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CORTINARIUS SUBGENUS *PHLEGMACIUM* SECTION *PHLEGMACIUM* IN EUROPE.

Descriptive part

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The taxonomy of *Cortinarius* subgen. *Phlegmacium* sect. *Phlegmacium* in Europe is emended to include 17 species, classified in three subsections: Subsect. *Triumphantes*: *C. saginus* (= *C. subvalidus*), *C. triumphans* (= *C. crocolitus*), *C. varius* (here neotypified), *C. variiformis* (= *C. luteocingulatus*), *C. tiliae* sp. nov., *C. pini* sp. nov. and *C. norrlandicus*; Subsect. *Arguti*: *C. argutus* (here neotypified), *C. fraudulosus* var. *fraudulosus*, *C. fraudulosus* var. *rosargutus* comb. nov., *C. paracephalixus* (= *C. rioussetiae*) and *C. herculeus*; Subsect. *Vulpini*: *C. vulpinus* (= *C. rufoalbus*, *C. fluryi*), *C. pseudovulpinus*, *C. maculosus*, *C. caligatus* (= *C. crustulinus*) and *C. aremoricus*. Species descriptions are provided, with emphasis on formerly little studied micromorphological characters. Most species are well delimitated and normally easily distinguished from closely related taxa. Their diagnostic characters are presented. The circumscription of a number of the species deviates from the one most frequently used, and many taxa are synonymized. Altogether, 18 species names which have been in use after 1900 are reduced to synonyms. The delimitation of the section towards the neighbouring sect. *Phlegmacioides* (= *Variecolores*) is discussed, as well as the typification of the name *Phlegmacium*.

Keywords. *Cortinarius tiliae* sp. nov., *Cortinarius pini* sp. nov., species descriptions, taxonomy.

CONTENTS

INTRODUCTION

The present contribution is the second part of a monograph of *Cortinarius* (Pers.) Gray subgen. *Phlegmacium* (Fr.) Trog. In the first part an analysis of the character variation and taxonomic structure in the section *Phlegmacium* was performed,

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including a numerical analysis of the *C. argutus* complex and a treatment of the ecology and chorology of the section (Brandrud, 1996). The present paper constitutes the descriptive part of the taxonomy in the section *Phlegmacium*.

Following Brandrud et al. (1990–95) the subgen. *Phlegmacium* is divided into 11 sections, of which sect. *Phlegmacium* (Fr.) Gillot & Lucand, together with five others, constitutes the 'backbone' of the subgenus. In the present concept, sect. *Phlegmacium* comprises species with (i) fairly warm ochraceous yellow to red-brown or pale ochre to whitish colours, (ii) greyish white to (persistently) lilac lamellae, (iii) clavate to fusiform stipe, frequently with (iv) abundant girdled to scaly universal veil. The pileipellis is normally smooth and viscid, but is frequently masked by a fibrillose to scaly veil.

Section *Phlegmacium* as here circumscribed includes elements from sect. *Phlegmacium* and sect. *Triumphantes* sensu Moser in Singer (1986), and it includes major elements from sect. *Phlegmacium* sensu Moënne-Loccoz & Reumaux (1990a) and Bidaud et al. (1994b), and from *Claricolores* sensu Kühner & Romagnesi (1953). Originally, this group was part of the much broader Friesian sect. *Cliduchii* (Fr.) Hennings, which comprised all *Phlegmacium* species with a clavate to bulbous, but never abruptly bulbous, stipe (Fries, 1838).

Earlier monographs of the subgenus *Phlegmacium* cover only a fairly limited number of the taxa treated here. Moser (1961) included seven of the presently accepted 18 taxa, whereas Orton (1955) included five species. Henry (1989) treated 12 species in a key to *Cliduchii* p.p. Brandrud et al. (1990–95), in a not yet completed photoflora, have so far included nine taxa. The species *C. argutus* Fr. and a few taxa in the *C. vulpinus* (Velen.) R. Henry group have normally been treated as part of subgen. *Sericeocybe* P.D. Orton ex Nezdojm. (= subgen. *Inoloma* (Fr.) p.p.) (Kühner & Romagnesi, 1953; Moser, 1983).

In this taxonomic part, the species are arranged in systematic order, that is in a succession of nearest neighbour taxa within each subsection.

MATERIAL AND METHODS

A total of 120 collections, mainly from Norway and Sweden, were studied fresh with complete macroscopical descriptions. These closely investigated specimens are marked with an asterisk in the lists of collections studied. The material represents on average 10 collections per taxon for the species present in N, W and C Europe. Outside N Europe, fresh material was examined from Scotland, Germany, Estonia, Switzerland, France, Italy, The Czech Republic and Hungary. Collections made by the author (abbreviated TEB in the text) are deposited in hb. O. Material included in the project *Cortinarius, Flora Photographica* (abbreviated CFP in the text) is deposited in hb. S.

Collections from Norwegian and Swedish herbaria (BG, GB, O, S, TR, UPS) were investigated, as was material (mainly type material) from the herbaria of BP, E, IB, K, L, M, MPU, and NY, and from the private herbaria of Mr A. Bidaud, G. Chevassut, J.-L. Cheype, R. Henry, J. Melot, and P. Moënne-Loccoz.

The taxonomic descriptions are based on personal observations except in the case of the macrocharacters of *C. aremoricus*, *C. herculeus*, and *C. maculosus*. The measurements are based on expanded, but never old (and then often aberrant) basidiocarps. The colour standard used is that of Cailleux (1981). Macrochemical reagents applied were 2% KOH and guaiac. The terminology of characters follows Brandrud et al. (1990), except for one aspect concerning pigment topography. Pigments giving an appearance of thickened, smooth, yellow to brown walls are termed parietal (not membranal).

Microscopical structures were observed partly from fresh material mounted in H_2O, then mounted in KOH, and partly from dried material mounted in 2% KOH. The spores were studied and measured in 2% KOH, with a × 100 oil immersion lens (achromatic Zeiss equipment). From each basidiocarp, a random selection of 10 mature spores obtained from cortina remnants were measured excluding apiculus and ornamentation. Mean values (MV) of spore length and width as well as Q-values (length/width ratio) were then calculated. Young, immature basidiocarps were avoided. For species with sufficient available material, spores from 15–30 collections were measured.

The pileipellis was studied from radial, free-hand sections, preferentially from fresh material. Wedge-like sections, ultra-thin at one end, were obtained by cutting at a slightly oblique angle. The sections were cut from c.5 × 5 × 3mm large pieces taken from young but expanded pilei, and at a position midway to the centre. The veil at the stipe surface was examined by taking a small sample from the surface of the upper girdle or outer limb of ring-like structure. Coloured parts of this upper veil girdle/ring were included if present.

Drawings of microscopical features were made by means of a camera lucida. Methanol extractable pigments were investigated by thin layer chromatography (TLC), with dried material, and developed in a water-saturated solvent-mixture of ethyl formate:formic acid:toluene (50:15:35) on silica gel aluminium plates. The position of the pigment bands on the chromatogram is indicated as relative Rf values, with the greenish yellow main pigment of *C. percomis* (phlegmacin-8′-methylether) used as a standard with rel. Rf = 0.0.

Herbarium abbreviations follow Index Herbariorum (Holmgren et al., 1981), and author abbreviations follow Kirk & Ansell (1992), except in a few cases where well-established usage is followed (see Moser, 1983; Brandrud et al., 1990–95): Max Britzelmayr is abbreviated Britz., Robert Henry is abbreviated R. Henry, Robert Kühner is abbreviated Kühn., Meinhard M. Moser is abbreviated Mos. (not M.M. Moser). Abbreviations of standard works follow 'Title abbreviations for some common mycological taxonomic publications' (Anon., 1969). The terminology of vegetation zones follows Sjörs (1963) and Noirfalise (1987).

RESULTS AND DISCUSSION

In the present study 17 species and one variety are accepted, and they are classified in three subsections: *Triumphantes* Mos. ex Moënne-Locc. & Reumaux, *Arguti* Kühn.

& Romagn. ex Brandrud & Melot and *Vulpini* Brandrud & Melot. An extensive character differentiation was found between most species (Brandrud, 1996), and except for the *C. argutus* complex, all species were well delimitated.

The species number is believed to be representative for the diversity of the section in Europe, at least north and west of the Alps, where 13 out of 14 taxa were studied from two or more countries and from more than five collections.

The majority of the species are little known and seldom treated in the literature. Seven of the species are more frequently treated, but often with conflicting circumscriptions. Except for *C. herculeus*, *C. fraudulosus* and *C. varius*, a broader species concept than usual is applied here: *C. saginus* (= *C. subvalidus* R. Henry) is emended to include *C. validus* Favre, whereas *C. triumphans* is emended to include the frequently accepted *C. crocolitus* Quél., thus comprising all *Betula*-associated variants described in the group. *Cortinarius argutus* is emended to include all reddish-staining, small-spored, *Populus*-associated variants described in various groups, whereas *C. vulpinus* is emended to comprise all *Fagus*-associated variants with red-brown pileus (= *C. rufoalbus* Kühn. and *C. fluryi* (Mos.) Mos.). Many names are reduced to synonymy with *C. fraudulosus*, but none of these names are in current use. The concept of *C. fraudulosus* applied here deviates from the most frequently used concepts mainly in the recognition of a broad-spored variety *rosargutus*.

The emendations are supported by an analysis of character variation within and between closely related taxa, especially that of variation in spore characters (Brandrud, 1996). The circumscription of the taxa are further discussed under the species descriptions.

Excluding completely inactive names older than 1900, 33 species names have been applied in the literature for the 17 here accepted species.

DELIMITATION OF SECTION *PHLEGMACIUM*

The section *Phlegmacium* is close to sect. *Phlegmacioides* (Fr.: Fr.) Brandrud, Lindström & Melot (= *Variecolores* Brandrud & Melot). These two sections constitute the bulk of *Phlegmacium* species with clavate-bulbous stipes, and they are also linked by their often fibrillose, only slightly viscid pileus, and the often yellowish KOH reaction. Section *Phlegmacioides* differs mainly in the simplex pileipellis structure, with a thick epicutis, and often strongly encrusted hyphae. Species of sect. *Phlegmacium* normally have a glabrous pileipellis under the thick veil, whereas those of sect. *Phlegmacioides* frequently have a fibrillose-tomentose pileus surface without veil remnants, and more grey brownish, rarely warm colours. The species of sect. *Phlegmacioides* are more or less violaceous when young, especially at the pileus margin and in the universal veil. These features are never seen in sect. *Phlegmacium*. Furthermore, the lilac pigment of the lamellae in sect. *Phlegmacium* is never seen in *Phlegmacioides*. Species of the latter section also show very strong macrochemical colour reactions; most species react instantly, both with bases (yellowish) and guaiac (bluish green).

A third, smaller group of species with cylindrical-clavate stipe is present in sect. *Claricolores* Kühn. & Romagn. ex Moënne-Locc. & Reumaux (= *Multiformis* R. Henry ex Moënne-Locc. & Reumaux), including taxa such as *C. claricolor* (Fr.) Fr., *C. variegatus* Bres., *C. cumatilis* Fr. and *C. praestans* (Cordier) Gillet. These differ mainly in their narrowly amygdaliform, often small and (almost) smooth spores, absence of encrusting pigment in the pileipellis and in their universal veil, normally leaving only a very fine silvery to white, frosty varnish at the pileus centre. Some of these species also have a slightly marginate bulb, a character never seen in sect. *Phlegmacium*. A few species with a clavate stipe can be found also in other sections, but these show a low resemblance with sect. *Phlegmacium* and are closely linked to species with an abruptly bulbous stipe (Brandrud et al., 1990–95).

The delimitation of sect. *Phlegmacioides* is widely accepted, whereas the species of *Claricolores* have frequently been classified together with the ones here included in sect. *Phlegmacium* (Kühner & Romagnesi, 1953; Moser in Singer, 1986).

The delimitation of sect. *Phlegmacium* in Moënne-Loccoz & Reumaux (1990a) and Bidaud et al. (1994b) is fairly similar to the present one, but includes some additional groups ('series'). According to the infrageneric classification accepted here (Brandrud et al., 1990–95) these should be placed partly in sect. *Glaucopodes* Konrad & Maubl. ex Moënne-Locc. & Reumaux ('Série *fulvoochrascens*' s. Bidaud et al., 1994b) due to presence of more or less abruptly bulbous stipes and deviating bluish colours, partly in sect. *Elastici* (Fr.) Hennings ('Série *olidus*') due to different structure and pigmentation of pileipellis and veil and partly in subgen. *Cortinarius*, sect. *Crassi* Melot ('Série *rubicundulus*, Série *pseudocrassus*') due to generally different microcharacters, including the lack of gelatinous hyphae. However, the taxonomic position of the last group still remains somewhat uncertain (see Brandrud et al., 1990–95), and it has some character resemblances to sect. *Phlegmacium*. For instance, the yellow staining reaction of *C. rubicundulus* (Rea) Pears. is reminiscent of that of *C. pseudovulpinus*, although the respective pigments are yet to be structurally elucidated.

Section *Phlegmacium*, as here understood, is fairly different from the circumscription by Moser in Singer (1986). Moser included a number of species with abruptly bulbous stipes, whereas the species with a clavate stipe and a distinctly brown veil were placed in a separate section *Triumphantes* Mos. This latter disposition is not supported by the present data, which show a gradual transition from species with a distinctly brown veil (such as *C. triumphans*) via species with a paler, ochraceous yellow veil (such as *C. variiformis* and *C. paracephalixus*) to species with a white veil (such as *C. argutus*). Moreover, species such as *C. triumphans* and *C. varius* show a very high overall similarity, in spite of their different veil colour.

DIAGNOSTIC CHARACTERS

A presentation of characters used in *Cortinarius* and their variation is given in Brandrud et al. (1990). Only the diagnostic (differential) characters of sect.

Phlegmacium will be focused on here. An analysis of character differentiation and a selection of differential characters were performed by Brandrud (1996).

Macromorphological characters

Universal veil. The universal veil is often prominent and highly differentiated in sect. *Phlegmacium*, and is regarded as the most diagnostic macrocharacter/character complex at the species level (Brandrud, 1996).

The structure of veil remnants on the pileus is dependent mainly on (i) the thickness of the initial veil, (ii) the development of a glutinous cuticle under the veil, and (iii) the speed of pileus expansion. Normally, the species have a thick, fibrillose veil cover when very young. In the glutinous and fairly quickly expanding species such as the subsect. *Triumphantes* members *C. saginus* (= *C. subvalidus*) and *C. triumphans*, the veil remnants are left mainly on the stipe, and sometimes as floating patches or scales at the pileus margin. In the less glutinous species, such as those of subsect. *Arguti*, the veil – if not exposed to very moist weather – usually remains as a thick, white fibrillose cover on the pileus. The fibrils can easily be rubbed off, revealing a glabrous, ochraceous yellow pileipellis underneath. The most extreme development is found in subsect. *Vulpini*, where species such as *C. maculosus* look more like a scaly species of *Pholiota* (Fr.) Kummer than a *Phlegmacium*. Some of these species are hardly gelatinous, and the distinction between pileipellis and the thick veil is often difficult to make.

The veil remnants on the stipe can be ring-like, volvate, peronate, girdled to scaly. The *Vulpini* species with a very abundant veil, such as *C. vulpinus* (= *C. rufoalbus*) and *C. caligatus* usually have a densely girdled to squarrose stipe with or without an annuliform zone. The upper margin of the 'volva' or ring zone is often viscid, and ochraceous brown. The often viscid ring zone is normally overlooked, or at least not mentioned in the literature, although it contradicts the old and still prevailing diagnosis of subgen. *Phlegmacium* as a group with a non-viscid stipe (but see: Moënne-Loccoz & Reumaux, 1990a; Bidaud et al., 1994b).

The well-developed universal veil in sect. *Phlegmacium* seems to be an adaptation to xerophilic conditions. Many of the species with abundant veil, such as *C. caligatus*, *C. herculeus* and *C. maculosus* are southern nemoral to Mediterranean, and grow in a warm, dry climate (see Brandrud, 1996). Others, such as *C. fraudulosus*, occur in dry microhabitats. *C. fraudulosus* is able to fruit in dry needle beds even in dry periods, and the compact and hardly expanding basidiocarps then have a very low water content.

Colours. The colours of pileus and lamellae are other taxonomically important macromorphological features (Brandrud, 1996). In sect. *Phlegmacium* the pilei vary from almost white to dark brown, with more or less warm yellow-brown or red-brown tinges. These warm colours are most developed in subsect. *Triumphantes* and are usually due to encrusting and parietal pigment of the basal part of epicutis and hypoderm.

The colour of the lamellae varies from greyish white to bright and persistently lilac-blue. Unlike the very variable and fugacious violaceous blue colours of some other sections (such as sect. *Phlegmacioides* (= *Variecolores*) and *Glaucopodes*), the lilac-blue pigment of sect. *Phlegmacium* is fairly persistent, restricted to the lamellae and shows a limited infraspecific variability. The pigment is concentrated in the hymenium and subhymenium and especially at the edge of the lamella, whereas the more fugacious violet pigments of sect. *Phlegmacioides* are found mainly in the hymenophore trama and in other parts of the basidiocarps. It is likely that these colours are caused by different pigments, but they have never been chemically elucidated. Lilac pigments with a similar topography and a high persistence are found also in sect. *Calochroi* Mos. & E. Horak.

Shape and size of the basidiocarps. Habit characters are of little taxonomic value at the species level, except for the shape of the stipe base (Brandrud, 1996). This is attenuate-(sub)radicate in many of the *Arguti* and *Vulpini* species. Closely related species are often quite identical in habit (cf. Figs 5, 8 & 13), whereas others can be distinguished in the shape of the stipe base (cf. Figs 3, 10 & 12).

Colour reactions. The sometimes remarkable staining reactions seen in sect. *Phlegmacium* may be difficult to reproduce, and are therefore not always suitable as diagnostic characters. A bright reddish, later dark bluish grey reaction can be developed in most of the species of subsect. *Arguti*, and this reaction is not seen elsewhere in the genus *Cortinarius*. But to develop this reaction, one needs young, fresh material and a great deal of patience: the basidiocarps must be strongly bruised, and then a reddish colour usually develops after one or more hours. Later a dark bluish grey colour may develop, and this represents the stable oxidation products which are formed when material is extracted and chromatographed. This colour reaction has frequently been overlooked, but was described in detail by Melot (1981) in a study of *C. fraudulosus* (as *C. argutus*), and it was mentioned by Bohus (1976) and Krisai-Greilhuber (1992) in descriptions of *C. paracephalixus*. Furthermore, the staining reaction was recorded in *C. argutus* by Moënne-Loccoz & Reumaux (1990b) and Henry (1992), both as *C. fuscotinctus*, and by Bon & Gaugue (1973 as *C. rufoalbus*).

A yellow staining reaction is characteristic of *C. pseudovulpinus*. A similar, but more weak and inconstant, reaction is seen also in *C. paracephalixus* and sometimes in *C. argutus*. These substances are not extractable with normal TLC procedures, and it is not known whether they are identical. Some species also become yellow with KOH, and these KOH-sensitive substances are now being chemically investigated in Munich (N. Arnold, pers. comm.). The species reacts negative with guaiac.

Micromorphological characters

According to character evaluation and numerical analysis (Brandrud, 1996), the micromorphological features are generally more suitable diagnostic characters than the macromorphological ones in sect. *Phlegmacium*, and the spore morphology characters appear to be especially well suited.

The spores. Spore size, shape and ornamentation structure can be used as diagnostic characters in the group (Brandrud, 1996), and the first is able to discriminate between most of the closely related taxa. The spore size variation between closely related taxa is illustrated in Figs 4, 6, 9, 11, 15, 17 & 18, and the differentiation is further commented on under each species description (see also Brandrud, 1996). According to Fig. 1 there is a high degree of similarity in spore shape and ornamentation between many of the species, but few of the most closely related taxa are identical in these characters. Most species have more or less amygdaliform to ellipsoid-amygdaliform spores, whereas some have more broadly ellipsoid ones (see also Brandrud 1996: table 3).

Pileipellis. Pileipellis structure and pigmentation are, besides the spore characters, among the taxonomically most important characters of the section (see Brandrud, 1996). The importance of these characters for the genus *Cortinarius* was pointed out by Kühner (1949), and in recent taxonomical treatments and floras of *Cortinarius* these characters are sometimes included and properly described (Høiland, 1984; Moënne-Loccoz & Reumaux, 1990a, b, 1991; Bidaud et al., 1992–95; Brandrud et al., 1990–95). Unfortunately, however, pileipellis structure and pigmentation are still very rarely used as diagnostic characters in this or related groups.

The pileipellis of the species in sect. *Phlegmacium* is more or less duplex, consisting of an epicutis above, and normally a well-developed hypoderm (subcutis) of inflated, cemented elements below (Fig. 2). The epicutis includes gelatinous, loosely arranged erect-entangled surface hyphae, and repent, parallel, non-gelatinous and often encrusted hyphae towards the hypoderm. Visually, the gelatinous hyphae ('the pellicle') appears like a distinct sublayer (see Fig. 2), but due to the high variability in the degree of development and arrangement of the gelatinous hyphae, this sublayer is treated as a part of the epicutis layer. This presently used terminology is also in accordance with that applied to other groups of *Cortinarius* (see Høiland, 1984; Brandrud et al., 1990–1995).

The pileipellis shows a high degree of differentiation at both the species and the subsection level. The hypoderm is more differentiated in subsect. *Triumphantes* than

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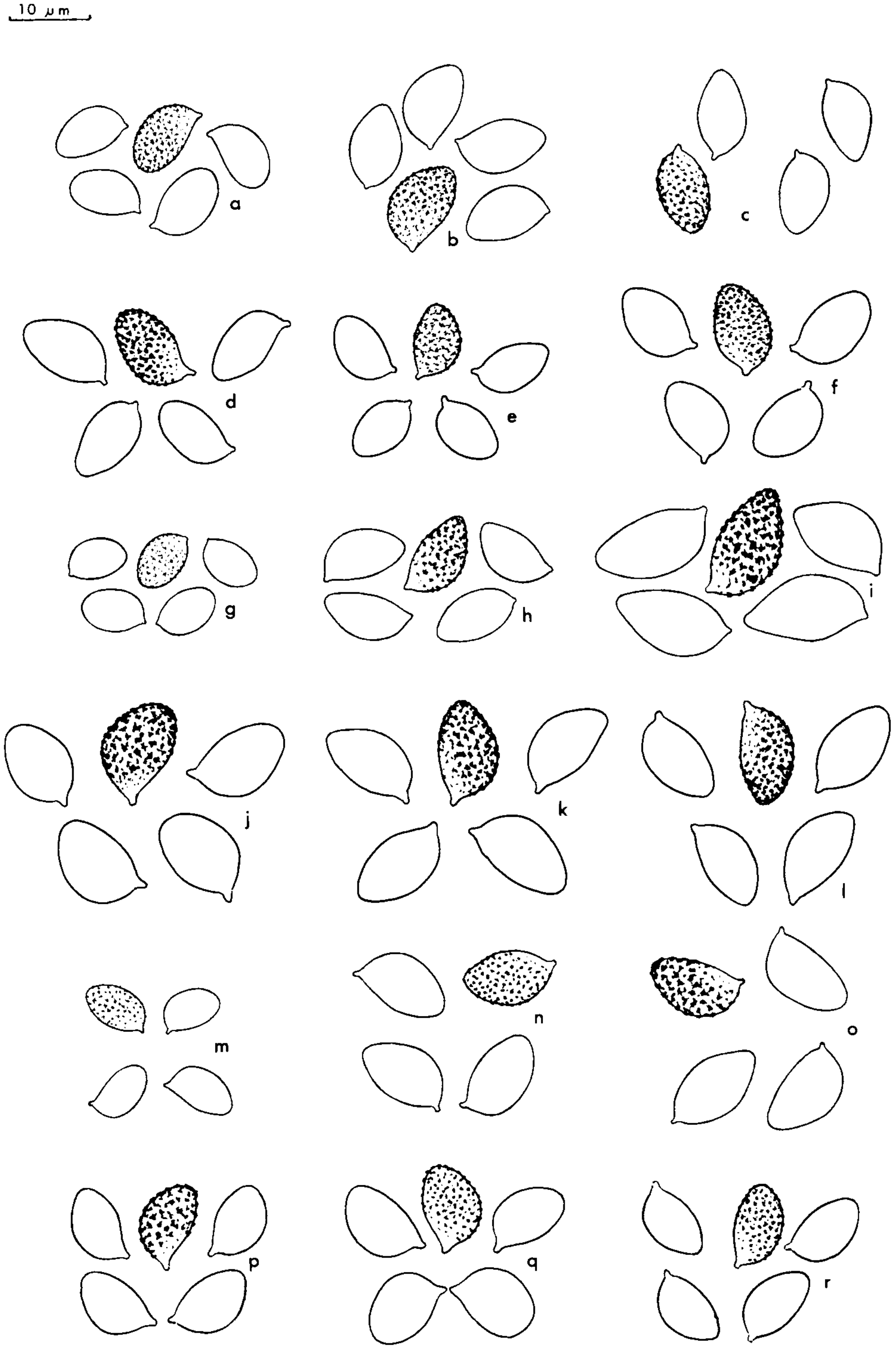
FIG. 1. Spore shape and ornamentation: (a) *C. saginus*, CFP 475; (b) *C. triumphans*, CFP 172 (neotype); (c) *C. varius*, CFP 801; (d) *C. variiformis*, *Malençon* 5311 (holotype); (e) *C. tiliae*, TEB 141-85 (holotype); (f) *C. pini*, CFP 394 (holotype); (g) *C. norrlandicus*, CFP 526 (holotype); (h) *C. argutus*, CFP 194; (i) *C. fraudulosus* var. *fraudulosus*, CFP 481; (j) *C. fraudulosus* var. *rosargutus*, *Henry* 70477 (holotype); (k) *C. paracephalixus*, *Bohus* 50.169 (holotype); (l) *C. herculeus*, *G. Gulden* 629-79; (m) *C. populinus*, CFP 642 (holotype); (n) *C. vulpinus*, CFP 781; (o) *C. pseudovulpinus*, CFP 868; (p) *C. maculosus*, *J. Melot* 86-184; (q) *C. caligatus*, TEB 139-84; (r) *C. aremoricus*, *Henry* 1045 (holotype), *J. Melot* 82-110 (3 spores to the right).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in the other subsections, often with a subcellular structure of somewhat irregular, almost isodiametric elements imbedded in a thick, brown, amber-like substance (Fig. 2). This very rigid, compact and cemented hypoderm structure sometimes gives

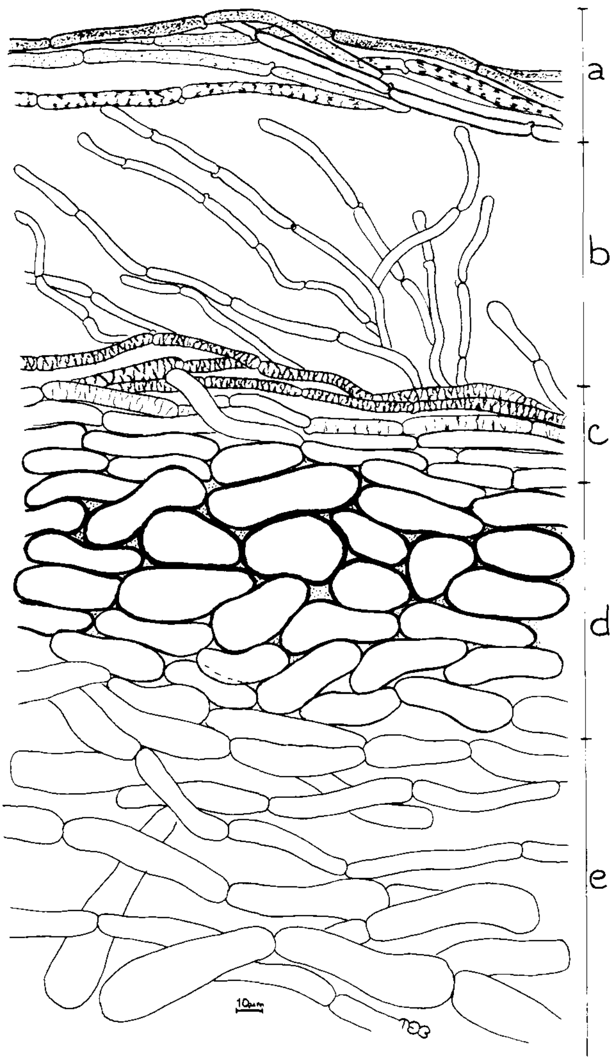

FIG. 2. Duplex pileipellis structure in sect. *Phlegmacium*. *C. saginus*, TEB 13-95. Radial section obtained midway to the pileus centre. The following features can be distinguished: (a) universal veil of hyphae with deep brown, encrusting-parietal and intracellular pigment; (b) loosely arranged, more or less erect-entangled, gelatinous hyphae in upper part of epicutis ('pellicle'); (c) basal part of epicutis with repent, frequently encrusted hyphae; (d) hypoderm (subcutis) of a subcellular structure, with inflated elements cemented in a brown, amber-like matrix; (e) trama of inflated, hyaline and more loosely arranged hyphae.

rise to a radially wrinkled-rugulose structure of expanded pilei in the species *C. varius* and *C. variiformis*.

