CORTINARIUS SUBGENUS *PHLEGMACIUM* SECTION *PHLEGMACIOIDES* (= *VARIECOLORES*) IN EUROPE

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The taxonomy of *Cortinarius* subgen. *Phlegmacium* sect. *Phlegmacioides* (= *Variecolores*) in Europe is emended to include 18 species, classified in three subsections: Subsect. *Variecolores*: *C. variecolor* (emended to include *C. nemorensis* sensu R. Henry, Mos.), *C. violaceomaculatus*, *C. spadicellus* (= *C. amigochrous*), *C. largus* (= *C. nemorensis* sensu J.E. Lange, *C. lividoviolaceus*), *C. coalescens*, *C. patibilis* var. *patibilis*, *C. patibilis* var. *scoticus*, *C. kuehneri* and *C. russus*; Subsect. *Balteati*: *C. balteatus* (= *C. subbalteatus*), *C. durus* var. *durus*, *C. durus* var. *chamaesalicis*, *C. balteatotomentosus*, *C. balteatoalbus* var. *balteatoalbus* (= *C. crassus* sensu J.E. Lange), *C. balteatoalbus* var. *areni-silvae*, *C. vacciniophilus* (= *C. latus* sensu Mos.), *C. acidophilus*, *C. balteatocumatilis* (= *C. violaceocinctus*), *C. hysginus* (= *C. latobalteatus*) and *C. borgsjoeensis*; Subsect. *Serarii*: *C. serarius* (= *C. eulepistus*). Nine taxa have not been previously included in taxonomic treatments of the group.

The species delimitations are discussed, and the diagnostic characters and their differentiation are studied. Species descriptions are provided. Two large species complexes were recognized, the *C. variecolor* and the *C. balteatus* complexes, the taxa of which had a large degree of overlapping character variation, frequently with only one, discontinuously varying character. The species have different and often less strict edaphic requirements than found elsewhere in the subgenus. Most species are rare and with a limited distribution, many of them belonging to a *Picea* or *Betula*-associated, ±northern, boreal element. A few species have a broad range of mycorrhizal hosts and a very wide distribution in Europe.

Keywords. Agaricales, species descriptions, taxonomy.

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INTRODUCTION

The present contribution is the third part of a monograph of *Cortinarius* (Pers.) Gray subgen. *Phlegmacium* (Fr.) Trog. The first two parts treat the taxonomy and the ecology of sect. *Phlegmacium* (including the subsections *Triumphantes*, *Arguti* and *Vulpini*; Brandrud, 1996a, b). The new names and combinations in the present monograph are validated in Brandrud (1997).

The section *Phlegmacioides* (Fr.: Fr.) Brandrud, Lindström & Melot was first introduced by Fries (1821) as *Agaricus* sect. *Phlegmacioides* (‘*Phlegmacioidea*’), and has recently been typified and emended to cover the group treated here by Brandrud et al. (1995). The section is better known under the name *Variecolores* Konrad & Maubl. ex Brandrud & Melot (Moser, 1961; Moser in Singer, 1986), and the name *Patibiles* Moenne-Locc. & Reumaux has also been applied to this group (Bidaud et al., 1994b, 1995). This is a fairly well-established entity within subgen. *Phlegmacium* (Kühner & Romagnesi, 1953; Moser, 1961; Moënne-Loccoz & Reumaux, 1990; Bidaud et al., 1994b, 1995).

Section *Phlegmacioides* includes violaceous to brown species with a clavate to bulbous stipe, a more or less fibrillose-tomentose pileus with a poorly developed gelatinous layer and a yellow KOH reaction in context (Moser, 1961). Most species in the section lack the typical characters for subgen. *Phlegmacium*, such as an abruptly bulbous stipe and a persistently glutinous-glabrous pileus surface, and some show affinity to species such as *C. crassus* Fr. and *C. vespertinus* (Fr.) Fr. of subgen. *Cortinarius* sensu Brandrud et al. (1990–95).

The number of species in sect. *Phlegmacioides* treated by different authors varies. The most extensive treatment covering the entire group was carried out by Moser (1961), who included 18 species and 6 varieties within the group as here circumscribed. Kühner & Romagnesi (1953) included 12 species from France, whilst Orton (1955, 1960) described 8 species from Great Britain. Orton (1955) placed the species with white lamellae in the group *Cumatiles*, and the ones with violaceous lamellae in *Variecolores*. Henry (1935, 1936, 1939) was the first to give an accurate description of some of the most widely distributed and frequently treated taxa in the group: *C. largus*, *C. variecolor* (Henry, 1935), *C. nemorensis* (Henry, 1936) and *C. balteatocumatilis* (Henry, 1939). Later, Henry (1958) and Bidaud et al. (1995 as subsect. *Crassi* Moënne-Locc. & Reumaux) provided more extensive treatments of parts of the subgroup *Balteati*, including 11 and 21 taxa, respectively.

MATERIAL AND METHODS

A total of 195 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 12 collections per taxon for the 15 species seen fresh. Fresh material was examined from Norway, Sweden, Finland, Denmark, Great Britain, Germany, The Czech Republic, Hungary, Switzerland, Italy and France. 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 well as material (mainly type material) from the herbaria of C, E, FR, G, IB, K, M and WAG-W and from the private herbaria of Mr G. Chevassut, R. Henry, J. Melot, P. Moënne-Loccoz and K. Soop.

The taxonomic descriptions are based on personal observations except in the case of the macrocharacters of *C. chamaesalicis*, *C. hysginus* and *C. kuehneri*. 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% and 40% KOH and guaiac (see Moser, 1983). The terminology of characters follows Brandrud et al. (1990), except for one aspect concerning pigment topography. Pigments appearing as thickened, smooth, yellow to brown walls are termed parietal (not membranal). The major features of pileipellis and their terminology are illustrated in Figs 6, 7.

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 ten 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 15–25 collections were measured.

The pileipellis was studied from radial (longitudinal), 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. Drawings of microscopical features were made by means of a camera lucida.

Scanning electron microscopy (SEM) photographs of the spores were made with a JEOL JSM 35C at the Electronmicroscopical Unit for Biological Sciences, University of Oslo. Dried gill fragments were first gold-palladium covered in an argon atmosphere.

An evaluation of character variation for species delimitation and the selection of diagnostic characters was carried out using the 195 completely studied collections. Each taxon was compared with its supposed most closely related taxa. The taxon pairs with the least number of differences are in the present study termed nearest neighbour taxa. Their character differentiation was classified in three categories: (i) no or insignificant differences, (ii) significant differences, with overlap between the neighbour taxa, but with different dominant character state (no overlap in SD intervals of the quantitative characters), (iii) non-overlapping variation.

The ecology of boreal species was investigated by a permanent plot study 1979–1980 at Lunner, 60km N of Oslo, SE Norway. Five *Picea abies*-dominated forest types, ranging from oligotrophic to calciphilous, were studied. The plots were situated 300–500m a.s.l. in the lower to middle boreal zone. The occurrence of the species was recorded in four permanent plots (each of 10,000m^2) per forest type. The pH of soil samples was determined with a glass electrode Methrom Herisau pH-meter, 25g soil: 50ml distilled water.

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): Britz. for Max Britzelmayr, R. Henry for Robert Henry, Kühn. for Robert Kühner, and Mos. for Meinhard M. Moser. Abbreviations of standard works follow 'Title abbreviations for some common mycological taxonomic publications' (Anon., 1969). The terminology of vegetation zones in N Europe follows Sjörs (1963) and in C and S Europe, Noirfalise (1987).

RESULTS AND DISCUSSION:

Altogether 18 species (21 taxa) are here distinguished in sect. *Phlegmacioides*, including 13 rare and little-known species. Seven of these occur mainly or exclusively in N Europe, and three are described as new.

DELIMITATION OF SECT. *PHLEGMACIOIDES* FROM SECT. *PHLEGMACIUM*

Section *Phlegmacioides* (= *Variecolores*) is closely related to sect. *Phlegmacium* sensu Brandrud (1996a, b) (including sect. *Triumphantes* and sect. *Arguti* sensu Moser, 1961). These taxa constitute the bulk of species in subgen. *Phlegmacium* with a cylindrical, clavate to bulbous, but never abruptly bulbous stipe (see Brandrud, 1996a, b). Both groups include species with a fibrillose-scaly, (almost) non-viscid pileus.

The main differences between the sections are the development of the universal veil and the bluish pigments, the pileipellis structure and pigmentation, as well as the ecology and distribution. In sect. *Phlegmacium* the veil is abundant, and is responsible for the often fibrillose-scaly, dry pileus surface. In sect. *Phlegmacioides*, the veil remnants are sparse, and more or less imbedded in the pileus surface. The often fibrillose-squamulose surface is a result of the structure of the pileipellis and not the veil. The gelatinous layer is normally less developed in sect. *Phlegmacioides* than in sect. *Phlegmacium* and the macrochemical reactions are more intense, including a yellow reaction with KOH. Such a yellow KOH reaction is rarely seen in sect. *Phlegmacium*.

The violaceous blue to lilac pigments have a different distribution and are probably of a different chemical nature in the two sections. Many species in sect. *Phlegmacioides* have distinct but fugacious violaceous blue colours on the pileus (margin), lamellae, stipe and veil. In sect. *Phlegmacium* bluish pigments are either absent or restricted to the lamellae. The lamella pigment is persistently lilac-blue, and is mainly restricted to the hymenium (see Brandrud, 1996a, b).

The pileipellis of the species in sect. *Phlegmacium* is normally duplex, with a well-developed, subcellular hypoderm of inflated, cemented elements, whilst that of the species in *Phlegmacioides* is usually simplex, with more loosely arranged and rarely inflated elements. The pigments are also different. Most species of sect. *Phlegmacium* have warm yellow-brown to red-brown colours due to parietal and encrusting pigment in the basal part of the epicutis and hypoderm, whilst many of the species in sect. *Phlegmacioides* have a more grey-brown to dark brown colour due to oleiferous, brown pigment. This pigment is almost absent when young, when the oleifers are only pale yellow, but often becomes strongly developed with age or on handling.

Finally, there is a considerable difference in ecology and distribution of the two taxa: the species of sect. *Phlegmacium* occur mainly in calcareous, warm and dry habitats, preferentially in S Europe, whilst the majority of species in sect. *Phlegmacioides* prefer non-calcareous, frequently acid, moist habitats in N Europe and montane parts of C Europe.

SUPRASPECIFIC CLASSIFICATION

Section *Phlegmacioides* is characterized by a weak differentiation between many of the taxa, and represents one of the most taxonomically complex groups in subgen. *Phlegmacium* (see Brandrud et al., 1990–95). Based on an evaluation of the character differentiation, two large species complexes can be distinguished: the *C. variecolor–C. largus–C. patibilis* complex and the *C. balteatus–C. balteatoalbus–C. durus* complex (Fig. 1). In the present study these complexes are treated as two subsections, subsect. *Variecolores* and subsect. *Balteati*. The former group is distinguished mainly by the presence of bluish tinges on the lamellae and in the context, and a (vinaceous) brown staining reaction on the stipe and in the context of young basidiocarps. However, species such as *C. patibilis* and *C. balteatocumatilis* have character affinities to both subsections.

Four species, *C. russus*, *C. balteatocumatilis*, *C. borgsjoeensis* and *C. serarius*, are well differentiated with discontinuous variation in number of characters towards their supposed neighbour taxa (see Diagnostic Characters below). *C. borgsjoeensis* appears to be the most isolated of these, but is classified in subsect. *Balteati* as it possesses most of the diagnostic characters of that subsection.

Cortinarius serarius (= *C. eulepistus*) deviates from both subsections in a number of taxonomically important features, and a third, monotypic subsection *Serarii* is

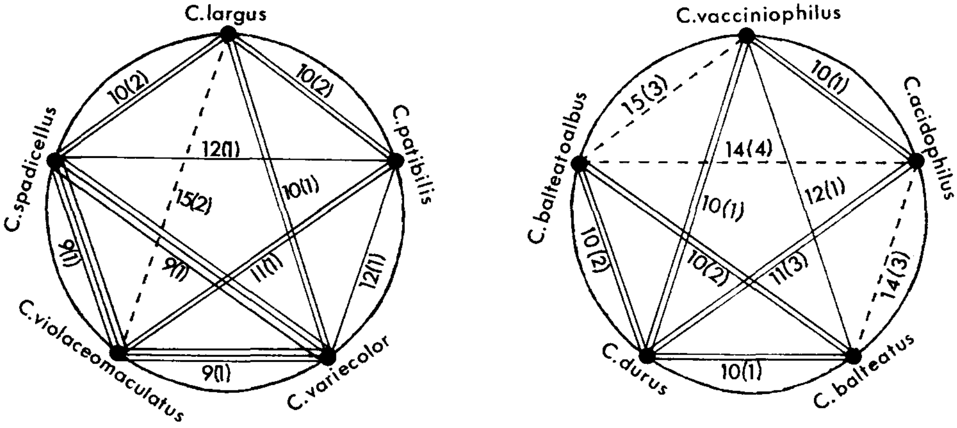

FIG. 1. Plexus diagram indicating taxonomic relationship in the *C. variecolor* and *C. balteatus* complexes. Number of differential characters between each taxa indicated; number in parentheses = number of characters with discontinuous (non-overlapping) variation. Taxa with limited data on the variation in quantitative characters are not included.

created for this species. Subsection *Serarii* seems to occupy an isolated position, and shows affinity also to the *C. papulosus* Fr.–*C. olidus* J.E. Lange group in sect. *Elastici* (Fr.) Sacc.

The supraspecific taxonomy presented here, with the two large subsections *Variecolores* and *Balteati*, is similar to the classification of Moser (1961) and Moser in Singer (1986), although Moser divided the latter group into stirps *Balteatus* and stirps *Latus*. Bidaud et al. (1994b) performed a more extensive subdivision, with four subsections (*Patibiles* Bidaud, Moënne-Locc. & Reumaux, *Cyanipedes* Bidaud, Moënne-Locc. & Reumaux, *Balteati* and *Crassi*), and they used different diagnostic characters (viscidity and colours of pileus). According to the present study these characters have more diagnostic value at the species level. Because of the complex taxonomy and the intimate and entangled morphological relationship shown in Fig. 1, I have found it impossible to subdivide the large subsections *Variecolores* and *Balteati*.

THE TAXONOMIC COMPLEXES

The character differentiation within the *C. variecolor* and *C. balteatus* complexes was studied by an analysis of the interspecific variation in the quantitative characters, and by an evaluation of the variation in qualitative characters (Fig. 1; see also Diagnostic Characters below). The number of differing characters was slightly higher in the latter complex, mainly due to (i) differentiation in habit characters, and (ii) more differentiation in microcharacters, especially those of the pileipellis. However, most of the species recognized in the *C. balteatus* complex had a high infraspecific variability, and the taxonomy of the complex is less clear-cut than that of the *C. variecolor* complex.

The C. variecolor *complex*

A complete evaluation of morphological relationships was performed on the five taxa with sufficient material available (Fig. 1). The taxa distinguished had a fairly high number of differential characters, but usually with only one, discontinuously varying character between the taxa. The character differentiation was found largely in qualitative characters, and the degree of overlap was often difficult to assess accurately. A high infraspecific variation was found in some of the species, e.g. *C. variecolor*. This species is the ecologically most variable and occurs in both coniferous and deciduous forests. The deciduous forest variant is often somewhat paler, and has normally been regarded as a separate species (*C. nemorensis* sensu R. Henry, Moser). However, pale specimens also occur in coniferous forest, and this variation seems to be phenotypic and dependent on habitat and weather conditions. Ecological variation is not correlated with the variation in the quantitative characters measured (see Tables 4, 6, 7; Figs 8, 14). Infraspecific variation is further discussed in the taxonomic part.

