to climatic influences.

In the original description Rabenhorst describes the spores as "rotundis v. ovoides ..." which gave rise to a certain confusion about the spore shape and subsequently in the inter-

pretation of this taxon. Although no original material is left (Pfister, 1977), it is clear that Patouillard described and depicted *Agaricus variabilis* var. *sphaerosporus* as a taxon with perfectly globose spores, leaving no doubt about the spore shape. Yet, he noticed coniferous twigs as substrate, which is very rare for this taxon. A re-examination of the holotype of *Agaricus cesatii* from Italy where it was growing on *Platanus*, showed globose spores of 7–9  $\mu$ m. The type material in B is in very poor condition: almost nothing is left. The spores were found in droppings of insects close to the original place of the fruit-body. But there is no longer any doubt that Rabenhorst described a taxon with globose spores. Therefore *C. sphaerosporus* must be regarded as a synonym of *C. cesatii*.

Examination of the type of *C. cesatii* var. *gothoburgensis* Pilát (Senn-Irlet, 1992c) has shown that it fits perfectly into the range variation of *C. cesatii* var. *cesatii*.

10b. ***Crepidotus cesatii* var. *subsphaerosporus*** (J. Lange) Senn-Irlet, *comb. nov.* — Figs. 23, 52

*Crepidotus variabilis* var. *subsphaerosporus* J. Lange, Fl. agar. dan. 5 (1940) IV (basionym). — Neotype (designated here): Switzerland: Bern, Röthenbach, Schallenberg, 1000 m, *Abieti-Fagetum*, on fallen *Picea* twigs, 11.X.1989, Senn-Irlet 89/240 (G). — *Crepidotus subsphaerosporus* (J. Lange) Hesler & Smith, N. Amer. Spec. Crepidotus (1965) 121.

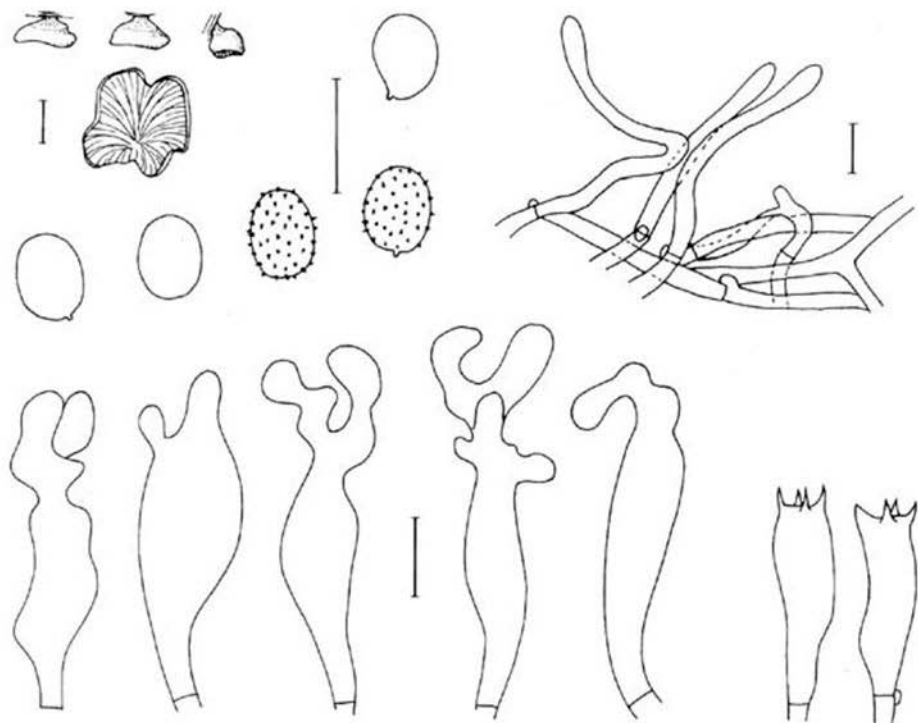


Fig. 52. *Crepidotus cesatii* var. *subsphaerosporus*: fruit-bodies, spores, cheilocystidia, basidia.

*Crepidotus subepibryus* Pilát, Studia bot. cech. 10 (1949) 50 (type PRM, see Senn-Irlet, 1993).

*Crepidotus kubickae* Pilát, Studia bot. cech. 10 (1949) 53 (type PRM, see Senn-Irlet, 1992c).

*Misapplied names.* *Crepidotus cesatii* var. *sphaerosporus* (Pat.) Ortega & Buendia sensu Ortega & Buendia, Int. J. Myc. Lichenol. 4 (1989) 96; sensu Norstein, Gen. *Crepidotus* Norway (1990) 94. — *Crepidotus cesatii* var. *cesatii* sensu Hesler & Smith, N. Amer. Spec. *Crepidotus* (1965) 125.

Pileus 2–26 mm, semicircular, more rarely rounded flabelliform, young often unguulate, later hemispherical to convex, with broadly inflexed margin, sometimes slightly lobed, sessile, laterally or dorsally attached, not striate except in very old, hygrophanous specimens, mat, felted-tomentose, tomentose, white and remaining so when dried; at point of attachment sometimes villose-tomentose. Lamellae, L = 12–20, l = 1–3, crowded to (sub)distant, narrow, up to 3 mm wide, ventricose, narrowly adnexed to adnate, young white, later cream to salmon, or pinkish cinnamon (M 7.5 YR 6/6, 6/8, 5/6); edge fimbriate and whitish. Stipe visible only in very young fruit-bodies. Flesh thin, white. Taste none or faintly adstringent. Smell none. Spore print ochraceous-tawny to fulvous or pinkish cinnamon (M 7.5 YR 6/6, 10 YR 5/6–6/6).

Spores 6–9 × 4.5–7 µm, Q = 1.2–1.45, mean volume 129 µm<sup>3</sup>, broadly oblong to oblong or ovoid to obovoid in frontal view, echinulate with spines clearly visible in optical section, faintly to moderately coloured. Basidia 17–28(–32) × 6–10 µm, four-spored, clamped. Cheilocystidia (13–)22–60(–70) × 6–12 µm, narrowly utriform, cylindrical or clavate, in upper part mostly branched, often antler-like, sometimes flexuous or angled, hyaline, thin-walled. Pileipellis a transition between a trichoderm and a loose cutis, mostly with straight, sometimes coiled, 2.5–6(–8) µm wide, hyaline hyphae; terminal cells undifferentiated; at the margin with pileocystidia shaped like cheilocystidia. Pigment lacking. Clamp-connections in all tissues.

**Habitat & Distribution** — On twigs, branches and logs of coniferous wood (*Picea*, *Abies*, *Pinus*), rarely on hardwood. Temperate to boreal. From lowlands up to subalpine zone (highest altitude: 1670 m). Frequent only in boreal and upper montane-subalpine zones. August–November.

*Collections examined.* AUSTRIA: Salzburg, Flachgau, Fürstenbrunn, 13 Oct. 1989, *Rücker* 373-89 (SZU); Tennengau, St. Koloman, 7 Aug. 1989, *Rücker* 118-89 (SZU); Steiermark, St. Gallen, Hennau, 22 Sept. 1979, *Moser* 79/589 (IB). — CZECHOSLOVAKIA: Moravia, Zdanický les, 28 Nov. 1963, *Lazebnick* (BRNM 333556). — ESTONIA: Jarvselja, Tartu, 30 Oct. 1985, *Kalamees* (TAA 124 561); Saaremaa, insula Kessulaid, 10 Oct. 1983, *Kalamees* (TAA 123268). — FINLAND: Sirkapuro, Oulankajoki, 24 Aug. 1978, *Moser* 78/297 (IB). — FRANCE: dpt Doubs, Russey, Tourbière de la Chenalotte, 27 Aug. 1934, *Favre* (G 7939). — GERMANY: Bayern, Bayerischer Wald, 18 June 1986, *Luschka* (herb. Luschka 1254). — RUSSIA: Krasnodar, reserv. caucasicum, 7 Sept. 1975, *Kalamees* (TAA 94496). — SWEDEN: Gotland, Atlingbo, 5 Sept. 1950, *Petersson* (UPS). — SWITZERLAND: Kt. Bern, Bern, Bremgartenwald, 30 Oct. 1982, *Irlet* 82/440 (BERN); Grindelwald, Itramerwald, 12 Oct. 1986, *Senn-Irlet* 86/184 (BERN); Rütli b. Riggisberg, Gurnigelwald, 6 Sept. 1989, *Bieri & Senn-Irlet* 89/173 (BERN); Rümliigen, Taanwald, 15 Nov. 1987, *Senn-Irlet* 87/301 and 87/302 (BERN); Kt. Graubünden, Cinuos-chel, Splars, 18 Aug. 1957, *Favre* (G 13807); Kt. Solothurn, Rüttenen, Weissenstein-Röti, 23 Oct. 1988, *Senn-Irlet* 88/435 and 88/451 (BERN); ct. Vaud, Pont de Nant, 31 Aug. 1982, *Irlet* 82/265 (BERN); Montreux-Pautex, 3 Oct. 1989, *Glansen* 89/229\* (BERN); ct. Valais, Verbier, 6 Nov. 1982, *Irlet* 82/460 (BERN); neotype (designated here): Bern, Röthenbach, Schallenberg, 1000 m, *Abieti-Fagetum*, on fallen *Picea* twigs, 11 Oct. 1989, *Senn-Irlet* 89/240 (G).

Favre (1935) and Pilát (1948) circumscribed *Crepidotus cesatii* as a species with a remarkable variability in spore shape, including the two variants accepted here. Singer (1947), also aware of that fact, guessed that *C. cesatii* may have 'mycoecotypes', one on hard-

wood, the other on coniferous wood. Other authors, however, accepted two (Norstein, 1990) or three taxa (Watling & Gregory, 1989; Moser, 1983) or even more taxa in this complex (Hesler & Smith, 1965).

After the study of about 100 collections from all over Europe, I am convinced that there exist but two taxa in Europe, separated on account of their spore shape. Small-spored collections are discussed in *C. cesatii* var. *cesatii*.

Some authors (e.g. Ortega & Buendia, 1989) stress the fact that the hyphae of the pileipellis are mostly straight in var. *subsphaerosporus* and mostly coiled in var. *cesatii*. Norstein (1990) was able to prove the correctness of that observation statistically by means of a Kruskal-Wallis one way analysis. My observations confirm this as a trend, but I could not prove it statistically.

A type study of *C. kubickae* Pilát (Senn-Irlet, 1992c) has shown that *C. kubickae* is based on old fruit-bodies of *C. cesatii* var. *subsphaerosporus*.

### 11. *Crepidotus variabilis* (Pers.: Fr.) Kummer — Figs. 12, 13

*Agaricus variabilis* Pers., *Observ. mycol.* 2 (1800) 46. — *Agaricus variabilis* Pers.: Fr., *Syst. mycol.* 1 (1821) 275. — *Crepidotus variabilis* (Pers.: Fr.) Kumm., *Führ. Pilzk.* (1871) 74. — *Claudopus variabilis* (Pers.: Fr.) Gill., *Champ. Fr.* (1876) 426. — *Dochmiopus variabilis* (Pers.: Fr.) Pat., *Hyménomyc. Eur.* (1887) 113. — Neotype (designated here): Netherlands, prov. Gelderland, Winterswijk, 'Willinks-werf', on dead fallen branches (*Fraxinus*) in mixed deciduous forest on calcareous loam, 30.IX.1973, *C. Bas* 6182 (L 973.164-257).

*Crepidotus variabilis* var. *microsporus* P. Karst., *Bidr. Känn. Finl. Nat. Folk* 32 (1879) 289. — *Dochmiopus microsporus* (P. Karst.) P. Karst., *Finlands Basitsvampar* (1889) 158 (type: Stockholm, Herbarium Romell 10218).

*Agaricus sessilis* Bull., *herb. France* (1783-84) pl. 152 (iconoleotype). — *Derminus sessilis* (Bull.) Schroet., *Krypt.-Fl. Schlesien* 1 (1889) 578. — *Hyporrhodius sessilis* (Bull.) Migula, *Krypt.-Fl.* 3 (2/2) (1912) 556.

*Crepidotus sessilis* Britz., *Ber. naturwiss. Ver. Schwaben Neuburg* 31 (1894) 167.

*Agaricus niveus* Sow., *Col. Figs., Engl. Fungi* (1797) 97 (non *Crepidotus niveus* Velen. 1947).

#### KEY TO THE VARIETIES

- 1a. Cheilocystidia small, 20-40 × 7-12 μm, spores 5.5-7.5 × 2.5-4 μm  
a. var. *variabilis*
- b. Cheilocystidia long, cylindric, flexuous, branched, 25-70 × 4-6 × 2-3 μm, spores  
6-8 × 3-4.5 μm ..... b. var. *trichocystis*

#### 11a. *Crepidotus variabilis* var. *variabilis* — Fig. 53, Plate 2a, b

*Crepidotus variabilis* var. *variabilis* sensu Hesler & Smith, *N. Amer. Spec. Crepidotus* (1965) 108.

*Crepidotus variabilis* var. *microsporus* P. Karst., *Bidr. Känn. Finl. Nat. Folk* 32 (1879) 289. —

*Dochmiopus microsporus* (P. Karst.) P. Karst., *Finlands Basitsvampar* (1889) 158 (type: Stockholm, herb. Romell 10218).

*Selected description.* Favre, *Schweiz. Z. Pilzk.* 13 (1935) 146.

Pileus 5-10 mm, rounded flabelliform to reniform, semicircular, plano-convex, with margin involute to inflexed but becoming lobed, undulate and straight, tomentose, becom-

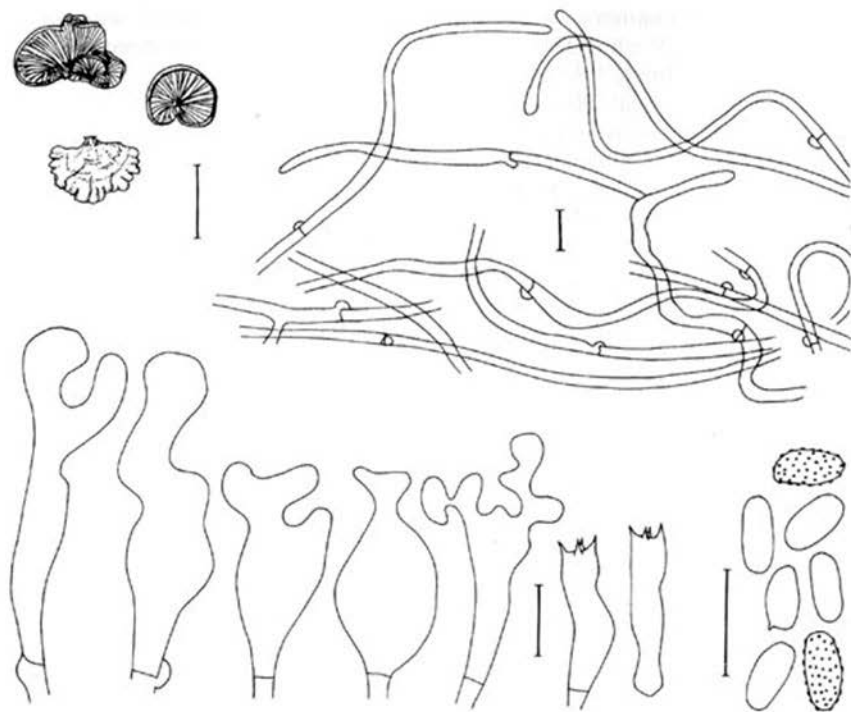


Fig. 53. *Crepidotus variabilis* var. *variabilis*: fruit-bodies, pileipellis, cheilocystidia, basidia, spores.

ing felted or silky-smooth, white, remaining so when dried but in one case pale yellow; at point of attachment sometimes tomentose-villose. Lamellae,  $L = 14-18$ ,  $l = 1-2$ , moderately broad, up to 3 mm wide, moderately crowded, subventricose, narrowly adnexed, white, soon pale ochraceous-salmon or ochraceous-tawny to finally cinnamon-brown (M 10 YR 8/4, 7/6-6/8, 7.5 YR 7/6-6/6); edge fimbriate, whitish. Stipe only visible in very young specimen. Flesh thin, whitish. Taste mild. Smell none or fungoid. Spore print pinkish cinnamon to cinnamon (M 7.5 YR 6/6-5/6).

Spores  $5.5-7.5 \times 2.5-4 \mu\text{m}$ ,  $Q = 1.6-2.3$ , mean volume  $37 \mu\text{m}^3$ , elongate to (sub-)cylindrical or oblong in frontal view, cylindrical in side view, distinctly punctate-warty, verruculose, moderately coloured. Basidia  $17-26 \times 4.5-7 \mu\text{m}$ , four-spored, clamped. Cheilocystidia  $20-24(-58) \times 5-12(-15) \mu\text{m}$ , clavate, obpyriform, flexuous, mostly branched, angulate. Pileipellis a trichoderm of straight, flexuous to distinctly coiled, filiform,  $2.5-5 \mu\text{m}$  wide hyphae; terminal cells never differentiated. Pigment lacking. Clamp-connections present in all tissues.

Habitat & Distribution — Gregarious, often imbricate on hardwood, rarely on coniferous woods, mostly on twigs, litter, sometimes on herbaceous stems. Meridional to boreal. From lowlands to montane zone. Locally frequent. August–January.



*Collections examined.* AUSTRIA: Steiermark, Burgau, 21 Sept. 1972, Riedl (W 25130). — BELGIUM: Louette-Saint-Pierre, Aubert (Westend & Wall. herb. Crypt. Belg. no. 1283 as *Agaricus variabilis*) (K); Bouillon, 12 Sept. 1957, Koster 6315 (L). — BULGARIA: Svinecni, Mt. Zozensva Planina, 28 Aug. 1975, Hinkova (SOM 9420). — ESTONIA: Rakvere, Nova Rihula, 11 Aug. 1958, Kalamees (TAA 70992); Ralkula, 8 Aug. 1958, Kalamees (TAA 70958). — FRANCE: dpt Finistère, Lanvéoc, Bois à Postic, 24 Dec. 1974, Mornand 74130B1 (herb. Mornand); Lanvéoc, Bois du Poulmic, 25 Dec. 1983, Mornand 8306B1 (herb. Mornand); dpt Somme, Ste. Segrée, Aug. 1966, Bon 60801 (herb. Bon); dpt Doubs, Tourbière de Remoray, 20 Aug. 1939, Favre (G 7932); Russey, Tourbière de Plaimbois, 7 Sept. 1935, Favre (G 7931); dpt Pas-de-Calais, Forêt de Desvres, 17 Oct. 1991, Senn-Irlet 91/247 (BERN). — GERMANY: Baden-Württemberg, Sandhausen, 15 May 1983, Winterhoff (herb. Winterhoff); Saarland, Neunkirchen, Elzenberger Mühle, Schmitt 7116 (herb. Schmitt); Brandenburg, Triglitz, 6 Oct. 1910, Jaap (Otto Jaap Fungi selecti no. 538 as *Crepidotus cesatii*) (BERN); Bredower Forst bei Nauen, 7 Oct. 1906, Sydow (Sydow-Mycotheca germanica no. 551 as *Crepidotus chimonophilus*) (BERN); Lothringen, Schoe-necker Wald bei Forbach, Sept./Oct. 1912, Ludwig (Sydow-Mycotheca germanica no. 1202 as *Crepidotus chimonophilus*) (BERN); Nordrhein-Westfalen, Sennelager-Roterbach, 8 Oct. 1988, Sonneborn 4118 (herb. Sonneborn). — NETHERLANDS: prov. Drente, Wijster, 7 Nov. 1958, Barkman 6001 (WAG-W); Mantinger bos, 22 Oct. 1958, Barkman 5855 (WAG-W), Schoonloer strubben, 19 Oct. 1976, Jansen 181 (WAG-W); Beilen, Brunstinger plas, 23 July 1984, Arnolds 5153 (WAG-W), Dwingeloo, 25 Sept. 1975, Arnolds (WAG-W 3413); prov. Gelderland, Winterswijk, 30 Sept. 1973, Bas 6182 (L 973.164-257); prov. Noord-Brabant, Dorst, 18 Dec. 1966, Jansen (L 966.342-002); Jansen & Maas Geesteranus (L 956.148-143); prov. Noord-Holland, Hilversum-Corversbos, 20 Jan. 1975, Daams (L 974.176-349); Leijduin, 16 Aug. 1968, Kits van Waveren (L 986.112-123); neotype (designated here): prov. Gelderland, Winterswijk, 'Willinkswerst', on dead fallen branches (*Fraxinus*) in mixed deciduous forest on calcareous loam, 30 Sept. 1973, C. Bas 6182 (L 973.164-257). — POLAND: Bialowieza National Forest, 17 Oct. 1981, Pegler (K). — SPAIN: Madrid, El Pardo, 27 Dec. 1978, Alvarez (GDAC 1631); Hervás, Cáceres, 7 Nov. 1976, Moreno 1643 (GDAC). — SWEDEN: Upland, Bondkyrka, Hammarby, 17 Sept. 1937, Lundell (Fungi Exsiccati Suecici praesertim Upsaliensis no. 531 as *C. variabilis*) (K). — SWITZERLAND: Kt. Bern, Bern, Bremgartenwald, 30 Oct. 1982, Irlet 82/439, 8 Oct. 1991, Senn-Irlet 91/197 (BERN); ct. Jura, Boécourt, sur la montagne, 25 Sept. 1989, Chételat (BERN); Les Ordon, Oct. 1990, Chételat 26 (BERN), Basse-court, Mt. Choisi, 26 Sept. 1989, Chételat 21 (BERN); cte Ticino, Malvaglia, 22 Oct. 1981, Lucchini 1666 (Lugano); ct. Vaud, Le Mont sur Lausanne, 17 June 1979, Cléménçon 79/13 (LAU).

*Crepidotus variabilis* belongs to those species with a white pileus and fairly crowded lamellae that are quite impossible to identify without microscopical examination. The lobed, undate margin, however, proved to be a rather good indication. The cylindrical spore-shape is the best indicative character for this species. *Crepidotus variabilis* has the smallest spores in respect to a calculated volume of  $36.5 \mu\text{m}^3$ .

Already Pilát (1948), after having examined several distributed exsiccates, emphasized the fact that *C. variabilis* has often been misinterpreted. I share with Norstein (1990) the suspicion that Fries himself may have included other small, white *Crepidotus* species, such as *C. cesatii*, *C. subverrucisporus* and probably *C. lundellii*, in his concept of a 'variable' species aptly named *Agaricus variabilis*, as these species are rather common in southern Scandinavia (see Norstein, 1990).

#### 11b. *Crepidotus variabilis* var. *trichocystis* Hesler & Smith — Fig. 54

*Crepidotus variabilis* var. *trichocystis* Hesler & Smith, N. Amer. Spec. Crepidotus (1965) 108. — Holotype: USA, Michigan, Burt Lake, Maple Bay, 18.VII.1963, Smith 66819 (MICH) (not seen).

Macroscopical characters as var. *variabilis*.

Spores  $6.5-9 \times 3-4.5 \mu\text{m}$ ,  $Q = 1.6-2.2$ , mean volume  $54 \mu\text{m}^3$ , elongate, to (sub-)cylindrical, in front view oblong, in side view cylindrical, distinctly punctate-warty, ver-

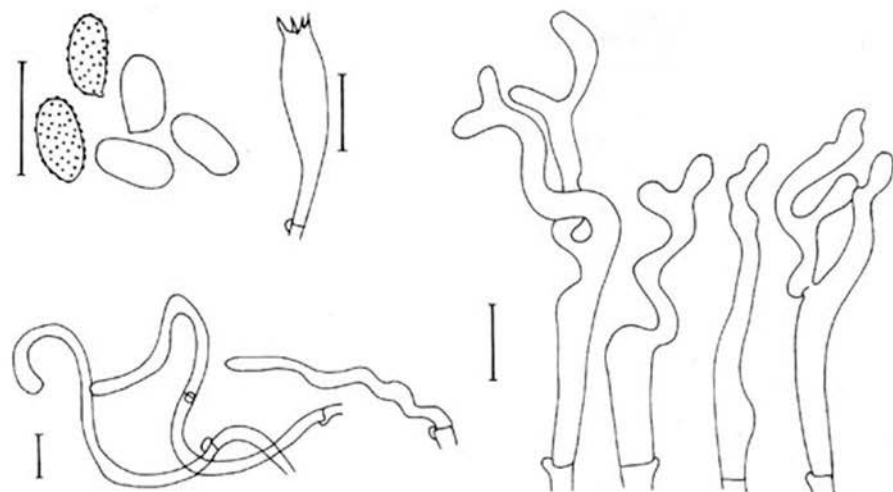


Fig. 54. *Crepidotus variabilis* var. *trichocystis*: basidium, pileipellis, spores, cheilocystidia.

rugulose, moderately coloured. Basidia  $25\text{--}30 \times 5.5\text{--}6.5 \mu\text{m}$ , clamped. Cheilocystidia  $25\text{--}70 \times 4\text{--}6$  (in upper parts  $2\text{--}3$ )  $\mu\text{m}$ , (sub)cylindrical to narrowly lageniform, flexuous, frequently branched. Pileipellis a trichoderm of straight, flexuous to distinctly coiled, filiform,  $2\text{--}4 \mu\text{m}$  wide hyphae; terminal cells never differentiated. Pigment lacking. Clamp-connections present in all tissues.

**Habitat & Distribution** — On twigs of hardwood. Submeridional. In Europe only known from France.

*Collections examined.* FRANCE: dpt Hérault, Roquehaute pr. Agde, 21 Nov. 1978, Monthoux (G 15569).

This variety is separated from the type variety by Hesler & Smith (1965) on account of the shape of the cheilocystidia and the somewhat wider spores. Exactly these characters can be found in this collection from southern France. The SEM reveals the same type of ornamentation as the type variety. This single collection does not allow any statement based on statistics.

### Section *Crepidotellae* Hesler & Smith

*Crepidotus* sect. *Crepidotellae* Hesler & Smith, N. Amer. Spec. *Crepidotus* (1965) 110 (type: *C. submollis* Murr.).

*Crepidotus* sect. *Versuti* Hesler & Smith, N. Amer. Spec. *Crepidotus* (1965) 35 (type: *Crepidotus versutus* (Peck) Sacc.).

*Crepidotus* sect. *Betulae* Hesler & Smith, N. Amer. Spec. *Crepidotus* (1965) 99 (type: *Crepidotus betulae* Murr.).

Spores always longer than broad, oblong, ellipsoid, ovoid or amygdaliform, smooth, rugulose or vermiculose; fruit-bodies white or yellow.

Subsection **Fibulatini** Sing.

*Crepidotus* subsect. *Fibulatini* Sing., Lilloa 13 (1947) 94 (type: *Crepidotus albidus* Ell. & Ev.).

Spores ellipsoid, oblong, ovoid or amygdaliform, ornamentation of spores rugulose or vermiculose; hyphae with or without clamp-connections.

12. ***Crepidotus lundellii*** Pilát — Figs. 8, 9, 55

*Crepidotus lundellii* Pilát in Lund. & Nannf., Fungi exs. succ., fasc. V-VI (1936) 10. — Lectotype (designated here): Fungi exs. succ. no. 220 (K).

*Crepidotus amygdalosporus* Kühn. in Kühn. & Romagn., Bull. Soc. Nat. Oyonnax 8 (1954) 74. — Lectotype, designated here by Senn-Irlet & Monthoux: France, Boissy, 3.VIII, Kühner (G 18394).

*Crepidotus subtilis* P.D. Orton, Trans. Brit. myc. Soc. 42 (1960) 221 (type: Great Britain, Whitlands Landslip, Rousdon, Devon, 2 Dec. 1958, Orton 1514 (E)).

*Crepidotus versutus* var. *subglobisporus* Pilát, Sb. Nar. Mus. Praha II B (3) (1940) 74 (type: Ucraina, Kobylecká Polana, Svidovec-Krajná Rika, 600–1000 m, in *Fagus virgin* forest, July–August 1937, Pilát (PRM 23529)).

*Crepidotus lundellii* var. *subglobisporus* (Pilát) Pilát, Atl. Champ. Eur. 6 (1949) 50.

*Misapplied names.* *Crepidotus inhoneustus* P. Karst. sensu P.D. Orton, Trans. Brit. mycol. Soc. 41 (1960) 221; Pegler & Young, Kew Bull. 27 (1972) 321; Norstein, Gen. *Crepidotus* Norway (1990) 83.

*Selected icon.* Mos. & Jül., Farbatl. Basidiomyc. 3 (1986) III *Crepidotus* 3.

*Selected descriptions.* Norstein, Gen. *Crepidotus* Norway (1990) 83. Stangl et al., Z. Mykol 57 (1991) 121–124, 138–141 (as *C. autochthonus*, *C. caspari*, *C. lundellii* and *C. sambuci*).

Pileus 4–30(–50) mm, circular, semicircular, rounded flabelliform to reniform, young ungulate, campanulate, later plano-convex, sessile, laterally or dorsally attached, with margin shortly inflexed, becoming straight and somewhat lobed, felted-tomentose, later silky except at tomentose margin, in very old specimen hygrophanous, white to cream-buff or chamois (M 2.5 Y 8/6, 10 YR 8/4–7/4–7/6), with similar colours when dried; point of attachment often tomentose-villose, white. Lamellae, L = 12–18, l = 1–5, narrowly to moderately broad up to 3.5 mm, (moderately) crowded, subventricose to ventricose, narrowly adnexed to free, pale whitish clay, later brown to snuff-brown, without pinkish tints (M 2.5 Y 7/4–6/6, 7.5 YR 6/6, 10 YR 8/3–8/4, 7/6–6/6); edge fimbriate (lens). Stipe only in very young fruit-bodies visible, < 1 mm, white. Flesh rather thin, up to 2 mm wide, white. Smell sometimes raphanoid. Taste slightly farinaceous. Spore print ochraceous-tawny to buffy brown (M 10 YR 5/4–6/6).

Spores 6–9.5 × 4–6 μm, Q = 1.3–1.7, mean volume 112 μm<sup>3</sup>, oblong to ovoid in frontal view, sometimes slightly amygdaliform in side view, marbled to faintly rugulose; walls rather faintly coloured. Basidia 20–37 × 5–10 μm, four-spored, clamped. Cheilocystidia 28–65(–90) × 6–12(–19) μm, clavate, narrowly utriform, more rarely capitate, branched or septate, hyaline, thin-walled, rarely with some granular bodies. Pilicpellis a transition between a cutis and a trichoderm of loosely interwoven, cylindrical, straight to coiled, 4–6 μm wide hyphae; segments of shorter, cylindrical, up to 10 μm wide hyphae with slightly thicker walls may be present; terminal cells towards the margin often broad and clavate, towards the point of attachment cylindrical, 2–4 μm wide; pileocystidia frequent; several hyphal segments with yellow contents or with many refractive bodies; further pigment lacking. Clamp-connections present in all tissues.

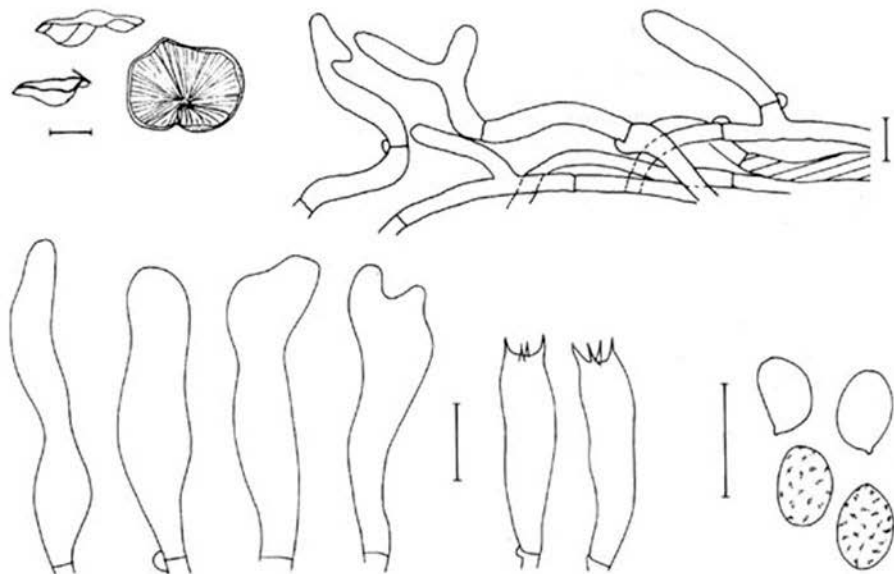


Fig. 55. *Crepidotus lundellii*: fruit-bodies, pileipellis, cheilocystidia, basidia, spores.

**Habitat & Distribution** — On hardwood twigs and branches, rarely on logs or herbaceous stems, mosses, litter, coniferous wood or on bare (?) soil. Submeridional to boreal. From lowlands to subalpine zone (highest altitude 1500 m). Frequent, probably common in alluvial forests. Throughout the year, mainly in August.