The pigmentation is fairly uniform in the subsections *Arguti* and *Vulpini*, whereas the interspecific variation is larger in subsect. *Triumphantes*. The fairly dark yellow-brown to red-brown species *C. saginus*, *C. varius*, *C. variiformis* and *C. norrlandicus* can be distinguished by their strongly brownish, encrusting to parietal pigment in hypoderm and their distinctly encrusted hyphae in the basal part of the epicutis (Fig. 2). The encrustations become more distinct with KOH. The other species have a more pale yellow and strictly parietal pigment.

Universal veil. In subsections *Arguti* and *Vulpini* the hyphae of universal veil are normally hyaline when young, but in *Vulpini* they often develop intracellular necropigment with age, and some species also have parietal pigment. In subsect. *Triumphantes* the veil pigment is frequently well developed and has a complex topography, being encrusting, parietal and intracellular (Fig. 2). The pigmentation is often fairly different on the pileus and on the stipe. The more exposed pilei have a stronger pigmentation, and brown, encrusted veil hyphae on the pileus are frequent and observed in most species of subsect. *Triumphantes*, whereas only *C. saginus* and *C. variiformis* have encrusted veil hyphae on the stipe. Such well-developed veil pigmentation on the stipe is otherwise rare in *Phlegmacium*.

Although the encrusting veil pigment is the taxonomically most interesting, it is not the dominant kind. The colour of the veil hyphae is due mainly to an oleiferous, initially granulate, intracellular, brown to golden yellow pigment. This substance is concentrated in more or less collapsed hyphae, and is probably a necropigment, which develops very early in species such as *C. saginus* and *C. triumphans*. The dominance of intracellular necropigment contrasts the situation in other *Cortinarius* species with a brown veil, such as *C. humicola* (Quél.) R. Maire or *C. helvelloides* (Fr.) Fr. In these species the colour is due to heavily deposited, encrusting pigments.

TYPIFICATION OF *PHLEGMACIUM*

Earle (1909) chose *C. saginus* (Fr.: Fr.) Fr. as type species for subgen. *Phlegmacium*, a choice that has become widely accepted during the latest decades (see Moser in Singer, 1986). Moreover, for nomenclatural and taxonomic reasons, this is the only possible type for the name *Phlegmacium* (Brandrud et al. 1992: 26). Fries (1821) included only three species in 'Tribus' *Phlegmacium*. The first, *Ag. vibratilis* Fr.: Fr., is at present regarded as a *Myxacium*, whereas *Ag. corruscans* Fr.: Fr. and *Ag. saginus* Fr.: Fr. have usually been placed in *Phlegmacium*. *C. corruscans* is, however, hardly possible to interpret, and may also be a *Myxacium*, possibly a variant of *C. delibutus* Fr.

Two different interpretations of the name *C. saginus* exist. The first was introduced by Henry (1939), and was followed by Moser in his early works (see e.g. Moser, 1961). The other was introduced by Melot (1986), and was followed by Moser in Moser & Jülich (1985–1994), Brandrud et al. (1990–95), apparently also Bidaud et al. (1994b), and is also applied in the present study.

Cortinarius saginus was neotypified by Melot (1986) based on the second interpretation (= *C. subvalidus*), and since not in contradiction with the protologue (Fries, 1821), this typification has to be followed and the interpretation accepted (Art. 8.1.). The protologue is fairly vague, but the unpublished Friesian illustrations in the herbarium of Uppsala agree fairly well with *C. subvalidus*, although the veil is not so abundant and not so distinctly brownish as normal for this species. Furthermore, this species occurs in the part of Sweden where Fries described *Ag. saginus*, and in the kind of habitat indicated. The interpretation is discussed in more detail in Brandrud et al. (1992) and in Melot (1986).

Cortinarius saginus s. R. Henry (= *C. crassus* s. Marchand?) is a species with (sub)globose spores, a very rare feature in subgen. *Phlegmacium*. Judging from the descriptions, and from the picture of *C. crassus* in Marchand (1982), which seems to be the same species, this is a taxon with little resemblance to sect. *Phlegmacium* in the present concept. An interpretation in this direction will therefore create great taxonomic complications for the circumscription of a section *Phlegmacium*, and will lead to instability. Fortunately, such an interpretation is very improbable, since no *Phlegmacium* species with round spores is known from Scandinavia where Fries collected his fungus. Very likely *C. saginus* s. R. Henry is a southern temperate to Mediterranean species.

TAXONOMY

Cortinarius (Pers.) Gray subgen. **Phlegmacium** (Fr.) Trog sect. **Phlegmacium** (Fr.) Gillot & Lucand, Hymen.: 190 (1891).

Syn.: *Agaricus* tribus *Phlegmacium* Fr., Syst. mycol. I: 226 (1821). Type: *C. saginus* (Fr.:Fr.) Fr. (lecto., Earle 1909: 441).

Cortinarius + + *Cliduchi* Fr., Epicr. Syst. mycol.: 256 (1838) (name without priority, Art. 35.2). *Cortinarius* sect. *Cliduchi* (Fr.) Hennings in Engler & Prantl, Nat. Planzenfam., I, Abt.1**, Fasc. 181: 249 (1898). Type: *C. cliduchus* Fr. (see Art. 22.4).

Pileus glabrous and viscid-glutinous to fibrillose-appressed scaly and slightly viscid to dry, whitish, yellowish brown to red-brown; lamellae whitish to persistently lilac; stipe more or less clavate to fusiform, never with a marginate bulb; universal veil frequently (very) abundant and more or less ochraceous brown, rendering the stipe girdled-floccose and the pileus fibrillose to appressed scaly. Spores amygdaliform to ellipsoid, sometimes broadly ellipsoid, rarely citriform, distinctly and densely to fairly coarsely verrucose; pileipellis duplex, with a thin, more or less encrusted epicutis, and a more or less subcellular hypoderm with amber-like, parietal, yellow-brown pigment; pigment of veil mainly intracellular to parietal, rarely encrusting. Frequently thermophilous, xerophilous and calciphilous, with very specific mycorrhizal associations; 17 European species are here accepted.

Key to the taxa of sect. Phlegmacium

1a. Pileus glabrous and persistently viscid-glutinous (subsect. *Triumphantes*) — 2
1b. Pileus fibrillose to appressed scaly from veil and slightly viscid or dry (if glabrous and distinctly viscid-glutinous, then stipe prominently girdled-floccose of initially whitish veil) (subsections *Arguti* & *Vulpini*) — 8

2a. Stipe with prominent, brown veil girdles or scales — 3
2b. Stipe with more sparse, pale ochre to whitish veil remnants — 4

3a. Lamellae greyish white, KOH negative, spores 8.5–10 × 5–6μm, associated with *Picea abies* and (rarely) with *Pinus sylvestris* — **1. C. saginus**
3b. Lamellae initially with a faint bluish lilac tinge, KOH yellow, spores 10.5–12.5 × 6–7μm, associated with *Betula* — **2. C. triumphans**

4a. Veil distinct, usually forming a slightly ochraceous girdle — 5
4b. Veil sparse, rendering the stipe fibrillose or indistinctly girdled — 6

5a. Pileus innately fibrillose, lamellae pale (bluish) grey, spores 8.5–10 × 4.5–5.5μm, associated with *Tilia cordata* — **5. C. tiliae**
5b. Pileus not or only faintly innately fibrillose, lamellae distinctly lilac, spores 9.5–11.5 × 5.5–6.5μm, associated with *Quercus* spp. — **4. C. variiformis**

6a. Lamellae whitish, spores 8–9 × 5–6μm, associated with *Picea abies* — **7. C. norrlandicus**
6b. Lamellae with bluish lilac tinge, spores larger (9.5–11.5 × 5.5–7μm) — 7

7a. Pileus not rivulose, yellow-brown, associated with *Picea abies* — **3. C. varius**
7b. Pileus rivulose, grey-brown, associated with *Pinus sylvestris* — **6. C. pini**

8a. Lamellae white, pileus usually fibrillose, normally whitish to pale ochraceous yellow (at least when young), stipe fibrillose or girdled, young basidiocarps often turning slowly reddish then bluish when bruised (subsect. *Arguti*) — 9
8b. Lamella edge normally persistently lilac-blue (if greyish, then pileus red-brown), pileus often (appressed) scaly, normally ochraceous brown to more red-brown, stipe girdled-scaly from (very) abundant veil, never reddening (subsect. *Vulpini*) — 14

9a. Associated with *Populus* spp. — 10
9b. Associated with conifers (*Picea* or *Cedrus*) — 12

10a. Spores small (7.5–8.5 × 4.5–5μm), pileus glabrous, distinctly viscid and ochre yellow, not reddening, stipe clavate, associated with *Populus tremula* — **12. C. populinus**
10b. Spores larger (>9.5μm), pileus usually whitish fibrillose when young, normally slowly reddening when bruised, stipe often (sub)radicate — 11

11a. Associated with *Populus tremula*, mainly in N Europe, stipe fibrillose, rarely girdled, KOH negative, spores 9.5–11.5 × 5–6.5μm — **8. C. argutus**

11b. Associated with *Populus alba* (& *P. nigra*, *P. canescens*) on S & C European river plains, stipe distinctly girdled, KOH yellow, spores 11–12.5 × 6.5–7µm ______ **10. C. paracephalixus**

12a. Associated with *Cedrus atlantica*. KOH yellow, veil forming thick girdles on stipe, spores 11–12.5 × 6–6.5µm ______ **11. C. herculeus**

12b. Associated with *Picea abies*, KOH negative, never with prominent girdles ______ 13

13a. Spores amygdaliform, 12.5–14.5 × 7–8µm ______ **9.1. C. fraudulosus** var. **fraudulosus**

13b. Spores broadly amygdalif., 9.5–12 × 6.5–8µm ______ **9.2. C. fraudulosus** var. **rosargutus**

14a. Associated with *Fagus sylvatica*, pileus normally glabrous and viscid, red-brown or ochraceous white, stipe attenuate to (sub)radicate ______ 15

14b. Associated with *Quercus* or *Carpinus*, pileus often dry and fibrillose-scaly, (pale) ochraceous brown, stipe clavate to subradicate ______ 16

15a. Pileus red-brown, lamellae greyish, spores 11–13 × 6.5–7.5µm ______ **13. C. vulpinus**

15b. Pileus ochraceous white, lamellae pale lilac, spores 9–10 × 5–6µm ______ **17. C. aremoricus**

16a. Associated with *Carpinus betulus*, context staining yellowish, stipe usually with one veil girdle, cylindrical-clavate; spores 12–14 × 6.5–7.5µm ______ **14. C. pseudovulpinus**

16b. Associated with *Quercus* spp., context not staining yellowish, veil very abundant, frequently brownish, rendering the stipe repeatedly girdled-floccose, stipe often subradicate ______ 17

17a. Associated with evergreen *Quercus* spp., pileus often viscid-glabrous, ochraceous brown, spores broadly amygdaliform, spores 8.5–10 × 6–7µm ______ **16. C. caligatus**

17b. Associated with deciduous *Quercus* spp., pileus normally dry and distinctly squamulose-fibrillose from abundant, brown veil, spores 8.5–10.5 × 5.5–6.5µm ______ **15. C. maculosus**

Cortinarius subsect. **Triumphantes** Mos. ex Moënne-Locc. & Reumaux, Atl. Cortin., 1: 14 (1990). Type: *C. triumphans* Fr.

Pileus viscid to glutinous, normally glabrous, veil absent or leaving scattered, appressed scales, normally warm ochraceous yellow to red brown; lamellae greyish white to persistently lilac-blue; stipe thick girdled to fibrillose of (yellow) brown to more rarely whitish veil. Spores amygdaliform to ellipsoid, distinctly and usually fairly densely verrucose; pileipellis with a distinctly subcellular hypoderm, elements often irregular, almost isodiametric, and imbedded in a brown, amber-like matrix, basal epicutis often with distinct, brown, encrusted pigment; universal veil often with well-developed, yellow-brown, encrusted, parietal and intracellular pigment.

1. **Cortinarius saginus** (Fr.: Fr.) Fr., Epicr. Syst. mycol.: 260 (1838). **Figs 1a, 2, 3a, 4.** Syn.: *Agaricus saginus* Fr.: Fr., Syst. mycol. I: 226 (1821). *Phlegmacium saginus* (Fr.: Fr.) Ricken, Blätterpilze: 140 (1915). Type: *M. Moser* 77/98 (as *C. subvalidus* R. Henry, IB), neotype designated by Melot in Docum. mycol. 16(63–64): 130 (1986).

Cortinarius validus J. Favre, Mat. Fl. Crypt. Suisse: 214 (1948). Type: *J. Favre* GK 7878 (syn. G).

Cortinarius subtriumphans R. Henry ex P.D. Orton in Trans. Brit. mycol. Soc. 43: 212 (1960). Type: 21 ix 1956, *P.D. Orton* 981 (holo. K).

Cortinarius subvalidus R. Henry in Bull. Soc. mycol. Fr. 101(1): 11 (1985). Type: *R. Henry* 524 (holo. hb. R. Henry).

Phlegmacium subtriumphans (R. Henry) nom. inval. var. *cephalixoides* Mos. nom. inval., Gatt. Phlegm.: 352 (1961). Type: *M. Moser* 53/37 (M?).

Phlegmacium subtriumphans (R. Henry) nom. inval. var. *eriophorum* Mos. nom. inval., loc. cit. Type: not indicated.

Selected icones: Brandr. et al. (1990), *Cortin., Fl. Photogr.* 1: Pl. A01; Marchand (1982), *Champ. nord midi* 7: Pl. 654 (as *C. subvalidus*); Mos. (1961), *Gatt. Phlegm.*: Pl. XI 57 (as *Phlegm. subtriumphans*); Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 10, f. 2; Rym. & Holm. (1984), *Svampar*: 496 (as *C. subvalidus*).

Pileus (5–)6–11(–12)cm, (hemi-)spherical and sometimes with distinctly involute margin, then plano-convex, glutinous, pellicle difficult to separate, thin, almost hyaline, glabrous to faintly fibrillose with age; ochraceous brown to leather brown (M 59, L-M-N 60), more red-brown to sometimes umber brown (N 57, S 37, R 40-45) at centre, involute margin ochraceous white, colours changing little with age. Universal veil remnants usually abundant, forming brown, loose scales or patches floating in the mucus. *Lamellae*, L = 80–110(–120), crowded, 4–8(–10)mm broad, pale greyish white when young; edge even to slightly crenulate-serrulate. *Stipe* 5–10 × 1.5–2(–2.5)cm, clavate at base (→3.5cm), whitish, greyish white at apex, ochraceous white towards base, often completely brownish in lower part from veil remnants. Universal veil very abundant and prominent, ochraceous brown to rather dark brown, rendering the lower part of stipe distinctly girdled-floccose, sometimes more fibrillose-peronate. *Context* white, more greyish in stipe apex when young. KOH negative to somewhat brownish. *Smell* indistinct or yeast-like.

Spores 8.5–10 × 5–6µm (MV = 9.2 × 5.7µm), Q = 1.63 ± 0.06, ellipsoid (to slightly amygdaliform), sometimes broadly ellipsoid, finely and densely verrucose, warts sometimes very dense and more like spines, and then suprahilar plage very distinct. *Basidia* 8–9µm wide, 4-spored. *Lamella edge* partly fertile to almost sterile, with small, inconspicuous, clavate, sometimes asymmetrical sterile cells, often arising from trama hyphae diverging near edge and often running parallel to edge. *Universal veil* on stipe surface consisting of c.20–25 layers on very young basidiocarps; hyphae partly fairly wide, 3–12(–15)µm, some terminal cells inflated; hyphae frequently more or less collapsed (even in young basidiocarps); pigment strongly yellowish brown, hyphae in dark parts often filled with brown, oleiferous necropigment, but many hyphae also with yellow, thick walls; thickened septa may indicate a mainly submembranal topography; some hyphae also distinctly zebra-striped encrusted; when young with abundant, pale, intra- and extracellular granules. Universal veil on pileus surface of c.3–10 layers of parallel, 4–10(–15)µm wide hyphae, often with strongly inflated terminal segments (→15–20µm wide); with deep brown pigmentation, forming crusts, zebra-striping or smooth, thick walls; many hyphae also with pale, granulate contents. *Cortina* of 2–5µm wide, hyaline hyphae. *Pileipellis* duplex. *Epicutis* thin, of c.4–8 hyphal layers; above c.3–4 layers of (2.5–)3–6µm wide, gelatinous and loosely entangled hyphae, hyaline or with slightly thickened yellowish walls and granulate content. Basal part of epicutis (2–4 layers) of 4–10µm wide, parallel hyphae, strongly brown zebra-striped encrusted, sometimes with obliquely adscending cystidium-like terminal cells, sometimes capitate. *Hypoderm* c.100(–150)µm thick, subcellular, with almost isodiametric elements up to 25(–30)µm wide, with strong, brownish, amber-like, thick walls, pigmented layer sometimes diffracted into crust on narrower, intermixed elements. *Stipitepellis* of narrow (3–6µm wide) and parallel hyphae, some hyphae brown, filled with oleiferous pigment.

Habitat: Boreo-nemoral, boreal and montane coniferous forests. Mainly associated with *Picea abies* in oligotrophic forests of *Vaccinium myrtillus* type, often on moist slopes, sometimes amongst *Sphagnum*. Sometimes recorded in *Molinia*/*Erica*/*Vaccinium*-dominated *Pinus sylvestris* forests (SW Norway, TEB 144-82, and N Italy, TEB 317-82), which is likely to be the habitat also in Scotland (Orton, 1960 as *C. subtriumphans*; '*typus . . . in betuletis*', but type material with pine litter).

Distribution: Widely distributed in N, NW and C Europe. In Scandinavia preferentially in (south-)western, oceanic areas, with an optimum in S Norway and W Sweden (pers. obs.). On the British Isles recorded in the Scottish Highlands and the Inner Hebrides (Orton, 1960; Dennis & Watling, 1983; both as *C. subtriumphans*). The species seems to prefer oceanic areas also in C Europe and is not rare in the montane-subalpine areas of Black Forest, Schwabian-Franconian Jura, the prealps (Krieglsteiner, 1986, 1991 as *C. subvalidus*), W Alps (Kühner, 1960 as *C. subvalidus*), and Tyrol (Moser, 1961 as *Phlegm. subtriumphans*). Apparently absent from E Europe (Nezdojminogo, 1983). In Black Forest recorded mainly from areas above 900m a.s.l. (Knoch, 1972 as *C. subvalidus*), but not recorded from the uppermost subalpine forests in the Swiss Alps (see Favre, 1960). In S Norway occurring up to the timberline at about 1000m a.s.l.

Collections examined (**including macrocharacters*). NORWAY. Oppland: Lunner, TEB 224-77*, 225-77*, 235-78, 238-78*, 281-78*, 13-95; Gausdal, TEB 103-84; Søndre Land 112-84. Telemark, Fyresdal, TEB 509-80. Vestfold, Solbergvannet, *S. Aase* 12 ix 1982 (O). Østfold, Kråkerøy, *W. Ramm* 24 ix 1969 & 9 ix 1967 (O). Aust-Agder, Øyestad, *T.H. Dahl* 20 ix 1987 (O). Rogaland, Sandnes, TEB 144-82, 38-94. SWEDEN. Södermanland, Vallentuna, TEB 78-82*, Ångermanland, Säbrå, CFP 229, 404, 475*. Dalarne: Garpenberg, *P. Printz* 28 viii 1974 (as *C. subvalidus*, UPS); Smedjebacken, *S.E. Blom* 26 ix 1982 (UPS). Dalsland, Nossemark, *S. Jacobsson* 80185 (as *C. subvalidus*, GB). Västergötland, Skepplanda, *S. Jacobsson* 78238 (as *C. subvalidus*, GB). FINLAND. Pohjois Savo, Karttula, Punnonmäki, *J. Vauras* 2004 F (O). GREAT BRITAIN. Scotland, Inverness-shire, Glen Affric, Badger Falls, *P.D. Orton* 981 (as *C. subtriumphans*; holo. K, iso. E), *P.D. Orton* 980 (as *C. subtriumphans*, E). AUSTRIA. Oberösterreich, Almtal, *M. Moser* 77/98 (as *C. subvalidus*; neotype for *C. saginus*, IB). FRANCE. Doubs(?), *R. Henry* 524 (as *C. subvalidus*; holo. hb. R. Henry). ITALY. Trento, Santa Colomba, TEB 317-82*.

Comments: *C. saginus* is characterized by its abundant, brown veil remnants, forming prominent girdle(s) on the stipe and scattered, loose scales on the pileus, reminiscent of the scales of glutinous *Pholiota* species. Microscopically, the species is characterized by the strong, parietal and encrusting pigmentation of veil and pileipellis (Fig. 2). The species differs from the closely related *C. triumphans* by its darker, more red-brown pileus, greyish white, never bluish, lamellae, negative KOH reaction, smaller, more ellipsoid spores, encrusted veil hyphae on the stipe and association with conifers.

Different names have been applied to this species, of which *C. subvalidus* R. Henry and *C. subtriumphans* P.D. Orton have been the most established (Kühner, 1960; Moser, 1961, 1983; Marchand, 1982). The type and the original description of *C. subvalidus* (Henry, 1958) correspond very well with the presently described taxon (see also discussion in Kühner, 1960). The type material of *C. subtriumphans* also corresponds, both in the colours of the exsiccatum and in the microcharacters (Fig. 4). The original description is in correspondence as well, except for the indication of a deviating habitat (Orton, 1960) (see comments above). Although described with a less prominent veil and somewhat deviating spores, Melot (1986) found on examination of the type that *C. validus* Favre (1948) also is identical with our *C. saginus*. The interpretation of the name *C. saginus* is discussed above under typification of subgen. *Phlegmacium*.

2. Cortinarius triumphans Fr., Epicr. Syst. mycol.: 256 (1838). **Figs 1b, 3b, 4.**
Syn.: *Phlegmacium triumphans* (Fr.) Blytt in Skr. Vidensk.-Selsk. Christiania, Math.-Naturvidensk. Kl. 6: 68 (1905). Type: Cortin., Fl. Photogr. no. 172, neotype (S), designated in Brandrud et al., Cortin., Fl. Photogr., Vol. 1 (Swedish version): A49 (1990).

Cortinarius crocolitus Quél. in Bull. Soc. bot. Fr., 6th suppl. (25): 288 (1878). Type: not indicated.

Selected icones: Brandr. et al. (1990), *Cortin., Fl. Photogr.* 1: Pl. A49; Mos. & Jülich (1985–1994), Farbatl. Basidiomyc.: Pl. Cort. 10, f. 1; Phillips (1981), Mushr. other fungi Gr. Br. & Eur.: 130 (as *C. crocolitus*); Dähnke & Dähnke (1979), *700 Pilze*: 425; Rym. & Holm. (1984), *Svampar*: 497.

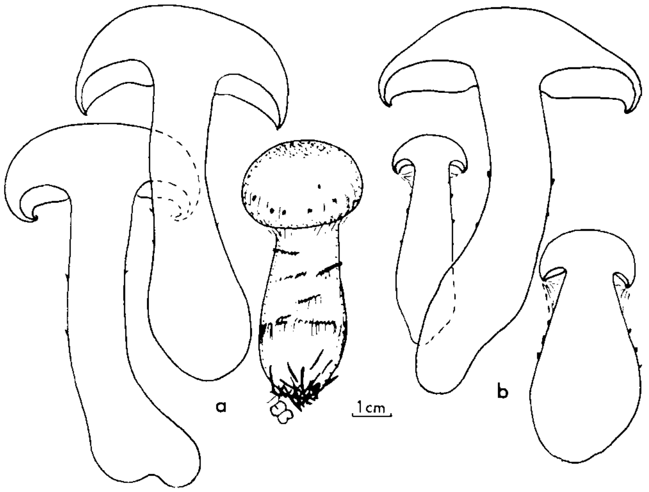

FIG. 3. (a) *C. saginus* (=*C. subvalidus*), TEB 281-78 (left), TEB 224-77; (b) *C. triumphans*, TEB 421-81.

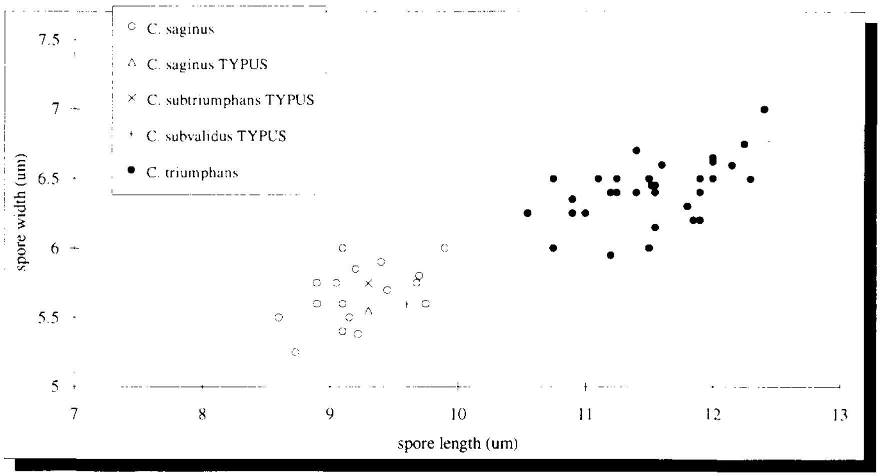

FIG. 4. Variation in spore size of *C. saginus* (=*C. subtriumphans*) and *C. triumphans*. Each symbol=MV of 10 spores measured per basidiocarp.