The C. balteatus *complex*

The character resemblance was almost equal between most taxa in the complex (Fig. 1), and the nearest neighbours were therefore difficult to resolve. Of the four most highly resembling taxa, two pairs of taxa with different habit could be distinguished (*C. balteatus*/*C. balteatoalbus* versus *C. durus*/*C. vacciniophilus*; see Figs 2, 3), but the habit differences were not correlated with the differentiation in microcharacters, where *C. balteatus* and *C. durus* had the highest resemblance and *C. balteatoalbus* the most isolated. Considerable infraspecific variation was found, for example in *C. balteatus*, *C. balteatoalbus* and *C. durus*, and their variation was often correlated with ecogeographical patterns (see under Distribution and Taxonomy).

SPECIES DELIMITATION AND SPECIES CONCEPT

The species delimitations applied here are frequently broader than normally used in this group. The more common and polymorphic species have often been treated as a number of taxa: for example, *C. largus* as here circumscribed was treated as five species by Henry (1957, 1958) and *C. variecolor* was classified as four taxa (including two species; see also taxonomic part) by Moser (1961).

The taxonomy of the group has hitherto been based almost solely on macromorphological characters (see, for example, Henry, 1958; Moser, 1961; Brandrud et al., 1990–95; Bidaud et al., 1995). This is due mainly to the fact that the spores are very uniform in the group (see Fig. 4), and that other microcharacters have rarely been

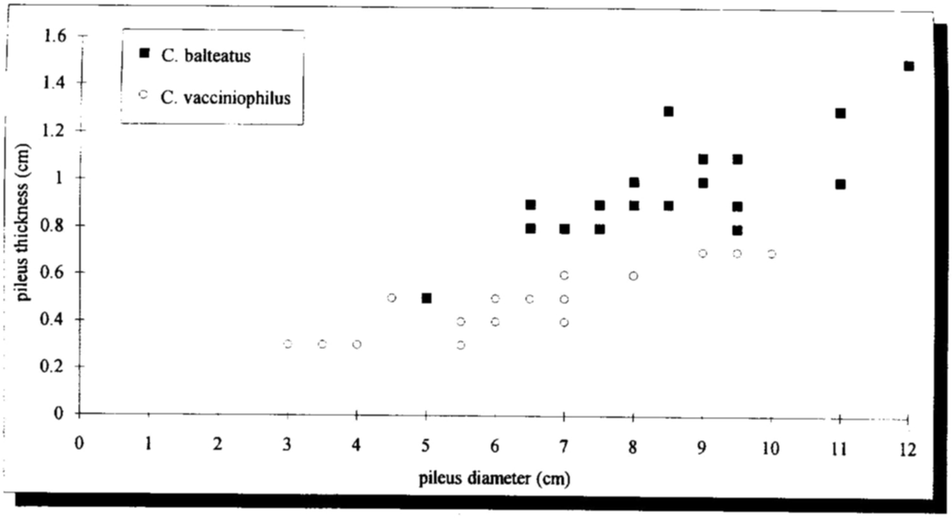

FIG. 2. Variation in macromorphological characters of *C. balteatus* and *C. vacciniophilus*: pileus diameter and pileus thickness (midway to centre). Each symbol = measurements from one basidiocarp.

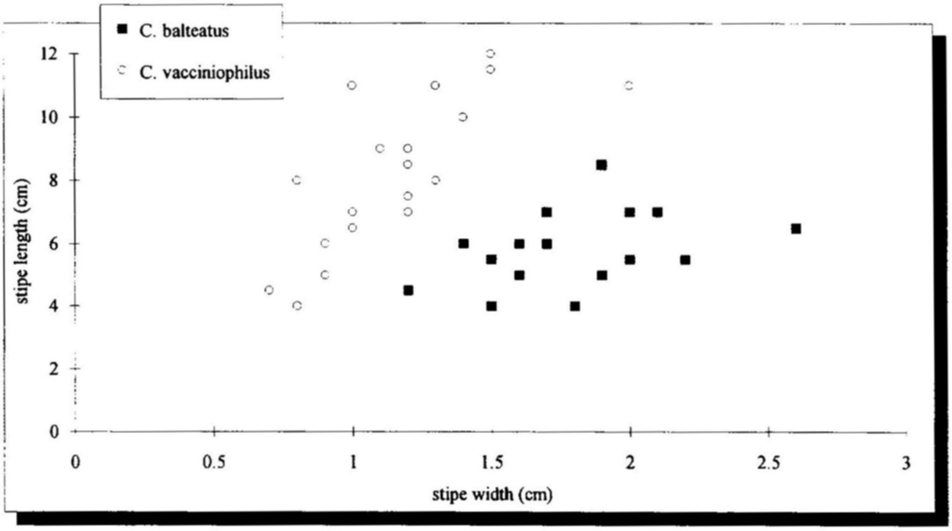

FIG. 3. Variation in macromorphological characters of *C. balteatus* and *C. vacciniophilus*: stipe length and stipe width (thickness) at apex. Each symbol = measurements from one basidiocarp.

applied in *Cortinarius* taxonomy. Based on macrocharacters and spore morphology, the taxonomy of sect. *Phlegmacioides* resembles that of critical groups in subgen. *Telamonia*: the character differentiation is weak, and the diagnostic characters are largely qualitative. The character differentiation is less than found for instance in the neighbour section *Phlegmacium* (Brandrud, 1996a, b).

The study of microcharacter differentiation largely confirmed and strengthened the intuitive species concept initially applied. A number of macroscopically critical taxa could be distinguished by more or less discontinuous varying microcharacters, e.g. *C. variecolor* versus *C. largus*, *C. patibilis* versus *C. russus*, and *C. balteatus* versus all closely related taxa. Microcharacters also more or less distinguished the macroscopically very similar *C. patibilis* var. *patibilis* from var. *scoticus* and *C. balteatoalbus* var. *balteatoalbus* from var. *areni-silvae*. On the other hand, the study of microscopic features gave no support in distinguishing the deciduous forest form of *C. variecolor* ('f. *nemorensis*') (see Tables 6, 7; Fig. 8), or any of the described variants of *C. largus*.

Since the taxonomic distance between the various taxa in the *C. variecolor* and *C. balteatus* complexes was found to be fairly equal (Fig. 1), (most of) these taxa should be treated at the same taxonomic level, either as varieties of *C. variecolor* and *C. balteatus* or as species. According to the species concept of Clémençon (1977), requiring discontinuous variation, the taxa should be treated as species, although the hiatus in character variation is very subtle (Fig. 1). A treatment as varieties would produce 6–8 infraspecific taxa in each complex, a clearly impractical solution in serious conflict with the prevailing concept in many other groups of *Cortinarius*.

A comparison with currently applied taxonomy in sect. Balteati

An extensive taxonomic treatment of the entire sect. *Phlegmacioides* has formerly been attempted only by Moser (1961; see also 1983), but (parts of) subsect. *Balteati* has been treated in detail by Henry (1958, 1989) and Bidaud et al. (1995). The taxonomic treatments by these authors are compared with the present one in Table 1. The nomenclature is fairly similar in all the works, although the French authors deviate in the interpretation of the Friesian name *C. crassus* (see taxonomic part under *C. balteatoalbus*).

The species circumscriptions in subsect. *Balteati* applied here deviate almost completely from those of earlier treatments. Each species accepted here usually comprises two species as circumscribed by Moser (1961, 1983), and three to sometimes four species as treated by the French authors (Table 1). Only in two cases does the present delimitation of taxa conform completely with the former ones. This deviation is more extensive than is concluded in related sections (Brandrud, 1996a, b), indicating that many species delimitations are critical and that sect. *Phlegmacioides* is one of the most complex and poorly understood groups in subgen. *Phlegmacium*. Some of the rare taxa remain little known, and there will probably be adjustments to their taxonomy in the future.

Of the here non-accepted species included in Moser (1961, 1983), *C. subbalteatus* is the most widely used. This was distinguished from *C. balteatus* by Moser (1961) on the subalpine habitat and the paler, less bluish pileus colours. Such pale variants

TABLE 1. Taxonomy and nomenclature of subsect. *Balteati* in ±complete taxonomic treatments of the group. Only taxa that belong to the subsection as here circumscribed are included. *Cases where earlier species delimitations clearly conform with the present ones.

Present study	Moser (1961, 1983)	Bidaud et al. (1995)	Henry (1958, 1989)
Subsect. *Balteati*	Stirps *Balteatum* & *Latum* p.p.	Subsect. *Crassi* p.p.	groupe de *C. balteatus* & de *C. crassus* p.p.
C. balteatus	*C. balteatus* *C. subbalteatus*	*C. subbalteatus* ?*C. subcrassoides*	*C. eubalteatus* *C. subbalteatus*
C. durus var. *durus*			
C. durus var. *chamaesalicis*			
C. balteatotomentosus	**C. balteatotomentosus*	*C. subbalteatus* f. *balteatotomentosus* ?*C. tomentosus*	*C. balteatotomentosus* ?*C. tomentosus* ?*C. imbricatoides*
C. balteatoalbus var. *baltalb.*	*C. balteatoalbus* *C. crassus* sensu Lange	*C. balteatoalbus* *C. crassus* *C. concrescens* *C. subconcrescens*	*C. balteatoalbus* *C. balteatoalbus* var. *agathosmus* *C. crassus* *C. crassorum* ?*C. pseudopimus*
C. baltalb. var. *areni-silvae*			
C. vacciniophilus	*C. latus* ?*C. schaefferianus*	?*C. imbricatoides*	?*C. latus*
C. acidophilus			
C. balteatocumatilis	*C. balteatocumatilis* *C. balteatoc.* var. *laetus*	[not treated]	**C. balteatocumatilis*
C. hysginus	*C. hysginus* *C. latobalteatus*	*C. latobalteatus* ?*C. subopimus* ?*C. hysginicolor*	*C. latobalteatus*
C. borgsjoeensis			

are recognized also in the present study, and might represent genotypic variation. However, the studied material indicates that the variation is continuous and apparently much habitat-dependent, and thus does not seem to allow taxonomic recognition. The same conclusion applies to the two varieties of *C. balteatocumatilis* included in Moser (1961, 1983). The widely accepted variety *laetus* was distinguished from var. *balteatocumatilis* on the brighter violaceous and red-brown pileus colours (Moser, 1961), but intermediates have been encountered, and the violaceous colours of *C. balteatocumatilis* are especially variable and fugacious.

The taxonomic treatments of Henry (1958, 1989) and Bidaud et al. (1995) are fairly similar, the latter's atlas being produced in collaboration with R. Henry. Unfortunately, the species included in Henry (1958, 1989) are often difficult to interpret, because of the lack of colour illustrations and poorly preserved type material. My interpretation of the French concepts is therefore based largely on Bidaud et al. (1995). The treatment of subsect. *Crassi* in Bidaud et al. (1995) comprises 21 fully described and depicted taxa, of which 12 taxa belong to subsect. *Balteati* as here circumscribed (Table 1). Only five of these 12 taxa are accepted here. Judging from type studies and from the excellent paintings and detailed descriptions, several of the remaining seven taxa are synonyms, such as the three species included in the variation of *C. balteatoalbus* as treated here (Table 1; see also taxonomic part under *C. balteatoalbus*). However, some of the here excluded taxa are more difficult to interpret because of limited and suboptimal material and presence of some deviating features (e.g. lack of violaceous tinges in *C. tomentosus*, which is here regarded as a probable synonym for the violaceous tinged *C. balteatotomentosus*). More material is needed to assess their character variation and taxonomic position. Many of the excluded taxa are distinguished by Bidaud et al. (1995) on presumably habitat-dependent, age-dependent or very subjective macrocharacters such as caespitose growth or light versus heavy basidiocarps. These circumscriptions do not seem to reflect a true narrow species concept, but more a preliminary concept based on limited and local knowledge of the range of variation.

DIAGNOSTIC CHARACTERS

Evaluation of the diagnostic, morphological characters was performed by comparing the nearest neighbour taxa (Tables 2–7).

Macromorphological characters

The variation in macrocharacters normally overlapped between the species. The pileus characters had the highest values for distinguishing between nearest neighbour taxa (Table 2).

Habit. The habit characters are usually of little taxonomic importance in subgen. *Phlegmacium* because of their plasticity, depending on age, weather conditions and microhabitat, combined with the limited variation between the species (Brandrud

TABLE 2. Differential (diagnostic) macromorphological characters/character complexes between nearest neighbour taxa in sect. *Phlegmacioides*. Taxa with limited material available are not considered. Only characters which discriminate between the nearest neighbour taxa in more than one case are included. XX = discontinuous (non-overlapping) variation between the two taxa, X = overlapping variation, — = insignificant or no differences. pil dia = pileus diameter, pil thi = pileus relative thickness (diam./thickness), pil bro = brown colours on pileus, pil blu = bluish colours on pileus, pil str = pileus surface structure (viscid or not, (innately) fibrillose or not), lm col = lamellae colour, sti sha = stipe shape (slender or not; length/width), bul sha = bulb shape (cylindrical-clavate or bulbous), sti col = bluish colour on stipe and in context, sta rea = staining reaction (red-brown or not) on stipe and in context, bas rea = reaction with bases (KOH) in context (yellow or not), vei sti = veil on stipe (colour and abundancy).

Sect. *Phlegmacioides*	pil dia	pil thi	pil bro	pil blu	pil str	lm col	sti sha	bul sha	sti col	sta rea	bas rea	sm ell	vei sti
Subsect. *Variecolores*													
C. variecolor/C. violaceomaculatus	—	—	—	XX	—	X	—	—	XX	—	—	X	—
C. variecolor/C. spadicellus	X	X	X	XX	X	—	—	—	—	—	—	X	—
C. spadicellus/C. violaceomaculatus	—	—	X	—	X	X	—	—	X	—	—	X	—
C. largus/C. coalescens	—	—	—	XX	X	X	—	—	—	—	X	—	—
C. patibilis/C. coalescens	—	—	—	—	X	X	X	—	X	X	—	—	—
C. russus/C. patibilis	—	—	X	—	X	X	—	—	X	X	—	—	—
Subsect. *Balteati*													
C. balteatus/C. durus	—	X	X	XX	X	—	X	X	—	—	—	—	—
C. balteatus/C. balteatoalbus	—	—	X	XX	X	—	—	X	—	—	—	—	—
C. durus/C. balteatoalbus	—	X	—	—	X	—	X	X	—	—	—	—	—
C. vacciniophilus/C. acidophilus	X	—	X	X	X	X	—	—	X	—	—	—	X
C. balteatocumatilis/C. balteatus	X	—	X	XX	XX	—	—	—	—	—	—	—	X
C. borgsjoeensis/C. acidophilus	—	—	XX	X	X	X	—	—	X	—	XX	X	—
Subsect. *Serarii*													
C. serarius/C. balteatocumatilis	X	XX	—	X	X	X	XX	XX	X	—	XX	X	X
Character score	4	5	9	15	13	8	5	5	8	2	5	5	3

et al., 1990; Brandrud, 1996a, b). However, in sect. *Phlegmacioides*, and especially in subsect. *Balteati*, an analysis of quantitative habit characters indicated a considerable degree of interspecific differentiation (Tables 3, 4). Many of the taxa in subsect. *Balteati* were significantly different in a number of these habit characters, and in the case of the stipe length/width ratio, the variation was sometimes discontinuous (Table 4). Within the group we find some of the largest, most robust and some of the smallest, most tiny species of *Phlegmacium*, with pileus size ranging from 2.5 to 20cm.

Based on basidiocarp shape, the species can be arranged in three categories (see Tables 3, 4):

TABLE 3. Subsect. *Variecolores*. Variation in characters related to basidiocarp size and shape. Mean values in bold. Taxa with limited material are not included.

