

NOTES ON CREPIDOTUS  
FROM MEXICO AND THE SOUTH-EASTERN USA

IRMGARD KRISAI-GREILHUBER<sup>1</sup>, BÉATRICE SENN-IRLET<sup>2</sup> & HERMANN VOGLMAYR<sup>1</sup>

Thirteen *Crepidotus* taxa collected in Mexico and the south-eastern USA are described and illustrated. One new infraspecific taxon of *C. croceitinctus* is proposed, var. *aurantiacus*. Type material of *C. ellipsoideus* and *C. occidentalis* has been re-examined.

The Systematics Agenda 2000 (Anonymus, 1994) is a fierce call to discover and describe the global species diversity. Many undescribed species still await detection especially among the fungi from tropical and subtropical regions. However, the situation is not the same in all genera, some as the genus *Crepidotus* (Fr.) Staude in the Americas are fairly well known due to the contributions of Singer (1973) and Hesler & Smith (1965). Recent investigations (Senn-Irlet & de Meijer, 1998; Bandala et al., 1999; Bandala & Montoya, 2000a, b) have contributed to a better understanding of the variability of several species and the identity with European material but have not revealed many new species. This study aims to add additional observations towards a predictive classification system in *Crepidotus*. Further, it is a small contribution to the knowledge of Mexican fungi and to the All-Taxa-Biodiversity-Inventory in the Great Smoky Mountains National Park, Tennessee and North Carolina, which is an extensive biodiversity project in the USA (Norvell, 1999; Kaiser, 1999). Two of us (IK and HV) could profit from an invitation to Mexico and the south-eastern USA in 1996, during which 18 collections of the genus *Crepidotus* were made, belonging to 13 taxa. Besides common species, like *C. applanatus*, some more rare taxa, e.g. *C. cinnabarinus*, were found and one new infraspecific taxon of *C. croceitinctus* is proposed.

MATERIALS AND METHODS

The microscopic structures were observed in dried material. Fragments of the carpophore were mounted in Congo red, heated and examined in 5% KOH. Per collection 20 spores were measured and the population limits estimated (see Senn-Irlet, 1995).

The macroscopic descriptions are from the first and third author, respectively; the first author provided colour slides of all collections, and the second author is responsible for the microscopic examinations and the identification. The material is kept in WU (Vienna University herbarium) and in TENN (University of Tennessee, Knoxville). Within the two subgenera the taxa are arranged alphabetically.

*Crepidotus* subgenus *Crepidotus*

*Crepidotus calolepis* (Fr.) P. Karst — Fig. 1

*Crepidotus calolepis* (Fr.) P. Karst., Bidr. Känn. Finl. Nat. Folk 32 (1879) 414.  
Selected literature: Senn-Irlet (1995).

1) Institute of Botany, University of Vienna, Rennweg 14, A-1030 Vienna, Austria.

2) Geobotanisches Institut der Universität Bern, Altenbergrain 21, CH-3013 Bern, Switzerland.

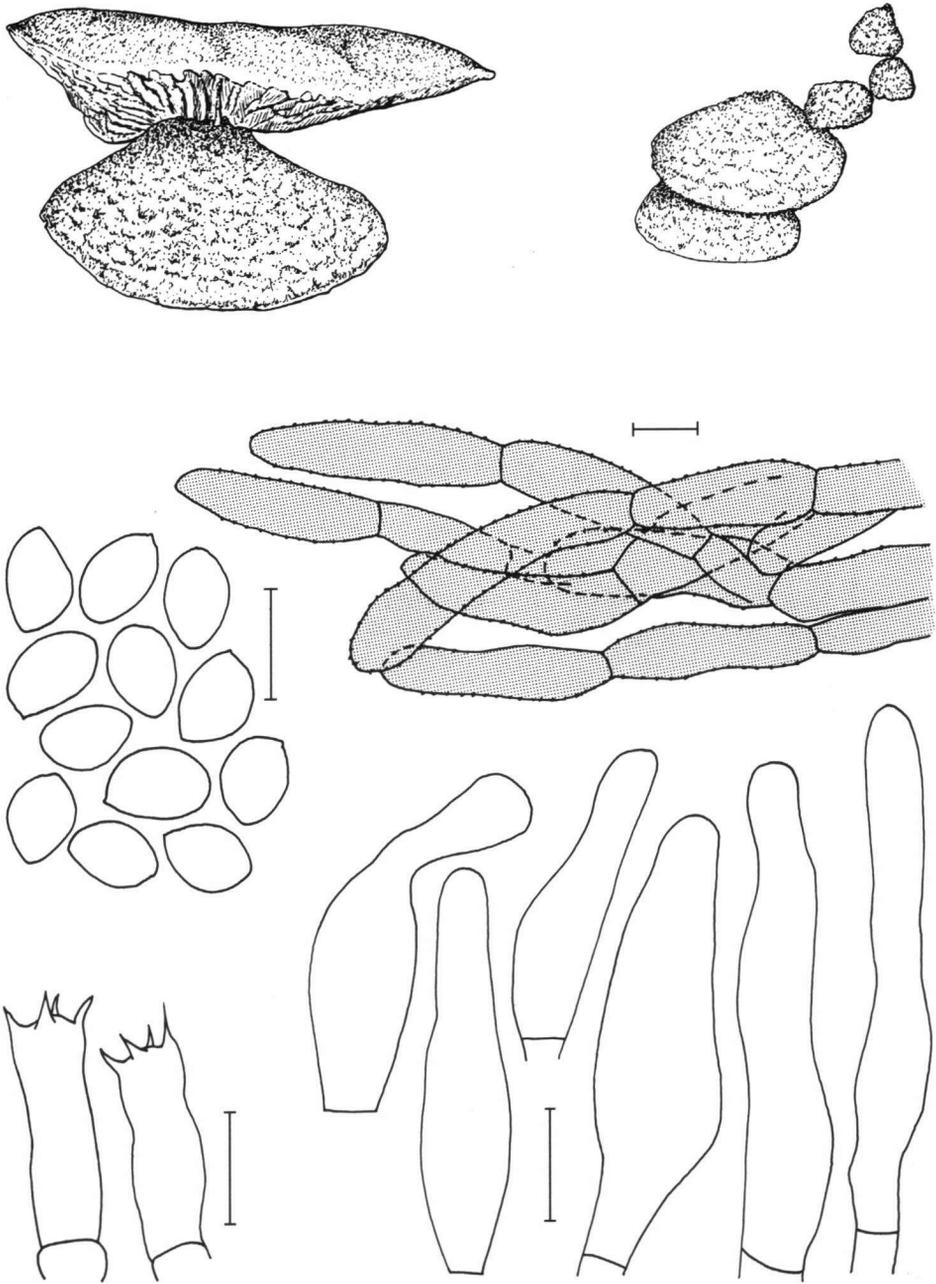


Fig. 1. *Crepidotus calolepis* (no. 6620). Carpophores, scale-forming hyphae, spores, basidia, and cheilocystida. Bar = 10  $\mu$ m.

Pileus 5–60 mm in diam., young nearly circular to semicircular, then appanate semi-circular to flabelliform, strongly hygrophanous, completely red-brown finely appressed scaly, scales lighter ochre when young, sometimes young only fine brownish fibrillose, when old and in wet weather conditions smooth, mat, macroscopically only with thin gelatinous layer, sometimes very water-soaked and then gelatinous layer not obvious, margin sharp, striate, young dirty yellowish, then ochraceous, golden-ochre, moist pale grey to ochraceous or ochre-brown, dry cream to ochre-yellow. Lamellae shortly decurrent to straightly adnate to deeply sinuate, ventricose, in normal distance to slightly crowded, with 1–3 lamellulae, young whitish to dirty cream or pale leathery brown, buff, later watery-cream, old dirty ochraceous to greyish brown, very old dark red-brown due to the mature spores; with lamellar edge concolourous or sometimes slightly brownish, smooth to finely denticulate. Stipe short or absent, not visible from above, cream, finely whitish tomentose to finely fibrillose. Context thin, watery, cream to whitish, smell none, taste mild.

Spores  $6.6\text{--}9.1 \times 4.5\text{--}6.2 \mu\text{m}$ ,  $Q = 1.3\text{--}1.6$ , av. vol. =  $119 \mu\text{m}^3$ , broadly ellipsoid to ellipsoid, smooth, thick-walled, strongly coloured ochre-brown. Basidia  $18\text{--}23(-28) \times 6\text{--}7.5 \mu\text{m}$ , 4-spored, clamps absent. Cheilocystidia  $27\text{--}50 \times 6\text{--}11 \mu\text{m}$ , narrowly conical or narrowly lageniform, more rarely cylindrical. Pileipellis scales formed by bundles of 7–13  $\mu\text{m}$  wide hyphae composed of botuliform short cells. Subpellis with a narrow band of filamentous, 2–3  $\mu\text{m}$  wide hyphae embedded in a gelatinous matrix. Lamellar trama towards the subhymenium with filamentous, slightly gelatinised hyphae, in the central part of short-celled, much wider hyphae, tending to form a jig-saw like structure. Pigment brown, encrusting and intracellular in scale-forming hyphae of the pileipellis.

Ecology — Saprotrophic, gregarious on rotten logs of *Quercus* in sclerophilous oak forest or mixed forest (*Quercus*, *Arbutus*, *Pinus*, *Juniperus*).

*Collections examined.* MEXICO: Federal State Mexico, El Ocotal, Chapa de Mota near Mexico City, 8 July 1996 I. Krisai-Greilhuber & H. Voglmayr no. 6615 & 6620 (WU 20098); *ibid.*, 9 July 1996 I. Krisai-Greilhuber & H. Voglmayr no. 6635.

When covered completely with red-brown scales as in coll. 6620 and with an elastic consistency, this species is easily recognised already in the field. However, the density of red-brown scales may vary greatly in this species, as in coll. 6615 where the coloured scales were hardly visible on the fresh watery carpophores, but distinctly visible in the microscopic examination.

Singer (1973), in his 'stirps mollis', tried to describe this great variation in thickness of the gelatinous layers, in the density of the brownish scales and in the shape pattern of the cheilocystidia with several species and infraspecific names. Coll. 6620 would key out under *C. calolepis* ssp. *tigrensis* var. *januarius*, and coll. 6615 under *C. variisporus*, however without the characteristic variable spore forms.

This group around *Crepidotus mollis* and *C. calolepis* is best recognised with a rather broad species concept. Species of this group show a world-wide distribution and are frequently found fruiting. Morphological studies of accidentally sampled carpophores seem hardly ever to give a sound classification. First results of molecular analyses of the genetic diversity of the large subunit of ribosomal DNA (Senn-Irlet & Hofstetter, 1996, plus unpublished results) show little variation, indicating a very close relationship at least of these analysed collections. Crossing experiments are still lacking.

