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TYPE STUDIES IN CREPIDOTUS – II

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Types of Pilát's *Crepidotus* species available in PRM and K and other types of *Crepidotus* species from different authors, available in E, F, H, and NYS, have been studied. For each taxon concerned microscopical characters and SEM pictures of the spores are given, followed by a concise discussion of its status.

A critical study of the species in many genera requires a careful re-examination of the type material. This holds true for *Crepidotus* all the more, because since the last monographic study of European species of *Crepidotus* (Pilát, 1948) eight new species have been described by seven different authors.

The spore ornamentation proved to be one of the most distinctive morphological characters within this genus. But as details of these ornamentations all lie at the limit of light optical recognition, the scanning electron microscope is a powerful tool to solve such problems. This paper reconsiders species described by Pilát, which have hardly ever been found again after their original description, two species originally described by Peck (1878) and by Singer (1960) from North America, and two British species described by Orton (1960, 1984).

For methods and presentation see Senn-Irlet (1992) (scale bars in Figures = 10 μm).

SPECIES DESCRIBED BY PILAT

Crepidotus serbicus Pilát — Pl. 1A

Crepidotus serbicus Pilát, Bull. trimest. Soc. mycol. Fr. 53 (1937) 82. — Type: Jugoslavia, Serbia, Kapaonik Mountains, May 1936, *Černjanski* (det. A. Pilát; PRM 485751).

Cap 4 cm long, fan-shaped, brown, dull, pale ochre and strigose near point of attachment. Lamellae narrow, crowded, brown partly carbonized. Stipe absent.

Spores abundant, 5 × 5 μm, globose, with a short, obtuse apiculus, minutely punctate, warty, thick-walled, brown. Basidia slender, not yet fully developed. Hymenophoral trama regular, consisting of hyphae 4–6 μm wide, hyaline. Subhymenium consisting of short-celled, branched hyphae. Cystidia not found. Clamps present.

The absence of fully developed basidia and the fact that there are spores in large quantities suggest that these spores (see Pl. 1A) belong to another fungus. They would perfectly fit in with many gasteromycetes, and indeed some fragments of a capillitium could also be found. Therefore *Crepidotus serbicus* is best regarded as a nomen dubium. The specimen could not be identified. Pilát (1948) recorded only one collection, and since then no other record of this species has been published nor could specimens of it be traced.

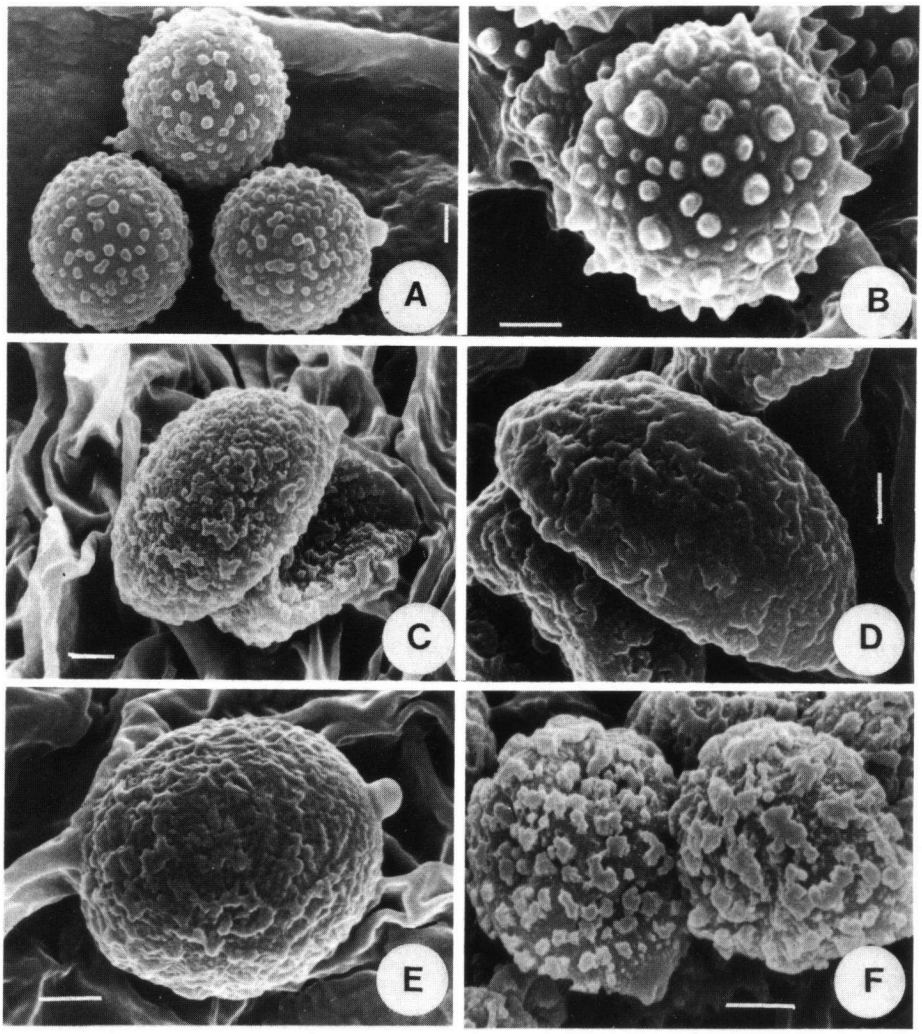

Plate 1. Scanning electron micrographs of spores from the type collections. — A. *Crepidotus serbicus*. — B. *Crepidotus subepibryus*. — C. *Crepidotus subverrucisporus*. — D. *Crepidotus velenovskyi*. — E. *Crepidotus versutus* var. *subglobisporus*. — F. *Crepidotus harperi*. — The scale markers in A–F represent 1 μm.