	Pileus diameter	Pileus thickness	Diameter/ thickness	Stipe length	Stipe width	Length/ width
C. variecolor 'f. *variecolor*' (*n* = 20)						
MV	**8.67**	**0.73**	**12.00**	**8.14**	**1.97**	**4.50**
SD	2.56	0.22	1.77	1.61	0.62	1.39
Min	5.0	0.4	9.23	6.0	1.0	2.14
Max	13.0	1.3	15.71	12.0	3.0	6.56
C. variecolor 'f. *nemorensis*' (*n* = 12)						
MV	**7.67**	**0.64**	**12.08**	**6.92**	**1.80**	**3.95**
SD	1.50	0.12	1.93	1.49	0.47	0.76
Min	6.0	0.5	8.88	5.0	1.4	2.40
Max	11.0	0.9	15.71	10.0	2.7	5.33
C. violaceomaculatus (*n* = 15)						
MV	**5.97**	**0.53**	**11.22**	**6.75**	**1.53**	**4.55**
SD	1.64	0.23	4.80	1.28	0.32	0.96
Min	3.5	0.3	10.00	5.0	1.0	2.86
Max	9.0	0.6	18.33	9.0	2.1	6.00
C. spadicellus (*n* = 20)						
MV	**5.97**	**0.37**	**16.40**	**7.11**	**1.37**	**5.35**
SD	1.71	0.1	4.55	2.09	0.40	1.35
Min	3.0	0.2	10.00	4.0	1.0	3.10
Max	10.0	0.6	28.33	12.0	2.3	7.33
C. largus (*n* = 25)						
MV	**7.89**	**0.69**	**11.58**	**7.35**	**1.91**	**4.05**
SD	1.89	0.13	1.96	0.73	0.51	0.89
Min	5.0	0.5	8.57	6.0	1.3	2.00
Max	11.5	1.0	16.00	8.5	3.2	5.00
C. patibilis var. *patibilis* (*n* = 25)						
MV	**4.84**	**0.38**	**13.01**	**6.74**	**1.07**	**6.42**
SD	1.46	0.09	2.93	1.81	0.22	1.53
Min	2.5	0.2	7.50	3.5	0.8	3.24
Max	9.0	0.6	20.00	11.5	1.7	9.50

1. Robust species with a thick pileus context, short stipes and a bulbous, almost abruptly bulbous stipe base. Pileus diameter exceeding the length of stipe. Stipe length/width ratio <3.5 (e.g. *C. balteatus*, Figs 2, 3).

2. Species with a less thick pileus context and with a longer and sometimes attenuate stipe. Pileus diameter on average equal to stipe length. Stipe length/width ratio c.4–5.5 (e.g. *C. variecolor*, *C. largus*).

TABLE 4. Subsections *Balteati* and *Serarii*. Variation in characters related to basidiocarp size and shape. Mean values in bold. Taxa with limited material are not included.

	Pileus diameter	Pileus thickness	Diameter/ thickness	Stipe length	Stipe width	Length/ width
C. balteatus (*n* = 25)						
MV	**8.53**	**1.00**	**8.91**	**5.79**	**1.86**	**3.27**
SD	1.77	0.21	1.32	1.17	0.43	0.69
Min	5.0	0.5	6.54	4.0	1.2	2.22
Max	18.0	1.5	11.88	8.5	3.0	4.47
C. durus var. *durus* (*n* = 10)						
MV	**8.40**	**0.80**	**10.65**	**9.15**	**1.76**	**5.35**
SD	1.85	0.18	1.97	2.24	0.42	1.39
Min	5.0	0.5	8.50	6.0	1.1	3.53
Max	16.0	1.0	14.38	15.0	3.0	8.21
C. vacciniophilus (*n* = 20)						
MV	**6.55**	**0.50**	**13.26**	**8.28**	**1.16**	**7.21**
SD	2.20	0.15	2.15	2.37	0.30	1.50
Min	3.0	0.3	9.00	4.0	0.7	5.00
Max	10.0	0.7	18.33	13.5	2.0	11.00
C. acidophilus (*n* = 8)						
MV	**4.92**	**0.34**	**17.36**	**6.25**	**1.04**	**6.09**
SD	1.02	0.12	3.89	1.58	0.20	1.28
Min	3.5	0.2	10.00	5.0	0.8	4.23
Max	6.0	0.5	20.00	9.5	1.3	8.13
C. balteatocumatilis (*n* = 25)						
MV	**9.92**	**0.97**	**10.20**	**6.69**	**2.43**	**2.88**
SD	3.04	0.24	1.72	1.45	0.79	0.57
Min	5.5	0.6	7.50	5.0	1.4	2.00
Max	20.0	1.5	13.33	9.5	4.5	3.93
C. borgsjoeensis (*n* = 20)						
MV	**4.03**	**0.24**	**19.05**	**6.75**	**0.92**	**7.46**
SD	1.05	0.10	9.78	2.33	0.28	1.69
Min	2.5	0.1	10.00	4.0	0.6	5.00
Max	6.0	0.5	50.00	11.5	1.6	11.00
C. serarius (*n* = 20)						
MV	**6.14**	**0.34**	**19.51**	**7.91**	**1.05**	**7.55**
SD	1.00	0.08	6.91	2.02	0.20	1.24
Min	4.0	0.2	12.50	6.0	0.8	5.83
Max	8.0	0.4	40.00	14.0	1.5	10.56

3. Species with thin context and slender stipes. Pileus diameter less than stipe length. Stipe length/width ratio >6 (e.g. *C. patibilis*, *C. vacciniophilus*, Figs 2, 3).

The first category is represented only in subsect. *Balteati*, including *C. balteatus*, *C. balteatoalbus* and *C. balteatocumatilis* (Table 4, see also Figs 21, 23, 27). These robust, thick-fleshed taxa are normally easily recognized macroscopically, and *C. balteatus* can be distinguished, for example, from the very closely related *C. vacciniophilus* on the combination of the characters pileus width/thickness and stipe length/width (Figs 2, 3). In the species of category 1 the pileus expands when the stipe is short, leaving universal veil remnants only at or near the base of the stipe. The well-developed universal veil remnants of *C. balteatocumatilis* normally become situated 1–2cm above the bulb (Fig. 27 in the taxonomic part). This corresponds with a pileocarpous development (Reijnders, 1979), a development most typically associated with abruptly bulbous species. According to some observation series from richly fruiting localities, the robust species of category 1 such as *C. balteatus* take approximately two weeks to expand their basidiocarps (Fig. 21).

In the last category the stipe develops before the pileus expands, leaving universal veil remnants on much of the mature stipe surface (up to c.⅔ of the length; see Fig. 17). This corresponds with a stipitocarpous development (Reijnders, 1979), a development which is typical for subgenus *Telamonia*, and untypical for subgenus *Phlegmacium*.

A correlation between habit and habitat characteristics was found within the section. All the oligotrophic species were small to medium and slender, belonging to category 3 above, whilst the eutrophic-calciphilous species were more robust, belonging to category 1 or 2. This habit/habitat relationship was especially well demonstrated among the species in subsect. *Variecolores*, where the deciduous forest species *C. largus* and specimens of *C. variecolor* from deciduous forests ('f. *nemorensis*') were the most compact with short stipes (l/w = 4.0–4.1), followed by the calciphilous coniferous forest species *C. violaceomaculatus* and coniferous forest specimens of *C. variecolor* (l/w = 4.5–4.6), the mesotrophic-eutrophic *C. spadicellus* (l/w = 5.4) and, finally, the oligotrophic *C. patibilis*, being the most slender (l/w = 6.4) (Table 3).

Some of the variation in basidiocarp size and shape is probably habitat dependent. The slender species usually grow in moist, organic, soft substrata, a habitat likely to produce this kind of basidiocarp. This habit/habitat relationship is also seen in the infraspecific variation, especially of *C. variecolor*, which is fairly tall and slender when growing in deep moss, more compact when growing in dry needle bed and most compact when growing in dry, deciduous forests ('f. *nemorensis*') (see Fig 13). In other cases, however, these habit characteristics seem to be genotypic, and can be used to distinguish closely related taxa, such as *C. balteatus* and *C. vacciniophilus* which sometimes occur in the same sites without overlapping basidiocarp shape (Figs 2, 3).

Pileus structure. According to the character evaluation in Table 2, pileus structure is one of the best diagnostic macrocharacters to distinguish closely related taxa in sect. *Phlegmacioides*. However, the interspecific variation in pileus structure is frequently masked by the large intraspecific, mainly phenotypic variation related to age and weather conditions. Most species gradually lose their viscosity and become fibrillose, tomentose to squamulose with age. Once dried up, the pileipellis hyphae often lose their gelatinous nature completely.

Most species in subsect. *Variecolores* have a viscid(-glutinous), glabrous and rivulose pileus surface at first, whereas the species of subsect. *Balteati* are frequently fibrillose-tomentose already when young. However, in both subsections there is a gradient from (almost) non-viscid species, such as *C. russus*, *C. balteatus* and *C. borgsjoeensis*, to distinctly and sometimes persistently glutinous species, such as *C. largus*, *C. spadicellus* and *C. balteatocumatilis*. *C. serarius* of subsect. *Serarii* has a strongly and persistently glutinous pileus.

Pileus colours. The pileus colours were, together with the pileus structure, the taxonomically most important macroscopical features (Table 2). Although often being fugacious, the presence/absence of a violaceous blue colour in young, unexposed specimens appears to be a stable character. The character often distinguishes between closely related taxa, contrasting the situation in many other groups of Cortinarii (see Melot, 1986b) (Table 2). The violaceous colours are mainly situated at the pileus margin, in the universal veil, cortina, and often also the gelatinous layer of pileipellis. Some species, such as *C. borgsjoeensis* and *C. acidophilus*, have a bluish colour only or mainly in the universal veil. In *C. balteatus*, the (lilac) bluish colour at the margin is mainly restricted to the pileipellis and absent in the veil.

The species of sect. *Phlegmacioides* are normally pale when young and unexposed, and then develop brown colours, in subsect. *Variecolores* even dark umber brown to chestnut-brown pileus colours. In the main, this colour development is probably caused by the same necropigment responsible for the brownish staining reaction on the stipe and in the context of these species. In *C. variecolor* there seems to be a connection between the violet blue and brown pigments: the more blue the young basidiocarps, the darker brown the old ones. This might be equivalent to the situation in *C. violaceus*, where the violet basic pigment becomes converted to dark brown/blackish necropigments (Brandrud, 1983).

Bluish colours of context and lamellae. The bluish colours in parts other than the pileus have a high degree of infraspecific variation, and species such as *C. variecolor* and *C. patibilis* occur with or almost completely without bluish tinges in the context and on the lamellae when young. However, this was found to be an important diagnostic character at the subsection level; the species of subsect. *Variecolores* usually have violaceous to greyish blue tinges in the context and on the lamellae, whilst the species of subsect. *Balteati* very rarely exhibit this character.

The universal veil. The universal veil is sparsely developed, varies little in structure and thickness, and has a low score as a differential character (Table 2). The evenly distributed veil fibrils on the pileus usually become so tightly integrated with the surface hyphae of the pileipellis that they are macroscopically indistinguishable. This is a normal development in the subgenera *Cortinarius* and *Telamonia*, but is rare in *Phlegmacium* (Brandrud et al., 1990–1995). The lack of taxonomic information in the veil characters contrasts with the situation in the closely related section *Phlegmacium* (Brandrud, 1996a, b).

Macrochemical reactions. The species of sect. *Phlegmacioides* react more strongly with certain macrochemical reagents than is normal elsewhere in subgen. *Phlegmacium* (Moser, 1961; Bidaud et al., 1994b). In the present study, guaiac and KOH have been applied on all taxa, being indicative of the reaction sensitivity of the species. Guaiac becomes instantly green to bluish green in the context of most species, and most taxa react yellow with KOH or other strong bases. Some taxa, such as *C. variecolor*, *C. violaceomaculatus* and *C. patibilis*, react deep yellow even with 2% KOH.

A bright yellow KOH reaction is strongly correlated with a brownish staining reaction, and is probably due to the same substance. After some hours the yellow KOH spots become brown like the stained spots. These colour reactions are highly age dependent, and often become weak or absent in mature basidiocarps. They should therefore be used with caution as diagnostic characters at the species level. For instance, variants of *C. largus* have been distinguished based on absence of a yellow KOH reaction (Henry, 1990; see also Kärcher & Seibt, 1991). However, according to my own observations, this species always has a distinct, although never strong, yellow KOH reaction when very young and fresh. Sometimes in the literature a distinction is made between a yellow KOH reaction, and a reaction with a yellow ring (Moser, 1961; Kärcher & Seibt, 1988). This variation, however, depends on where in the context the drop of KOH is added, and on the concentration of KOH: 2% KOH normally gives a uniform, yellow reaction, whereas 40% KOH produces a strong yellow ring around a pale brownish centre.

In sect. *Phlegmacioides* (= sect. *Variecolores*) the presence of a yellow KOH reaction in the context is frequently used as a diagnostic character (Moser, 1961; Kärcher & Seibt, 1988; Bidaud et al., 1994b). However, four species in sect. *Phlegmacium* (*C. herculeus* Malençon, *C. paracephalixus* Bohus, *C. triumphans* Fr. and *C. varius* (Schaeff.: Fr.) Fr.) also exhibit a yellow reaction (Brandrud, 1996b). However, these species do not develop a distinct yellow ring with strong KOH, and do not have a brown staining reaction. According to N. Arnold (pers. comm.), who is investigating these features chemically, the reactions in the two sections are probably due to different substances.

Micromorphological characters

Spores. The features reflecting spore morphology had moderate to high values as differential characters at the species level (Table 5), but show much less interspecific variation than in the related sect. *Phlegmacium* (Brandrud, 1996a, b) and sect.

Claricolores (Brandrud et al., 1990–1995). Most species have spores of medium size: 9.5–11 × 5.5–6.5μm. In subsect. *Variecolores* almost all of the taxa have identical spore size, whereas in subsect. *Balteati* there is more differentiation (MVs 8.65–12.25μm).

The spore shape varies fairly little (Fig. 4). In particular the length/width ratio (Q-value) was found to be remarkably constant when mature spores from spore prints were considered (Table 6). In subsect. *Variecolores* the Q-values from spore prints were in the range 1.70–1.80(–1.88), whereas in subsect. *Balteati* the spores were frequently slightly narrower: Q=(1.65–)1.75–1.90(–2.00) (Table 6). Nearest neighbour species were usually identical in this character, and the Q-values have hardly any diagnostic value in sect. *Phlegmacioides*. The variation found in this character, and its diagnostic value, is considerably less than for sect. *Phlegmacium* (Q=1.50–1.88; Brandrud, 1996a, b).

The shape of the spore apex frequently shows some differentiation between nearest neighbour taxa (Tables 5, 6). Normally the spores are more or less amygdaliform, usually with a faintly elongated apex, producing a slightly citriform shape (Table 6; Figs 4, 5). Sometimes the apex is broad with a more or less distinct subapical depression on the dorsal side, making some of the spores slightly skew (Fig. 4d,h). This slightly irregular shape is typical in *C. patibilis*, but can also be found for example in *C. borgsjoeensis* and *C. spadicellus*, and is not seen in *Phlegmacium* species outside sect. *Phlegmacioides*. The subapical depression is found mainly on spores with fairly weak ornamentation, and is often more pronounced on immature spores on the lamellae than on the mature ones shed on the stipe.

The species of the two subsections differ slightly in their spore ornamentation. The taxa of subsect. *Variecolores* mainly have slightly darker spores, with more distinct, thicker and coarser sculptures (Table 6). According to the SEM pictures (Fig. 5) the ornamentation is somewhat less interconnected than that in sect. *Phlegmacium* (Brandrud, 1996a). A suprahilar plage with smaller and denser sculpturing can be seen on many spores (see Fig. 5d), but this has no taxonomic value.

Pileipellis. Features of the pileipellis were found to be the most taxonomically important microcharacters (Table 5). Two characters distinguished more or less between all of the nearest neighbour species compared in Table 5: (i) the structure of the upper, ±gelatinous part of pileipellis ('ixocutis'), and (ii) the structure of the basal, pigmented part of the pileipellis (see Figs 6, 7). In almost half of the cases, the latter character expressed discontinuous variation between nearest neighbour taxa.