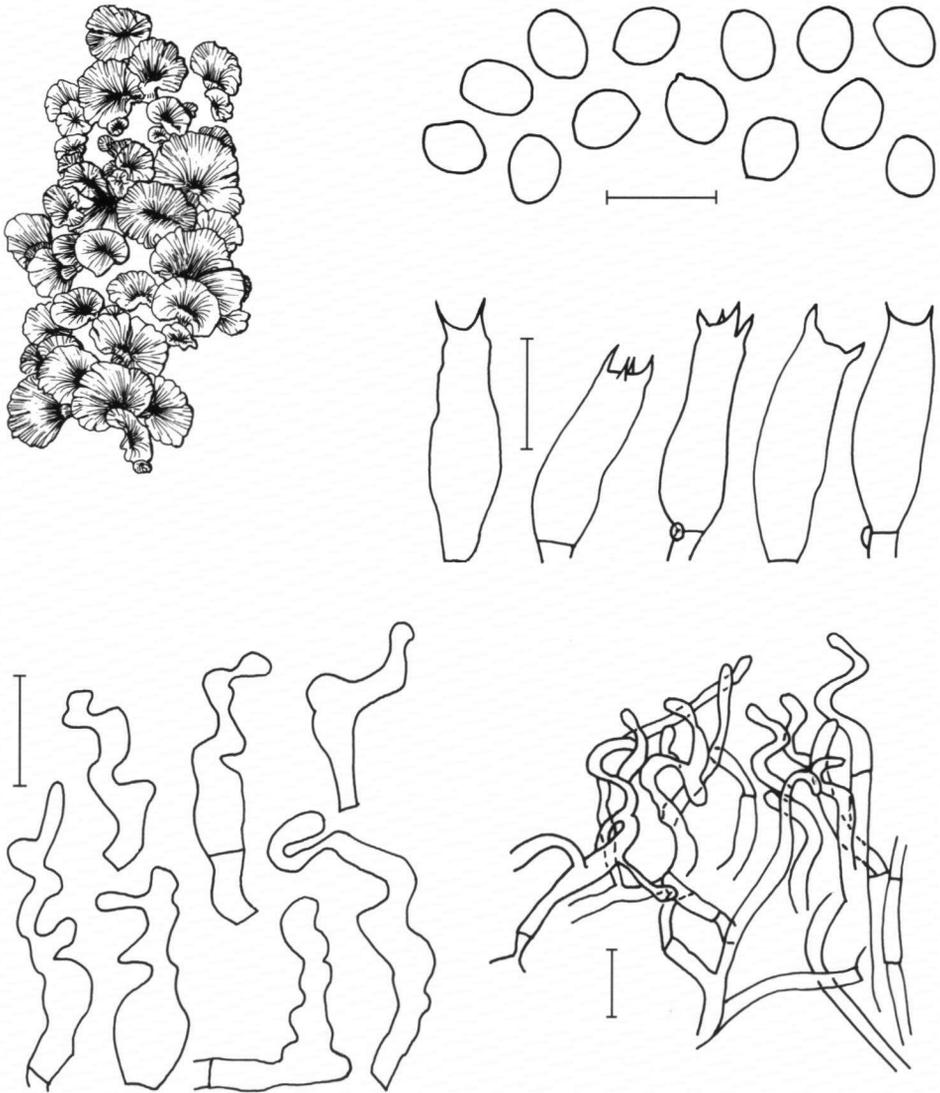


Fig. 2. *Crepidotus albidus* (no. 6522). Carpophores, spores, basidia, cheilocystida, and pileipellis. Bar = 10  $\mu$ m.

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

*Crepidotus* subgenus *Dochmiopus* (Pat.) Pilát, Atl. Champ. Eur. 6 (1948) 12.

#### *Crepidotus albidus* Ellis & Everh. — Fig. 2

*Crepidotus albidus* Ellis & Everh., Philadelphia Acad. Nat. Sci. Proceed. (1895'1894') 322.  
Selected literature: Bandala & Montoya (2000b).

Pileus 8–12 mm in diam., nearly circular, shell-shaped, kidney-shaped, regularly crenulate at the margin; white, finely tomentose hairy. Lamellae regular, crowded, narrow, with lamellulae, young white, soon pale grey-brown. Stipe absent. Context thin, smell none, taste mild. Spore-print dark chocolate brown (very dark for a *Crepidotus*).

Spores  $5.9\text{--}6.9 \times 4.7\text{--}5.6 \mu\text{m}$ ,  $Q = 1.1\text{--}1.3$ , av. vol. =  $88 \mu\text{m}^3$ , broadly ellipsoid, smooth, thick-walled, dark brown. Basidia  $17\text{--}21 \times 5.5\text{--}6.5 \mu\text{m}$ , 4-spored, clamped. Cheilocystidia  $18\text{--}30 \times 3\text{--}5 \mu\text{m}$ , cylindrical, strongly flexuous and contorted. Pileipellis a trichoderm with a turf of erect and contorted hyphae. Clamps rare. No pigment.

Ecology — Saprotrophic, gregarious on rotten branch of deciduous tree in subtropical mixed forest (mainly *Quercus*, *Pinus*).

*Collection examined.* MEXICO: Federal State Mexico, Nevada de Toluca, Temascaltepec, 5 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6522.

This species with small carpophores is easily recognised due to its microscopic characters: strongly contorted cheilocystidia and a trichoderm with similar contorted hyphae. This species is only known from the Americas (Hesler & Smith, 1965; Singer, 1973; Senn-Irlet & de Meijer, 1998).

### *Crepidotus applanatus* (Pers.) Kumm. var. *applanatus* — Fig. 3

*Crepidotus applanatus* (Pers.) Kumm. var. *applanatus*, Führ. Pilzk. (1881) 74.  
Selected literature: Senn-Irlet (1995).

Pileus 10–30 mm in diam., flat flabelliform or spatulate, margin first enrolled, distinctly striate, hygrophanous, from faintly marginally to strongly striate when moist, young whitish, old only near the stipe whitish to ivory, elsewhere dirty grey-brown to dirty buff, pale creamy grey, with faint pinkish tinge, translucent, smooth. Lamellae very crowded, sinuate, slightly ventricose, decurrent, dirty grey to concolorous to pileus, only slightly more brownish pink, lamellar edge white, denticulate. Stipe short, eccentric or rudimentary, not visible from above, ivory and hairy. Context thin, watery, concolorous, not gelatinous, whitish, smell none, taste mild.

Spores  $4.0\text{--}6.4 \times 3.9\text{--}6.3 \mu\text{m}$ ,  $Q = 0.94\text{--}1.1$ , av. vol =  $78 \mu\text{m}^3$ , globose, punctate-warty, rather thin-walled, rather pale brown. Basidia  $18\text{--}22 \times 5\text{--}6 \mu\text{m}$ , 4-spored, clamped. Cheilocystidia  $34\text{--}52 \times 6\text{--}10 \mu\text{m}$ , cylindrical, slightly lageniform, subcapitate. Pileipellis a cutis of rather broad  $8\text{--}13 \mu\text{m}$  wide hyphae, with scattered pileocystidia. Lamellar trama with rather inflated hyphae ( $14\text{--}20 \mu\text{m}$  wide) and with oleiferous hyphae. Clamps abundant in all parts of the carpophore. Pigment not observed in trama and pellis.

Ecology — Saprotrophic, gregarious on rotten logs of deciduous trees in mixed forests (*Pinus*, *Quercus*, *Rhododendron*, *Tsuga*, *Liriodendron*, *Toxicodendron*).

*Collections examined.* USA: North Carolina, Macon County, Nantahala National Forest, Blue Valley, 4 Aug. 1996, I. Krisai-Greilhuber & H. Voglmayr no. 7062 (WU 20097); Tennessee, Blount County, Great Smoky Mountains National Park, Abrams Creek, Little Bottoms Trail, c. 3 miles from Ranger Station, 28 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6915.

The two collections differ in spore size, best seen when expressed as the calculated mean spore volume:  $49 \mu\text{m}^3$  and  $107 \mu\text{m}^3$ . As has been shown by Senn-Irlet (1995) these represent extremes of values observed also in European collections.

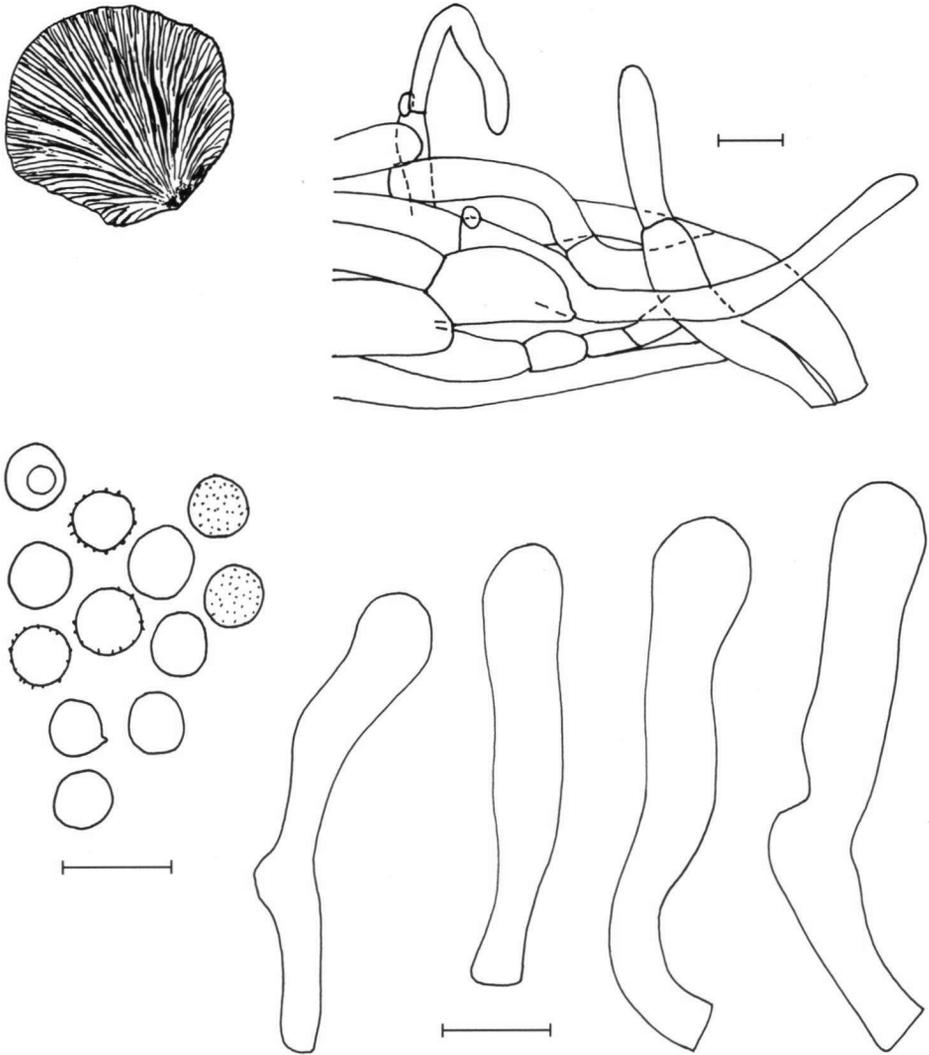


Fig. 3. *Crepidotus applanatus* (no. 6915). Carpophores, pileipellis, spores, and cheilocystidia. Bar = 10  $\mu$ m.

#### ***Crepidotus cinnabarinus* Peck — Fig. 4**

*Crepidotus cinnabarinus* Peck, Bull. Torrey Bot. Club 22 (1895) 489.

Selected literature: Luther & Redhead (1981), Cifuentes et al. (1989), Senn-Irlet (1995), Bandala & Montoya (2000a).

Pileus 8 mm in diam., pleurotoid, circular to flabelliform, cinnabarine, distinctly tomentose. Lamellae crowded, cream, lamellar edge straight, even and cinnabarine. Stipe absent. Context thin, whitish.