**Collections examined.** AUSTRIA: Kärnten, Sattnitz, bei Stemmeritsch, 21 Sept. 1969, *Moser 68/124* (IB); Salzburg, Pinzgau, Kaprunertal, 25 July 1992, *Senn-Irlet 92/118* (BERN). — BULGARIA: Kokaljave, Svinecni, Mt. Zozenska planina, 28 Aug. 1975, Hinkova (SOM 9420). — ESTONIA: Haapsalu, reserv. Matsalu, 21 July 1979, *Vaasma* (TAA 113162); Viljawi, Loodi, 10 Aug. 1988, *Kalamees & Vaasma* (TAA 143772). — FRANCE: dpt Maine-et-Loire; Vaudelnay, Bois de Chanteloup, 3 Oct. 1982, *Mornand 8127* (herb. Mornand); Bauné, Les Bruères, 7 Nov. 1989, *Mornand* (herb. Mornand); dpt Somme, Hangest vers Conde-Folies, 14 Oct. 1979, *Bon 79101014* (herb. Bon). — GERMANY: Baden-Württemberg, Weisweiler, 4 Oct. 1982, *A. F. M. Reijnders 67* (herb. Reijnders); Untergronbach, 11 June 1984, *Winterhoff 84108* (herb. Winterhoff); Nordrhein-Westfalen, Borgentreich-Rösebecker Bruch, 24 Oct. 1982, *Runge* (Münster); Saarland, Eimerdorf, 28 July 1982, *Schmitt 9526* (herb. Schmitt); Bayern, München, 9 Oct. 1966, *Einhellinger* (M). — GREAT BRITAIN: Middlesex, Ruislip woods, 9 Sept. 1992, *Senn-Irlet 92/207* (BERN). — LICHTENSTEIN: Schaan, 10 May 1989, *Prongué 8935* (herb. Prongué). — NETHERLANDS: prov. Flevoland, Oostelijk Flevoland, Larserbos, 21 Sept. 1988, *Tjallingii* (L 983.353-110); prov. Gelderland, Buren, 23 Oct. 1971, 22 July 1974, *Tjallingii* (L 982.216-933, 982.216-972), idem, Kleiputten, 25 Aug. 1982, *Kuyper 2126* (L); prov. Limburg, Linne, 20 Sept. 1969, *Benjaminsen 690921*; prov. Noord-Holland, Amsterdamse bos, 8 Dec. 1960, *Kits van Waveren* (L 986.112-109); Amsterdam, Amsterdamse Bos, 1 Nov. 1954, *Reijnders* (L 954.292-064); prov. Overijssel, Ommen, 29 Sept. 1977, *Kuyper 2916* (WAG-W); prov. Utrecht, Zeist, Appellaantje, 25 Aug. 1982, *Bas 7806* (L), Linschoten, 2 July 1982, *Kuyper 2033* (L); Winterswijk, 'Bekendelle', 29 Sept. 1973, *Bas 615* (L); prov. Zeeland, Hontenisse, Kruisdorp, 23 Nov. 1981, *Meijer* (L 981.180-132); prov. Zuid-Flevoland, Eind, Jan. 1989, *Chrispijn* (WAG-W); prov. Zuid-Holland, Voorschoten, 'Ter Wadding', 31 Aug. 1985, *Bas 8374* (L); Gieten, 'De kleine Houten', 3 Nov. 1982, *Arnolds 4962* (WAG-W). — SWEDEN: Uppland, Djurö,

Runmarö, 19 Aug. 1949, *Rydberg* (S); Almunge parish, near Harparbol lund, 15 Sept. 1935, Lundell & Ålberg Fungi exs. succ. no. 220) (neotype, K). — SWITZERLAND: Kt. Aargau, Niederrohrdorf, Taumoos, 1 Dec. 1984, *Gsell* (BERN); Kt. Bern, Biel-Beaumont, Nov. 1989, *Aeberhard* 90136 (BERN); Kappelen, alte Aare, 9 Sept. 1988, *Senn-Irlet* 881359, 26 Oct. 1988, *Senn-Irlet* 881462, 881460, 881459 (BERN); Lenk, Rohrbach, 29 June 1948, *Favre* (G 7894); Neuenegg, Forst, 5 Sept. 1988, *Senn-Irlet* 881349 (BERN); ct. Jura, Boécourt, Les Moulins, 5 Oct. 1989, *Chételat* (BERN); Les Ordon, 6 Oct. 1989, *Chételat* (BERN); sur Paicheux, 15 Sept. 1989, *Chételat* (BERN); Kt. Luzern, Entlebuch, Emmenmätteli, 1 Oct. 1988, *Senn-Irlet* 881426, 881424 (BERN); Immensee, Volgisried, 23 Nov. 1987, *Mürner* 2311/RM (NMLU); Schiltwald-Grundwald, 14 June 1979, *Bächler* 1406-79 Ba14 (NMLU); Emmen, 3 July 1979, *Bächler* 0307-79 Ba1 (NMLU); Haltikon-Meggerwald, 30 Oct. 1989, *Kränzlin* 3010-89 (NMLU); Kt. Schwyz, Muotathal, Bödmerenwald, 3 Oct. 1991, *Senn-Irlet* 91/172 (Bern); ct. Vaud, Pont de Nant, 1 Sept. 1986, *Moser* 86/148 (IB).

*Crepidotus lundellii* belongs to the white *Crepidotus* species that require an accurate microscopical analysis for identification. However, the clay-coloured to snuff-brown lamellae without any pinkish tints may be a good indication in the field.

The faint spore ornamentation, the shape of the cheilocystidia, and the structure of the pileipellis distinguish *C. lundellii* from *C. subverrucisporus*, the latter with narrowly lageniform cheilocystidia and strongly ornamented spores. Crooked terminal cells in the pileipellis, typical for *C. subverrucisporus*, have never been observed in *C. lundellii*.

The type of spore ornamentation, viz. very low ridges and warts, proved to be very constant in the SEM.

Beside *C. epibryus* and *C. subverrucisporus* no other European *Crepidotus* species got so many names as *C. lundellii*. The main differences for the separation of these taxa are the shape (broadly oblong vs amygdaliform) of the spores and minor discrepancies in spore size, and the presence or absence of yellowish tints on the pileus (see paragraph 5.2.4). It is true, that *C. lundellii* shows considerable variation in these characters, but I am unable to separate more taxa; too many intermediates exist. I did not find one single collection with exclusively amygdaliform spores; all collections have a certain percentage of oblong to broadly oblong spores. Norstein (1990) comes to the same conclusion.

One infraspecific delimitation, however, seems possible: three collections from *Fagus* and *Salix* twigs (L 981.282-322, L 981.180-132, SZU 223-89) have very small (mean length < 7 µm) spores which are all broadly oblong. They fit perfectly the concept of *C. lundellii* var. *subglobisporus* (Pilát) Pilát. For the time being the recognition of an infraspecific taxon is, however, not warranted, since the difference of the mean length of the spores between the largest of the small-spored group and the smallest of the large-spored group is only 0.3 µm (see also Fig. 38) and no other distinguishing character has been found.

### 13. *Crepidotus luteolus* (Lamb.) Sacc. — Figs. 10, 56, Plate 3a

*Agaricus luteolus* Lamb., Fl. mycol. Belg. 1 (1880) 181. — *Crepidotus luteolus* (Lamb.) Sacc., Syll. Fung. 5 (1887) 888. — Neotype (designated here): Switzerland: Kt. Bern; Dorfwald ob Schwarzenburg, clearing in mixed forest, on dead stems of various plants (*Rubus fruticosus*, *Urtica dioica*, *Athyrium filix-femina*), 12.X.1989, leg. & det. *Senn-Irlet* 891243 (G).

*Misapplied names.* *Dochmiopus terricola* (Britz.) Favre sensu Favre, Schweiz. Z. Pilzk. 13 (1935) 147. — *Crepidotus pubescens* Bres. sensu J. Lange, Dansk bot. Ark. 9 (6) (1938) 51; sensu A. Pears., Trans. Br. mycol. Soc. 32 (1949) 268. — *Dochmiopus epibryus* (Fr.: Fr.) Romagn., Rev. Mycol. 2 (1937) 137.

*Selected icones.* Mos. & Jül., Farbatl. Basidiomyc. 3 (1986) III *Crepidotus* 4; Mal. & Bert., Fl. Champ. sup. Maroc 2 (1975) 481.

Pileus 2–25 mm, orbicular, semicircular to reniform, young unguulate, campanulate, later plano-convex, sessile, laterally or dorsally attached, with narrowly inflexed margin, later often lobed, not hygrophanous, mat, felted-tomentose, later smoothly-silky, but at margin sometimes remaining tomentose, yellowish to cream or pinard-yellow to straw-yellow (M 10 YR 8/4–8/6, 2.5 Y 8/4–8/8); in dried specimen cream to yellow, antimon, apricot-yellow, yellow-buff, pinard-yellow; at point of attachment tomentose. Lamellae, L = 10–22, l = 1–3, rather narrow, moderately crowded, subventricose, narrowly adnexed, young white or yellowish to sulphur-yellow, later cinnamon-buff to cinnamon (10 YR 7/4–7/6, 8/6, 7.5 YR 7/4–7/6–5/6); edge white, minutely fimbriate, later even. Stipe only visible in very young fruit-bodies, curved, tomentose. Flesh thin, white. Odour none. Taste slightly farinaceous. Spore print pinkish-cinnamon, cinnamon-buff to cinnamon (M 7.5 YR 6/6–5/6).

Spores  $7.5\text{--}10.5 \times 4.0\text{--}5.5 \mu\text{m}$ ,  $Q = 1.65\text{--}2.2$ , mean volume  $105 \mu\text{m}^3$ , elongate in frontal view, amygdaliform in side view, minutely punctate to rugulose; walls moderately coloured. Basidia  $20\text{--}32 \times 5.5\text{--}8.5 \mu\text{m}$ , four-spored, clamped. Cheilocystidia  $35\text{--}65$  ( $-83$ )  $\times 5\text{--}10 \mu\text{m}$ , cylindrical, flexuous, branched and angled, more rarely slightly clavate or narrowly lageniform. Pileipellis a transition between a cutis and a trichoderm of  $3\text{--}6 \mu\text{m}$  wide, filiform hyphae. Pigment yellowish, intracellular, visible only in fresh material. Clamp-connections abundant in all tissues.

Habitat & Distribution — On hardwood twigs, herbaceous stems (*Urtica*, *Rumex*, *Rubus*, etc.), sometimes on mosses and coniferous twigs. Submeridional to temperate. From lowlands to subalpine zone (highest altitude 1380 m). Common. Throughout the year.

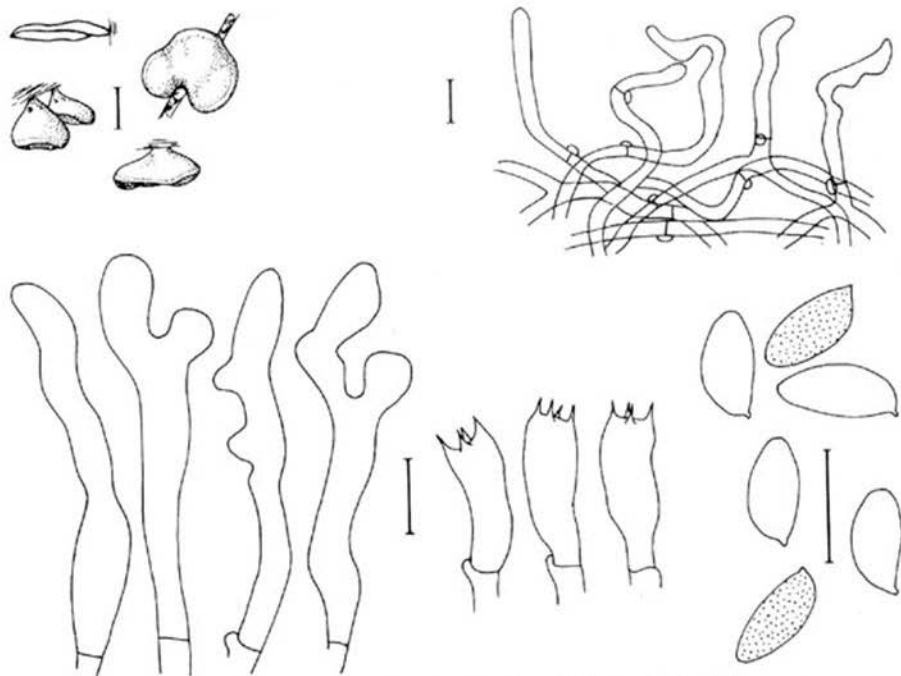


Fig. 56. *Crepidotus luteolus*: fruit-bodies, pileipellis, cheilocystidia, basidia, spores.

*Collections examined.* AUSTRIA: Kärnten, Ober Göltschach, Sattnitz, 10 Sept. 1967, Moser 67/120 (IB); Steineritsch, Sattnitz, 21 Sept. 1968, Moser 68/123 (IB); Tirol, Waldhüttel bei Innsbruck, 29 Oct. 1948, Moser 48/88 (IB); Wörgl, Berglsteinersee, 10 Sept. 1982, Irlet 82/302 (BERN); Wien, Deutsch Kaltenbrunn, 10 Oct. 1973, Reijnders 179 (herb. Reijnders). — BULGARIA: Sofia, Svinecu Dol., Mt. Zozenska planina, 7 Sept. 1976, Hinkova (SOM 12030). — FRANCE: dpt Finistère, Lanvéoc, 28 Dec. 1989, Mornand 8922 (herb. Mornand); dpt Maine-et-Loire, Vauldenay, Chanteloup, 31 Feb. 1979, Lohmeyer 7936B1 (herb. Mornand); Ecoflant, 31 Jan. 1988, Mornand (herb. Mornand); dpt Savoie, Allevard, Gleysin de Pinsot, 4 Sept. 1978, Bon; dpt Doubs, Besançon, Mamirolle, Forêt du Gros Bois, 6 Nov. 1981, Moser 81/526 (IB); ex herb. Kühner sub nomen *Dochmiopus remotus* (G 18432). — GERMANY: Baden-Württemberg, Sandhausen, 23 Nov. 1972, Winterhoff 7244b (herb. Winterhoff); Bayern, Kreis Coburg, Plesten, 2 Nov. 1985, Engel 318 (K); Bayerischer Wald, Lärchenberg, 13 Aug. 1987, Luschka (herb. Luschka 1258); Nordrhein-Westfalen, Hohenlimburg, 25 Oct. 1989, Runge (Münster); Warburg-Scherfede, 21 Oct. 1982, Runge (Münster); Münster, 28 June 1985, Papen (Münster); Warendorf, 14 Oct. 1984, Runge (Münster); Rheder, Sieselberg, 24 Oct. 1982, Runge (Münster); Saarland, Völklingen-Kreuzberg, 21 Oct. 1973, Schmitt 10572, 30 Oct. 1974, Derbsch 10603 (herb. J.A. Schmitt); Saarbrücken-Schafsbrücke, 25 Oct. 1981, Schmitt 9080 (herb. J.A. Schmitt). — ITALY: Varese, Vergiate, Sept. 1982, Macchi 3056 (Lugano); Reggio Emilia, 25 Oct. 1991, Schild (BERN). — LICHTENSTEIN: Eschnerberg, 27 June 1989, Prongué 8956 (herb. Prongué); Schaanwald, 26 Sept. 1989, Prongué 89216 (herb. Prongué); Profaschwald, 1 Nov. 1989, Prongué 89262 (herb. Prongué). — NETHERLANDS: prov. Drente, Ruinen, 15 Oct. 1984, Arnolds (WAG-W 5276); Dwingeloo, 9 Nov. 1983, Arnolds 5144 (WAG-W); prov. Friesland, Schiermonnikoog, 27 Dec. 1985, Jalink & Nauta (L 985.125-039); prov. Gelderland, Wageningen-Hoog, 1 May 1979, Tjallingii; Hierden-Bloemkampen, 1 Oct. 1988, Tjallingii; Putten-Schovenhorst, 15 Nov. 1986, Tjallingii (L 970.294-008); prov. Limburg, St. Pietersberg, Encibos, 18 Oct. 1950, Maas Geesteranus (L 950.293-145); prov. Noord-Brabant, Dorst, 4 Dec. 1954, Jansen (L 954.292-117); Leemkuilen, 1 Nov. 1956, Jansen (L 956.148-147); prov. Noord-Holland, Vogelenzang, Bekslaan, 18 April 1970, Bas (L 968.190-165); Overeen, 2 Nov. 1974, Tjallingii (L 970.294-002); prov. Utrecht, Bunnik, Rijnauwen, 24 Nov. 1973, Arnolds 3118 (WAG-W); Maarssen, Kleine Plas, 31 Oct. 1981, van der Aa; prov. Zeeland, Hontenisse, Hengstdijk, 23 Nov. 1981, Meijer (L 981.180-182); prov. Zuid-Holland, Warmond, 2 Dec. 1951, Maas Geesteranus (L 950.24-29); Oostvoorne Mildenburg, 8 Nov. 1975, Bas (L 969.16-160). — SPAIN: Salamanca, 19 Oct. 1979, Sanchez 1799 (GDAC). — SWITZERLAND: Kt. Bern, Bern, Bremgartenwald, 17 Nov. 1988, Senn-Irlet 88/480 (BERN); Schwarzenburg, Dorfwald, 12 Oct. 1989, Senn-Irlet 89/243\* (G) (neotype, G); ct. Jura, Montavon, Les Lavoires, 27 Sept. 1989, Senn-Irlet 89/194 (BERN); Kt. Luzern, Horw, Birregwald, Iff 1510-79Ba10 (MNLU); Sempach, Chrüsenrainwald, 10 Jan. 1977, Breitenbach 1001-77 Br1 (MNLU); Entlebuch, 1 Oct. 1988, Senn-Irlet 88/423 (BERN); Kt. Obwalden, Alpnach, Wichelsee, 26 Dec. 1978, Bächler 2612-78Ba1 (NMLU); Kt. Schwyz, Haltikon, Meggerwald, 30 Oct. 1989, Kränzlin 3010-89K (NMLU); Kt. Solothurn, Biberist, 13 Oct. 1988, Aeberhard 88/482 (BERN); Biberist, Altisberg, 22 Oct. 1988, Aeberhard 88/483 (BERN); Biberental, 1 Nov. 1982, Aeberhard 88/481 (BERN); Ichertswil, Nov. 1989, Aeberhard 90/37 (BERN).

If the yellow colours are present, *Crepidotus luteolus* is easily recognized. Otherwise the spore shape and size as well as the cylindrical, flexuous, branched cheilocystidia are very distinctive characters.

It is remarkable that this common species has obviously not been described earlier than in the late 19th century.

#### 14. *Crepidotus subverrucisporus* Pilát — Figs. 11, 57

*Crepidotus subverrucisporus* Pilát, Studia bot. cech. 10 (1949) 151. — Holotype: Czechoslovakia, Bohemia, Chrštenica, 20.VIII.1948, Vacek (PRM 49034).

*Crepidotus velenovskii* Pilát, Studia bot. cech. 10 (1949) 152 (type: PRM 14309).

*Crepidotus bickhamensis* P.D. Orton, Notes R. bot. Gdn Edinb. 41 (1984) 573 (type: E).

*Misapplied names.* *Crepidotus epibryus* (Fr.: Fr.) Quél. sensu Norstein, Gen. *Crepidotus* Norway (1990) 102; sensu Pilát, Atl. Champ. Eur. 6 (1948) 66. — *Phialocybe epibrya* (Fr.: Fr.) P. Karst. sensu Horak, Syn Gener. Agaricalium (1968) 453.

*Selected descriptions.* P.D. Orton, Notes R. bot. Gdn Edinb. 41 (1984) 573 (as *C. bickhamensis*); Stangl et al., Z. Mykol. 57: 143 (as *C. velenovskyi*); Senn-Irlet, Nordic J. Bot. 11 ('1991'; 1992) 592–593.

Pileus 5–10 mm, semicircular, rounded flabelliform, reniform, unguulate, campanulate, later plano-convex, young with inflexed margin, later with straight margin, at times lobed, not or only slightly hygrophanous, felted-tomentose, white to cream (M 10 YR 8/4); in dried specimens yellowish cream, pale orange or greyish orange; at point of attachment often tomentose, white. Lamellae, L = 8–15, l = 1–3, medium broad, close to substiant, ventricose, narrowly adnate, white, becoming light ochraceous-buff to cinnamon or reddish brown (M 2.5 Y 8/3–6/6, 7.5 YR 6/6–10 YR 7/4–6/6–5/6); edge fimbriate, white. Flesh thin, white. Odour none. Taste mild. Spore print sordid flesh-pink to cinnamon (M 5 YR 6/6).

Spores 7.5–10 × 4.5–6 μm, Q = 1.3–1.8, mean volume 152 μm<sup>3</sup>, oblong in frontal view, slightly amygdaliform in side view, distinctly rugulose; walls dark coloured. Basidia 20–29(–35) × 6–8.5 μm, four-spored, clamped. Cheilocystidia 21–65(–80) × 5–12 μm, narrowly lageniform, cylindrical, angled, sometimes faintly flexuous. Pileipellis a transition between a cutis and a trichoderm, towards margin a distinct trichoderm of 3–5 (–7) μm wide, cylindrical, more or less straight to coiled, branched, hyaline hyphae; terminal cells often slightly narrower, straight or crooked; pileocystidia sometimes present at pileus margin. Pigment in general lacking, but some cells of pileipellis occasionally filled with yellow (necro-?) pigment. Clamp-connections present in all tissues.

*Habitat & Distribution* – On hardwood, on twigs of various deciduous trees or shrubs. Submeridional to boreal. From lowlands up to subalpine zones. Scattered. July–December.

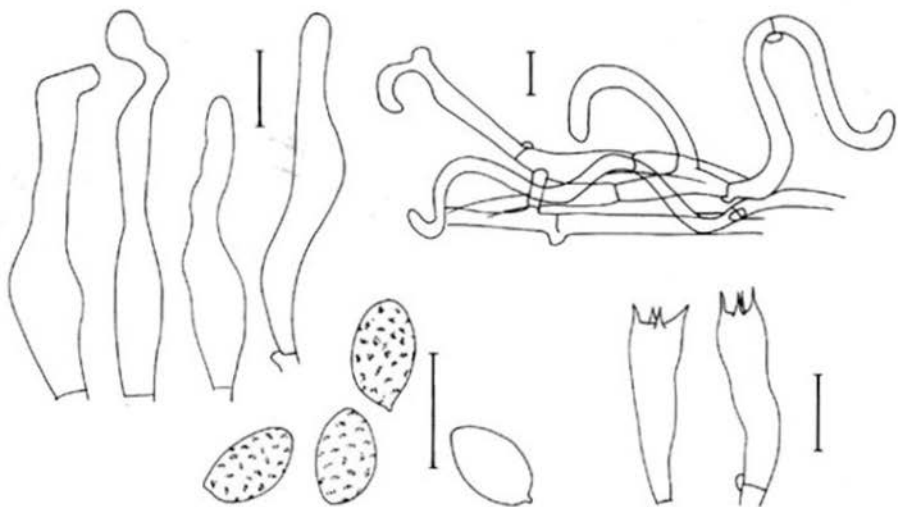


Fig. 57. *Crepidotus subverrucisporus*: cheilocystidia, pileipellis, spores, basidia.



*Collections examined.* AUSTRIA: Tirol, Stamserswald, 2 Aug. 1966, Moser 66/112 (IB) and 22 July 1968, Moser 68/32 (IB); Salzburg, Flachgau, Käferheim, 9 July 1990, Rücker 51-90 (BERN); Pinzgau, Kaprunertal, 26 July 1991, Senn-Irlet 92/120 (BERN). — BULGARIA: Kokaljave, Zozenska planina, 28 Nov. 1968, Hinkova et al. (SOM 6989), 7 Oct. 1976, Hinkova (SOM 12030). — CZECHOSLOVAKIA: Bohemia, Chrštenica, 20 Aug. 1948, Vacek (PRM 49034, holotype); Moravia, Pavlovské vrchy, 19 Aug. 1965, Kriz\* (BRNM 313003). — ESTONIA: Kothla-Järve, Kuremaa, 18 Sept. 1987, Kalamees (TAA 141819); Toila, 5 July 1961, Kalamees (TAA 72392). — FRANCE: ex herb. Kühner sub nomen *C. epibryus* (G 18420-21). — GERMANY: Baden-Württemberg, Kaiserstuhl, Weisweil, 25 Oct. 1978, 4 Oct. 1982, Reijnders (herb. Reijnders); Hockenheim, Mörlach, 15 Sept. 1988, Winterhoff 8892 (herb. Winterhoff); Bayern, Nationalpark Berchtesgaden, 19 June 1985, Schmid-Heckel (M), Erding, Eichenrieder Moos, 16 July 1974, Einhellinger (M); Bayreuth, Oberaufsess, 10 June 1990, Engel E/13035 (herb. Engel). — ITALY: prov. Parma, Borgotaro, Passo Cento Croce, 3 Oct. 1983, Moser 83/466 (IB); prov. Trento, Val di Sol, Malé, 5 Aug. 1972, Bresinsky & Sarclotti (M). — LICHTENSTEIN: Valina, 15 July 1989, Prongué 8977 (herb. Prongué). — NORWAY: Sør-Trøndelag, Trondheim, Malvik, 15 Sept. 1972, Strid 11226 (S). — RUSSIA: Krasnodar, reserv. Caucasus, Kisa, 10 Sept. 1975, Kalamees (TAA 94631). — SPAIN: Granada, Alhama de Granada, 13 Nov. 1980, Ortega & Galan 1762 (GDAC) (as *C. microcarpus*). — SWEDEN: Västmanland, Sala stad, 27 July 1948, Morander (UPS). — SWITZERLAND: Kt. Bern, Oberburg, 18 Dec. 1988, Senn-Irlet 88/494 (BERN); Brienz, Birchetal, 25 Sept. 1991, Senn-Irlet 91/151 (BERN); Kt. Graubünden, S-chanf, Val Trupchun, 28 Aug. 1954, Favre (G 13813), Scuol/Schuls, Val Tavrü, 31 Aug. 1943, Favre (G 13809); 27 Aug. 1948, Favre (G 13811); Chamosch-Flurins, 6 Sept. 1945, Favre (G 13810); Val Sesvenna, 29 Aug. 1943, Favre (G 13808); 21 Aug. 1945, Favre (G 13812); Ct. Jura, Boécourt, Oct. 1989, Chételat 16 (BERN); Kt. Schwyz, Steinen, 3 Oct. 1991, Senn-Irlet 91/171 (BERN); Cte Ticino, Bolle di Magadino, 6 Oct. 1988, Lucchini 55 (Lugano). — PAKISTAN: W. Pakistan: Loon Bogla Muzafarabad, 23 July 1963 (K).

Macroscopically it is difficult to distinguish this species from other white *Crepidotus* species. The dark, distinctly rugulose spores and the narrowly lageniform cheilocystidia are the most important distinctive characters.

Dried specimens are most often light orange (K & W 5A5, 5A4, 6A5, 6A4) which may give rise to a confusion with *Crepidotus luteolus* from which *C. subverrucisporus* is best separated by the shape of the spores and the elongate cystidia with acute apex. Unfortunately most herbarium collections lack notes on the fresh fruit-body colours; therefore it remains uncertain if *C. subverrucisporus* exhibits yellowish tints also in living specimens.

*Crepidotus subverrucisporus* is rather variable in several microscopical characters: among the cheilocystidia of the holotype are some septate and branched ones. Exactly the same shapes were found in one other collection (IB, Moser 83/466) from northern Italy, on *Robinia* also. If further collections will prove that this character is constant, it might well serve for infraspecific delimitation.

The spore ornamentation as observed in the SEM varies from verruculose-rugulose to almost vermiculate-rugulose. Faintly ornamented spores come close to *C. luteolus*.

#### Subsection **Autochthoni** Senn-Irlet, *subsect. nov.*

Type: *C. autochthonus* J. Lange.

Sporis levibus, hyphis fibulatis, sine hyphis gelatinosis.

Spores smooth, hyphae with clamp-connections.

15. *Crepidotus autochthonus* J. Lange — Figs. 4, 58

*Crepidotus autochthonus* J. Lange, Fl. agar. dan. 5 (1940) III. — Neotype (designated here): Denmark, Jylland, Marie Lund ved Kodling, 24.VIII.1987, JHP 74.87 (C).

*Crepidotus fragilis* Joss., Bull. trimest. Soc. mycol. Fr. 53 (2) (1937), 18 (not val., no Lat.).

*Crepidotus mollis* var. *pseudoapplanatus* Pilát, Studia bot. cech. 10 (1949) 151 (type: W, Acqu. 1889 no. 370793, see Senn-Irlet, 1992c).

*Misapplied names.* *Derminus* (*Crepidotus*) *depluens* (Batsch) Schroet. sensu Schroet., Pilze Schlesiens (1889) 279. — *Crepidotus applanatus* sensu Quél., *Crepidotus applanatus* sensu Rea, British Basidiomycetae (1922) 455.

*Selected icon.* J. Lange, Fl. agar. dan. 4 (1939) pl. 132E.

*Selected description.* Joss., Bull. trimest. Soc. mycol. Fr. 53 (1937) 216–219 (as *C. fragilis*).

Pileus 20–30(–40) mm, flabelliform, semicircular to circular, convex to infundibuliform, with inflexed, sometimes lobed margin, indistinctly hygrophanous, mat, young distinctly tomentose, later minutely felted, becoming furrowed, cream-buff to pale buff or olive-buff (M 10 YR 7/4, 8/4–8/6); in dried state cream-buff to chamois; at point of attachment strigose-fibrillose. Lamellae, L = 16, l = 1–3, moderately to distinctly crowded, narrow up to 2–3 mm broad, arcuate to subventricose, when young whitish, becoming buffy-brown to snuff-brown (M 7.5 YR 5/6, 10 YR 5/4–5/6); edge even, at times undulate. Stipe often visible, short and thick, often in the shape of a pseudostipe, white, villose or tomentose, eccentric. Flesh thin, thicker near base, whitish, brittle, very brittle when dried. Taste mild. Odour not recorded. Spore print cinnamon to fulvous (M 7.5 YR 4/6).

Spores 7–9 × 5–6 μm, Q = 1.3–1.7, mean volume 122 μm<sup>3</sup>, oblong to ovoid in frontal view, amygdaliform with acute apex in side view, apex at times almost mucronate, absolutely smooth, rather thick-walled, dark coloured. Basidia 24–30(–35) × 6–10 μm,

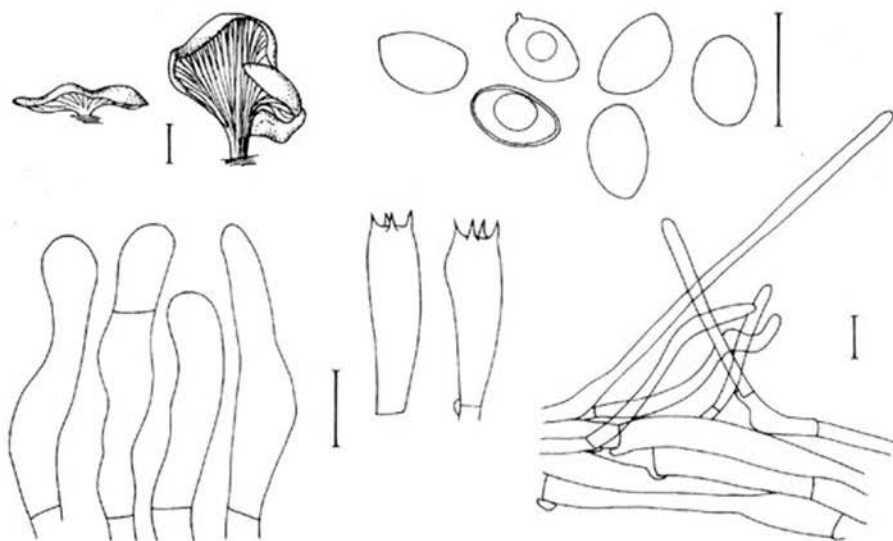


Fig. 58. *Crepidotus autochthonus*: fruit-bodies, spores, cheilocystidia, basidia, spores.

four-spored, occasionally mixed with some two-spored, clamped. Cheilocystidia (11–) 20–45(–55) × 5.5–11 µm, cylindrical to narrowly utriform, sometimes subcapitate, occasionally septate, hyaline, thin-walled. Pileipellis a transition between a trichoderm and a cutis; terminal cells straight, 3–6 µm wide, sometimes some pileocystidia shaped like cheilocystidia present. Pigment lacking. Clamp-connections present in all tissues.

**Habitat & Distribution** – On soil, most probably always in connection with litter or wood debris, rarely clearly on wood, in frondose forests, probably mainly in alluvial forests. Temperate. From lowlands up to submontane zone (highest altitude 640 m). Scattered. July–September.

**Collections examined.** AUSTRIA: Wien, Maurerwald, 26 June 1983, *Mrasek* (WU 2738); Lainzer Tiergarten, 5 July 1981, *Mader* (WU 1070). — BELGIUM: prov. Namur, Han, Bois banal, 8 Sept. 1975, *Tjallingii* (herb. Tjallingii). — CZECHOSLOVAKIA: Moravia, Kromerize, 17 July 1954, *Zavrel* (BRNM 333532). — DENMARK: Jylland, Marie-Lund ved Kolding, 24 July 1987, *Petersen 74.87* (neotype, C); Falster, Pomle Nakke, 31 July 1985, *Knudsen & Petersen* (C). — FRANCE: dpt Ht-Rhin, Colmar, Forêt le Neuland, 20 Sept. 1986, *Wilhelm 881485\** (BERN); dpt Doubs, Lougres, 17 Sept. 1955, *Huijsman* (L 955.239-420); dpt Maine-et-Loire, Forêt de Longuenée, 27 July 1981, *Mornand* (herb. Mornand); Champigny, 18 Oct. 1975, *Mornand 75151B1* (herb. Mornand); dpt Rhône, Laye, 29 May 1955, *Josserand* (herb. Josserand). — SWITZERLAND: ct. Vaud, Mauraz, 10 Sept. 1970, *Cléménçon 700910B* (LAU).