Crepidotus subepibryus Pilát — Pl. 1B; Fig. 1

Crepidotus subepibryus Pilát, Studia bot. čech. 10 (1949) 153. — Type: Czechoslovakia, Moravia, Žarošice, in *Picea* forest among mosses on naked soil, 10 Sept. 1943, *V. Vacek* (det. A. Pilát; PRM 149050).

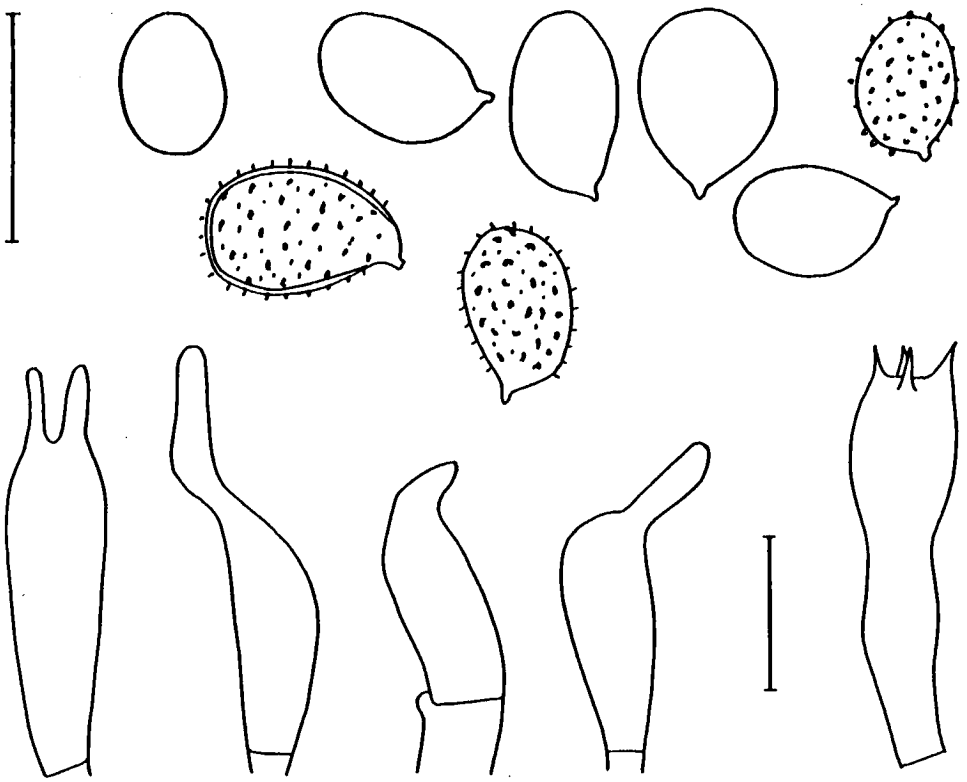

Fig. 1. *Crepidotus subepibryus.* — Basidioles, basidium, and spores.

The following description is based on unpublished notes of L.R. Hesler and own observations.

Spores 6.0–8.5 × 4.5–6.0 µm (Hesler: 5.5–7.5 × 4.3–5.7 µm), Q = 1.2–1.6, av. Q = 1.40, ellipsoid, only slightly or not inequilateral in profile, conspicuously punctate; ornamentation seen as small warts or spines in the optical section, mixed with some abnormally large ones, revealed by SEM as echinulate with isolated, conical spines (Pl. 1B); thick-walled spores, 12–14 × 6–6.5 µm; walls moderately strongly coloured. Basidia 20–28 × 5–8 µm, 4-spored, mixed with numerous 2-, and single-spored ones, with clamp-connections. Cheilocystidia scarce, 23–45 × 5–8 µm, mostly cylindrical, sometimes more or less ventricose and capitate. Pleurocystidia absent. Hymenophoral trama made up of subparallel to interwoven, 2.5–5 µm wide hyphae. Pileipellis a transition between a cutis and a trichoderm with tufts of more or less erect, undifferentiated, mostly straight, 2.5–5 µm wide hyphae; terminal cells at cap margin somewhat flexuose, never coiled. Clamp-connections present in all tissues.

The numerous 2-spored and even single-spored basidia indicate an abnormal development of this material and therefore it is very difficult to interpret this small collection,

consisting of only one and a half tiny, flattened fruit-body. Pilát (1948) mentions the apparently close relationship of this species with *Crepidotus epibryus* sensu Pilát. The ultrastructure of the spore ornamentation, however, indicate a close relationship with *C. cesatii*. Therefore *C. subepibryus* must be interpreted as an abnormality of *C. cesatii*, probably close to *C. cesatii* var. *subsphaerosporus*. No other records of this fungus are known.

Crepidotus subverrucisporus Pilát — Pl. 1C; Fig. 2

Crepidotus subverrucisporus Pilát, Studia bot. čech. 10 (1949) 151. — Type: Czechoslovakia, Bohemia, Chrustenica (near Prague), on twig of *Robinia pseudacacia*, 20 Aug. 1949, *V. Vacek* (det. A. Pilát; PRM 149034).