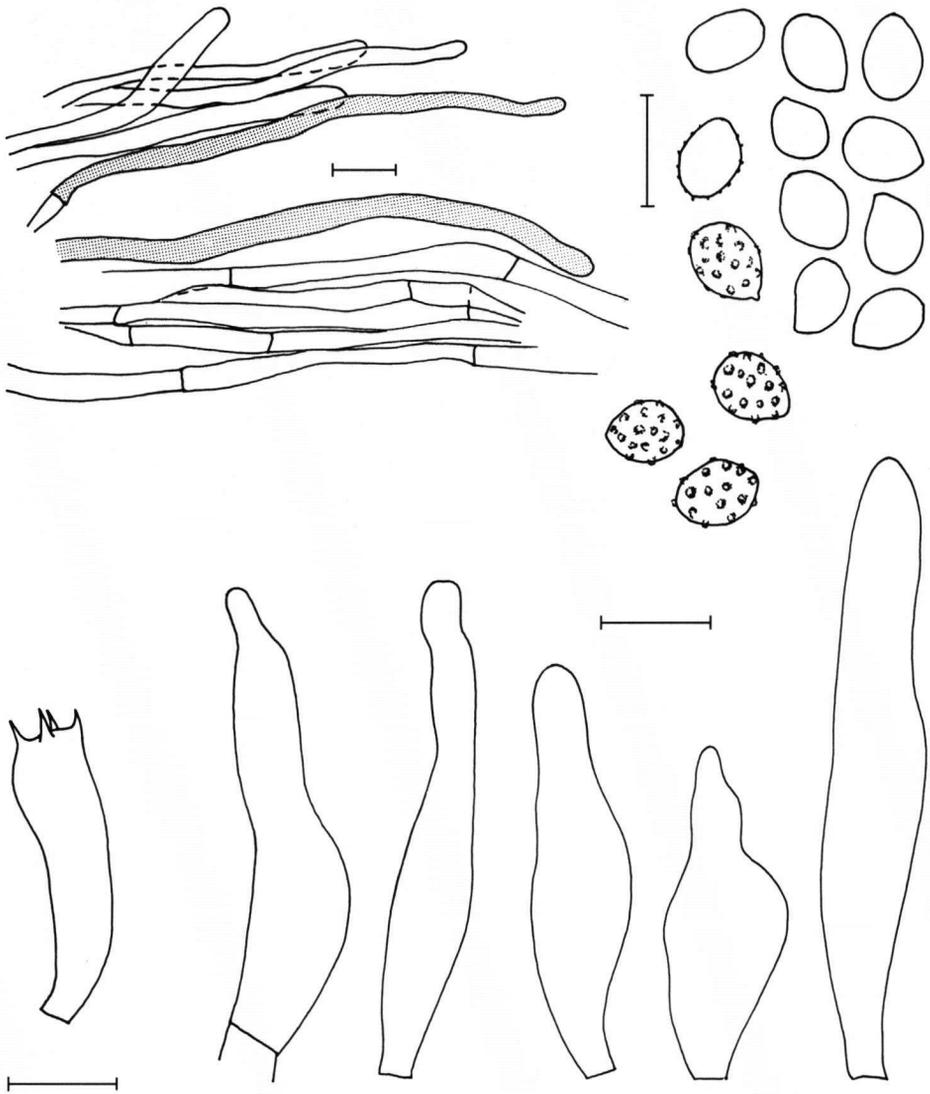


Fig. 4. *Crepidotus cinnabarinus* (no. 6678). Pileipellis, spores, basidium, and cheilocystidia. Bar = 10  $\mu\text{m}$ .

Spores 6.7–8.9  $\times$  5.2–6.4  $\mu\text{m}$ ,  $Q = 1.2\text{--}1.5$ , av. vol. = 139  $\mu\text{m}^3$ , broadly ellipsoid, marbled, medium dark brown. Basidia 25–31  $\times$  6.5–8  $\mu\text{m}$ , 4-spored, clamps absent. Cheilocystidia 31–58  $\times$  7–11  $\mu\text{m}$ , cylindrical, tapering. Pileipellis a transition between a trichoderm and a cutis. Clamps absent. Pigment red, intracellular, in hyphae of pileipellis and in cheilocystidia, dissolving in ammonia.

Ecology — Saprotrophic, solitary on rotten branch of *Quercus* (?) in a mixed oak forest (*Quercus*, *Pinus*, *Abies*).

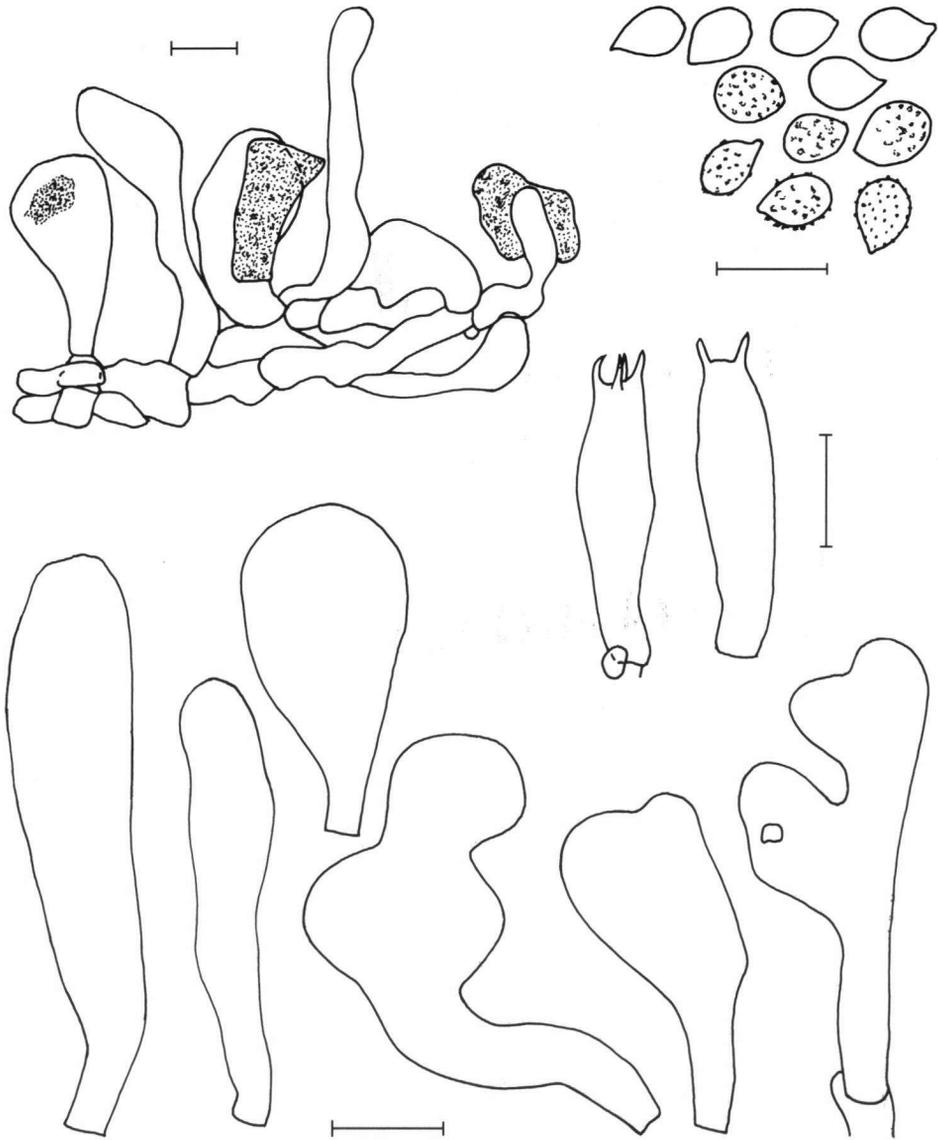


Fig. 5. *Crepidotus croceitinctus* var. *aurantiacus* (no. 6561). Pileipellis, spores, basidia, and cheilocystidia. Bar = 10  $\mu$ m.

*Collection examined.* MEXICO: Federal State Tlaxcala, Volcanic belt, City Tlaxcala E of Mexico City, 5 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6678 (WU 20096).

The cystidia are distinctly shorter than found in the scanned European material. Yet, with its striking colour, the absence of clamps and the dissolving pigment it is a very typical and distinctive species already known from Mexico (Bandala-Muñoz et al., 1988; Cifuentes et al., 1989).

**Crepidotus croceitinctus** Peck

*Crepidotus croceitinctus* Peck, Ann. Rep. N.Y. Stat. Mus. 39 (1886) 72.

Selected literature: Bandala & Montoya (2000a).

Short species characteristics (detailed descriptions see the varieties below). Pileus semi-circular, flabelliform, somewhat conchate, becoming plane, never white, with yellow, orange or buff colours. Spores not longer than 7.5 µm, globose to broadly ellipsoid, distinctly warty, in SEM verruculose (*C. carpaticus* type sensu Senn-Irlet, 1995); pileipellis a cutis with repent hyphae with often some scattered erect outgrowths or pileocystidia, at times with turfs of erect shorter hyphae. Cheilocystidia with or without excrescences, in the first case often di- to polymorphic, up to 14 µm broad.

## KEY TO THE VARIETIES OF CREPIDOTUS CROCEITINCTUS

- 1a. Pileus deep orange, pileipellis sharply separated from pileitrama, with amorphous clumps of yellow pigment . . . . . var. *aurantiacus*  
 b. Pileus buff to yellow, pileipellis not sharply separated from pileitrama, amorphous clumps of yellow pigment absent . . . . . var. *croceitinctus*

*Crepidotus croceitinctus* seems to be restricted to the Americas where it has been reported from Michigan, New York and Tennessee (Hesler & Smith, 1965), from Central America (Bandala & Montoya, 2000a) and from Argentina and Brazil (Singer, 1973; Senn-Irlet & de Meijer, 1998). The collections made during the present investigations showed some important differences from typical *C. croceitinctus*, which lead us to propose a new variety.

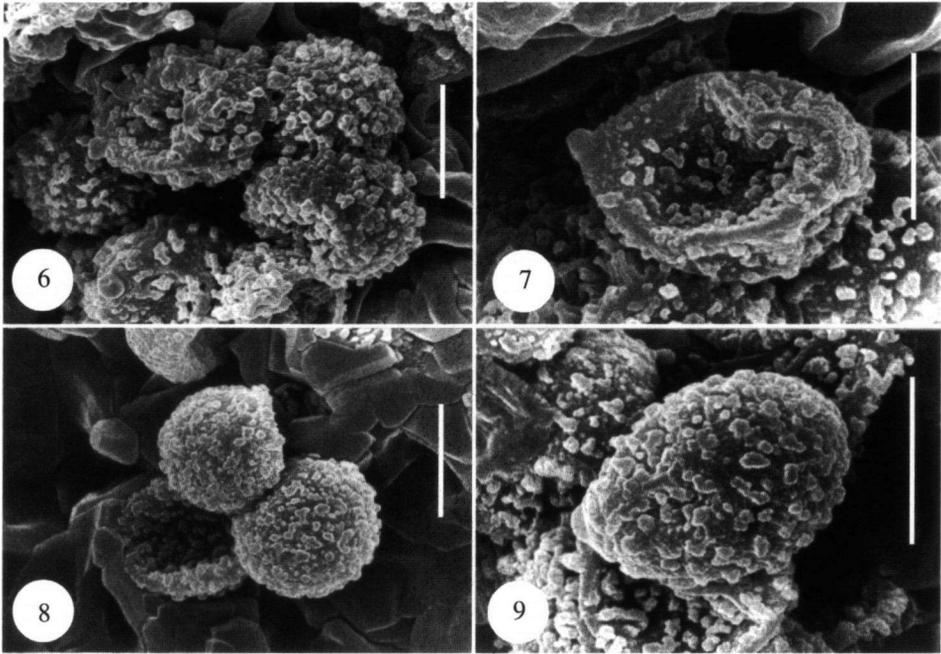
**Crepidotus croceitinctus** var. *aurantiacus*, var. nov. — Figs. 5–7, Plate 1

A typo differt pileo aurantiaco. In zona subtropicalis.

Holotypus: *I. Krisai-Greilhuber & H. Voglmayr 6561*, 6-VI-1996, Mexico, Mexico Federal State, Temascaltepec (WU 20093) (isotypus in TENN).