*Crepidotus autochthonus* is the sole European *Crepidotus* growing almost exclusively on soil and exhibiting rather large flabelliform to deeply infundibuliform fruit-bodies. Microscopically the smooth, dark-coloured, thick-walled spores are characteristic features. In shape and surface structure they resemble those of *C. mollis*. The combination of the above mentioned characters together with the character of the simple shaped cheilocystidia give *C. autochthonus* a rather isolated systematic position within section *Crepidotellae*.

#### Subsection **Pleurotellus** (Fay.) Senn-Irlet, *subsect. et stat. nov.*

*Pleurotellus* Fay., Ann. Sci. nat. (Bot.) VII, 9 (1889) 339 (basinym; type: *Pleurotellus graminicola* Fay. = *Crepidotus epibryus*).

Hyphae without clamp-connections; spores smooth or minutely rugulose, oblong to fusoid; fruit-bodies white.

### 16. *Crepidotus epibryus* (Fr. Fr.) Quél. — Figs. 5, 59, Plate 3c, d

*Agaricus epibryus* Fr.: Fr., Syst. mycol. 1 (1821) 275. — *Crepidotus epibryus* (Fr.: Fr.) Quél., Fl. mycol. France (1888) 107. — *Phialocybe epibrya* (Fr.: Fr.) P. Karst., Bidrag Känn. Finl. Nat. Folk 32 (1879) 415. — *Dochmiopus epibryus* (Fr.: Fr.) Romagn., Rev. Mycol. 2 (1937) 137. — Neotype (designated here): Netherlands, prov. Zuid-Holland, Warmond, Huis te Warmond, on rotten gramineous stalks and leaves, leg. *Maas Geesteranus 15643* (L 978.18-915).

*Agaricus variabilis* var. *hypnophilus* Pers., Mycol. eur. 3 (1828) 28 (type: K, examined by Singer, see Singer, 1961: 143). — *Agaricus hypnophilus* (Pers.) Berk., Outl. Brit. Fungol. (1860) 139. — *Crepidotus hypnophilus* (Pers.) Norstein, Gen. Crepidotus Norway (1990) 78.

*Agaricus herbarum* Peck, Bull. Buffalo Soc. nat. Sci. 1 (1873) 53 (type: NYS, examined by Singer, see Singer, 1947). — *Crepidotus herbarum* (Peck) Sacc., Syll. Fung. 5 (1887) 888. — *Pleurotellus herbarum* (Peck) Sing., Lilloa 13 (1947) 84.

*Agaricus (Pleurotus) hypnophilus* Berk., Outl. Br. Fungol (1860) 39. — *Pleurotellus hypnophilus* (Berk.) Fay., Ann. Sci. nat. (Bot.) VII, 9 (1889) 339.

*Pleurotellus graminicola* Fay., Censimento dei funghi osservati nelle Valli Valdesi del Piemonte durante il mese Agosto-Ottobre del 1885–87, off-print p. 12, 1892. (Type: G, examined by Horak, see Horak, 1968).

*Crepidotus commixtus* Bres. in Krieger, Fungi saxon. Exsicc. no. 1766-1767 (1912) (type: K).

*Crepidotus bufonius* Velen., Novit. mycol. nov. (1947) 76 (fide Pilát, 1948).

*Misapplied names.* *Agaricus sessilis* Bull. sensu Fries, Syst. mycol. I (1821) 275. — *Pleurotus chioneus* (Pers.) sensu Favre, Schweiz. Z. Pilzk. 13 (1935) 148. — *Crepidotus pubescens* (Vahl) Schroet. sensu Schroet., Krypt. Fl. Schlesien I (1889) 624; sensu Kühner & Romagn., Fl. anal. Champ. sup. (1953) 57.

*Selected icon.* Cooke, Ill. Brit. Fungi (1885) pl. 516 C (as *Agaricus epibryus*).

*Selected descriptions.* Favre, Schweiz. Z. Pilzk. 13 (1935) 148 (as *Pleurotus chioneus*). Horak, Beitr. Kryptog. fl. Schweiz 13 (1968) 481–483 (as *Pleurotellus graminicola*).

Pileus 2–20(–25) mm, semicircular, rounded flabelliform, reniform, sometimes circular, campanulate, plano-convex, sessile, laterally or dorsally attached, with margin shortly inflexed, later straight and often lobed, mat, not hygrophanous, never striate, felted-tomentose, white, also when dried; at point of attachment tomentose, never strigose-villose, white. Lamellae, L = 8–14, l = 1–2, moderately crowded to crowded, narrow, 1–2 mm broad, arcuate to subventricose, narrowly adnexed, white, then pale ochraceous, later cinnamon-buff to cinnamon or sayal-brown (M 7.5 YR 8/6, 10 YR 8/3–8/6, 7/6–5/6); edge minutely fimbriate. Stipe in younger fruit-bodies clearly visible, eccentric, 1–2 × 1 mm, white, tomentose. Flesh very thin, white. Taste and odour none. Spore print ochraceous-buff to ochraceous-tawny (M 10YR 7/6–6/6).

Spores 6.5–9.5 × 2.5–3.5  $\mu\text{m}$ , Q = 2.1–3.2, mean volume 38  $\mu\text{m}^3$ , cylindrical to fusoid in frontal view, amygdaliform to distinctly pip-shaped in side view, smooth, faintly coloured, hyaline in light microscope. In preparation often in dyads and tetrads. Basidia 17–25 × 5–7  $\mu\text{m}$ , four-spored, clampless. Cheilocystidia (20–)33–55 × 4–7 × 1.8–2.5

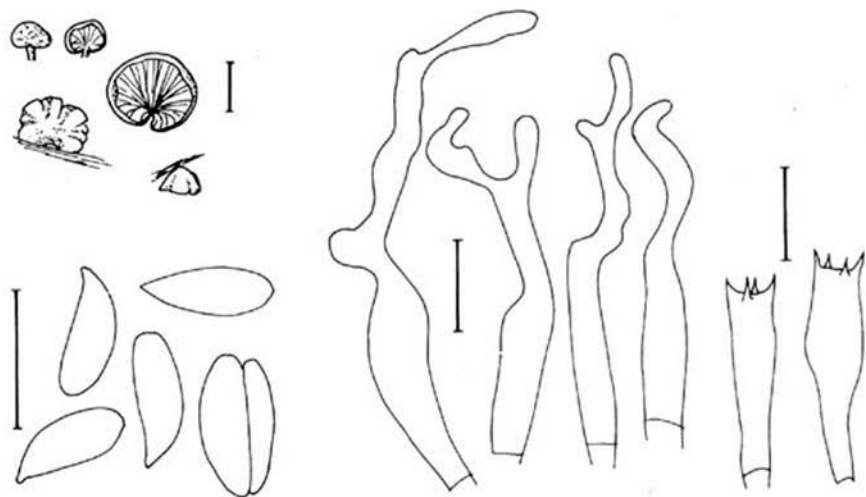


Fig. 59. *Crepidotus epibryus*: fruit-bodies, spores, cheilocystidia, basidia.

(-4)  $\mu\text{m}$ , cylindrical, narrowly lageniform, whip-like, flexuous, often branched, hyaline, thin-walled. Pileipellis a transition between a cutis and a trichoderm of loosely interwoven or slightly coiled, cylindrical, 2-4  $\mu\text{m}$  wide hyphae; terminal cells not differentiated, straight. Pigment none. Clamp-connections absent.

Habitat & Distribution - On herbaceous stems, mainly grasses, hardwood twigs, litter, mosses, or even man-made substrates (rope). At a given spot mycelium fruiting sometimes on various substrates. Meridional to boreal. Rather common and widespread throughout Europe from lowlands to upper montane zone (highest altitude 950 m). May-February.

*Collections examined.* AUSTRIA: Wien, Deutsch Kaltenbrunn, 10 Oct. 1973, A. F. M. Reijnders (herb. Reijnders). - CZECHOSLOVAKIA: Moravia, Kurim in silva Siberna, 1 Oct. 1952, Smarda (BRNM 333562). - FRANCE: dpt Maine-et-Loire, La Poueze, 17 Feb. 1987, Galand (herb. Mornand 8783 B1); St. Sylvain, l'Echarbot, 25 Nov. 1979, Mornand; dpt Deux-Sèvres, Taizé, 18 Nov. 1979, Mornand 79239; dpt Paris, Bois de Boulogne, 1845, Leveillé (G 15572); ex herb. Kühner sub nomen *C. pubescens*, 15 Oct. 1944 (G 18423); Corse, Val de Nielhe, Verghio, 1 Nov. 1982, Maas Geesteranus 15695 (L). - GERMANY: Königstein, 24 June 1902, Krieger (Krieger, Fungi saxonici no. 1766, paratypus *Crepidotus commixtus* Bres.); Schandau, Oct. 1901, Krieger (Krieger, Fungi saxonici no. 1767 as *Crepidotus commixtus* Bres., paratypus) (K); Nordrhein-Westfalen, Lennestadt-Bilstein, 27 Oct. 1983, Runge (Münster); Brilon-Alme, Nettetal, 6 Oct. 1983, Runge (Münster); Saarland, Halde Jägersfreude, 11 Oct. 1981, Schmitt 8884 (herb. Schmitt). - GREAT BRITAIN: England, Arbrook common, Esher, Surrey, 5 Nov. 1989, Spooner (K). - ITALY: prov. Trento, Calcaranica-Caldonazzo, 8 Oct. 1974, Moser 74/572 (IB). - LICHTENSTEIN: Balzers, 30 Oct. 1989, Prongué 89263 (herb. Prongué). - NETHERLANDS: prov. Flevoland, O. Flevoland, Roggebotbos, 1 Nov. 1980, A. F. M. Reijnders; prov. Noord-Holland, Velzen, Midden-Herrenduin, 6 Nov. 1976, Bas (L 976.300-581); prov. Overijssel, Rijsen, Rijsserberg, 11 Sept. 1955, Maas Geesteranus (L 955.117-184); neotype (designated here): prov. Zuid-Holland, Warmond, Huis te Warmond, on rotten gramineous stalks and leaves, leg. Maas Geesteranus 15643 (L 978.18-915). - SPAIN: Madrid, 17 Nov. 1982, Esteve 2819 (GDAC). - SWITZERLAND: Kt. Aargau, Bremgarten, Fischbachmoos, 9 Oct. 1981, Irlet 81/428; 20 Oct. 1984, Gsell 9014\* (BERN 90/4); Kt. Bern, Belp, Hunzigenau, 28 Oct. 1986, Senn-Irlet 86/194; 11 Dec. 1988, Senn-Irlet 88/487 (BERN); ct. Jura, Bassecour, Mt. Choisi, 5 Oct. 1989, Chételat (BERN); Kt. Luzern, Horw, Birregwald, 3 Jan. 1976, Kränzlin 1412-75-K (NMLU); Kt. Schaffhausen; Stein a. Rh., 22 Nov. 1881, Schenk (Rabenhorst-Winter, Fungi europaei, no 2732 pro parte) (BERN); Kt. Solothurn, Oberdorf, Nesselboden, 23 Oct. 1988, Senn-Irlet 88/452 (BERN); cte Ticino, Barbegno, 9 Nov. 1980, Weidmann (Lugano 1176); Bedigliora, 15 April 1983, Riva (Lugano 3189).

Several mycologists (Pilát, 1948; Moser, 1983; Watling & Gregory, 1990) separate this species from the genus *Crepidotus* and place it in *Pleurotellus*. Their main reason for maintaining the genus *Pleurotellus* is the pale spore colour. Indeed, that is a striking character of *C. epibryus*. Yet, spore colour varies considerably within the genus *Crepidotus*, being an important taxonomic character on species level for most authors.

The spore shape, another striking character of *Crepidotus epibryus*, resembles strongly that of *C. versutus*. Again this can be seen as the extreme on a line along which spores are becoming more and more elongated. Dyads and tetrads of spores are often observed in *C. versutus* as well.

Smooth spore walls occur in several species of *Crepidotus*.

The cheilocystidia of *C. epibryus* have often been overlooked in the past, as they collapse easily and therefore seem to be lacking in old or poorly dried herbarium material. The circumscription of *Pleurotellus* as having no cystidia is therefore untenable, as it is typified by *P. graminicola* Fay. (see Horak, 1968), in my opinion a synonym of *C. epi-*

*bryus*. The whip-like shape of the cystidia can again be regarded as an extreme form of those found in *C. versutus*. Singer (1973) indicates similar cystidia for *C. polylepidis* and *C. longicystis*. Substrates and habitats of *C. epibryus* are similar to those of *C. luteolus*.

In view of the above picture I do not see any good reason for separating *C. epibryus* from *Crepidotus* in a genus of its own. The characters in common are overwhelming: (i) fruit-body development, (ii) structure of hymenophoral trama, (iii) structure of the pileipellis, (iv) colour of the lamellae; occasionally with pinkish tinges (collection of Spooner at Kew); snuff-brown in occasional large fruit-bodies (e.g. BERN 90/4), shape of fruit-body.

*Agaricus (Crepidotus) epibryus* Fr. has been interpreted in many different ways, at least three species have been confused in this process.

Fries stresses the fact that his small species with a white, sericeous pileus grows on mosses. Not so many *Crepidotus* species occur on mosses (see Table II). Besides with *C. luteolus*, this is occasionally the case with *C. lundellii* and *C. cesatii*, but these three species have brownish lamellae, thus not fitting Fries' description: "lamellis confertis gilvis." The descriptions of *C. epibryus* of Quélet (1872) and Romagnesi (1937) stress mainly spore shape and ornamentation and agree with *C. luteolus*. A critical analysis of Pilát's description (1948) of *C. epibryus* and a re-examination of specimens listed under *C. epibryus* (e.g. de Thümen, Mycoth. univ. no. 401) convinced me, that Pilát's circumscription of *C. epibryus* includes at least partly *C. luteolus* and *C. subverrucisporus*.

Cooke (1884–1886) illustrates on plate 516 C a fungus, growing on grasses, with a very thin pileus called *Agaricus epibryus*, representing what many mycologists call *Crepidotus (Pleurotellus) herbarum*. Karsten (1879) as well notes herbs as substrate of *Phialocybe epibrya* and thus describes most probably the same species as Cooke.

An important macroscopical character of *Crepidotus herbarum*, i.e. *C. epibryus*, is the fact that the lamellae rarely turn deep brown, but remain pale ochraceous, that is 'gilvus'! Having in mind that this species is widely distributed in Scandinavia (Norstein, 1990) and grows sometimes on mosses I conclude that it can hardly be doubted that Fries' original description of *A. epibryus* covers what is usually called *C. herbarum*.

## 17. *Crepidotus versutus* (Peck) Sacc. — Figs. 7, 60

*Agaricus (Crepidotus) versutus* Peck, Ann. Rep. N.Y. State Mus. 30 (1878) 70. — *Crepidotus versutus* (Peck) Sacc., Syll. Fung. 5 (1887) 888. — Holotype: USA, New York; Forestburgh, Sept., Peck (NYS) (see also Singer, 1947).

*Agaricus pubescens* Vahl, Fl. danica 8 (1792) t. 1073/2. — *Pleurotus pubescens* (Vahl) Schroet., Krypt. Fl. Schlesien 1 (1889) 624 (misappl. to *C. epibryus*). — *Crepidotus pubescens* Bres., Iconogr. mycol. 16 (1930) 790.

*Crepidotus bresadolae* Pilát, Atl. Champ. Eur. 6 (1948) 46 (superfl. name change for *C. pubescens* Bres.). *Geopetalum geophilus* Murr., N. Amer. Fl. 9 (1916) 299. — *Crepidotus geophilus* (Murr.) Redhead, Sydowia 37 (1986) 255.

*Agaricus chimonophilus* Peck (fide Murrill, 1917).

*Selected descriptions.* Norstein, Gen. *Crepidotus* Norway (1990) 70; Senn-Irlet, Nordic J. Bot. 11 ('1991': 1992) 593–595.

Pileus 7–25 mm, semicircular, rounded flabelliform to reniform, rarely spatulate, young unguulate, campanulate, later convex to plano-convex, sessile, laterally or dorsally attached, old slightly undulate, with margin shortly inflexed, soon becoming straight, later

sometimes crenate, felted, slightly tomentose at margin, white, in old hygrophanous specimens more greyish; white or more rarely buff or chamois when dried; at point of attachment sometimes villose, white. Lamellae, L = 10–14, l = 1–3, moderately broad, moderately crowded, rarely subdistant or distinctly crowded, subventricose to ventricose, narrowly adnexed or free, white, soon clay-white, pale yellow-orange, pinkish buff, light ochraceous-buff, cinnamon-buff (M 2.5 Y 8/3, 10 YR 7/6, 7.5 YR 6/8–5/8, 5/6), when dried cinnamon-brown; edge fimbriate and whitish. Stipe absent or only visible in very young fruit-bodies, < 1 mm, tomentose, white. Flesh thin, white, very brittle when dried. Odour and taste none. Spore print sayal-brown, buckthorn-brown, clay-brown.

Spores 8.5–12 × 5–6.5 μm, Q = 1.6–2.1, mean volume 165 μm<sup>3</sup>, elongate in frontal view, slightly amygdaliform in side view, sometimes with a faint suprahilar depression, marbled to almost smooth; walls rather faintly coloured; in preparations often in dyads and tetrads. Basidia 25–40 × 7–10.5 μm, four-spored, sometimes mixed with two-spored, clampless. Cheilocystidia 26–75 × 5–9 μm, cylindrical, flexuous, more rarely narrowly lageniform, often slightly moniliform and subcapitate, rarely branched, often septate, i.e. forming chains, hyaline, thin-walled. Pileipellis a transition between a trichoderm and a cutis of loosely interwoven, cylindrical, curved, up to 6 μm wide hyphae; terminal cells erect, undifferentiated, i.e. cylindrical or at pileus margin shaped like cheilocystidia. Pigment lacking. Clamp-connections absent from all tissues.

Habitat & Distribution – On hardwood (mainly *Betula*, *Alnus*) or on soil in connection with wood, mainly at damp places. Temperate to arctic. From lowlands to montane zone (highest altitude: 630 m). Frequent only in boreal Europe, otherwise scattered to rare. September–December.

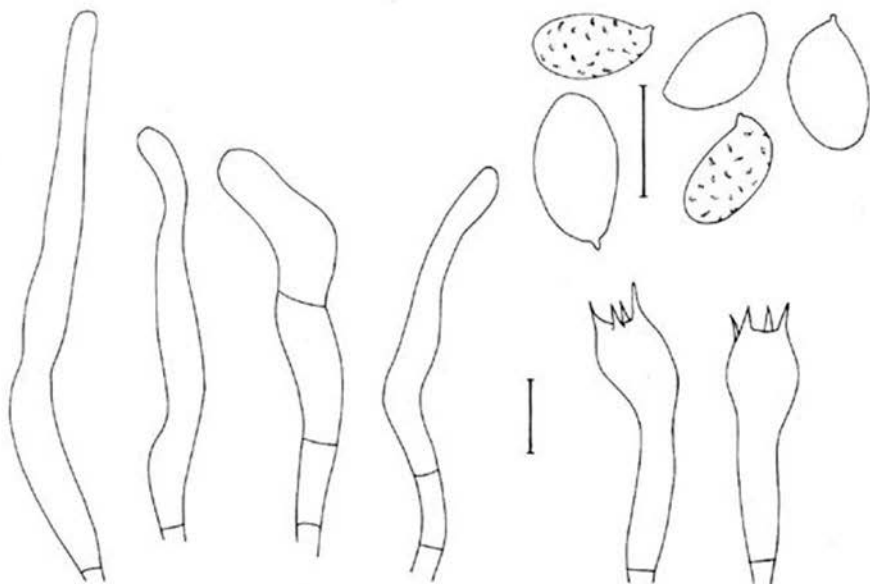


Fig. 60. *Crepidotus versutus*: spores, basidia, cheilocystidia.

*Collections examined.* AUSTRIA: Wien, Riltchen, 11 Oct. 1973, *A.F.M Reijnders* 35 (herb. Reijnders). — ESTONIA: Ahunapalu, Tartu, 7 Oct. 1989, *Kalamees* (TAA 144415); Pärnu, Nigula reserv., 19 Sept. 1982, *Kalamees* (TAA 122508); Ilumetsa, Rapina, 21 Sept. 1956, *Kalamees\** (TAA 70405). — FRANCE: dpt Pas-de-Calais, Forêt Domaine de Boulogne, 13 Oct. 1991, *Senn-Irlet 91/214* (BERN). — GERMANY: Schleswig-Holstein, Sachsenwald, 4 Nov. 1903, *Jaap* (Otto Jaap-Fungi selecti exsiccati no. 67 as *Crepidotus cesatii* Rab. var. *versutus* Peck) (BERN). — ICELAND: Egilstadir, Selskogur, 25 Sept. 1987, *Hallgrímsson 11614*; 26 Sept. 1987, *Hallgrímsson 11640*; 4 Sept. 1985, *Hallgrímsson 10125*; Langhus, Fljotum, 15 Sept. 1976, *Hallgrímsson 9022*; Thvera, Dalsmynni, 24 Sept. 1968, *Hallgrímsson 5479*. — NETHERLANDS: prov. Limburg, Epen, Bovenste Bos, 27 Oct. 1965, *Jansen* (L 964.296-111). — SWITZERLAND: Kt. Luzern, Lamperdingen, Dietschibergwald, 14 Dec. 1975, *Kränzlin 1412-75 K* (NMLU); cte Ticino, Bolle di Magadino, 6 Nov. 1987, *Lucchini* (Lugano).  
USA: New York, Orange Co, Harriman State Park, 14 Oct. 1962, *Rogerson 178* (NY); County Park, 7 Nov. 1975, *Rogerson* (NY), Ulster Co, Catskill Park, 14 Oct. 1990, *Senn-Irlet 90/109* (BERN); New Hampshire, White Mts Nat. Park, 16 Aug. 1963, *Bigelow 12333* (NY).

*Crepidotus versutus* is another pure white *Crepidotus* species which needs to be microscopically checked. It differs from other white *Crepidotus* species in lacking clamp-connections and in distinctly elongate spore shape.

For a discussion on the nomenclature see Norstein (1990).

#### EXCLUDED OR DOUBTFUL SPECIES

*carpatorossicus*. — *Crepidotus carpatorossicus* Pilát, *Studia bot. cech.* 10 (1949) 153.

Type: Ucraina, Transcarpates, VIII.1934 (PRM 23474). As shown elsewhere (Senn-Irlet, 1992c) the type collection represents *Chromocyphella muscicola* (Fr.) Donk.

*caspari*. — *Crepidotus caspari* Vel., *Mykologia* 3 (1926) 70.

Type: PRM, not seen. If a re-examination of the type material would prove the expected identity with *C. autochthonus* J. Lange, *C. caspari* would become the correct name for that species.

*citrinus*. — *Crepidotus citrinus* Larsen, *Botany of Iceland* 2 (1932) 545, non *Crepidotus citrinus* Petch, *Ann. R. bot. Gdns Peradeniya* 9 (1924) 225. — *Crepidotus larsenii* Pilát, *Atl. Champ. Eur.* 6 (1948) 74.

No type material is left in Iceland and Copenhagen. Judging from the original description this is probably *C. carpaticus*; *C. citrinus* Larsen (non Peck) is best regarded as a nomen dubium.

*microcarpus*. — *Crepidotus microcarpus* Malençon in Mal. & Bert., *Fl. Champ. sup. Maroc* (1975) 482.

Type: MPU. I failed to obtain the type material. Judging from the original description *C. microsporus* comes very close to *C. subverrucisporus* Pilát.

*muscigenus*. — *Crepidotus muscigenus* Vel., *Novit. mycol. nov.* (1947) 77.

Type: PRM, not seen. Judging from the description given by Pilát (1948) conspecificity with *C. luteolus* seems probable.

*niveus*. — *Crepidotus niveus* Vel., *Nov. mycol. noviss.* (1947) 87.

Type: PRM, not seen. See Pilát (1951).



*pallescens*. — *Crepidotus pallescens* Quél., Bull. Soc. bot. Fr. 25 (1878) 287.

Pilát (1948) examined the type specimen and found only young, not yet sporulating fruit-bodies. Judging from the protologue it could represent *C. luteolus*.

*sambuci*. — *Crepidotus sambuci* Vel., České Houby (1922) 919.

According to Pilát (1949) a synonym of *Crepidotus haustellaris*, i.e. *Simocybe rubi*. The Latin description of Pilát (1948), however, differs in some details from the present concept of that species. The cap is described as "... extus glaber, albus, solum basi long tomentosus, ..."; the lamellae "... initio sublutescentibus, tum griseo-ochraceis ...". While the microscopical characters are in accordance with those of *S. rubi*, the macroscopical characters fit other species better. Orton (1960) recorded tentatively a collection as *C. sambuci*, which represents undoubtedly a typical *Crepidotus* species close to *C. lundellii*. Indeed, the microscopical details for *C. sambuci* given by Velenovský agree very well with those of *C. lundellii*, viz. the ovoid spores and the often capitate cheilocystidia. Unfortunately the original description lacks any information on spore ornamentation. Moser (1983) accepted Orton's interpretation; but till now the species has been only recorded from Great Britain. I examined only one collection labelled as *C. sambuci* gathered by the Dutch mycologist F.A. Tjallingii accompanied by extensive notes. With the exception of the lemon-yellow colours observed in the young fruit-bodies, the collection did not deviate from the range of variation of *C. lundellii*. For the time being I consider *C. sambuci* as doubtful species.

*serbicus*. — *Crepidotus serbicus* Pilát, Bull. trimest. Soc. mycol. Fr. 53 (1937) 82.

Type: Yugoslavia, Serbia, Kapaonik Mountains, V.1936, *Cernjanski* (PRM 485751). A re-examination of the type material (Senn-Irlet, 1993) convinced me that *C. serbicus* must be regarded as a nomen dubium as it consists of an immature fruit-body covered with alien spores.

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## Legends to Plates 1–3 (pages 77–79)

**Plate 1**

- a. *Crepidotus mollis*  
Switzerland: Jura, Bolcourt, 23 Aug. 1977, Chételat EHC 1977
- b. *Crepidotus mollis*  
Switzerland: Brienz, Birchtal, 25 Sept. 1991, Senn-Irlet 91/149
- c. *Crepidotus cesatii* var. *cesatii*  
Switzerland: Jura, Bolcourt, Dec. 1984, Chételat EHC1984
- d. *Crepidotus cesatii* var. *cesatii*  
Switzerland: Bern, Oberburg, 18 Dec. 1988, Senn-Irlet 88/493

**Plate 2**

- a. *Crepidotus variabilis* var. *variabilis*  
Switzerland: Bern, Bremgartenwald, 30 Oct. 1982, Senn-Irlet 82/439
- b. *Crepidotus variabilis* var. *variabilis*  
Switzerland: Jura, Bassecourt, 1979, Chételat EHC 1979
- c. *Crepidotus lundellii*  
Austria: Salzburg, Pinzgau, Kaprunertal, 25 July 1992, Senn-Irlet 92/118
- d. *Crepidotus lundellii*  
Netherlands: Utrecht, Zeist, Appellaantje, 25 Aug. 1982, C. Bas 7806

**Plate 3**

- a. *Crepidotus applanatus* var. *applanatus*  
Austria: Salzburg, Flachau, 27 July 1990, T. Rücker 96/90
- b. *Crepidotus luteolus*  
Switzerland: Zollikofen, Williwald, 1 Nov. 1992, Senn-Irlet 92/601
- c. *Crepidotus epibryus*  
Switzerland: Bern, Belpau, 11 Dec. 1988, Senn-Irlet 88/487
- d. *Crepidotus epibryus*  
26 Oct. 1989, Senn-Irlet 89/284

Plate 1



b. *Crepidotus mollis*



d. *Crepidotus cesatii* var. *cesatii*



a. *Crepidotus mollis*



c. *Crepidotus cesatii* var. *cesatii*

## Plate 2

b. *Crepidotus variabilis* var. *variabilis*d. *Crepidotus landellii*a. *Crepidotus variabilis* var. *variabilis*c. *Crepidotus landellii*

Plate 3



b. *Crepidotus latetolus*



d. *Crepidotus epibryus*



a. *Crepidotus appplanatus* var. *appplanatus*



c. *Crepidotus epibryus*

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TAXONOMICAL NOTES ON MACROFUNGI IN ROADSIDE VERGES  
PLANTED WITH TREES IN DRENTHÉ (THE NETHERLANDS) - IIPETER-JAN KEIZER & EEF ARNOLDS<sup>1</sup>

Biological Station, Wijster (Drenthe), The Netherlands

In the second part of this study special attention is paid to the genera *Hebeloma*, *Psathyrella* and *Russula*. *Psathyrella rhombispora* is described as a new species. *Russula cicatricata* Romagn., *R. elaeodes* (Bres.) Romagn. and *R. purpurata* Crawsh. are reduced to formae of *R. graveolens* Romell. in Britz.

This paper is a continuation of an earlier paper (Keizer & Arnolds, 1994). It presents descriptions, drawings and observations of rare, critical or less well-known macromycetes that were encountered during mycocoenological investigations carried out in road-side verges planted with *Quercus robur* (53 plots) or *Fagus sylvatica* (23 plots). For further details on the scope of this study, the reader is referred to the first part of this paper (Keizer & Arnolds, l.c.).

## MATERIAL AND METHODS

The fungi dealt with in this study comprise the Macrofungi. Groups with relatively small or hidden fruit-bodies (e.g. the majority of the Helotiales, resupinate Aphyllophorales) have been omitted because a complete inventory would require a much more time consuming search strategy. The following groups have been included: Basidiomycetes: Agaricales; Gasteromycetes; non-resupinate Aphyllophorales and Heterobasidiomycetes. Ascomycetes: Clavicipitales: *Cordyceps*; Elaphomycetales: *Elaphomyces*; Helotiales: *Geoglossum*, *Leotia*; Pezizales: *Helvellaceae*, *Pezizaceae*, *Tuberaceae*; Deuteromycetes: *Paecilomyces*.

The nomenclature of the Basidiomycetes is mainly after Kreisel (1987) or Arnolds (1984) if species are not mentioned in the former work. The nomenclature of the smooth spored species of the genus *Inocybe* is after Kuyper (1986) and of the genus *Psathyrella* after Kits van Waveren (1985). Ascomycetes are after Cannon et al. (1985) and Deuteromycetes after Arnolds (l.c.).

Full understanding of mycocoenological studies is often hampered by the absence or incompleteness of descriptions of critical taxa. Therefore, descriptions and/or critical notes are given in this paper of rare and critical taxa and of collections, which disagreed with descriptions in literature. This criterion has been taken in a rather broad sense. The

<sup>1</sup>) Comm. no. 445 of the Biological Station, Centre of Soil Ecology, Wijster, The Netherlands.

Table I. List of plots.

Survey of the plots where the described species originate. All plots are situated in the province Drenthe, the Netherlands, except the plots F15 and Q5, which lie in the province Friesland.

F = roadside verge planted with Beech; Q = roadside verge planted with Common Oaks; Age = age of trees (in 1988); Exp. means exposition of the plot: + = in open landscape, ± = half shady, - = shady; Pav. refers to the pavement of the roads: A = asphalt, B = bricks, N = no pavement.