Spores 7–9 × 4.5–6 µm, Q = 1.4–1.7, av. Q = 1.54, ellipsoid or ovoid in frontal view, slightly amygdaliform in side view, conspicuously punctate-rugulose; walls mod-

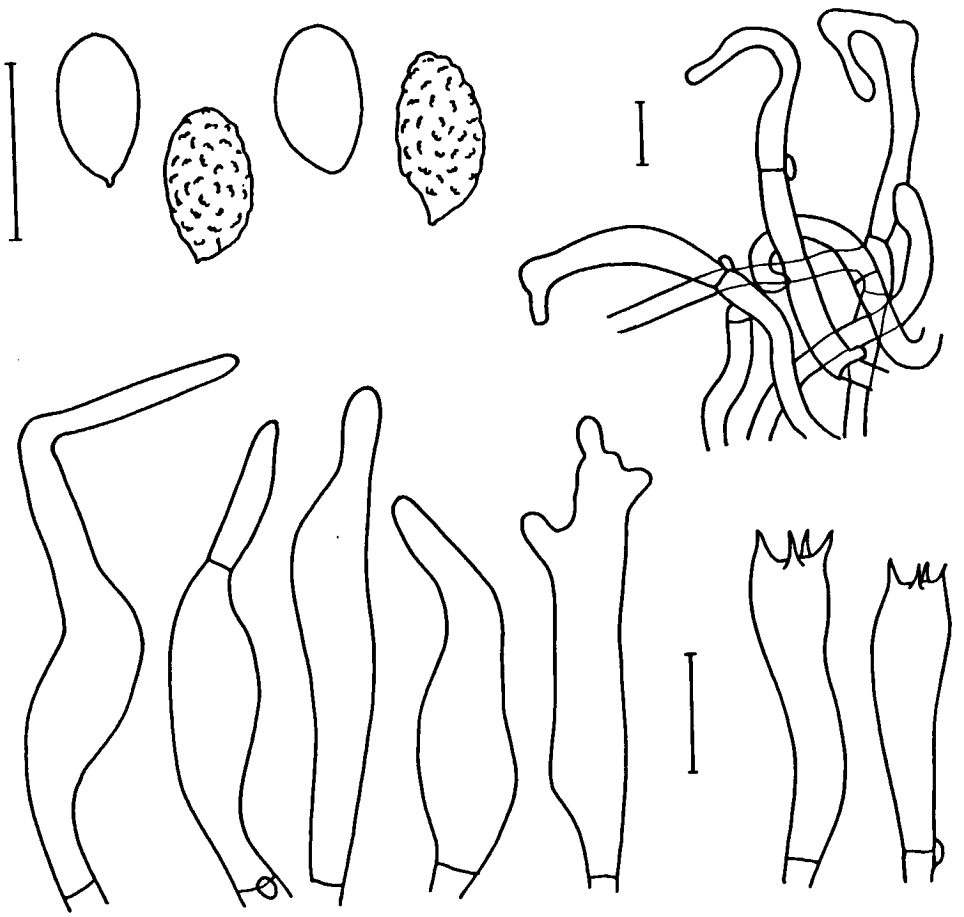

Fig. 2. *Crepidotus subverrucisporus*. — Cheilocystidia, basidia, spores, and pileipellis.

erately coloured. Basidia 22–27 × (5–)6–8 µm, 4-spored. Cheilocystidia 39–60(–73) × 5–8 µm, cylindrical to narrowly lageniform, often septate, sometimes branched, hyaline. Hymenophoral trama made up of subparallel, interwoven, 3–6 µm wide hyphae. Pileipellis a transition between a cutis and a trichoderm of cylindrical, 4–6 µm wide hyphae, bearing a turf of erect, flexuose, cylindric or rostrate, terminal cells. Clamp-connections present in all tissues.

In contrast with Pilát (1948), who believed in a close relationship of *C. subverrucisporus* with *C. lundellii*, re-examination of the type shows a great similarity of *C. subverrucisporus* with *C. epibryus* sensu Pilát. The spore ornamentation as seen in the SEM (Pl. 1C) belongs to the rugulose-vermiculose type, but is distinctly more pronounced than in *C. lundellii*. The shape of the cheilocystidia, too, resembles those of *C. epibryus* sensu Pilát much more than those of *C. lundellii*, as no clavate or capitate form could be found. The rostrate terminal cells of the pileipellis are a further indication of a close relationship with *C. epibryus* sensu Pilát. Nevertheless, there are some points of difference with *C. epibryus*: the spores are more faintly coloured and the cheilocystidia are septate at times, but more often branched. Perhaps *C. subverrucisporus* s. str. represents an ecotype on *Robinia* (see also notes on *C. bickhamensis*).

Crepidotus velenovskyi Pilát — Pl. 1D

Crepidotus velenovskyi Pilát, Studia bot. čech. 10 (1949) 152. — Type: Czechoslovakia, Bohemia, Solopisky near Prague, on *Juniperus communis*, 29 Oct. 1925, leg. & det. *J. Velenovský* (PRM 14309; as *Crepidotus juniperi* Velen., but not the type of *C. juniperi*!).

Scarcely any material is left of the type specimen, which consists of very small fruit-bodies with caps only 1–2 mm wide.

Spores 7.5–9 × 4.5–6 µm, Q = 1.4–1.7, av. Q = 1.54, ellipsoid to ovoid in frontal view, faintly punctate, with moderately to faintly coloured walls. Basidia no more left, except for two isolated elements which may represent 2-spored crassobasidia. Hymenophoral trama made up of subparallel to interwoven, 4–6 µm wide hyphae. Cheilocystidia destroyed in most parts, 30–40 × 7–10 µm, narrowly lageniform, cylindrical.

On account of the spore ornamentation, Pilát (1948) put this species in the group around *Crepidotus epibryus* sensu Pilát. I agree with this interpretation; but in my opinion the collection falls fully within the range of *C. epibryus* sensu Pilát and *C. subverrucisporus* respectively, mainly due to its rugulose-vermiculose spore ornamentation (Pl. 1D) and the shape of the cheilocystidia, although the shape of the spores is generally not so typically amygdaliform. The minute size of the fruit-bodies can hardly be regarded as of high taxonomic value. After the original description no other record of *C. velenovskyi* seems to have been published.