The interspecific variation of the pileipellis characters is generally very large in sect. *Phlegmacioides*. The surface hyphae sometimes form a well-defined pellicle of gelatinous, narrow and erect-sinuous, hyaline hyphae, as in *C. balteatocumatilis*, *C. largus* and *C. serarius* (Table 7). In other cases, the surface is non-gelatinous even when young, with scattered, cystidium-like, brown, thick-walled terminal cells arising from repent, strongly pigmented hyphae, as in *C. balteatoalbus* and *C. russus*

TABLE 5. Differential (diagnostic) micromorphological characters/character complexes between nearest neighbour taxa in sect. *Phlegmacioides*. Taxa with limited material available are not considered. XX = discontinuous (non-overlapping) variation between the two taxa, X = overlapping variation, — = insignificant or no differences. pel str = 'pellicle' structure (arrangement, gelatinosity and width of surface hyphae of pileipellis), pel pig = pigmentation of 'pellicle' hyphae, cut str = structure of basal part of cuticle/pileipellis (arrangement and width of hyphae), cut pig = pigmentation of basal part of cuticle/pileipellis, vel str = velum (veil) structure (arrangement and width of hyphae), vel pig = velum (veil) pigmentation, sp si = spore size (length), sp sh = spore shape (shape of apex), sp or = spore ornamentation (degree and coarseness of ornam.).

Sect. *Phlegmacioides*	pel str	pel pig	cut str	cut pig	vel str	vel pig	sp si	sp sh	sp or
Subsect. *Variecolores*									
C. variecolor/*C. violaceomaculatus*	—	—	X	—	—	—	X	X	X
C. variecolor/*C. spadicellus*	—	X	X	X	—	—	—	—	X
C. spadicellus/*C. violaceomaculatus*	—	X	X	—	—	—	X	X	X
C. largus/*C. coalescens*	X	—	—	X	X	—	—	—	—
C. patibilis/*C. coalescens*	X	—	X	X	—	—	—	X	X
C. russus/*C. patibilis*	X	X	XX	XX	X	—	X	X	X
Subsect. *Balteati*									
C. balteatus/*C. durus*	X	—	X	—	—	—	X	X	—
C. balteatus/*C. balteatoalbus*	X	X	XX	—	X	—	X	—	X
C. durus/*C. balteatoalbus*	X	X	XX	—	X	—	XX	X	—
C. vacciniophilus/*C. acidophilus*	X	X	—	—	—	—	X	—	—
C. balteatocumatilis/*C. balteatus*	XX	X	XX	X	—	X	—	—	—
C. borgsjoeensis/*C. acidophilus*	X	X	XX	X	—	—	XX	XX	XX
Subsect. *Serarii*									
C. serarius/*C. balteatocumatilis*	X	—	X	X	X	X	X	X	—
Character score	11	8	16	8	5	2	11	9	8

(Table 7). However, normally the surface hyphae are gelatinous at first, and then develop thick, brownish walls and become non-gelatinous.

The reduced gelatinous layer is characteristic for the majority of species in sect. *Phlegmacioides*. Wide, brown, non-gelatinous surface hyphae can be observed also in sect. *Phlegmacium* (e.g. *C. norrlandicus*; see Brandrud, 1996b), but are otherwise rare. Such surface hyphae are often accompanied by wide, and strongly zebra-striped encrusted hyphae in the central part of the pileipellis, and are most frequently found in subsect. *Balteati*.

The basal part of the pileipellis is often composed of parallel, loosely connected, narrow, encrusted hyphae as in *C. balteatus* (Fig. 7) and *C. vacciniophilus*, or of subparallel-entangled, slightly shortened elements, embedded in a refractive, golden yellow (brown) amber-like matrix as in *C. borgsjoeensis*, *C. largus* and *C. russus*. The latter structure is more or less distinguishable as a weakly developed hypoderm

TABLE 6. Spore shape and ornamentation. All accepted taxa in sect. *Phlegmacioides* are included, and the coniferous and deciduous forest variants of *C. variecolor* are treated separately (the latter as 'f. *nemorensis*'). Numbers = percentage of observations in each category, dominating category in bold. *n* = number of observations/spore samples (one spore sample per basidiocarp). Q = MVs of spore length/spore width ratio. Spore shape: amy elli = amygdaliform-ellipsoid, irr amy = irregularly amygdaliform (broad apex and a subapical depression), str amy = strictly (acutely) amygdaliform, amy citr = amygdaliform with a faintly citriform apex, citr = citriform. Degree of ornamentation: fine orn = fine (weak) ornamentation, dist orn = distinct ornamentation, ver orn = very distinct (strong) ornamentation.

Sect. *Phlegmacioides*	amy elli	irr amy	str amy	amy citr	citr	Q	fine orn	dist orn	ver orn	*n*
Subsect. *Variecolores*										
C. variecolor 'f. *variecolor*'	—	12.0	12.0	**64.0**	12.0	1.80	—	20.0	**80.0**	25
C. variecolor 'f. *nemorensis*'	—	—	13.3	**86.7**	—	1.76	—	26.7	**73.3**	15
C. violaceomaculatus	**40.0**	35.0	10.0	15.0	—	1.75	—	**75.0**	25.0	20
C. spadicellus	26.7	6.7	26.7	**40.0**	—	1.70	6.7	**60.0**	33.3	15
C. largus	16.0	12.0	12.0	**60.0**	—	1.75	—	48.0	**52.0**	25
C. coalescens	30.0	20.0	10.0	**40.0**	—	1.77	—	**60.0**	40.0	10
C. patibilis var. *patibilis*	15.0	**65.0**	10.0	10.0	—	1.76	**55.0**	45.0	—	20
C. patibilis var. *scoticus*	—	—	16.7	**83.3**	—	1.88	—	33.3	**66.6**	6
C. kuehneri	—	—	40.0	**60.0**	—	1.80	—	40.0	**60.0**	5
C. russus	—	30.0	10.0	**60.0**	—	1.72	—	30.0	**70.0**	10
Subsect. *Balteati*										
C. balteatus	8.0	4.0	28.0	**60.0**	—	1.80	16.0	**64.0**	20.0	25
C. durus var. *durus*	6.7	—	**60.0**	33.3	—	1.87	26.7	**40.0**	33.3	30
C. durus var. *chamaesalicis*	—	—	**100**	—	—	1.96	**100**	—	—	1
C. balteatotomentosus	—	—	—	**100**	—	1.86	—	**100**	—	5
C. balteatoalbus var. *baltalb.*	—	33.3	**40.0**	26.7	—	1.84	**60.0**	40	—	15
C. baltalb. var. *areni-silvae*	20.0	—	**80.0**	—	—	1.85	**80.0**	20.0	—	15
C. vacciniophilus	—	—	—	**100**	—	1.76	20.0	**60.0**	20.0	20
C. acidophilus	—	—	20	**80**	—	1.78	—	**70**	30	10
C. balteatocumatilis	—	—	35.0	**65.0**	—	1.84	5.0	**60.0**	35.0	20
C. hysginus	25.0	—	**75.5**	—	—	1.65	**75.0**	25.0	—	4
C. borgsjoeensis	40.0	**60.0**	—	—	—	1.80	**100**	—	—	15
Subsect. *Serarii*										
C. serarius	**33.3**	13.3	**33.3**	20.0	—	1.80	46.7	**53.3**	—	15

(subcutis). The slightly differentiated hypoderm seems always to be equivalent to the basal part of a simplex epicutis, so these structures should be compared as one character (see Tables 5, 7). Such a slightly duplex pileipellis structure is found mainly in subsect. *Variecolores* and in *C. borgsjoeensis* (Table 7).

Hyphae of the basal part of the pileipellis often form bundles of c.20–40(–50) densely interwoven and more or less cemented hyphae. In surface view the bundles are subparallel and frequently interconnected, forming a kind of rivulose or net-like

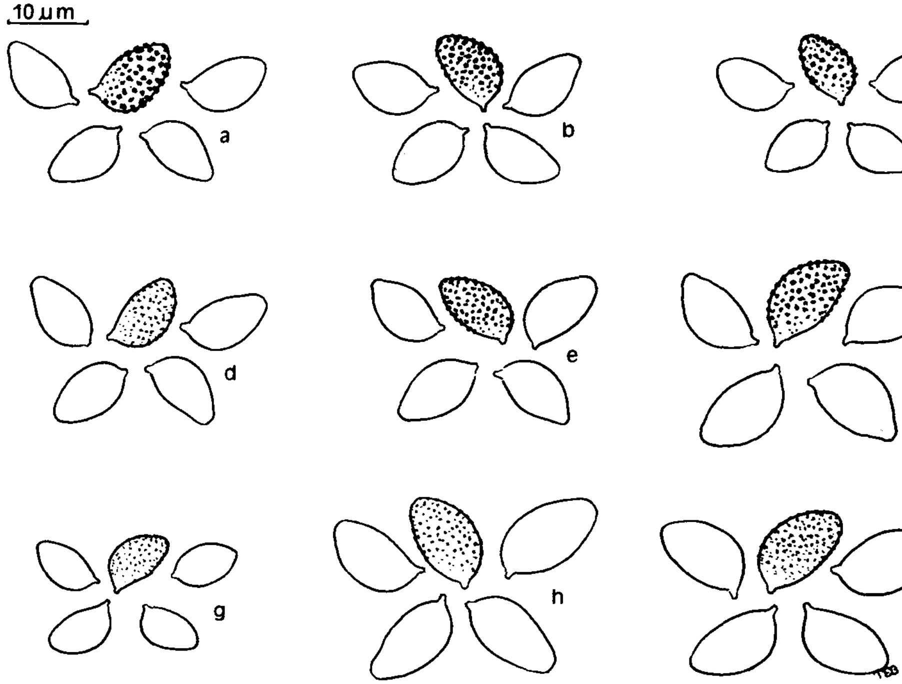

FIG. 4. Spore shape and ornamentation. (a) *C. variecolor* CFP 1021; (b) *C. largus* CFP 1085; (c) *C. violaceomaculatus* CFP 1249 (holotype); (d) *C. patibilis* var. *patibilis* TEB 213-78 (holotype); (e) *C. balteatus* CFP 940; (f) *C. vacciniophilus* TEB 17-88 (holotype); (g) *C. balteatoalbus* var. *areni-silvae* CFP 461b (holotype); (h) *C. borgsjoeensis* CFP 728 (holotype); (i) *C. serarius* CFP 959.

pattern. At the branching points, the hyphae are irregularly entangled. This structure is characteristic for the section, and is most pronounced in subsect. *Variecolores* (Fig. 6).

Frequently, the pileipellis characters can be used to distinguish closely related taxa that are very difficult to separate macroscopically. For instance, *C. largus* can be distinguished from *C. variecolor* (including 'f. *nemorensis*') by the constantly narrower gelatinous surface hyphae (Fig. 8, Table 7).

Gelatinous, erect-sinuose hyphae are normally present only in the upper part of the pileipellis, whereas the basal part is composed of repent-parallel, more strongly pigmented hyphae. In *C. balteatus*, however, the thick pileipellis is a mixture of these kinds of hyphae (Fig. 7), producing the characteristic appressed tomentose pileus structure seen macroscopically.

Pigmentation of the pileipellis shows considerable infraspecific variation, probably mainly due to age and exposure of the basidiocarps. In *C. balteatus*, the entire range of variation is sometimes present in a single individual; basidiocarps from the same mycelium can exhibit strongly brown to pale yellow-brown encrusted hyphae, and the erect-sinuous surface hyphae have brown, thick walls or not. However, other

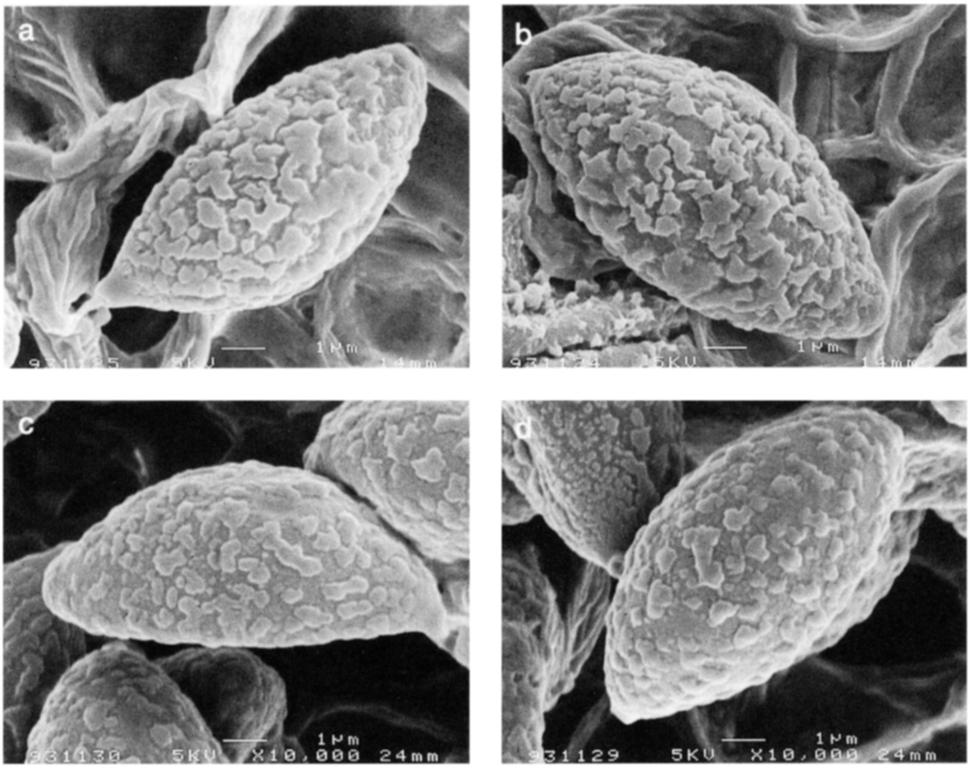

FIG. 5. Scanning electron micrographs of spores. (a), (b) *C. variecolor* TEB 241-77; (c), (d) *C. balteatus* TEB 37-83, in (d) a finely ornamented suprahilar plage area can be seen in the upper left corner.

species such as *C. russus* and *C. vacciniophilus* show a more constant and strong yellow-brown to red-brown encrustation, and species such as *C. borgsjoeensis* have constantly pale and weakly encrusted hyphae (Table 7).

Fairly warm yellow-brown to red-brown encrustations are the dominant pigments in species such as *C. balteatus*, *C. spadicellus* and *C. vacciniophilus*, but more frequently, oleifers filled with dark brown necropigment dominate. The darkening of these oleifers is dependent on age, exposure and handling, and varies from spot to spot on a pileus surface. These brown pigmented hyphae are responsible for the darkening of most species of the subsect. *Variecolores* (see also description of macrocharacters).