Plot	Municipality	Near village	Coordinates on the topographic map	Local name	Age of trees	Exp.	Pav.	Description of the vegetation
F11	Peize	Altena	227,3–571,6	Lieverseweg	58	+	B	poor grassland
F12	Rolde	Deurze	237,5–556,7	Rolder Hoofdweg	78	+	A	mod. poor grassl.
F13	Beilen	Wijster	232,2–537,1	Bruntingerweg	37	+	A	mod. poor grassl.
F14	Beilen	Bruntinge	234,7–536,5	Hamweg	37	+	A	poor grassland
F15	Ooststellingwerf	Wateren	219,7–548,2	Bosweg	51	+	A	poor grassland
F16	Diever	Wateren	217,4–546,3	Oude Willem	51	+	A	mod. poor grassl.
F17	Anloo	Annen	244,7–563,7	Anloerweg	54	+	A	poor grassland
F21	Vries	Rhee	234,4–561,4	N 870	66	+	A	mod. rich grassl.
F22	Sleen	't Haantje	252,6–537,5	Slenerweg	63	+	A	mod. rich grassl.
F23	Anloo	Annen	244,8–563,7	Eexterweg	61	+	A	rich grassland
F24	Peize	Peize	229,5–573,5	Zuurse weg	57	+	B	mod. rich grassl.
F25	Odoorn	Klijndijk	253,1–539,1	Odoornerzigtak	41	+	A	rich grassland
F31	Havelte	Havelte	211,7–531,2	Linthorst-Homanlaan	140	-	B	poor woodland
F32	Diever	Diever	217,9–542,1	Bosweg	55	-	B	poor woodland
F33	Gasselte	Gieten	246,3–555,5	Houtvester Jansenweg	66	-	A	± absent
F34	Anloo	Eext	245,6–561,6	Annerweg	81	-	A	poor woodland
F35	Eelde	Eelde	235,7–572,5	Hooghullen	70	-	A	rich woodland
F36	Odoorn	Klijndijk	253,4–539,3	Odoornerzigtak	41	-	A	rich woodland
F40	Ruinen	Hoogeveen	228,6–529,7	Spaarbankbos	44	-	N	poor woodland
F41	Gasselte	Gieten	245,3–557,6	Gieterveld	69	-	N	poor woodland
F42	Havelte	Havelte	211,7–531,2		72	-	N	± absent
F43	Eelde	Eelde	245,2–557,4	Hooghullen	82	-	N	mod. rich woodl.
F44	Roden	Roden	225,1–571,1	Mensingebosch	81	-	N	± absent
Q1	Sleen	Schoonoord	247,8–541,2	Oranjekanaal Z.Z.	100	+	A	poor grassland
Q2	Westerbork	Zwiggelte	235,5–545,0	Oranjekanaal N.Z.	100	+	A	poor grassland
Q3	Westerbork	Zwiggelte	236,2–545,0	Oranjekanaal Z.Z.	100	+	A	poor grassland
Q4	Anloo	Gieten	243,5–557,2	Gieterstraat	110	+	A	poor grassland
Q5	Ooststellingwerf	Wateren	219,7–548,0	Oude Willem	55	+	A	poor grassland
Q6	Vledder	Frederiksoord	209,0–540,1	Vledderweg	91	+	A	poor grassland
Q11	Assen	Deurze	236,9–556,6	Rolder Hoofdweg	113	+	A	poor grassland
Q12	Diever	Wateren	215,4–547,2	Waterenweg	130	+	B	mod. poor grassl.
Q13	Roden	Foxwolde	226,3–574,7	Roderwolderweg	114	+	B	mod. poor grassl.
Q14	Vledder	Vledder	209,9–541,1	Vledderweg	91	+	A	poor grassland

Plot	Municipality	Near village	Coordinates on the topographic map	Local name	Age of trees	Exp.	Pav.	Description of the vegetation
Q21	Assen	Deurze	236,6-556,6	Rolder Hoofdweg	113	+	A	rich grassland
Q22	Westerbork	Westerbork	236,5-541,5	Zwiggelsterstraat	98	+	A	mod. rich grassl.
Q23	Ruinen	Pesse	225,3-532,2	Eursinge	112	+	A	rich grassland
Q24	Ruinen	Kraloo	225,5-533,8	Kraloerweg	70	+	A	rich grassland
Q26	Sleen	't Haantje	252,5-537,5	Oranjekanaal Z.Z.	116	+	A	rich grassland
Q31	Beilen	Ter Horst	230,9-540,1	Ter Horst	41	+	B	poor grassland
Q32	Odoorn	Odoornerveen	251,9-538,5	Odoornersijtak	68	+	A	poor grassland
Q33	Beilen	Drijber	234,0-534,5	De Hullen	25	+	A	mod. poor grassl.
Q34	Odoorn	't Haantje	252,6-537,5	Oranjekanaal N.Z.	26	+	N	mod. poor grassl.
Q35	Peize	Altena	227,8-572,6	Hooghaar	47	+	B	poor grassland
Q36	Beilen	Klatering	232,9-543,5	Klatering	15	+	A	mod. poor grassl.
Q37	Beilen	Klatering	233,0-543,5	Klatering	15	+	A	mod. poor grassl.
Q38	Diever	Dieverbrug	218,6-540,6	Dieverbrug	10	+	A	poor grassland
Q39	Beilen	Beilen	234,6-544,0	Eursing	12	+	A	mod. rich grassl.
Q41	Beilen	Wijster	231,6-538,8	Beilerweg	48	+	A	mod. poor grassl.
Q42	Odoorn	Odoornerveen	248,8-540,8	Oranjekanaal N.Z.	32	+	A	mod. poor grassl.
Q43	Beilen	Wijster	230,5-537,6	Looveen	32	+	N	poor grassland
Q44	Beilen	Hooghalen	232,6-548,2	Stationsstraat	34	+	A	mod. poor grassl.
Q45	Beilen	Wijster	231,3-537,1	Boerkoelweg	35	+	B	mod. rich grassl.
Q46	Beilen	Wijster	231,8-536,9	Marsweg	35	+	B	mod. rich grassl.
Q51	Zweeloo	Witteveen	241,5-536,0	Bosweg	48	+	B	mod. poor grassl.
Q52	Odoorn	Odoornerveen	251,5-538,9	Torenweg	23	+	A	rich grassland
Q53	Sleen	Noordsleen	249,9-534,8	Middleweg	28	+	A	rich grassland
Q54	Dwingeloo	Dwingeloo	222,3-538,1	Lheeweg	15	+	A	rich grassland
Q61	Zweeloo	Schoonoord	246,3-540,2	Oranjekanaal Z.Z.	116	-	B	rich grassland
Q62	Dwingeloo	Lheebroek	226,5-539,8	Lheebroek	76	-	B	mod. poor grassl.
Q63	Havelte	Havelte	210,9-531,3	Busselterweg	146	-	B	rich grassland
Q64	Havelte	Havelte	212,1-531,6	Overcingelaan	85	-	B	rich grassland
Q65	Anloo	Gieten	243,9-557,4	Gieterstraat	110	-	A	mod. poor grassl.
Q71	Zweeloo	Schoonoord	245,9-540,0	Oranjekanaal N.Z.	116	-	A	rich grassland
Q72	Westerbork	Zwiggelte	236,8-545,0	Oranjekanaal N.Z.	100	-	A	mod. poor grassl.
Q73	Havelte	Havelte	210,6-531,3	Busselterweg	125	-	B	mod. rich grassl.
Q74	Roden	Alteveer	225,3-570,3	Melkweg	106	-	A	mod. poor grassl.
Q81	Ruinen	Pesse	224,9-532,1	Leeuwte	110	-	A	ruderal
Q82	Assen	Assen	235,4-556,9	Steendijk	110	-	B	mod. rich grassl.
Q83	Roden	Roden	225,6-571,6	Mensingeweg	97	-	A	mod. rich woodl.
Q84	Anloo	Gieten	243,6-557,3	Gieterstraat	100	-	A	poor woodland
Q85	Havelte	Havelte	212,1-531,3	Van Helomaweg	140	-	A	rich grassland
Q87	Havelte	Havelte	212,1-530,8	Boskampbrugweg	143	-	B	mod. rich woodl.
Q88	Ruinen	Rheerbruggen	216,9-553,2	Rheerbruggen	114	-	B	mod. poor woodl.
Q92	Havelte	Havelte	211,6-530,0		144	-	N	poor woodland
Q93	Ruinen	Hoogeveen	228,6-529,9	Spaarbankbos	105	-	N	poor woodland
Q94	Roden	Roden	225,4-571,5	Mensingebosch	102	-	N	poor woodland

reason for this is in the first place to provide a reference for some names used in the myco-enological work and secondly to present the rate of disagreement with the current literature of some names that were accepted.

In the descriptions the following abbreviations of colour-codes have been used: Expo for Cailleux & Taylor (1958), K & W for Kornerup & Wanscher (1978) and Mu for Munsell Color Company (1954).

In the microscopic descriptions Q indicates the length/width ratio of the spores and av. Q the average of Q usually based on 10 spores per collection. In the figures the habit sketches are  $0.8 \times$  the natural size; in the microscopic drawings the bar always represents 10  $\mu\text{m}$ . All collections mentioned below are made in the selected plots and deposited in the herbarium of the Biological Station in Wijster (WBS), part of the Agricultural University Wageningen. For each collection the plot number is given, where it originates. This refers to Table I, where the exact place and some brief ecological notes of the plots are listed.

#### ACKNOWLEDGEMENTS

We are greatly indebted to Dr. Th. W. Kuyper, Dr. M. E. Noordeloos, Prof. Dr. R. A. A. Oldeman and Dr. A. J. Termorshuizen for their critical comments on earlier versions of this paper. Dr. E. Kits van Waveren is thanked for his valuable advices concerning *Psathyrella rhombispora* Keizer & Arnolds.

#### I. AGARICALES (continued)

##### **Hebeloma** (Fr.) Kumm.

"Il n'est pas de genre où la taxonomie des espèces soit plus embrouillée. C'est un véritable chaos." (Favre, 1960). It seems that little has changed since, despite recent revisions of the genus (Bruchet, 1970; Boekhout, 1982). The taxa that could be distinguished in the present material agreed rather well with the concepts of Boekhout (l.c.), which, for the time being, have been adopted. Particularly the taxa which belong to the species complex *H. crustuliniforme* sensu lato are difficult to separate (see there). The extremes in this complex are widely different, but most of the differentiating characters are not correlating in many less typical collections.

##### **Hebeloma anthracophilum** Maire — Fig. 1

Pileus 6–25 mm, convex to plano-convex, sometimes umbonate, when young with involute margin, pale pinkish brown (Expo C56), paler towards the margin. Lamellae 1–1.5 mm broad, moderately crowded, ventricose, narrowly adnate, purplish grey-brown, with white-floccose edge. Stipe 20–35  $\times$  1.5–3.0 mm, cylindrical, at base slightly rooting, narrowly fistulose, apex cream-coloured, downwards brownish, at base dark brown, at apex white-floccose, downwards glabrous. Context in pileus and apex of stipe white, downwards in stipe darker brown. Smell faint to absent, taste unknown.

Spores (9.3–)9.5–10.3(–11.2)  $\times$  (4.7–)4.9–5.9(–6.1)  $\mu\text{m}$ , Q = 1.7–2.0(–2.1), av. Q = 1.72–2.00, ellipsoid-subamygdaliform with loose exosporium, enveloping the complete spore, except for the hilar appendage; inner sporewall (episporium) thick-walled, with coarse

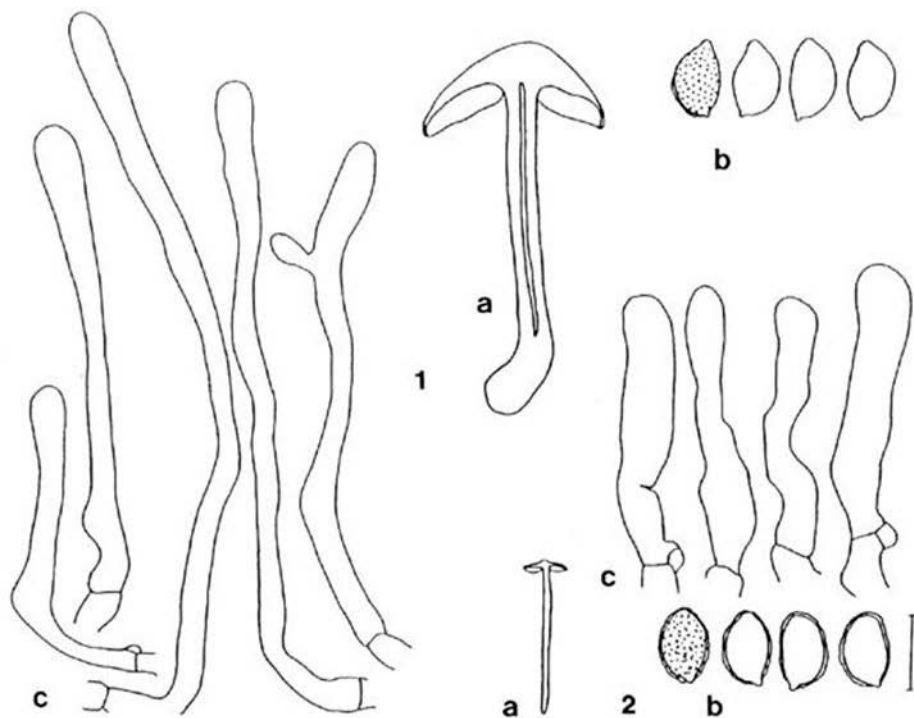


Fig. 1. *Hebeloma anthracophilum*. a. Habit; b. spores; c. cheilocystidia (88268). — Fig. 2. *Hebeloma crustuliniforme*. a. Habit; b. spores; c. cheilocystidia (88201).

roundish or irregularly shaped warts, rather dark brown under the microscope. Cheilocystidia  $30\text{--}40 \times 4\text{--}6 \mu\text{m}$ , more or less cylindrical, not or hardly enlarged at base or apex, thin-walled.

Habitat — Terrestrial in roadside verges planted with *Quercus* on nutrient-poor sandy soil.

*Collections examined.* Plot Q93, 30 Oct. 1987, Keizer 87268; Odoorn, Odoornerveen, 13 Oct. 1987, Keizer 87338; 31 Oct. 1989, Keizer 89100.

*Hebeloma anthracophilum* shows much resemblance with *H. spoliatum* in the microscopical characters. Macroscopically, the distinctly rooting stipe and more uniformly red-brown pileus of the latter are characteristic. We agree with Boekhout (1982) in considering *H. calyptosporum* Bruchet synonymous with *H. anthracophilum*. The only differences mentioned by Bruchet (1970) are the habitat (growing on burnt places or not) and the stipe turning brownish with age or not. Differences in habitat alone cannot serve as distinguishing characters and a discolouring of the stipe with age is so common in the genus *Hebeloma* that it is certainly not sufficient to distinguish taxa on the level of species, if it is of any use at all.

### *Hebeloma crustuliniforme sensu lato*

It appeared to be difficult to identify *Hebeloma* species of the group of *H. crustuliniforme* ( $\pm$  section *Denudata* (Fr.) Sacc.). This group as a whole is characterized by carpophores without veil, with long ( $\pm$  50–100  $\mu$ m), narrowly clavate to capitate cheilocystidia and amygdaliform spores with at most partially loosening perispore.

In order to separate taxa in a more or less objective way, groups have been distinguished in the 30 available collections, following the method described by Arnolds (1974): the groups were distinguished on the basis of characters that will be mentioned below, independent from previous species concepts in the literature. Subsequently, these groups were compared with taxa (species) described in literature. The advantage of this method is that individual collections are not 'forced' to match the description of a certain taxon. The following characters have been used: 1) habit, i.e. size and shape of the fruit-body; 2) colour of the pileus; 3) stipe hollow or not; 4) lamellae weeping at the edge or not, droplets watery or milk-white; 5) size and shape of the cheilocystidia; 6) size and shape of the spores; type of ornamentation; loosening of the perispore or not; reaction with Melzer's reagent; 7) smell.

The characters 3 and 4 appeared to be too variable, even within collections, to be useful, although they are considered by some authors as rather important (e.g. Bruchet, 1970; Moser, 1978, 1992; Vesterholt, 1992). In general, the stipe tends to become hollow as the sporocarp ages. Moreover, slender carpophores tend to have less often hollow stipes. Also the formation of droplets at the edge of the lamellae appears to be age-dependent (old specimens cease guttation) and varies with weather conditions. Dry weather hampers the excretion of liquid. This liquid can turn milky white after some time, which again makes the character dependent of the moment of collecting of the fruit-body. Vesterholt (1992) considers the degree of browning in the course of sporocarp development of taxonomic importance. In our opinion its use offers difficulties in practice as sporocarps of the same age must be compared, which are often not available.

Because mycocoenologists, unlike taxonomists, are often forced to study fruit-bodies in far from optimal conditions, most value has been assigned in this study to microscopic characters, assuming that they are less influenced by external factors than macromorphological characters. In our opinion, the characters of weeping lamellae and the presence of a cavity in the stipe as well as the density of the white floccose squamules covering the stipe, discussed in Boekhout (1982), together with so-called ecological characters, have been overestimated in literature, thus contributing to the confusion in this group.

On the basis of the shape and size of the cheilocystidia three groups could be distinguished with a) cheilocystidia rather short, e.g. 40–60  $\mu$ m, the majority slenderly clavate with somewhat ventricose base, frequently with (sub)capitate apex; b) cheilocystidia 40–80  $\mu$ m long, except for the very short ones (< 40  $\mu$ m, always present together with the longer cystidia) usually not ventricose but with more or less parallel walls near the basis, very gradually broadening towards the apex; apex frequently furcate or more or less irregularly shaped; c) cheilocystidia up to 100  $\mu$ m long, not ventricose near the base, hardly broader towards the apex to slenderly clavate, or a minority of the cystidia irregularly capitate. These groups were identified as *H. helodes*, *H. longicaudum* and *H. crustuliniforme* ss.str. respectively.

Some of the above-mentioned characters correlated rather well with the different form and size of the cheilocystidia.

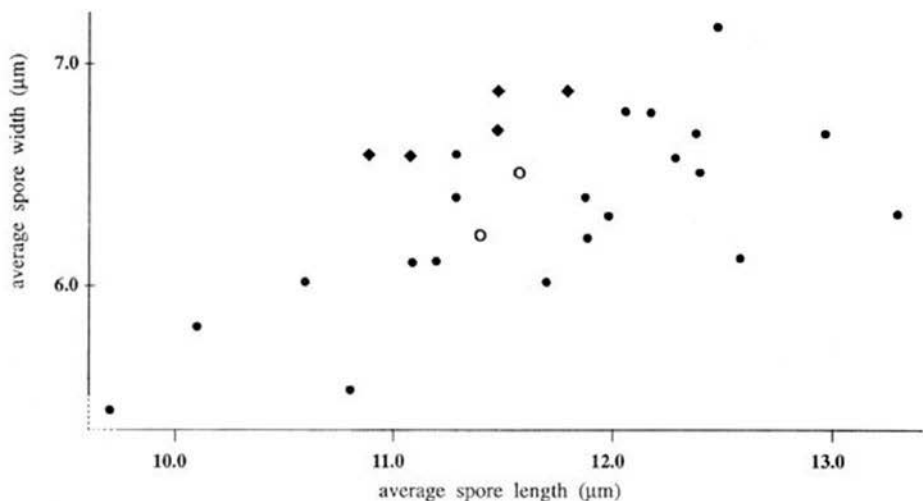


Fig. 3. Scatterdiagram of spore-sizes in *Hebeloma* species. Length (horizontal) and width (vertical) of spores of *H. helodes* (●), *H. longicaudum* (◆), and *H. crustuliniforme* s. str. (○). Each symbol represents the average values of 10 spores of one collection.

1) Habit of the fruit-body: *Hebeloma crustuliniforme* ss.str. has large and relatively thick-set carpophores, with context in the pileus relatively thick (up to more than 10 mm in centre) and with thick stipe (over 6 mm, near base over 10 mm thick). *Hebeloma helodes* and *H. longicaudum* generally have smaller pilei and more slender stipes.

2) Colour of the pileus: *H. crustuliniforme* has a  $\pm$  uniform pale brown or alutaceous pileus; the other two species usually have a darker reddish brown centre contrasting with a pale margin.

6) Size and shape of the spores: *H. longicaudum* has relatively broad spores with av.  $Q = 1.56-1.71$ , whereas *H. crustuliniforme* and *H. helodes* have more slender spores with av.  $Q = (1.69-1.72-1.92(-2.14))$  respectively (Fig. 3).

Differences in consistence of the stipe (3), weeping of lamellae (4) and smell (7) did not correlate with the size and shape of the cheilocystidia; all specimens had a raphanoid smell. The differences in characters of the spores (6) other than size and shape, such as type of ornamentation, colour (under the microscope), loosening of the outer spore-wall and differences in dextrinoid reaction with Melzer's reagent, described by Boekhout (l.c.), Bruchet (l.c.) and Vesterholt (l.c.), could not be confirmed by the study of the present material.

*Hebeloma crustuliniforme* comes closest to *H. helodes*. Robust carpophores of the latter with long cystidia can only be separated from the former by the darker and contrasting centre of the pileus, and this hardly warrants a distinction on specific level. It seems, however, that this problem occurs in only a minority of the collections. For further details, see descriptions of the individual species.

**Hebeloma crustuliniforme** (Bull.) Quél. sensu Boekhout — Fig. 2

Pileus 38–80 mm, convex, then expanding, at centre pale beige yellowish (Expo A62), towards the margin gradually paler (A61), viscid when moist, with age turning dirty ochre yellowish. Lamellae  $\pm$  6 mm broad, moderately distant, narrowly adnate, pale brown to pale purplish brown, with white-floccose edge, without droplets. Stipe 70  $\times$  6 mm, cylindrical but at the base enlarged up to 10 mm broad, whitish with white floccose squamules, mainly in the apical part, narrowly fistulose. Context whitish. Smell raphanoid.

Spores (9.5–)9.7–10.5(–10.6)  $\times$  5.5–5.9(–6.0)  $\mu\text{m}$ ,  $Q = 1.6–1.8$ , av.  $Q = 1.75$ , often with loosening perispore (not at apex), therefore seemingly thick-walled, rather coarsely verrucose; pale yellowish brown under microscope, not discolouring in Melzer's reagent. Cheilocystidia 50–100  $\times$  2.5–3  $\mu\text{m}$ , long, slender, more or less cylindrical, slightly enlarged in the apical part, up to 6  $\mu\text{m}$  broad, the short ones somewhat ventricose near the base, the long ones with parallel walls throughout.

Habitat – Terrestrial in a roadside verge planted with *Fagus* on nutrient-poor sandy soil.

*Collection examined.* Plot F41, 28 Oct. 1988, Keizer 88201.

This collection has been named *Hebeloma crustuliniforme* on account of the long (up to 100  $\mu\text{m}$ ) cheilocystidia, the more or less uniformly coloured, pale pileus and the rather robust habit of the carpophores. The species is accepted here in the sense of Boekhout (1982) and not in the sense of Bruchet (1970). Their interpretations of *H. crustuliniforme* differ in the range of the length of the cystidia: 40–60(–70)  $\times$  4(–5)  $\mu\text{m}$  according to Bruchet (l.c.) and 35–95  $\times$  2–9  $\mu\text{m}$  according to Boekhout (l.c.). *Hebeloma crustuliniforme* ss. Bruchet (l.c.) possibly represents *H. longicaudum*.

**Hebeloma helodes** J. Favre — Figs. 4–6

Synonym: *Hebeloma fragilipes* Romagn., *H. oculatum* Bruchet, *H. velutipes* Bruchet, *H. helodes* var. *capitatum* prov. Boekhout.

Pileus 20–100 mm, convex, soon expanding, finally sometimes somewhat depressed, with centre orange to brown-yellow or reddish ochre-brown (Expo B56, C64, E52, D58, E32, E54, C-B56, C46), paler towards the margin, pinkish beige (B52, A21–22, C63), viscid when moist. Lamellae up to 7 mm broad, moderately to slightly crowded, sometimes ventricose, narrowly adnate or emarginate, rather pale brownish, 'caramel'-coloured, pale 'café-au-lait' (B32, C64), with white-floccose edge, sometimes guttating hyaline droplets or with brown spots (aggregations of spores where drops have evaporated), but frequently no trace of guttation visible. Stipe 40–100  $\times$  3–12 mm, cylindrical or with somewhat broader base, mostly fistulose with a narrow or wide cavity, in the latter case with a hanging strand in the cavity, sometimes stuffed, whitish or cream-coloured, on handling dirty pale brown, white-floccose, mainly at the apex. Context in the pileus with a grey watery zone above the gills, in the stipe white. The smell is weakly or distinctly raphanoid.

Spores (9.0–)10.5–13.3(–14.8)  $\times$  (5.0–)5.6–7.0(–7.7)  $\mu\text{m}$ , narrowly amygdaliform,  $Q = (1.5–)1.7–2.1(–2.4)$ , av.  $Q = (1.69–)1.72–1.92(–2.14)$ , perispore (in ammonia



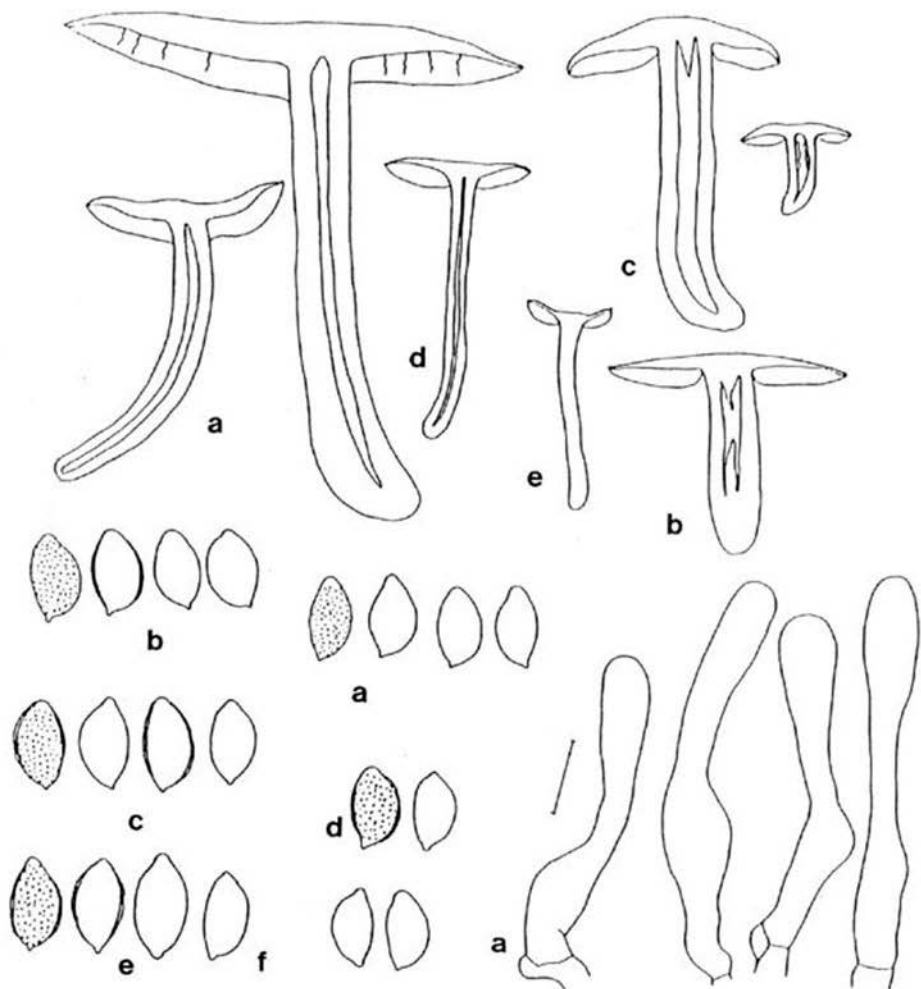


Fig. 4. *Hebeloma helodes*. Habit, spores, and cheilocystidia (a: 87313; b: 87126; c: 88120; d: 87255; e: 86173; f: 86276).

10%) often loosening in part of the spores, not so at the apex, sometimes with some hyaline blisters, usually with fine warts, the biggest spores often with only weak ornamentation, no dextrinoid reaction in Melzer's reagent. Cheilocystidia  $30-70(-90) \times (2-)3-8(-16) \mu\text{m}$ , ventricose at the base, apical part clavate to (frequently) capitate, usually thin-walled.

Habitat - Terrestrial in roadside verges planted with *Fagus* or *Quercus* on nutrient-poor or enriched sandy soil, often very near the paved road surface.

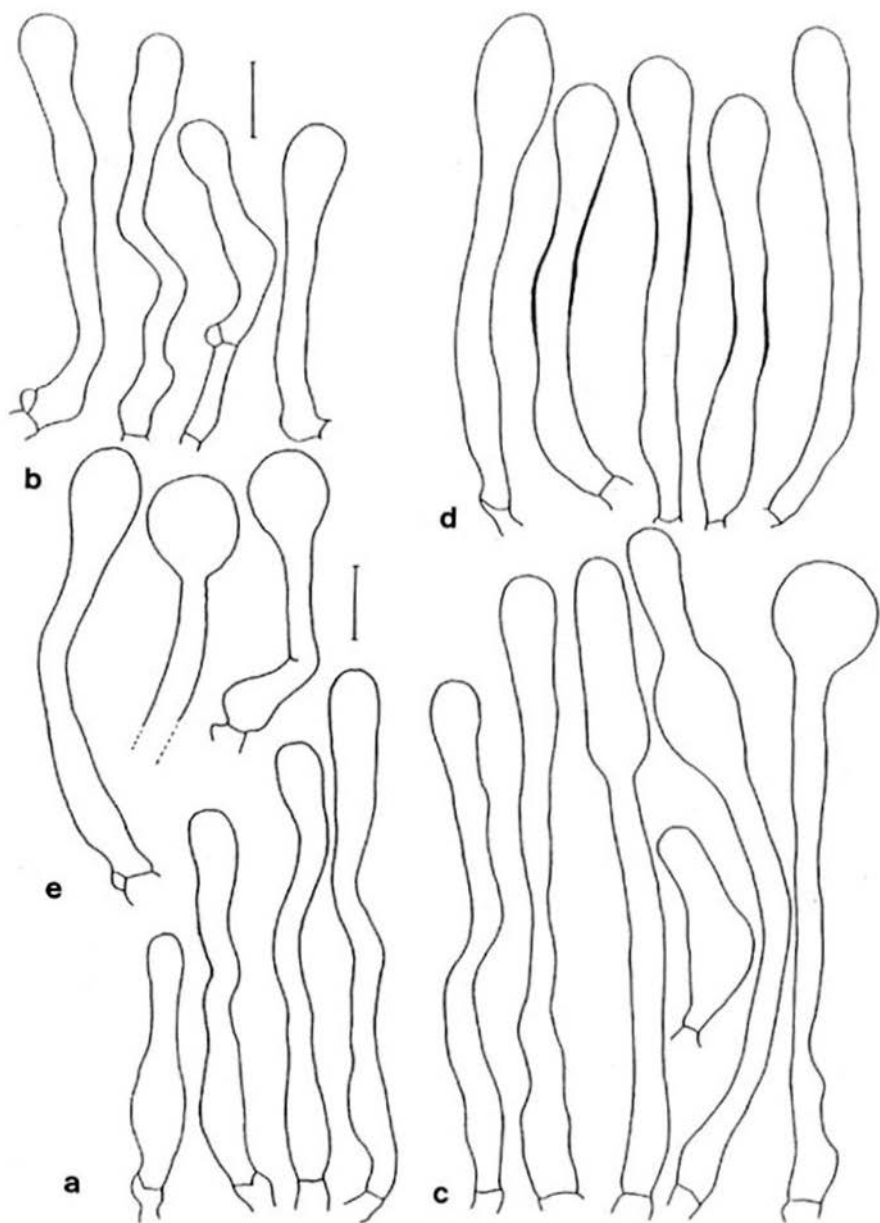
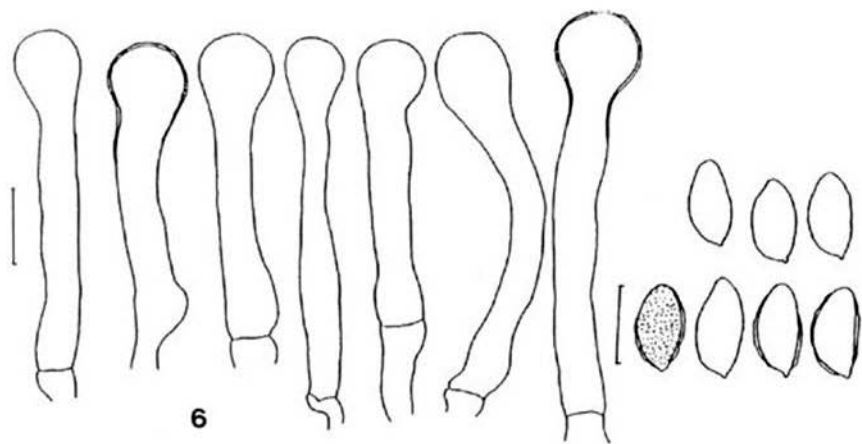
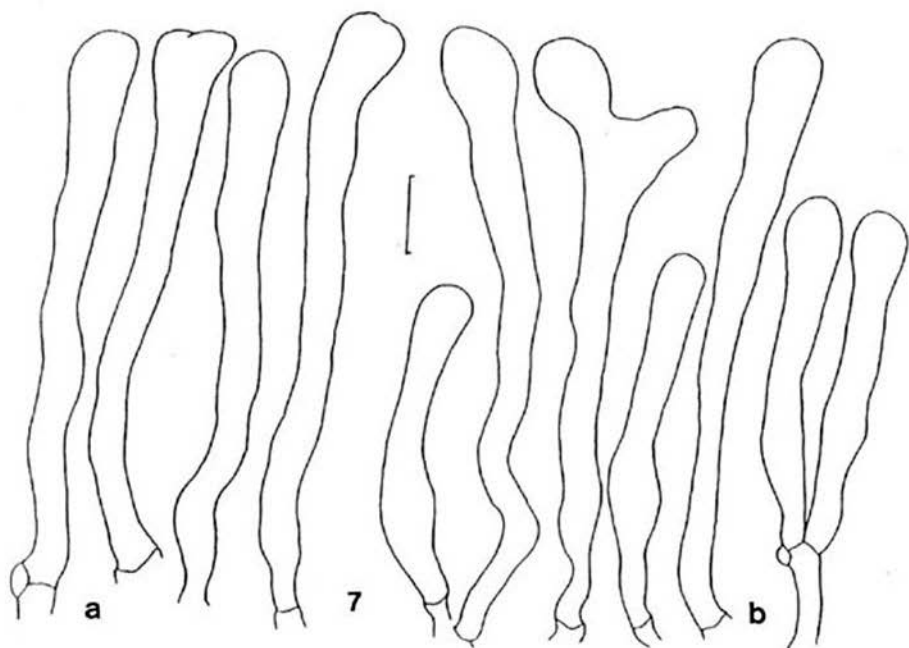


Fig. 5. *Hebeloma helodes*. Cheilocystidia (a: 86276; b: 87126; c: 88120; d: 87255; e: 86173.).