Pileus (5–)6–11(–12)cm, (hemi-)spherical, then plano-convex, rarely umbonate, viscid to glutinous, pellicle difficult to separate, fairly thin, distinctly pigmented; glabrous to faintly fibrillose (from veil), with age sometimes finely appressed tomentose at centre; yellow-brown, centre more (fulvous) brown, ochraceous yellow towards margin, changing little with age. Universal veil remnants usually sparse, diffusely fibrillose to diffracted scaly, but sometimes forming distinct, whitish to ochre patches near margin. *Lamellae*, L=70–100, crowded, 4–8(–10)mm broad, greyish white, normally with a lilac-bluish tinge when very young, edge often unevenserrulate. *Stipe* 7–12 × 1.5–2.5cm, at base more or less clavate (→4cm), sometimes subradicate, firm, whitish, with a yellowish tinge towards base. Universal veil very abundant, prominent, and persistent, ochraceous brown, rendering the stipe irregularly girdled to scaly-floccose, above often with a thick ring-like zone. *Context* white, with a faint yellowish tinge (most easily observed if stipe is cut transversally), stipe apex with a faint greyish tinge, sometimes even with a bluish tinge when very young. KOH bright yellow in context, except pale yellow in stipe apex. *Smell* weak to distinct and reminiscent of yeast or dough.

Spores 10.5–12.5 × (5.5–)6–7μm (MV = 11.5 × 6.4μm), Q = 1.80 ± 0.07, amygdaliform, finely to distinctly and densely verrucose, suprahilar plage ± distinct, immature spores in hymenium often abnormally long, slender (12–15(–20) × 5–7μm), irregularly fusiform and only slightly ornamented. *Basidia* 9.5–11μm wide, 4-spored. *Lamella edge* more or less fertile to almost sterile, with small, inconspicuous, clavate sterile cells. Sterile cells often arising from trama hyphae diverging near the edge and running parallel to edge. *Universal veil* on stipe surface consisting of c.20–25 layers on very young basidiocarps; hyphae partly fairly wide, 3–12μm, frequently 7–10μm, interwoven to parallel, terminal cells rarely inflated (→15μm), directed both downwards and upwards; the outermost (c.10–15) layers distinctly yellowish brown pigmented (except in 2–3cm large primordia where the veil is still white). Pigment initially connected to slightly thickened, yellow walls, but soon also developing golden yellow oleiferous necropigment, which dominates in strongly pigmented areas. Universal veil on pileus surface usually of 3–5 layers of parallel, 3–7(–10)μm wide hyphae; at primordial stage the veil may be 10–15 layers at margin; terminal cells mainly directed upwards; pigment yellowish, mainly oleiferous and intracellular, but also parietal and sometimes encrusting. *Cortina* of 2–5μm wide, hyaline hyphae, at primordial stage c.100 layers thick between pileus margin and stipe apex. *Pileipellis* duplex. *Epicutis* thin, of c.4–8 hyphal layers; above of c.3–4 layers of fairly wide, (3–)4–6(–7)μm, gelatinous hyphae, mainly erect-entangled and fairly short, consisting of 2–3 outer segments arising from the basal layers; hyaline or with slightly yellowish brown thick walls or pale, verrucose encrustations. Basal part of epicutis (2–4 layers) of parallel, 4–10(–12)μm wide, distinctly to very distinctly, yellowish brown zebra-striped encrusted hyphae. *Hypoderm* c.100(–150)μm thick, subcellular with up to 25(–30)μm wide elements; when young with a complex mixture of typical trama-like, long and inflated hyphae, and rather small, almost isodiametric elements; with distinct to strong, yellowish brown, smooth, amber-like parietal pigment, sometimes irregularly crust-like on narrower elements. *Stipitepellis* of mainly narrow (3–6μm wide) and parallel hyphae, some hyphae with brown, oleiferous necropigment.

Habitat: Nemoral to boreal and in C Europe montane forests with *Betula* spp. In Fennoscandia, *C. triumphans* is recorded exclusively in association with *Betula pendula* (= *B. verrucosa*), most frequently on more or less calcareous, dry mull soils in mixed, herb-rich or grassy secondary forests, pastured woodlands or parks (pers. obs., see also Jacobsson et al., 1991). Similar habitat requirements are described from various (sub)montane areas of S Germany (Krieglsteiner, 1986), whereas in the lowlands/coastal parts of W Europe the species is more frequently associated with *Betula pubescens* on oligotrophic, moist, peaty ground, sometimes in *Sphagnum* (Moser, 1961; Michael & Hennig, 1958–70; Bon & Gaugue, 1973; Phillips, 1981 as *C. crocolitus*). In Spain it is recorded in association with *Betula celtiberica* (Moreno et al., 1986).

Distribution: Widespread in all parts of Europe (Krieglsteiner, 1986; Brandrud, 1996). Fairly frequent in the lowlands of N Europe (Jacobsson et al., 1991; Brandrud, 1992) and most parts of W Europe (Bon & Gaugue, 1973; Orton, 1955; Bertaux, 1966; Kreisel, 1987; the last three as *C. crocolitus*). This is the only species of section *Phlegmacium* that can be regarded as more or less common in Britain including the Scottish Highlands (see Watling, 1984) and W Norway. Uncommon in C and S Europe (see Krieglsteiner, 1986), and not recorded from higher altitudes in the Alps (Moser, 1961). According to Nezdojminogo (1983) widespread in the former Soviet Union, including the Asian part. Reported also from North America (Kauffman, 1932).

The species seems to be declining in heavily polluted areas of W, C and E Europe, and is included in red data lists of The Netherlands (Arnolds, 1989; category 1, threatened by extinction), Poland (Wojewoda & Lawrynowicz, 1992) and Germany (Winterhoff & Krieglsteiner, 1984). Except for two recent records (P.-J. Keyzer, pers. comm.), the species has not been recorded since 1950 in The Netherlands (Arnolds, 1984). The species has also become rare in NW Germany (Derbsch & Schmitt, 1987).

*Collections examined (*including macrocharacters)*. NORWAY. Oppland: Nordre Land, CFP 172 (neotype)*; Lunner, TEB 300-78*, 421-81*, 40b-94*. Oslo: Sognsvann, TEB 252-78*; Grorud, 261-78*; Nordre Gravlund, *A. Bratsberg* 11 ix 1949 (O). Akershus: Fet, TEB 304-78*; Asker, *F.E. Eckblad* 20 viii 1953 (O), TEB 598-80; Bærum, *K. Bjorlykke* 17 ix 1887 (O); Frogn, *K. Østmoe* ix 1979 (O). Vestfold: Stokke, *K. Høiland* 128-78 (O); Tønsberg, *K. Høiland* 131-78 (O); Sem, *A. & T. Gjelsås* 5 x 1969 (O). Telemark: Kragerø, TEB 253-85; Porsgrunn, *G. Gulden* 23 ix 1968 (O). Østfold: Jeløya, *J. Markussen* 23 ix 1980 (O); Halden, *S. Diesen* 23 x 1966 & 7 x 1969 (O). Vest-Agder: Farsund, *G. Gulden* 28 ix 1969 (O); Lyngdal, *G. Gulden* 27 ix 1969 (O). Hordaland: Bergen, *A. Blytt* ix 1884 (O); Bergen, Åsane, *B.F. Moen* 1980 (BG); Granvin, *J. Stordal* 2007 (O); Voss, *J. Stordal* 2 ix 1948 & *J. Stordal* 5730 (O). Sør-Trøndelag, Trondheim, *S. Sivertsen* 28 viii 1973 (O). Troms, Harstad, *I. Hansen* 1 ix 1977 (O). SWEDEN. Ångermanland, Häggdånger, CFP 121, 195*. Medelpad, Stöde, *H. Lindström* 20 ix 1977 (UPS). Uppland: Uppsala, Stadsparken, *Fungi exsiccati Suecici* 546 (S); Djurö, Runmarö, *Haglund & Rydberg* 1949 (S). Dalarne, Smedjebacken, *S.E. Blom* 26 ix 1982 (UPS). Småland, Femsjö, *Haglund & Lundell* 12 ix 1948 (S), *S. Lundell* 3995-3998 (UPS). GREAT BRITAIN. Scotland: Perthshire: Calvine, Struan Wood, *R. Watling* 14493 (E), TEB 163-83*; Kindrogan, *R. Watling* 7958 (E) (both as *C. crocolitus*); Rannoch, Dall, *P.D. Orton* 4681 (E); Pitlochry, Faskally, *I. Tebbet* 8 ix 1981 (as *C. subtriumphans*, E). Inverness-shire, Tomich, *P.D. Orton* 5346, 5347, 5348 (E). Dumfriesshire, Moniave, *D.M. Henderson* 914 (E). England: Yorkshire, Kidson, *R. Watling* 22953 (as *C. crocolitus*, E). Somerset, Horner Water, *P.D. Orton* 2205 (as *C. crocolitus*, E). Surrey, Wimbledon Common, *Ch. E. Harley-Smith* 22 ix

1908 (E). GERMANY. Rheinland-Pfalz, Bad Dürkheim, *M. Moser* 58/56 (as *C. crocolitus*, IB). Bavaria, Munich, *A. Einhellinger* 12 x 1992 (as *C. crocolitus*, M).

Comments: *C. triumphans* is characterized by its prominent, thick, yellow-brown veil girdles, a feature which distinguishes it from all other *Phlegmacium* species except *C. saginus*. *Cortinarius triumphans* differs from *C. saginus* in its distinct yellow tinges (pileus margin), bluish tinged lamellae, frequently pointed stipe base, yellow KOH reaction, larger and more amygdaliform spores, lack of encrusting veil pigment (stipe) and its association with *Betula* species. *Cortinarius triumphans* may also resemble *C. paracephalixus*, but the latter differs in initially whitish veil, reddish to bluish staining reaction and the association with *Populus*.

The interpretation of *C. triumphans* Fries (1838) is straightforward, and well supported by the later published plate (Fries, 1877–1884: Pl. 141, 1). The species is frequent in Femsjö and Uppsala from where Fries described it, and since no original material exists, the species was neotypified by Brandrud et al. (1989). The neotype was described and the nomenclature discussed in Brandrud et al. (1992).

Cortinarius triumphans as here circumscribed is often treated as two species: *C. triumphans* s. str. and *C. crocolitus* (Orton, 1955; Moser, 1961, 1983; Marchand, 1982; Kreisel, 1987, etc.). The criteria for distinguishing *C. crocolitus* is not consistent in the literature, and this was thoroughly documented by Krieglsteiner (1986), who also demonstrated the widespread confusion among mycologists about this delineation. Generally, *C. crocolitus* is described as a smaller, more slender and more yellow species, referable to *C. triumphans* forma *minor* Fries (1851). Moser (1961) also used large, slender and less verrucose spores as a distinguishing character for *C. crocolitus*. In my opinion, this variant does not deserve taxonomic recognition. On the contrary, I find the *Betula* species here described as one of the more well-defined and uniform *Phlegmacium* species, a conclusion also held by Krieglsteiner (1986). Scandinavian authors (Lange, 1938; Ryman & Holmåsen, 1984; Brandrud et al., 1990; Jacobsson et al., 1991) and most contemporary French authors (except Marchand, 1982) also synonymize *C. crocolitus* with *C. triumphans* (Kühner & Romagnesi, 1953; Henry, 1958; Kühner, 1960).

According to my own observations, the most variable characters are those of size, especially the stipe length, but this variation seems strictly habitat dependent. The stipe is short, very firm and sometimes subradicate in compact clay soils, whereas it is elongated and slender in moist, peaty soils (Brandrud et al., 1990). The kind of large and slender spores described by Moser (1961) in *C. crocolitus* can often be found on the lamellae of *C. triumphans* as here circumscribed. But these are never found in spore deposits, and must be regarded as abnormal and of no taxonomic value (='proterospores' sensu Krieglsteiner, 1986; see also Brandrud et al., 1992). The dimensions of the spores in spore deposits are not more variable than those of related species (Figs 4, 6 & 11). Krieglsteiner (1986) received spore measurements from a number of collectors of *C. triumphans*. These 14 measurement series taken together give a spore size of 10–13 × 5.5–7.5µm, and this is within the variation spectrum found in the present study, based on 30 measurement series: sp. (10–)10.5–12.5(–13) × (5.5–)6–7(–7.5)µm (min/max values in parentheses). This spore variation indicates the presence of one, homogeneous *Betula*-associated taxon in this group.

3. **Cortinarius varius** (Schaeff.: Fr.) Fr., Epicr. Syst. mycol.: 258 (1838). **Figs 1c, 5a, 6.** Syn.: *Agaricus varius* Schaeff: Fr., J.C. Schaeffer, Fung. Bav. Icon., IV: 20 (1774). (Sanctioned in Fries, Syst. mycol. I: 225). *Phlegmacium varium* Wünsche, Pilze: 133 (1877). Type: Cortin., Fl. Photogr. no. 801 (S), neotype designated here (type material depicted in Brandrud et al., 1992, pl. B14).

Selected icones: Brandr. et al. (1992), *Cortin., Fl. Photogr.* 2: Pl. B14 (neotype); Dähnke & Dähnke (1979), *700 Pilze*: 432; Rym. & Holm. (1984), *Svampar*: 499; Marchand (1982), *Champ. nord midi* 7: Pl. 687.

Pileus 4–9(–10)cm, (hemi-)spherical, then plano-convex, sometimes broadly umbonate, rarely rugulose towards margin, viscid-glutinous, with somewhat waxy-greasy appearance when almost dry, glossy when dry, pellicle difficult to separate, thin, almost hyaline; glabrous, very rarely somewhat rivulose of fine hygrophanous streaks near margin; (pale) ochraceous brown to lion brown (L-M-N 60, M-N 65), more fulvous to red-brown (P 45, R-S 49, P 60, R 55) at centre, involute margin almost whitish, colours changing little with age. Universal veil remnants absent, or very rarely forming whitish patches near margin when young. *Lamellae*, L = 70–100(–110), crowded, 4–8(–10)mm broad, pale lilac-grey, distinctly lilac towards edge and in a ring at stipe apex often fairly persistent; edge even to somewhat crenulate-serrulate. *Stipe* 4–10 × 1–2cm, clavate-bulbous at base (→4cm), firm, persistently white. Universal veil sparse, white, inconspicuously fibrillose, but sometimes with a faint ochraceous white, viscid girdle. *Context* white, with a yellowish tinge in pileus and especially stipe apex when young (easily observable when stipe cut transversally). KOH deep yellow in context (except in base of stipe), red-brown on pileus surface. *Smell* indistinct or with a faint, unpleasant, somewhat yeast-like component.

Spores 9.5–11.5 × 5.5–6.5µm (MV = 10.6 × 6.2µm), Q = 1.71 ± 0.06, amygdaliform, (very) distinctly and fairly densely to sometimes coarsely verrucose, suprahilar plage weak to distinct. *Basidia* 9–11µm wide, 4-spored, lilac pigment concentrated to hymenium, especially towards edge. *Lamella edge* fertile, sometimes with small, clavate sterile cells. *Universal veil* on stipe surface of 3–10(–12)µm wide hyphae, terminal cells sometimes wider, hyaline, or sometimes narrow hyphae with golden yellow, oleiferous necropigment. Universal veil on pileus surface sparse, of c.3–8µm wide hyphae, frequently somewhat oleiferous pigmented, rarely pale verrucose to zebra-striped encrusted. *Cortina* of 2–5µm wide, hyaline hyphae. *Pileipellis* duplex. *Epicutis* thin, of 3–6 hyphal layers, at surface of 3–4µm wide, hyaline to pale verrucose, gelatinous hyphae, (2–)3–6 outer segments of hyphae more or less erect. Basal part of epicutis (2–3 layers) of 3–8(–10)µm wide, parallel, distinctly to strongly verrucose zebra-striped encrusted hyphae. *Hypoderm* (sub)cellular, of c.10 layers, elements frequently isodiametric or quite irregular, 10–20μm wide, basally up to 25(–30)μm wide; with strongly brownish, smooth, amber-like, parietal pigment, pigmentation sometimes also more crust-like, and distinctly zebra-striped, narrower hyphae are also intermixed. A transition layer to trama, of narrower, hyaline hyphae can sometimes be observed.

Habitat: Boreo-nemoral, boreal, montane and subalpine coniferous forests. Exclusively associated with *Picea*, on somewhat richer to calcareous, mull soils, often on fairly dry needle beds, not rarely in younger plantations (>25 years old).

Distribution: Widespread and common in herb-rich coniferous forests in N Europe (Ryman & Holmåsen, 1984; Brandrud, 1992) and montane areas of C and E Europe (Moser, 1961; Pilát & Usák, 1961; Krieglsteiner, 1991), reaching *Picea* forest limit at 1850m a.s.l. in the Alps (Favre, 1960), and at 1000m a.s.l. in S Norway. More or less restricted to areas with naturally occurring *Picea abies*, and absent from the lowlands of W Europe (W Norway, Denmark, N Germany, The Netherlands, W France), including all parts of Great Britain. The species is apparently rare within the former Soviet Union (Nezdojminogo, 1983). Records from W North America are doubtful; the description includes bluish tinges on stipe apex (never seen in Europe) and it was collected from an area dominated by pine, douglas fir and hemlock, apparently without spruce (Kauffman, 1932).

Collections examined (**including macrocharacters*). NORWAY. Oppland: Lunner, TEB 472-80*, 420-81*, 40b-94*; Jevnaker, TEB 334-78*. Hedmark, Ringsaker, TEB 175-80. Akershus: Nannestad TEB 368-78; Enebakk, *K. Høiland* 137-78 (O), *E. Wiborg* 6 ix 1978 (O). Buskerud: Nedre Eiker, TEB 348-82; Ringerike, *K. Høiland* 67-78 (O). Telemark, Langesund, TEB 521-80. Vestfold, Sande, Bjørkøya, *S. Åse* 3 x 1982 (O). Østfold, Rygge, *J. Stordal* 9 x 1955 (O). SWEDEN. Ångermanland: Häggdånger, CFP 801*; Säbrå, CFP 806*. Medelpad, Attmar, Sörfors, *S. Muskos* 2 x 1982 (UPS). Uppland, Börje, *S. Lundell* 19 ix 1944 (UPS). Dalarne: Borlänge, *S.E. Blom* 24 ix 1982 (UPS); Rättvik, *S.E. Blom* 27 ix 1982 (UPS). Gotland: Stenkyrka, *E. Th. Fries* 29 ix 1950 (UPS); Halla, 23 x 1950, *E. Th. Fries* (UPS). Blekinge, Fridlerstad, *Lundell & Wickland* 10 ix 1946 (UPS). Skåne, Balsberget, *L. Örstadius* 30782 (O). GERMANY. Baden-Württemberg: Trossingen, TEB 355-81*; Stuttgart, Schönbuch, *A. Bollmann* 26 x 1991 (M?). SWITZERLAND. Bern: Bulle, Jaunebach, TEB 27-91; Fribourg, Rechthalten, TEB 28-91.

Comments: *C. varius* is one of the most frequent and characteristic species of richer, preferentially calcareous coniferous forests in Europe, and it is always found in association with spruce. It is recognized by its ochraceous brown to fulvous, glossy pileus, the persistently (pale) lilac-blue lamellae contrasting the white stipe and the yellow KOH reaction. The lilac-blue colour of the lamellae (edge) can be fairly bright and persistent, or sometimes pale and rather fugacious, but usually with a narrow, lilac 'ring' at the point of stipe attachment. Microscopically the strong pigmentation of pileipellis, and the highly differentiated hypoderm of isodiametric or irregular cells is characteristic.

The oak-associated *C. variiformis* is closely related, but differs in more abundant and coloured veil with encrusting pigment and is normally smaller. *Cortinarius varius* can hardly be misidentified with any other species in subgen. *Phlegmacium*. Slender and pale variants, which have sometimes been named *C. varius* var. *decolorans* (Fr.) Mos. (see Moser, 1961), may at first sight be mistaken for the round-spored *C. delibutus* of subgen. *Myxacium*, especially if the veil is slightly viscid.

Owing to its not very obvious affinity with other *Phlegmacium* species except *C. variiformis*, *C. varius* has been placed in various taxonomic groups, for instance in sect. *Phlegmacioides* (= *Variecolores*) (Moser, 1961; Moser in Singer, 1986), or in a small 'residual group' *Varii* (Orton, 1955), whereas Kühner & Romagnesi (1953) classified it together with *C. triumphans* and *C. validus* (= *C. saginus*) in sect. *Claricolores*. In essential microcharacters, such as the pigmentation and structure of the pileipellis, *C. varius* is very similar to *C. triumphans* and *C. saginus*, and less similar to the species of sect. *Phlegmacioides*. Only the poor development of the veil, which is also responsible for the glabrous and glossy pileus surface, deviates greatly from *C. triumphans*/*C. saginus*. But in this character, there is a more or less continuous gradient from *C. varius* via *C. variiformis* to *C. triumphans*/*C. saginus*.

The name *Agaricus varius* Schaeff.: Fr. was sanctioned by Fries (1821), and according to the Code (Art. 7.20), a sanctioned name can be typified on any element in the protologue of Fries (1821). It is therefore not necessary to select the original (and not very typical) plate in Schaeffer (1770, pl. 42) as (lecto)type. The name is therefore neotypified here on representative material depicted in Brandrud et al. (1992, pl. B14).

Cortinarius varius seems to have a fairly eastern distribution in Europe, more or less following the natural distribution of *Picea abies* (Brandrud, 1996: fig. 13). The reports of *C. varius* from England are based on material from *Quercus-Corylus* forests (Orton, 1988), representing *C. variiformis*. Scottish material from *Picea* plantations deposited under the name *C. varius* (*P.D. Orton* 3454, 3455, E) are misidentifications of *C. spadicellus* Mos. Records south of the Alps (see Chevassut, 1991) are likewise doubtful and probably represent *C. variiformis*.

4. Cortinarius variiformis Malençon in Mal. & Bert., Fl. Champ. sup. Maroc I: 526 (1970). Type: *G. Malençon* 5311 (holo. MPU). **Figs 1d, 5b, 6**.
Syn.: *Cortinarius psalliotoides* Chevassut & R. Henry in Docum. mycol. 8(32): 19 (1978). Type: *R. Henry* 3154 (holo. hb. R. Henry).
Cortinarius luteocingulatus Bidaud & Fillion in Bull. Féd. mycol. Dauphiné-Savoie 31(124): 9 (1992). Type: *A. Bidaud* 91-10-260 (holo. hb. A. Bidaud).

Icones: Bidaud & Fillion op. cit.: 1, 8 (as *C. luteocingulatus*); Mal. & Bert. op. cit.: Pl. 30.

Pileus (3–)4–7cm, (hemi-)spherical, then plano-convex, rarely broadly umbonate, viscid-glutinous, with a waxy-greasy appearance on drying, fairly glossy and finely micaceous when dry, rarely rugulose, glabrous, sometimes diffusely innately fibrillose-rivulose towards margin; yellowish brown (L-M-N 60, N 65), more fulvous to

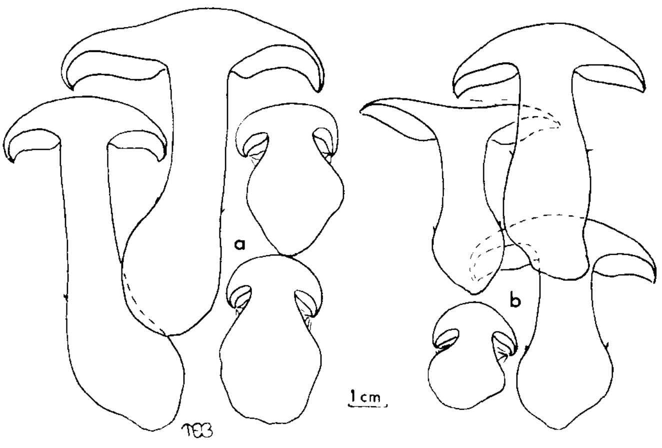

FIG. 5. (a) *C. varius*, TEB 472-80 (large specimens), TEB 355-81; (b) *C. variiformis*, TEB 162-92 (upper left), TEB 146-93 (upper right), TEB 18-86.

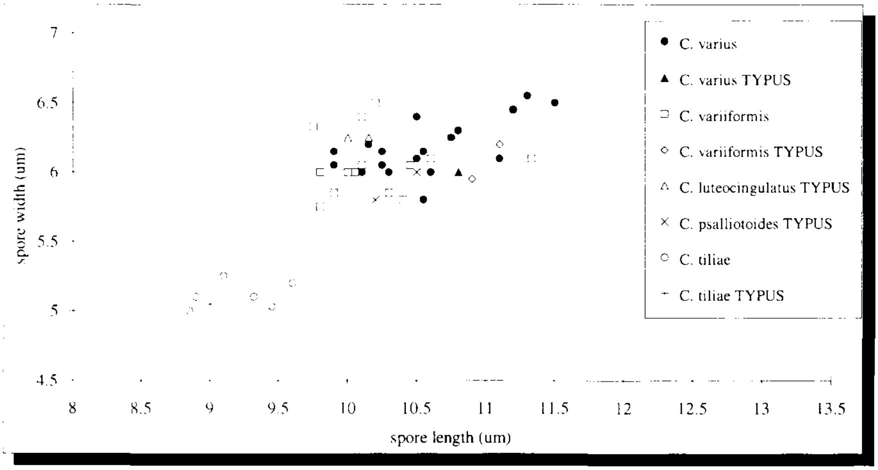

FIG. 6. Variation in spore size of *C. varius, C. variiformis* (= *C. luteocingulatus, C. psalliotoides*) and *C. tiliae*. Each symbol = MV of 10 spores measured per basidiocarp.

red-brown (P 45, R-S 49) at centre, often with a faint olivaceous ochre tinge towards margin, involute margin ochraceous white, colours changing little with age. Universal veil remnants fairly sparse, often forming a silvery white to pale ochre zone or patches near margin. *Lamellae* L = 50–80, crowded, 3–6(–8)mm broad, (pale) lilac-blue, most distinct towards edge (and towards stipe apex), lilac tinge sometimes persistent; edge even to slightly fimbriate. *Stipe* (3–)4–6(–7) × 0.8–1.6cm, often distinctly bulbous at base (→3cm), greyish at apex when young, sometimes even with a bluish reflex, otherwise rather persistently whitish. Universal veil fairly abundant, fibrillose-peronate, terminating in a volva-like, later appressed girdle 1–3cm from base, slender specimens sometimes with more girdles; whitish, upper limb of volva/girdle more or less ochraceous brown and viscid. *Context* white, greyish in stipe apex; KOH negative. *Smell* none or reminiscent of yeast or dough.