Crepidotus versutus var. **subglobisporus** Pilát — Pl. 1E; Fig. 3

Crepidotus versutus var. *subglobisporus* Pilát, Sb. nár. Mus. Praze 2 B (3) (1949) 74. — *Crepidotus lundellii* var. *subglobisporus* (Pilát) Pilát, Atl. champ. Eur. 6 (1948) 50. — Type: USSR, Ucraina, Kobylecká Polana (Rossia subcarpaticae), Svidovec-Krajná Rika, 600–1000 m, in *Fagus* virgin forest, July–Aug. 1937, leg. & det. *A. Pilát* (PRM 23529), on twig of hardwood and litter of *Fagus*.

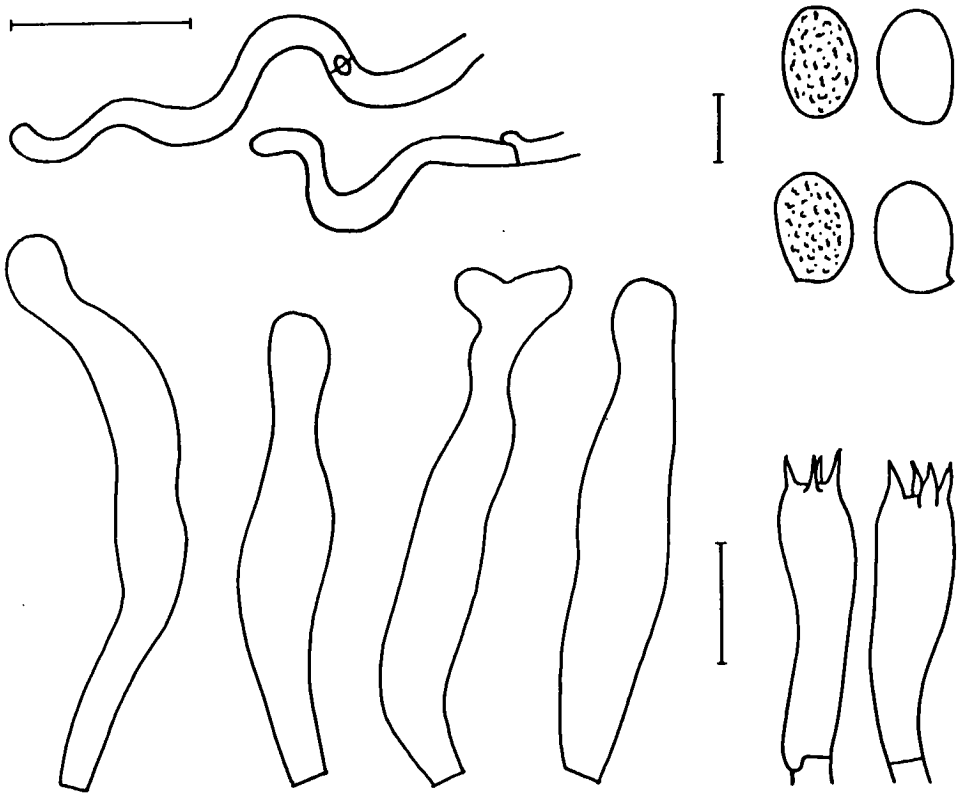

Fig. 3. *Crepidotus versutus* var. *subglobisporus*. — Cheilocystidia, basidia, spores, and terminal cells of the pileipellis.

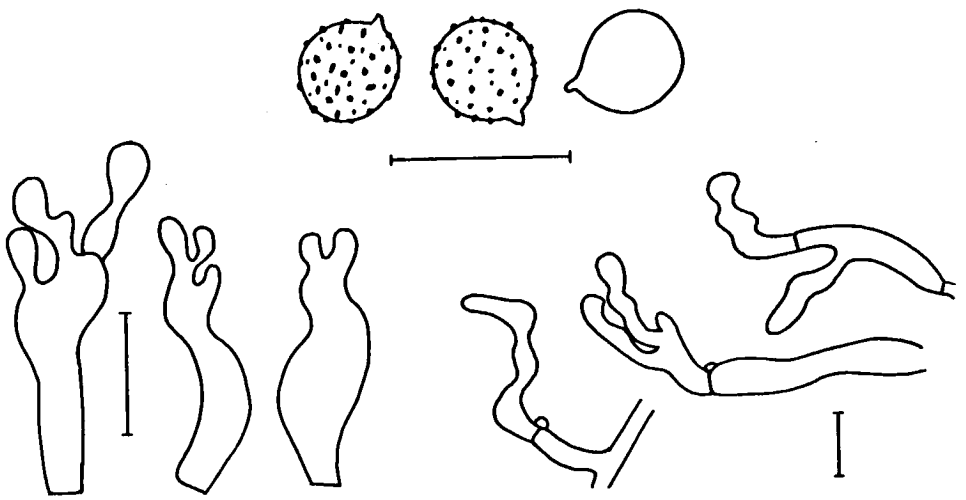

Fig. 4. *Crepidotus harperi*. — Cheilocystidia, spores, pileipellis.