Lamella edge. The structure of the lamella edge shows very little variation, and is of no taxonomic significance in sect. *Phlegmacioides*. All species have a fertile lamella edge, with only scattered, normally small, clavate-cylindrical sterile cells between the basidia (Fig. 9). These sterile cells were difficult to distinguish from basidioles, but lacked granular content, and were sometimes slightly irregularly shaped. Larger sterile cells were mentioned for species such as *C. variecolor* and *C. balteatus* by

TABLE 7. Pileipellis structure and pigment. Three qualitative and one quantitative character scored on a selected number of species. The coniferous and deciduous forest variants of *C. variecolor* are treated separately (the latter as 'f. *nemorensis*'). Numbers = percentage of observations in each category, dominating category in bold; *n* = number of observations (one observation per basidiocarp); mod = moderately.

	pellicle; width of hyphae (MVs, μm)			pellicle; parietal, brown pigment			basal epicutis; encrust. pigment			'hypoderm' (cemented hyphae)			
Sect. *Phlegmacioides*	<4	4–5	>5	no	mod	much	no	mod	much	much	mod	no	*n*
Subsect. *Variecolores*													
C. variecolor													
'f. *variecolor*'	—	**66.7**	33.3	**73.3**	26.7	—	13.3	**80.0**	6.7	—	**60.0**	40.0	15
'f. *nemorensis*'	—	**53.3**	46.7	**80.0**	20.0	—	26.7	**73.3**	—	—	**53.3**	46.7	15
C. violaceomaculatus	10	**60**	30	**60**	40	—	10	**50**	40	**70**	30	—	10
C. spadicellus		40.0	**60.0**	10.0	30.0	**60.0**	—	40.0	**60.0**	30.0	**70.0**	—	10
C. largus	**100**	—	—	**86.7**	13.3	—	**80.0**	20.0	—	20.0	**80.0**	—	15
C. patibilis	20.0	**60.0**	20.0	**50.0**	40.0	10.0	**50.0**	30.0	20.0	—	—	**100**	10
C. russus	—	—	**100**	—	30.0	**70.0**	—	—	**100**	**100**	—	—	10
Subsect. *Balteati*													
C. balteatus	—	33.3	**66.7**	**46.7**	40.0	13.3	—	**53.3**	46.7	—	—	**100**	15
C. durus	30	**40**	30	**50**	30	20	30	**50**	20	—	**60**	40	10
C. balteatoalbus	—	10	**90**	—	20	**80**	—	**50**	**50**	—	—	**100**	10
C. vacciniophilus	—	30.0	**70.0**	10.0	30.0	**60.0**	—	20.0	**80.0**	—	—	**100**	10
C. acidophilus	**40**	**40**	20	20	**60**	20	20	**40**	**40**	—	20	**80**	10
C. balteatocumatilis	**70.0**	30.0	—	**90.0**	10.0	—	20.0	**70.0**	10.0	—	—	**100**	10
C. borgsjoeensis	**100**	—	—	**100**	—	—	40.0	**60.0**	—	**80.0**	20.0	—	10
Subsect. *Serarii*													
C. serarius	**100**	—	—	**100**	—	—	20.0	**80.0**	—	—	—	**100**	10

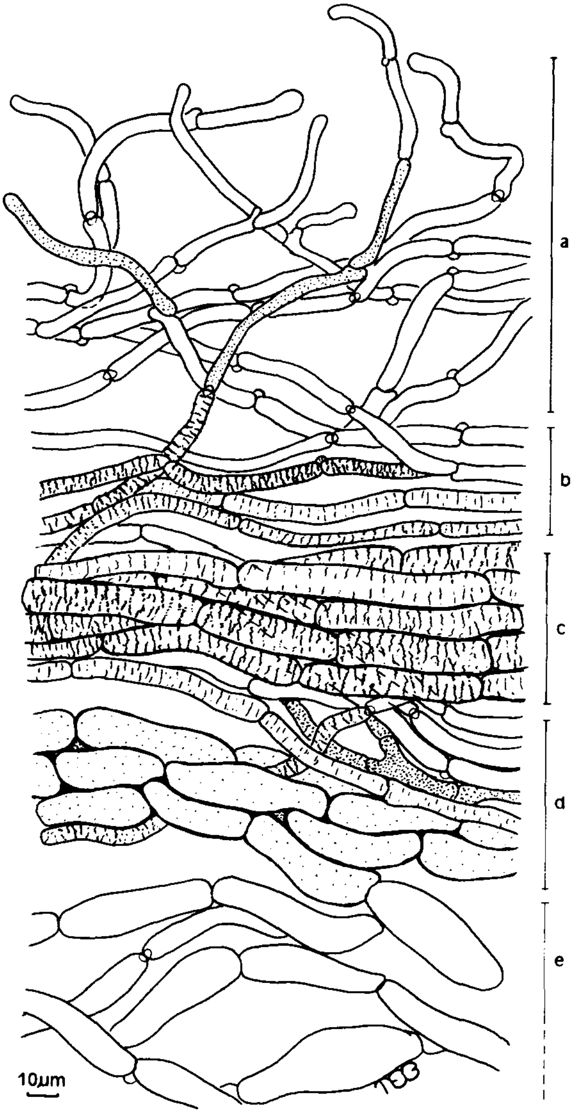

FIG. 6. Representative, simplex (slightly duplex) pileipellis structure in sect. *Phlegmacioides*. *C. variecolor* TEB 241-77. Radial section obtained midway to the pileus centre. The figure illustrates the following features: (a) loosely arranged, more or less erect-entangled, initially gelatinous surface hyphae (often become repent with age); (b) central part of epicutis with repent, frequently encrusted hyphae; (c) basal part of epicutis with cemented hyphae forming well-defined bundles; (d) transition to trama of shorter subparallel-entangled hyphae embedded in a golden yellow-brown, amber-like matrix (equivalent to hypoderm/subcutis); (e) trama of inflated, hyaline and more loosely arranged hyphae.

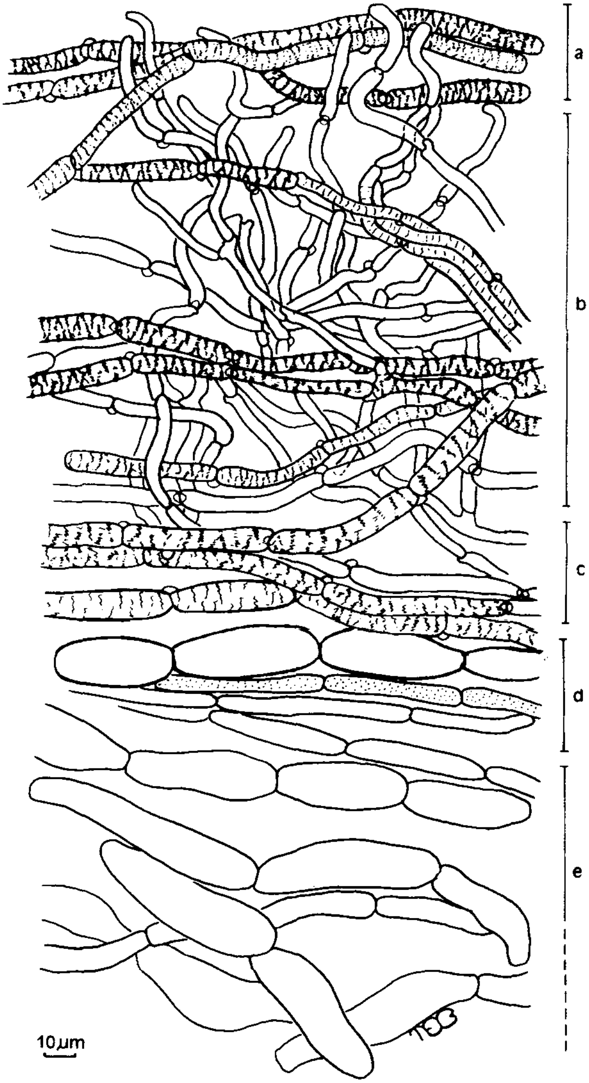

FIG. 7. Complex pileipellis structure in *C. balteatus* TEB 43-81. Radial section obtained midway to the pileus centre. The following features are illustrated: (a) repent, encrusted, often wide surface hyphae (not belonging to the veil!); (b) main part of the epicutis, consisting of a mixture of erect-entangled, initially gelatinous hyphae and repent, usually encrusted hyphae; (c) basal part of the epicutis of a few, repent hyphae; (d) transition layer to trama of variable composition (hyphae usually not cemented); (e) trama of inflated, hyaline and more loosely entangled elements.

Moser (1961), but according to the present study such elements must be very rare and are not typical (see Fig. 9). Moser (1974) found brownish encrusted cystidia/ sterile cells in *C. kuehneri*, but, on examination of this species, I was not able to find them.

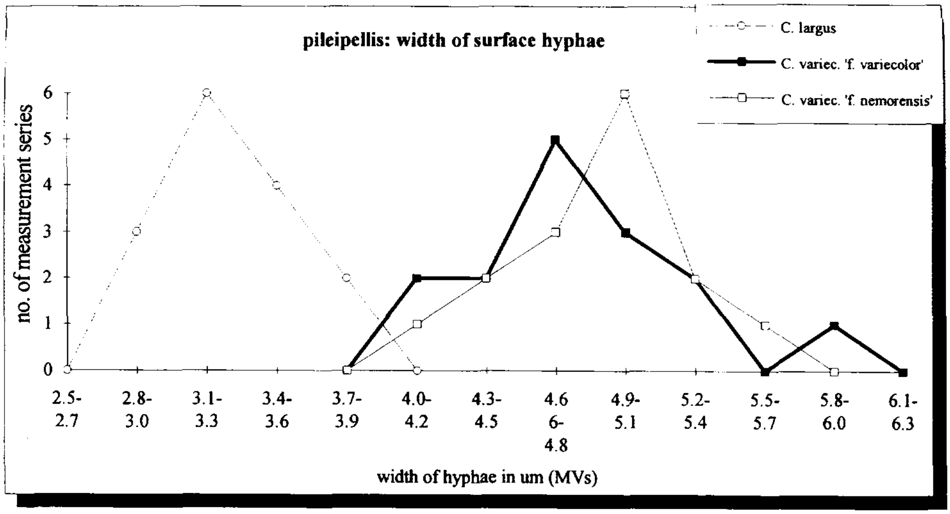

FIG. 8. Variation in morphological characters of *C. variecolor* and *C. largus*. Width of (gelatinous) surface hyphae of pileipellis. Based on MVs of 10 hyphae measured per basidiocarp.

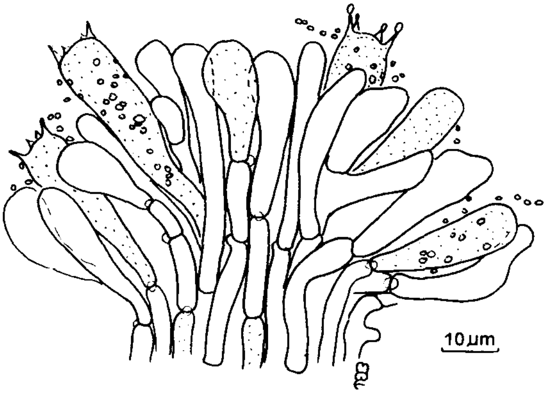

FIG. 9. Representative, fertile lamella edge in sect. *Phlegmacioides*, showing basidia, clavate basidioles (usually with granulate content), clavate-cylindrical to irregular, small sterile cells and trama. Extracellular and intracellular, diffractive granules are indicated. *C. variecolor* TEB 241-77.

A fertile lamella edge is typical for many groups in *Cortinarius* (Brandrud et al., 1990–1995), and offers little in the way of diagnostic character(s).

ECOLOGY

Ecologically, many species in sect. *Phlegmacioides* deviate from the normal pattern encountered in subgen. *Phlegmacium* by having different and often less strict requirements for particular edaphic conditions. Some also deviate by apparently having less specific mycorrhizal associations, being associated with both deciduous and coniferous trees (Table 8).

The majority of species are associated with conifers, most frequently with *Picea abies*. Fifteen taxa were found in association or probable association with *Picea abies*, of which 12 seem to be exclusive conifer associates (Table 8). Only 5 taxa were found in association with thermophilous, frondose trees, and no species was exclusive for this element, an untypical situation elsewhere in subgen. *Phlegmacium* (Moser, 1961; Vesterholt, 1991; Brandrud, 1996a, b). A comparatively large element of 6 taxa was found in association with boreal-alpine frondose trees and shrubs, mainly with *Betula* spp. (Table 8).

TABLE 8. Mycorrhizal associations among the species in sect. *Phlegmacioides*. Based on observations of associated trees. ● = association frequently observed; ⊕ = association rarely observed, or not well documented; Pi = *Picea abies*; Ab = *Abies alba*; Ps = *Pinus sylvestris*; La = *Larix decidua*; Be = *Betula* spp.; Fa = *Fagus sylvatica*; Qu = *Quercus* spp.; Ca = *Carpinus betulus*; Co = *Corylus avellana*; Ti = *Tilia cordata*; Cs = *Castanea sativa*; Sa = *Salix* spp.; Al = *Alnus viridis*.

Sect. *Phlegmacioides*	Pi	Ab	Ps	La	Be	Fa	Qu	Ca	Co	Ti	Cs	Sa	Al
Subsect. *Variecolores*													
C. variecolor	●	●	⊕	—	—	●	●	—	⊕	●	—	—	—
C. violaceomaculatus	●	⊕	●	—	—	—	—	—	—	—	—	—	—
C. spadicellus	●	—	—	—	—	—	—	—	—	—	—	—	—
C. largus	⊕	●	—	—	⊕	●	●	●	●	●	●	—	—
C. coalescens	—	—	—	—	—	⊕	●	—	—	—	●	—	—
C. patibilis var. *patibilis*	●	—	—	—	—	—	—	—	—	—	—	—	—
C. patibilis var. *scoticus*	—	—	—	—	●	—	—	—	—	—	—	—	—
C. kuehneri	—	—	—	—	—	—	—	—	—	—	—	—	●
C. russus	●	—	—	—	—	—	—	—	—	—	—	—	—
Subsect. *Balteati*													
C. balteatus	●	—	●	●	—	—	—	—	—	—	—	—	—
C. durus var. *durus*	—	—	⊕	—	●	—	—	—	—	—	—	—	—
C. durus var. *chamaesalicis*	—	—	—	—	—	—	—	—	—	—	—	●	—
C. balteatotomentosus	●	—	—	—	—	—	—	—	—	—	—	—	—
C. balteatoalbus var. *balteatoalbus*	●	—	—	—	—	●	●	—	—	—	—	—	—
C. balteatoalbus var. *areni-silvae*	●	—	●	—	⊕	—	—	—	—	—	—	—	—
C. vacciniophilus	●	—	—	—	—	—	—	—	—	—	—	—	—
C. acidophilus	●	—	—	—	—	—	—	—	—	—	—	—	—
C. balteatocumatilis	—	⊕	—	—	●	●	●	⊕	●	●	—	—	—
C. hysginus	●	—	—	—	—	—	—	—	—	—	—	—	—
C. borgsjoeensis	●	—	●	—	—	—	—	—	—	—	—	—	—
Subsect. *Serarii*													
C. serarius	●	—	—	—	—	—	—	—	—	—	—	—	—
No. of taxa	15	4	6	1	5	5	5	2	3	3	2	1	1

Edaphic requirements vary considerably (Table 9), but only 2 out of the 21 taxa (*C. variecolor* and *C. violaceomaculatus*) occur in typical *Phlegmacium*-rich, calcareous habitats. The majority of the species are found in less base-rich, mesotrophic(-eutrophic) habitats with mull soils, but a considerably high number (9 taxa) occur also in strictly oligotrophic, acid, organic soils of raw humus (mor/moder) type (Table 9), and 5 taxa are strictly bound to such acid soils. True oligotrophic species are very rare in subgen. *Phlegmacium*, and these 5 taxa constitute

TABLE 9. Edaphic requirements and occurrence in the various vegetation zones and major regions of Europe. ● = soil types/vegetation zones with major occurrence; ⊕ soil types/vegetation zones with few (documented) occurrences; c = common; o = occasional; r = rare; + = 1–2 records; oli = oligotrophic soils; me = mesotrophic soils; eu = eutrophic soils; cal = calcareous soils; arc = (sub)arctic and (sub)alpine zones; bor = boreal zone; mo = montane zone; bon = boreo-nemoral zone; ne = nemoral zone; med = mediterranean zone; NE = N Europe (Fennoscandia + Iceland); WE = W Europe (UK, Denmark, N Germany, Be-Ne-Lux, W and C France); CE = C Europe (C Germany–N Italy; E France–Hungary); SE = S Europe (S of the Alps). †Taxa ± restricted to N and NW Europe (incl. Scotland).