Spores 9.5–11.5 × 5.5–6.5µm (MV = 10.2 × 6.1µm), Q = 1.70 ± 0.09, amygdaliform-ellipsoid, sometimes somewhat irregularly ovoid with a faint, subapical depression, (very) distinctly and fairly densely to sometimes more coarsely verrucose, suprahilar plage more or less distinct. *Basidia* (8–)8.5–10.5µm wide, 4-spored. *Lamella edge* ± sterile, with small, clavate-cylindrical sterile cells. *Universal veil* on stipe surface of 3–10µm wide hyphae, mainly hyaline, but distinctly pigmented at upper limb of girdle/volva; hyphae partly filled with yellow-brown clumps or oleiferous content, partly with yellow walls or ± distinctly zebra-striped to irregularly verrucose encrusted. Universal veil on pileus surface of c.3–5(–7) layers, hyphae 3–10(–12)µm wide, with very distinct yellowish brown, irregularly zebra-striped to verrucose-crustulose ornamentation, sometimes with smooth yellow-brown walls, hyphae often filled with yellowish brown, granulate to oleiferous content. *Pileipellis* duplex. *Epicutis* thin, of c.5–6(–8) layers, hyphae rather wide, 4–8(–10)µm, parallel and repent in basal part, erect-entangled and gelatinous at surface; basal layers very distinctly zebra-striped, yellowish brown encrusted. *Hypoderm* subcellular and distinctly separated from epicutis and trama, elements fairly regular and parallel, more rarely irregularly interwoven, elements up to 30µm wide, with strong, yellow-brown amber-like, parietal pigment, sometimes more crustulose, sometimes with cystidium-like protrusions into epicutis. Transition layer to trama of ± narrow, parallel, hyaline hyphae.

Habitat: Mediterranean to nemoral frondose forests and woodlands. Associated with *Quercus* spp. (including *Q. ilex* and *Q. suber*), on calcareous, often dry and shallow soils, in NE Europe typically in open, grass and herb-rich, mown or grazed *Quercus-Corylus* 'woodland-meadows', in W and C Europe in *Quercus-Carpinus* forests, even steppe-like forest rims, and finally in the Mediterranean area amongst leaf litter in more closed stands of evergreen *Quercus* spp.

Distribution: Rare, but widely distributed, known from SE Sweden (mainly from the 'woodland-meadows' on the island of Gotland, pers. obs.), Estonia (Bendiksen & Bendiksen, 1992, published as *Cortinarius* (*Phlegm.*) sp.), SE Belgium (Th. Kuyper, pers. comm.), SE England (Orton, 1988 as *C. varius*), Hungary (pers. obs.), E France (Caillet & Moyne, 1984 as *C. metrodii*; Bidaud & Fillion, 1992 as *C. luteocingulatus*), S France (A. Bidaud & J. Melot, pers. comm.; Chevassut & Henry, 1978 as *C. psalliotoides*), C Italy (Quadraccia & Lunghini, 1990), Spain (Mallorca; pers. obs.) and Morocco (Malençon & Bertault, 1970).

The species is included as vulnerable in the red data list of Great Britain (Ing, 1992 as *C. varius*). Due to its rareness and decline of its habitat it should be treated on red data lists in all countries, at least north of the Alps.

Collections examined (**including macrocharacters*). SWEDEN. Västergötland: Österplana, TEB 240-82*, TEB 18-86*, CFP 363*. Drottningkullen, TEB 36-86*. Gotland: Levide, CFP 1033*; Roma, TEB 159-92*; Visne, TEB 160-92*; Lummelunda, TEB 161-92*; Stenkyrka, TEB 162-92*; Laxare, TEB 146-93*. GREAT BRITAIN. England, Somerset: near Somerton, *P.D. Orton* 5858, 5859; Thurlbear, *P.D. Orton* 6069 (all as *C. varius*, E). ESTONIA. Kalli, TEB 5-89* (leg. *E. Bendiksen*). HUNGARY. Börzsöny, Törökmező, TEB 230-94*. FRANCE. Haute-Savoie, Ain, Semine, *A. Bidaud* 91-10-260 (holo. *C. luteocingulatus*, hb. A. Bidaud). Languedoc: Bedarieux, *J. Melot* 86-221 (hb. J. Melot); St Mitre-les-Remparts, *R. Henry* 3154 (holo. *C. psalliotoides*, hb. R. Henry). SPAIN. Mallorca, Son Massip, Escorca, Lluc, TEB 147-84*. MOROCCO. Between Rabat and Casablanca, Sidi-Bettache, *G. Malençon* 5311 ('1272') (holo. hb. MPU).

Comments: *C. variiformis* is characterized by its distinct, ochre veil girdle(s), fairly small basidiocarps, yellow-brown to red-brown, glabrous pileus and pale lilac-blue lamellae. It can be distinguished from the closely related spruce forest species *C. varius* by its prominent veil girdle(s) with encrusted, yellow-brown pigment and a negative KOH reaction. The spores of *C. variiformis* (=*C. luteocingulatus*) are usually more ellipsoid(-ovoid) and often more distinctly verrucose than those of *C. varius* (Fig. 1; see also Bidaud & Fillion, 1992).

C. variiformis was originally described from Mediterranean *Quercus suber* and *Q. ilex* forests of Morocco (Malençon & Bertault, 1970). The colour plate of *C. variiformis* in Malençon & Bertault (1970) fits well with the species described here, which I have collected in both Mediterranean and nemoral *Quercus* forests. The spores of the type material also agree well (Fig. 6), but the type is in too bad a condition to allow examination of other microcharacters. The original description, however, deviates in a few aspects; the species is described as fairly large, with abundant veil, leaving fibrillose-appressed scaly remnants at the pileus centre, and a persistently lilac gill (edge). The last feature is not typical for the presently discussed species, but I have sometimes observed strong lilac colours that persist even in exsiccates. More prominent veil remnants on the pileus surface are probably to be expected if the basidiocarps develop slowly in a dry climate. Malençon & Bertault (1970) indicate a pileus size of 7–9cm, but the depicted specimens in the original publication are smaller, with pileus 4–7cm wide, which is well in correspondence with the material from Europe.

The above-described material corresponds very well with the type as well as with the excellent plates and description from E France of *C. luteocingulatus* (Bidaud & Fillion, 1992). *Cortinarius luteocingulatus* is described from temperate *Quercus* (-*Carpinus*) forests, and is regarded by the authors to be a vicariant species to the Mediterranean *Quercus* forest species *C. variiformis*. However, the name *C. variiformis* has in France been used in a sense that corresponds with *C. caligatus* (see discussion under *C. caligatus*), which makes this comparison ambiguous. This was recently confirmed by Bidaud (pers. comm.), who concludes that the Mediterranean *C. variiformis* sensu French mycologists represents two species, partly *C. caligatus* and partly *C. luteocingulatus*.

Based on an investigation of the type material, it seems that *C. psalliotoides* (Chevassut & Henry, 1978) is also conspecific with *C. variiformis*. The spores fit well, while other microcharacters are difficult to examine on the badly preserved material. The species was collected in a very dry *Quercus ilex* forest of S France, was described with a very short stipe and an *Agaricus*-like ring zone, and apparently represents a fairly abnormal development due to drought.

5. Cortinarius tiliae Brandrud, **sp. nov. Figs 1e, 6,** 7.

Pileus 5–8cm, innate fibrillosus, luteo-brunneus, reliquiis velo tenues argenteis tectus. Lamellae pallide, griseae, debiliter cyaneo-tinctae. Stipes 5–7.5 × 1–1.8cm, claviformis, albidus, e velo ochraceus floccoso-virgatus. Caro albida, in apicem stipiti grisea debiliter cyaneo-tincta. Sporae 8.5–10 × 4.5–5.5μm, amygdaliformes, interdum subellipsoideae, distincte et satis dense verrucosae. Pileicutis e stratis duplicibus formata, epicute tenui et hypodermate subcelluloso, pigmento brunneo lutescenti, incrustanti vel parietali. Habitatione sub *Tilia cordata* in solo calcareo sicco. Holotypus: TEB 141-85, Norvegia, Akershus, Bærum, Løkkeåsen, 28 viii 1985, *T.E. Brandrud* 141-85 (O).

Pileus 5–8(–9)cm, (hemi-)spherical, then plano-convex, rarely broadly umbonate, rarely rugulose towards margin, viscid, rarely glutinous, drying up easily, pellicle difficult to peel off, fairly thin, but distinctly coloured, when young (due to veil) usually dull and fibrillose, even tomentose-diffracted at centre, soon more glabrous, glossy, micaceous and innately fibrillose-rivulose, rarely with fine hygrophanous spots near margin; ochraceous yellow, yellow-brown to (pale) leather brown (M-N 60), centre darker ochraceous brown, when mature sometimes more red-brown (P 57, P 60, R 55, S 39), towards margin paler (greyish) ochre, sometimes even with an olivaceous ochre tinge, involute margin ochraceous grey-white (K 89-90), colours changing little with age. Universal veil at first fairly abundant, fibrillose, covering the entire pileus, soon more or less restricted to pale ochraceous white patches near margin, elsewhere often leaving a varnish of silver-like, fine threads, alternating with the darker pileipellis colour, and giving rise to the innately fibrillose-rivulose structure. When very young and dry, the fibrillose veil cover gives an ochraceous white colour with a peculiar greyish green tinge. *Lamellae*, L = 60–80(–90), crowded, 3–7(–8)mm broad, pale greyish to pale bluish grey, rarely with a faint lilac tinge towards edge; edge even to slightly wavy, sometimes fimbriate. *Stipe* (4.5–)5–7.5(–8.5) × 1–1.8cm, (cylindrical-)clavate (base→2.8cm), dull and fibrillose; above (the sparse) cortina zone pale greyish with a faint bluish reflex when young, whitish towards base. Universal veil fairly abundant, ochraceous white to more distinctly ochraceous brown, rendering the stipe irregularly girdled-floccose. Base often with well-developed, white mycelial strands. *Context* when very young sometimes with bluish grey hygrophanous streaks in stipe apex, otherwise whitish, faintly ochre in bulb. KOH slightly brownish in context. *Smell* faintly to distinctly of yeast or dough, when older sometimes strong and unpleasant (probably due directly or indirectly to a mould that attacks certain *Phlegmacium* species, producing a characteristic smell).

Spores 8.5–10 × 4.5–5.5μm (MV = 9.2 × 5.1μm), Q = 1.80 ± 0.05, amygdaliform,

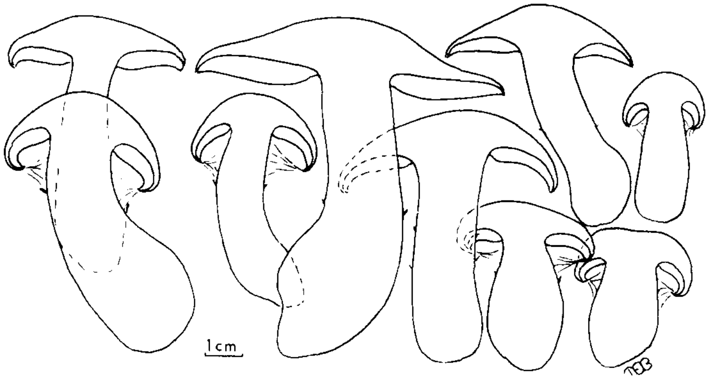

FIG. 7. *C. tiliae*. Holotype (TEB 141-85), TEB 20-92 (upper left), TEB 90-93 (lower left).

sometimes more ellipsoid, finely to distinctly and fairly densely verrucose, sometimes warts coarser, more confluent, suprahilar plage usually weak or absent. *Basidia* 8–10µm wide, 4-spored. *Lamella edge* ± fertile, with scattered, small, clavate sterile cells. *Universal veil* on stipe surface of 3–8(–10)µm wide hyphae, hyaline or with pale yellow walls. Distinctly pigmented parts with ±collapsed elements filled with golden yellow, oleiferous necropigment. Universal veil at very young pileus surface of c.4–6(–8) layers, later usually only 2–4 layers, hyphae 3–8(–10)µm, frequently collapsed and with golden yellow, granulate-oily content, some hyphae also with yellow walls. *Pileipellis* duplex, with pigment concentrated to upper part of hypoderm. *Epicutis* very thin, of c.3–6 layers, at surface with 3–7µm wide hyphae, the 2–4 outer segments normally erect-entangled, sometimes irregular, not distinctly gelatinous; hyphae hyaline or with thick, yellow, smooth to verrucose walls, sometimes with pale yellow, refractive content. Basal part of epicutis of 2–3 parallel layers, of 4–8(–10)µm wide, ±yellowish brown hyphae, pigment parietal, smooth, or as zebra-stripes or crusts; hyphae sometimes interwoven in surface of hypoderm and difficult to distinguish from this layer. *Hypoderm* subcellular of elements twice as long as wide, or elements more elongated; elements progressively larger towards trama, up to c.25µm wide, imbedded in distinct to strong, yellow-brown amber-like, parietal pigment, dark brown oleifers occur intermixed.

Habitat: Boreo-nemoral deciduous forests. In mixed *Tilia cordata-Corylus avellana* forests, usually under large *Tilia* trees, on calcareous ground, in shallow, more or less mineral soil with little or no leaf litter, partly on steep slopes with unstable, scree soil. Forming mycorrhiza with *Tilia cordata* (connection from basidiocarps via well-developed, white mycelial strands to *T. cordata* roots observed). Fruiting (in August) after wet summers.

Distribution: Hitherto known only from the innermost Oslofjord area of Norway. Due to the limited extension and the relict character of its localities, the species is included as endangered in the forthcoming, revised red data list for Norway.

Collections examined (**including macrocharacters*). NORWAY. Akershus, Bærum, Løkkeåsen, TEB 141-85 (holotype)*, 142-85*, 90-93*, 82-94*. Oslo, Bygdøy, Dronningberget, TEB 602-80*, 603-80*, 190-85*, 20-92*, 94-94*.

Comments: *C. tiliae* is characterized by its ochraceous brown, innately fibrillose pileus, (blue) greyish lamellae, the pale ochre girdled-floccose veil on the stipe and the mycorrhizal association, probably exclusively with *Tilia cordata*. It seems likely that the species is most closely related to *C. variiformis*, but it is distinguished by the fibrillose, later innately fibrillose-rivulose pileus surface structure, as well as the almost complete lack of bluish-lilac pigments on the lamellae. In contrast to *C. variiformis*, the veil girdle(s) of *C. tiliae* is never gelatinous, and the veil pigment is more purely yellow and never encrusting. Furthermore, the encrustation of pileipellis hyphae is less distinct in *C. tiliae*, and the spores are smaller.

The colours as well as the innately fibrillose pileus structure indicate a relationship to *C. pini*, which is distinguished mainly on the poorly developed veil, the larger spores, the well-developed gelatinous epicutis of narrow hyphae and the association with *Pinus sylvestris*. *Cortinarius tiliae* is also reminiscent of *C. populinus* of subsect. *Arguti*, which is mainly distinguished by its smaller spores and different habitat.

6. **Cortinarius pini** Brandrud, **sp. nov. Figs 1f, 8a, 9**.

Pileus 4–8(–10)cm, innate fibrillosus, (griseo-)brunneus. Lamellae pallide, lilaceo-griseae. Stipes 6–10 × 1–2cm, cylindrico-claviformis, albidus, apice griseo-cyane, e velo albidus fibrillosus(-cingulatus). Caro albida, ad apicem stipiti grisea debiliter cyaneo-tincta. Sporae 10–11.5 × 6–7μm, amygdaliformes-ellipsoideae, distincte et dense verrucosae. Pileicutis e stratis duplicibus formata, epicute tenui et hypodermate subcelluloso, pigmento brunneo lutescenti, parietali. Habitatione sub *Pinis sylvestribus*, inter musci in solo calcareo crescit. Holotypus: Cortinarius, Flora Photographica no 394, Norvegia, Oppland, Østre Toten, Balke, 25 ix 1985 (O, iso. S).

Pileus 4–8(–10)cm, (hemi-)spherical, then plano-convex, rarely rugulose towards margin, viscid to distinctly glutinous, pellicle fairly easily separable, thin but slightly pigmented, glabrous, ±glossy, silvery-micaceous and frequently innately fibrillose-rivulose, marbled at centre, rarely with fine hygrophanous spots or streaks near margin; ochraceous grey-brown to (pale) leather brown (P-N 65), centre darker ochraceous brown (P 49, R 45, R 49), towards margin paler ochraceous grey (L 75), involute margin ochraceous grey white (K 75), colours changing little with age. Universal veil sparse, leaving a varnish of silver-like, fine threads, alternating with the darker pileipellis colour, and giving rise to the innately fibrillose structure. *Lamellae*, L = 60–90, crowded, 4–8(–10)mm broad, pale bluish grey to pale lilac grey, soon greyish (brown); edge even to slightly crenulate. *Stipe* 6–10 × 1–2cm, slender, cylindrical-clavate, or with a rounded, sometimes irregular bulb (→2.5cm), underside often flattened; dull and fibrillose; persistently whitish, with a greyish blue tinge (at least) at apex when young. Universal veil fairly sparse to sometimes abundant, whitish, sometimes ochraceous white, rendering the stipe fibrillose to inconspicuously girdled. *Context* somewhat spongy in stipe, whitish, when young with bluish grey, sometimes ochraceous grey hygrophanous streaks in stipe apex, faintly ochre in bulb. KOH slightly yellowish in context. *Smell* none or indistinct.

Spores 10–11.5 × 6–7μm (MV = 10.7 × 6.4μm), Q = 1.67 ± 0.05, ellipsoid-amygdaliform, finely to distinctly and (very) densely verrucose, suprahilar plage sometimes (very) distinct. *Basidia* 9.5–11μm wide, 4-spored. *Lamella edge* ± fertile, with some small, clavate sterile cells. *Universal veil* on stipe surface of 2.5–7μm wide hyphae, ± hyaline. Universal veil on pileus surface of 2–4 layers, hyphae 2.5–6μm wide, hyaline, pale yellowish or with yellowish brown oleiferous to granulate content. *Pileipellis* duplex. *Epicutis* thin, of c.4–6 layers, the 3–4 outer layers gelatinous, of more or less erect-entangled, hyaline, (2.5–)3–5μm wide hyphae. Basal part of epicutis of 3–6(–8)μm wide, some hyphae with yellowish brown, granulate, cytoplasmic pigment, some also with slightly thickened, yellowish walls. *Hypoderm* subcellular, of progressively larger elements towards trama, up to c.30μm wide, with yellow-brown, amber-like, parietal pigment, some darker brown, oleifers intermixed.

Habitat: Boreo-nemoral to boreal-montane coniferous forests. Associated exclusively with *Pinus sylvestris* in mature, mixed pine-spruce(-fir) forests on mossy, calcareous ground, typically on dry shale gravel covered by deep *Hylocomium splendens* moss. Often together with *C. mussivus* (Fr.) Melot (= *C. russeoides* Mos.), *C. sulfurinus* Quél. and *C. inexpectatus* Brandrud.

Distribution: Very rare and little known, with certainty recorded only from a few localities in C Scandinavia and S Germany (pers. obs.). Distribution identical to that of *C. inexpectatus* (see Brandrud et al., 1990–95). Due to rareness, specialized habitat and probable vulnerability to clear-cutting, the species is included in the forthcoming, revised red data list from Norway. *Cortinarius pini* should be included also in the red data lists for Sweden and Germany.

Collections examined (**including macrocharacters*). NORWAY. Oppland: Østre Toten, 25 ix 1985, CFP 394 (holotype)*, TEB 348-77*, 112-85*; Jevnaker, TEB 371-78*, 261-79*, 481-80*, 551-80*, 375-82*. Buskerud, Ringerike, TEB 191-83*, 192-83*. SWEDEN. Jämtland, Andersön, CFP 617*. GERMANY. Baden-Württemberg, Baar, TEB 417-81*.

Comments: *C. pini* is a fairly anonymous species, but can be characterized by its greyish ochre, rivulose-micaceous pileus with a well-developed pellicle, pale lilac-grey lamellae, sparse veil and association with *Pinus sylvestris*. The habitus and the pileus surface structure indicate a relationship with *C. tiliae*, and perhaps also with *C. norrlandicus* (cf. Figs 7 & 8). These species are distinguished from *C. pini* by their warmer pileus colours, less developed pellicle, more or less ochraceous brown veil and smaller spores.

Cortinarius pini also resembles *C. riederi* Weinm. (= *C. fulvoochrascens* R. Henry) in sect. *Glaucopodes*. However, *C. riederi* and allied species differ in their glabrous, glossy, violaceous then brass brown staining stipe, frequently with a slightly marginate bulb. Probably the pale lilac grey pigment of *C. pini* is dissimilar to the violaceous pigment(s) in *Glaucopodes*. *Cortinarius pini* fits fairly well with the description of

C. pseudodiabolicus (Mos.) Mos. in Moser (1961), but examination of the holotype of *C. pseudodiabolicus* (*Moser* 48/856) showed it to be a different taxon with unclear affinity, having smaller spores (8–8.5 x 5µm).

7. Cortinarius norrlandicus Brandrud in Docum. mycol. 20(77): 110 (1989). Type: Cortin., Fl. Photogr. no. 526 (holo. O, iso. S). **Figs 1g, 8b, 9.**

Icon: Brandr. et al. (1990), *Cortin., Fl. Photogr.* 1: Pl. A26.

Pileus 3–8cm, (hemi-)spherical, then plano-convex, sometimes slightly umbonate, slightly viscid to completely dry, pellicle difficult to separate, fairly thin but distinctly

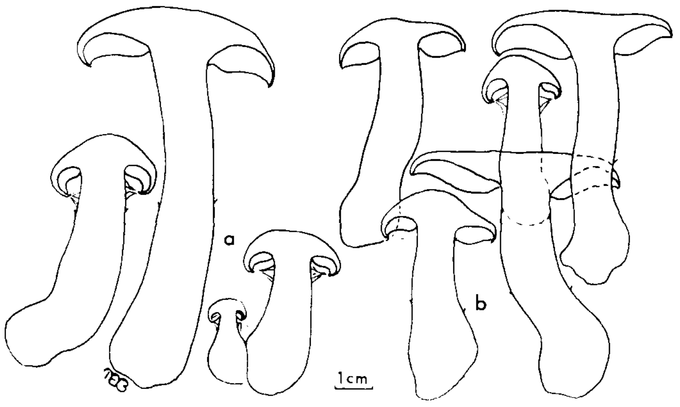

FIG. 8. (a) *C. pini.* Holotype (CFP 394); (b) *C. norrlandicus.* Holotype (CFP 526), TEB 115-84 (large specimens to the right).

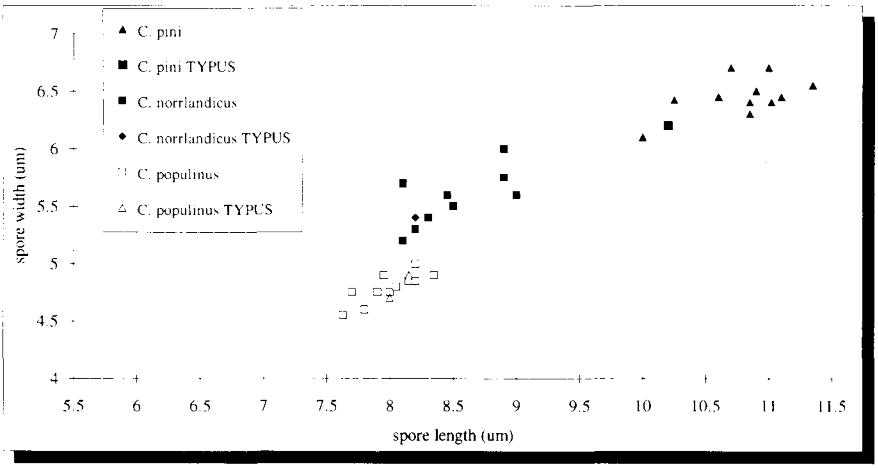

FIG. 9. Variation in spore size of *C. pini*, *C. norrlandicus* and *C. populinus*. Each symbol = MV of 10 spores measured per basidiocarp.

pigmented; more or less glabrous, dull, coarsely innately fibrillose-rivulose or with hygrophanous spots towards margin, frequently appressed tomentose-diffracted at centre; ochraceous brown, yellow-brown to leather brown (M-N-P-60), centre umber brown (P 45-47-49), involute margin ochraceous white, colours changing little with age. Universal veil fairly sparse, but often leaving whitish, fibrillose patches near margin. *Lamellae*, L = 50–80, fairly crowded, 4–8mm broad, greyish white when young; edge even. *Stipe* 3–8 × 0.5–1.5cm, cylindrical or irregularly clavate-bulbous at base (→2cm), fibrillose and dull, initially greyish white at apex, soon developing a (pale) ochraceous brown colour from base. Universal veil fairly abundant to rather sparse, whitish, paler than stipe surface, but finally becoming somewhat ochraceous brown, fibrillose or forming indistinct girdles. *Context* whitish, with an ochraceous brown tinge, especially towards base, becoming more distinctly ochraceous brown from base and when bruised; context of pileus also becomes somewhat ochraceous brown with age. KOH somewhat brownish in context. *Smell* faint, as of yeast or dough, or faintly spicy.

Spores 8–9 × 5–6µm (MV = 8.5 × 5.6µm), Q = 1.53 ± 0.05, (broadly) ellipsoid, (very) finely and (very) densely verrucose, suprahilar plage sometimes distinct. *Basidia* 7.5–9µm wide, 4-spored, sometimes filled with golden yellow ('oleiferous') necropigment, especially towards edge. *Lamella edge* fertile to almost sterile, normally with few, small, clavate (sometimes asymmetrical) sterile cells, sometimes arising from trama hyphae running parallel to edge. *Universal veil* on stipe surface of 3–7(–12)µm wide hyphae, often with pale yellow to strongly brown granulate to oleiferous (amorphous) content. Universal veil on pileus surface of 4–10µm wide hyphae, strongly brown, oleiferous pigmented, some also with yellowish brown walls, some with slightly verrucose surface. *Pileipellis* duplex. *Epicutis* thin, of c.4–7 layers, hyphae usually non-gelatinous (or gelatinous hyphae collapsed), surface hyphae remarkably wide (4–7(–10)µm), repent and irregularly entangled with some cystidium-like, ±erect terminal cells; with yellowish brown, smooth to slightly verrucose or zebra-striped walls, some also filled with oleiferous pigment. Basal part of epicutis of c.3–4 layers, forming bundles of tightly connected, 4–10(–15)µm wide hyphae, with (very) strong, brownish zebra-striped encrustations. *Hypoderm* subcellular, or sometimes rather indistinct, of gradually larger elements towards trama, basally up to 25(–30)µm wide, near epicutis of almost isodiametric 10–15µm wide elements, with strongly yellowish brown, amber-like parietal (to crust-like) pigment, some narrower intermixed hyphae may also be zebra-striped encrusted. *Pileus trama* of large, loosely interwoven elements, above with somewhat granulate, intracellular pigment, otherwise hyaline.

Habitat: Boreal coniferous forests. Associated with *Picea abies* in herb-rich, somewhat eutrophic and often moist forests.

Distribution: Very rare and apparently northern. Hitherto recorded from a few localities in C and N Scandinavia, mainly in continental areas. Probably belonging to the north-eastern taiga element. Included in the Norwegian red data list (Størkersen, 1992).

Collections examined (**including macrocharacters*). NORWAY. Oppland: Søndre Land, TEB 115-84*; Vest Torpa, CFP 231*. SWEDEN. Ångermanland, Häggdånger, Torrom, CFP 526 (holotype)*, CFP 530*, CFP 1212*.