6



a

7

b

Fig. 6. *Hebeloma helodes*. Cheilocystidia and spores (J. Favre, GK 7721, 29 Sept. 1940, Haut Marais des Pleiades, Switzerland, G). — Fig. 7. *Hebeloma longicaudum*. Cheilocystidia (a: 88123; b: 86172).

*Collections examined.* Plot F14, 30 Oct. 1987, Keizer 87313; Plot F15, 26 Aug. 1987, Keizer 87126; Plot F16, 13 Nov. 1986, Keizer 86232; Plot F21, 30 Oct. 1986, Keizer 86192; 19 Nov. 1986, Keizer 86260; 24 Sept. 1988, Keizer 88120; Plot F24, 22 Sept. 1987, Keizer 87181; 3 Nov. 1987, Keizer 87255; Plot F41, 4 Sept. 1987, Keizer 87123; Plot Q2, 13 Oct. 1988, Keizer 88223; Plot Q11, 19 Nov. 1986, Keizer 86259; Keizer 86273; Plot Q26, 18 Sept. 1986, Keizer 86155; Plot Q33, 20 Oct. 1986, Keizer 86173; 22 Oct. 1988, Keizer 88308; Plot Q35, 10 Sept. 1986, Keizer 86141; 24 Oct. 1986, Keizer 86189; 10 Nov. 1986, Keizer 86231; 7 Oct. 1988, Keizer 88157; Plot Q43, 29 Sept. 1986, Keizer 86112; Plot Q83, 8 Sept. 1988, Keizer 88175; Odoorn, Odoornerveen, 1 Nov. 1988, Keizer 88257.

For an evaluation of the differences of this species with *Hebeloma longicaudum* and *H. crustuliniforme*, see the discussion under the *H. crustuliniforme* group.

Typically, the cheilocystidia of *H. helodes* are rather short and slender. Other types of cheilocystidia have been encountered in several collections: 1) Cystidia up to 60 µm long, clavate and frequently with thickened walls in the middle part. This variant is identical with *H. fragilipes* Romagn., which was regarded by Boekhout (1982) as a variety of *H. helodes* (Fig. 4d). 2) Cystidia long and slender (up to 90–100 µm), only slightly clavate. This variant is identical with *H. oculatum* Bruchet and was regarded by Boekhout (l.c.) as a form of *H. helodes*. 3) Cystidia in addition to the typical ones broadly clavate to capitate, with heads up to 12(–16) µm broad; distinguished by Boekhout (l.c.) as *H. helodes* var. *capitatum* prov. Until the study of extensive material shows the contrary, we consider these as taxonomically insignificant variants.

Bruchet (1970) used the name *H. velutipes* for the present species. He apparently did not know *H. helodes* J. Favre because he did not mention it explicitly. Two collections of *H. helodes* J. Favre, one of them being the lectotype (collection G.K. 9139, 30 Aug. 1939, Tourbière du sentier, Herb. G.), the other collected and identified by the author (collection G.K. 7721, 29 Sept. 1941, Haut Marais des Pleiades, Herb. G.), have been studied here in order to compare some of the microscopic characters (Fig. 5). The spores differed somewhat between the two collections, and were (9.3–)9.6–10.0(–10.7) × (4.9–)5–5.5(–5.7) µm, Q = 1.7–1.9, av. Q = 1.8 and (10.4–)10.5–11.7(–12.5) × (5.3–)5.4–5.9(–6.0) µm, Q = 1.9–2.1, av. Q = 2.0 respectively, narrowly amygdaloid, perispore loosening in part of the spores, ornamentation consisting of fine warts, pale brown in ammonia 10%. Cheilocystidia 35–65 × 4–5 µm, in majority cylindrical with more or less capitate apex, 7–11 µm wide, sometimes slightly ventricose at the base, some slightly thick-walled. These collections show in our opinion sufficient similarities with the collections described here to justify the name *H. helodes*. Consequently we consider *H. velutipes* Bruchet as a later synonym of *H. helodes*.

Probably, this common species has been included by most authors in *H. crustuliniforme* (*sensu lato*) until recently. It seems likely that still an older name exists somewhere in the literature because it is remarkable that such a common and wide-spread species is 'discovered' as late as 1948 in montane peat-bogs.

### **Hebeloma longicaudum** (Pers.: Fr.) Kumm. — Figs. 7, 8

Pileus 28–35 mm, convex, then plano-convex, often with broad and low umbo, with margin at first involute, pale orange-pinkish brown (Expo D54, E54 or paler: C64) with paler margin (D52 or much paler), or ± uniformly pale beige (A61) with somewhat paler margin, viscid when moist. Lamellae 3–5 mm broad, moderately crowded, narrowly ad-

nate or emarginate, pale beige-brown, with age purplish brown, with white-floccose edge, sometimes slightly serrulate, sometimes weeping. Stipe 35–60 × 6–10 mm, usually cylindrical but base often bulbous, up to 15 mm wide, fistulose or stuffed, cream-coloured, downwards pale brownish, entirely white-pruinose or floccose, but less distinctly so to the base. Context in the pileus and stipe very pale beige to white. Smell raphanoid.

Spores (10.0–)10.5–12.2(–12.6) × (5.9–)6.3–7.3(–7.5)  $\mu\text{m}$ . Q = 1.5–1.8, av. Q = 1.56–1.71, usually rounded, sometimes tapering or papilla-like, perispore sometimes somewhat loosening (in ammonia 10%), with ornamentation consisting of fine, punctiform warts, pale brown under the microscope, not dextrinoid. Cheilocystidia 40–80 × 8–11  $\mu\text{m}$ , usually slenderly clavate, gradually broadening towards the apex, apex frequently lobed or bifurcate, usually not ventricose at the base, sometimes slightly ventricose towards the base of short cystidia, sometimes a few slightly thick-walled.

Habitat – Terrestrial in roadside verges planted with *Quercus* on nutrient-poor or enriched sandy soil.

*Collections examined.* Plot Q1, 6 Oct. 1986, Keizer 86172; Plot Q2, 22 Sept. 1986, Keizer 86156; Plot Q43, 6 Oct. 1987, Keizer 87215; 12 Oct. 1988, Keizer 88089.

The combination of the non-ventricose and frequently lobed or furcate cystidia and the relatively broad spores is characteristic for this species. For a more detailed comparison of this species with *Hebeloma helodes* and *H. crustuliniforme*, see the observations under the *H. crustuliniforme* group.

The name *Hebeloma longicaudum* was rejected by Boekhout (1982: 97), but on the basis of an incorrect interpretation of the rules of nomenclature. He compared his description with Fries' description in *Epicrisis* (1838: 181), but that is not relevant from a nomenclatural point of view. Fries sanctioned *Agaricus longicaudus* in 1821 (: 248) on the basis of Persoon's diagnosis from 1801 (: 332), which consequently should be regarded as the basis for (neo)typification. Both descriptions differ considerably from the concept in the *Epicrisis*. *Agaricus longicaudus* Pers. fits the present fungus well (although the description is very short and therefore an irrefutable interpretation cannot be given). The combination of a pale leather-coloured pileus, a white, cylindrical stipe and punctate lamellae (due to dried excreted droplets!) suggests a *Hebeloma* near *H. crustuliniforme*. The small pileus and slender stipe exclude *H. crustuliniforme* *sensu stricto*. It should be noted that Persoon's description concerns a slender variant (pileus  $\pm$  40 mm, stipe  $\pm$  100 × 4–6 mm), as depicted by Lange (1938: 119E). However, more thick-set variants are equally wide spread and represent in our opinion the same taxon. This interpretation of *Agaricus longicaudus* is in agreement with widely accepted interpretations by Konrad & Maublanc (1924–1937: pl. 79), J. Lange (l.c.) and Bruchet (1970: 77).

### ***Hebeloma spoliatum* (Fr.) Gillet — Fig. 9**

Pileus 7–35 mm, convex to plano-convex, warm red-brown (Expo F48, F-H36, E26), on drying more yellowish red-brown (E56), towards the margin paler, pinkish beige (C63), viscid. Lamellae up to 5 mm broad, crowded, emarginate to narrowly adnate, not or slightly ventricose, pale purplish brown, with white-floccose edge, not weeping. Stipe 22–35 × 1–5 mm (exclusive of the rooting part), cylindrical with rooting base, upper half pale beige to whitish, downwards greyish brown ( $\pm$  E68), solid, floccose. Flesh in pileus

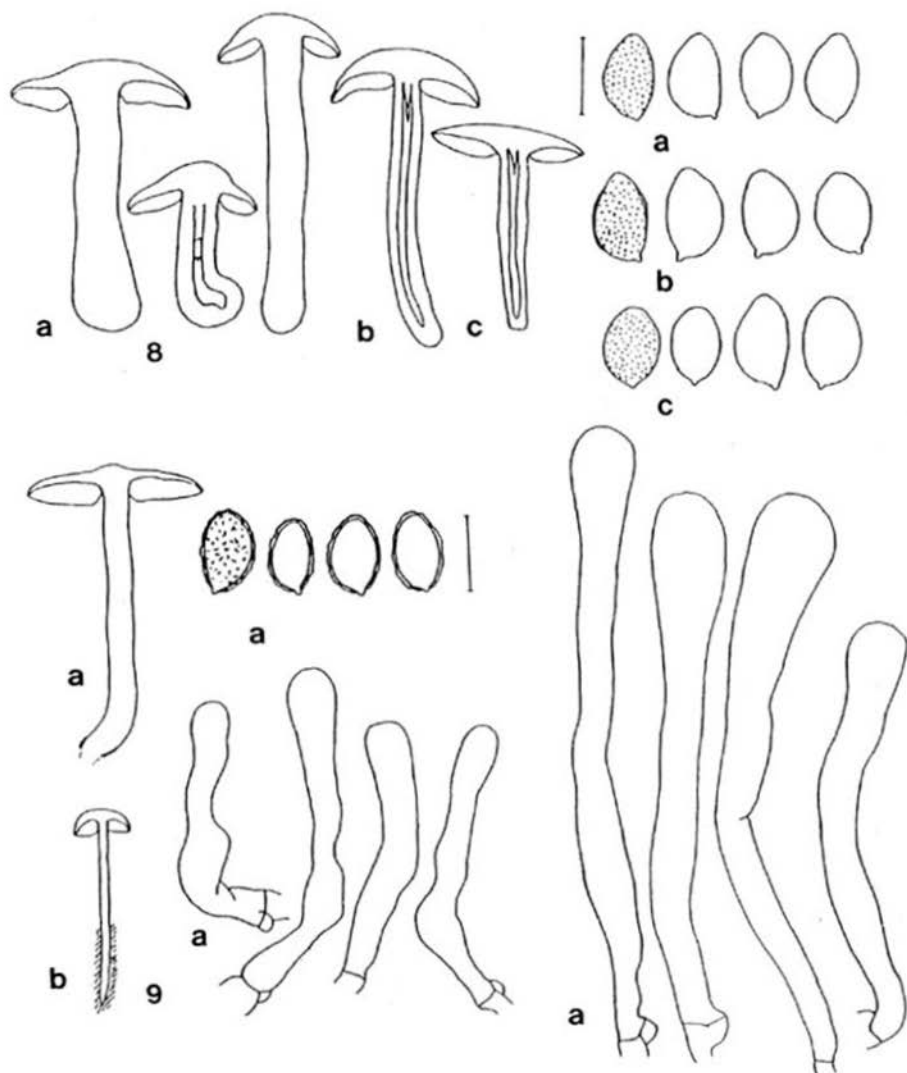


Fig. 8. *Hebeloma longicaudum*. Habit, spores, and cheilocystidia (a: 87215; b: 88123; c: 86172). — Fig. 9. *Hebeloma spoliatum*. Habit, spores, and cheilocystidia (a: 88128; b: 86233).

white, above the lamellae greyish, in stipe cream-coloured in upper part, becoming brownish more downwards. Smell faintly raphanoid; taste bitter.

Spores  $(8.6-9.4-10.6(-10.7) \times (5.0-5.2-5.9(-6.1) \mu\text{m}$ ,  $Q = 1.7-2.0(-2.1)$ , av.  $Q = 1.75-1.85$ , ellipsoid with loosening perispore which envelopes the complete spore, except for the hilar appendix, episporium thick-walled with coarse, rounded or elongate warts,

rather dark brown under the microscope. Cheilocystidia 25–50  $\mu\text{m}$  long, more or less cylindrical or apex slightly enlarged, base sometimes slightly ventricose, sometimes with slightly thickened walls.

Habitat – Terrestrial in a shady roadside verge planted with *Fagus* on nutrient-poor sandy soil.

*Collections examined.* Plot F32, 22 Oct. 1986, Keizer 86190; 13 Nov. 1986, Keizer 86233; Plot Q2, 13 Oct. 1988, Keizer 88128.

This rare species, well characterised by the rooting stipe, shows microscopically much similarity with *Hebeloma anthracophilum*, which has no rooting base of the stipe. The interpretation of Boekhout (1982), which has been followed, deviates from Bruchet (1970); the latter author mentions that the perispore is not loosening.

Gröger (1987) distinguished two taxa within *Hebeloma spoliatum* on the basis of habitat preference: 1) *H. spoliatum* Fr. in the original sense of Fries (1838) i.e. occurring in mountainous pine forests and 2) *H. danicum* Gröger (= *H. spoliatum* as interpreted by various modern authors e.g. Bruchet (1970), Romagnesi (1983), Weholt (1983)), which occurs in beech forests. We do not support this view because ecological differences alone do not warrant a distinction on specific level.

### *Hebeloma truncatum* (Schaeff.: Fr.) Kumm. — Fig. 10

Pileus 28–80 mm, hemispherical, then plano-convex, with broad umbo or not umbonate, rather irregularly shaped, red-brown, then more yellowish brown (Expo E58,

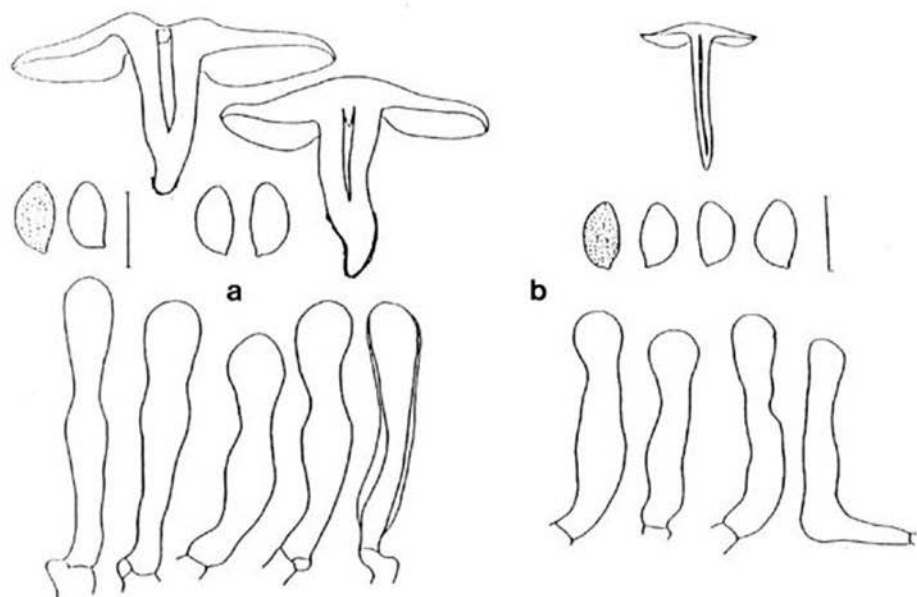


Fig. 10. *Hebeloma truncatum*. Habit, spores, and cheilocystidia (a: 88085; b: 87028).

D56) towards the margin slightly paler, smooth, dry. Lamellae up to 8 mm broad, moderately crowded, ventricose, emarginate-adnate, at first pale cream-coloured, then with colour of milk-chocolate, with white-floccose and sometimes serrulate edge, without droplets. Stipe 30–55 × 4–22 mm, mostly tapering to the base, sometimes with tendency of rooting, fistulose, apex whitish to beige, densely white-floccose, downwards brown to dark brown, slightly flocculose. Context pale cork-coloured in cap, darker brown in stipe. Smell raphanoid. Taste unknown.

Spores (8.0–)8.5–10.2(–10.4) × (4.1–)4.5–5.0(–5.2)  $\mu\text{m}$ ,  $Q = 1.7\text{--}2.1$  and av.  $Q = 1.79\text{--}2.01$ , oblong to amygdaloid, finely punctate without loosening perispore, not dextrinoid. Cheilocystidia 25–45  $\mu\text{m}$  long, sometimes more or less cylindrical, more often with both apex and base ventricose, frequently some cystidia with thickened walls.

Habitat – Terrestrial in roadside verges planted with old *Quercus* trees on nutrient-poor sandy soil.

*Collections examined.* Plot Q2, 28 Oct. 1986, Keizer 86193; 15 Sept. 1988, Keizer 88085; 14 Oct. 1988, Keizer 88235; Plot Q32, 18 Aug. 1987, Keizer 87028.

According to Bruchet (1970), the cheilocystidia of *Hebeloma truncatum* are more cylindrical and longer than observed in the present material. However, the spores and the colour and habit of the carpophores point to *H. truncatum*.

### **Inocybe albomarginata** Velen. (variant with slender spores) — Fig. 11

Pileus 24–48 mm, plano-convex, then expanding with faint umbo, dark reddish brown sometimes with greyish tinge (Expo J22, J42), paler towards the margin (D44–E58), with appressed squamules, at margin not rimulose, no velipellis observed. Lamellae up to 5 mm broad, thin, crowded, pale (yellow-)brown, soon darker, narrowly adnexed, with white-flocculose edge. Stipe 46–52 × 5–9 mm, cylindrical but towards the base sometimes enlarged up to 11 mm, subbulbous, pale beige-isabella, pinkish orange or pale brown (A22–C56), longitudinally striate, pruinose to about 2/3 radius. Context whitish in the pileus, more reddish in the stipe, especially near the cortex. Smell and taste unknown.

Spores (8.0–)8.3–10.0(–10.3) × (4.0–)4.1–4.8(–5.0)  $\mu\text{m}$ , oblong,  $Q = (1.8\text{--})1.9\text{--}2.3$ , av.  $Q = 2.04\text{--}2.13$ , smooth,  $\pm$  regular but sometimes with a faint depression, brown. Basidia 4-spored. Pleurocystidia 50–68 × 12–17  $\mu\text{m}$ , lageniform, with 1–2  $\mu\text{m}$  thick, pale, faintly yellowish walls, crystalliferous at apex, cheilocystidia as pleurocystidia, roundish cells abundant between the cheilocystidia.

*Collections examined:* Plot Q83, 3 Nov. 1987, Keizer 87349; 23 July 1988, Keizer 88356.

Macroscopically this collection fits well in *I. albomarginata* and shows some resemblance with *I. grammopodia* Malenç. The former has smaller spores ((6.0–)6.5–8.0(–8.5) × 4.0–5.0  $\mu\text{m}$ ,  $Q = 1.4\text{--}1.7$ , av.  $Q = 1.5\text{--}1.7$  (Kuyper, 1986)) and the latter has larger spores with a conical apex and more (sub)cylindrical pleurocystidia. Since this taxon grows in the same place where typical *I. albomarginata* is present and intermediate variants may occur, no final decision on its taxonomy could be taken; it is considered as a long-spored variant of *I. albomarginata*.



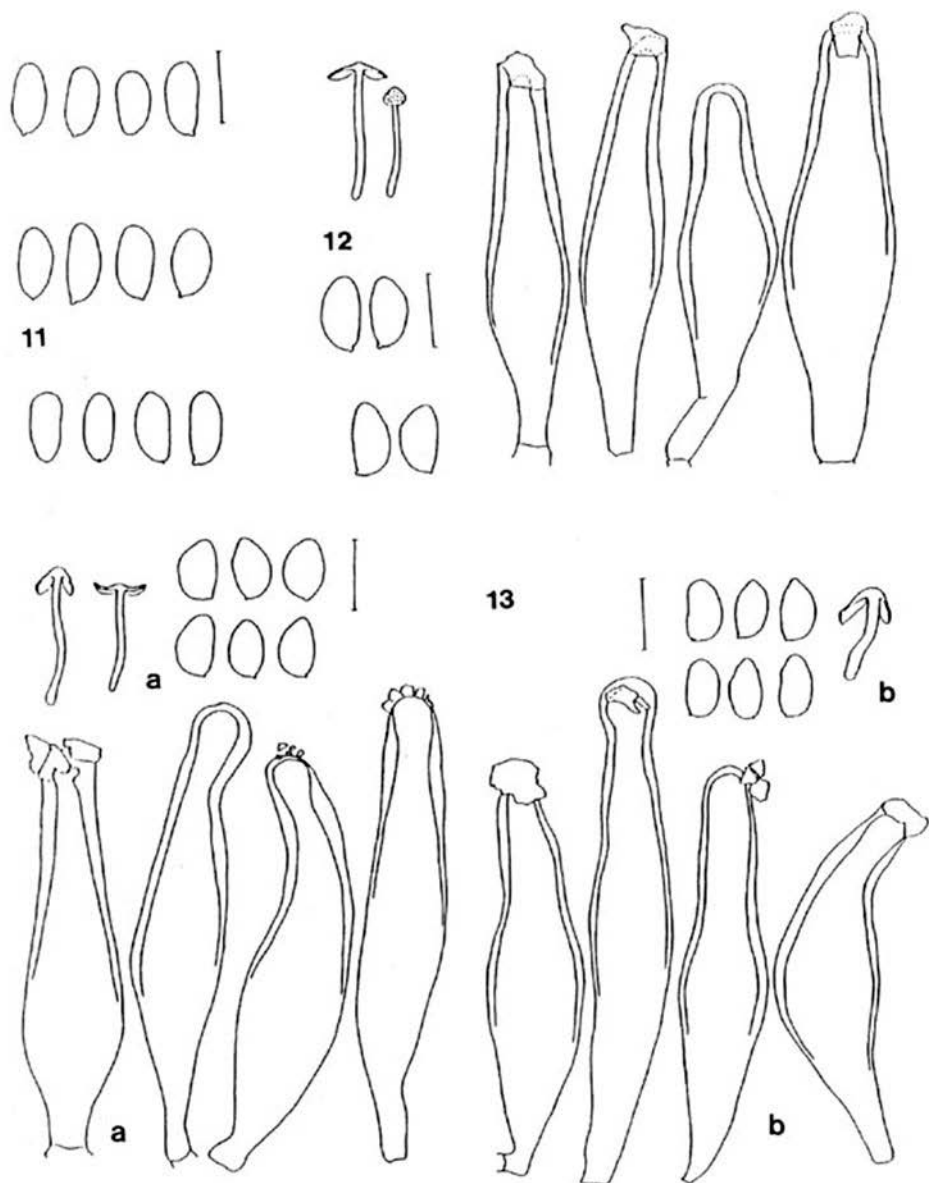


Fig. 11. *Inocybe albomarginata* (long-spored variant). Spores (88356). — Fig. 12. *Inocybe amethystina*. Habit, spores, pleurocystidia (88296). — Fig. 13. *Inocybe huijsmanii*. Habit, spores, and pleurocystidia (a: 88272; b: 88304).

**Inocybe amethystina** Kuyp. — Fig. 12

Pileus 6–13 mm, broadly campanulate, soon plano-convex with indistinct umbo, brown, then pale grey-brown (Expo F62 to C62), woolly fibrillose, near centre with scales darker than the surface of the pileus, with some remains of veil. Lamellae up to 2 mm broad, moderately crowded, narrowly adnate, rather dark brown, with white-floccose edge. Stipe up to 28 × 2 mm, cylindrical, hardly broader at the base, upper half pinkish-violet, downwards pale beige, in older carpophores violet colour only visible at the apex, only apex ( $\pm 1/10$ ) pruinose, downwards brown-fibrillose. Smell indistinct.

Spores 9.3–10.3 × 4.5–5.2  $\mu\text{m}$ ,  $Q = 1.9\text{--}2.2$ , av.  $Q = 1.99$ , oblong-amygdaliform, with the abaxial side more rounded than the adaxial side. Pleurocystidia 40–50 × 11–15  $\mu\text{m}$ , narrowly lageniform, with 1.5–2.0  $\mu\text{m}$  thick, yellow walls and some crystals at apex, cheilocystidia similar.

Habitat — Terrestrial in a roadside verge planted with *Fagus* on moderately nutrient-rich sandy soil.

*Collection examined.* Plot F24, 7 Oct. 1988, Keizer 88296.

The identification of our collections was confirmed by Kuyp. It differs in several respects from Kuyp. description (1986: 136), viz. in very small carpophores, narrower spores and smaller pleurocystidia.

**Inocybe huijsmanii** Kuyp. — Fig. 13

Pileus 8–15 mm, convex or campanulate without prominent umbo, ochraceous grey-brown, orange-brown to pale ochraceous isabella (Expo D63, E54, Mu 2.5 YR 7/4–6/4), radially fibrillose, fibrils not diverging, with some indistinct patches of veil around centre, at margin with remains of cortina. Lamellae 1.5–2 mm broad, slightly to moderately crowded, not or slightly ventricose, narrowly adnate, pale brown with pink-lilac hue, with white-floccose edge. Stipe 20–31 × 1.5–2.5 mm, cylindrical with slightly enlarged base, pale beige or isabella ochraceous, entirely or only at apex with a lilac hue (Mu 2.5 YR 7/3–7/4), covered with white fibrils. Context in pileus and apex of stipe pinkish-lilac, in the other parts white. Smell spermiatic.

Spores 8.0–9.0(–9.4) × 4.2–5.0(–5.7)  $\mu\text{m}$ ,  $Q = 1.5\text{--}2.1$ , av.  $Q = 1.7\text{--}2.0$ , ellipsoid or somewhat amygdaliform, in collection 88304 often with a depression at the adaxial side. Pleurocystidia narrowly lageniform or narrowly fusiform, with walls 1.0(–1.5)  $\mu\text{m}$  thick and usually crystals at apex, cheilocystidia similar.

Habitat — Terrestrial in roadside verges planted with *Fagus* on nutrient-poor sandy soil.

*Collections examined.* Plot F21, 24 Sept. 1988, Keizer 88272; Plot F24, 7 Oct. 1988, Keizer 88304; Plot F43, 6 Oct. 1988, Keizer 88357.

Collection 88304 unites some characters of both *Inocybe huijsmanii* and *I. griseo-lilacina* J. Lange: it shows a more or less smooth pileus surface with yellowish brown colours and lacks a *Pelargonium* smell (*I. huijsmanii*), but it shows violaceous colours and some subcapitate pleurocystidia (*I. griseo-lilacina*; cf. Kuyp., 1986: 133–134). The spores deviate from other collections in the relatively narrow ellipsoid-subamygdaliform

shape with frequently a depression in the adaxial wall. For the time being, this collection has been called *I. cf. huijsmanii*. Spores of all collections were smaller than those reported for *I. huijsmanii* by Kuyper (1986: 135). The species was not recorded before from the Netherlands (Arnolds, 1984; Arnolds et al., 1989; Kuyper, l.c.).

### **Laccaria** Berk. & Br.

Although representatives of this genus are extremely common, taxonomic problems still exist. The following notes illustrate how the species were distinguished.

### **Laccaria bicolor** (R. Maire) P.D. Orton — Figs. 14, 15

Habitat — Terrestrial in roadside verges planted with *Quercus* or *Fagus*.

*Collections examined.* Plot Q62, 4 Oct. 1987, Keizer 87210; Plot Q38, 18 Sept. 1988, Keizer 88053; Plot F21, 28 Oct. 1988, Keizer 88305.

In typical cases, *Laccaria bicolor* has violaceous tinges in the lamellae and the basal mycelium. However, the intensity of the violaceous colour is variable and specimens are met without this colour at the basal tomentum and with only a lilac-pink hue in the lamellae, which come very close to typical *L. proxima* (see also observations under *L. purpureobadia*). Spores subglobose to broadly ellipsoid with small spines.

### **Laccaria laccata** (Scopoli: Fr.) Cooke — Fig. 18

Habitat — Terrestrial in roadside verges planted with *Quercus* or *Fagus* on nutrient-poor or enriched soil, often near the paved road surface or on otherwise disturbed places.

*Collections examined.* Plot Q93, 8 Sept. 1986, Keizer 86134; Plot Q33, 31 Aug. 1987, Keizer 87036.

*Laccaria laccata* is readily distinguished from *L. proxima* by the smoother (less squamulose) pileus, less striate stipe and especially by the globose spores with long spines (> 1 µm). According to Mueller (1991) the correct name for this taxon is *Laccaria laccata* var. *pallidifolia* (Peck) Peck. The typical variety, however, seems hardly distinct from *L. proxima*.

### **Laccaria proxima** (Boud.) Pat. — Fig. 16

Habitat — Terrestrial in roadside verges planted with *Quercus* or *Fagus* on nutrient-poor soil, often near young trees.

*Collections examined.* Plot Q33, 3 Dec. 1986, Keizer 86275; Plot Q37, 7 Oct. 1987, Keizer 87288; Plot Q93, 8 Sept. 1986, Keizer 86135.

Three taxa around *L. proxima* can be distinguished in the field, which all are characterized by small scales on the cap, striate stipe and, microscopically, broadly ellipsoid to subglobose spores with small spines (< 1 µm), viz. *L. bicolor*, *L. proxima* and *L. purpureobadia* (see observations under *L. purpureobadia*).

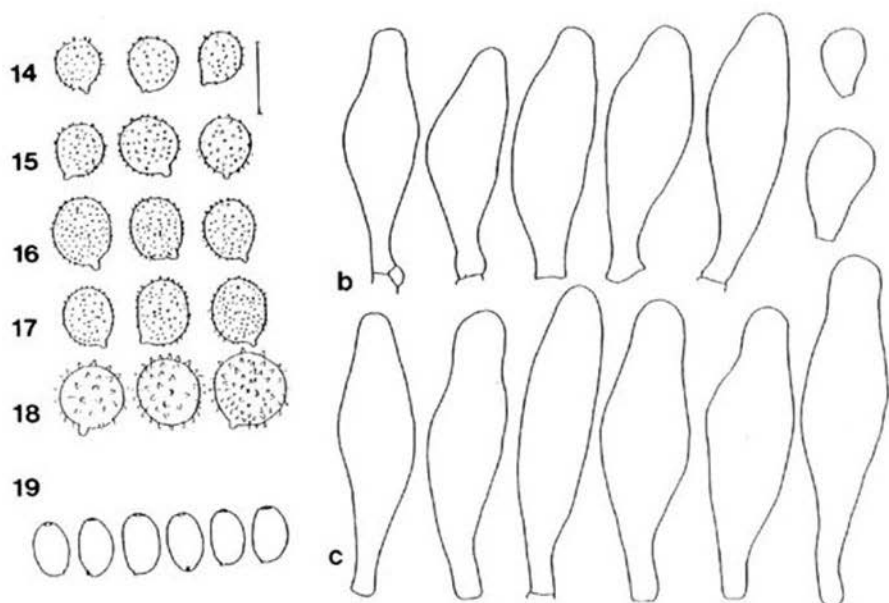


Fig. 14. *Laccaria bicolor*. Spores (87210). — Fig. 15. *Laccaria bicolor*. Spores (A.E.Jansen 1264). — Fig. 16. *Laccaria proxima*. Spores (87288). — Fig. 17. *Laccaria purpureobadia*. Spores (87266). — Fig. 18. *Laccaria laccata*. Spores (87036). — Fig. 19. *Psathyrella fulvescens* var. *brevicystis*. Spores, cheilocystidia (b), pleurocystidia (c) (86140).

### *Laccaria purpureobadia* Reid — Fig. 17

Habitat — Terrestrial in roadside verges planted with old *Quercus* on nutrient-poor soil.

Collections examined. Odoorn, Odoornerveen, 6 Oct. 1986, Keizer 86169; Plot Q31, 28 Oct. 1987, Keizer 87266.

*Laccaria purpureobadia*, which is characterized by the dark purplish brown colours of pileus and stipe, was found twice, and in one case it grew mixed in a large group of typical *L. proxima*. The fruit-bodies of both 'species' were identical except for the dark colours in *L. purpureobadia* (like the water painting in Reid, 1966: pl. 5 and the photograph in Phillips, 1981: 53).