Sect. *Phlegmacioides*	oli	me	eu	cal	arc	bor	mo	bon	ne	med	NE	WE	CE	SE
Subsect. *Variecolores*														
C. variecolor	—	⊕	●	●	—	●	●	●	●	●	c	r	c	r
C. violaceomaculatus	—	—	⊕	●	—	●	●	●	—	—	r	—	r	—
C. spadicellus	—	●	●	—	—	●	●	●	—	—	o	r	o	—
C. largus	—	●	●	⊕	—	⊕	●	●	●	●	o	c	c	r
C. coalescens	—	●	●	—	—	—	⊕	●	●	—	+	r	r	r
†*C. patibilis* var. *patibilis*	●	—	—	—	—	●	●	—	—	—	o	—	r	—
†*C. patibilis* var. *scoticus*	●	—	—	—	●	—	—	—	—	—	—	r	—	—
C. kuehneri	—	—	●	—	—	—	●	—	—	—	—	—	r	—
†*C. russus*	—	●	●	—	—	●	⊕	—	—	—	r	—	+	—
Subsect. *Balteati*														
C. balteatus	⊕	●	●	—	—	●	●	—	—	—	c	r	o	—
†*C. durus* var. *durus*	⊕	●	●	—	●	●	—	—	—	—	o	r	—	—
C. durus var. *chamaesalic.*	—	—	●	—	●	—	—	—	—	—	—	—	r	—
C. balteatomentosus	—	●	●	—	—	●	●	—	—	—	+	—	r	—
C. balteatoalbus var. *balt.*	—	●	●		—	—	●	—	●	—	—	r	r	—
†*C. balt.* var. *areni-silvae*	●	—	—	—	—	●	—	●	—	—	r	r	—	—
†*C. vacciniophilus*	●	⊕	—	—	—	●	●	⊕	—	—	r	—	+	—
†*C. acidophilus*	●	—	—	—	—	●	—	—	—	—	r	—	—	—
C. balteatocumatilis	—	●	●	⊕	—	⊕	●	●	●	●	o	o	o	r
C. hysginus	?	?	?	—	—	—	●	⊕	—	—	+	—	r	—
†*C. borgsjoeensis*	●	—	—	—	—	●	—	—	—	—	r	—	—	—
Subsect. *Serarii*														
†*C. serarius*	⊕	●	●	—	—	●	⊕	—	—	—	r	—	+	—
No. of taxa	9	12	14	4	3	15	15	9	5	3	17	10	16	3

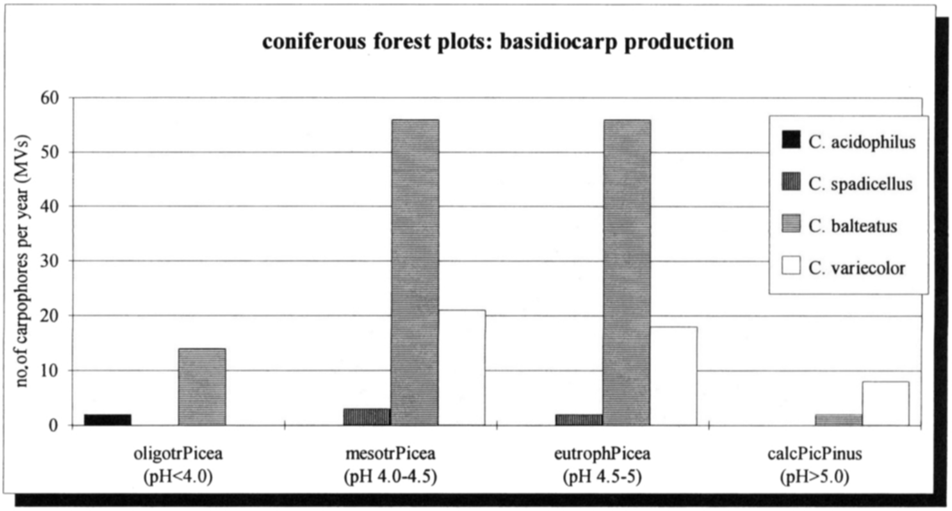

FIG. 10. Abundance of species of sect. *Phlegmacioides* along an edaphic gradient in boreal coniferous forests. Based on a plot study 1979–1980 at Lunner, SE Norway. Four plots (each of 10,000 m^2) analysed per vegetation type. oligotPicea = oligotrophic *Picea abies* forest with raw humus of $pH < 4.0$; mesotrPicea = mesotrophic *Picea* forest with pH 4.0–4.5; eutrophPicea = eutrophic/slightly calciphilous *Picea* forest with mull soil of pH 4.5–5(–6); calcPicPinus = calciphilous *Picea abies–Pinus sylvestris* forest with $pH > 5.0$.

almost half of the total number of oligotrophic/acidophilous species in the entire subgenus (see Brandrud et al., 1990–95).

In a permanent plot study of boreal coniferous forest types, it appeared that the productivity of species belonging to sect. *Phlegmacioides* was highest in mesotrophic-eutrophic mull soil habitats (Fig. 10), but the species diversity was highest in oligotrophic spruce forests, gradually declining towards calciphilous habitats (Fig. 11).

DISTRIBUTION

Many of the species in sect. *Phlegmacioides* have a limited and often northern distribution (Fig. 12c,d; Table 9). Only five species can be regarded as widespread and occasional to locally common in Europe (Fig. 12a,b). In accordance with their preferences for *Picea abies* forests, most species are boreal-montane (Table 9). All species except for the *Alnus viridis*-associated *C. kuehneri* are recorded in N Europe.

Just a few taxa are found in the nemoral-mediterranean zones (Table 9). According to Malençon & Bertault (1970), Chevassut (1991) and Ortega & Mahiques (1995) only three species occur in the mediterranean evergreen *Quercus* forests. These taxa, viz. *C. balteatocumatilis*, *C. largus* and *C. variecolor* ('f. *nemorensis*'), are the most frequent ones of sect. *Phlegmacioides* in the nemoral, boreo-nemoral and montane zones where *Quercus* and *Fagus* are present, and *C. largus* is one of the most frequent of all *Phlegmacium* species in *Fagus* forests (Kühner & Romagnesi, 1953; pers. obs.).

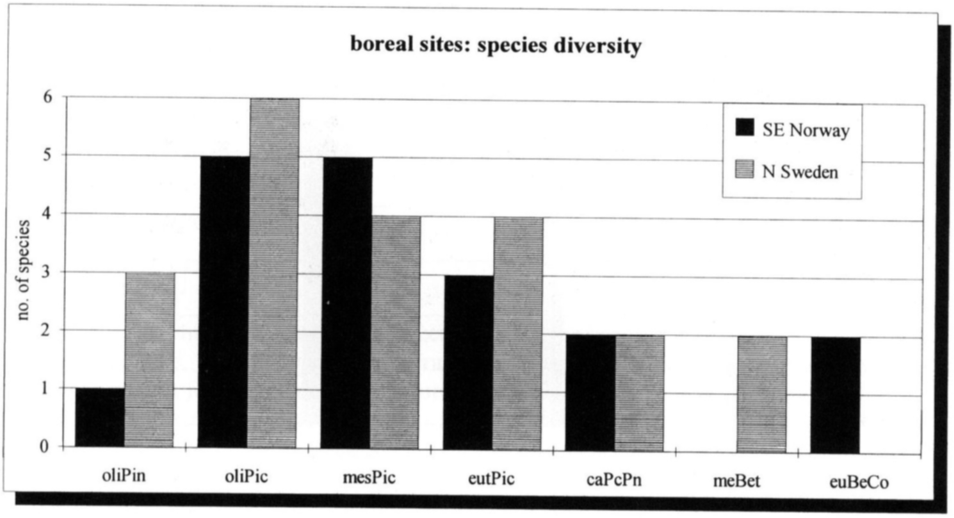

FIG. 11. Species richness/α-diversity of sect. *Phlegmacioides* in various boreal forest types of two well-investigated areas in SE Norway (Lunner, Oppland) and N Sweden (Häggdånger-Säbrå, Ångermanland). oli = oligotrophic; mes = mesotrophic; eut = eutrophic; ca = calciphilous. Pin = *Pinus sylvestris*; Pic = *Picea abies*; Bet = *Betula pubescens* and *B. pendula*; Co = *Corylus avellana*.

The three species seem to be almost ubiquitous in Europe, in particular *C. variecolor* which occurs also in the coniferous zones of N and C Europe (see Fig. 12a). *C. balteatocumatilis* and *C. largus* are limited to the north by the distribution of mixed forests with *Betula pendula* and *Corylus avellana* (Fig. 12b).

Section *Phlegmacioides* includes at least one true (sub)arctic-northern (sub)alpine taxon: *C. durus* var. *durus* is, together with *C. porphyropus* Fr. and *C. talus* Fr., the most frequent *Phlegmacium* species in the subalpine-subarctic birch forests of Fennoscandia (pers. obs.) and Iceland (Melot, 1992 as *C. errabundus*). It also seems to be widely distributed in arctic-alpine *Betula glandulosa–B. nana* heaths, hitherto known from such habitats in Greenland and Scandinavia. *Cortinarius durus* var. *durus* and the rarer *Betula* associate *C. patibilis* var. *scoticus* are not recorded outside N Europe and the British Isles (Fig. 12c,d). The virtual absence in C Europe of habitats with *Betula pubescens* and *Betula nana* probably explains this distribution pattern. In the Alps, however, C. *durus* var. *chamaesalicis* occurs in association with dwarf shrubs of *Salix* (Bon, 1985), and the ecogeographical differentiation between the two varieties of *C. durus* needs further study. Also, other *Cortinarius* species of (sub)alpine-arctic *Betula* habitats, such as *C. septentrionalis* Bendiksen et al., are apparently absent in the Alps (Bendiksen et al., 1993).

Nine taxa, including the *Betula* and the oligotrophic conifer associates, constitute a typical N European element (see Tables 8, 9). The scarcity of the oligotrophic taxa in C Europe seems to be due to the lack of well-developed, acid, organic soils except in bog rims, a habitat avoided by these species. Two of them, *C. acidophilus* and *C.*

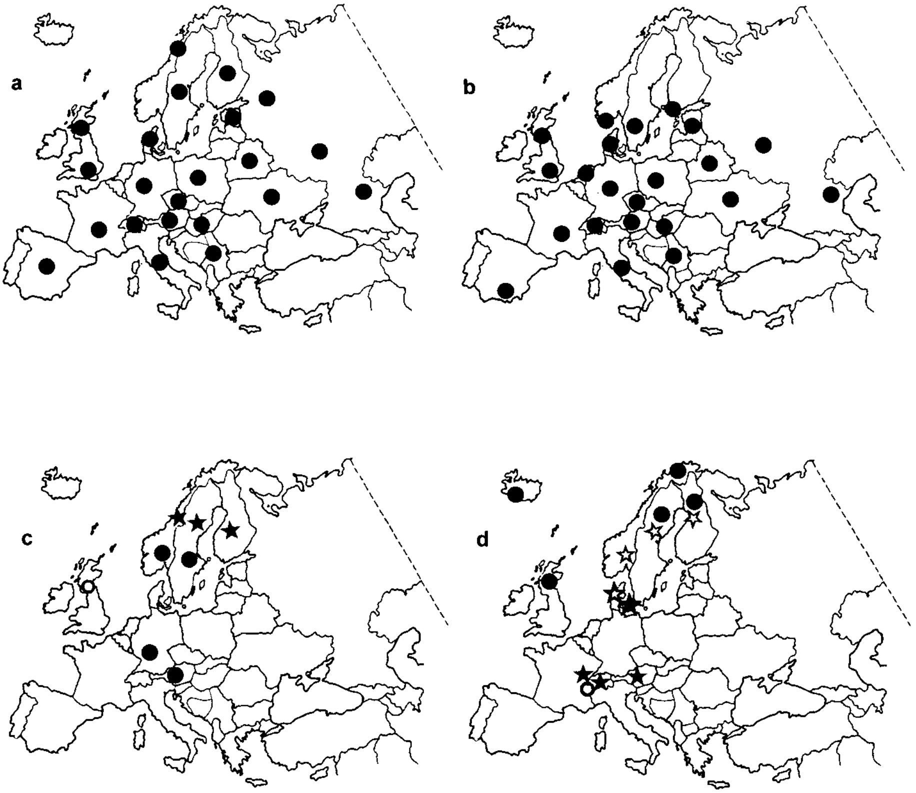

FIG. 12. Distributional patterns among species of sect. *Phlegmacioides* in Europe. (a) *C. variecolor*, a more or less ubiquitous species; (b) *C. balteatocumatilis* and *C. largus* (similar distribution), almost ubiquitous species with a limited distribution in N Europe; (c) *C. patibilis* var. *patibilis* (filled circles), N and C European boreal-montane distribution; *C. patibilis* var. *scoticus* (open circles) and *C. borgsjoeensis* (stars), Scottish and N European boreal distribution; (d) *C. durus* var. *durus* (filled circles), Scottish-N European northern (sub)alpine-(sub)arctic distribution (the occurrence in Greenland is not included on the map); *C. durus* var. *chamaesalicis* (open circle), C European alpine distribution; *C. balteatoalbus* var. *balteatoalbus* (filled stars), C European-Danish nemoral-montane distribution; *C. balteatoalbus* var. *areni-silvae* (open stars), N European mainly boreal distribution.

borgsjoeensis, are hitherto known only from N Europe (Fig. 12c), whilst a few reports from C Europe exist for *C. patibilis* var. *patibilis* (Brandrud & Melot, 1983; Krieglsteiner, 1991; Moser, 1961 as *Phlegmacium spadicellum* (Batsch) Mos.) (Fig. 12c) and *C. vacciniophilus* (Favre, 1960; Moser, 1961, both as *C. latus* Fr.). Very little is known about the occurrence of the many rare coniferous forest species in E Europe.

The ecology and distribution of sect. *Phlegmacioides* contrasts that of the closely related sect. *Phlegmacium*, where the species are mainly thermophilic, xerophilic and calciphilous, and many belong to a S European element (Brandrud, 1996a, b).

DECLINE DUE TO ANTHROPOGENIC INFLUENCE

The more well-known and widely distributed deciduous forest species *C. balteatocumatilis* and *C. largus* (= *C. nemorensis* sensu auct.) are included in a number of national red data lists as endangered or vulnerable, and seem to have declined severely in certain heavily polluted areas. *C. balteatocumatilis* has almost disappeared from the Netherlands, and is now known only from a roadside verge, a kind of refugium for many endangered species in chronically polluted areas (see Keizer, 1993 and Keizer & Arnolds, 1994 as *C. balteatoalbus*). The species was regarded as probably extinct in the Netherlands by Arnolds (1989 as *C. balteatus*). *C. balteatocumatilis* is also included in red data lists in Great Britain (Ing, 1992), Denmark (Vesterholt & Knudsen, 1990), Germany (DGM, 1992) and Poland (Wojewoda & Lawrynowicz, 1992). *C. largus* is included in the red data list of the Netherlands (Arnolds, 1989 as *C. nemorensis*), and both species are regarded as locally endangered in westernmost Germany (Derbsch & Schmitt, 1987). In a study from S Sweden, *C. largus* was indicated as one of the clearly declining species in mull soil beech forests affected by air pollution (Rühling & Tyler, 1990 as *C. nemorensis*). These two species are in N, W and C Europe indicator species of slightly base-rich mull soil oak–beech forests. The mycoflora of these forest types seems to be especially vulnerable to pollution effects (see Rühling & Tyler, 1990), and the *Phlegmacium* species of such forests in the Netherlands seem to have disappeared almost completely (see Arnolds, 1989).

Although probably declining, *C. balteatocumatilis* and *C. largus* are not however among the most endangered species in less polluted countries. Firstly, these two species are of the more frequent *Phlegmacium* species in many temperate areas, and also sometimes occur in calcareous areas with a high buffer capacity less influenced by acidification. Secondly, these species seem to withstand a certain degree of pollution, and persist in areas with an otherwise depauperated *Phlegmacium* flora such as the Frankfurt area of W Germany (Kärcher & Seibt, 1990; Kärcher, pers. comm.). In Norway, where *Phlegmacium*-rich thermophilous, deciduous forests are fragmentary and endangered because of altered land-use, *C. largus* and *C. balteatocumatilis* are among the few broad-leaved forest *Phlegmacium* species that are not included in the red data list due to many records and less strict habitat requirements (Bendiksen et al., 1996).