Spores 5.5–7.5 × 4.5–6 µm, Q = 1.2–1.4, av. Q = 1.31, broadly ellipsoid to ellipsoid, with very faint punctate ornamentation; walls rather pale. Basidia 20-23 × 6-8 µm, 4-spored. Cheilocystidia cylindrical to narrowly utriform, sometimes flexuose, narrowly capitate, rarely branched and knobbed, hyaline. Hymenophoral trama subparallel to interwoven, of hyphae 4-10 µm wide. Pileipellis thin, a transition between a cutis and a trichoderm, of mostly repent to somewhat flexuose, cylindrical, 4–6 µm wide hyphae with yellowish segments, bearing scattered tufts of almost erect terminal cells, sometimes flexuose, slightly coiled and cylindrical or in the shape of the cheilocystidia. Clamp-connections abundant in all tissues.

The spore ornamentation as seen in the SEM (Pl. 1E), the shape of the cheilocystidia, and the structure of the pileipellis fit in perfectly well with *C. lundellii* Pilát. In agreement with Norstein (1990) I interpret *C. lundellii* (*C. inhonestus* sensu Norstein) as a species with great variation in the shape and the size of the spores and therefore *C. versutus* var. *subglobisporus* falls fully within its range of variability.

If based on the original description only, this species may be confused with *C. inhonestus* P. Karst., as was done by Norstein (1990) and Watling & Gregory (1989). A re-examination of the type material of *C. inhonestus* (in herb. P.A. Karsten, H), however, showed perfectly smooth spores with strongly coloured walls and an apical pore and finely incrusted hyphae in the pileipellis, which does not agree at all with *C. lundellii*.

In his earlier publications Pilát considered *Crepidotus versutus* (Peck) Sacc. to be identical with *C. lundellii*. Later he (Pilát, 1948) became convinced by Singer's publication (1947), that these species are not identical; *C. versutus* being a clamp-less species.

Crepidotus wakefieldiae Pilát

Crepidotus wakefieldiae Pilát, Studia bot. čech. 10 (1949) 152. — Type: Great Britain, Manchester, Donhead St. Mary, Oct. 1944, *Harthan* (K).

The type is no more in a good condition. Therefore I abstained from a further examination, as it has already been re-examined several times. Pearson (1952) gave a description, Orton (1960) described topotypical material, and Pegler & Young (1972) published SEM photographs of the spores of the type collection. This species is thus rather well known, and there is no doubt that Pilát (1929) has described this species earlier under the name *Crepidotus carpaticus* (see Senn-Irlet, 1992), which name has priority over *C. wakefieldiae*!

OTHER TYPE COLLECTIONS

Crepidotus harperi Singer — Pl. 1F; Fig. 4

Crepidotus harperi Singer, Mycologia 51 (1960, '1959') 586. — Type: U.S.A., Virginia, Bedford, May 1919, *Harper 1177* (F 1178).

The type collection is very large. Due to inappropriate drying, however, the trama and the hymenium are in poor condition. Moreover, crystals of a pesticide hamper proper examination. Only the spores are well preserved and abundantly present.

Spores 5–6 × 5–5.5 µm, Q = 1–1.1, globose, conspicuously punctate, warty in optical section, with pronounced apiculus; walls moderately coloured. Basidia 25–30 × 6–7

µm. Cheilocystidia 20–28 × 5–8 µm, clavate to narrowly utriform, with several short finger-shaped, coralloid protuberances. Hymenophoral trama made up of subparallel, 3.5–6 µm wide hyphae. Pileipellis a cutis with transitions to a trichoderm with tufts of erect terminal cells, at the cap margin as pileocystidia in the shape of the cheilocystdia, some segments yellowish. Clamp-connection present.