In Figs. 14–17 it is shown that the spores of *L. proxima*, *L. bicolor* and *L. purpureobadia* are largely similar. Consequently, if these taxa are only characterized by (rather variable) colours, it becomes questionable whether a distinction on specific level is desirable in this case. It would seem that the rank of variety is more appropriate. However, mating experiments have shown the interdependency of these species (Fries & Mueller, 1984), except for *L. purpureobadia*, which was not tested. In conclusion, although it seems that the species differ in only one character (colour of carpophore and mycelium) which would point

to a distinction on the level of variety, the specific status is maintained here because of the proven intersterility of most of the collections belonging to the taxa distinguished on the basis of their morphology.

### ***Leccinum oxydabile* (Sing.) Sing.**

Pileus 30–42 mm, convex to hemispherical, hazel-brown (Expo E-F62), at margin and in young specimens slightly paler, slightly tomentose, near centre with very fine hairy scales. Tubes up to 7 mm long, at first white, soon greyish-brown, often ochraceous yellow-brown. Stipe 95 × 12 mm, slightly tapering upwards, cream-coloured, covered with warts which are white and small near apex, coarser downwards and with purplish brown tips near base spotted greenish blue. Context white, after a few minutes becoming pink, in extreme base of stipe dirty yellow. Smell absent, taste not tested.

Spores 17.0–19.5 × 6.0–6.5 µm, fusiform.

Habitat – Terrestrial in a roadside verge planted with old *Quercus* on nutrient-poor sandy soil, also small, mown *Betula* present.

*Collection examined.* Plot Q2, 15 Sept. 1988, Keizer 88137.

The pinkish discoloration of the context, rather pale pileus and the broad spores are distinctive for *Leccinum oxydabile*. This collection fits well with the description by Watling (1970: 53). The sporocarps grew between small, yearly mown birches. Most records of *L. oxydabile* from the Netherlands concern *L. variicolor* Watling (= *L. oxydabile* ss. Sing. 1967) or *L. roseofractum*. *Leccinum oxydabile* was not reported with certainty before in the Netherlands.

### ***Mycena aetites* (Fr.) Quéf.**

*Collections examined.* Plot Q53, 5 Nov. 1986, Keizer 86214; Odoorn, Odoornerveen, 2 Nov. 1989, Keizer 89071; 11 Nov. 1983, Keizer 89090.

For descriptions of *Mycena aetites* the reader is referred to Kühner (1938) and Maas Geesteranus (1988). With help of the keys by Maas Geesteranus (l.c.) it is rather simple to identify this species. In the field, however, it may show much resemblance with variants of the very common *M. leptocephala* (Pers.) Gill. which sometimes has a hardly perceptible chlorine-like smell, especially during cold and wet weather. Moreover, inodorous variants of both species seem to exist (Maas Geesteranus, l.c.). Field characters to separate *M. aetites* from *M. leptocephala* are among other things: 1) the stouter habit, 2) the more rigid consistency, and 3) the more broadly adnate lamellae that are usually paler grey in *M. aetites*. In mycocoenological work, one is forced to identify large numbers of carpophores so that it is impossible to check every carpophore under the microscope. In this study, small specimens of *M. aetites* might have been mistaken for *M. leptocephala* in some cases.

### ***Mycena filopes* (Bull.: Fr.) Kumm.**

*Collection examined.* Plot Q2, 17 Nov. 1988, Keizer 88325.

Typical *Mycena filopes* with grey-brown pileus with a pale margin is common and well-known. Another taxon exists which is more or less similar (Arnolds, 1982: 409 f.f.) except for the pink pileus. It is called *Mycena filopes* var. *metata* (Fr.) ss. Oort (Arnolds, 1982) or *M. metata* (Fr.) Kumm. ss. Oort.

Although all intermediates exist between a grey-brown, pinkish grey-brown, greyish pink and pink pileus, the extremes seem to be rather different in several aspects. How subtle the difference in colour can be, is illustrated when fig. 7a (third fruit-body) and fig. 7b (first fruit-body) by Arnolds (1982) are compared. Minor differences between these two taxa, apart of those given by Arnolds (l.c.), are: 1) the greyish taxon has a more (narrowly) parabolical pileus, the pinkish taxon has a slightly more campanulate-expanded pileus; 2) in the greyish taxon the dark colours in the centre of the pileus are more contrasting to the pale whitish colour of the margin; 3) the greyish taxon tends to grow solitary while the pinkish form usually occurs in groups of for instance 5–10 carpophores in an area of 1 dm<sup>2</sup>. These characters are correlated, but in each character intergradations seem possible. The possibility to distinguish the taxa by using differences in the shape of the cheilocystidia, as proposed by Maas Geesteranus (1980), was rejected by Arnolds (l.c.). We support this last view and therefore recognize them as varieties, named var. *filopes* and var. *metata*, respectively.

Maas Geesteranus (1984) proposed another distinction of the species of this group, mainly on the basis of differences in the cheilocystidia and of the excrescences on top of them. Maas Geesteranus (l.c.) suggested that *Mycena sepia* consists of two different taxa: *M. sepia* J. Lange (considered as synonymous with *M. filopes*) and *M. sepia* ss. Lundell, named *M. septentrionalis* Maas G. The differences between *M. metata* and *M. filopes* were extensively elaborated, but many of the characters mentioned seem variable.

In this study, where large numbers of carpophores had to be identified, preferably for the greater part in the field, the distinction of the species as proposed by Arnolds (1982), largely based on habit and colour characters, was preferred. See also *M. vitrea*.

### ***Mycena vitrea* (Fr.) Quél.**

Synonym: *M. sepia* J. Lange.

Collections examined. Plot Q34, 5 Nov. 1986, Keizer 86125; Odoorn, Odoornerveen, 13 Oct. 1987, Keizer 87235; 1 Nov. 1989, Keizer 89088.

*Mycena vitrea* has been distinguished in this study from *M. filopes* on account of two macroscopic characters, viz. the dark pileus with only slightly paler, not contrasting margin and the somewhat stouter habit. Using the key presented by Maas Geesteranus (1980), the problem arose that the cheilocystidia did not agree entirely with one of the described and depicted types, owing to their great variation even within one lamella. This renders cheilocystidia morphology a character of limited value. Therefore we refrained from the use of cystidial characters and we agree with Arnolds (1982) who came to the same conclusion. Arnolds (l.c.) noted that in his collections of *M. filopes* 18% had a majority of 4-spored basidia whereas in *M. sepia* 82% of the collections was 4-spored. Consequently, this feature cannot be used as a distinctive character, at most as an additional character in case of doubt.

Collection 89088 had 4-spored basidia and collection 87235 had 4- and 2-spored basidia with a majority of 4-spored ones.

See also observations under *M. filopes*.

***Pluteus pallescens* P.D. Orton — Fig. 20**

Pileus 27 mm, plano-convex, without umbo, hygrophanous, when moist rather dark (greyish) brown (Expo F63), margin strongly striate, on drying paler grey-brown (E63), dull. Lamellae 4 mm broad, somewhat ventricose, free from stipe, salmon-coloured pink with white-floccose edge. Stipe 65 × 4 mm, cylindrical, creamy white, striate lengthwise, fistulose.

Spores (5.8–)6.3–7.2(–7.8) × (5.0–)5.7–6.2(–6.5) μm, Q = 1.0–1.2, av. Q = 1.13, (sub)globose, thick-walled with ± 0.4 μm thick walls. Pleurocystidia 30–70 × 15–39 μm, broadly utriform to ± vesiculose, thin-walled, rather sparse. Cheilocystidia 30–50 × 15–25 μm, more or less similar to pleurocystidia but smaller and often broader clavate. Pileipellis consisting of sphaeropedunculate and broadly clavate cells.

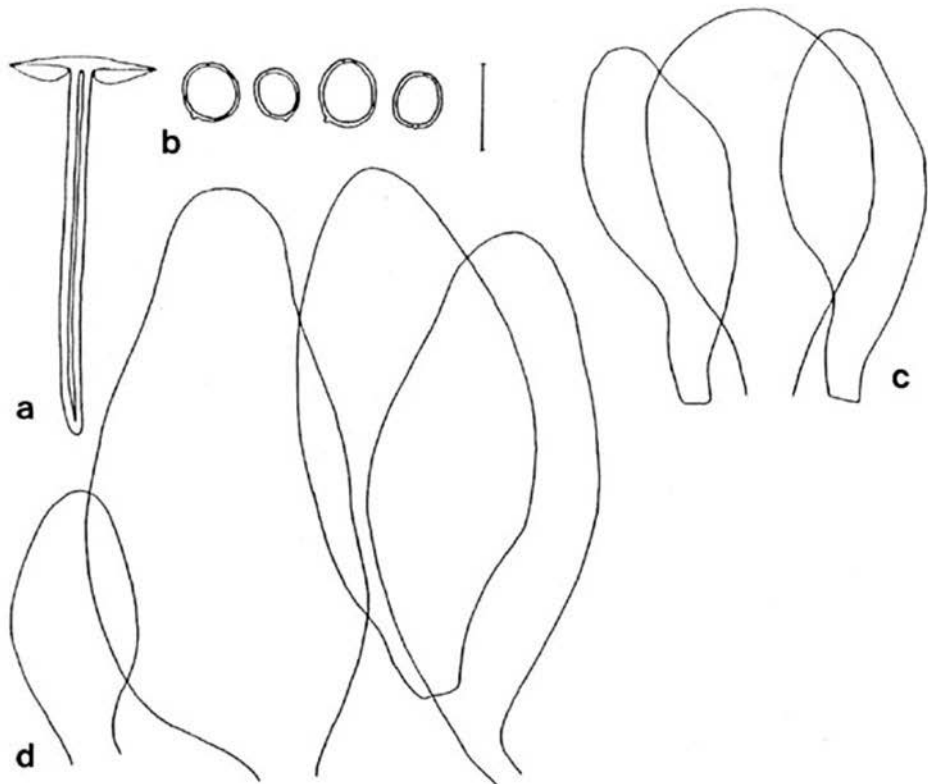


Fig. 20. *Pluteus pallescens*. Habit (a), spores (b), cheilocystidia (c), and pleurocystidia (d) (87136).

Habitat — Terrestrial in a roadside verge planted with *Quercus* on nutrient-poor sandy soil.

Collection examined. Plot Q22, 15 Sept. 1987, Keizer 87136.

This collection fits well with the description by Huijsman (1955) of *Pluteus umbrinellus* (misapplied name according to Orton (1960) and Vellinga & Schreurs (1985) and the plate by Bresadola (1927-1933: 544-2)). The specimen found here was not as dark brown as mentioned by Moser (1978) and Vellinga (1990). On account of the lack of olivaceous colours and the broad pleurocystidia it is called *P. pallescens*, which is a rare species in the Netherlands.

***Psathyrella fulvescens* (Romagn.) A.H. Smith var. *brevicystis* Kits van Wav. — Fig. 19**

Collections examined. Plot Q24, 8 Sept. 1986, Keizer 86140; Plot Q72, 26 Sept. 1988, Keizer 88142; Plot Q88, 25 Sept. 1986, Keizer 86160.

It seems that still some confusion exists about this extremely common taxon. It is difficult to identify with the aid of the *Psathyrella*-monograph by Kits van Waveren (1985), owing to differences between his descriptions and drawings of the pleurocystidia and the pleurocystidioid cheilocystidia ('lageniform or fusoid') and the usual shape of these cells. The cystidia are usually more or less ventricose with a rounded cylindrical apical part, as figured by Arnolds (1982: 438, sub nomine *P. trivialis*) and in Fig. 19 of the present study. They may be called (narrowly) utriform or obtusely fusiform. Consequently, this species may therefore also be placed in sect. *Spadiceogriseae*, subsect. *Lutenses*. The macroscopic characters and other microscopic characters of the material found during this study agree with the descriptions by Arnolds (l.c.) and Kits van Waveren (l.c.).

Among the large numbers of carpophores of this species, growing on pieces of wood, often some specimens with an irregular and strongly wrinkled pileus were present. They could key out as *P. reticulata* (Romagn.) Sing., but all other characters agreed with *P. fulvescens* var. *brevicystis*. Therefore, *P. reticulata* may very well be only a variant of the latter taxon.

***Psathyrella rhombispora* Keizer & Arnolds, *spec. nov.* — Fig. 21**

Pileus 15 mm latus, late campanulatus, obtuse umbonatus, hygrophanus, quando uvidus cinereo-brunneus, quando vero desiccatur colore stramineo. Lamellae purpureo-fuscae, acie albo-flocculosa, subconfertae. Stipes 20 × 1.5–2.0 mm, cylindraceus, albidus, fistulosus. Sporae (8.2–)8.3–9.8(–10.0) × (4.2–)4.3–5.0 μm, Q = 1.7–2.0, medius Q = 1.90, ellipsoideae vel rhomboideae, saepe cum apiculo satis magno, poro nullo. Basidia 16–23 × 7–8 μm, (1–)2–3(–4)-sporigera, fibulata. Pleurocystidia 35–50 × 9–13 μm, plerumque utriformia, cheilocystidia utriformia 35–55 × 12–17 μm, modice numerosa, cheilocystidia sphaeropedunculata 15–25 × 10 μm, rara. Habitat: terrestris in solo arenoso.

Holotypus: The Netherlands, prov. Drenthe, Anloo, Plot Q65, 10 Nov. 1987, Keizer 87234 (WBS).

Pileus 15 mm, expanded, broadly campanulate with broad umbo, hygrophanous, when moist grey-brown (Expo F64), at centre more reddish brown, on drying straw-coloured (C63), at centre more ochre-coloured, no velar remains observed. Lamellae moderately crowded, ventricose, narrowly adnate, purplish brown, with white-floccose edge. Stipe



20 × 1.5–2.0 mm, cylindrical, slightly broader downwards, shiny, whitish, near the base pale beige, with some white-floccose velar remains, fistulose. Smell insignificant.

Spores (8.2–)8.3–9.8(–10.0) × (4.2–)4.3–5.0 μm, Q = 1.7–2.0, av. Q = 1.90, ellipsoid to rhomboid, frequently with a fairly large hilar appendix, without germ-pore, rather light red-brown in H<sub>2</sub>O, somewhat darker in NH<sub>4</sub>OH 10%, rather variable in shape and size. Basidia 16–23 × 7–8 μm, (1–)2–3(–4)-spored, spheropedunculate, with basal

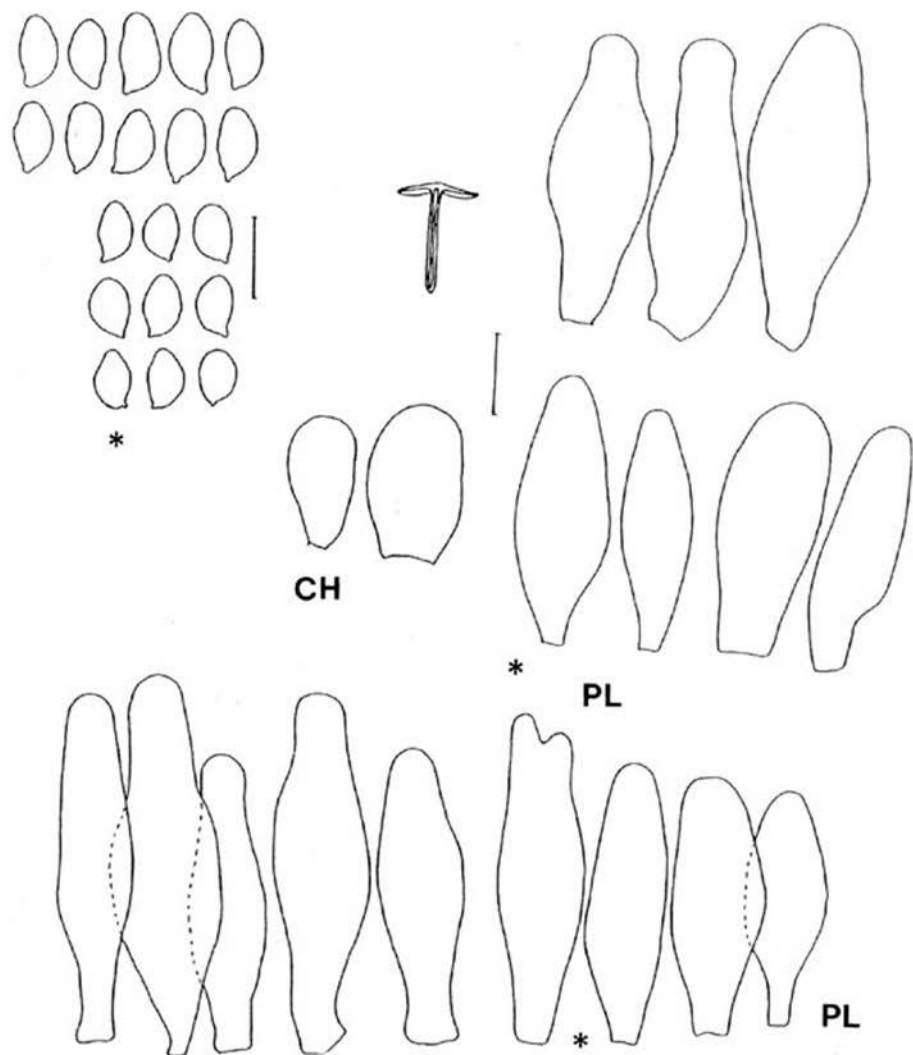


Fig. 21. *Psathyrella rhombispora*. Habit, spores, cheilocystidia, and pleurocystidia (spores marked with \* from 88314, all other figs. from 87324; cystidia with \* del. E. Kits van Waveren).

clamp. Pleurocystidia  $35-50 \times 9-13 \mu\text{m}$ , (narrowly) utriform to obtusely fusiform, pleurocystidioid cheilocystidia (narrowly) utriform to obtusely fusiform, occasionally apically bifurcate,  $35-55 \times 12-17 \mu\text{m}$ , frequently slightly thick-walled with pale brown walls (in  $\text{NH}_4\text{OH}$ ), rather scarce, spheropedunculate cheilocystidia scarce. Hymenophoral trama pale yellow-brown at the base of the lamella, gradually less pigmented towards the edge.

Habitat — Terrestrial in a roadside verge planted with *Quercus* on moderately nutrient-poor sandy soil.

Collection examined. Plot Q65, 10 Nov. 1987, Keizer 87234.

*Psathyrella rhombispora* agrees in macroscopical appearance and pleurocystidia with the descriptions of *P. fulvescens* var. *brevicystis* in Kits van Waveren (l.c.) and Arnolds (l.c.), among other things because of the reddish brown centre of the pileus. However, the spores differ markedly in shape, a large proportion of the spores being rhomboid and tapering in a fairly large hilar appendix and in the absence of a germ-pore.

The present species belongs to sect. *Spadiceogriseae* subsect. *Spadiceogriseae* according to the in majority (narrowly) utriform pleurocystidia and the rather scarce pleurocystidioid cheilocystidia. *Psathyrella clivensis* (Berk. & Br.) P.D. Orton (as described by Orton (1960), Kits van Waveren (l.c.), not by Smith, 1972) is one of the few *Psathyrella*-species which (almost) lacks a germ-pore. It differs in 1) the shape of the spores: ellipsoid to subphaseoliform in *P. clivensis* and ellipsoid to rhomboid in *P. rhombispora*; 2) the spores of *P. clivensis* are  $5.5-6.0 \mu\text{m}$  broad, the spores of *P. rhombispora* are more slender,  $4.3-5.0 \mu\text{m}$  broad; 3) the bases of the spores of *P. clivensis* are rounded with a small hilar appendix; in *P. rhombispora* they are often tapering in a large hilar appendix; 4) the basidia are 4-spored in *P. clivensis* but in majority 2-3-spored in *P. rhombispora*. In addition, the habitat of *P. clivensis* is chalk grassland; the present species was found on nutrient-poor sandy soil.

It is after some hesitation that this species was described as new, because the collection consists of only one specimen. It is obvious that there exists not yet a clear view of the possible variation of the studied characters. However, the noted differences with other (similar) species, especially in the morphology of the spores, warrant in our view a distinction on specific level. In the current literature no description could be found that sufficiently fits this material. We thank Dr. E. Kits van Waveren, who kindly studied the present material and gave valuable suggestions and opinions on this species.

### *Psathyrella seymourensis* A.H. Smith — Fig. 22

Pileus 6-17 mm, hemispherical or paraboloid, hygrophanous, when moist dark brown (Expo  $\pm$  J42), translucently striate up to 1/3 of the radius, on drying pale grey-brown (C63) with slightly darker centre (E68), some remnants of the veil present near the margin. Lamellae up to 2 mm broad, subdistant, narrowly to rather broadly adnate, pale (brownish) grey (J78), edge white. Stipe 15-23  $\times$  1-2 mm, cylindrical, apical part white, downwards pale brown (E42-52), sometimes near base dark brown (J42), covered with small floccose veil remains.

Spores  $8.0-9.1(-9.3) \times 5.0-5.8(-6.0) \mu\text{m}$ ,  $Q = 1.4-1.7(-1.9)$ , av.  $Q = 1.55$ , slightly lentiform, in side-view ellipsoid-oblong, in face-view frequently subtriangular with largest width below middle, under the microscope dark chocolate brown. Pleurocystidia

30–45 × 9–14 μm, lageniform, thin-walled, hyaline. Cheilocystidia 35–40 × 9–11 μm more or less similar to the pleurocystidia, frequent, in addition sphaeropedunculate to clavate cells, 15–30 × 10–14 μm.

Habitat – Terrestrial in a roadside verge planted with *Fagus* on nutrient-poor sandy soil.

Collection examined. Plot F16, 13 Nov. 1986, Keizer 86222.

The carpophores and the spores of this collection are slightly larger than those described by Kits van Waveren (1985). *Psathyrella seymourensis* is a very rare species. The description by Kits van Waveren (1985: 266) was based on three collections only.

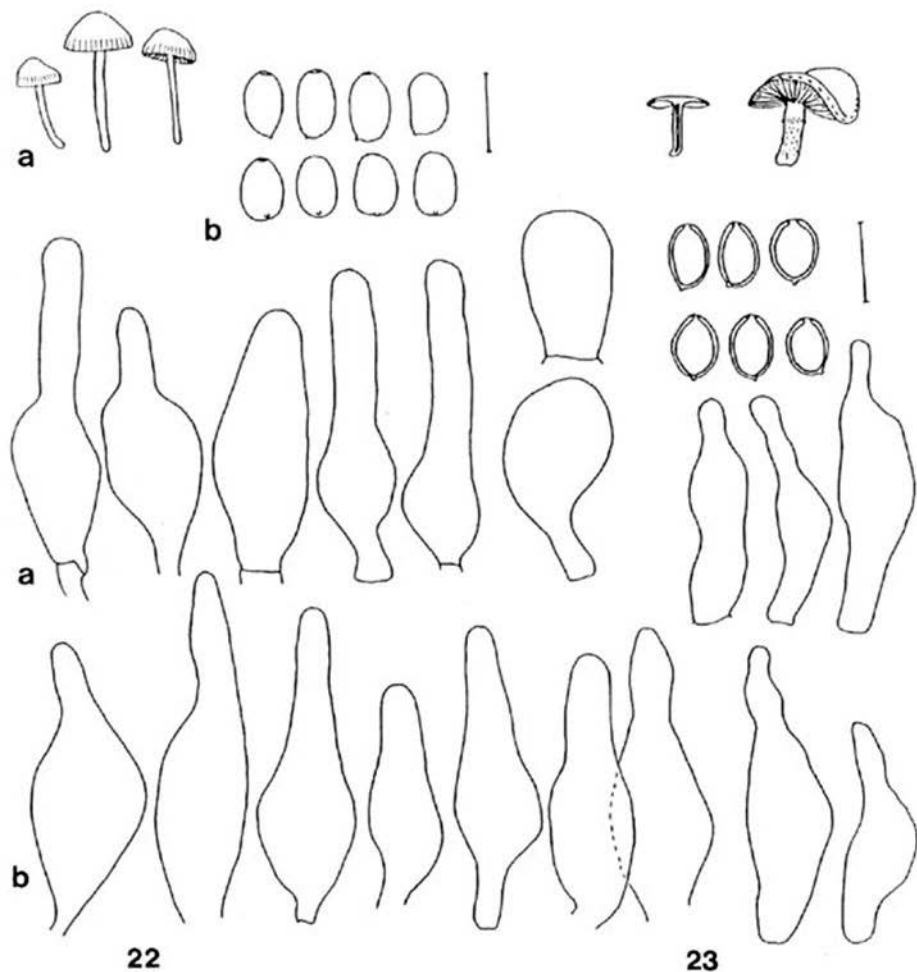


Fig. 22. *Psathyrella seymourensis*. Habit, spores, cheilocystidia (a), and pleurocystidia (b) (86222). — Fig. 23. *Psilocybe bullacea*. Habit, spores, and cheilocystidia (88333).

**Psilocybe bullacea** (Bull.: Fr.) Kumm. — Fig. 23

Pileus 7–24 mm, plano-convex or convex, soon becoming appanate, sometimes with slightly depressed centre, hygrophanous, when moist warm red-brown (Expo F44 (slightly more brown) or F54), with paler margin, translucently striate up to 1/3 of the radius, on drying ± orange-brown (D56–58), viscid and gelatinous pellicle slightly separable, near the margin with white, dentate veil remnants. Lamellae up to 2 mm broad, crowded, broadly to rather narrowly adnate, not ventricose, greyish pink-brown with paler edge. Stipe up to 10 × 1–2 mm, cylindrical or flattened and then up to 4 mm broad, concolorous with the pileus or slightly darker, white fibrillose, squamulose below an annular zone of veil. Smell indistinct.

Spores (7.4–)7.5–8.1(–8.5) × (4.7–)4.9–5.7(–6.0) μm, Q = 1.3–1.7, av. Q = 1.49, ellipsoid-oblong, slightly lenticular, differences between side and face view about 0.5 μm, thick-walled with walls ± 0.6 μm thick, under the microscope (purplish) brown. Basidia 4-spored. Cheilocystidia 27–37 × 6–11 μm, irregularly lageniform, thin-walled, hyaline. Pleurocystidia not observed. Pileipellis an ixocutis of up to 300 μm thick, made up of hyphae of 2–4.5 μm wide, the thin hyphae hyaline, the thicker ones with brown encrusting pigment. Clamp-connections present in all tissues.

Habitat – Growing on dung of horse in a roadside verge planted with *Quercus* on nutrient-poor sandy soil.

*Collections examined.* Plot Q3, 14 Oct. 1988, Keizer 88205; 21 Dec. 1988, Keizer 88333.

These collections differ in several respects from previous descriptions. Ricken (1915), Orton (1969), Geesink (1972), Guzmán (1983), and Watling & Gregory (1987) described or illustrated this species with a more or less hemispherical or paraboloid pileus. Only Guzmán (l.c.) mentioned that older specimens become appanate or depressed. The specimens described here very soon become appanate. The lamellae in our collections are not exclusively broadly adnate but also sometimes narrowly adnate. The same is drawn by Geesink (l.c.). The habitat is described as manure or arable fields (Ricken (l.c.), Watling & Gregory (l.c.), Guzmán (l.c.)), bonfire places (Geesink, l.c.), other organic debris (Watling & Gregory (l.c.), Guzmán (l.c.)). Only the last author and Orton (l.c.) explicitly mentioned dung as habitat. The specimens described here grew on (old) horse dung. Arnolds (1982) regarded *P. bullacea* as a synonym of *P. montana*, in our opinion incorrectly so. Differences between these species are, besides the habitat: the generally stouter habit and the presence of whitish dentate veil remnants at the margin of the pileus of the former species.

**Russula decipiens** (Sing.) Svrcek — Fig. 24

Pileus 50–125 mm, convex, then expanding with slightly depressed centre and mostly somewhat involute margin, sometimes more funnel-shaped, colour rather variable, between cream-coloured beige and brick-red, often on a pale buff groundcolour, with a cloudy, often-concentric pattern of orange red to mostly brick-red (e.g. Expo D-E16), sometimes completely pale beige (A73, B72, C64) when older or only with a faint orange-pink colour at the margin, dull and white-pruinose when young, not viscid. Lamellae up to 10–12

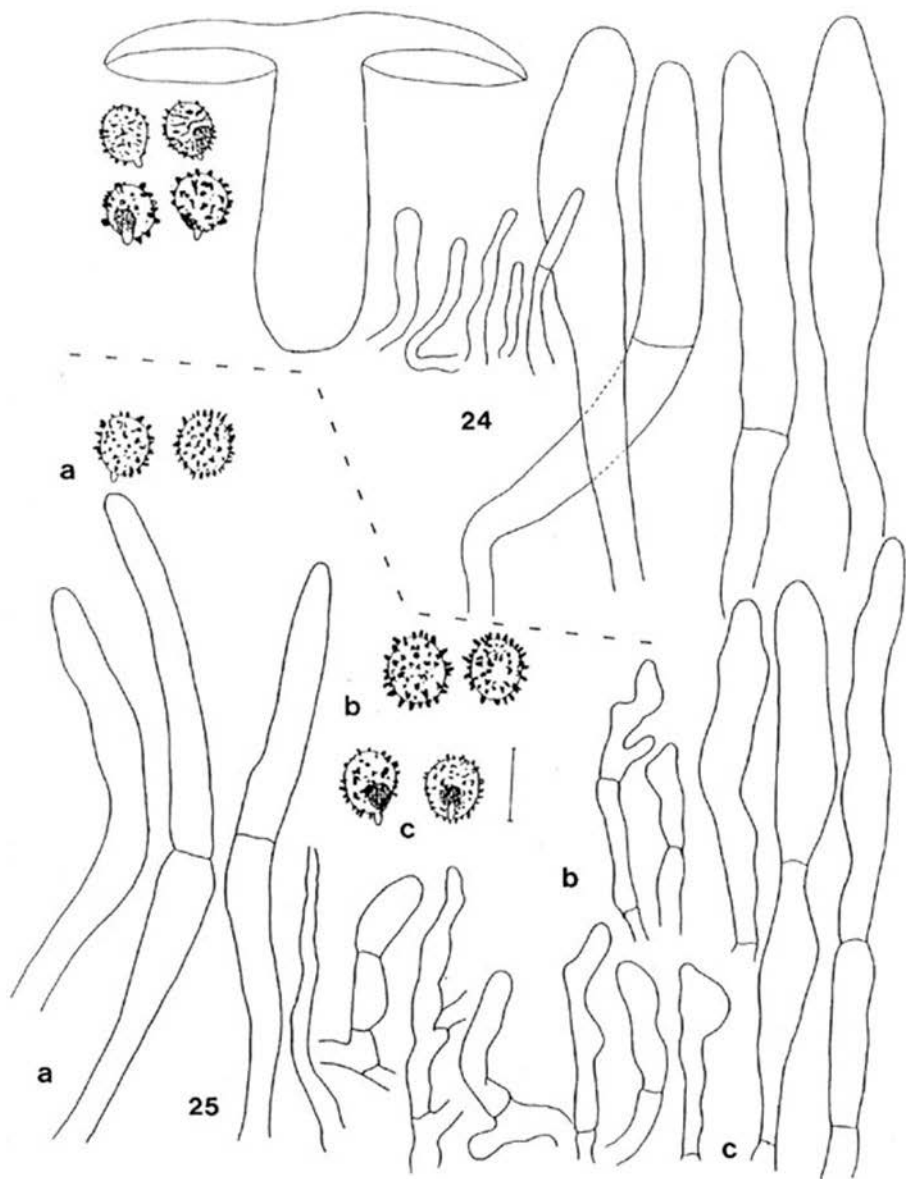


Fig. 24. *Russula decipiens*. Habit, spores, pileocystidia, and hyphae of pileipellis (86130). — Fig. 25. *Russula graveolens* f. *cicatricata*. Spores, pileocystidia, and hyphae of pileipellis (a: 87034; b: 87219; c: 88162).

mm broad, subdistant, rather ventricose, narrowly adnate, near stipe frequently forked, in large specimens c. 7 per 10 mm at the margin of the pileus, at first pale yellow, then apricot-yellow, edge concolorous. Stipe up to 60 × 30 mm, cylindrical to (more often) club-shaped, white, with age and on handling yellowish grey-brown. Context in cap and stipe white, very firm, in stipe slowly turning brownish in age. Smell weak, fruit-like ( $\pm$  as *R. fellea*), taste sharp (but mild in collection 86199). Reaction with  $\text{FeSO}_4$  dirty orange. Spore print dark yellow (IVd-)IVe (according to Romagnesi, 1967).

Spores (7.2-)7.4-9.4(-10.1) × (6.0-)6.2-8.0  $\mu\text{m}$ ,  $Q = 1.2-1.3(-1.4)$ , av.  $Q = 1.23$ , broadly ellipsoid, ornamentation variable, mostly with isolated warts or warts arranged in crests or connected with lines, rather blunt and c. 0.5  $\mu\text{m}$  high, but a minority of the spores (sometimes a rather large proportion) with coarse, blunt, isolated warts, up to 1.0(-1.2)  $\mu\text{m}$  high. Pileocystidia numerous, rather variable, some up to 50  $\mu\text{m}$  long, with suddenly enlarged apex, 7-9  $\mu\text{m}$  broad, but in majority longer and gradually broader towards apex up to 10-12(-14)  $\mu\text{m}$  broad, frequently 1-2-septate, contents granular, dark in sulfovanillin. Hyphae of the cutis inconspicuous, cylindrical, 1.5-3.0  $\mu\text{m}$  broad.

Habitat - Terrestrial in a roadside verge planted with *Quercus* on nutrient-poor sandy soil.