Several of the coniferous(-deciduous) forest species seem to have a satisfactory status in man-influenced areas. *Cortinarius balteatoalbus* and *C. balteatotomentosus*, and to some degree the more frequent *C. balteatus*, *C. spadicellus* and *C. variecolor*, thrive in young conifer plantations, and apparently become temporarily revitalized by modern silviculture. In contrast to these taxa is the northern, boreal element of rare to very rare species which occur in mature forests with a long continuity, and which are probably vulnerable to intensive forestry. Some of the species of this element, viz. *C. acidophilus*, *C. borgsjoeensis* and *C. serarius*, are included in the revised red data list of Norway (Bendiksen et al., 1997). The northeastern species, *C. russus*, is for similar reasons included in the Swedish red data list (Aronsson et al., 1995).

TAXONOMY

Cortinarius (Pers.) Gray subgen. **Phlegmacium** Trog sect. **Phlegmacioides** (Fr.: Fr.) Brandrud, Lindström & Melot, Cortin., Fl. Photogr. 3 (Swedish version): 26 (1994). Type: *C. variecolor* (Pers.: Fr.) Fr.
Syn.: *Cortinarius* sect. *Variecolores* Konrad & Maubl. ex Brandrud & Melot, Nord. J. Bot. 10: 538 (1990). Type: *C. variecolor* (Pers.: Fr.) Fr.
Cortinarius sect. *Patibiles* Moënne-Locc. & Reumaux, Atl. Cortin. 1: 16 (1990). Type: *C. patibilis* Brandrud & Melot.

Basidiocarps very large and robust to small and slender; pileus viscid to non-viscid, soon losing viscosity with age, fibrillose to appressed tomentose, at least with age, rarely more persistently viscid-glutinous and glabrous, initially pale grey-brown to pale ochraceous (rarely whitish), becoming ochraceous brown, chestnut to umber brown, often with violaceous tinges towards margin when young; lamellae greyish white to (pale) violaceous blue; stipe clavate-bulbous, never with a sharply marginate bulb; universal veil sparse, whitish to bluish, sometimes turning brownish, rendering the stipe fibrillose to indistinctly girdled, usually not visible on pileus; context white or with bluish tinges when young, pale yellowish to strongly yellow with KOH, instantly (bluish) green with guaiac. Spores normally amygdaliform with a faint citriform apex, some species with more irregular, broadly amygdaliform spores, distinctly and densely to fairly coarsely verrucose; pileipellis more or less single layered (simplex), surface hyphae erect-entangled, thin, hyaline and gelatinous, or frequently fairly wide, brown, thick-walled and non-gelatinous, rest of epicutis of parallel-subparallel, often strongly zebra-striped-verrucose encrusted hyphae, basally sometimes embedded in a yellow (brown), amber-like matrix. Associated mainly with conifers, especially *Picea abies*, some species associated with frondose trees (including *Betula*), mainly in mesotrophic to oligotrophic and acid soil, rarely on calcareous ground; many species rare and with a limited, ±N European distribution; 18 European species here accepted.

Key to the taxa of sect. Phlegmacioides

1a. Young lamellae, stipe and context normally with bluish tinge (if not, then basidiocarps (vinaceous) brown spotted when bruised), context normally with a strong yellow reaction with KOH (subsect. *Variecolores*) ______ 2
1b. Bluish colours frequently lacking or restricted to pileus and veil (if bluish elsewhere, then with no brownish staining reaction), context with a pale yellowish to sometimes negative KOH reaction (subsections *Balteati* and *Serarii*) ______ 10

2a. Pileus (margin) bluish when young, spores 10–11.5 × 5.5–6.5µm, strongly ornamented ______ 3

2b. Pileus without bluish colours, spores 8.5–11.5 × 5–6.5μm, weakly to strongly ornamented 4

3a. Pileus (margin) violaceous blue when young, centre brown, soon darkening, viscid, soon drying out, smell unpleasant, earth-like, gelatinous hyphae 4–6μm wide. In coniferous and deciduous forests on ±calcareous ground **1. C. variecolor**
3b. Pileus paler bluish grey when young, frequently glutinous, smell indistinct, gelatinous hyphae 2.5–4μm wide, associated with deciduous trees, mainly *Fagus* **4. C. largus**

4a. Stipe whitish with violaceous spots in lower half, spores fairly small (8.5–10 × 5–5.5μm), associated with conifers on calcareous ground **2. C. violaceomaculatus**
4b. Stipe bluish or whitish without violaceous spots, spores normally >10μm, not calciphilous 5

5a. Associated with *Picea* 6
5b. Associated with deciduous trees 8

6a. Pileus persistently viscid-glutinous, uniformly ochraceous brown, lamellae and stipe pale bluish, spores 9.5–10.5 × 5.5–6μm **3. C. spadicellus**
6b. Pileus soon dry, margin pale greyish to ochraceous white when young 7

7a. Pileus when young viscid and pale grey-brown to ochraceous, lamellae and stipe bluish to more rarely whitish, spores 10–11.5 × 5.5–6.5μm, weakly to distinctly verrucose, in oligotrophic forests, sometimes in *Sphagnum*, N and C Europe **6.1. C. patibilis** var. **patibilis**
7b. Pileus when young often completely dry, soon leather brown-fulvous brown, without bluish tinges, lamellae ochraceous brown already when young, spores 9–10.5 × 5.5–6μm, strongly verrucose, in richer (eutrophic) forests, mainly NE Europe **8. C. russus**

8a. Associated with *Alnus viridis*; basidiocarps small, pileus (pale) ochraceous, darkening, fibrillose lamellae whitish to pale bluish, spores 10–11.5 × 5.5–6.5μm, C Europe **7. C. kuehneri**
8b. Not with *Alnus*; basidiocarps medium to fairly large, pileus ± glabrous 9

9a. Associated with *Castanea*, *Quercus* and probably *Fagus*, pileus pale ochre brown, lamellae lilac to pale violaceous blue, spores 10–11.5 × 5.5–6.5μm, mainly C and W Europe **5. C. coalescens**
9b. Associated with *Betula*; pileus ochre grey-brown, darker brown from centre,

lamellae pale bluish to almost greyish, spores 11–12 × 5.5–6.5µm, NW Europe **6.2. C. patibilis** var. **scoticus**

10a. Pileus viscid-glutinous, glabrous *and* distinctly violaceous blue tinged 11

10b. Pileus dry to viscid, rarely glutinous (and then without bluish), fibrillose-tomentose, bluish colours lacking or only at margin 12

11a. Associated with *Picea*, pileus violaceous/purplish brown, red-brown with age, basidiocarps fairly small and slender, stipe <1.5cm wide, spores 10.5–12.5 × 6–7µm **18. C. serarius**

11b. With frondose trees, pileus violaceous mainly towards margin, then umber brown, basidiocarps (very) large and fleshy, stipe >1.5cm wide, spores 9.5–11 × 5–6µm **15. C. balteatocumatilis**

12a. Spores small, 8–10.5 × 4.5–5.5µm, and finely ornamented; pileus ± dry, pale ochre, darkening, stipe often with a ± marginate bulb; pileipellis hyphae wide, with distinctly brown walls 13

12b. Spores larger (normally >9.5µm long) and (very) distinctly ornamented, pileus normally viscid at least at margin when young, bulb not marginated, pileipellis hyphae wide or narrow, but frequently hyaline towards surface 14

13a. Spores very small, 8–9.5 × 4.5–5µm, narrowly amygdaliform-ellipsoid, in *Pinus* (or *Picea*) forests on sandy soils in N Europe **12.2. C. balteatoalbus** var. **areni-silvae**

13b. Spores larger, 9–10.5 × 5–5.5µm, irregularly amygdaliform to ± citriform, in deciduous forests or *Picea* plantations on ± richer soils in C and W Europe **12.1. C. balteatoalbus** var. **balteatoalbus**

14a. In subalpine *Betula* forests and alpine heaths with *Betula nana* or dwarf *Salix* 15

14b. In oligotrophic-mesotrophic, *Picea*(*-Pinus*) forests 16

15a. Associated with *Betula*, normally large, KOH normally yellowish, pileus pale ochre brown when young, darkening, spores 10.5–12.5 × 5.5–6.5µm, N and NW Europe **10.1. C. durus** var. **durus**

15b. Associated with alpine dwarf *Salix*, fairly small, pileus pale ochraceous brown, KOH negative, spores 12–13 × 6–6.5µm, C Europe **10.2. C. durus** var. **chamaesalicis**

16a. With lilac to violaceous blue tinges at the pileus margin or on the lamellae and in the context 17

16b. Bluish tinges absent (or restricted to veil remnants) 18

17a. The (involute) pileus margin with lilac tinges, basidiocarps fleshy and robust, pileipellis a mixture of erect-entangled and repent-parallel hyphae, spores 9.5–11.5 × 5–6.5µm **9. C. balteatus**

17b. Lamellae, context and sometimes pileus margin with violaceous blue tinges, pileipellis with erect-entangled hyphae only at surface, spores 10.5–12 × 5.5–6.5µm ________ **11. C. balteatotomentosus**

18a. Pileus persistently pale greyish brown, viscid to dry, veil bluish, hypoderm ±developed, with parietal pigment, spores 11.5–13.5 × 6.5–7.5µm, N Europe ________ **17. C. borgsjoeensis**

18b. Pileus darker, viscid-glutinous, no hypoderm, pileipellis with zebra-striped encrustations ________ 19

19a. Basidiocarps fleshy, stipe short, ochraceous yellow to red-brown, spores 9–10 × 5.5–6µm, C Europe ________ **16. C. hysginus**

19b. Basidiocarps not fleshy, stipe normally long and slender spores normally >10µm ________ 20

20a. Pileus 4–10cm, (warm) ochraceous brown, veil ± sparse on the stipe, whitish, spores large, 11–12.5 × 6–7µm, mainly N Europe ________ **13. C. vacciniophilus**

20b. Pileus 3–7cm, umber brown with bluish margin, veil fairly abundant, bluish, spores smaller, 10–11.5 × 5.5–6.5µm, N Europe ________ **14. C. acidophilus**

Cortinarius subsect. **Variecolores** Brandrud & Melot, Nord. J. Bot. 10: 538 (1990). Type: *C. variecolor* (Pers.: Fr.) Fr.

Syn.: *Cortinarius* subsect. *Patibiles* Moënne-Locc. & Reumaux, Atl. Cortin. 1: 16 (1990), nom. inval. *Cortinarius* subsect. *Patibiles* Bidaud, Moënne-Locc. & Reumaux, Atl. Cortin., Cle gener. sous-gen., sect., sous-sect. et ser.: 40 (1994). Type: *C. patibilis* Brandrud & Melot.

Cortinarius subsect. *Cyanipedes* Bidaud, Moënne-Locc. & Reumaux, loc. cit. Type: *C. cyanopus* Fr.

Pileus viscid-glutinous to dry, glabrous to fibrillose, veil normally not distinguishable, grey-brown to chestnut or umber brown, frequently with violaceous tinges towards margin; lamellae normally pale violaceous blue to violaceous grey, soon discolouring; stipe clavate-bulbous, sometimes subradicate, normally with bluish tinges, veil sparse; context normally with bluish tinges when (very) young. Context of most species reacts strongly yellow with KOH. Spores normally amygdaliform to slightly citriform, some species with more irregular, broadly amygdaliform spores.

1. Cortinarius variecolor (Pers.: Fr.) Fr., Epicr.: 259 (1838). **Figs 4a, 5a, 6, 9, 12a, 13, 14.**

Syn.: *Agaricus variecolor* Pers.: Fr., Persoon, Syn. meth. fung.: 280 (1801). (Sanctioned in Fries, Syst. mycol. I: 222 (1821)). *Phlegmacium variecolor* Wünsche, Pilze: 133 (1877). Type: not indicated.

Cortinarius nemorensis (Fr.) J.E. Lange, Fl. agar. dan.: 21 (1938). *Phlegmacium nemorense* (Fr.) Mos., Gatt. Phlegm.: 245 (1961). *Cortinarius variecolor* (Pers.: Fr.) Fr. var. *nemorensis* Fr., Epicr.: 259 (1838). Type: not indicated.

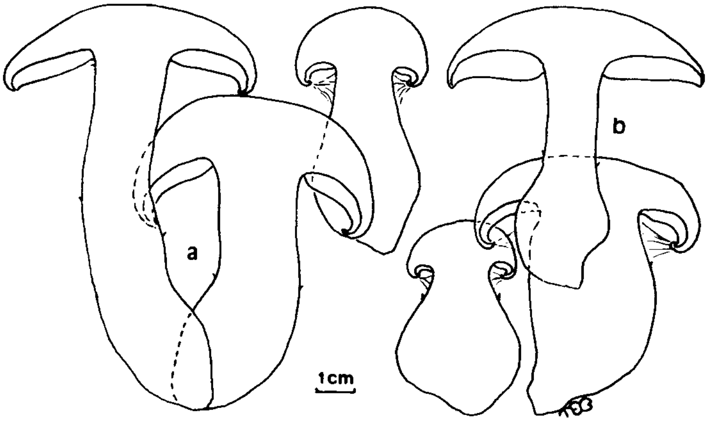

FIG. 13. *C. variecolor*. (a) 'f. *variecolor*' from coniferous forest. TEB 104-93 (specimen to the left), TEB 241-77; (b) 'f. *nemorensis*' from deciduous forest. TEB 57-91 (specimen above), TEB 57-93.

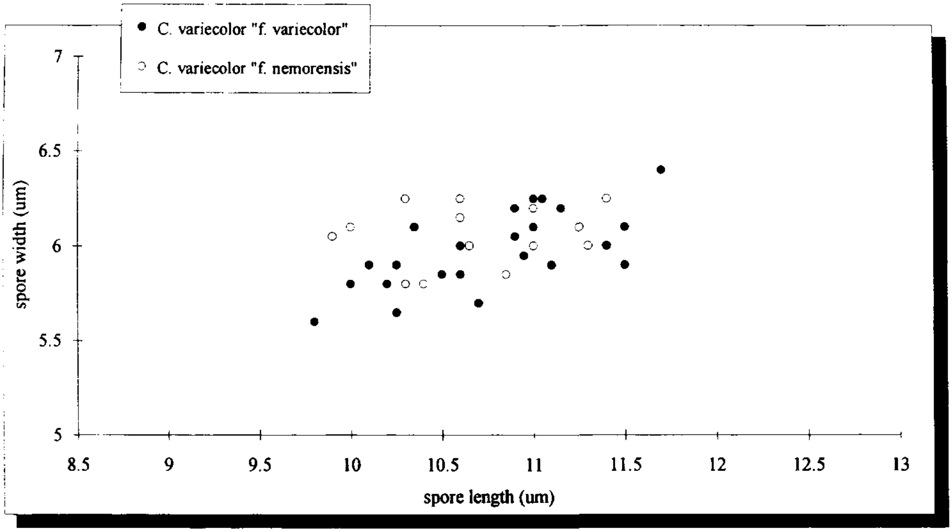

FIG. 14. Variation in spore size of *C. variecolor*. Variants from deciduous forests are distinguished as 'f. *nemorensis*'. Each symbol = MV of 10 spores measured per basidiocarp.

?*Cortinarius paracrassus* Reumaux in Bidaud et al., Atl. Cortin. 7: 230 (1995). Type: *P. Moënne-Loccoz* 3522 (holo. hb. Moënne-Loccoz, n.v.).