Pileus 20–70 mm in diam., pleurotoid, flabelliform, shell-shaped, young margin slightly striate, hygrophanous, fresh vividly yellow-orange, orange to brown-orange, old fading to greyish yellow, tomentose, upper side with white felty mycelium near point of attachment. Lamellae crowded, first cream yellow, then rusty orange. Stipe short, eccentric, later rudimentary or absent, cream yellow, then orange. Context thin, smell mouldy-sour, taste mild.

Spores 5.3–7.5 × 4.5–5.9 µm, Q = 1.0–1.5, av. vol. = 90 µm<sup>3</sup>, broadly ellipsoid, with faint suprahilar depression, distinctly warty, with warts visible in optical section and with myxosporium, in exsiccates easily collapsed, strongly coloured. Basidia 18–31 × 6–7.5 µm, 4-spored, clamped. Cheilocystidia 25–60 × (7–) 9–15.5 µm, clavate to broadly clavate, rarely broadly cylindrical or lageniform, almost vesiculose, rarely broadly cylindrical, sometimes apically depressed or even forked and branched, hyaline. Pileipellis sharply separated from the pileitrama, with a rather complex morphology, a transition between a cutis and a hymeniderm with many erect pileocystidia; hyphae rather short-celled, 5–12 µm wide. Pileocystidia variable, broadly clavate, narrowly lageniform to flexuous mixed with some filiform, cylindrical ones. Clamps abundant everywhere. Pigment yellow, brownish yellow, amorphous in water, as amorphous exudates around some pileocystidia or intracellular, membranous and scattered between the repent hyphae of the pileipellis, in addition locally finely encrusting.



Figs. 6–9. SEM pictures of basidiospores. — Fig. 6, 7. *Crepidotus croceitinctus* var. *aurantiacus* (no. 6483). Fig. 8, 9. *Crepidotus croceitinctus* var. *croceitinctus* (no. 6927). Bars = 3  $\mu$ m.

**Ecology** — Saprotrophic, gregarious on rotten twigs of deciduous trees in moist subtropical mixed forests (mainly *Pinus*, *Quercus*).

**Collections examined.** MEXICO: Federal State Mexico, Nevada de Toluca, Temascaltepec, c. 130 km W Mexico City, 6 July 1996, *I. Krisai-Greilhuber & H. Voglmayr* no. 6561 (WU 20093 - holotype, TENN - isotype). *ibid.*, c. 132 km W Mexico City, El Povador, 4 July 1996, *I. Krisai-Greilhuber & H. Voglmayr* no. 6483 (WU 20094).

The protologue of *Crepidotus croceitinctus* as well as the descriptions by Hesler & Smith (1965), Singer (1973), Bandala & Montoya (2000a) and others never mention such a deep orange to almost fulvous colour of the pileus. The abundance of pigment causing these intense colours is also seen in the microscopic analysis. The presence of such yellow exudates forming amorphous clumps is not mentioned in any of the studies mentioned. In other collections of *C. croceitinctus* previously examined (Senn-Irlet & de Meijer, 1998) no such yellow extracellular pigments have ever been observed.

In the type collection (no. 6561) the pileipellis structure is very well preserved and therefore we can emphasize for the first time the very special type of pileipellis within the genus *Crepidotus*. Even if Hesler & Smith (1965), Singer (1973) and in detail Bandala & Montoya (2000a) describe a more or less loose turf of erect hyphae mixed with some very undifferentiated pileocystidia, they do not mention such a unique type within the genus as found in our collections. The dense turf of variously shaped pileocystidia and the amorphous masses

of yellow pigment, sometimes encrusting the pileocystidia form a very well differentiated pileipellis. In our second collection (no. 6483) no amorphous clumps of yellow pigments were noticed beside still very obvious amounts of intracellular, membranous and finely incrusting yellow pigments. Nevertheless, we suggest that also this collection belongs to the same taxon on account of the other fully matching characters, especially the dense turf of pileocystidia.

As the colour and the structure of the pileipellis are so striking in our collections, we propose the status of a new variety. Further collections have to show if intermediate forms exist or whether this coloured form is better regarded as a species of its own.

### ***Crepidotus croceitinctus* var. *croceitinctus* — Figs. 8–10**

*Crepidotus subcroceitinctus* Hesler & A.H. Sm., N. Am. Sp. Crep. (1965) 139.

Pileus 5–40 mm in diam., semicircular, old nearly circular, kidney-shaped, shell-shaped, very flat, margins near point of attachment sometimes overlapping, near point of attachment whitish-cream, other parts vividly golden ochre, completely whitish to cream hairy-tomentose, hygrophorous, shortly and indistinctly striate when moist, very young upper side pale lemon yellow and margin enrolled, margin staying pale very long. Lamellae sinuate, ventricose, lamellar edge white denticulate, young pale lemon yellow, later vividly golden ochre with orange tinge (more vivid than pileus surface). Stipe short, 1–2 mm long, pale lemon yellow, soon sessile, young and old whitish tomentose. Context thin, paler watery cream, smell none, taste mild.

Spores 5.5–6.5 × 4.4–5.7 μm, Q = 1.0–1.3, av. vol. = 81 μm<sup>3</sup> (n = 22), globose to broadly ellipsoid, broadly ellipsoid, strongly warty, visible in optical section, easily broken, with strongly coloured walls. Basidia 21–26 × 6–7 μm, 4-spored, clamped, broadly clavate. Cheilocystidia 31–52 × 5–8 μm, cylindrical, flexuous, contorted, branched and antlerlike. Pileipellis a transition between a cutis and a trichoderm of repent 4–7 μm wide hyphae with some erect 10–20 × 3–5 μm filiform outgrowths. Pigment absent in pileitrama and lamellar trama. With scattered small crystals on some loosely repent hyphae of the pileipellis.

Ecology — Saprotrophic, gregarious on rotten trunk of a deciduous tree in a mixed forest (*Tsuga*, *Liriodendron*, *Pinus*, *Quercus*, *Rhododendron*).

Collection examined. USA: Tennessee, Blount County, Great Smoky Mountains National Park, Abrams Creek, Little Bottoms Trail, c. 3 miles off Ranger Station, 28 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6927 (WU 20095).

In a very accurate study Bandala & Montoya (2000a) give an emended description of *Crepidotus croceitinctus* based on type studies and collections from Mexico. The pileus colour of this rather variable species is described as ranging from yellowish white to egg-yellow. Another morphological character, the shape of the cheilocystidia, otherwise a very distinctive character in *Crepidotus*, seems to vary considerably from simple clavate to flexuous, contorted, or knobbed, circumscribed as dimorphic by Singer (1973). This variability has already been noted by several authors but only the comparative study of Bandala & Montoya (2000a) allowed for a comprehensive picture of this taxon which should include *Crepidotus subcroceitinctus*. Our collection shows a lamellar edge with a majority of flexuous, contorted cheilocystidia with some outgrowths.

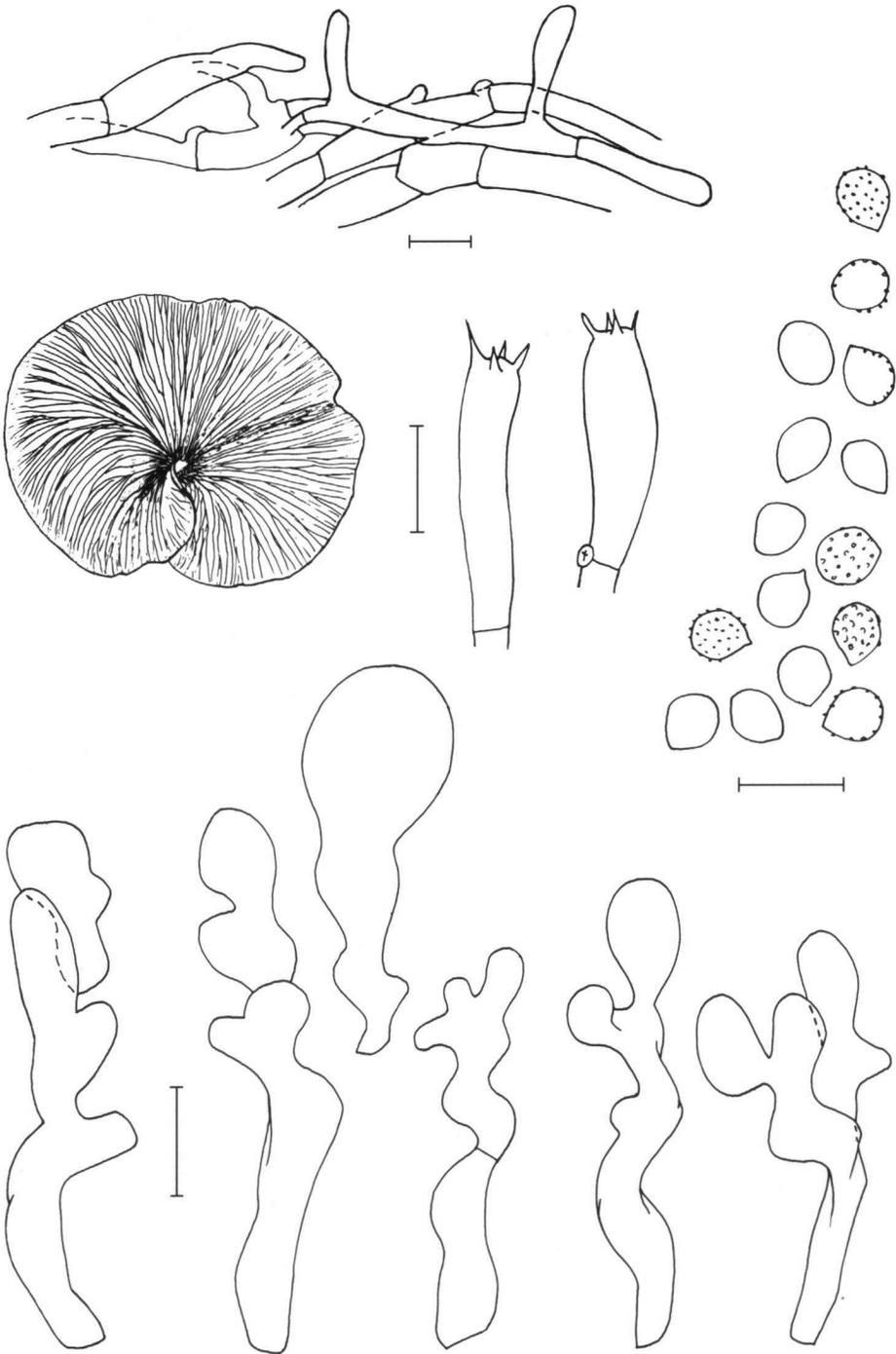


Fig. 10. *Crepidotus croceitinctus* var. *croceitinctus* (no. 6927). Pileipellis, carpophore, basidia, spores, and cheilocystidia. Bar = 10  $\mu$ m.