Comments: *C. norrlandicus* is characterized by the normally dry and dull, innately fibrillose and fairly dark pileus and the absence of lilac-bluish tinges. Microscopically, the species is remarkable for its small and ellipsoid spores and the very pronounced, brown parietal-encrusting pigmentation of pileipellis. The wide, usually non-gelatinous and brown surface hyphae of the epicutis also differ from those of other subsect. *Phlegmacium* species, and resemble more the hyphae of many taxa in sect. *Phlegmacioides* (= *Variecolores*). *Cortinarius norrlandicus* possibly occupies an intermediate position between this section and sect. *Phlegmacium*, but differs from the species of sect. *Phlegmacioides* in its well-developed hypoderm, its small spores, lack of bluish pigments and lack of yellow KOH reaction.

Cortinarius subsect. **Arguti** Kühn. & Romagn. ex Brandrud & Melot in Nord. J. Bot. 10: 535 (1990). Type: *C. argutus* Fr.

Pileus viscid or not, usually fibrillose from veil when young, whitish to (pale) ochraceous yellow; lamellae normally white; stipe fibrillose or girdled; young basidiocarps often staining slowly reddish, then sometimes bluish grey when bruised, greyish blue oxidation products can be extracted. Spores amygdaliform, rarely citriform, ellipsoid or broadly ellipsoid, distinctly to sometimes fairly strongly and coarsely verrucose; pileipellis with a more or less distinct hypoderm, elements imbedded in a (pale) yellow, amber-like matrix, basal epicutis without, or with pale, indistinct, encrusted pigment; universal veil normally with hyaline, sometimes yellow, intracellular pigmented hyphae.

8. Cortinarius argutus Fr., Epicr. Syst. mycol. I: 278 (1838). **Figs 1h, 10, 11**.
Syn.: *Inoloma argutum* (Fr.) Ricken, Blätterpilze: 152 (1915). Type: *Fungi exsiccati Suecici* 2818, Sweden, Uppland, Uppsala, Nordbyskogen, *S. Lundell* 4 ix 1950, neotype, selected here (UPS).

Cortinarius opimus Fr., Epicr. Syst. mycol. I: 278 (1838). Type: not indicated.

Cortinarius fuscotinctus Rea in Trans. Br. mycol. Soc. 5: 435 (1917). Type: not indicated.

Cortinarius fraudulosus Britz. var. *radicosus* Reumaux in Bull. Soc. mycol. Fr. 96: 355 (1980). Type: *P. Reumaux* 236 (holo. hb. P. Reumaux).

Selected icones: Brandr. et al. (1990), *Cortin., Fl. Photogr.* 1: Pl. A52; Fries (1877–1884), *Icones selectae*: 151/2; Rym. & Holm. (1984), *Svampar*: 507; R. Henry (1993), *Bull. Soc. mycol. Fr.* 109: Atl. Pl. 267 (as *C. fuscotinctus* Rea); Moënne-Locc. & Reum. (1990), *Atl. Cortin.* 2: Pl. 28, 30 (as *C. argutus* var. *fulvescens* Jul. Schäff. and *C. fuscotinctus*, resp.).

Pileus 4–9(–11)cm, (hemi-)spherical, then plano-convex, rarely umbonate, viscid to non-viscid, rarely glutinous, and then easily drying out, pellicle normally very difficult to separate, thin to moderately thick, ±pigmented; universal veil moderate to rather abundant, rendering pileus surface completely (silky) fibrillose and dull, at least when young, later sometimes leaving appressed scales or patches at centre; centre sometimes also diffracted, larger specimens (when quickly expanding in moist weather) often partly devoid of veil, and these areas become more or less permanently viscid, glabrous and coarsely innately fibrillose-rivulose; completely white when young (due to veil cover masking yellow-brown pileipellis), soon ochraceous white from centre (K 71, 75-77), later (very) pale ochraceous brown to greyish ochre (L 70, 77, M 70-71), sometimes turning spotwise more leather brown, rarely even spotted with bluish grey (N 71) where damaged, glabrous specimens without veil (or if veil is rubbed off) more bright and concolorous ochraceous yellow (M-N-P 60). *Lamellae*, L = 60–100, crowded, 3–8mm broad, initially pure white, rarely with a faint pink reflex when very young, fairly persistently pale with an ochraceous brown tinge; edge even to slightly crenulate-serrulate. *Stipe* (4–)5–10(–12) × (0.8–)1.0–2.0(–2.5)cm, at base ±clavate (→3.5cm) and frequently attenuate to subradicate, rarely distinctly radicate, firm, whitish, later turning somewhat (spotwise) ochre brownish to grey brownish, frequently turning reddish pink after one hour or more, then dark bluish grey when strongly bruised or persistently handled and slowly dried (e.g. at exhibitions). Universal veil rather sparse to sometimes more abundant, persistently white and non-viscid, rendering stipe fibrillose or more rarely girdled (on specimens with short stipe). Cortina sparse when expanded. *Context* white, faintly (greyish) yellow tinged in stipe apex, sometimes distinctly yellowish towards surface of stipe, base sometimes hollow and spotted with bluish grey; when bruised the context in young, fresh specimens first becomes saffron ochre, saffron reddish after c.1 hour, and often distinctly reddish after a few hours, sometimes finally bluish grey. KOH negative, sometimes yellowish tinged towards cortex of stipe. *Smell* variable, reminiscent of yeast or dough, as well as with an earth-like component, but often more strongly unpleasant, reminiscent of *Tricholoma sulphureum*/*T. inamoenum*. *Exsiccates* of (very) young specimens frequently become spotted with (bluish) grey or grey-brown on cut surfaces (especially in stipe apex) and on the lamellae.

Extractable pigments: Extracts when fresh basidiocarps crushed, or when dry specimens extracted with ethanol dark (bluish) grey, with a greyish blue front-line on paper. Two to three greyish blue bands are developed on TLC (Rel. Rf = −0.35, +0.05, +0.08).

Spores 9.5–11.5 × 5–6.5µm (MV = 10.5 × 5.8µm), Q = 1.82 ± 0.05, strictly amygdaliform, finely to distinctly and densely, sometimes more coarsely verrucose, suprahilar plage sometimes distinct. *Basidia* 8.5–10µm wide, 4-spored, many filled with hyaline-greenish, refractive granules or oil-drops, when young also with epimembranal-extracellular granules, when mature sometimes filled with more condensed, amorphous, hyaline to brownish substance. Minute, hyaline granules often abundant in subhymenium, sometimes also in lamella trama, these granules become dark greenish, and the whole tissue appears yellowish on bluish grey discoloured lamellae (dried specimens). *Lamella edge* ±fertile, but centrally with some, or rarely many, incon-

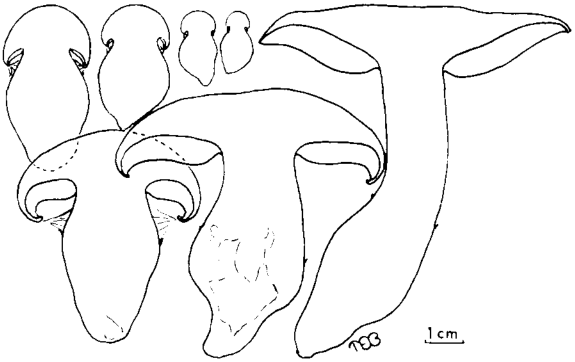

FIG. 10. *C. argutus*, TEB 23-90.

spicuous, small, clavate-cylindrical, hyaline sterile cells. *Universal veil* on stipe surface of 3–6(–8)μm wide hyphae, ±hyaline, sometimes with granulate content. *Pileipellis* ±duplex. *Epicutis* thin, of c.4–8(–10) hyphal layers. At surface with c.2–4 layers of 2–5μm wide, hyaline hyphae, when young these are ±gelatinized, loosely entangled and the outer 2–5 segments usually erect, sometimes with irregularly wavy walls, when mature often collapsed, pale yellow and non-gelatinous. Basal part of epicutis (c.2–5 layers) of parallel, more tightly connected 4–8(–10)μm wide hyphae, wider elements sometimes distinctly but pale zebra-striped encrusted, and when young and fresh with abundant intracellular, epimembranal and extracellular, hyaline, small granules. The external granules become ±washed away or dissolved with KOH, rendering the surface distinctly, pale brownish verrucose to zebra-striped encrusted. *Hypoderm* normally well differentiated, but rarely typically subcellular, elements irregularly interwoven and up to 20(–25)μm wide and tightly cemented, (pale) yellow, with amber-like, smooth, parietal pigment and hyaline granules. Sometimes the pale, amber-like substance imbedding the hyphae reaches a thickness of 1μm. Pigment concentrated to upper part and transition layers to epicutis. Irregular, ±branched, golden yellow to brown oleiferous hyphae often occur intermixed on darker, older specimens. *Pileus trama* hyaline, of inflated (up to 30–40μm wide) elements. *Stipe cortex* of parallel, narrow (3–6μm wide) hyphae, with hyaline, small intra- and extracellular granules. On dark bluish grey coloured (oxidated) spots, the hyaline granules have become dark greenish-bluish, and hyphae filled with olive yellowish oleiferous necropigment occur.

Habitat: Nemoral, boreo-nemoral and sometimes boreal-montane deciduous forests. Associated with *Populus tremula* in small, secondary forest stands, along roads, paths or in pastured woodlands with large trees of *P. tremula*, often in mixed stands with *Quercus* spp., *Betula pendula*, *Salix caprea* or other trees, on more or less calcareous, often clayey soil. The species can withstand heavy cattle trampling, due to the mycorrhiza developed 5–10cm deep (probably even deeper) in the soil.

Distribution: Locally fairly abundant in certain boreo-nemoral areas in

Fennoscandia (along the axis Oslo–Uppsala–Turku), where *Populus tremula* is frequent and increasing in the cultural landscape. Apparently rare outside N Europe, but widespread in W Europe. It is recorded from S England (Rea, 1917 as *C. fuscotinctus*), Belgium (Soop, 1987), N France (Reumaux, 1980 as *C. fraudulosus* var. *radicosus*), E France (Moënne-Loccoz & Reumaux, 1990b; Henry, 1992, both as *C. fuscotinctus*), W France (Bon & Gaugue, 1973 as *C. rufoalbus*) and SW Germany (Henry, 1992 as *C. fuscotinctus*). Distribution in C and E Europe very little known.

Collections examined (**including macrocharacters*). NORWAY. Oppland, Lunner, TEB 23-90*, 26-92*, 3-93*, 54-90*, 46-93*. Akershus: Oppegård, TEB 42-92*; Frogn, Håøya, TEB 35-94, Frogn, NW of Årungen, *E. & K.M. Bendiksen* 5 x 1995 (O). Oslo, Kjelsås, TEB 40-92*, 85-93*. Buskerud, Ringerike, TEB 18-95 (leg. *T. & M. Spolén-Nilsen*). Vestfold: Tjøme, TEB 81-82*, 85-82*; Hella, *S. Aase* 28 ix 1982 (O). Telemark, Kragerø, Skåtøy, TEB 41-86. Østfold: Hvaler, TEB 646-80*; Kråkerøy, *W. Ramm* ix 1981 (O). SWEDEN: Uppland: Uppsala, *Fungi exsiccati Suecici* 2818 (UPS, S, O; neo. UPS, selected here); Värmdö, anon. 4 x 1896 (S). Dalarne, Borlänge, *S.E. Blom* 23 ix 1982 (UPS). Medelpad, Tuna, CFP 194*, *S. Muskos* 28 ix 1982 (UPS). Ångermanland, Härnösand, CFP 1145*. FINLAND. Varsinais-Suomi, Nauvo, *J. Vauras* 1577 F (O)*. Pohjois-Savo, Kuopio, *J. Vauras* 1565 F (O)*. Etelä-Häme, Tampere, Peltolammi, *U. Söderholm* 1122*. FRANCE. Ardennes, ? Mont Dieu, *P. Reumaux* 236 (holo. *C. fraudulosus* var. *radicosus*, hb. P. Reumaux). Doubs, Germiny, *R. Henry & E. Ramm* (as *C. fuscotinctus*; hb. R. Henry). Haute-Savoie, Ain, Arlod, Semine, *P. Moënne-Loccoz* 961, 1267 (as *C. fuscotinctus*, hb. L. Moënne-Loccoz).

Comments: *C. argutus* is characterized by its initially whitish pileus, frequently (sub)-radicate stipe with sparse veil and association with *Populus tremula*. The pileus has a more or less viscid pileipellis, but this is normally covered by a dry, fibrillose veil. Microscopically, the entire subsection is characterized by a moderately developed hypoderm, abundant extracellular granules and a pale encrustation of the epicutis. The thin veil and the habitat distinguish the species from the closely related *C. fraudulosus*, *C. paracephalixus* and *C. herculeus*. *Cortinarius argutus* is further distinguished from *C. fraudulosus* var. *fraudulosus* mainly by its smaller spores (Figs 1h, i, 11), crowded lamellae and subradicate stipe (Brandrud, 1996: figs 10 & 11), from *C. fraudulosus* var. *rosargutus* by its narrower, amygdaliform (never subglobose) spores and subradicate stipe, and from *C. paracephalixus* by its paler pileus, pure white (never ochraceous) veil and negative KOH reaction. The taxonomy of the complex is discussed in detail in Brandrud (1996).

Cortinarius argutus, together with *C. fraudulosus*, *C. paracephalixus* and *C. herculeus*, is also characterized by its reddish, later bluish grey staining reaction. This is a striking feature, not seen elsewhere in *Phlegmacium*, but it should be noted that young and quite fresh material is needed to obtain this colour reaction, or sometimes these colours can be observed on damaged specimens. These limitations explain why this character is rarely mentioned in the literature (but see Moënne-Loccoz & Reumaux, 1990b and Henry, 1992, both as *C. fuscotinctus*; and Bon & Gaugue, 1973 as *C. rufoalbus*).

Fries (1838) described *C. argutus* from the Uppsala area, where the species is fairly well known (Lundell & Nannfeldt, 1979; Ryman & Holmåsen, 1984; Melot, 1986). *Cortinarius argutus* in the sense applied here seems to have been in continuous use in Sweden from Fries via S. Lundell to contemporary mycologists. The protologue in Fries (1838) and the plate (Fries 1877–1884; pl. 151, 2) fit, except that the reddish reaction is not mentioned. The plate shows a pale fungus with the characteristic, subradicate stipe. This Swedish tradition is the only prevailing and active interpretation, and the name is therefore neotypified here, on material from *Fungi exsiccati Suecici* (Lundell & Nannfeldt, 1979). This material is well distributed, typical (see numerical treatment in Brandrud, 1996), and taken from Fries' collecting grounds near Uppsala. Material deposited in hb. UPS is selected as neotype.

This *Populus tremula*-associated fungus is poorly known outside N Europe, usually described under names other than *C. argutus* (*C. fuscotinctus* Rea, *C. fraudulosus* var. *radicosus* Reumaux, etc.). Many extra-Scandinavian descriptions of *C. argutus* seem to be literature compilations ('*C. argutus* s. Ricken'), or the name is used for the *Picea* forest species *C. fraudulosus* (Lenz, 1968; Melot, 1981) or a taxon in the *C. urbicus* Fr.-*C. diosmus* Kühn. group (Chevassut & Henry, 1978). Following Fries (1838), the species has been placed in subgen. *Sericeocybe* (=*Inoloma*) by most authors (see Kühner & Romagnesi, 1953; Chevassut & Henry, 1978; Moser, 1983). The position of *C. argutus* in subgen. *Phlegmacium* and its affinity to taxa such as *C. fraudulosus* was thoroughly discussed and documented by Melot (1981, 1986), and has been followed by Brandrud et al. (1990), Moënne-Loccoz & Reumaux (1990b as *C. argutus* var. *fulvescens*) and Bidaud et al. (1994b).

C. fuscotinctus Rea (1917), described as a pale fungus with a reddening, then blackening, radicate stipe and spores 9–10 × 5µm, is obviously a synonym for *C. argutus*, although the species is described 'in quercetis' (no original material is kept at K). Material seen of *C. fuscotinctus* sensu Moënne-Loccoz & Reumaux (1990b) and Henry (1992, 1993) covers the present species as well, with exsiccata more or less spotted with black, and with abundant pigment-granules of *C. argutus* type in the hymenium. In the former case, the material comes from a forest ('Forét de Semine') where *Populus tremula* is present (Bidaud, pers. comm.); in the latter case, remnants of *Populus* leaves were present on the exsiccatum. *Cortinarius fuscotinctus* var. *sanguinolentus* Moënne-Loccoz & Reumaux (1990b) is not a taxon in the *C. argutus* group, and probably represents *C. spilomeus* (Fr.: Fr.) Fr. *Cortinarius argutus* has also been described under the name *C. fraudulosus* var. *radicosus* Reumaux (1980), from the French Ardennes. The spore dimensions on the type correspond with *C. argutus* as here circumscribed (Fig. 11), and the material was collected in an area of mixed *Betula-Fraxinus* forests with *Populus tremula* (Reumaux, 1980).

A study of their types showed that both *C. ovargutus* Chevassut & R. Henry (1978) and *C. laetargutus* Chevassut & R. Henry, as well as *C. argutus* s. Chevassut & R. Henry (1978), all represent small-spored taxa in the *C. urbicus*-*C. diosmus* group.

Typical *C. argutus* is apparently not reported from North America. However, *Cortinarius hedyaromaticus* Cripps & O.K. Miller (1994), a recently described, whitish taxon from *Populus tremuloides* stands in western North America, obviously belongs to the *C. argutus* complex ('. . . bruising vinaceous . . . gray-violet . . . ; . . . stipe . . . tapered . . .'). According to the protologue, it conforms precisely with *C. argutus* in all characters except a strong, sweetish smell. The major diagnostic character in the complex, the spore size, shows no differentiation (MV = 10.4 × 6.0µm of *C. hedyaromaticus*). With character differentiation (only?) in one character, and with an apparently considerable geographical isolation, *C. hedyaromaticus* should probably be treated as a subspecies of *C. argutus*.

9. Cortinarius fraudulosus Britz., Hym. Südbayern: 122 (1885).

Syn.: *Phlegmacium fraudulosum* (Britz.) Mos., Gatt. Phlegm.: 157 (1961). *Cortinarius argutus* Fr. subsp. *fraudulosus* (Britz.) Brandrud & Melot, in Melot in Docum. mycol. 20(77): 94 (1989). Type: not indicated.

Cortinarius fucilis Britz., Hymen. Südbayern: 126 (1885). Type: not indicated.

Cortinarius percognitus Britz. in Bot. Centralbl. 27: 5 (1892). Type: not indicated.

Cortinarius odoratissimus Britz., Hymen. Südbayern: 204 (1894). Type: not indicated.

Cortinarius argutus Fr. var. *fulvescens* Jul. Schäff. nom. inval., in Ber. Bayer. bot. Ges. 27: 219 (1947). Type: not indicated.

9.1. Cortinarius fraudulosus var. **fraudulosus. Figs 1i, 11, 12.**

Syn.: *Cortinarius fraudulosoconnatus* R. Henry in Bull. Soc. mycol. Fr. 105(2): 136 (1989). Type: *R. Henry* 1121 (holo. hb. R. Henry).

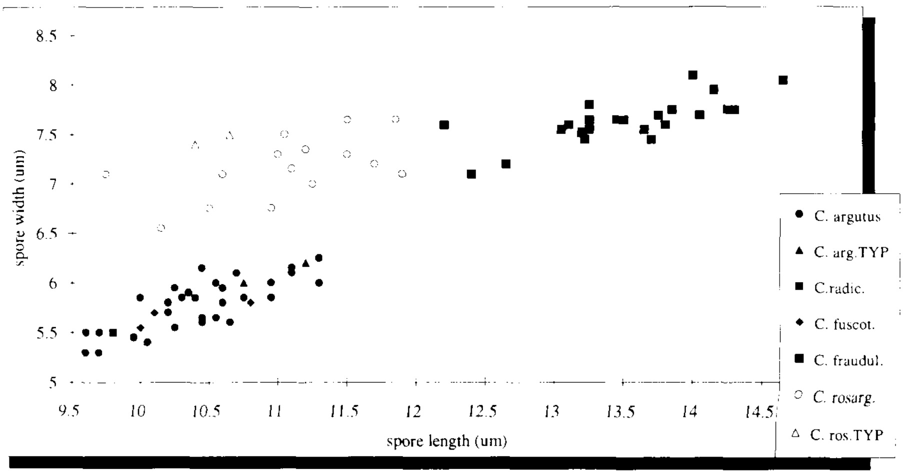

FIG. 11. Variation in spore size of *C. argutus* (= *C. fuscotinctus* sensu Henry & Ramm, abbr. *C. fuscot.* and *C. fraudulosus* var. *radicosus*, abbr. *C. radic.*), *C. fraudulosus* var. *fraudulosus* and *C. fraudulosus* var. *rosargutus* (*C. ros.*). Each symbol = MV of 10 spores measured per basidiocarp.

Cortinarius parafraudulosus R. Henry op. cit.: 135. Type: *R. Henry* 3052 (holo. hb. R. Henry).

Phlegmacium fraudulosum (Britz.) Mos. var. *tenuifolia* W. Gams & Mos. in Mos., Gatt. Phlegm.: 352 (1961). *Cortinarius fraudulosus* Britz. var. *tenuifolius* (W. Gams & Mos.) Mos., Röhrl. Blätt., Bd. IIb/2, in Kl. Kryptog. Fl., 3rd ed.: 289 (1967). Type: *M. Moser* 52/55 (holo., M?).

Selected icones: Brandr. et al. (1990), *Cortin., Fl. Photogr.* 1: Pl. A07; Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 11, f. 2; Mos. (1961), Gatt. Phlegm.: Pl. IX 43a,b.

Pileus 3–9(–11)cm, hemispherical to distinctly spherical, often with somewhat flattened top and sides, then plano-convex, viscid to non-viscid, rarely glutinous, and then easily drying out; universal veil moderate to abundant, rendering the pileus surface completely (silky) fibrillose and dull, at least when young, often with thick, loose patches at margin, later sometimes leaving appressed scales/patches at centre; centre often also diffracted, larger specimens (when quickly expanding in moist weather) often devoid of veil, and then more distinctly viscid-glutinous, glabrous and coarsely innately fibrillose-rivulose or with hygrophanous spots; completely white when young, soon ochraceous white from centre (K 71, 75-77), later (very) pale ochraceous brown to greyish ochre (M 69-70-71), rarely staining blackish brown or even bluish grey where damaged, specimens without veil (or if veil is rubbed off) more bright and concolorous ochraceous yellow (M 60-65). *Lamellae*, L=40–80, moderately crowded to distant, 4–10mm broad, initially pure white, rarely with a faint pink reflex when very young, fairly persistently pale with a ochraceous brown tinge; edge even to crenulate-serrulate. *Stipe* (5–)6–11 (–13)×0.8–2.0(–3.0)cm, often irregular, at base ±clavate (→4.0cm), frequently attenuate and sometimes subradicating, firm, whitish, later turning more or less (grey) brownish, frequently turning reddish pink, then dark bluish grey one hour or a few hours after being strongly bruised or persistently handled and slowly dried (e.g. at exhibitions). Universal veil abundant, when young sometimes very abundant, persistently white and non-viscid, forming 1–2 (or more) lanate girdles, girdles remaining distinct due to their persistently whitish colour contrasting with the stipe surface which turns brownish. Cortina sparse when expanded. *Context* white, faintly greyish yellow tinged in stipe apex, base sometimes hollow and with bluish grey spots; very young and fresh specimens may turn slightly yellowish or pink when cut, and when bruised or scraped young specimens first become saffron ochre, saffron reddish after c.1 hour, and often distinctly pinkish red after a few hours, sometimes finally bluish grey. KOH negative. *Smell* variable, normally reminiscent of yeast or dough, as well as with an earth-like component, but often more strongly unpleasant, reminiscent of *Tricholoma sulphureum*/*T. inamoenum*. *Exsiccates* of (very) young specimens frequently become spotted with (bluish) grey or grey-brown on cut surfaces (especially in stipe apex) and on the lamellae.

Extractable pigments: Extracts (when fresh basidiocarps crushed, or when dry specimens extracted with ethanol) dark (bluish) greyish, with a greyish blue front-line on paper. Two to three greyish blue bands are developed on TLC (Rel. Rf= −0.35, +0.05, +0.08).

Spores (12–)12.5–14.5 × 7–8µm (MV=13.5 × 7.6µm), Q=1.78±0.04, amygdaliform, sometimes faintly citriform, rarely more ellipsoid, (very) distinctly and densely to fairly coarsely verrucose, apex often smooth (due to confluent warts), suprahilar plage often distinct. *Basidia* 10–12µm wide, 4-spored, with hyaline, refractive, intracellular, epimembranal and extracellular granules, with age often filled with hyaline-greenish to brownish substance. Minute, hyaline granules also abundant in subhymenium, sometimes also in lamella trama, these granules become dark greenish, and the whole tissue appears yellowish on bluish grey discoloured lamellae (dried specimens). *Lamella edge* ±fertile, with some small, clavate sterile cells. *Universal veil* on stipe surface of 3–8µm wide hyphae, ±hyaline. *Pileipellis* normally duplex. *Epicutis* thin, of c.3–7(–10) hyphal layers. At surface with c.2–4 layers of (2–)2.5–5µm wide, hyaline hyphae, when young these are more or less gelatinized, loosely entangled and the outer 2–5 segments usually erect, sometimes with irregularly wavy walls, when mature often collapsed, and then pale yellow and non-gelatinous. Basal part of epicutis (c.2–4 layers) of parallel, more tightly connected, (3–)4–8(–10)µm wide hyphae, wider elements frequently pale zebra-striped-verrucose encrusted, and when young and fresh with abundant intracellular, epimembranal and extracellular, hyaline, small granules. The external granules become ±washed away or dissolved with KOH, rendering the surface distinctly, pale brownish verrucose to zebra-striped encrusted. *Hypoderm* normally well differentiated, c.5–10 layers thick, but rarely typically subcellular; elements irregularly interwoven and up to 20(–25)µm wide and tightly cemented, with (pale) yellow to more rarely darker brown, up to 1µm thick walls, due to an amber-like, smooth, parietal pigment (concentrated to upper part),

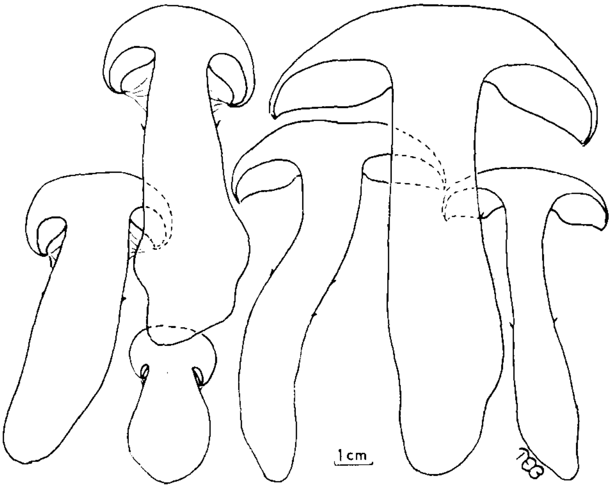

FIG. 12. *C. fraudulosus* var. *fraudulosus*, TEB 68-88 (left), TEB 18-90.

hyaline granules also present. Irregular, ±branched, golden yellow to brown oleiferous hyphae often occur intermixed, especially on darker, old specimens. *Pileus trama* of inflated (up to 30–40µm wide) elements, hyaline, with scattered intra- and extracellular granules. *Stipe cortex* of parallel, narrow (3–6µm wide) hyphae, with hyaline, small intra- and extracellular granules and ±yellowish necropigment. Dark blackbluish coloured (oxidated) spots with greenish-bluish staining granules, and hyphae filled with olive yellowish oleiferous necropigment.