*Collections examined.* Plot Q13, 4 Aug. 1986, Keizer 86125; 10 Sept. 1986, Keizer 86130; 1 Oct. 1986, Keizer 86167; 24 Oct. 1986, Keizer 86199; 24 Aug. 1987, Keizer 87112; 23 July 1988, Keizer 88031; 29 Sept. 1988, Keizer 88071.

Since there exists some confusion with regard to the delimitation of *Russula decipiens*, *R. maculata* and, to a lesser extent, *R. veterrosa*, a description is given of this species. The colours of the pileus of *R. maculata* and *R. decipiens* show large overlap, although the red colours tend to fade more often in the latter species. The greyish or brownish discoloration of the flesh is often difficult to assess with certainty. Both species seem to occur in the same habitats. The main difference is the presence of numerous large pileocystidia in *R. decipiens*, whereas these are smaller and less abundant in *R. maculata*.

*Russula veterrosa* is macroscopically rather similar, but differs among other things in a paler spore print. Of these three species *R. decipiens* seems to be the most common in the Netherlands.

### ***Russula graveolens* Romell in Britz. — Figs. 25-29**

Many problems arose with the identification of taxa within the *R. xerampelina* complex, which is well-characterized by the green reaction of the context with  $\text{FeSO}_4$ , the fishy smell and the brown discoloration of stipe and lamellae. Many characters show a large variation in this group. However, often the extremes of a certain character are connected by intermediates (although these intermediates seem to be less frequent than the 'extreme' variants) and none of the characters studied appear to be mutually correlated. Thus, following the criteria proposed by Kuyper (1988): at least two independent characters must be present to separate one species from another, it would be impossible to maintain a specific status for many of the variants observed during this study.

On the other hand, the intuitive feeling exists that it is hardly realistic to unite such different variants into one species. In modern literature (Moser, 1983; Romagnesi, 1967; Einhellinger, 1985; Marchand, 1977; Bon, 1988) this problem is reflected in the differ-

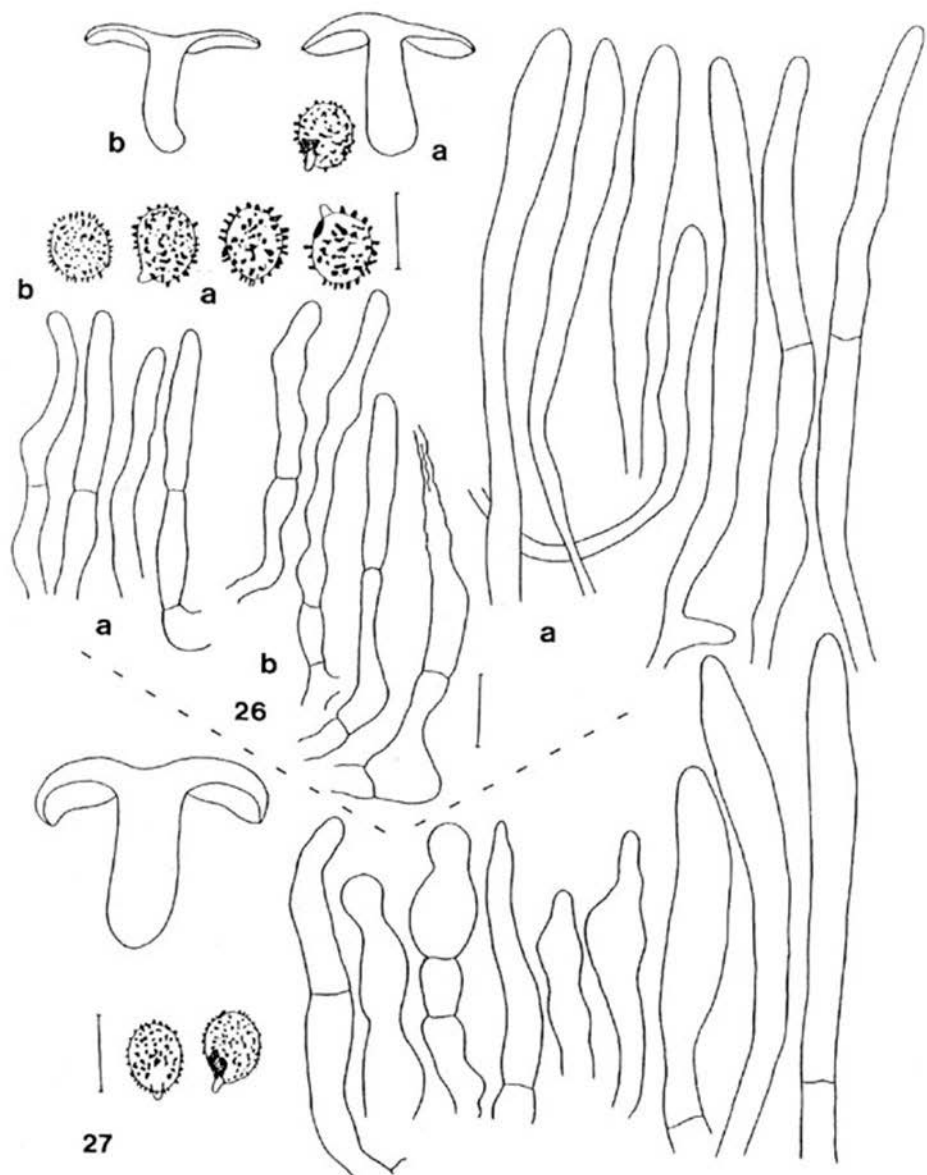


Fig. 26. *Russula graveolens* f. *elaeodes*. Habit, spores, pileocystidia and elements of pileipellis (a: 88133; b: 86166). — Fig. 27. *Russula graveolens* f. *purpurata*. Habit, spores, and pileocystidia (Habit: 87186, all other figs.: 87228).

ences in species concepts in this group. Before Romagnesi's (1967) monograph the different variants were usually considered as varieties of one variable species (e.g. Schaeffer, 1952) which is in our opinion still the best taxonomic solution except for some characteristic and constant taxa like *R. xerampelina* (Schaeff.) Fr., *R. pasqua* (Møller) J. Schaeff. and *R. faginea* Romagn., which deserve the rank of species. In order to give the possibility to compare the present data with other studies, some names proposed in the modern literature will be adopted here.

Romagnesi (1967) was the first one who tried to disentangle tentatively and eloquently the species of the *R. xerampelina* complex. Generally, he has been followed by the later authors except Moser (1983), who presented only a very brief key for the *Xerampelinae*.

On the other hand Bon (1988) presents a large number of taxa (39 species and varieties!) based on minute differences. The result of such extensive splitting must be that different names will be in vogue with different mycologists or groups of mycologists for the same taxon, each of them forced to find small differences in their own way. This procedure renders many mycological data, which are usually not provided with descriptions of the collections presented, of diminished value.

In this study the taxonomic classification by Einhellinger (1985) has been followed, which is based on Romagnesi (1967), but some doubtful 'species' were discarded. The taxa named here can be recognized only by macroscopical characters like the colour of the pileus, size and consistence of the fruit-body.

Other macroscopic characters like colour of the stipe (with/without red), discoloration of the flesh and stipe (always brownish), reaction with  $\text{FeSO}_4$ , smell, and separability of the cutis are more or less constant throughout the material or vary widely within collections and do not correlate with any other character.

The colour of the spore print generally is an important character in *Russula*. However, it appeared that within this group there was only little variation in the collections studied; sporeprints varied between IIId–IIIa(–IIIc) according to the system of Romagnesi (l.c.). Unfortunately, spore prints were not produced by many young, old and damaged carpophores. Study of more material might show some value of this character.

Microscopic characters appear to be remarkably constant throughout the material. This is true for the spores (shape, size, properties of the ornamentation), the dermatocystidia (shape, size, number of septa) and hyphae in the epicutis. So it appears that these characters, which are normally so useful in the study of the genus *Russula*, fail largely in this particular group.

In view of the observed patterns of variation in the collections studied, it is in our opinion not possible to distinguish taxa in the rank of species, bearing in mind the criteria used by Kuyper (1988). In this context the taxa observed should be considered as formae: taxa where (single) character differences show limited intergradation.

Probably speciation within the *Xerampelina*-group is going on at present and has in most cases not yet resulted in morphologically well-defined species (with some exceptions, mentioned above). Therefore the taxa described here are distinguished as formae of *R. graveolens* Romell in Britzelmayer (1893), the oldest available species epithet in this group. There is no indication that the older name *R. barlae* Quél. belongs to the group of *R. xerampelina* and this name is rejected as a *nomen dubium*, in agreement with e.g. Krieglsteiner (1987: 24).



Key to the formae of *Russula graveolens* distinguished in the present study:

- 1a. Pileus predominantly green, olive-green, yellowish or brownish green . . . . . 2  
 b. Pileus predominantly purplish red, red, brick-red or brownish violaceous . . . . . 3
- 2a. Pileus small (c. 40–50 mm), firm, pileus rather dark brownish green to dark olive green or olive brown (sometimes with reddish or purplish hue)  
*R. graveolens* f. *elaodes*
- b. Pileus rather large (up to 75–100 mm), consistency not firm, pileus middle to pale olive green to yellow, sometimes a faint purplish hue present at the margin of the pileus, in centre often more brownish . . . . . *R. graveolens* f. *cicatricata*
- 3a. Pileus rather large (up to 80–100 mm or more), broadly expanded with age, dark purple-violaceous to (dark) reddish brown, sometimes mixed with olivaceous colours, in centre usually darker than margin; with viscid surface in wet weather, in dry situations dull, almost fine-granular; habit often much like *R. atropurpurea*, less often like *R. vesca* . . . . . *R. graveolens* f. *graveolens*
- b. Pileus rather small (c. 35–45 mm), often less expanded with age, (brick-)red to purple, but large overlap with f. *graveolens*; often with remarkably dull-velvety granular surface . . . . . *R. graveolens* f. *purpurata*

***Russula graveolens* forma *cicatricata* (Romagn. ex) Keizer & Arnolds, *forma nova***  
— Fig. 25

A typo differt pileo olivaceo, luteo vel brunneo-virido pro parte maximo.

Holotypus: 'France, Coye-la-Forêt (Oise)', 13 Aug. 1960, *H. Romagnesi* 60-69 (herb. Romagnesi; PC).

Pileus (40– when young) 75–100 mm or more, convex, then plano-convex with depressed centre, with different shades of olive-green or olive-brown to brown (Expo C78, D76, E76, D78, D88), towards the margin paler (e.g. B84, A84, A86, A76, D83 or K & W 4C5, 5E7, 5D8), sometimes with a concentric zone with purplish colours or this colour present in 'cloudy' patches (D64, D54, D52), surface dull to almost velvety, sometimes cracked in small patches towards the margin, in one case more or less concentrically arranged grooves present. Lamellae up to 8 mm broad, moderately distant, a few forked, not ventricose, narrowly adnate or slightly emarginate, cream-coloured, with concolorous edge. Stipe 32–60 × 12–25 mm, cylindrical or often broader towards the base, white, in one case with red colour at one side of the base of the stipe, discolouring brownish on handling and with age. Context spongy in the stipe, firmer in the pileus, white, turning brownish. Smell distinctive, fishy, like other members of the *Xerampelina*-complex. Chemical spot test: FeSO<sub>4</sub>: blue-green. Spore print: IId–IIIa according to the system of Romagnesi (1967).

Spores 8.0–10.5 × 6.5–7.5(–8.0) μm, with Q = 1.1–1.3(–1.4), av. Q = 1.23, broadly ellipsoid, with ornamentation of coarse warts or spines, usually isolated but sometimes connected by a thin line, mostly acute, sometimes blunt, 1.0–1.3(–1.5) μm high, amyloid, supra-hilar spot obvious, amyloid. Dermatocystidia usually abundant, 80–100 × 3.5–7.0(–8.0) μm, frequently 1-septate, cylindrical or narrowly clavate, contents ± granular, with weak SV reaction. Hyphae of pileipellis 2.5–4.5 μm broad, usually cylindrical, sometimes inflated, up to 6(–13) μm.

Habitat — Terrestrial in roadside verges planted with *Quercus* on nutrient-poor sandy soil.

Collections examined. Plot Q11, 15 Sept. 1986, Keizer 86127; Plot Q32, 18 Aug. 1987, Keizer 87034; 3 Oct. 1988, Keizer 88343; Plot Q64, 19 Sept. 1988, Keizer 88147; Plot Q82, 4 Sept. 1987, Keizer 87074; 1 Oct. 1987, Keizer 87219; Plot Q83, 8 Sept. 1988, Keizer 88162.

*Russula cicatricata* was described by Romagnesi (1967: 694) as a species ad interim, without Latin diagnosis and therefore invalidly published. Romagnesi (l.c.) stated that the concentric furrows in combination with olive colours and a certain amount of ampulliform hyphae in the cutis are characteristic for *R. cicatricata*. This seems to be a solid base for a species, but according to our observations these characters are not reliable. The concentric furrows or cracks have been found only once (collection 87074) and it seems to be a character which develops in dry weather conditions. Marchand (1977) also indicated that this character can be variable, even in specimens of one collection, and that the character may disappear after collecting.

The greenish colour is the most striking feature, but this colour can be mixed with a purple hue. It is clear that carpophores of this species can contain various quantities of purple pigment; the more purple pigment present, the more brownish the pileus. On the other hand, in forma *graveolens*, the pileus usually is purple red-brown, and can contain a variable proportion of olive or brownish colours. Such intermediates with colour of the pileus between greenish and purplish, are a minority among the studied collections. Occasionally, one can find purple and green carpophores so close together that one has to assume that they originate from the same mycelium. In the present material the hyphae of the cutis are usually cylindrical, but in two collections a small minority is inflated (collections 88162 and 88147). This character occasionally also occurs in specimens which have been called f. *graveolens* and f. *purpurata* on account of the colour of the pileus.

In conclusion, none of the characters which are in use to determine f. *cicatricata* is reliable under all circumstances, and it is especially difficult to separate it from f. *graveolens*. A good plate is given by Marchand (1977: 480).

### ***Russula graveolens* forma *elaeodes* (Bres.) Arnolds & Keizer, comb. nov. — Fig. 26**

Basionym: *Russula xerampelina* var. *elaeodes* Bres., Iconogr. mycol. 9 (1929) 420.

Pileus 30–40 mm, convex, then plano-convex to depressed, olive-green, olivaceous green-brown, or greyish (Expo E76, D74, E82), sometimes mixed with a faint purplish hue, short-sulcate at the margin (1–2 mm), surface moderately dull. Lamellae up to 4 mm broad, somewhat crowded, pale yellowish or cream-coloured with concolorous edge. Stipe 20–25 × 7–10 mm, more or less cylindrical or broader towards the base, whitish but strongly discoloring brownish on handling and with age. Context spongy in the stipe, firm in the pileus, white, turning brownish. Smell characteristic for the group, ± fish-like, not strong. Chemical spot test: FeSO<sub>4</sub>: blue-green. Spore print: not obtained.

Spores 8.0–9.5(–10.2) × 6.2–8.3 μm, Q = (1.0–)1.1–1.3, av. Q = 1.20, broadly ellipsoid to subglobose, ornamentation 1.0–1.3 μm high, consisting of rather dense to scattered, usually isolated spines and warts, some may be connected by lines, amyloid,

suprahilar spot distinct, amyloid. Dermocystidia  $60-100 \times 4-6 \mu\text{m}$ , more or less cylindrical or narrowly clavate, occasionally with a septum, contents granular or hyaline, with weak SV-reaction. Hyphae of pileipellis  $2.0-4.5 \mu\text{m}$  broad, usually more or less cylindrical, sometimes inflated in places.

Habitat - Terrestrial in roadside verges planted with *Quercus* on nutrient-poor sandy soil.

*Collections examined.* Plot Q11, 24 Sept. 1988, Keizer 88133; Plot Q83, 1 Oct. 1986, Keizer 86166; Plot Q84, 29 July 1988, Keizer 88011.

The main differences between *f. elaeodes* and *f. cicatricata* are (1) the small, slender habit and (2) the less dull, almost grabrous surface of the pileus of the former. Possibly the pileus is darker than in *f. cicatricata*. This taxon is well-illustrated by Phillips (1981: 105, lower right).

### **Russula graveolens** Romell in Britz. forma **graveolens** — Fig. 28

Pileus 45–83 mm, young convex, then plano-convex with depressed centre, in centre dark brown-purple, purplish red-brown, sometimes mixed with olivaceous colour (Expo H23), towards the margin paler, red purple-brownish (D23-24, E23-24, E34, D18), surface varying from smooth and viscid to dull and almost velvety, in part densely cracked. Lamellae up to 10 mm broad, distant, narrowly adnate, not ventricose, pale yellowish, cream-coloured, edge sometimes discoloring brownish with age. Stipe 40–80  $\times$  13–25 mm, more or less cylindrical or broader towards the base to clavate, white, frequently with red colour at one side near the base, turning brown on handling and with age. Context firm in pileus and spongy in stipe, white, turning brownish. Smell characteristic for the group, fish-like, taste mild. Chemical spot test:  $\text{FeSO}_4$ : blue-green. Spore print IId–IIIb (mostly IId), in one case (IIIb–)IIIc.

Spores (8.1–)9.0–10.5  $\times$  6.5–8.0(–8.2)  $\mu\text{m}$ ,  $Q = 1.1-1.3(-1.4)$ , av.  $Q = 1.26$ , broadly ellipsoid, ornamentation up to 1.0–1.3(–1.5)  $\mu\text{m}$  high, consisting of usually isolated spines, rarely connected, mostly acute, some broader and blunt, amyloid, supra-hilar spot distinct, amyloid. Pileocystidia abundant, 80–100  $\times$  (3.5–)4.5–7.0  $\mu\text{m}$ , frequently with a septum, cylindrical or narrowly clavate, contents granular. Hyphae of cutis 2.5–5.0 (–7.0)  $\mu\text{m}$  broad, mostly  $\pm$  cylindrical, rarely inflated up to 7.0  $\mu\text{m}$  wide.

Habitat - Terrestrial in roadside verges planted with *Quercus* on nutrient-poor sandy soil.

*Collections examined.* Plot Q12, 18 Sept. 1988, Keizer 88144, Keizer 88145; Plot Q13, 23 July 1988, Keizer 88019; 7 Oct. 1988, Keizer 88156; Plot Q84, 1 Sept. 1986, Keizer 86128; 9 Oct. 1986, Keizer 86164.

For a discussion on the separating characters from *f. cicatricata* see under that taxon.

*Russula megacantha* Romagn. ad interim is, in agreement with Krieglsteiner (1987), considered a synonym, because the only reported difference, a slightly coarser and wider spore ornamentation, is not reliable since all kinds of transitions occur. Representative illustrations of *f. graveolens* were published by Marchand (1977: pl. 479), Einhellinger (1985: pl. 25) and Lange (1940: pl. 190A).

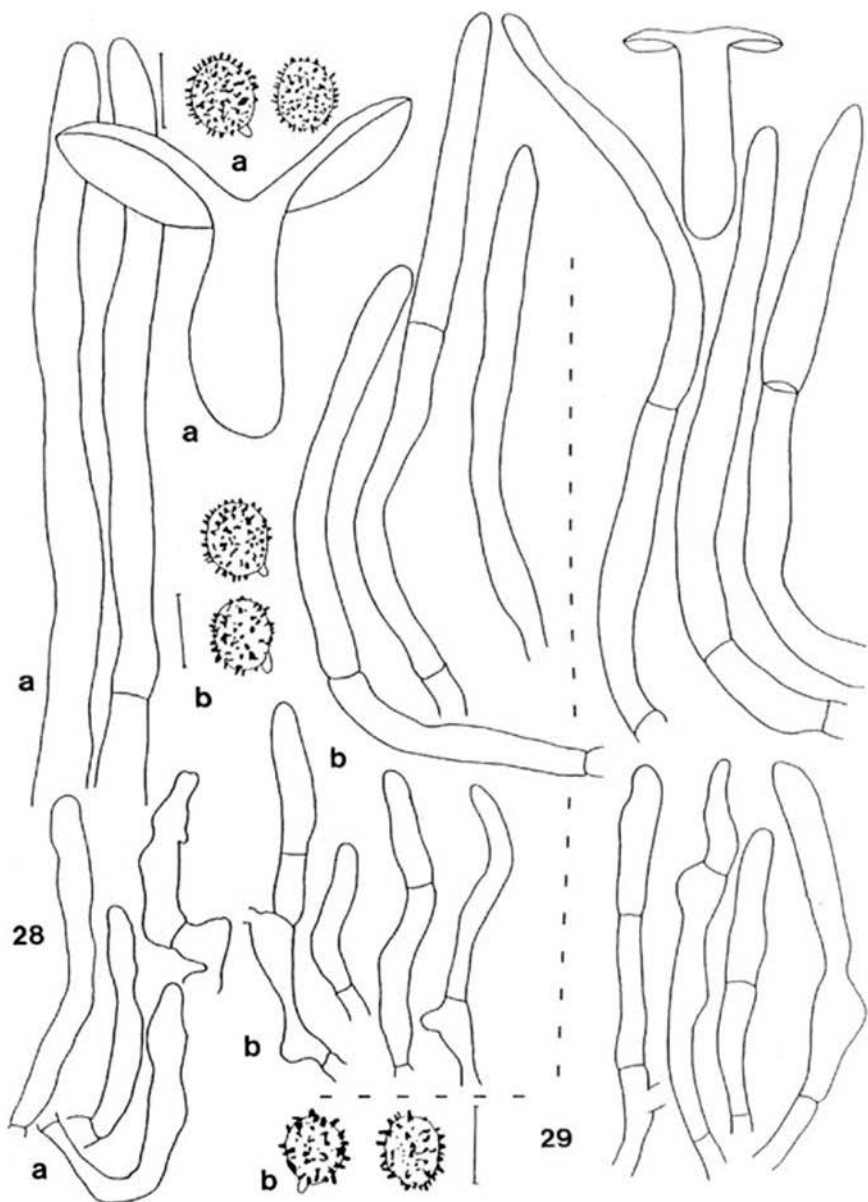


Fig. 28. *Russula graveolens* f. *graveolens*. Habit, spores, pileocystidia, and hyphae of pileipellis (a: 86164; b: 88019). — Fig. 29. *Russula graveolens* f. *purpurata*. Habit, pileocystidia, and hyphae of pileipellis (87186).

**Russula graveolens** forma **purpurata** (Crawshay) Keizer & Arnolds, *comb. nov.* —  
Figs. 27, 29

Basionym: *Russula purpurata* Crawshay, The spore ornamentation of *Russula* (1930) 103.

Pileus 33–45 mm, convex, then plano-convex, centre at most slightly depressed, deep purplish red or dark brownish purple (K. & W. 10F8 or Expo J62) with olive-brown tinge, towards the margin usually purplish red (K & W 10D8 or Expo E16), in one case more olive-brown (Expo J62), sometimes with yellowish spots, more or less viscid when moist, normally dull, almost velvety to minutely granular. Lamellae narrowly adnate, c. 2 mm broad, moderately crowded, not ventricose, occasionally forked, pale yellowish or cream-coloured. Stipe 23–40 × 9–13 mm, more or less cylindrical to clavate, white, base reddish at one side, on handling and with age brownish. Context white, remarkably firm, especially in stipe turning brownish. Smell rather weak, fish-like, as other members of the group. Chemical spot test: FeSO<sub>4</sub>: blue-green. Colour of spore print unknown.

Spores 8.5–9.4 × 6.5–7.5 μm, Q = 1.1–1.4, av. Q = 1.25, broadly ellipsoid, with up to (0.7–)1.2–1.3(–1.5) μm high ornamentation of usually isolated warts or spines, sometimes connected by lines, amyloid, suprahilar spot distinct, amyloid. Dermotocystidia cylindrical to narrowly clavate, up to 80–100 × 4–6(–8) μm, frequently with 1–2 septa, with granular contents. Hyphae of cutis 3–5 μm wide, more or less cylindrical, with frequent inflations up to 7–10 μm wide.

Habitat – Terrestrial in roadside verges planted with *Quercus* on nutrient-poor sandy soil.

*Collections examined.* Plot Q4, 4 Oct. 1987, Keizer 87228; Plot Q13, 22 Sept. 1987, Keizer 87186; Plot Q82, 24 Sept. 1988, Keizer 88344; Plot Q84, 9 Oct. 1986, Keizer 86165.

The delimitation of *Russula graveolens* f. *purpurata* and *R. amoenoides* Romagn. seems to be very weak: the only separating character is the dull, more or less pruinose cap in *amoenoides* and a more glabrous cap in f. *purpurata*. Einhellinger (1985) described the surface of the pileus of f. *purpurata* as 'distinctly dull'. We regard *R. amoenoides* as a synonym. This forma was well depicted in Einhellinger (1985: pl. 25).

**Russula parazurea** J. Schaeff. ex J. Schaeff.

Habitat – Terrestrial in roadside verges planted with *Fagus* or *Quercus* on nutrient-poor to moderately nutrient-rich sandy soil.

*Collections examined.* Plot F21, 19 Nov. 1986, Keizer 86270; Plot F22, 25 Nov. 1986, Keizer 86265; Plot F33, 19 Nov. 1986, Keizer 86269; Plot F41, 19 Nov. 1986, Keizer 86268; Plot Q5, 2 Aug. 1988, Keizer 88009; Plot Q71, 25 Nov. 1986, Keizer 86266.

*Russula parazurea* proved to be very variable with respect to colour and surface of the pileus, more so than generally acknowledged in literature. Typically, the pileus is dark blue-greenish grey and pruinose. Frequently, specimens with violet or brick-red (e.g. Expo F44, C43; like the colour of *Russula vesca*) pileus can be found. In direct sunshine the original colour may fade to shiny yellowish, buff or straw-colour. Late in the season, from November onwards, the cutis becomes cracked, more or less like *R. virescens*, and then shows often brownish or violaceous colours.

The grey sporocarps preferably grow on or along footpaths in forests or on other shady places. The brick-red variants seem to prefer open habitats. The cracked cutis is only observed in places where other forms have been found before, and is consequently considered as a variant, induced by low temperatures.

All variants are considered as caused by environmental conditions and hence without taxonomic significance.

The species is relatively constant in microscopical characters with as most important feature the spore ornamentation which consists of warts in rows or crests, connected with lines, forming a more or less closed network. Among the related species in the subsection *Griseinae* this species has the most obviously reticulate spore ornamentation. In addition, the dermatocystidia often show a characteristic subapical constriction. In the field the lack of any pink colour in the stipe and the yellowish cream colour of the lamellae may help the identification.

### **Tricholoma scalpturatum** (Fr.) Quél. var. **scalpturatum**

Habitat — Terrestrial in a roadside verge planted with *Quercus* on nutrient-poor sandy soil.

*Collection examined.* Plot Q14, 18 Sept. 1988, Keizer 88148.

We agree with Bon (1984) and Marchand (1986) to consider *Tricholoma scalpturatum* and *T. argyraceum* as different on the level of variety, the main separating character being the pale colour of the pileus in the latter. The microscopical features are more or less identical according to Bon (l.c.) and Marchand (l.c.). However, Moser (1978) gives different spore-sizes:  $5-6(-7) \times 3-4 \mu\text{m}$  and  $7-9 \times 4-5 \mu\text{m}$  respectively. The spores of this collection measure  $(4.1-4.2-4.8(-5.4) \times 2.8-3.2(-3.3) \mu\text{m}$ , and are somewhat smaller than the spore sizes cited above.

### **Tubaria furfuracea** (Pers.: Fr.) Gillet incl. **T. hiemalis** Bon, **T. romagnesiana** Arnolds

Habitat — Terrestrial in roadside verges planted with *Fagus* or *Quercus* on nutrient-poor or enriched sandy soil; with a preference for *Fagus*.

*Collections examined.* Plot F22, 16 Nov. 1988, Keizer 88320; Plot F24, 10 Nov. 1986, Keizer 86205; Plot F43, 10 Nov. 1986, Keizer 86204.

Kühner & Romagnesi (1953: 243) distinguish three 'small' species within *Naucoria furfuracea* s. lat., viz.: *Naucoria segestria*, *N. furfuracea*, and *N. pellucida*. Arnolds (1982) followed this concept, although doubting whether the specific rank is deserved here. He changed the names in *Tubaria furfuracea* s. str., *T. hiemalis* and *T. romagnesiana*. After our experience the diagnostic characters (shape of cheilocystidia: capitate or not; very slight differences in spore-size; width of the hyphae in the trama of the lamellae) show large overlap. Even within one single fruit-body cheilocystidia may be found either of the 'hiemalis'-type (capitate) or cylindrical-clavate or irregularly cylindrical. Therefore, we prefer to consider *Tubaria furfuracea* as one, rather variable, species.

## II. APHYLLOPHORALES

**Ramariopsis kunzei** (Fr.) Corner

Synonym: *R. tenuiramosa* Corner.

Carpophores solitary or gregarious, up to 25 mm high, sparsely to strongly branched with 3 to 50 tips in one carpophore, branches c. 1 mm thick, with rounded axils, dirty white-yellowish to pale brownish beige (Expo B64, A62), on drying paler, stipe slightly darker, minutely velvety, base tomentose. Smell indistinct. Spores in mass white.

Spores (3.5-)3.6-4.7(-4.8) × 3.0-4.2(-4.4) μm, Q = 1.0-1.3, av. Q = 1.13, globose, subglobose or broadly ellipsoid, finely echinulate, with one oil-drop. Clamp-connections present.

Habitat - Terrestrial in roadside verges planted with *Quercus* on nutrient-poor sandy soil.

*Collections examined.* Plot Q2, 14 Oct. 1988, Keizer 88234; Plot Q38, 22 Oct. 1988, Keizer 88244.

The carpophores found here could not be unambiguously assigned to *Ramaria kunzei* or *R. tenuiramosa*. The drawings of the habit by Corner (1950) of these species look rather different, but our collections include intermediate carpophores. Besides, he stated under *R. kunzei* (p. 642) that it is an extremely variable species. Maas Geesteranus (1976) is inclined to consider *R. tenuiramosa* a modification of *R. kunzei*. The two collections differ in spore-size: collection 88324 has spores of 3.5-4.0 × 3.0-3.4 μm, collection 88244 of 3.5-4.7(-4.8) × (3.0-)3.5-4.2(-4.4) μm. These values fall within the range given by Corner (l.c.) for *R. kunzei*.

## III. ASCOMYCETES

**Helvella cf. corium** (Weberb.) Masee

Ascocarp stalked-cupulate; excipulum 10 mm wide, grey to dark grey, villose-granulose, hymenium brown-black. Stipe 7 × 1.5 mm, cylindrical, somewhat paler than excipulum, grey, villose-granulose.

Spores 17.5-18.7 × 11.5-12.0 μm, ellipsoid, with one large oil-drop. Paraphyses 3.5-4.0 μm broad cylindrical, apical part enlarged, up to 7.0 μm, septate, apical cell 70-140 μm long, content diffuse greenish (in NH<sub>4</sub>OH 10%).

*Collection examined.* Plot F43, 6 Oct. 1988, Keizer 88230.

The ascocarp of our collection is not as dark as on plate 239 in Boudier (1905: 10).

**Helvella cupuliformis** Dissing & Nannf.

Ascocarp 25 mm high, stalked-cupulate, excipulum 18 mm broad, roundish, with margin strongly incurved, grey (Expo D81, D61), rugose-tomentose, hymenium dark brown-grey (H-J32, central part F64). Stipe 15 × 2.5 mm, towards the base broad (up to 8 mm) and partially split, ivory-white or cream-coloured, at apex tomentose, at base finely tomentose. Smell none.

Spores  $17.5-20.3 \times 10.3-11.3 \mu\text{m}$ , elliptical with one large oil-drop. Paraphyses  $3 \mu\text{m}$  broad, cylindrical but apical part irregularly enlarged, up to  $5 \mu\text{m}$ , contents pale greyish, under the microscope in  $\text{NH}_4\text{OH}$  10%. Hairs of excipulum multicellular, cells  $14-22 \times 14-17 \mu\text{m}$ , inflated.

*Collection examined.* Odoorn, Odoornerveen, 17 Sept. 1987, Keizer 87167.

This specimen has been named *H. cupuliformis* on account of the white stipe. The microscopic characters seem to be identical with *H. villosa*.

### **Otidea alutacea** (Bres.) Masec

Apothecia  $15-40 \text{ mm}$  broad and up to  $30 \text{ mm}$  high, irregularly cup-shaped, often more or less stalked, split at one side; excipulum pale brownish beige, alutaceous (Expo D63, but more greyish and somewhat paler or K. & W. 5D4), finely granulose; hymenium concolorous or a little more reddish.

Spores  $(12.0-12.3-15.0(-15.5) \times (5.7-6.0-6.5(-7.0) \mu\text{m})$ , ellipsoid, smooth, usually with two oil-drops, obliquely uniseriate. Asci  $160-200$  (or more)  $\times 9.0-12.5 \mu\text{m}$ , cylindrical; paraphyses  $2-3 \mu\text{m}$  thick, apical part slightly thicker, curved, sometimes slightly lobed.

*Collections examined.* Plot Q32, 3 Oct. 1988, Keizer 88220; Plot Q83, 8 Sept. 1988, Keizer 88178.