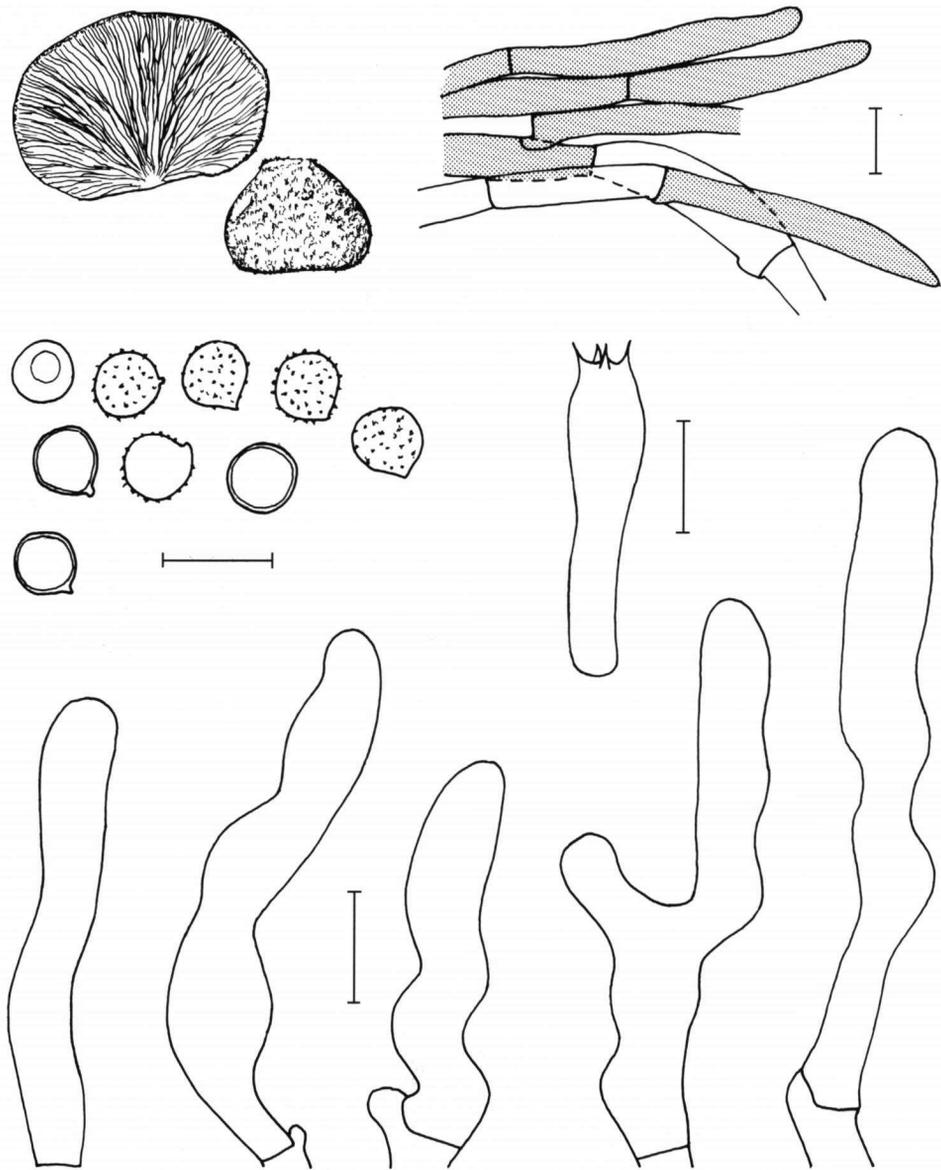


Fig. 11. *Crepidotus crocophyllus* (no. 7006). Carpophores, scale forming hyphae, spores, basidia, and cheilocystidia. Bar = 10  $\mu$ m

***Crepidotus crocophyllus* (Berk.) Sacc. — Fig. 11**

*Crepidotus crocophyllus* (Berk.) Sacc., Syll. Fung. 5 (1887) 886.

Selected literature: Senn-Irlet (1995).

Pileus 10–90 mm in diam., pleurotoid, circular, heart- to kidney-shaped, pale pinkish brown with fine fibrillous orange- to red-brown scales, hygrophanous, margin distinctly

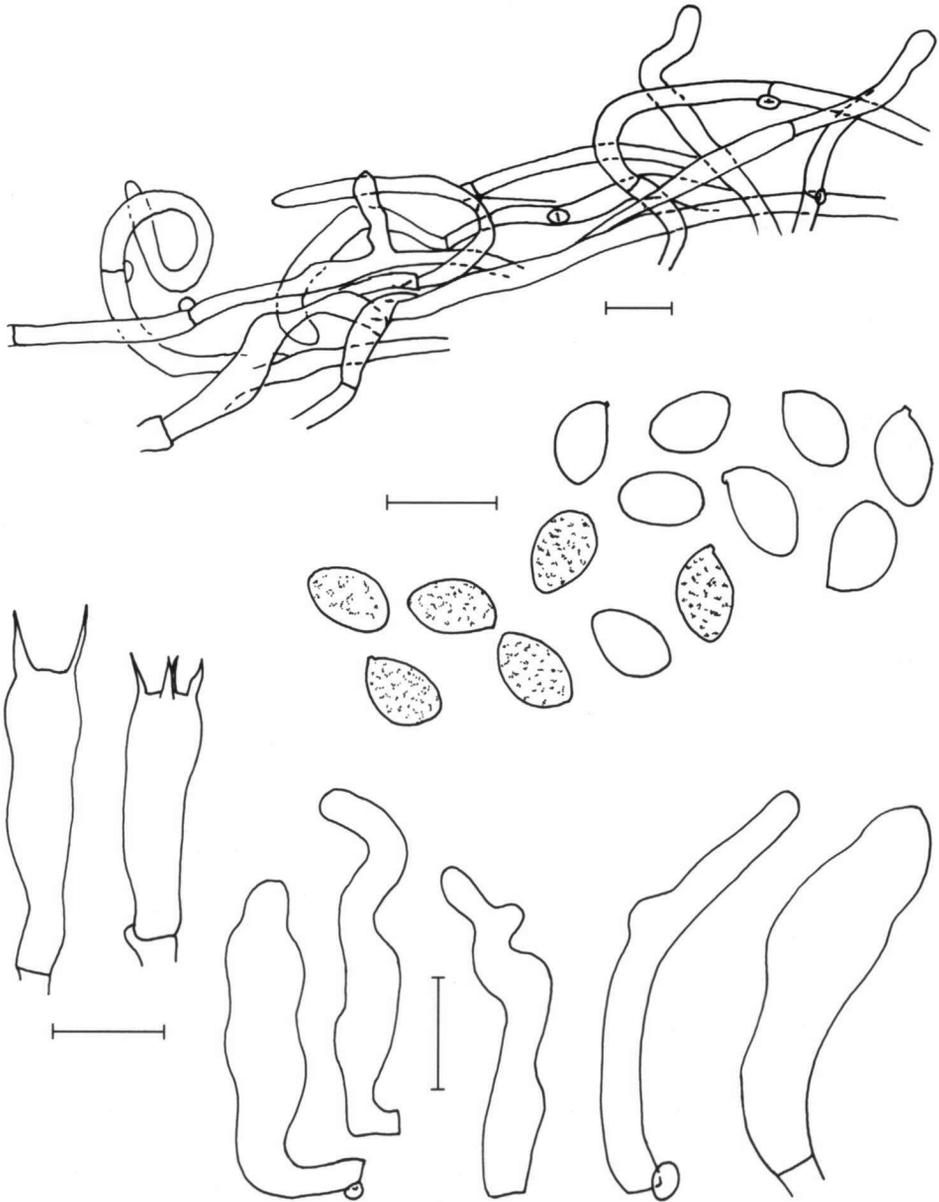


Fig. 12. *Crepidotus furcatus* (no. 6523). Pileipellis, spores, basidia, and cheilocystidia. Bar = 10  $\mu\text{m}$ .

enrolled and smooth, heavily striate, mat, not gelatinous, above point of attachment finely tomentose. Lamellae slightly crowded, dirty orange to grey-ochre, lamellar edge straight, concolorous. Stipe absent. Context thin, concolorous to pileus, smell none, taste mild.

Spores 5.5–6.8  $\times$  5.4–6.7  $\mu\text{m}$ ,  $Q = 0.95\text{--}1.1$ , av. vol = 120  $\mu\text{m}^3$ , globose, punctate-warty, rather thin-walled, rather pale brown. Basidia 26–33  $\times$  5–6  $\mu\text{m}$ , 4-spored, clamped.

Cheilocystidia 38–61 × 6–12 µm, cylindrical, rarely lageniform, flexuous, in both collections a few branched. Pileipellis a cutis covered with dense trichodermal clusters of coloured scales with undifferentiated, 40–60 × 6–8 µm terminal cells. Clamps abundant everywhere. Pigment golden brown, parietal and in addition encrusting, present in the scale-forming hyphae and at times in the subhymenium.

Ecology — Saprotrophic, gregarious on rotten logs of deciduous trees in mixed forests (*Liriodendron*, *Quercus*, *Tsuga*, *Pinus*).

*Collections examined.* USA: Tennessee, Blount County, Great Smoky Mountains National Park, Cades Cove, 2 August 1996, I. Krisai-Greilhuber & H. Voglmayr no. 7006; *ibid.*, Abrams Creek, Little Bottoms Trail, c. 3 miles off Ranger Station, 28 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6928 (WU 20099).

The orange colours of the scaly pileus and the orange lamellae make this a rather easy recognisable species. The shape of the cheilocystidia seems to be more variable than in the type collection. While the holotype shows only rather simple cylindrical cheilocystidia of 30–50 × 6–8 µm, the two presented collections exhibit both at least some branched cheilocystidia, as has been observed in some European collections as well, where also subcapitate forms have been encountered.

The species is of scattered occurrence throughout the northern hemisphere.

### ***Crepidotus furcatus* Hesler & A.H. Sm. — Fig. 12**

*Crepidotus furcatus* Hesler & A.H. Sm., N. Am. Sp. Crep. (1965) 115 [Figs. 12, 13 (holotype of *C. ellipsoideus*)].

Selected literature: Hesler & Smith (1965).

Pileus 15–30 mm in diam., circular to undulating-wavy, young off-white, old pale cream, surface tomentose to finely villose. Lamellae crowded, pale pinkish brown. Stipe absent. Context thin, smell spicy, taste mild.

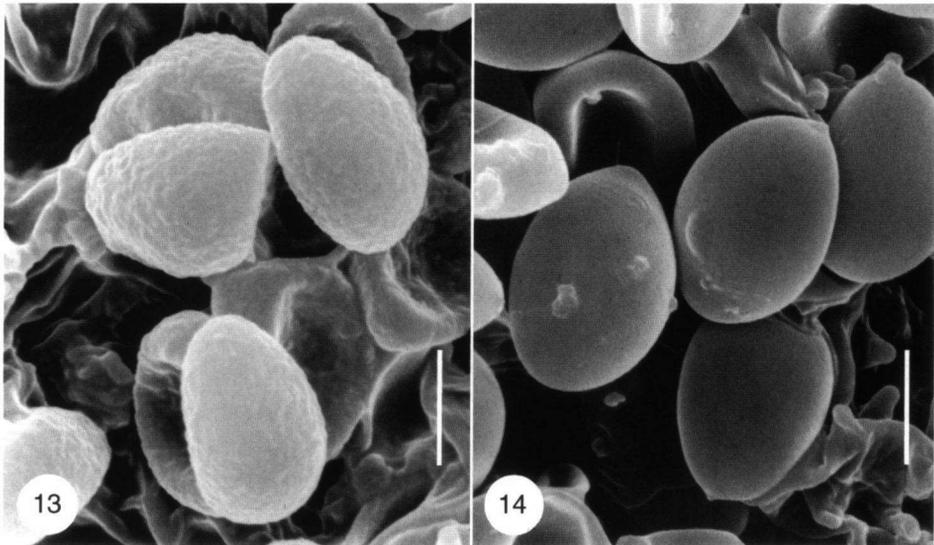
Spores 7.1–9.2 × 4.7–6.3 µm, Q = 1.3–1.7, av. vol. = 130 µm<sup>3</sup>, ellipsoid, with a faint supra-hilar depression, faintly ornamented, marbled, rugulose-verruculose, rather thin-walled with faintly coloured walls. Basidia 23–29 × 7–9 µm, 2- and mixed 4-spored, clamped. Cheilocystidia 23–35 × 6–12 µm, cylindrical, contorted, rarely angled, broadly clavate and flexuous. Pileipellis a transition between a cutis and a trichoderm with crooked and bent hyphae and undifferentiated terminal cells. Pileitrama regular. Clamps abundant. Pigment not present.