Habitat: Boreo-nemoral and (boreal-)montane coniferous forests. Associated with *Picea abies*, often in forests mixed with *Pinus* or *Abies*, mainly in mature stands. On dry, calcareous soil, in deep needle litter, frequently in large groups.

Distribution: Widespread, but not reported from W Europe (W France, British Isles, The Netherlands, N Germany, Denmark and W Norway). Locally fairly frequent in calcareous, montane areas of C Europe (Tyrol, Moser, 1961; Black Forest, Knoch, 1972; pers. obs.) and on the island of Gotland (pers. obs.). Recorded east to Estonia (Shutshukin, 1992 as *C. rosargutus*), the St Petersburg area and Byelorussia (Nezdojminogo, 1983). In the Alps apparently occurring more or less to the spruce forest limit (1800m a.s.l.; Favre, 1960, but this report could include var. *rosargutus*), in S Scandinavia not recorded higher than 350m a.s.l. Included in the Norwegian and Swedish red data lists (Størkersen, 1992; Aronsson et al., 1995).

Collections examined (**including macrocharacters*). NORWAY. Oppland: Lunner, TEB 87-93*; Jevnaker, TEB 338-78*, 429-81*, 68-88*, 18-90*; Gran, TEB 106-93*; Østre Toten, TEB 220-77*; Biri, TEB 122-85*. Buskerud, Ringerike, TEB 288-79, 19-95. Sør-Trøndelag, Trondheim, Bjørnåsen, TEB 249-79. SWEDEN. Uppland: Börstil, CFP 481*, CFP 235*; Djurö, *Rydberg & Haglund* 21 x 1951 (S). Västergötland, Medelplana, S of Hällekis, TEB 234b-82, 31-86. Gotland: Tjaukle, TEB 53-90*; Stenkumla, *E. Th. Fries* 22 ix 1950 (UPS). GERMANY: Baden-Württemberg, Donau-Eschingen, Wolterdingen, TEB 85-91*, *A. Bollman* 1990 (M?).

Comments: This polymorphic species is characterized by its pale, fibrillose and fairly dry pileus, large spores and association with *Picea abies*. *Cortinarius fraudulosus* var. *fraudulosus* is distinguished from var. *rosargutus* mainly by its larger and narrower, amygdaliform spores (Figs 1i, j, 11) and occurrence in calcareous forests. When young, the species is sometimes easy to recognize by its pileus shape, being rather spherical with slightly flattened top and sides, reminiscent in shape and colour of a young *Agaricus abruptibulbus* (Fig. 12). Melot (1986) and Brandrud et al. (1990) regarded *C. fraudulosus* as an infraspecific taxon of *C. argutus*. However, according to a numerical analysis (Brandrud, 1996), these taxa are completely distinguished on spore size, and show clear differences also in macromorphological characters such as number of lamellae, veil structure and shape of stipe base (Brandrud 1996: figs 6–11), and should thus be regarded as separate species. As in the case of *C. argutus*, the complex reddish(-blackish) staining reaction has rarely been observed and commented upon (but see Melot, 1981 as *C. argutus*).

Together with species such as *C. odorifer* and *C. varius*, *C. fraudulosus* var. *fraudulosus* is one of the most characteristic and frequent *Phlegmacium* taxa of dry, calcareous, coniferous forests of C Europe. Like *C. varius*, it may often occur in forests dominated by *Abies* or *Pinus*, but is always found on the needle bed under a *Picea* tree. *Cortinarius fraudulosus* is the most frequent species in the *C. argutus* complex, and due to its variability (pileus glabrous-viscid and ochraceous or dry-fibrillose and whitish, stipe slender or robust and bulbous, subradicate or not, reddening or not), it has been described under at least a dozen different names. For a further discussion on the synonymy, see Melot (1981, 1986). The species is apparently absent from W Europe. The report from Britain by Phillips (1981) represents *C. vulpinus* (= *C. rufoalbus*), and the same probably applies to the report of *C. fraudulosus* from W France (Bon & Gaugue, 1973). The North American material depicted in Phillips (1991) under the name *C. fraudulosus* probably represents a non-European species with a red-brown pileus reminiscent of *C. vulpinus* and with a sparse veil.

Based on an interpretation of the protologue of Britzelmayr (1885), Henry (1989) concluded that the name *C. fraudulosus* was not applicable for the present species, and he gave it a new name (*C. parafraudulosus* R. Henry). However, although the protologue of *C. fraudulosus* is vague, and the original plate depicts a slender, clavate, brownish species, I cannot find clear contradictions to the current concept. The characteristic, large spores are indicated by the author (12–14 × 6–8µm), as well as a yellow reddish context. Britzelmayr (1885), furthermore, described *C. fraudulosus* as a frequent taxon of calciphilous, coniferous forests, a statement which characterizes the presently discussed taxon, and does not fit well with any other slender, clavate, large-spored *Phlegmacium* known to me. A rejection of the name *C. fraudulosus* would also lead to great nomenclatural complications and instability, because a dozen other name candidates already exist (see Melot, 1986). The name *C. fraudulosus* is well established and widely accepted amongst mycologists today, and I see no serious reason to change this tradition.

9.2. Cortinarius fraudulosus var. **rosargutus** (Chevassut & R. Henry) Brandrud, **comb. nov. Figs 1j, 11, 13a.**

Basionym: *Cortinarius rosargutus* Chevassut & R. Henry in Docum. mycol. 8(32): 34 (1978). Type: *R. Henry* 70477 (holo. hb. R. Henry).

Pileus 4–7cm, (hemi-)spherical, then plano-convex, sometimes slightly umbonate, sometimes with persistently decurved margin, viscid or not, universal veil usually rendering the pileus surface completely fibrillose when young; ochraceous white to uniformly ochraceous yellow (L 60-M 69), never completely white when young, later (pale) ochraceous brown to greyish ochre (M 60-65, L-M 69). *Lamellae*, L = 45–70(–100), crowded to fairly distant, 3–6mm broad, initially pure white, edge even to crenulate-serrulate. *Stipe* 5–9 × 0.7–1.5cm, often irregular, cylindrical or slightly clavate at base (→2.5cm) and ±attenuated, whitish, later becoming (spotwise) pale ochraceous brown, turning slightly yellowish when bruised. Universal veil abundant, dry or sometimes sticky, forming 1–2 (or more) girdles, sometimes a ring-like zone, whitish, or (upper) girdle ochraceous yellow. *Context* white, with slightly greyish yellow hygrophanous streaks in stipe apex, young and fresh specimens may turn slightly yellowish or rarely pinkish when bruised, a few greenish blue (oxidated) spots observed in cavities. *Smell* somewhat unpleasant, normally reminiscent of yeast or dough. *Exsiccates* of (very) young specimens develop a ±grey brownish colour on cut surfaces; bluish grey tinges observed once.

Spores 9.5–12 × 6.5–7.5(–8)μm (MV = 11.0 × 7.2μm), Q = 1.51 ± 0.08, fairly polymorphic, broadly ellipsoid-amygdaliform, sometimes subglobose, unripe spores on the lamellae more regularly amygdaliform, distinctly and densely to fairly coarsely verrucose, suprahilar plage sometimes ±distinct. *Basidia* 9–10(–11)μm wide. *Epicutis* basally of long and fairly wide elements, 4–10(–14)μm. *Hypoderm* often subcellular, elements up to 25(–30)μm wide.

Habitat: Boreal coniferous forests. Associated with *Picea abies*, mainly in oligotrophic-mesotrophic spruce forests, frequently growing in old ants' nests, sometimes also on mossy, richer soil.

Distribution: Rare but widespread in Scandinavia, apparently more frequent to the north and in somewhat montane forests. In C and W Europe known only from two localities in E France, probably more widespread but overlooked in C Europe.

Collections examined (**including macrocharacters*). NORWAY. Oppland: Lunner, TEB 84-88*; Aust-Torpa, TEB 82-84, 83-84. Hedmark, Elverum, TEB 250-81*. Aust-Agder, Valle, TEB 48-88*. Nord-Trøndelag: Levanger, TEB 206-79*, 207-79*; Steinkjer, TEB 307-85. SWEDEN. Medelpad, Njurunda, *R. Lidberg* 27 viii 1977. FRANCE. Ain, Brenod, Jalinard, TEB 58-91*. Haute-Doubs, *R. Henry* 70477 (holo. hb. R. Henry).

Comments: The above description includes only character variations that differ from those of var. *fraudulosus*. The var. *rosargutus* is distinguished from the other taxa in the *C. argutus* group mainly by its broadly ellipsoid to sometimes subglobose spores (Fig. 1j). This character may easily be overlooked if spores are measured from the

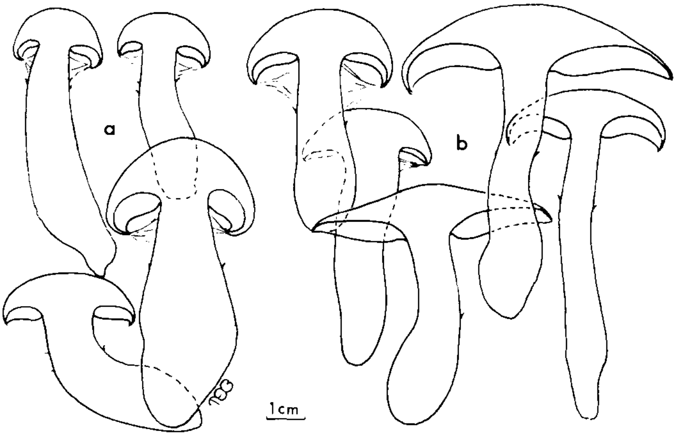

FIG. 13. (a) *C. fraudulosus* var. *rosargutus*, TEB 48-88, TEB 58-91 (lower right); (b) *C. populinus*. Holotype (CFP 642), TEB 156-79 (two specimens to the right).

lamellae, where more narrow, amygdaliform spores of the var. *fraudulosus* type are found intermixed. The spores and basidia are also normally smaller than those of var. *fraudulosus*, but otherwise these varieties are very similar. Based on the fairly limited material seen fresh (nine collections) var. *rosargutus* seems to be less variable in habit than var. *fraudulosus*. Normally, var. *rosargutus* is a fairly small and slender taxon, with the habit of *C. populinus* (Fig. 13), and it has a more ochraceous yellow pileus than var. *fraudulosus*. Furthermore, var. *rosargutus* often has an ochraceous colour on the veil girdles not seen in var. *fraudulosus*, but more material is needed to see if this feature is constant. Finally, a reddish to blue greyish staining reaction is more difficult to develop in var. *rosargutus*. The variation in the diagnostic characters is further discussed in connection with the numerical treatment.

Both varieties seem strictly associated with *Picea abies*, and normally occur in deep needle litter. Var. *fraudulosus* is calciphilous, whereas var. *rosargutus* seems to occur mainly in oligotrophic-mesotrophic forests, but frequently in ants' nests, which represent a less acid microhabitat.

The type material of *C. rosargutus*, having comparatively small and wide spores (Fig. 11), clearly represents the present taxon, but it was never the intention of the authors to describe this particular variant by the name *C. rosargutus*. In fact, *C. rosargutus* was described as a nomen novum for *C. argutus* s. Ricken, focusing on the following diagnostic characters: (i) strong, unpleasant smell, (ii) reddening context, (iii) very large spores (up to 15µm long) and (iv) habitat in coniferous forests (Chevassut & Henry, 1978). This diagnosis clearly covers *C. fraudulosus* s. lat. The name *C. rosargutus* is somewhat misleading because both *C. argutus* and *C. fraudulosus* var. *fraudulosus* turn rose or reddish more distinctly and more easily than the present taxon.

Cortinarius rosargutus has been reported from the calcareous island of Vormsi in Estonia (Shutshukin, 1992), but this report very likely refers to var. *fraudulosus*, which is frequent on the adjacent island of Gotland in Sweden (pers. obs.).

10. Cortinarius paracephalixus Bohus in Ann. Hist.-nat. Mus. Nat. Hung. 68: 52 (1976). Type: *G. Bohus* 50.169 (holo. BU). **Figs 1k, 14a, 15**.
Syn.: *Cortinarius rioussetiae* Chevassut & R. Henry in Docum. mycol. 16(63–64): 103 (1986). Type: *R. Henry* 84.70 = 78 (hb. R. Henry).

Pileus 5–8(–10)cm, plano-convex with or without a slight umbo, sometimes with persistently decurved margin, viscid, when young white fibrillose to appressed scaly from universal veil, later often more glabrous, sometimes innately fibrillose-rivulose, whitish, later ochraceous brown with ochraceous yellow margin. *Lamellae*, L = 60–80, crowded, whitish, then pale ochraceous brown; edge even. *Stipe* 5–10 × 1–1.5cm, slightly clavate at base (→2cm), frequently subradicate, whitish, turning somewhat ochre brownish from base, and ±yellowish when bruised. Universal veil remnants abundant, white, then turning ochraceous brown, rendering the stipe girdled-scaly, sometimes with a prominent ring zone. *Context* whitish, turning slightly yellow when cut, and often reddish and finally bluish black when (strongly) bruised; 2% KOH yellow in pileus context. *Smell* somewhat pleasant, corn-like when cut, soon unpleasant, strong, reminiscent of that of *C. variecolor* (earth-like), but also with a component like that of *Tricholoma lascivum*. *Exsiccates* of (very) young specimens may become spotted with (bluish) grey on cut surfaces.

Spores (10.5–)11–12.5 × (6–)6.5–7µm (11.7 × 6.8µm), Q = 1.71 ± 0.06, amygdaliform, distinctly and fairly densely verrucose. *Basidia* 9–11µm wide, 4-spored. *Lamella edge* ± fertile, with only scattered, small, clavate sterile cells. *Universal veil* on stipe surface of 3–10µm wide hyphae, hyaline or with pale golden yellow to sometimes darker brown oleiferous necropigment. *Pileipellis* duplex. *Epicutis* of c.5–8 hyphal layers, at surface of 2.5–5µm wide, ± hyaline, gelatinous hyphae. Basal part of epicutis of parallel and wider hyphae (4–8µm), sometimes very wide hyphae up to 15µm can be found, some hyphae, especially the wider ones, (very) distinctly yellowish brown encrusted. Some hyaline (intra- and extracellular) granules also observed (probably more abundant on fresh material). *Hypoderm* ± subcellular, elements progressively wider towards trama, above with 10–15µm wide elements, basally up to 25(–30)µm, with yellow-brown (rarely darker brown) parietal pigment.

Habitat: Mediterranean to nemoral deciduous woodlands. Associated with *Populus alba*, sometimes also *P. nigra* or *P. canescens* on rich, sandy, moist to dry soils. Mainly in moist, alluvial river plain forests with large trees of *P. alba*, but also mossy steppe woodlands with *P. alba* and *Juniperus communis* ('puszta') or in planted avenues.

Distribution: Rare. So far known from a number of localities on the Danube river plain in Hungary (Bohus, 1976; Rimóczi & Albert, 1992) and NE Austria (Krisai-

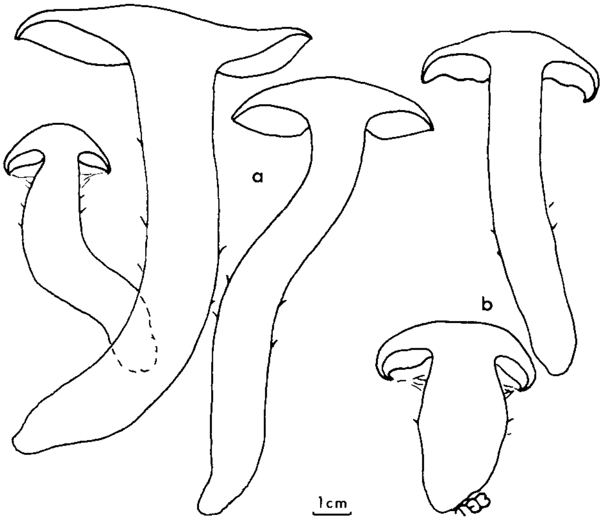

FIG. 14. (a) *C. paracephalixus*, TEB 217-94, TEB 216-94 (small specimen to the left); (b) *C. caligatus*, TEB 236-94.

Greilhuber, 1992), and a few localities in S France (along the Rhone: Chevassut & Henry, 1986; Chevassut, 1991, both as *C. rioussetiae*) and The Netherlands (Reijnders, 1989 as *C. inamoenus*). The species is apparently locally common along the Danube, for instance in the Vienna area (Krisai-Greilhuber, 1992) and at the type locality on the large island of Horány, N of Budapest (pers. obs.). *C. paracephalixus* probably has a wider distribution along the larger rivers of C and S Europe. With the extensive threats to the river plain forests, the species should be regarded as endangered or vulnerable throughout Europe.

Collections examined (**including macrocharacters*). HUNGARY. Budapest, Danube, the island of Horány, *G. Bohus* 50.169 (holo. BP), *G. Bohus* 57.459, *G. Bohus* 79.284 (BP), *G. Bohus* 12 x 1974 (BP), TEB 217-94*, 218-94* (O, BP). Bacs-Kiskun, Bugac puszta, *H. Lindström*, TEB 216-94*. THE NETHERLANDS. Beesd, Abelenlaan, *A.F.M. Reijders* (O). Utrecht, Utrecht-Lunetten, *P.-J. Keizer* 89046 (L). FRANCE. Provence, Avignon, *R. Henry* 84.70 = 78 (holo. *C. rioussetiae*, hb. R. Henry), *G. Chevassut* 3304 (leg. Mrs Riousset; as *C. rioussetiae*).

Comments: *C. paracephalixus* is characterized by its (pale) ochraceous yellow pileus, abundant veil, frequently subradicating stipe and habitat in river plain forests. The species is closely related to *C. argutus*; they both have the reddish staining context and the association with *Populus* spp. in common. However, the veil of *C. paracephalixus* is constantly more abundant, and develops an ochraceous brown colour never seen in *C. argutus*. *Cortinarius paracephalixus* develops a more ochraceous yellow pileus than *C. argutus* as well. Furthermore, the more or less yellowish KOH reaction of *C. paracephalixus* seems to be a constant character separating it from *C. argutus*, and the spores of *C. paracephalixus* are larger than those of *C. argutus*. The smell of *C. paracephalixus* is somewhat different, with a more pronounced earth-like component, like that of *C. variecolor* or *C. herculeus* (see Reijnders, 1989). However, more components are present, and in the protologue (Bohus, 1976), a strong mouldy smell – more like *C. argutus* – is indicated. Except for the spores, *C. paracephalixus* is microscopically very similar to *C. argutus*, but the hypoderm is usually slightly more pigmented. A few long and wide hyphae, usually found in the basal part of the epicutis, seem also to be characteristic, but this feature sometimes occurs in *C. argutus* as well.

Cortinarius paracephalixus also resembles *C. herculeus*, with which it has the ochraceous veil, yellow KOH reaction and fairly large spores in common. However, *C. herculeus* has much larger and more robust basidiocarps, with more prominent, thick veil girdles and a bulbous (not subradicate) stipe base. Furthermore, it is associated with *Cedrus*, but in S France these two taxa occur in the same areas. *Cortinarius paracephalixus* is closely related to *C. populinus* as well, but the latter lacks a reddish staining reaction, and differs microscopically, having much smaller spores and not so well-developed hypoderm. When the veil is well developed and becomes brownish, the species may also look very much like a pale *C. triumphans*.

Although both *C. argutus*, *C. populinus* and *C. paracephalixus* are associated with *Populus*, the last taxon seems to be fairly well separated eco-geographically: *C. argutus* and *C. populinus* occur mainly in Northern European, boreo-nemoral to boreal *Populus tremula* forests, whereas *C. paracephalixus* is restricted to southern, Mediterranean to warm temperate river plain habitats with other *Populus* species, mainly *P. alba*. In the Mediterranean zone of S France, the species is described under the name *C. rioussetiae* Chevassut & R. Henry (1986), known from a few localities of *Populus alba* forests along the Rhone (see Chevassut, 1991). The type material is well in correspondence (Fig. 15), and the description of *C. rioussetiae* fits in almost all respects, except that no reddening of stipe or context is mentioned (a feature normally overlooked in the *C. argutus* complex), and that young lamellae are described with a very pale lilac tinge. Unpublished photographs of *C. rioussetiae* (Chevassut, presented at congress in Dole, E France 1989) also fit well with the present species.

11. Cortinarius herculeus Malençon in Malençon & Bertault, Fl. Champ. sup. Maroc I: 503 (1970). Type: *G. Malençon* 769 (MPU). **Fig. 11, 15.**
Syn.: *Cortinarius turmalis* Fr. var. *cedrorum* Heim nom. inval., Champ. d'Eur.: 491 (1969). Type: not indicated.

Selected icones: Marchand (1982), *Champ. nord midi* 7: Pl. 653; Dähnke & Dähnke (1979), *700 Pilze*: 423; Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 55, f. 1; Mal. & Bert. (1970), *Fl. Champ. sup. Maroc* I: 25; Azéma & Jacquetant (1968), *Bull. Soc. mycol. Fr.* 84: Pl. 177.

Pileus 5–15(–20)cm, (hemi-)spherical to plano-convex, when (very) young often white fibrillose from the universal veil, or fibrillose cover only at margin, soon more glabrous, glossy and distinctly (and persistently) viscid, somewhat fibrillose-appressed scaly towards centre, often innately fibrillose-rivulose towards margin,

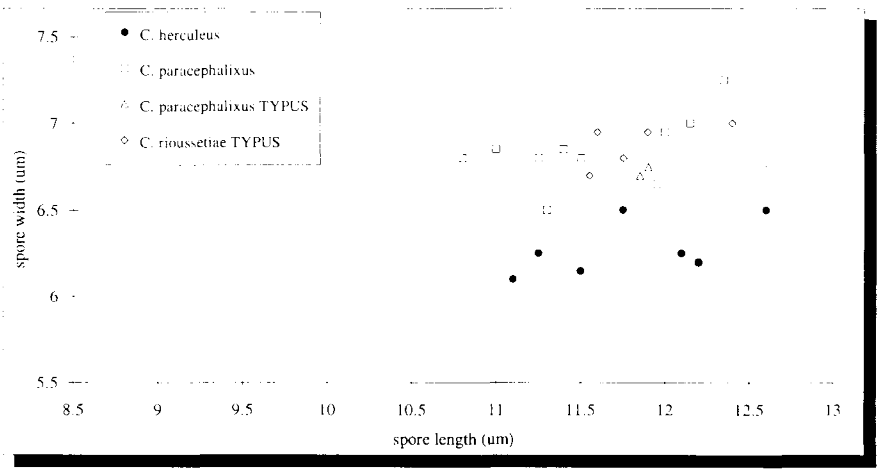

FIG. 15. Variation in spore size of *C. paracephalixus* (= *C. rioussetiae*) and *C. herculeus*. Each symbol = MV of 10 spores measured per basidiocarp.

with white, fibrillose veil (patches) remaining near margin; uniformly (pale) ochraceous yellow-brown, sometimes also darker, almost red-brown or umber brown. *Lamellae*, L=80–120, crowded, 8–13mm broad, whitish, sometimes with a pink reflex, rather persistently pale ochraceous brown; edge even to serrulate. *Stipe* 8–15 × 1.5–2.5cm, very robust, at base clavate (→4cm) and sometimes attenuate (-subradicate), whitish, turning somewhat ochre brownish on handling. Universal veil (very) abundant, forming one or more distinct, annuliform but appressed, white girdle(s), often turning more or less ochraceous yellow at surface of the thick girdles. *Context* whitish, sometimes turning slightly ochraceous yellow. KOH yellow in context. *Smell* unpleasant, strong and penetrating, reminiscent of that of *C. variecolor* (earth-like). *Exsiccates* of (very) young specimens may become spotted with (bluish) grey on cut surfaces.

Extractable pigments: Extracts (when fresh basidiocarps crushed, or when dry specimens extracted with ethanol) (bluish) grey, with a greyish blue front-line on paper. Two to three, sometimes fairly weak greyish blue bands are developed on TLC (Rel. Rf= −0.35, +0.05, +0.08).

Spores 11–12.5 × 6–6.5(–7)µm (MV=11.8 × 6.3µm), Q=1.88±0.07, amygdaliform, distinctly and densely to fairly coarsely verrucose, suprahilar plage often distinct. *Basidia* 9.5–10.5µm wide, 4-spored. Hymenium and lamellae trama with only few intra- and extracellular granules (probably more on fresh material). *Lamella edge* ±fertile, with scattered, small, clavate-cylindrical sterile cells. *Universal veil* on stipe surface of 3–6(–8)µm wide, parallel hyphae, hyaline or sometimes with pale golden yellow intracellular pigment, some golden brown oleifers intermixed. Veil upon pileus surface of 3–8µm wide hyphae, some with distinct, yellowish brown, intracellular and parietal pigment. *Pileipellis* duplex. *Epicutis* of c.5–8 hyphal layers, at surface of 2.5–5µm wide, ±hyaline, distinctly gelatinous hyphae. Basal part of epicutis of parallel and wider hyphae (4–7(–9)µm), hyaline or sometimes with pale yellowish, zebra-striped encrustations. Some hyaline (intra- and extracellular) granules also observed (probably more abundant on fresh material). *Hypoderm* subcellular, basally with up to 25(–30)µm wide elements, with yellow-brown parietal pigment, especially in upper part.

Habitat: Mediterranean coniferous forests. Associated with *Cedrus atlantica*, in plantations on calcareous soil.

Distribution: Very rare and with a limited distribution in Europe, but locally frequent in some *Cedrus* plantations of S France (Chevassut, 1991). Recorded also from different parts of Spain (Moreno et al., 1986), and according to M. Clericuzio (pers. comm.) once collected in C Italy. *Cedrus atlantica* is apparently used in forest plantations only in S France, Spain and Portugal, and the species is probably more or less restricted to these areas in Europe. Frequent in natural *Cedrus atlantica* forests in the Atlas mountains of Morocco (Malençon & Bertault, 1970).

Collections examined. FRANCE. Languedoc, Herault, Bedarieux, *G. Gulden* 629/79 (O). Haute-Savoie, Thonon-les-Bains, *P. Escallon*, *J. Melot* 84-113 (hb. J. Melot).

Comments: Fresh material of this species has not been available, and the description of macromorphological characters is based on the photographs of the species in Moser & Jülich (1985–1994), Marchand (1982) and the plate in Malençon & Bertault (1970), as well as the descriptions in the last two publications. The species seems to be well characterized by its robust and very large basidiocarps with an ochraceous brown pileus, its very abundant veil developing thick girdles, its yellow KOH reaction, its strong, earth-like smell and the association with *Cedrus* spp. The slightly coloured veil, the KOH reaction and the smell indicate a close relationship with *C. paracephalixus*. However, the latter has smaller, less robust basidiocarps, a more radicate stipe and is associated with *Populus* spp.