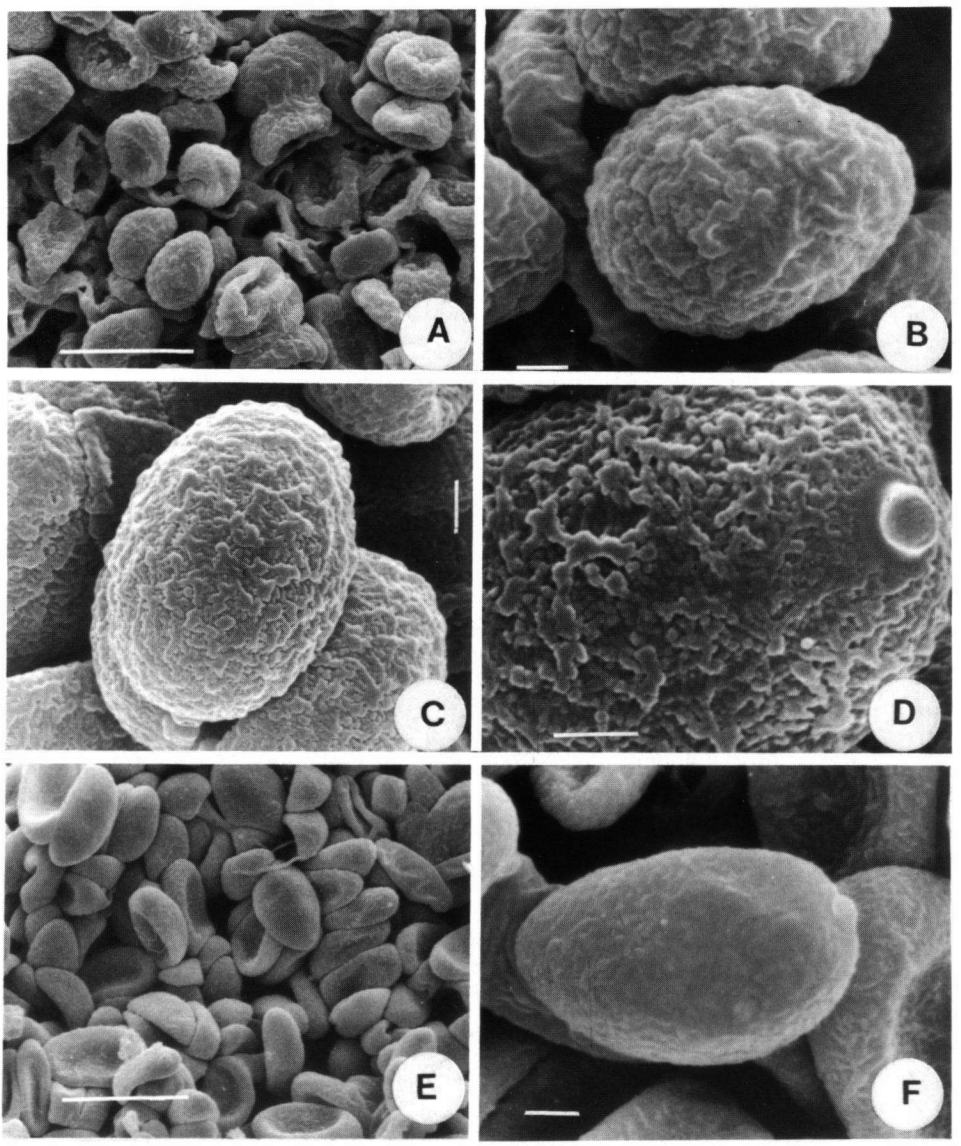

Plate 2. Scanning electron micrographs of spores from the type collections. — A, B. *Crepidotus bickhamensis*. — C, D. *Crepidotus subtilis*. — E, F. *Crepidotus versutus*. — The scale markers in A and E represent 10 µm, in B–D and F 1 µm.

Josserand (1965) already suggested that *Crepidotus harperi* would be identical with *C. wakefieldiae* Pilát. And indeed both species are found to be conspecific. The SEM (Pl. 1F) revealed the same type of spore ornamentation as shown by Pegler & Young (1972) for *C. wakefieldiae*, differing clearly from that of *C. applanatus*, although with the light microscope no differences could be seen in size, colour, and ornamentation of the spores.

Crepidotus bickhamensis P.D. Orton — Pl. 2A, B; Figs. 5, 6

Crepidotus bickhamensis P.D. Orton, Notes R. bot. Gdn Edinb. 41 (1984) 573. — Type: Great Britain, Somerset, Crawley, Bickham wood, on bark on *Salix*, 25 Sept. 1981, *Orton 5255* (E).

Spores 8.5–10.5 × 5.5–7.5 µm, Q = 1.3–1.6, av. Q = 1.49, ellipsoid, slightly amygdaliform in side view, sometimes with a suprahilar depression, conspicuously punctate-rugulose; walls strongly coloured. Basidia 22–30 × 7.5–10 µm, 4-spored, clamped. Cheilocystidia (23–)30–55 × 5–8(–10) × 3–6 µm, narrowly lageniform, cylindrical, sometimes slightly flexuose, very rarely septate, hyaline, thin-walled. Hymenophoral trama subregular, consisting of 3–7 µm wide hyphae. Pileipellis a trichoderm of erect, interwoven cylindrical hyphae with the terminal cell often differentiated as pileocystidia. Pileocystidia 30–40 × 4–6 µm, cylindrical, narrowly lageniform, flexuose or angled, rarely branched, sometimes rostrate at the tip. Clamp-connections present in all tissues.

Crepidotus bickhamensis is identical with *C. epibryus* sensu Pilát (1948). Orton established this new species in order to avoid further misleading interpretations of *Agaricus epibryus* Fr. (Fries, 1821: 275) as Pilát clearly did. However, Orton overlooked the similarity with *C. subverrucisporus* Pilát, a species which was placed by its author in the relationship of *C. lundellii* and *C. luteolus*. Pilát described a more fleshy cap, lamellae without reddish tints, and spores which are fainter ornamented than in *C. epibryus* sensu Pilát as distinguishing characters from *C. subverrucisporus*. A critical re-examination of *C. subverrucisporus* (see above), however, showed distinctly rugulose spores even with the light microscope. In the SEM exactly the same rugulose type of ornamentation is found (Pl. 1C) in *C. bickhamensis* (Pl. 2A, B).

The mean spore size of 43 European collections of this species is shown in Fig. 6. This figure illustrates the variability of spore size, with *C. bickhamensis* and *C. subverrucisporus* as two collections with opposing positions in the cluster. A similiar variability was found in the degree of the spore wall hue ranging from strongly to (more rarely) moderately coloured. Pilát (1948) indicated *Robinia* as the substrate for *C. subverrucisporus*, but he never attached much importance to that feature, and later he (Pilát, 1950) described collections from Poland on *Carpinus* with large spores (8–11 × 6–7.5 µm!).

From all these observations I conclude that *C. subverrucisporus* is an older synonym of *C. bickhamensis* and thus the correct name for *C. epibryus* sensu Pilát.

Crepidotus subtilis P.D. Orton — Pl. 2C, D; Fig. 7

Crepidotus subtilis P.D. Orton, Trans. Br. mycol. Soc. 43 (1960) 221. — Type: Great Britain, Devon, Roudon, Whitlands Landslip, on fallen twigs of *Sambucus* and *Hedera*, 2 Dec. 1958, *P.D. Orton* (K; paratype, E).