Ecology — Saprotrophic, gregarious on rotten trunk of a deciduous tree in a broad-leaved subtropical oak forest.

*Collection examined.* MEXICO: Federal State Mexico, Nevada de Toluca, Temascaltepec, c. 132 km W. of Mexico City, Avandaro Mexico, 6 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6523.

Our specimen fits the description of *Crepidotus furcatus* rather well, a species of temperate to boreal North America with somewhat contorted cheilocystidia, distinctly coiled and crooked hyphae on the pileipellis and a spore size of 7–10 × 4.5–5.5 µm. However, there is a difference in the colour of the lamellae: whereas Hesler & Smith (1965) state it to be clay to ochre-tawny in colour, we have seen distinct pinkish brown tints.

In section *Crepidotellae* Hesler & A.H. Sm. more very similar species have been described. The separation of *C. ellipsoideus* Hesler & A.H. Sm. and *C. furcatus* is solely



Figs. 13, 14. SEM pictures of basidiospores. — Fig. 13. *Crepidotus ellipsoideus* (holotype). Fig. 14. *Crepidotus occidentalis* (holotype). Bars = 3  $\mu$ m.

Table I. Distinctive characters of *Crepidotus ellipsoideus* and *C. furcatus* based on the original descriptions (Hesler & Smith, 1965).

Characters	<i>C. ellipsoideus</i>	<i>C. furcatus</i>
Spore size ( $\mu$ m)	(5.5–)6–8 $\times$ (4–)4.5–5.5	7–10 $\times$ 4.5–5.5(–6)
Spore ornamentation	punctate	minutely punctate
Cheilocystidia size ( $\mu$ m)	26–45(–66) $\times$ 5–12(–17)	30–50 $\times$ 4–10
Cheilocystidia shape	ventricose, clavate, crooked, contorted, at times forked	cylindrical, clavate, contorted, more rarely forked or knobbed
Spore ornamentation in SEM	faintly rugulose-vermiculose (holotype; see Fig. 13)	

based on small differences in spore size (see Table I). A re-examination of the type of *C. ellipsoideus* Hesler & A.H. Sm. showed a faintly rugulose-vermiculose spore ornamentation when examined under the SEM (see Fig. 13) and most spore sizes within the overlapping range. More observations are needed to decide if these two species are conspecific.

#### *Crepidotus obscurus* Hesler & A.H. Sm. — Fig. 15

*Crepidotus obscurus* Hesler & A.H. Sm., N. Am. Sp. Crep. (1965) 128.  
Selected literature: Hesler & Smith (1965).

Pileus 5–30 mm, white, white fibrillose, slightly tomentose, finally almost smooth near the margin, older dirty brownish, flat, semicircular to circular, sometimes wavy or lobed.

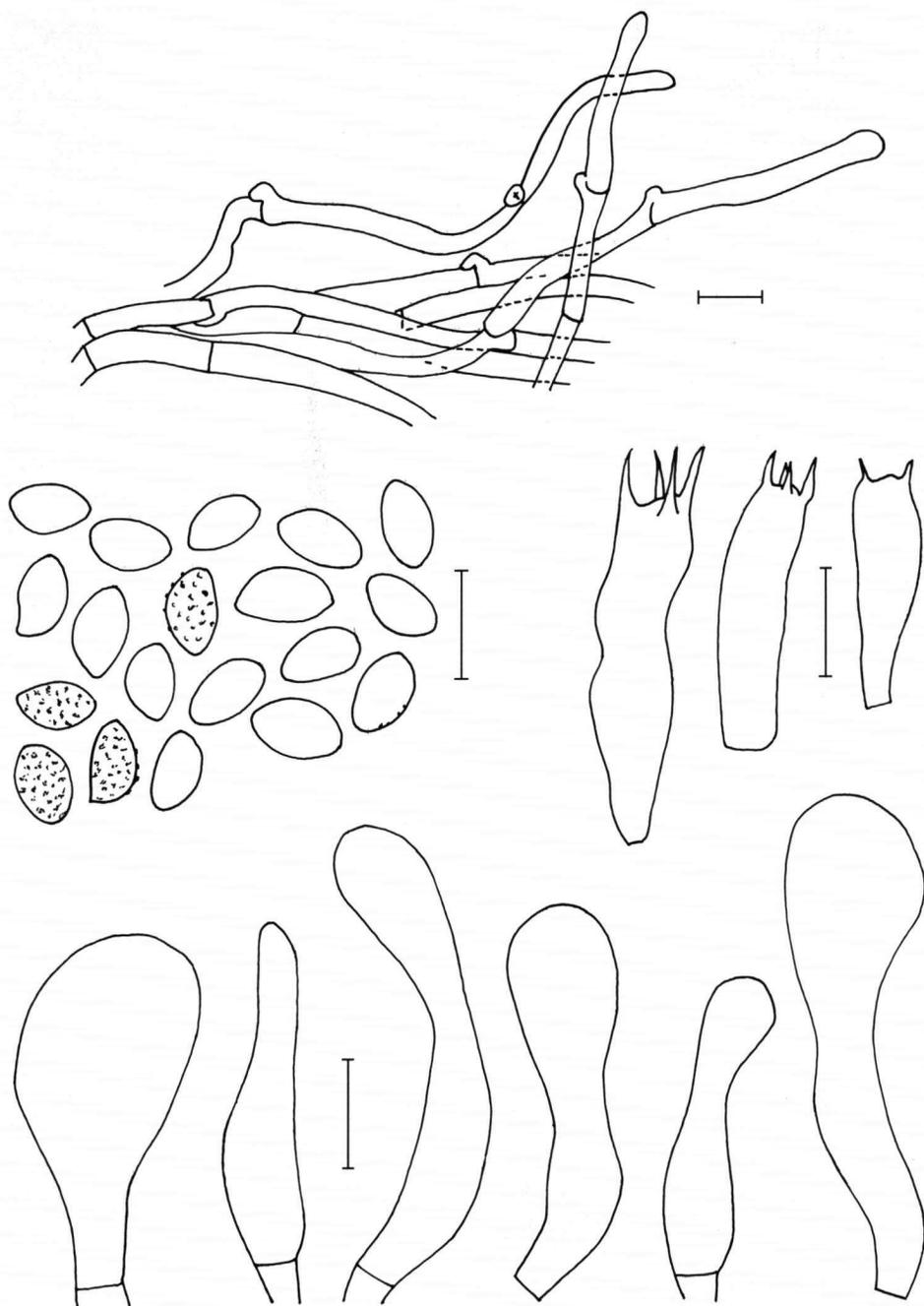


Fig. 15. *Crepidotus obscurus* (no. 7058). Pileipellis, spores, basidia, and cheilocystidia. Bar = 10  $\mu$ m.

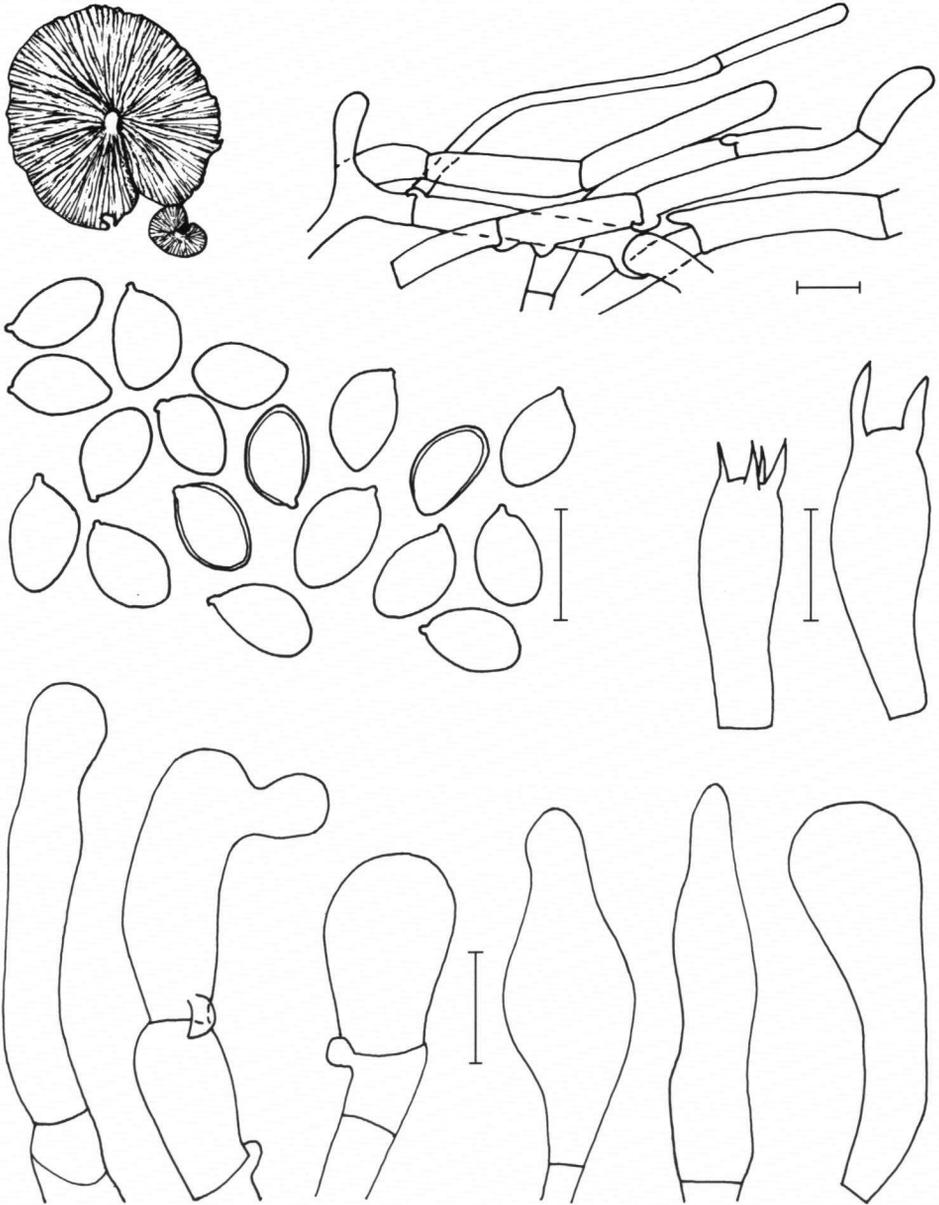


Fig. 16. *Crepidotus occidentalis* (no. 6566). Carpophores, pileipellis, spores, basidia, and cheilocystidia. Bar = 10  $\mu$ m.

Lamellae crowded, white then orange to dirty brown. Stipe 2–3 mm long, eccentric, white. Context thin, whitish, smell and taste mild.

Spores 6.5–8.9 × 4.3–5.4 μm, Q = 1.37–1.8, av. vol. = 94 μm<sup>3</sup>, ellipsoid, slightly amygdaliform in side view, faintly marbled, rugulose-verruculose, moderately thin-walled, rather pale brown. Basidia 22–32 × 6–7 μm, 4-spored, clamped. Cheilocystidia 30–48 × 7–10 μm of two types, cylindrical, narrowly lageniform i.e. bottle-shaped, or broadly clavate up to 18 μm broad to almost sphaeropedunculate. Pileipellis a cutis of more or less repent 3–4 μm wide hyaline hyphae, with some ascending hyphae. Clamps abundant. No pigment found in trama and pellis.

Ecology — Saprotrophic, gregarious on rotten twig of a deciduous tree in a mixed forest.