The reddish, then bluish grey staining reaction often observed in *C. argutus*, *C. fraudulosus* and *C. paracephalixus* is not mentioned in the literature on *C. herculeus*. However, since this reaction has normally been overlooked in *C. argutus* and *C. fraudulosus*, it is also likely that it has been overlooked in *C. herculeus*. These species develop the same coloured granules upon oxidation (see photograph in Melot, 1981), and the same dark bluish grey oxidation products with TLC.

Cortinarius herculeus seems to be one of the more frequent mycorrhizal species of calciphilous *Cedrus atlantica* forests, and even though this tree is not native to Europe, the species occurs regularly in the cedar plantations of SW Europe (Marchand, 1982; Chevassut, 1991). It seems to be one of the few *Agaricales* species exclusively associated with *Cedrus*. It is not known whether *Cortinarius herculeus* occurs under *Cedrus libanotis* in the eastern part of the Mediterranean area.

A taxon with lilac lamellae growing under *Quercus suber* in Morocco was described by Bertault (1983) under the name *C. herculoides*. Since type material of *C. herculoides* is not available on loan from MPU, I cannot judge the relationship between this and *C. herculeus*. Two more variants with lilac bluish lamellae have been described in the *C. herculeus* complex (*C. cliduchus* Fr. var. *ionophyllus* Malençon & Bertault 1970 nom. inval. = *C. herculeus* var. *ionophyllus* (Malençon & Bertault) R. Henry 1986 nom. inval., and *C. herculeus* f. *violascens* R. Henry 1989 nom. inval.), and their taxonomic status remains uncertain. Based on the available photographs as well as descriptions, it seems unlikely that bluish tinged lamellae is included in the normal variation spectrum of *C. herculeus*. The position of *C. herculoides* and the bluish variants of *C. herculeus* need further clarification, both ecologically and taxonomically.

12. Cortinarius populinus Brandrud in Brandrud et al., Cortin., Fl. Photogr., Vol. 2 (Swedish version): 33 (1992). Type: Cortin, Fl. Photogr. 642 (holo. O, iso. S). **Figs 1m, 9, 13b**.

Icones: Brandr. et al. op. cit.: Pl. B46; Moënne-Locc. & Reum. (1990), *Atl. Cortin.* 2: Pl. 36 (as *C. sebaceus* Fr.).

Pileus (3–)4–8(–10)cm, (hemi-)spherical, then plano-convex, viscid to glutinous, but when mature often easily drying out, pellicle fairly easy to separate, rather thick and distinctly pigmented; universal veil normally sparse, rendering pileus margin whitish fibrillose when young (sometimes patches floating in the gluten), sometimes with fine, brownish appressed scales at centre; normally glabrous and with a coarse, innately fibrillose-rivulose pattern with hygrophanous spots, sometimes more dull and minutely fibrillose, especially with age, centre then more fibrillose-tomentose, even fine scaly and with age diffracted; homogeneous ochraceous yellow to yellowish brown (M-N 60), in dry weather at least margin whitish when very young (due to fibrillose veil cover); later ochraceous brown, somewhat darker at centre (P 60). *Lamellae*, L = 70–120, very crowded, 4–7mm broad, when young greyish white to ochraceous white, fairly persistently pale ochraceous brown; edge even to slightly crenulate-serrulate. *Stipe* 5–9 × 0.8–1.5(–2.0)cm, cylindrical or slightly clavate at base (→2.5cm) and attenuate to sometimes subradicate, dull, fibrillose, persistently whitish, turning somewhat ochraceous yellow towards base on handling. Universal veil (fairly) abundant, dull white, thick girdles slightly viscid and distinctly ochraceous yellow at surface; rendering the stipe girdled-floccose, sometimes somewhat peronate-volvate. Cortina sparse when expanded. Base often with well-developed, white mycelial strands. *Context* often with fairly soft-fistulose medulla, persistently whitish, with a faint greyish ochre tinge in stipe apex, sometimes turning faintly yellowish in base; KOH negative. *Smell* distinct, somewhat unpleasant, reminiscent of yeast or dough.

Spores 7.5–8.5(–9) × 4.5–5μm (MV = 8.0 × 4.8μm), Q = 1.67 ± 0.03, ellipsoid (to more amygdaliform), finely and densely verrucose, suprahilar plage indistinct or absent. *Basidia* 6.5–7.5μm wide, 4-spored, hyaline, sometimes filled with brown necropigment near edge. *Lamella edge* normally ± sterile, set with numerous, inconspicuous, small, narrowly clavate-cylindrical sterile cells. Trama often divergent near edge, sometimes even running parallel to edge. *Universal veil* on stipe surface of 2–7(–12)μm wide hyphae, superficial hyphae distinctly pigmented, mainly with golden yellow, intracellular, granulate to oleiferous-like necropigment, often filling the more or less collapsed hyphae, intact hyphae usually with a thick, yellow wall (pigment submembranous?). A pale, faintly verrucose encrustation also observed on some hyphae. Universal veil upon pileus surface consisting usually of a few layers of c.3–8μm wide hyphae, with ± thickened, yellow walls. Some golden yellow, 'oleiferous' hyphae and a few more verrucose encrusted ones also observed. *Pileipellis* ± duplex. *Epicutis* fairly thin, of c.6–8(–10) hyphal layers. At surface with c.2–4 layers of 2–5μm wide, (persistently) gelatinized, loosely entangled hyphae, the outer 3–8 segments usually erect; hyphae hyaline-granulate, some extracellular granules also observed. Basal part of epicutis well developed, of c.4–6(–8) parallel, repent and more tightly connected layers; hyphae 3–8(–10)μm wide and distinctly yellowish brown pigmented, with KOH (very) distinctly verrucose to zebra-striped encrusted. When young and fresh with abundant intracellular-epimembranal and extracellular, small, hyaline granules. The interhyphal deposits become washed away with KOH, and generally soon disappear with age or on drying. *Hypoderm* little differentiated, of c.5–8 layers, hyphae fairly narrow, 8–15μm, above usually 8–10μm and not much shortened; hyphae irregularly entangled and tightly cemented by a strong yellowish brown, amber-like parietal pigment, intercellular spaces may be filled with brown crusts or clumps. A transition zone to trama consists of wider, and sometimes pigmented elements. *Trama* hyaline, of 25–40µm wide, loosely interwoven elements. *Stipe cortex* of parallel, narrow (3–5µm wide) hyphae, with abundant hyaline to pale yellow granules, mainly intercellular, some also extracellular.

Habitat: Boreo-nemoral and boreal-montane mixed deciduous forests. Associated with *Populus tremula*, in mixed *Populus-Quercus* or *Populus-Picea* forests on richer, preferentially calcareous soil, often in deep leaf litter, in (semi-)natural, normally old forest stands.

Distribution: Very rare, known with certainty only from eight localities in Fennoscandia (Brandrud et al., 1992; see also list of collections) and one locality in E France (Moënne-Loccoz & Reumaux, 1990b as *C. sebaceus*). Included in the Norwegian red data list (Størkersen, 1992).

Collections examined (**including macrocharacters*). NORWAY. Telemark, Kragerø, CFP 642 (holo.)*, TEB 215-85*, 216-85, 252-87, 114-92*. Østfold, Fredrikstad, TEB 156-79*. SWEDEN. Södermanland, Runmarö, CFP 273*. Ångermanland, Högsjö, CFP 534. Medelpad, Tuna, *S. Muskos* 92-043 (O). Västergötland, Fors, *L. & A. Stridvall* 85/260 (GB, O). FINLAND. Pohjois-Häme, Korpilahti, Vaarunvuoret, TEB 3-86*. FRANCE. Haute-Savoie, Ain, Semine, *P. Moënne-Loccoz* 707 (as *C. sebaceus*, hb. P. Moënne-Loccoz).

Comments: *C. populinus* is characterized by its homogeneous ochraceous yellow pileus, its ochraceous tinged veil, small spores and its association with *Populus tremula*. It is closely related to the two other *Populus*-associated taxa in the subsection, *C. argutus* and *C. paracephalixus*, but differs mainly in its glabrous, viscid-glutinous and bright ochraceous pileus, as well as the lack of reddish-staining context. Microscopically, it is distinguished by its much smaller spores, the stronger pigmentation of pileipellis and veil, the less differentiated hypoderm, and an almost sterile lamella edge. Although they both occur under *Populus tremula*, *C. argutus* and *C. populinus* have rarely been found in the same localities. This seems to be due to the preference of *C. argutus* for culturally influenced woodlands, whereas *C. populinus* prefers climax oak or spruce forests with aspen. Both taxa seem to have their optimal areas in Fennoscandia, in regions where old aspen stands on calcareous soils are not infrequent. *C. populinus* seems to be slightly more northern than *C. argutus*, and both probably occur further north-east in Europe than present records indicate.

Cortinarius populinus also resembles *C. tiliae* in subsect. *Triumphantes*, but the latter has larger spores and a pileus with a different kind of innately fibrillose pattern (due to a silky veil cover) and an olive tinge never seen in subsect. *Arguti*. Superficially, *C. populinus* can easily be mistaken for *C. turmalis* (= *C. sebaceus* s. Mos.) and *C. claricolor*, but these always have a glabrous and glossy pileus surface, with very fine, silvery veil remnants at the centre and a very thin, hyaline pellicle. Furthermore, they lack veil pigment and encrusting pigment in the epicutis, and they have a well-developed, subcellular hypoderm.

Cortinarius subsect. **Vulpini** Brandrud & Melot in Nord. J. Bot. 10: 538 (1990). Type: *C. vulpinus* (Velen.) R. Henry.

Pileus with abundant veil remnants, often (appressed) scaly, or with a thick, fibrillose zone at margin, viscid or not, rarely glutinous, normally ochraceous brown to more red brown; lamellae normally persistently lilac, stipe girdled-scaly of (very) abundant veil. Spores amygdaliform to broadly ellipsoid, distinctly and fairly densely verrucose; pileipellis normally with a little differentiated hypoderm, basal elements imbedded in a yellow-brown, amber-like matrix or not, basal epicutis without, or with pale, encrusted pigment; universal veil normally with hyaline hyphae, but often developing some yellow-brown, intracellular necropigment with age.

Comment: *Cortinarius* subsect. *Ophiopodes* Moënne-Locc. & Reumaux (1990a: 16), as circumscribed by the authors, comprises the taxa *Arguti* and *Vulpini*. According to Moënne-Loccoz & Reumaux (1990a, b) the selected type (*C. ophiopus* Peck) is conspecific with *C. vulpinus* (= *C. rufoalbus*). Consequently, the name *Ophiopodes* should therefore replace the here used name *Vulpini* at the subsection level. However, an examination of the lectotype (ix 1877, *Peck*) gave in my opinion little support to this idea. The type has narrowly amygdaliform (MV = 12.0 × 6.4µm) and very finely verrucose spores. The size and shape are not within the variation spectrum of *C. vulpinus* (Fig. 17), and the weak ornamentation is of a kind not found in sect. *Phlegmacium*. According to Moënne-Loccoz & Reumaux (1990b), the spores of the *C. ophiopus* lectotype are more or less identical to that of *C. vulpinus* (= *C. rufoalbus*). This may be true when unripe and more narrow spores from the lamellae are compared, but not when spore deposits are compared. The pileipellis of the *C. ophiopus* type is more or less simplex, contrary to the duplex structure of *C. vulpinus* and almost all other species of the section (see sketches in Moënne-Loccoz & Reumaux, 1990b). Conclusively, the species seems to belong to another section (possibly sect. *Claricolores* or *Elastici*). The identity of *C. ophiopus* Peck must remain dubious for the time being, and subsect. *Ophiopodes* must therefore be regarded as a nomen dubium.

13. Cortinarius vulpinus (Velen.) R. Henry in Bull. Soc. mycol. Fr. 62(3/4): 207 (1947). **Figs 1n, 16a, 17**.

Syn.: *Inoloma vulpinum* Velen., Ceské houby III: 428 (1921). Type: not indicated.

Cortinarius rufoalbus Kühn. in Bull. Soc. linn. Lyon 24(2): 45 (1955). Type: not indicated.

Phlegmacium fluryi Mos., Gatt. Phlegm.: 352 (1961); *Cortinarius fluryi* (Mos.) Mos., Röhrl. Blätt., Bd. IIb/2, in Kl. Kryptog. Fl., 3rd ed.: 289 (1967). Type: *M. Moser* 57/85 (holo. IB).

Cortinarius albomarginatus P.D. Orton nom. inval., Cortin. I: 71 (1955). Type: J.E. Lange (1938), Fl. agar. Dan. 3: Pl. 85A.

Selected icones: Brandr. et al. (1992), *Cortin., Fl. Photogr.* 2: Pl. B45; Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 11, f. 1 (as *C. fluryi*); Mos. (1961), Gatt. Phlegm.: Pl. IX 45, 46 (as *Phlegm. fluryi*); Moënne-Locc. & Reum. (1990b), *Atl. Cortin.* 2: Pl. 28 (as *C. ophiopus*); J.E. Lange (1938), *Fl. agaric. Dan.*: 85A (as *C. claricolor*); Phillips (1981), *Mushr. other fungi Gr. Br. & Eur.*: 128 (as *C. fraudulosus*); Bon (1986), *Fung. rar. icon. color.*: Pl. 117, 1 (as *C. rufoalbus*) & 2 (as *C. fluryi*).

Pileus 4–9cm, (hemi-)spherical (rarely more campanulate), then plano-convex, often with persistently involute margin, viscid to more rarely non-viscid, sometimes fairly persistently glutinous, pellicle fairly easy to difficult to separate, moderately thick and pigmented; universal veil (very) abundant, forming a thick fibrillose, white marginal zone, sometimes more scattered patches when mature, towards centre often difficult to distinguish from elements belonging to pileipellis, when very young the entire pileus may be white fibrillose; development of surface structures very much depending on weather conditions, dull fibrillose-tomentose in dry weather, in moist weather glutinous, ± glabrous and glossy; whitish ochre (L 60-67) when unexposed or veil covered, soon developing a (dark) ochraceous brown (M 57, N 60, P 59), to warm red-brown or chestnut brown (P 45-40, S 37) colour from centre. *Lamellae*, L = 70–110, crowded, 3–9mm broad, greyish white, greyish or rarely pale bluish grey; edge even to slightly crenulate-serrulate. *Stipe* 5–12 × (0.8–)1.0–2.0cm, fusiform, more rarely cylindrical-clavate (base →2.5cm) and frequently tapering (especially when growing in large clusters), firm, whitish or very faintly bluish tinged at apex, later turning somewhat (spotwise) ochre brownish from base, especially when bruised. Universal veil very abundant, whitish, then often turning somewhat ochraceous brown, non-viscid, rendering the stipe conspicuously and repeatedly girdled-scaly, even squarrose, more rarely peronate-volvate with a ring-zone. Cortina sparse when expanded. *Context* white, or with a very faintly bluish lilac tinge at apex, towards base tinged ochraceous brown with age. KOH negative. *Smell* unpleasant, reminiscent of yeast or dough, becoming strong with age or storage.

Spores 11–13 × 6.5–7.5(–8)µm (MV = 11.9 × 7.1µm), Q = 1.68 ± 0.06, fairly variable, ellipsoid-amygdaliform, sometimes broadly ellipsoid, distinctly and densely verrucose, broadly ellipsoid spores frequently very densely-spiny verrucose, suprahilar plage usually indistinct or absent. *Basidia* 10–11.5µm wide, 4-spored. *Lamella edge* ± fertile, with some small, clavate sterile cells intermixed. *Universal veil* on stipe surface of 3–8(–10)µm wide hyphae, ± hyaline, sometimes with granulate content, sometimes with yellowish brown, amorphous necropigment. *Pileipellis* duplex. *Epicutis* fairly thin, of c.4–8(–10) hyphal layers. Surface hyphae 2.5–5µm wide, hyaline, sometimes distinctly gelatinized, loosely entangled, the outer segments usually erect. Basal part of epicutis (c.3–6 layers) of parallel, more tightly connected 4–8(–10)µm wide hyphae, with a distinct, yellowish verrucose to zebra-striped encrusting pigment, and when young and fresh with abundant epimembranal and extracellular, hyaline, small granules. The external granules become washed away or dissolved with KOH. *Hypoderm* well differentiated and subcellular, elements irregularly interwoven and up to 25µm wide and tightly cemented, strongly pigmented, with golden (yellowish) brown, amber-like, smooth, parietal pigment, sometimes forming very thick walls, and even interhyphal crusts or clumps. Irregular, ±branched, deep brown oleiferous hyphae often occur intermixed.

Habitat: Nemoral, boreo-nemoral and montane deciduous forests. Associated with *Fagus sylvatica*, on more or less calcareous soil, or richer mull soil, frequently fasciculate, in deep leaf litter.

Distribution: Fairly rare, but sometimes in large groups. According to Krieglsteiner (1991) not rare in Germany, and according to Kühner (1955 as *C. rufoalbus*) locally frequent in the western Prealps (Samoëns). Widespread in the entire natural distributional area of *Fagus sylvatica*, from S Scandinavia (Brandrud et al., 1992; Lange, 1938 as *C. claricolor*) to SE France (Kühner, 1955 as *C. rufoalbus*), west to S England (Orton, 1955 as *C. albomarginatus* P.D. Orton), W France (Marchand, 1982 as *C. rufoalbus*) and east to former Yugoslavia (Moser, 1961 as *Phlegm. rufoalbum*), E Austria (Krisai-Greilhuber, 1992 as *C. fluryi*) and Poland (Nespiak, 1975 as *C. fluryi*). Associated with *Fagus* to 1500m a.s.l. in the Alps (Marchand, 1982 as *C. fluryi*).

Probably declining in heavily polluted areas due to the vulnerability of herb-rich mull soil beech forests to acidification. Included on the red data lists of Great Britain (Ing, 1992 as *C. rufoalbus*), Sweden (Aronsson et al., 1995), Denmark (Vesterholt & Knudsen, 1990) and Germany (Winterhoff & Krieglsteiner, 1984 as *C. rufoalbus*).

*Collections examined (*including macrocharacters)*. SWEDEN. Skåne: Degerberga, CFP 781*, TEB 94-88*; Kristianstad, *L. Örstadius* 4 x 1983* (O); Ivö, *S. Jacobsson* 81169 (as *C. rufoalbus*, GB); Oppmanna, *S. Jacobsson* 81183 (as *C. rufoalbus*, GB); Anderslöv, *S. Jacobsson* 79224 (as *C. rufoalbus*, GB). GREAT BRITAIN. Surrey, Boxhill, Ashurst Valley, *P.D. Orton* 5479 (as *C. rufoalbus*, E). GERMANY. Bavaria: Main-Spessart, Karlstadt, TEB 108-94*, 186-94; Pappenheim, *M. Moser* 57/85 (holo. *C. fluryi*, IB), 57/79 (as *C. rufoalbus*, M); Riederau, Ammersee, *A. Einhellinger* 16 x 1980, 3 x 1981 (as *C. rufoalbus*, M); Munich S, Grünwald, *A. Einhellinger* 8 x 1981 (as *C. rufoalbus*, M). Hessen, Gobert bei Hitzelrode, *A. Bresinsky* ix 1968 (as *C. fluryi*, M). Baden-Württemberg, Karlsruhe, *M. Moser* 54/94 (M), 58/55 (IB) (both as *C. rufoalbus*). FRANCE. Sallanches, Luzier, *J.-L. Cheype* 15 x 1988 (as *C. rufoalbus*, hb. J.-L. Cheype).

Comments: *C. vulpinus* is characterized by its repeatedly girdled-floccose stipe and a more or less red-brown pileus with a contrasting white veil zone at margin. These contrasting colours are reflected in the names *C. rufoalbus* Kühn. and *C. albomarginatus* Orton. The fungus is exclusively associated with *Fagus sylvatica*, often growing fasciculate deep in leaf litter with a fusiform-radicate stipe. When growing solitary, the stipe may be cylindrical-clavate. The species is closely related to *C. pseudovulpinus*, but it is separated on the more viscid pileus with vivid colours and contrasting white margin, the (normally) lack of lilac-bluish colours, the lack of yellow staining in the context, the more or less fusiform stipe and the association with *Fagus sylvatica*. In moist weather *C. vulpinus* is often distinctly glutinous and glabrous, and may then resemble *C. claricolor*, a name that has also been used for the present species (Lange, 1938). The latter is, however, easily distinguished by its much smaller spores and different habitat.

Inoloma vulpinum Velenovský (1921) was characterized in the protologue by a tomentose-squamulose red-brown pileus with white margin, pale lilac-tinged lamellae and stipe apex and amygdaliform spores. Unfortunately no material of *I. vulpinum* is left at the Velenovský herbarium in Prague. The features described in the protologue are all characteristic for the present species, and, moreover, this striking character combination can hardly be applied to any other *Inoloma*-like species, except possibly *C. pseudovulpinus*. However, this has a yellow-staining context, a remarkable character not mentioned by Velenovský, and the pileus lacks the characteristic red-white colour combination typical for the above-described species.

According to Velenovský (1921), *Inoloma vulpinum* was collected in a dense spruce forest at Jevany near Prague (300–400m a.s.l.). However, this area is dominated by beech forests (including a nature reserve) (R. Fellner, pers. comm.), and it is thus very likely that the species was collected in some stand with a mixture of planted (young) *Picea* and elements of the indigenous *Fagus* forest. Forests with *Carpinus betulus* are rare or absent from this particular area (Fellner, pers. comm.), thus making the *Carpinus*-associate, *C. pseudovulpinus*, a less probable candidate for the Velenovský name.

The present species has normally been treated in the literature as *C. rufoalbus* Kühn. (Kühner & Romagnesi, 1953; Kühner, 1955; Henry, 1958, etc.) or *C. fluryi* (Mos.) Mos. (Moser, 1961, 1983), both names corresponding well with the present species. The synonymization of *C. rufoalbus* with *C. vulpinus* was introduced by Melot (1981), and was later confirmed by Kühner (Marchand, 1983: 7). The nomenclature is further discussed in Brandrud et al. (1992). Lately, the species has been called *C. ophiopus* Peck by Moënne-Loccoz & Reumaux (1990b), but the type material does not show conformity (see comment in the introduction to the subsection).

14. Cortinarius pseudovulpinus R. Henry in Bull. Soc. mycol. Fr. 105(1): 57–58, 93 (1989). Type: *R. Henry* 88.194 (holo. hb. R. Henry). **Figs 1o, 16b, 17.**
Misapplied names: *Cortinarius vulpinus* (Velen.) R. Henry sensu R. Henry & Ramm in Bull. Féd. mycol. Dauphiné-Savoie 115: 7 (1989). *Cortinarius plumiger* Fr. sensu Quél., Fl. mycol. Fr.: 138 (1888).

Selected icones: Brandr. et al. (1992), *Cortin., Fl. Photogr.* 2: Pl. B43; Mos. (1961), *Gatt. Phlegm.*: Pl. IX 47 (as *Phlegm. rufoalbum*); Moënne-Locc. & Reum. (1990b), *Atl. Cortin.* 2: Pl. 27 (as *C. vulpinus*); Cetto (1978), *Der gr. Pilzf.* 2: 513 (as *C. vulpinus*); R. Henry (1991), *Bull. Soc. mycol. Fr.* 107: Atl. Pl. 261 (not typical).

Pileus 4–8(–10)cm, (hemi-)spherical, then plano-convex, sometimes umbonate, sometimes with persistently involute margin, non-viscid to viscid, and then easily drying out, pellicle difficult to impossible to separate, (moderately) thick and pigmented; universal veil (very) abundant, white, soon turning brownish, forming a

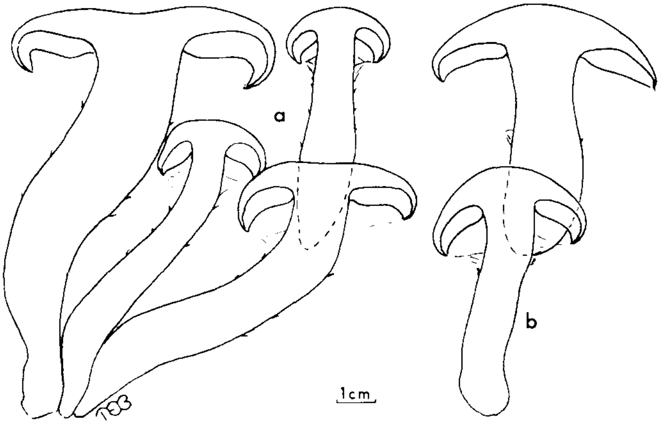

FIG. 16. (a) *C. vulpinus* (=*C. rufoalbus*), CFP 781; (b) *C. pseudovulpinus*, TEB 34-89.

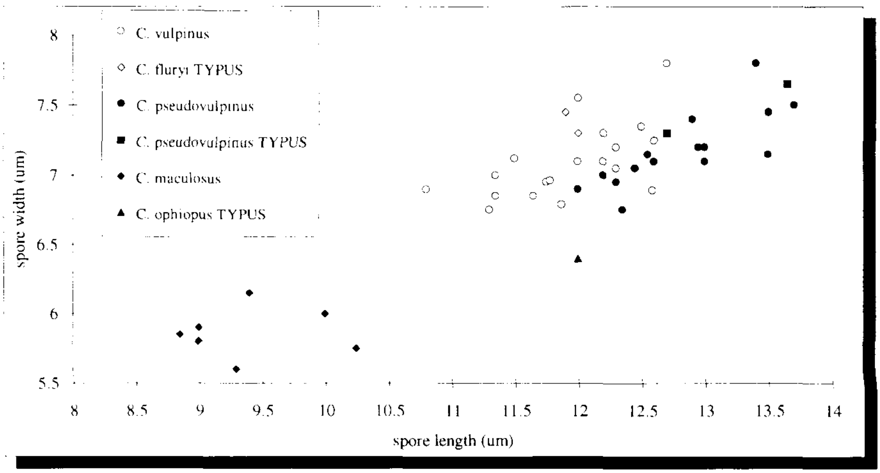

FIG. 17. Variation in spore size of *C. vulpinus* (=*C. fluryi*), *C. pseudovulpinus* and *C. maculosus*. Each symbol=MV of 10 spores measured per basidiocarp.

thick fibrillose to appressed scaly cover when young, later frequently impossible to distinguish from the pileipellis, except for a paler zone or patches at margin; surface dull and persistently fibrillose-tomentose to fine scaly, even somewhat rimose-diffracted at centre; initially whitish at least towards margin, then brownish white (M 69-N 60), soon turning ochraceous brown to leather brown (M 57, N 60, P 59), darkening when bruised. *Lamellae*, L=60–90(–100), fairly crowded, 4–8mm broad, persistently pinkish lilac, especially at edge, paler and more greyish lilac towards context; edge even. *Stipe* 5–10×0.8–1.5(–2)cm, cylindrical to slightly clavate (base →2.5cm), sometimes attenuated, whitish or when young with lilac tinge at apex, turning distinctly brownish from base, especially when bruised. Universal veil abundant, normally forming a thick ring zone, floccose below, initially whitish, soon turning leather brown. Cortina remnants sparse to distinct when expanded. *Context* white, turning distinctly yellow, almost golden yellow when cut. KOH negative. *Smell* unpleasant, earth-like, or reminiscent of yeast, with age strong, like that of overripe camembert.