The specimens studied agree well with the plates in Boudier (1905-1910: pl. 327), Bresadola (1927-1933: pl. 1228-2), Breitenbach & Kränzlin (1981: pl. 60), Dennis (1978: pl. 8B), but not so well with the illustration in Phillips (1981: 270), which looks like *O. concinna* (Pers.) Sacc. on account of the yellow colour present in the excipulum. However, the spores are given as  $12-15 \times 6-7 \mu\text{m}$ , which is in agreement with the spore-size given above for *O. alutacea*. The spores of *O. concinna* as reported by Maas Geesteranus (1967) are smaller:  $9.8-11.8 \times 5.4-5.8 \mu\text{m}$ .

### **Otidea bufonia** (Pers.) Boud.

Apothecia up to  $40 \text{ mm}$  broad and high, irregularly cup-shaped and deeply split at one side, indistinctly stalked; excipulum dark brown (Expo H32 - J21), finely velvety; hymenium darker than excipulum, blackish brown (J41 but darker).

Spores  $13.4-15.6 \times 5.8-7.2(-7.9) \mu\text{m}$ , ellipsoid, smooth, with two oil-drops, obliquely uniseriate; asci  $150-200$  (or more)  $\times 9-12 \mu\text{m}$ , cylindrical; paraphyses  $2-3 \mu\text{m}$  broad, apically enlarged up to  $4 \mu\text{m}$  broad and slightly bent or straight, septate with cells of  $15-40 \mu\text{m}$  long.

*Collections examined.* Plot F44, 8 Sept. 1988, Keizer 88177; Plot Q22, 13 Oct. 1988, Keizer 88358; Plot Q83, 10 Sept. 1986, Keizer 86138.

Among the large, dark brown species of *Otidea* described in literature, two species are found, one with large and one with smaller spores. Three names seem to be available for them: *Otidea bufonia*, *O. cochleata* and *O. umbrina*. The description of *Peziza umbrina* in Persoon (1801) is very short: "*magna cespitosa contorta umbrina*". Boudier (1905-1910) and Bresadola (1927-1933) used the name *O. umbrina* for the small-spored taxon (spores



15–16 × 7–8 µm and 14.7–17 × 6.5–8 µm respectively). However, Dennis (1978) and Maas Geesteranus (1967) mentioned *O. umbrina* as a (possible, Maas Geesteranus) synonym under the large-spored *O. cochleata* (spores 16–18 × 7–8 µm and 17.7–20.7 × 9.9–10.8 µm respectively). It is clear that Persoon's very briefly described *P. umbrina* variously has been interpreted and in the absence of authentic material better can be regarded as a *nomen dubium*. The material found during the present study fits well with the small-spored species and is therefore called *Otidea bufonia*.

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GYROPORUS AMMOPHILUS, A NEW POISONOUS BOLETE  
FROM THE IBERIAN PENINSULAM.L. CASTRO<sup>1</sup> & L. FREIRE<sup>2</sup>

*Gyroporus ammophilus*, a poisonous bolete occurring in *Pinus* woods on sandy soils along the western Atlantic coast of the Iberian Peninsula, originally published as a variety of *G. castaneus*, is formally raised to the rank of species. The distinguishing characters of *Gyroporus ammophilus* are given against *G. castaneus* (Bull.: Fr.) Quéf. The new species causes severe gastroenteritis when consumed.

Along the Atlantic coast of the Iberian Peninsula a bolete has frequently been collected that initially has been identified as *Gyroporus castaneus* (Bull.: Fr.) Quéf. However, neither the shape nor the colour of the pileus fit well with the original description (Quélet, 1886), nor with later descriptions by modern authors such as Watling (1970), Gründ & Harrison (1976), Moser (1983), and Alessio (1984). Moreover, several habitual consumers of the edible *Gyroporus castaneus* suffered from strong and long-lasting gastroenteritis (during 6 to 8 days), some hours after they have ingested specimens of this unknown bolete.

A microscopic study of a few specimens proved that our collections were very similar to *Gyroporus castaneus*. After consulting Dr. Alessio, we decided therefore to publish our material on the rank of variety as *G. castaneus* var. *ammophilus* (Castro & Freire, 1989).

However, the analysis of a great number of additional samples, from different populations and during several years, revealed that the shape and size of pleuro- and cheilocystidia, as well as size of the spores differ significantly from those of *Gyroporus castaneus*. Moreover, ammonia applied to the cap cuticle of our taxon produces a positive reaction (reddish brown after 5 min.), in contrast to *Gyroporus castaneus* which does not show any reaction with this reagent. Table I gives a comparison of the diagnostic characters of both species.

The ecology of our taxon is constant as it has always been found along the Atlantic coast on fixed dunes in association with *Pinus* spp., or, less frequently with other trees and shrubs, such as *Quercus suber* and *Cistus salviaefolius*, on sandy soils with great lixiviation and basic pH (up to 9 in water).

For all these reasons we propose here that our material should be considered a species of its own right, different from *Gyroporus casta*, typical of the Atlantic-Mediterranean region of the Iberian Peninsula.

***Gyroporus ammophilus*** (Castro & Freire) Castro & Freire, *comb. & stat. nov.* — Fig. 1

Basionym. *Gyroporus castaneus* var. *ammophilus* M.L. Castro & L. Freire, *Anales Jard. Bot. Madrid* 45 (1989) 549 (as '*ammophilus*').

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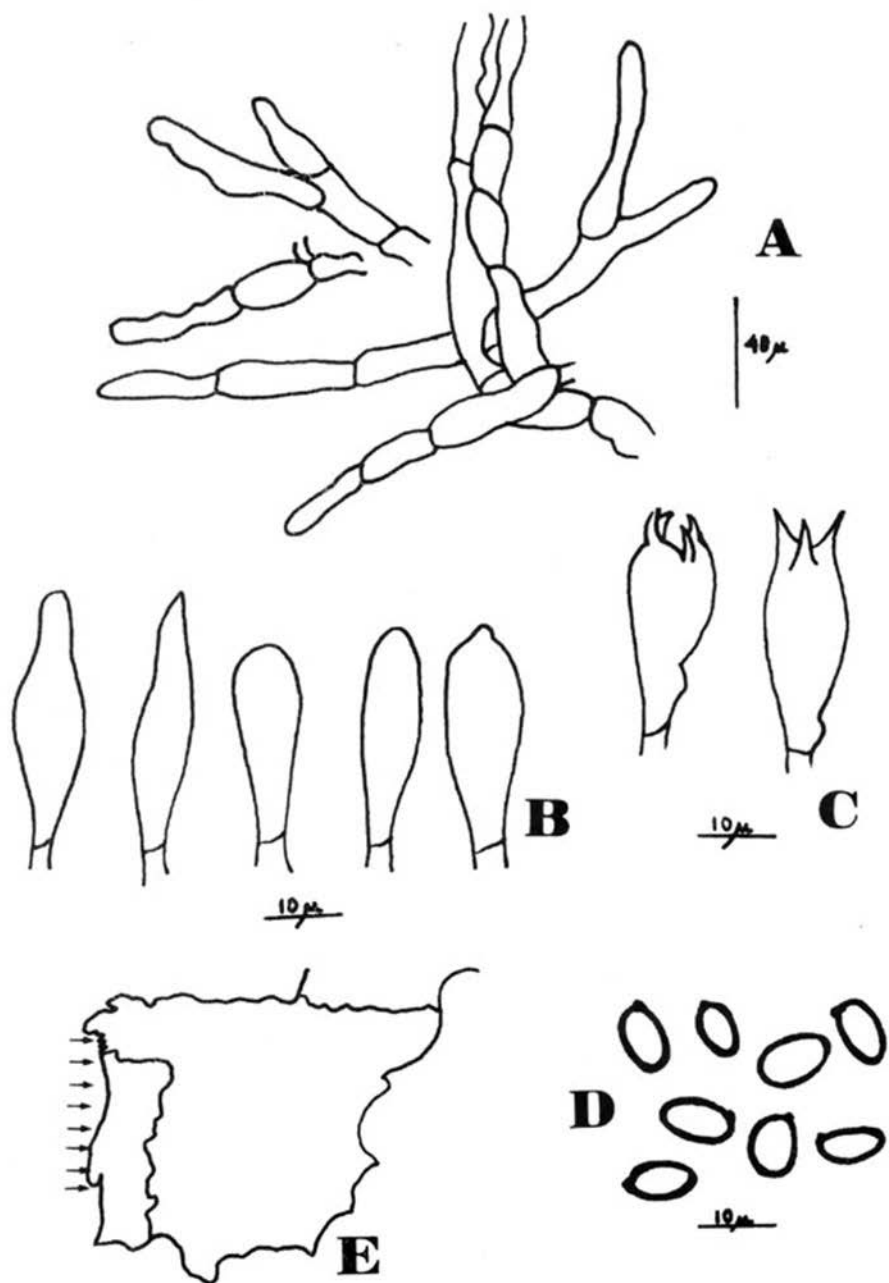


Fig. 1. *Gyroporus ammophilus*. A. Cuticle hyphae; B. cystidia; C. basidia; D. spores; E. distribution map.

Table I. Comparison of the diagnostic characters of *Gyroporus castaneus* and *G. ammophilus*.

	<i>G. castaneus</i>	<i>G. ammophilus</i>
Cap	cinnamon to brown, up to 10 cm in diameter	salmon-colour to brown, up to 15(-20) cm in diameter
Stem	brown, solid, then cavernous, finally hollow	salmon-colour, finally brown, solid soon hollow
Tubes and pores	white to straw-colour	salmon to straw-colour, becoming brown in young specimens
Flesh	white or cream-colour, immutable	salmon-colour to pinkish cream, finally bluish
Chemical reaction	cuticle NH <sub>3</sub> negative	cuticle NH <sub>3</sub> positive, reddish brown in 5 min.
Pleuro- and cheilocystidia	capitate or lageniform 25-35 × 5-8(-11) μm	capitate or lageniform, sometimes mucronate 25-30 × 8-11 μm
Spores	8-12(-14) × 4.5-6(-7) μm Q = 1.7-2	8.5-12 × 4-5.5(-6.5) μm Q = 2.1-2.2
Edibility	good	toxic, causing severe gastroenteritis
Habitat	broad-leaved forest, acid soil	coniferous forest, basic sandy soils

Cap up to 15(-20) cm broad, salmon-colour in young specimens, then brown with pink shades, dry, velvety in young specimens, glabrescent with age. Tubes 0.5 cm long, salmon or straw-colour, with concolorous pores, 3-4 per mm. Stem up to 25 cm long and 2 cm thick, irregular and very thick, salmon-colour, turning purple when bruised in young specimens, stuffed at first, but soon becoming hollow. Flesh salmon-colour, not changing colour in contact with air in younger stages, but changing to blue in mature specimens. Smell faint. Taste sweetish.

Spores 8.5-12 × 4-5.5(-6.5) μm, Q = 2.1-2.2, ellipsoid, slightly thick-walled, straw-coloured in water. Basidia 28-35 × 10-15 μm, 4-spored, clamped. Cheilo- and pleurocystidia 25-30 × 8-11 μm, clavate, sometimes mucronate or capitate. Clamp-connections present.

Chemical reactions - Cuticle of cap turns brown red after 5 min. with ammonia.

Habitat & Distribution - In coniferous or mixed coniferous/broad-leaved woods on sandy soil with basic pH, forming ectomycorrhiza with *Pinus* spp. and possibly also with some *Cistaceae* (*Cistus salviaefolius*), *Fagaceae* (*Quercus suber*) and *Ericaceae* (*Erica* spp., *Daboecia cantabrica*). Widely distributed along the Atlantic coast of the Iberian Peninsula, from the Ria de Arousa (Pontevedra, Spain) to the region of Setubal (Estremadura, Portugal).

Toxicity - Causing severe gastroenteritis which increases when consumed for the second time.

*Holotype*. M.L. Castro & L. Freire, Nov. 1986, Pontevedra, Cangas do Morazo, Barra, Spain (LOU-fungi 5862).

*Other collections studied*. PORTUGAL: Estremadura, Gambia, 13 Nov. 1991, *Castro & Freire* (LOU-fungi 5150). — SPAIN: Pontevedro, Vilanova de Arousa, O Terrón, 19 Nov. 1983, *Valdés-Bermejo* (LOU-fungi 1019); idem, 14 Dec. 1984, *Valdés-Bermejo* (LOU-fungi 1009); Cangas, Cabo Home, 22 Oct. 1983, *Diz & Grupo Micol. Porriño* (LOU-fungi 1010).

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NOTULAE AD FLORAM AGARICINAM NEERLANDICAM - XXIII  
**Psilocybe and Pholiota**

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While preparing the Strophariaceae for the Flora agaricina neerlandica, vol. 4, and the new edition of the 'Standaardlijst van Nederlandse Macrofungi' (Arnolds et al., 1995), the author decided to accept the generic concepts within the family as conceived by A. H. Smith (1979) and Kühner (1980) resulting in two genera: *Psilocybe* (comprising the genera *Psilocybe* s.str., *Stropharia*, *Hypholoma* or *Naematoloma*, and *Melanotus*), and *Pholiota*. This made the following new combinations and new taxa necessary.

**Psilocybe** subg. **Hypholoma** (Fr.) Noordel., *comb. & stat. nov.*

Basionym: *Agaricus* tribus *Hypholoma* Fr., Syst. mycol. 1 (1821) 11.

**Psilocybe** subg. **Melanotus** (Pat.) Noordel., *comb. & stat. nov.*

Basionym: *Melanotus* Pat., Ess. taxon. Hymenomyc. (1900) 175.

**Psilocybe** subg. **Stercophila** Romagn. ex Noordel., *subg. nov.*

*Stercophila* Romagn., Rev. mycol. 1 (1936) 36 (nom. nud., no Latin diagn.).

Basidiomata cum velo glutinoso sporis grandis. — Species typica: *P. semiglobata* (Batsch: Fr.) Noordel.

Basidiomata with glutinous veil and very large spores.

**Psilocybe** subg. **Stropharia** (Fr.) Noordel., *comb. & stat. nov.*

Basionym: *Agaricus* subg. *Stropharia* Fr., Summa Veget. 2 (1849) 295.

**Psilocybe** subg. **Stropholoma** (Sing.) Noordel., *comb. & stat. nov.*

Basionym: *Nematoloma* sect. *Stropholoma* Sing., Sydowia 2 (1948) 36.

**Psilocybe** sect. **Fasciculares** (Fr.) Noordel., *comb. & stat. nov.*

Basionym: *Agaricus* sect. *Fasciculares* Fr., Monogr. Hymenomyc. Succiae 1 (1857) 415.

**Psilocybe** sect. **Psilocyboides** (Sing.) Noordel., *comb. nov.*

Basionym: *Nematoloma* sect. *Psilocyboides* Sing., Sydowia 2 (1948) 36.

**Pholiota** subg. **Sordidae** (Sing.) Noordel., *comb. & stat. nov.*Basionym: *Pholiota* sect. *Sordidae* Sing., Sydowia 15 (1961) 79.**Psilocybe aeruginosa** (Curtis: Fr.) Noordel., *comb. nov.*Basionym: *Agaricus aeruginosus* Curtis, Cat. pl. London 2 (1774) pl. 309.**Psilocybe albonitens** (Fr.) Noordel., *comb. nov.*Basionym: *Agaricus albonitens* Fr., Monogr. Hymenomyc. Sueciae 1 (1857) 415.**Psilocybe aurantiaca** (Cooke) Noordel., *comb. nov.*Basionym: *Agaricus squamosus* forma *aurantiaca* Cooke, Handb. Brit. Fungi 2 (1883–1891) 199.**Psilocybe caerulea** (Kreisel) Noordel., *comb. nov.*Basionym: *Stropharia caerulea* Kreisel, Beih. Sydowia 8 (1980.'1979') 229.**Psilocybe capnoides** (Fr.) Noordel., *comb. nov.*Basionym: *Agaricus capnoides* Fr., Syst. mycol. 1 (1821) 289.**Psilocybe coronilla** (Bull.: Fr.) Noordel., *comb. nov.*Basionym: *Agaricus coronilla* Bull., Hist. Champ. Fr. 2 (1812) 633.**Psilocybe ericaeoides** (P.D. Orton) Noordel., *comb. nov.*Basionym: *Hypholoma ericaeoides* P.D. Orton, Trans. Brit. mycol. Soc. 43 (1960) 273.**Psilocybe fasciculare** (Huds.: Fr.) Noordel., *comb. nov.*Basionym: *Agaricus fasciculare* Huds., Fl. angl. 2 (1778) 615.**Psilocybe fasciculare** var. **pusilla** (J. Lange) Noordel., *comb. nov.*Basionym: *Hypholoma fasciculare* var. *pusilla* J. Lange, Dansk bot. Ark. 4 (4) (1923) 40.**Psilocybe halophila** (Pacioni) Noordel., *comb. nov.*Basionym: *Stropharia halophila* Pacioni, Trans. Br. mycol. Soc. 91 (1988) 579.**Psilocybe horizontalis** (Bull.) Vellinga & Noordel., *comb. nov.*Basionym: *Agaricus horizontalis* Bull., Hist. Champ. Fr. 2 (1812) 573.**Psilocybe hornemanii** (Fr.) Noordel., *comb. nov.*Basionym: *Agaricus hornemanii* Fr., Observ. mycol. 2 (1818) 13.**Psilocybe inuncta** (Fr.) Noordel., *comb. nov.*Basionym: *Agaricus inunctus* Fr., Elench. fung. 1 (1828) 40.



**Psilocybe laeticolor** (F.H. Moeller) Noordel., *comb. nov.*Basionym: *Naematoloma laeticolor* F.H. Moeller, Fung. Faeroes 1 (1945) 192.**Psilocybe lateritia** (Schaeff.: Fr.) Noordel., *comb. nov.*Basionym: *Agaricus lateritius* Schaeff., Fung. Bavariae 4 (1774) 22.**Psilocybe magnivelaris** (Peck in Harriman) Noordel., *comb. nov.*Basionym: *Stropharia magnivelaris* Peck in Harriman, Alaska Series (1904) 44.**Psilocybe marginata** (Pers.: Fr.) Noordel. *comb. nov.*Basionym: *Agaricus marginatus* Pers., Observ. mycol. 1 (1821) 11.**Psilocybe melanosperma** (Bull. ex Pers.: Fr.) Noordel.Basionym: *Agaricus melanospermus* Bull., Hist. Champ. Fr. (1792) pl. 540, fig. 2.**Psilocybe philipsii** (B. & Br.) Vellinga & Noordel., *comb. nov.*Basionym: *Agaricus philipsii* B. & Br., Ann. Mag. nat. Hist. 17 (1878) 21.**Psilocybe pseudocyanea** (Desm.: Fr.) Noordel., *comb. nov.*Basionym: *Agaricus pseudocyaneus* Desm., Cat. pl. omises botanogr. Belgique (1823) 22.**Psilocybe radicosum** (J. Lange) Noordel., *comb. nov.*Basionym: *Hypholoma radicosum* J. Lange, Dansk bot. Ark. 4 (4) (1923) 39.**Psilocybe rugosoannulata** (Farlow ex Murrill) Noordel., *comb. nov.*Basionym: *Stropharia rugosoannulata* (Farlow ex) Murrill, Mycologia 14 (1922) 139.**Psilocybe semiglobata** (Batsch: Fr.) Noordel., *comb. nov.*Basionym: *Agaricus semiglobatus* Batsch, Elench. Fung. Contin. 1 (1783) 141, fig. 110.**Psilocybe squamulosa** (Massee) Noordel., *comb. nov.*Basionym: *Stropharia aeruginosa* var. *squamulosa* Massee, Trans. Br. mycol. Soc. 1 (1897) 73.**Psilocybe xanthocephala** (P.D. Orton) Noordel., *comb. nov.*Basionym: *Hypholoma xanthocephalum* P.D. Orton, Notes R. bot. Gdn. Edinb. 41 (1984) 586.

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## NEW NAMES IN PHOMA

G.H. BOEREMA<sup>1</sup>, J. DE GRUYTER<sup>2</sup> & M.E. NOORDELOOS<sup>3</sup>

The names of two species of *Phoma*, discussed in our recent papers (de Gruyter & Noordeloos, 1992 and Noordeloos et al., 1993) appeared to be illegitimate as later homonyms (Art. 64). Therefore the following new names are proposed as avowed substitutes.

### ***Phoma andigena*** Turkensteen, *nom. nov.*

= *Phoma andina* Turkensteen, Fitopatologia 13 (1978) 67; not *Phoma andina* Saccardo & Sydow, Annls mycol. 2 (1904) 170.

### ***Phoma opuntiae*** Boerema, de Gruyter & Noordeloos, *nom. nov.*

= *Phoma opunticola* Boerema, de Gruyter & Noordeloos in de Gruyter & Noordeloos, Persoonia 15 (1) (1992) 77 (as '*opunticola*'); not *Phoma opunticola* Spegazzini, An. Mus. nac. Hist. nat. B. Aires 6 (= IIa, 3) (Fg. Arg. novi v. crit.) (1899) 316. [There exists a *Phoma opuntiae* Ellis in Baker, Bull. S. Calif. Acad. 4 (1905) 57, but this is a nomen nudum and therefore has no nomenclatural standing as far as priority and homonymy is concerned.]

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Noordeloos, M.E., J. de Gruyter, G.W. van Eijk & H.J. Roelijmans, 1993. Production of dendritic crystals in pure cultures of *Phoma* and *Ascochyta* and its value as a taxonomic character relative to morphology, pathology and cultural characteristics. *Mycological Research* 97 (11): 1343–1350.

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## BOOKS RECEIVED BY THE RIJKSHERBARIUM LIBRARY

T.E. Brandrud, H. Lindström, H. Marklund, J. Melot & S. Muskos. *Cortinarius Flora Photographica*, Vol. 3. (Cortinarius HB Svamp Konsult, Matfors, Sweden. 1994.) Pp. 37, 60 col. pls. Price: approx. DM 120 excl. postage.

The third volume of this Flora presents another set of 60 coloured plates and descriptions of *Cortinarius* in Europe. The text part contains an update taxonomic arrangement of the plates, Errata and addenda to vol. 1 and 2, references to literature, a glossary of terms, and a rather extensive parts devoted to nomenclature and typification of species and subspecific taxa as well as a reevaluation of sectional names. New taxa are validly published in an appendix, followed by references and an index to all three volumes. It is very satisfactory to see that the present series continues, and is able to maintain its very high standard.

M.J. Carlile & S.C. Watkinson. *The Fungi*. (Harcourt Brace Academic Press, Sidcup, Kent, UK. 1994.) Pp. 482, numerous illust. Price: £ 24.95.

The authors present with this textbook an overview of mycology for students and researchers. After an introduction, the authors give a concise overview of fungal diversity, in which they stick to a rather conservative classification of fungi, including also the cellular and plasmodial slime moulds, which, according to recent insights, better can be regarded as separate phyla or classes in the kingdom of protocista. Further chapters are devoted to fungal cells and vegetative growth, spore dormancy and dispersal, genetic variation and evolution, saprotrophs and ecosystems, parasites and mutualistic symbionts, fungi and biotechnology. Each chapter contains classified references. In an appendage the classification of the fungal kingdom is given.

R. Courtecuisse & B. Duhem. *Les Champignons de France. Guide encyclopédique*. (Ecléctis. 1994.) Pp. 448, 160 col. pls. Price: Ffr. 179 (pocket size), Ffr. 299 (A4 size).

This field guide is available in two different sizes: a pocket edition, that is handy to take into the field, and a large-sized edition, suitable for the library. All together 1751 species have been depicted on 160 coloured plates, mainly higher basidiomycetes (Agaricales and Gastromycetes) and a few Aphylophorales (30 spp.) and Ascomycetes (46 spp.). The illustrations are of high standard, and in many cases fairly representative for the species. One of the very good facets of this book is the relative completeness in many genera. For example, 164 species of *Russula* have been depicted, 100 *Lactarius*-species, 62 *Hygrocybe*-species etc. The species descriptions are short, and contain only the characteristic macroscopical features. Distribution data are given, as well as the red-list status of many species. The book also contains chapters on mycology, the system used, and extensive keys, in which not only the depicted species are treated, but in addition some 1300 other taxa, so the total number of species treated is around 3000. Unfortunately the keys use

macroscopical characters only, which inevitably makes identification difficult, if not impossible in many cases, and additional literature must be consulted. The species concept tends to be rather narrow, and in some cases several species are keyed out and depicted that according to recent monographs belong to one and the same taxon. Despite these small shortcomings, this field guide will prove to be one of the best available in the French language.

J. Ginns & M.N.L. Lefebvre. *Lignicolous Corticioid Fungi (Basidiomycota) of North America. Systematics, Distribution, and Ecology*. Mycological Memoir no. 19. (APS Press, St. Paul. USA. 1993.) Pp. 247. Price: US \$ 58.-.

This publication offers an extensive checklist of all corticioid fungi known from North America listed in alphabetical order according to genera. The nomenclature has been based on recent monographs. For each entry the accepted name is given, followed by the basionym, synonyms, distribution, hosts, ecology, culture characteristics and references. The introductory contains a table listing genera, families, and orders used in this work. With a remark from the authors that it still is an unstable system, due to continuing research in this fairly heterogeneous group of fungi. The list of references contains 659 entries. Two indexes, a genus species index and species index facilitate the use of this book, that is an indispensable reference guide for all workers in the group of fungi concerned.

G. S. de Hoog & J. Guarro (Eds.). *Atlas of clinical fungi*. (Centraalbureau voor Schimmelcultures, P.O. Box 273, 3740 AG Baarn, The Netherlands & Faculty of Medicine, University at Rovira i Virgili, Reus, Spain. 1995.) Pp. 720, numerous line-drawings and black-and-white photographs. Price: c. Dfl. 120.- excl. postage and handling.

The Atlas of clinical fungi is the result of a close cooperation between the Centraalbureau voor Schimmelcultures at Baarn, the Netherlands and the Medical Faculty of the University at Rovira i Virgili, Reus, Spain. It treats over 120 pathogenic fungi and 190 opportunistic fungi, including species causing animal mycoses. All taxa are described and illustrated with line-drawings and light and electron microscopic photographs. References to taxonomic and clinical literature is made and keys are provided to such groups as black yeasts, coelomycetes and pathogenic species of *Aspergillus*, *Fusarium*, *Penicillium*, and other genera. In addition, the atlas contains chapters on techniques of isolation, culture, and identification, and forms as such a complete manual for medical and veterinary fungi. It is highly recommended for all workers in these fields, as well as for teaching purposes. Order forms are available at the CBS.

S. Isaac, J.C. Frankland, R. Watling & A.J.S. Whalley (Eds.). *Aspects of tropical mycology*. (Cambridge University Press. 1993.) Pp. 324, numerous line-drawings, maps and black-and-white photographs. Price: £ 50.- (US \$ 89.95).

This publication contains the proceedings of a symposium held by the British Mycological Society at the University of Liverpool, April 1992. It is opened by an address by Prof.

E.J.H. Corner, entitled "I am part of what I have met", which is a most interesting introduction for the rest of the book, which brings together all major groups of fungi in the tropics, covering topics like ecology, taxonomy, experimental mycology, and industrial mycology. The bundle offers therefore a very important résumé of research done in the tropics, and will certainly stimulate those interested in this aspect of mycology.

W. Jülich (Ed.). *Colour atlas of Micromycetes, consignment one*. (Gustav Fischer Verlag, Stuttgart, Jena, New York, 1994.) Pp. 53, 112 col. pls. Price: DM 110.- (by continuation order on the whole series only).

This new series aims to give in the form of a loose-leaf edition in annual consignments of 100 pp. and 60 coloured plates a reference work for 'Micromycetes'. As such it claims to fill a gap in literature, since identification keys for this group of fungi are said to be widely available, but photographic illustrations of many taxa are seemingly lacking. This first part is devoted to a number of taxa in Myxomycetes, here considered to belong to the Micromycetes, which is disputable. The photographs are generally of good quality. Although in brackets the maker of the photographs is indicated, the editor fails to indicate reference to descriptions, material and literature, which makes the work less valuable than it claims to be. To the opinion of the reviewer, this kind of atlases only can be really valuable if the illustrations should refer to original descriptions and herbarium material *cf.* cultures, deposited in an official and accessible herbarium or culture collection. As such, the excellent publication of Neubert *et al.*, 1993, discussed in *Persoonia* 15 (4) offers a much better reference book for Myxomycetes, combining excellent photography with keys, descriptions and references.

P.H. Kelderman. *Parasolzwammen van Zuid-Limburg, Nederland. Lepiota s.l. excl. Macrolepiota*. (Publicatiebureau Natuurhistorisch Genootschap van Zuid-Limburg, Groenstraat 106, 6074 EL Melick, The Netherlands, 1994.) Pp. 207, numerous line-drawings. Price: Dfl. 80.- incl. postage.

Mr Kelderman is an esteemed amateur mycologist, who is mainly working in the area of South Limburg, a region rich in Lepiotaceous fungi which grow in the sun-lit thermophilous forests on calcareous loam present in the area. Also the mining activities in the area created waste-heaps, which are now abandoned and partly covered with scattered trees, which provide habitats for rare species of *Lepiota* s.l. After the introductory chapters on the habitats and the methods used, 61 species, 6 varieties and 1 forma are treated in the genera *Lepiota*, *Melanophyllum*, *Cystolepiota*, *Sericeomyces*, *Leucocoprinus* and *Leucogaricus*. All taxa are described in the form of lengthy descriptions and elaborate drawings of basidiocarps and relevant microscopical structures. Data are also given on ecology, distribution, and phenology. All species are keyed out in dichotomic keys, and at the end of the book distribution maps are given, a list of references, and an index to all treated taxa. The book is printed on recycled paper, which unfortunately lead to a poor reproduction of the beautifully designed illustrations. It is bound in hard-cover of good quality. Despite the Dutch language used, this book of high quality will certainly find its way in Europe to all (amateur) mycologists interested in this group of toadstools.

U. Kirschbaum & V. Wirth. *Flechten erkennen – Luftgüte bestimmen*. (Eugen Ulmer Verlag, Stuttgart. 1995.) Pp. 128, 74 col. figs., line-drawings and tables. Price: DM 19.80.

This guide to lichens is in fact an identification tool, with which the user is able to identify the epiphytic lichens used as bioindicators for mapping programs to estimate the degree of air pollution in certain areas. The booklet gives, after an introduction, chapters on the biology of lichens, methods for mapping lichens, collecting and identifying lichens, followed by identification keys and a descriptive part with very beautiful photographs of all taxa treated with descriptions and notes on ecology and sensibility for certain agents in the air. The book concludes with tables giving the colour reactions of all treated species with standard reagents.

M. Moser & W. Jülich. *Farbatlas der Basidiomyceten. Colour Atlas of Basidiomycetes, Lief. 12*. (Gustav Fischer Verlag, Stuttgart & New York. 1994.) Pp. 195, 60 pls. Price: DM. 92.-.

The twelfth issue of this loose-leaf atlas contains figures in colour of the genera *Polyporus*, *Boletus*, *Chroogomphus*, *Gomphidius*, *Hygrophoropsis*, *Leccinum*, *Tylopilus*, *Agaricus*, *Armillaria*, *Arrhenia*, *Camarophyllopsis*, *Camarophyllus*, *Campanella*, *Catathelasma*, *Clitocybe*, *Clitopilus*, *Conocybe*, *Coprinus*, *Cortinarius*, *Echinoderma*, *Entoloma*, *Fayodia*, *Haasiella*, *Hebeloma*, *Hygrocybe*, *Hygrophorus*, *Inocybe*, *Kuehneromyces*, *Laccaria*, *Lachnella*, *Lepiota*, *Leista*, *Leucoagaricus*, *Limacella*, *Lyophyllum*, *Macrolepiota*, *Marasmius*, *Mycena*, *Lactarius*, *Macowanites*, and *Russula*. The photographs are, as in all former issues of this rather useful series, of variable quality, some being very good, others rather poor.

R. Walley & J. Rammeloo. *The poisonous and useful fungi of Africa south of the Sahara*. (Scripta Botanica Belgica 10. 1994.) (National Botanic Garden of Belgium, Domein van Bouchout, B-1860 Meise.) Pp. 56. Price: BEF 370 postpaid.

This booklet is a compilation of literature on the toxicity, edibility, and miscellaneous uses by indigenous people, of the macrofungi in Africa south of the Sahara. As such it serves as a reference book and stimulant towards a better knowledge of poisonous African species and ethnomycology. Recommendations are given for future research, particularly considering the need of good revisions of important genera. The book contains two main parts, one treating the poisonous fungi, the second one useful fungi, including food, medicinal and religious purposes.

A. Zuccherelli. *I Funghi delle Pinete delle zone mediterranee*. (A. Longo, P.O. Box 431, 48100 Ravenna, Italy. 1994.) Pp. 377, 500 col. pls. Price: LIT 38,000.

This book, in the size of a field guide, offers an extensive source of information on the higher fungi that have been collected by the author and his collaborators during a ten-years period in the coastal pine forests of the Adriatic Sea near Ravenna. 500 species have been depicted in colour photographs of high quality, provided with short descriptions, all in Italian language. Many interesting Mediterranean taxa can be found in this book, which will therefore be of interest not only for those people living in the area, but also as a reference book for all mycologists interested in this group of fungi.