*Collection examined.* USA: North Carolina, Macon County, Nantahala National Forest, Blue valley, 4 Aug. 1996, I. Krisai-Greilhuber & H. Voglmayr no. 7058 (WU 20100).

*Crepidotus obscurus* is characterised by the ellipsoid, rugulose-verruculose spores and the shape of the cheilocystidia which are of two distinct types. It is a member of the species-rich section *Crepidotellae* Hesler & A.H. Sm.

### *Crepidotus occidentalis* Hesler & A.H. Sm. — Fig. 16

*Crepidotus occidentalis* Hesler & A.H. Sm., N. Am. Sp. Crep. (1965) 103 (Figs. 14, 16).

Selected literature: Hesler & Smith (1965).

Pileus 1–3.5 cm in diam., pleurotoid, tomentose-hairy, greyish white to silver-grey, old brown-grey. Lamellae pink-brown grey, lamellar edge concolorous. Stipe present, short. Context thin, white, smell indistinct, taste mild.

Spores 8.1–10.1 × 5.4–6.7 μm, Q = 1.3–1.7, av. vol. = 176 μm<sup>3</sup>, ellipsoid, smooth, rather thick-walled, and distinctly brown-coloured. Basidia 23–29 × 7–9 μm, 4-spored, clamped. Cheilocystidia 23–35 × 6–12 μm, lageniform, apex acute and tapering or rounded and subcapitate, some angled. Pileipellis a cutis with narrow, 2 μm wide, long, undifferentiated terminal cells (as 'hairs') on a pileitrampa with distinctly broader hyphae. Trama not jigsaw like, without any gelatinous layer. Clamps abundant. No pigment present in trama and pellis.

Ecology — Saprotrophic, gregarious on rotten branch of a deciduous tree in a subtropical evergreen oak forest.

*Collection examined.* MEXICO: Federal State Mexico, Nevada de Toluca, Temascaltepec, c. 132 km W. of Mexico City, 6 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6566.

On account of the thick-walled spores which are smooth and deeply coloured and the pileipellis type with distinctly narrow hyphae this species resembles *Crepidotus autochthonus* J. Lange and has to be placed in section *Autochthoni* Senn-Irlet. A re-examination of the holotype of *C. occidentalis* showed the same spore type (Fig. 14), although the shape of the cheilocystidia differs from our collection: whereas the holotype exhibits throughout cylindrical, slightly flexuous cheilocystidia of 34–55 × 5–7 μm (as described and depicted by the authors!) our collection has shorter, thicker and in shape more variable ones. More collections are needed to decide if our collection still falls within the range of *C. occidentalis* or if it has to be recognised as a different species.

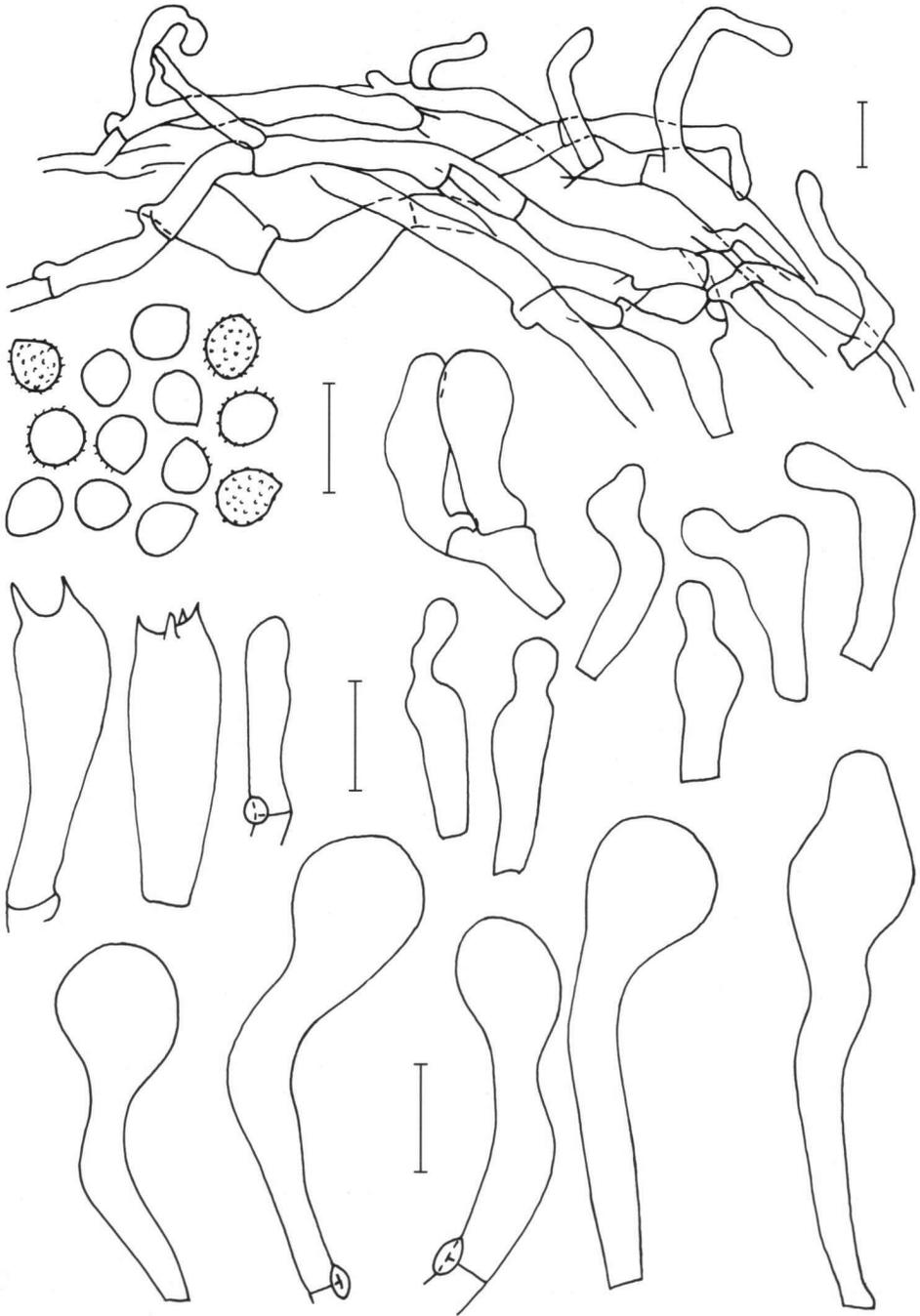


Fig. 17. *Crepidotus palmarum* (no. 6730). Pileipellis, spores, pleurocystidia, basidia, and cheilocystidia. Bar = 10  $\mu$ m.

***Crepidotus palmarum* Sing. — Fig. 17**

*Crepidotus palmarum* Sing. in Sing. & Digilio, Lilloa 25 (1952, '1951') 406.

*Crepidotus luridus* Sing., Beih. Nova Hedwigia 44(1973) 479.

*Crepidotus luridus* var. *oaxacae* Sing., Beih. Nova Hedwigia 44 (1973) 479.

Selected literature: Senn-Irlet & de Meijer (1998), Bandala & Montoya (2000a).

Pileus 5–15 mm, flabelliform, smooth, striate when moist, hygrophanous, dirty whitish, ivory. Lamellae slightly distant, lamellar edge smooth, concolorous, young dirty whitish, then with pinkish brown tinge. Stipe short, present only in very young fruit-bodies, soon sessile, and then only a bit thicker at point of attachment. Context thin, smell none, taste mild.

Spores 5.8–6.3 × 4.6–5.6 µm, Q = 1.1–1.3, av. vol. = 82 µm<sup>3</sup>, subglobose to broadly ellipsoid warty-punctate, with warts clearly visible in optical section, moderately coloured. Basidia 23–29 × 7–10 µm, 4-spored, clamped. Cheilocystidia 32–51 × 4–5 × 10–12 µm, clavate-subcapitate to distinctly capitate (i.e. vesiculose), sometimes slightly flexuous. Hymenium full of basidioles, which can be interpreted as cystidioid elements ('pleurocystidia'), 16–21 × 4–7 µm, cylindrical to lageniform, in the upper part flexuous. Pileipellis a cutis of moderately broad repent hyphae, with erect, angled, bent terminal cells.

Ecology — Saprotrophic, gregarious on rotten trunk of *Quercus* in a mixed, humid, subtropical deciduous oak forest.

Collection examined. MEXICO: Federal State Nayarit, City Tepic, near the W coast, Villarruez-Orbaz, 18 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6730.

With Singer (1973) this collection keys out as *Crepidotus luridus* var. *oaxacae* Singer on account of the combination of subglobose warty spores and vesiculose cheilocystidia. A figure even illustrates the shape of the pileocystidioid terminal cells. With the exception of the substrate – not palms – the characters are the same as for *Crepidotus palmarum*. A careful comparison of the different types led Bandala et al. (1999) to conclude that these species are conspecific. We agree with this conclusion as also our observations on a collection from Brazil growing on decayed leaf petioles of a palm tree (Senn-Irlet & de Meijer, 1998) show a striking similarity with the Mexican specimen.

This collection shows a feature encountered in several, especially tropical specimens of *Crepidotus*: the hymenium is full of cystidioid elements, which can be termed as pleurocystidia (Hesler & Smith, 1965). As we firmly believe that such elements do not deserve any taxonomic status because they may simply be a modification due to climatic conditions or unknown biotic triggers (bacteria?) we abandon even the idea of describing a variety of this species as this has been done by several authors.

***Crepidotus subverrucisporus* Pilát — Fig. 18**

*Crepidotus subverrucisporus* Pilát, Studia bot. cech. 10 (1949) 151.

Selected literature: Senn-Irlet (1995), Bandala et al. (1999).

Pileus 8–40 mm in diam., typically flabelliform, margin strongly undulating, young pure white, old cream-white, watery and slightly translucent when moist, dry cottony, mat, tomentose, older near point of attachment light yellowish (similar to *Crepidotus luteolus* (Lamb.) Sacc.) and strigose-hairy to scaly. Lamellae crowded, first pure white, soon dirty pinkish, not directly brownish or only when very old. Stipe absent. Context white, watery, smell fruity, taste mild to slightly bitter.