Spores 12–14 × 6.5–7.5µm (MV = 12.9 × 7.2µm), Q = 1.79 ± 0.04, amygdaliform, sometimes more ellipsoid, (very) distinctly and fairly densely, sometimes coarsely verrucose, warts often confluent at apex, suprahilar plage ±distinct. *Basidia* 10.5–11.5(–12)µm wide, 4-spored. *Lamella edge* fertile, sometimes with small, clavate sterile cells intermixed. *Universal veil* on stipe surface of 3–8(–10)µm wide hyphae, frequently with golden brownish, amorphous, oleiferous necropigment. Universal veil upon pileus surface of partly encrusted and partly oleiferous, golden yellowish brown pigmented, frequently collapsed hyphae, at centre the oleiferous pigment may be very dark and pronounced. *Pileipellis* simplex to slightly duplex. *Epicutis* fairly thick, of c.8–12(–15) hyphal layers. Above of irregularly entangled to subparallel, comparatively wide hyphae (5–7µm), hardly gelatinous, with thick, smooth, brownish yellow walls, often with large clamps and slightly irregular terminal cells. Basal part of epicutis (c.3–5(–8) layers) of cemented hyphae, often appearing in bundles of 3–5 filaments when squashed, hyphal elements long (or somewhat shortened) and wide (6–15(–20)µm). Very distinctly yellowish brown pigmented, pigment mainly parietal (thick yellow walls), but long and wide elements also with (sometimes very pronounced) zebra-striped encrustations, or larger, more irregular crusts, sometimes also with epimembranal drops/granules, a few hyphae with oleiferous, probably submembranal (necro) pigment also observed. Young and fresh specimens also with abundant extracellular, hyaline granules. *Hypoderm* little differentiated, forming a transition layer to trama, of some ±cemented, sometimes subcellular elements up to 20µm wide, with slightly pigmented and thickened walls.

Habitat: Nemoral to submontane deciduous forests. Associated with *Carpinus betulus*, on calcareous, often dry ground.

Distribution: Fairly rare, but locally more frequent in the *Carpinus*-dominated plateaux of the French Jura, Bohemia and the Hungarian foothills of the Carpathians (c.300–600m a.s.l.; pers. obs.). Distribution otherwise little known due to confusion with *C. vulpinus*/*C. rufoalbus*. Recorded in E France (Henry & Ramm, 1989a, b; Moënne-Loccoz & Reumaux, 1990b as *C. vulpinus*), Switzerland (Moser, 1961 as *C. rufoalbus*), N Italy (Cetto, 1978 as *C. vulpinus*), S and E Germany (material in M), Austria (Krisai-Greilhuber, 1992 as *C. vulpinus*), Hungary (Bohus, 1976 as *C. rufoalbus*) and SE Sweden (leg. & det. S. Jacobsson).

Collections examined (**including macrocharacters*). FRANCE. Jura, Salins-les-Bains, Thésy, CFP 868*, TEB 25-89*, TEB 34-89*. Doubs, Vellevans, TEB 37-89*. Doubs, *R. Henry* 88/194, 88/XX (paratypes, hb. R. Henry), *R. Henry* 88/YY (as *C. vulpinus*, hb. R. Henry). Haute-Savoie, exhibition at Seynod, *P. Moënne-Loccoz* 87 (as *C. vulpinus*, hb. P. Moënne-Loccoz). Sallanches: Cordon, *J.-L. Cheype* 20 ix 1988; Oëx-Luth, *J.-L. Cheype* 4 x 1988 (as *C. vulpinus*, hb. J.-L. Cheype). GERMANY. Bavaria: Main-Spessart, 'Steinberg w. Stetten', *L. Krieglsteiner* 1046 (M); Freising, Eching, *A. Einhellinger* 28 ix 1974 (as *C. rufoalbus*, M). Theringen, Jena, *U. Luhman & M. Huth*, 16 ix 1994 & 18 ix 1994 (O). CZECH REPUBLIC. Bohemia, Karlstejn: S of Srbsko, TEB 199-94*; NE of Skalou, TEB 200-94*, 201-94*. HUNGARY. Börzsöny: Magashegy, TEB 215-94; Törökmezö, TEB 226-94*. SWEDEN. Öland, Borgholm, Halltorps Hage, *S. Jacobsson* 28 ix 1994 (GB, O).

Comments: *C. pseudovulpinus* is characterized by its normally non-viscid and fibrillose-appressed scaly pileus, pronounced and persistent lilac lamellae, yellow discolouring context, poorly developed hypoderm, pronounced epicutis pigment and the association with *Carpinus betulus*. These features normally also distinguish it from *C. vulpinus*, *C. argutus* and other related species. In Brandrud et al. (1992) *C. pseudovulpinus* was treated as a subspecies of *C. vulpinus*, but more material and a closer examination reveal constant differences in the two taxa, especially in microcharacters such as the pileipellis morphology, pigmentation and also a slightly different spore morphology (Figs 1, 17). When these character differences are added to the differences in pileus structure, lilac pigmentation, staining reaction and shape of the stipe, these taxa clearly deserve the rank of species.

The yellow staining of the context is a striking feature, and according to the nine collections seen fresh, this is a constant character. Both Moser (1961 as *C. rufoalbus* p.p.) and Cetto (1978 as *C. vulpinus*) depict specimens with a clearly yellow-staining context, and the feature is mentioned as a differential character also by Moënne-Loccoz & Reumaux (1990b as *C. vulpinus*). *Cortinarius* (*Sericeocybe*) *vulpinus* sensu Moser (1983) is probably the same species, but the yellow-staining context is not mentioned here, neither is it mentioned by Henry (1985, 1989; see below).

C. pseudovulpinus in the sense here applied was accurately circumscribed by Henry (1985) under the name *C. (Inoloma) plumiger* Fr. sensu Quél. ('Syn. probable: *C. (Inol.) vulpinus* Velen.'), and a detailed comparison with *C. rufoalbus* was provided. The dry, floccose pileus, lilac lamellae and habitat (calcareous mixed *Carpinus* forests versus *Fagus* forests) were emphasized as the separating characters of *C. plumiger* sensu Quél versus *C. rufoalbus*. Later Henry & Ramm (1989a, b) adopted the name *C. vulpinus* Velen. for *C. plumiger* sensu Quél., and *C. pseudovulpinus* was separated as a variant with viscid pileus. *C. pseudovulpinus* was described as new with a Latin diagnosis in not less than three different publications (Henry, 1989; Henry & Ramm, 1989a, b). It appears that the brief presentation in Henry (1989, published in April) is the first and valid one, although the name here is published as a nom. nov. (see Art. 33.3), and with a very short Latin diagnosis (Art. 32.2). The citation '*C. pseudovulpinus* Hry. et Ramm' used in Henry & Ramm (1989a, b) and Henry (1989) is therefore incorrect.

The plate of *C. pseudovulpinus*, published by Henry (1991), does not quite correspond to the interpretation adopted here: the pileus colour is too red-brown, the stipe is fusiform and the yellow stains are lacking. On the other hand, the persistently lilac lamellae depicted and the veil development are well in correspondence. Original material of both *C. pseudovulpinus* (paratypes, holotype not available) and *C. vulpinus* s. Henry have been examined, and both correspond with the here described *Carpinus* forest species (Fig. 17). Strangely enough, the yellowish staining of the context is not emphasized in the descriptions of *C. pseudovulpinus*, although the protologue has a slight indication of such a reaction ('Chair ... *jaunissant* dans le bas'; Henry, 1989).

C. pseudovulpinus seems to be a character species of calciphilous *Carpinus betulus* forests, and the species is probably widely distributed in the *Quercus*-*Carpinus*-dominated areas of the submontane foreland region fringing the Alps. The *Carpinus* forests have a number of characteristic associates such as *C. prasinus* (Schäff.: Fr.) Fr. and *C. terpsichores* Melot var. *calosporus* Melot (see Brandrud et al., 1990–95), but *C. pseudovulpinus* is the only *Cortinarius* that seems restricted to this kind of forest. A strict association with *Carpinus* cannot be fully confirmed with the limited material seen and the few and vague indications in the literature, but the conclusion is indirectly supported by the lack of *C. pseudovulpinus* in calciphilous oak, beech or lime forests in W and N Europe and montane beech forests in C Europe. Furthermore, *C. pseudovulpinus* follows the *Carpinus* forests to the northernmost outpost locality at the island of Öland, Sweden in the Gulf of Bothnia (material in GB, O).

15. Cortinarius maculosus (Pers.: Fr.) Fr., Epicr. Syst. mycol.: 271 (1838). **Figs 1p, 17**.

Syn.: *Agaricus maculosus* Pers.: Fr., Persoon, Synop. method. Fung.: 288 (1801). (Sanctioned in Fries, Syst. mycol. I: 253). Type: not indicated.

Cortinarius squameo-radicans Bellivier nom. inval., in Bull. Soc. Nat. Oyonnax 6: 67 (1952). Type: not indicated.

Icones: Cheype (1985), *Bull. Fed. mycol. Dauph.-Sav.* 24(96): 16 (as *C. vulpinus*); Moënne-Locc. & Reum. (1990b), *Atl. Cortin.* 2: Pl. 30; Bellivier op. cit.: 68 (as *C. squameo-radicans*).

Pileus 3–6(–8)cm, (hemi-)spherical, then plano-convex with fairly persistently decurved margin, usually non-viscid; universal veil very abundant, ochraceous brown to dark greyish brown, darkest at centre, rendering pileus distinctly and persistently squamulose-fibrillose, often coarsely fibrillose and with larger patches towards margin, completely covering the pileipellis; pileipellis difficult to distinguish from veil remnants, but apparently ±glabrous; colour between veil fibres/scales pale ochraceous brown, almost whitish towards margin when young. *Lamellae*, L = 60–70, fairly crowded, persistently pinkish lilac-blue, especially at edge. *Stipe* 4–8(–9) × 0.8–1.3cm, cylindrical to slightly clavate (base → 1.5cm), with (sub)radicate base, apex whitish, turning distinctly red brownish from base, especially when bruised. Universal veil abundant, girdled-floccose, initially pale ochraceous brown, becoming reddish brown to dark brown. *Context* whitish. KOH negative (red-brown). *Smell* faint, pleasant when cut, developing an unpleasant smell with age.

Spores 8.5–10.5 × 5.5–6(–6.5)µm (MV = 9.4 × 5.8µm), Q = 1.60 ± 0.10, (broadly) amygdaliform, distinctly and fairly densely to coarsely verrucose, suprahilar plage indistinct. *Basidia* 8.5–10µm wide, 4-spored. *Lamella edge* ± fertile, with clavate sterile cells. *Universal veil* upon pileus surface of variable thickness, but usually 5–10 layers; hyphae wide, 5–15µm, many hyphae 10–12µm, strongly pigmented, wide hyphae mainly with thick, brown walls, narrow ones also with yellowish brown, intracellular clumps, outer hyphae of scales frequently collapsed and with brown, oleiferous content, some hyphae faintly encrusted. Universal veil on stipe similar, but hyphae mainly 5–10µm, often collapsed and then mostly with brown content. *Pileipellis* slightly duplex. *Epicutis* thin, of c.5–7 hyphal layers, hyphae subparallel and fairly loosely entangled, comparatively wide (3–8µm), hardly gelatinous, hyaline, sometimes with an epimembranal, hyaline, light-dispersing, oily, drop-like coating. Basal part of epicutis of more parallel, densely connected hyphae, up to 10µm wide, forming a transition to hypoderm. *Hypoderm* slightly differentiated, of c.5–6(–8) layers, 2–3 central layers subcellular, of elements up to 20µm wide, with slightly yellow, thickened walls, but no amber-like matrix.

Habitat: Nemoral to submontane deciduous forests. Collected in *Quercus* forests (probably *Q. robur* and *Q. cerris*) on rich, clayey soil.

Distribution: Very rare, and known only from a few localities in E and S France. Probably threatened by extinction in Europe due to its extreme rareness and specialized habitat.

Collections examined. FRANCE. Haute-Savoie: Ain, Semine, *P. Moënne-Loccoz* 377 (hb. P. Moënne-Loccoz); Ain, Oyonnax, *J. Melot* 86-184 & 84-129 (hb. J. Melot).

Comments: Fresh material of this species has not been available, and the description of macro-morphological characters is based on photographs (slides) by J. Melot (*Melot* 86-184) and the illustrations in Moënne-Loccoz & Reumaux (1990b) and Cheype (1985; as *C. vulpinus*). The illustrations show a remarkable species with a Pholiotoid-Inocyboid appearance, mainly characterized by its abundant, squamulose, brown universal veil, its persistently lilac-blue lamellae and the (sub)radicate stipe base. *C. maculosus* resembles *C. pseudovulpinus* in habit and colours, but the latter differs in less abundant, more fibrillose and not so dark veil, rarely (sub)radicate stipe and yellow-staining flesh. Microscopically *C. maculosus* can easily be distinguished from *C. pseudovulpinus* by its small spores and little developed, hyaline epicutis. In *C. maculosus* most of the pileus pigmentation is concentrated to the veil.

C. maculosus has been recorded from *Quercus* forests (Cheype, 1985), and from an area with mixed deciduous forests dominated by *Quercus* (Moënne-Loccoz & Reumaux, 1990b). With its striking characters, it is not likely to be much overlooked, and is probably a truly rare species, apparently restricted to SW Europe.

The interpretation of *C. maculosus* adopted here was introduced by Moënne-Loccoz & Reumaux (1990b). The name *Agaricus maculosus* Pers. was sanctioned by Fries (1821: 253), and the species was placed among the Pholiotas, after *Ag. lentus*. Both the original description in Persoon (1801) and the sanctioning description in Fries (1821) correspond well with the species described here, and no serious contradictions are found. On the other hand, it is not unlikely that the fairly vague descriptions cover a *Pholiota* species in the *P. lenta* group, but there is no tradition in the use of the name *Ag. maculosus* for a species in the genus *Pholiota* (Jacobsson, 1991). The main objection against the present interpretation is that Fries probably never saw this species. He hardly had access to material from calcareous *Quercus* forests, and it is unlikely that the species here described occurs in Sweden. However, it is somewhat more probable that Persoon could have seen this in C Germany where his *Agaricus maculosus* was collected. Since Persoon's description is part of the protologue (see Article 7.20 in the Code), and especially since Fries largely copied the Persoonian description, it seems reasonable to base the present interpretation mainly on Persoon (1801), and accept the interpretation of Moënne-Loccoz & Reumaux (1990b). The species has also been described and depicted by Bellivier (1952) under the name *C. squameo-radicans*, but without a Latin diagnosis.

16. Cortinarius caligatus Malençon in Malençon & Bertault, Fl. Champ. sup. Maroc I: 482 (1970). Type: *G. Malençon* 5691 (holo. MPU). **Figs 1q, 14b, 18.**
Syn.: *Cortinarius crustulinus* Malençon in Malençon & Bertault op. cit.: 495. Type: *Malençon* 1410 (holo. MPU).

Icones: Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 12, f. 1; Mal. & Bert. op. cit. Pl. 22 (as *C. crustulinus*).

Pileus 3–8cm, (hemi-)spherical, then plano-convex, viscid, but soon drying out, universal veil abundant, whitish to ochraceous brown, usually rendering the surface appressed scaly at centre, and with smaller or larger, fibrillose patches near margin; sometimes more glabrous and innately fibrillose-rivulose, slightly micaceous when dry; pale greyish brown to ochraceous brown (K-L 75, N 67, M-N-P-R 49), centre often darker fulvous to almost red-brown, when young often more whitish towards margin (K-L 75), sometimes with a purplish brown tinge (P-R 55, M 50-51). *Lamellae*, L = 60–90(–100), fairly crowded, 4–8mm broad, bright- and normally persistent bluish-lilac towards edge, greyish towards context; edge even to somewhat crenulate. *Stipe* 5–9 × 1–2cm, at base slightly clavate (→3cm), and often pointed to subradicate, whitish, turning (pale) ochraceous brown from base. Universal veil (very) abundant and prominent, ochraceous brown, sometimes pale when young, turning more brownish with age, rendering the stipe distinctly girdled-floccose, sometimes even squarrose-annuliform. Cortina remnants sparse to distinct when expanded. *Context* white, somewhat ochraceous brown on bruising. KOH slightly brownish. *Smell* weak to distinctly of yeast or dough.

Spores 8.5–10(–10.5) × 5.5–7µm (MV = 9.4 × 6.3µm), Q = 1.50 ± 0.08, broadly amygdaliform-ellipsoid, sometimes subglobose, with a high variability within each collection (ranging from 9 × 7µm to 10 × 6µm); distinctly and rather densely verrucose, suprahilar plage sometimes distinct. *Basidia* 8.5–9.5(–10)µm wide, 4-spored. *Lamella edge* ± sterile, with numerous clavate-cylindrical sterile cells. *Universal veil* on stipe surface of narrow to sometimes fairly wide, frequently collapsed hyphae; 3–12µm; distinctly pigmented, forming thick, yellowish brown walls, and some hyphae ± filled with oleiferous, brown necropigment. Universal veil on pileus surface usually of c.5(–10) layers of parallel, 4–8μm wide hyphae, yellowish brown pigmentation parietal or intracellular (necro)pigment. *Pileipellis* duplex. *Epicutis* thin, of c.4–6(–8) layers, hyphae 3–6(–8)μm, parallel and repent, terminal segments erect-entangled and gelatinous; pigment yellowish, parietal to distinctly zebra-striped encrusting, pigment concentrated to the basal layers. *Hypoderm* ± subcellular, elements up to c.30 μm wide, with yellow-brown amber-like, parietal pigment.

Habitat: Mediterranean frondose forests. Associated with sclerophyllous oak species (*Quercus ilex*, rarely *Q. suber*) on calcareous soil, usually in closed forests with deap leaf litter and typically with *Ruscus aculeatus*.

Distribution: Fairly rare but widespread in the Mediterranean area, and apparently locally not infrequent in S France (Chevassut & Henry, 1978; Chevassut, 1991 as *C. variiformis*), Mallorca (Brandrud & Bendiksen, 1985), C Italy (pers. obs.) and Morocco (Malençon & Bertault, 1970). In the Italian Apennines recorded up to approx. 800m a.s.l. (Umbria, Spoleto, pers. obs.), in the Atlas mountains up to 1600m a.s.l. (Malençon & Bertault, 1970).

Collections examined (**including macrocharacters*): ITALY. Umbria, Spoleto, TEB 236-94*, 237-94*. SPAIN. Mallorca: Son Massip, Escorca, Lluc, TEB 139-84*; Son Massip, Mt Massanella TEB 153-84*. FRANCE. Languedoc, Herault, Montpellier, *R. Henry* 3385 (as *C. variiformis*; hb. R. Henry), *G. Chevassut* no. 2820 (25 xi 1975) & 27 x 1984 (as *C. variiformis*, hb. G. Chevassut), *G. Chevassut* no. 1243 & 2 xi 1984 (hb. G. Chevassut), *J. Melot* 86-233, 87-273 (hb. J. Melot). MOROCCO. Col du Zad, Azrou, *G. Malençon* 5691 (holo. MPU), *G. Malençon* 1410 (holo. *C. crustulinus*, MPU), *G. Malençon* 1408 (as *C. crustulinus*, MPU).

Comments: *C. caligatus* is characterized by its appressed scaly, ochraceous brown pileus, bright lilac lamellae, annulate girdled, fusiform stipe, small and broad spores and habitat in evergreen, Mediterranean oak forests. It is distinguished from related species mainly by its small, broadly ellipsoid spores, bright lilac lamellae, and the abundant veil, which soon turns brownish. The more or less fibrillose-appressed scaly ochraceous brown pileus resembles that of *C. pseudovulpinus*, but the latter is separated on the yellowish staining context, rarely fusiform stipe and the habitat (*Quercus* versus *Carpinus*). *Cortinarius aremoricus* differs in a much paler pileus and not so bright lilac lamellae. The pileus colour and structure distinguish the species from *C. variiformis*, which may occur in the same habitat. The latter is further separated on the much less developed veil girdles on the stipe, and the usually larger (and never radicating) bulb. The resemblance to *C. variiformis* is further indicated by the fact that Chevassut & Henry (1978) misapplied this name for *C. caligatus*. With this resemblance to *C. variiformis*, *C. caligatus* represents a kind of 'missing link' between subsect. *Triumphantes* and subsect. *Vulpini*.

Cortinarius caligatus is a character species of calcareous, evergreen, mesomediterranean oak forests, and seems to be one of very few *Phlegmacium* species associated exclusively with sclerophyllous *Quercus* spp. (pers. obs.; see also Malençon & Bertault, 1970; Brandrud & Bendiksen, 1985). *C. crustulinus* Malençon is described from the same habitat, and is very probably a synonym, although described with larger and more citriform spores (12–13 × 7–7.5µm). Malençon & Bertault (1970) indicate too large spores also for *C. caligatus* (sp. 10–12 × 5.7–6.4µm). The herbarium in Montpellier does not send types on loan (Holmgren et al., 1981), but the type material has formerly been studied by J. Melot (pers. comm.). This investigation of the types revealed considerably smaller, 9–10(–11) × 5.5–7µm, broadly amygdaliform(-ellipsoid) and very similar spores of *C. caligatus* and *C. crustulinus* (J. Melot, unpublished notes and spore-sketches). The spores of the types are also well in correspondence with the material studied here (Fig. 18). The type material of the two species is in a bad condition, only suitable for the study of the spores (J. Melot, in notes).

According to Fig. 18 the spores of *C. caligatus* have a remarkably variable shape and Q-values, but fairly constant area/volume.

In their atlas, Moser & Jülich (1985–1994, Pl. Cort. 12 f. 2) depict, in addition to a normal *C. caligatus*, a yellowish variant without bluish lamellae. This variant appears very deviant and is not mentioned in the literature, and further study is needed.

17. Cortinarius aremoricus Lebeurier & R. Henry in R. Henry in Docum. mycol.: 64 (1988). Type: *R. Henry* 1045 (holo. hb. R. Henry). **Fig. 1r, 18**.

Syn.: *Cortinarius aremoricus* Lebeurier & R. Henry, in Henry in Bull. Soc. mycol. Fr. 79: 320 (1963), nom. inval.

Misapplied name: *Cortinarius caligatus* Malençon sensu Marchand, Champ. nord midi 7: 108 (1982).

Icones: Marchand op. cit.: Pl. 651; Henry (1963), *Bull. Soc. mycol. Fr.* 79: Pl. 139.

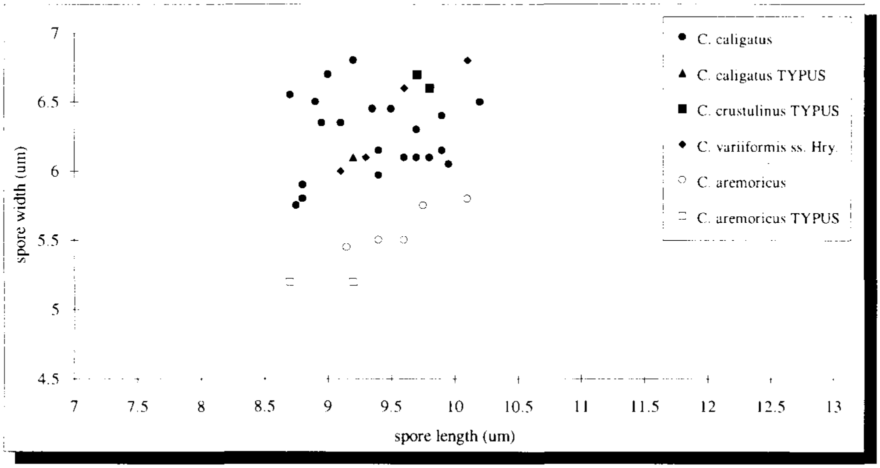

FIG. 18. Variation in spore size of *C. caligatus* (= *C. crustulinus*, *C. variiformis* s. R. Henry) and *C. aremoricus*. Each symbol = MV of 10 spores measured per basidiocarp.

Pileus 6–8cm, (hemi-)spherical, then plano-convex, slightly viscid-glutinous, universal veil fairly sparse, leaving white, fibrillose patches near margin, otherwise glabrous and more or less innately fibrillose-rivulose, slightly micaceous when dry; ochraceous white (K 71, 75-77), then (very) pale ochraceous brown to greyish ochre from centre (L 70, 77, M 70-71). *Lamellae*, L=80–90, fairly crowded, 4–8mm broad, greyish white with a fugacious bluish-lilac tinge, most persistent towards edge; edge even to somewhat crenulate. *Stipe* 7–8 × 1–1.5cm, at base clavate (→3cm), and (sub)radicate, whitish, turning ochraceous grey-brown from base. Universal veil (very) abundant and prominent, ochraceous brown (probably whitish when quite young), rendering the stipe distinctly girdled-floccose, with an annuliform zone above. *Context* white, with age becoming somewhat ochraceous brown from base.

Spores 8.5–10.5 × 5–6µm (MV=9.4 × 5.5µm), Q=1.72±0.04, amygdaliform, distinctly and fairly densely verrucose, suprahilar plage indistinct. *Basidia* 8–9.5µm wide, 4-spored. *Lamella edge* ± fertile, with scattered clavate-cylindrical sterile cells. *Universal veil* on stipe surface of 3–10µm wide, frequently collapsed hyphae, often ± filled with yellow-brown, oleiferous necropigment. Universal veil on pileus surface usually of c.2–3 layers of 5–8µm wide hyphae, often with golden yellow, intracellular lumps of pigment. *Pileipellis* duplex. *Epicutis* thin, of c.5–7 layers, hyphae 3–10(–12)µm, parallel and repent, terminal segments 3–4µm, ± erect-entangled and gelatinous; pigment concentrated to the basal layers, pale yellowish, finely but distinctly verrucose to zebra-striped encrusting. *Hypoderm* ± subcellular, elements up to c.25(–30)µm wide, with pale yellow (brown) amber-like, parietal pigment.

Habitat: Nemoral deciduous forests. Associated with *Fagus sylvatica* on more or less calcareous soil.

Distribution: Very rare, hitherto only known from France: Bretagne (Henry, 1963), the Paris region (material in hb. J. Melot) and Haute-Savoie (Marchand, 1982). Probably threatened by extinction in Europe due to its extreme rareness and specialized habitat.

Collections examined. FRANCE. Bretagne, *R. Henry* 1045 (holo. hb. R. Henry). Beauce, Fontainebleau, *Barbeau, Martelli & J. Melot* 82-110 (hb. J. Melot).

Comments: *C. aremoricus* was not seen fresh, and the above description of macroscopical characters is based on photographs (slides) and notes by J. Melot (collection from Fontainebleau near Paris) and the picture in Marchand (1982 as *C. caligatus*). The species is characterized by its pale, almost whitish pileus, much reminiscent of *C. argutus*, its pale lilac lamellae and its prominently annulate girdled to floccose, (sub)radicate stipe. The pileus was described by Henry (1963) as distinctly viscid-glutinous, but this does not always seem to be the case. Although superficially reminiscent of *C. argutus*, it lacks the reddish to bluish grey staining reaction of this species, and is probably most closely related to the Mediterranean *C. caligatus*. However, it is distinguished from the latter by its paler pileus and lamellae, its narrower spores and its habitat. The species was described by Marchand (1982) under the name *C. caligatus*. Based on the limited, available material, the species seems to have a south-western, atlantic distribution in Europe.

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