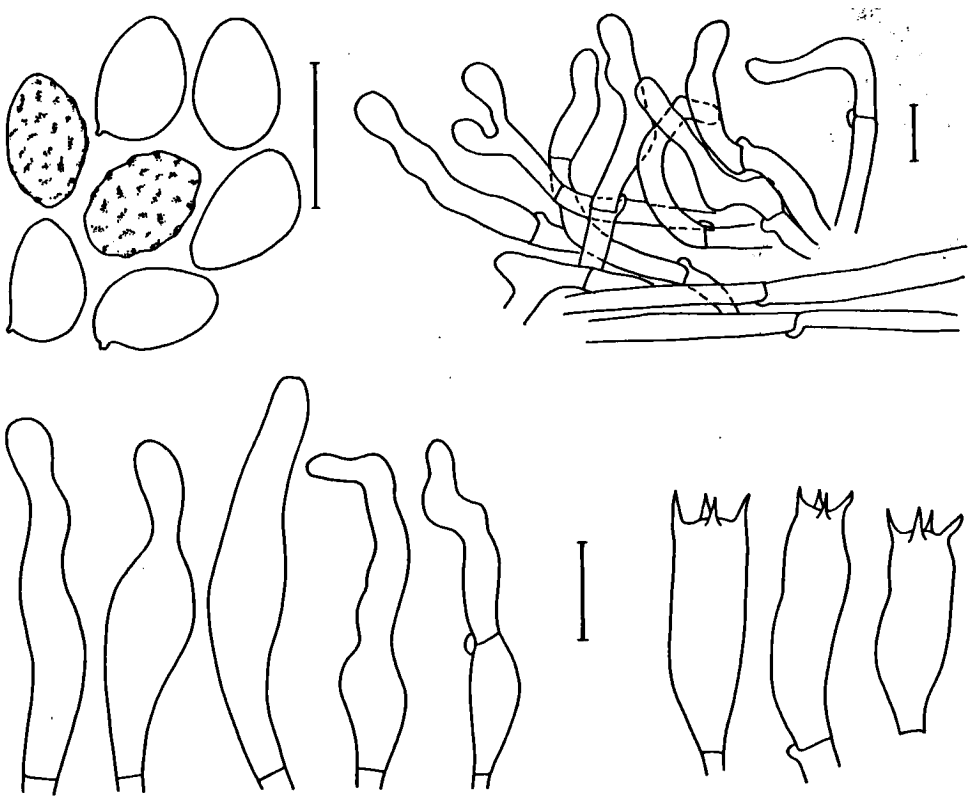

Fig. 5. *Crepidotus bickhamensis*. — Spores, pileipellis, cheilocystidia, and basidia.

Spores 7–9 × 4.5–6 µm, Q = 1.3–1.6, av. Q = 1.49, ellipsoid, slightly ovoid, faintly ornamented, with SEM minutely rugulose; walls pale brown in the light microscope. Basidia 28–36 × 7–9 µm, 4-spored, mixed with 2-spored, clamped. Cheilocystidia 28–68 × 5–8 µm, narrowly lageniform to narrowly utriform, sometimes slightly tibiiform (i.e. subcapitate or kneeled), hyaline, thin-walled, forming a sterile band at the lamellae edge. Pleurocystidia absent. Pileipellis a trichoderm, especially at the pileus margin with erect, 4–6 µm wide, cylindrical to narrowly lageniform, flexuose, sometimes angled terminal cells; in the centre of the pileus a transition between a trichoderm and a cutis; subterminal cells 6–8 µm wide. Clamp-connections present in all tissues.

Orton separated *C. subtilis* from the closely related *C. lundellii* because of its somewhat broader spores (4–5 µm versus mostly > 5 µm) and the spore ornamentation (smooth in *C. lundellii* versus very minutely punctate in *C. subtilis*). As is shown in a previous paper (Senn-Irlet, 1992), *C. lundellii* has spores which are undoubtedly ornamented, bearing the same rugulose-vermiculose type of ornamentation, as can be demonstrated in *C. subtilis* (Pl. 2C, D). The faint ornamentation is even visible with the light microscope. Equally the spore size does not differ significantly between the two type collections. As a conclusion, *C. subtilis* must be regarded as a synonym of *C. lundellii*.

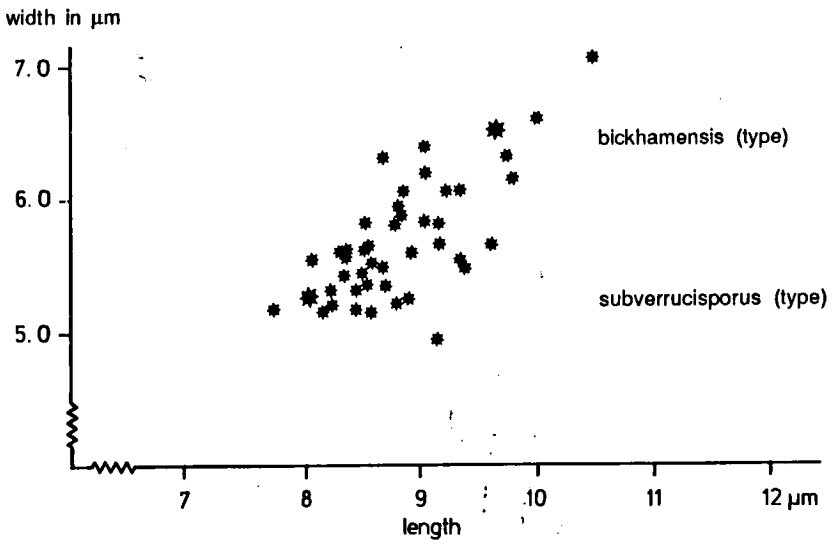

Fig. 6. Mean spore sizes of 43 European collections of *C. subverrucisporus*. The type collections are marked with larger symbols.