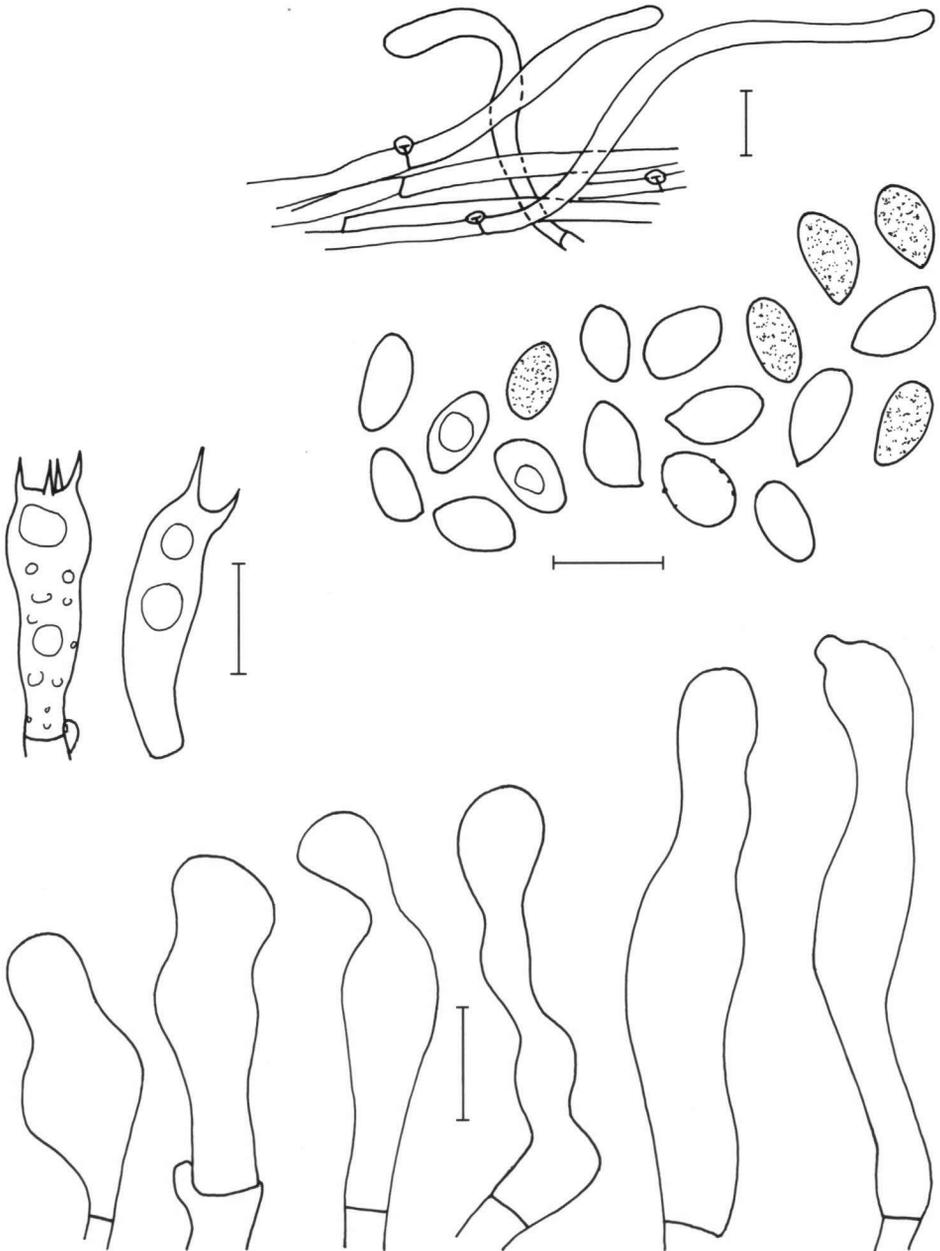


Fig. 18. *Crepidotus subverrucisporus* (no. 6474). Pileipellis, spores, basidia, and cheilocystidia. Bar = 10  $\mu$ m.

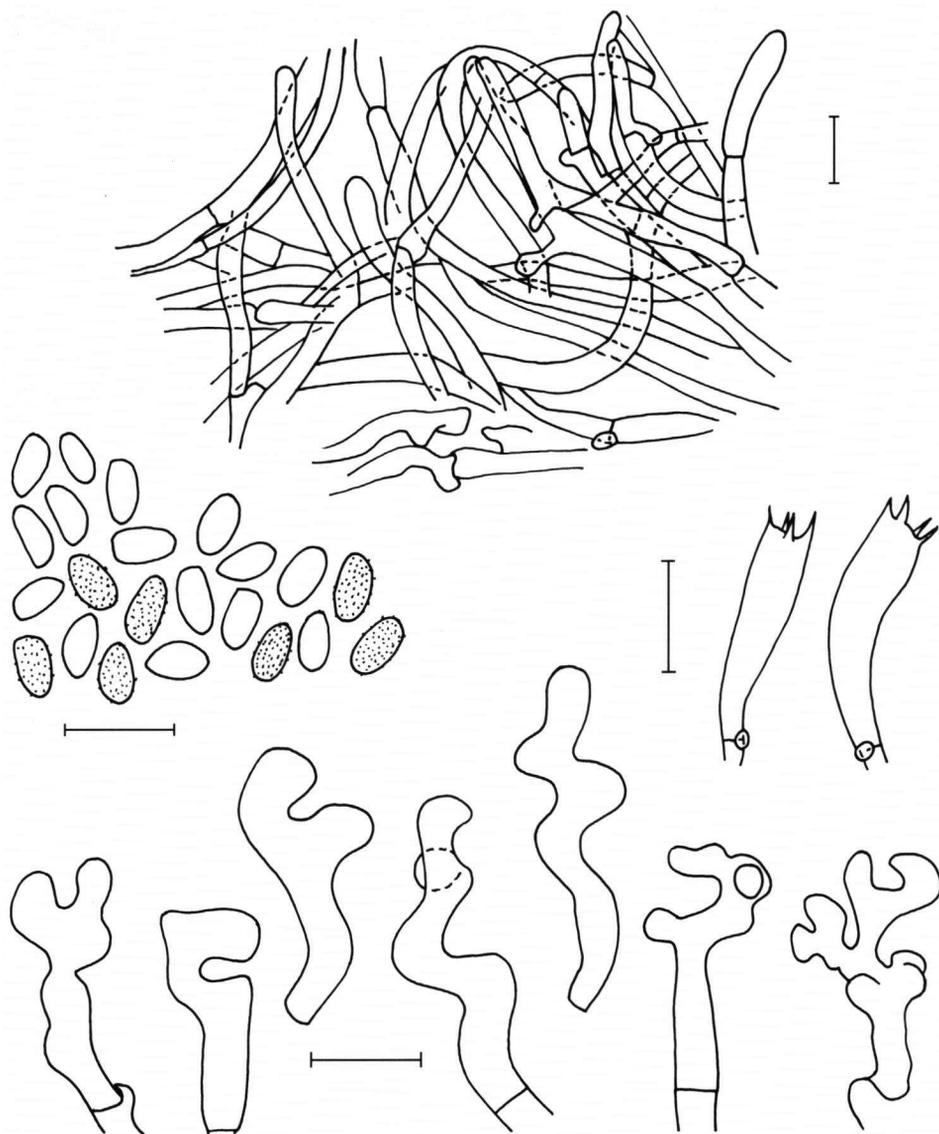


Fig. 19. *Crepidotus variabilis* (no. 6612). Pileipellis, spores, basidia, and cheilocystidia. Bar = 10  $\mu\text{m}$ .

Spores  $7.2\text{--}9.1 \times 4.3\text{--}5.3 \mu\text{m}$ ,  $Q = 1.5\text{--}1.9$ , av. vol. =  $97 \mu\text{m}^3$ , ellipsoid to oblong, faintly to coarsely marbled, rugulose, rather thin-walled, not too dark brown. Basidia  $22\text{--}24 \times 6\text{--}8 \mu\text{m}$ , 4-spored, clamped. Cheilocystidia  $30\text{--}53 \times 7\text{--}10 \mu\text{m}$  cylindrical, more rarely narrowly lageniform, bottle-shaped, slightly flexuous, often slightly capitate. Pileipellis a cutis, with a rather dense hypocutis. Clamps abundant. No pigment.

Ecology — Saprotrophic, gregarious on rotten *Quercus* (?) twig in subtropical mixed forest (mainly *Quercus*, *Pinus*).

*Collection examined.* MEXICO: Federal State Mexico, Nevada de Toluca, Temascaltepec, c. 132 km W. of Mexico City, El Polvador, 4 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6474 (WU 20092).

The character combination indicates a close relationship with a species described from Europe, i.e. *Crepidotus subverrucisporus*. Recent studies by Bandala et al. (1999) with type studies and SEM observations on the spore ornamentation could demonstrate that indeed Mexican collections can be attributed to this species.

### ***Crepidotus variabilis* (Pers.: Fr.) Kumm. — Fig. 19**

*Crepidotus variabilis* (Pers.: Fr.) Kumm., Führ. Pilzk. (1871) 74.  
Selected literature: Senn-Irlet (1995).

Pileus 5–10 mm in diam., circular to shell-shaped, carpophores partly fused, white, white tomentose-hairy, not gelatinous. Lamellae straight adnate to sinuate, crowded, lamellar edge white denticulate, young white, then dirty brownish, no pink tinge. Stipe up to 3 mm long, white, tomentose. Context thin, white, smell none, taste mild.

Spores 5.6–6.4 × 2.9–4.0 µm, Q = 1.5–2.0, av. vol. = 37 µm<sup>3</sup>, elongate to subcylindrical, distinctly finely punctate-warty, with warts hardly visible in optical section, moderately coloured. Basidia 19–25 × 4–6 µm, 4-spored, clamped. Cheilocystidia 20–30 × 4–5 µm, cylindrical to narrowly clavate, flexuous, often branched and contorted, with finger-like protuberances. Pileipellis a thick trichoderm of undifferentiated, often bent hyphae. Clamp-connections in all parts of the carpophore. No pigment observed in trama and pellis.

Ecology — Saprotrophic, gregarious on rotten twig of deciduous tree in a sclerophilous *Quercus* forest.

*Collection examined.* MEXICO: Federal State Mexico, El Ocotol, Chapa de Mota near Mexico City, 8 July 1996, I. Krisai-Greilhuber & H. Voglmayr no. 6612.

In all respects identical with European collections of this species known to us. Reported from several places in North America (Hesler & Smith, 1965), however apparently not yet known from the Neotropics.

### ACKNOWLEDGEMENTS

We thank Margrit Kummer (Bern) for inking the figures and providing us with line drawings of the carpophores based on colour slides, and H. Halbritter and F. Zweili for taking the SEM pictures. Ron H. Petersen and Joaquin Cifuentes Blanco are gratefully acknowledged for providing excellent support to IKG and HV during their trip to the south-eastern USA and Mexico. IKG wishes to thank the Hesler Fund and HV the Lindsay S. Olive Fund for financial support, and the Highlands Biological station for providing working and living facilities. We also thank the herbarium curators for the loans of type material.

### REFERENCES

- Anonymous. 1994. Systematics Agenda 2000 – charting the biosphere. New York Botanical Gardens, New York.
- Bandala, V.M. & L. Montoya. 2000a. A revision of some *Crepidotus* species related to Mexican taxa. Mycol. Res. 104: 495–506.
- Bandala, V.M. & L. Montoya. 2000b. A taxonomic revision of some American *Crepidotus*. Mycologia 92: 341–353.
- Bandala, V.M., L. Montoya & G. Moreno. 1999. Two *Crepidotus* species from Mexico with notes on selected type collections. Mycotaxon 72: 403–416.

- Bandala-Muñoz, V.M., G. Guzmán & L. Montoya-Bello. 1988. Macrofungi reported from Mexico, VII. Agaricales, part II (1972–1987). *Rev. Mex. Micol.* 4: 205–250.
- Cifuentes, J., L. Pérez-Ramírez & M. Villegas. 1989. Description of macrofungi little known from Mexico, III. *Rev. Mex. Micol.* 5: 103–115.
- Hesler, L.R. & A.H. Smith. 1965. North American species of *Crepidotus*. Hafner Publishing Co., New York.
- Kaiser, J. 1999. Great Smokies Species Census under way. *Science* 284: 1747–1748.
- Luther, B.S. & S.A. Redhead. 1981. *Crepidotus cinnabarinus* in North America. *Mycotaxon* 12: 417–430.
- Norvell, L. 1999. The GSMNP-ATBI diaries. Fungal TWIG diary entry 4. *Inoculum* 50 (5): 29.
- Senn-Irlet, B. 1995. The genus *Crepidotus* in Europe. *Persoonia* 16: 1–80.
- Senn-Irlet, B. & V. Hofstetter. 1996. Wie vermögen molekulare Daten die Klassifikation von *Crepidotus*-Arten zu verändern? *Mycologia Helvetica* 8: 101–107.
- Senn-Irlet, B. & A.A.R. de Meijer. 1998. The genus *Crepidotus* from the state of Paraná, Brazil. *Mycotaxon* 66: 165–199.
- Singer, R. 1973. The genera *Marasmiellus*, *Crepidotus* and *Simocybe* in the Neotropics. *Beih. Nova Hedwigia* 44: 1–517.