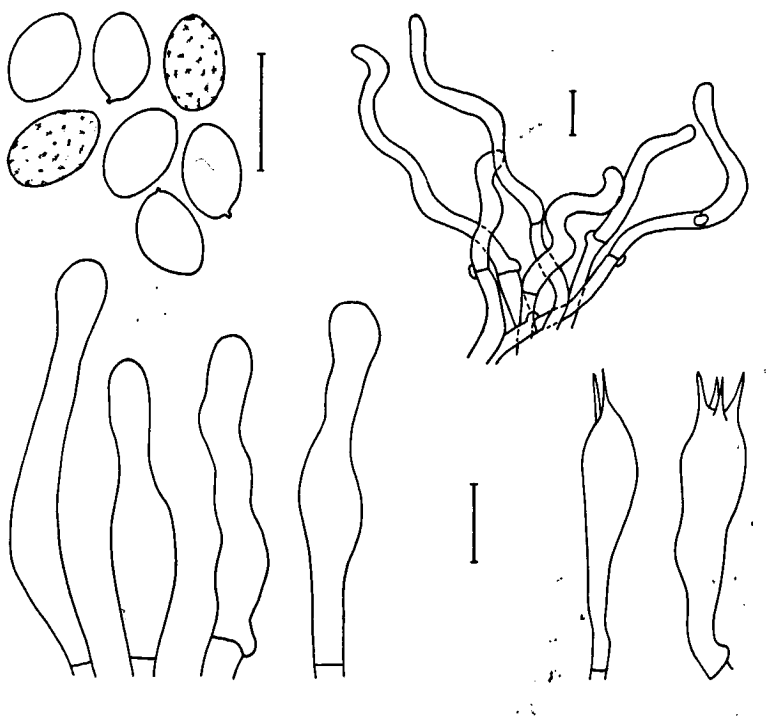

Fig. 7. *Crepidotus subtilis*. — Spores, pileipellis, cheilocystidia, and basidia.

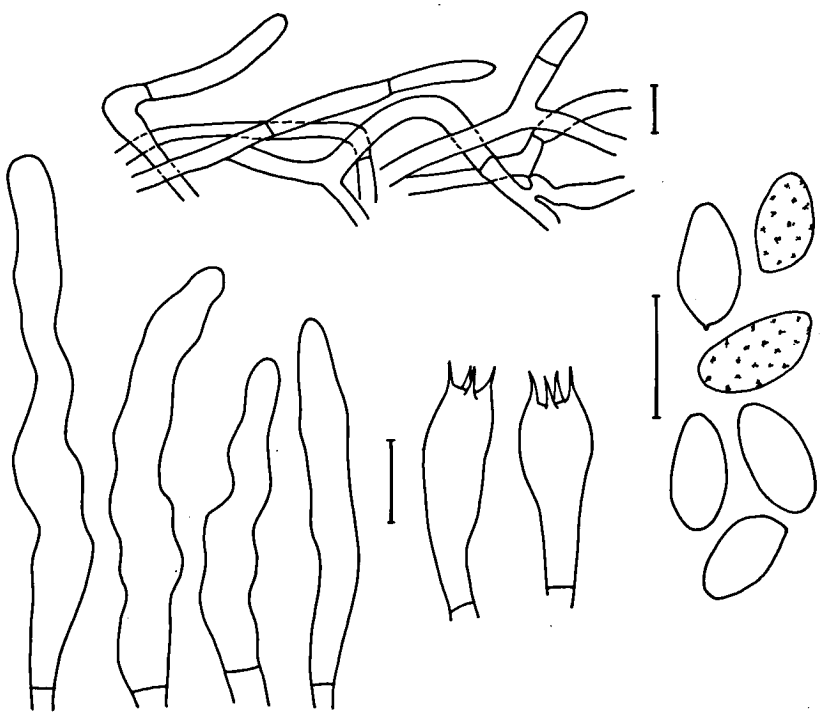

Fig. 8. *Crepidotus versutus*. — Pileipellis, cheilocystidia, basidia, and spores.

Crepidotus versutus (Peck) Sacc. — Pl. 2E, F; Fig. 8

Agaricus (Crepidotus) versutus Peck, Ann. Rep. N.Y. St. Mus. 30 (1878) 70. — *Crepidotus versutus* (Peck) Sacc., Syll. Fung. 5 (1887) 888. — Type: U.S.A., Forestburgh, Sept., *Peck* (NYS).

Spores 9–11.5 × 5–6.5 µm, Q = 1.6–2.1, av. Q = 1.87, elongate, amygdaliform in side view, with blunt apex, faintly marbled with the light microscope, rugulose in SEM; walls weakly coloured. Basidia 22–33 × 7.5–9 µm, 4-spored, clamp-less. Cheilocystidia 21–66 × 6–8 µm, cylindrical, narrowly lageniform, flexuose, hyaline, thin-walled. Pleurocystidia absent. Pileipellis a cutis of repent 3–6 µm wide, cylindrical, hyaline hyphae; terminal cells undifferentiated, straight, never coiled or branched. Clamp-connections absent in all tissues, also in the basal tomentum.

The type collection is well preserved and consists of several fruit-bodies. Already Singer (1947) and Hesler & Smith (1965) examined this collection and stressed the very faint but even with the light microscope clearly visible punctate ornamentation of the rather large spores. The SEM (Pl. 2E, F) reveals a very low ornamentation of the rugulose-vermiculose type. Such a faint ornamentation is also documented with SEM pictures of a British collection named *C. pubescens* Bres. by Pegler & Young (1972). As also the other characters of this collection agree with *C. versutus* (Peck) Sacc., there is no doubt that this species occurs also in Europe and that Peck's description has been neglected for many years by European mycologists.

ACKNOWLEDGEMENTS

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