Selected icones: Brandr. et al. (1992), *Cortin., Fl. Photogr.* 2: Pl. B20; Mos. & Jülich (1985–1995), *Farbatl. Basidiomyc.*: Pl. Cort. 15, f. 2; Mos. (1961), *Gatt. Phlegm.*: Pl. XVI 87, (?)XVII 93 (as *Phlegm. nemorense*); Dähnke & Dähnke (1979), *700 Pilze*: 430.

Pileus 5–11(–13)cm, (hemi-)spherical, then plano-convex, viscid when young, but soon dry, especially at centre, cuticle when young usually separable to centre, thick and pigmented, glabrous when (very) young, then ± fibrillose, with age appressed tomentose and sometimes diffracted-scaly at centre, usually coarsely rivulose-innately fibrillose towards margin when mature, sometimes with hygrophanous spots; when young pale to distinctly violaceous blue towards margin, due largely to cortina and universal veil hyphae, soon discolouring, the involute margin whitish grey, centre initially greyish brown (M 70–71, N 69), darkening, soon the entire pileus becomes (spotted with) umber brown to chestnut (P-R 49, R 47). Universal veil remnants sparse and difficult to distinguish. *Lamellae*, L = 80–140, crowded, 4–7(–10)mm broad, greyish, usually with a violaceous tinge, especially towards pileus margin, soon more brownish grey, edge even or slightly crenulate. *Stipe* 5–10(–14) × (1–)1.5–2.5cm, at base (irregularly) clavate to bulbous (→4cm), sometimes almost abruptly bulbous, sometimes attenuate, fibrillose to almost glabrous and glossy, fugacious to sometimes persistently pale violaceous blue, spotted brownish with age or when bruised. Universal veil remnants sparse, fibrillose to slightly bluish girdled, sometimes viscid when young and fresh, very soon turning brownish. Cortina fairly sparse to abundant, pale violaceous blue. *Context* greyish to pale violaceous grey in stipe apex, otherwise whitish, rarely bluish white when very young; base sometimes with bluish green spots, slightly (vinaceous) brown in young basidiocarps when cut and distinctly so when bruised. 2% KOH, 40% KOH or 10% NH_4OH bright yellow, especially in pileus, yellow also on mycelial strands. Guaiac instantly green. *Smell* pleasant, faintly sweetish-fruity when young and cut, developing an unpleasant and sometimes strong and penetrating earth-like or dust-like smell with age.

Spores 10–11.5 × 5.5–6.5µm (MV = 10.73 × 6.01µm), Q = 1.79 ± 0.07, acutely amygdaliform to slightly citriform, rarely distinctly citriform, very distinctly and fairly coarsely verrucose, warts/crusts rarely interconnected. *Basidia* 7.5–9µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface of c.2–4 layers, hyphae narrow, 3–6(–8)µm wide, frequently collapsed, and then filled with brown, granulate to oleiferous necropigment. *Pileipellis* simplex (to slightly duplex). *Epicutis* fairly thick, of c.10–15(–20) hyphal layers. At surface of (3–)4–6(–7)µm wide hyphae, the outer (2–)4–7 segments distinctly gelatinous, loosely erect-entangled and hyaline to pale yellow refractive when young, diffuse, bluish, probably cytoplasmatic pigment also sometimes possible to observe; hyphae becoming more repent with age, not gelatinous and sometimes finely, pale verrucose to zebra-striped, sometimes with large, brown oil-drops/granules, hyphae often difficult to distinguish from veil. The basal part of epicutis of 5–10(–15), parallel to slightly interwoven layers, tightly connected and often cemented, hyphae 4–8(–10)µm wide, in surface view often forming subparallel, interconnected bundles in a rivulose pattern, with c.20–50 hyphae in each bundle, the hyphae often irregularly entangled at the points where the bundles branch; pigmentation strong, hyphae usually with distinct brown zebra-striped encrustations and towards trama also with thick brownish walls, frequently with dark brown oleiferous hyphae intermixed, these becoming more strongly pigmented with age and exposure. Scattered, hyaline to pale yellow, extracellular, small granules present in (very) young basidiocarps. Segments slightly wider and shorter, up to 40 × 15μm towards trama, sometimes producing a slightly duplex pileipellis; these elements may be embedded in a golden yellow, refractive, diffuse, amber-like matrix.

Habitat: Boreal-montane to mediterranean forests. Associated mainly with *Picea abies*, *Abies alba* and sometimes *Pinus sylvestris* (Scotland), but also with *Quercus* and sometimes *Fagus*, *Tilia*, *Corylus*, probably also *Carpinus*. On richer, mull soils, normally on ± calcareous ground.

Distribution: Distributed in most parts, probably all parts of Europe (Fig. 12a). Recorded from N Scandinavia (Brandrud, 1992) to the Mediterranean area (Chevassut, 1991; Ortega & Mahiques, 1995, both as *C. nemorensis*) including N Africa (Malençon & Bertault, 1970 as *C. nemorensis*) and from Great Britain (Orton, 1955) to various parts of NE and SE Europe (Nespiak, 1975; Nezdojminogo, 1983; Rimóczi, 1994), including the steppe forests of S Russia (Iwanow & Durandin, 1996). Rather frequent in N Europe (Brandrud, 1992; Hallingbäck, 1994) and in montane areas of C Europe (Moser, 1961; Krieglsteiner, 1991), rare in oceanic parts of W and NW Europe. In the Alps up to 2000m a.s.l. (Favre, 1960).

*Collections examined (*including macrocharacters).* NORWAY. Oppland: Lunner, TEB 241-77*, 243-78*, 79-79*, 105-79*, 300-80*, CFP 164*; Gran, TEB 104-93*; Nordre Land, Austsinni, *E. Vellinga*, TEB 91-84; Nordre Land, Ullsjøen, TEB 91b-84. Oslo: Romsås, Røverkollen, TEB 246-83; Bygdøy, TEB 467-80, 57-93*, 96-94* (all 'f. *nemorensis*'). Akershus: Asker, Semsvann, TEB 496-80; Ås, *G. Gulden* 90-78 & 100/78 (O). Buskerud: Ringerike, TEB 279-79, 104-93*, 50-94*; Nedre Eiker TEB 157-87*, 103-93 (leg. *I. Sørensen*). Vestfold, Horten, *P. Marstad* 11 ix 1980 ('f. *nemorensis*'; O). Telemark: Bamble, Gjømle, *Ø. Weholt* C 15/81 (O); Kragerø, TEB 1-93*, 136-94*, 137-94* (all 'f. *nemorensis*'). Aust-Agder: Gjerstad, TEB 24-94*; Arendal, *E. Blomdal* 30 ix 1982 ('f. *nemorensis*'; O)*; Grimstad, *T.H. Dahl, I.L. Fonneland* & TEB 26-94* ('f. *nemorensis*'). Hordaland, Modalen, Mo, *B.F. Moen* ix 1983 (BER). Sør Trøndelag, Trondheim, Bjørnåsen, TEB 247-79, 248-79. Nordland, Evenes, TEB 234-81. SWEDEN. Ångermanland, Häggdånger, CFP 1426*. Uppland: Lövö, Drottningholm, *L. Romell* 10 ix 1905 (including excellent painting; as *C. largus*, S); Danmark, *Eriksson* 10 ix 1945 (UPS); Börje, *S. Lundell* 19 x 1944 & 14 viii 1948 (UPS); Älvkarleby, *Fåhraeus & Stenlid* 25 ix 1949 (UPS). Södermanland, Stockholm, Hansta, TEB 53-82. Västergötland: Medelplana, TEB 115-93 ('f. *nemorensis*'); Eggby, Drottningkullen, *S. Jacobsson & L. Stridvall* 77189 ('f. *nemorensis*'; GB). Småland, Femsjö, Boldshult, *Lundell & Stordal* 6088 (UPS). Gotland: Viklau, CFP 1021*; Stenkumla, *E. Th. Fries* 30 viii 1948 & 29 ix 1950 (UPS). Västergötland, Medelplana, *S. Jacobsson* 79214 (GB). DENMARK. Fyn, Møns Klint, TEB 540-80* ('f. *nemorensis*'). GREAT BRITAIN. Scotland: Perthshire, Loch Rannoch S, *P.D. Orton* 3149 and (?) *P.D. Orton* 3445 (as *C. crassus*; E); Inverness-shire, Rothiemurchus, Loch an Eilan, *D.M. Henderson* 4169 (as *C. nemorensis*; E). GERMANY. Baden-Württemberg: Black Forest, Neubulach, TEB 697-80*; Stuttgart, Schönbuch, *A. Bollman* 94/18 ('f. *nemorensis*'; O). Bayern, Main-Spessart, Karlstadt, TEB 187-94* ('f. *nemorensis*'). SWITZERLAND. Fribourg, Bulle, Rechthalten, TEB 29-91*. Fribourg, Bulle, Jaunbach, TEB 36-96. FRANCE. Ain, Brenod, TEB 57-91*. Doubs, Frasne, TEB 35-91. Isère, Grenoble, *G. Gulden* 737-79 ('f. *nemorensis*'; O).

Comments: *C. variecolor* is characterized by its (innately) fibrillose pileus with a bright violaceous margin at first. The pileus normally discolours umber brown from the centre, contrasting with the often more persistently pale and glossy, bluish stipe. The earth-like smell becomes strong and unpleasant with age, and is well known and often used as a standard in the literature ('smell of *C. variecolor*'). However, it is perceived very differently by different persons, and some apparently cannot detect this smell at all. The situation is the same with the strong, unpleasant smell developing with age in *C. mussivus* Fr. (= *C. russeoides* Mos.) which is probably caused by the same substance. Microscopically, *C. variecolor* is characterized by its more or less gelatinous and hyaline surface hyphae of the pileipellis, and the bundles of slightly inflated elements in the basal part of the epicutis (Fig. 6).

The species is closely related to *C. violaceomaculatus* and *C. spadicellus*, but when young and fresh these are easily distinguished by the lack of bluish pigment on the pileus. Furthermore, *C. violaceomaculatus* has greyish white lamellae, and violaceous spots in the stipe cortex. *Cortinarius spadicellus* has a warmer brown pileus surface with wider and more encrusted hyphae. *Cortinarius largus* resembles *C. variecolor* macroscopically in its habit and combination of bluish and brown colours, but is paler and more glabrous, and has a different smell and a weaker KOH reaction. *Cortinarius largus* furthermore differs in having narrower pileipellis and veil hyphae, especially the gelatinous surface hyphae (Fig. 8).

Cortinarius variecolor is here treated in a wider sense than normal, including *C. nemorensis* sensu Henry (1936) and Moser (1961). The latter taxon has normally been distinguished by the habitat in deciduous forests as well as the paler pileus colours and a weaker smell. However, by testing with various persons, it appears that the smell of the deciduous forest variant (referred to in the text and tables as 'f. *nemorensis*') is indistinguishable from the coniferous forest variant. The colour of the pileus varies considerably depending on age and exposure, and fairly pale specimens can also be met with in sheltered habitats such as dense conifer plantations. The variation in a number of characters between these variants has been analysed (Tables 3, 6, 7), and it appears that the variants are almost identical in all features. The basidiocarps in deciduous forest appear on average to be slightly more compact, but there is a complete overlap in variation in all habit characters measured.

Cortinarius variecolor is the most widespread species of sect. *Phlegmacioides* in Europe, and is also the most frequent one in the coniferous forest regions. It is rarer in frondose forests, but is the most frequent species of the section in calciphilous *Quercus* forests, including mediterranean *Q. ilex* forests. The species is rare west of the natural distributional area of *Picea abies*, but material from coniferous forests is seen from both Scotland (*Pinus*) and W and N Norway (*Picea* plantations).

2. Cortinarius violaceomaculatus Brandrud in Edinb. J. Bot. 54: 115 (1997). Type: Cortinarius, Flora Photographica no. 1449 (holo. S, iso. O). **Figs 4c, 15, 16.**
Misapplied name: *Cortinarius cyanobasalis* R. Henry sensu Moënne-Locc. & Reumaux p.p., Atl. Cortin. 1: 24, Pl. 13 (1990).

Icon: Moënne-Locc. & Reum., loc. cit. (three specimens above).

Pileus 4–9cm, (hemi-)spherical, then plano-convex, viscid and glabrous, but soon drying out and then finely fibrillose and appressed tomentose at centre, cuticle fairly easy or difficult to separate, thick and coloured, slightly micaceous, with age often rivulose-innately fibrillose near margin, sometimes with a narrow, concentric hygrophanous zone near margin; pale greyish brown (M 50) with greyish white involute margin, soon darker and homogeneous greyish brown (P 49, 50), and finally umber brown (R 49-S 49), spotted with dark brown when bruised. Universal veil remnants sparse and usually not distinguishable, sometimes with small, appressed scales at centre. *Lamellae*, L = 60–90, crowded, 4–8mm broad, greyish white, soon pale greyish brown, edge even to slightly crenulate. *Stipe* 5–9 × 1–2cm, at base cylindrical to clavate, rarely bulbous (→3cm), sometimes attenuate, fibrillose to glabrous and glossy, whitish grey to bluish grey in upper part, downwards ±distinctly and persistently lilac-blue to violaceous blue, especially in a zone or patches just above the soil surface, at base of bulb the lilac-blue is ±masked by a white mycelial felt, elsewhere brownish with age, young basidiocarps turn distinctly vinaceous brown when bruised, base sometimes also with yellowish brown to orange-brown spots where debris has been attached. Mycelial strands sometimes abundant, white, turning slightly brownish. Universal veil remnants sparse, whitish to brownish fibrillose; cortina sparse, whitish. *Context* often hollow in stipe or stipe base; white or tinged with grey-brown, especially with age, stipe cortex in lower half with a ±distinct lilac bluish tinge, sometimes persistently lilac in a c.5mm zone in the periphery of the bulb, rarely with a small, bluish green spot at the very base of stipe, young basidiocarps turning slightly (vinaceous) brown when cut, distinctly so when bruised. 2% KOH, 40% KOH or 10% NH_4OH strongly and instantly yellow in context and on surfaces, saffron yellow in pileus, yellow on the mycelial strands. Guaiac instantly dark green. *Smell* indistinct or somewhat pleasant, when young and cut reminiscent of mown grass or corn, frequently also with a sweetish malt or honey-like component; developing an unpleasant earthy or dust-like smell, reminiscent of *C. variecolor*, with age.

Spores 8.5–10 × (4.5–)5–5.5µm (MV = 9.18 × 5.24µm), Q = 1.75 ± 0.08, amygdaliform-ellipsoid, rarely faintly citriform, (very) distinctly and densely to sometimes coarsely verrucose. *Basidia* 7–8.5µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface abundant, of c.4–7 layers, hyphae 4–8(–14)µm wide, frequently collapsed, filled with strongly brown, oleiferous to granulate pigment, sometimes also with thick, brownish walls. *Pileipellis* slightly duplex. *Epicutis* thin to fairly thick (if hypoderm-like elements are included), of c.5–8(–15) hyphal layers. At surface a few to sometimes many (3–)4–5(–7)µm wide, repent to erect-entangled hyphae, gelatinous or not, hyaline or with yellow walls; often difficult to distinguish from the veil. Below this a few layers of repent, parallel to slightly interwoven hyphae, 4–8(–10)µm wide, with distinct, brown zebra-striped encrustations or thick, brownish walls. Often with abundant, hyaline to pale yellow, extracellular, small granules. *Hypoderm* ±distinguishable, of thickness comparable to epicutis or thicker (c.7–8(–10) layers), of tightly cemented, slightly wider and shorter hyphae, 30–50 ×

10–15(–20)μm, with yellow-brown walls, often embedded in a golden yellow, refractive, diffuse, amber-like matrix, frequently with dark brown oleifers intermixed.

Habitat: Boreo-nemoral(-boreal) to montane coniferous forests. Associated with *Pinus* and *Picea* on ±calcareous soil, in mossy forests rich in *Phlegmacium* species. Sometimes densely fasciculate.

Distribution: Rare. Probably with a mainly C and N European distribution. Known from E Sweden (5 localities; 4 on Gotland), S Norway (2 loc.), E France (2 loc.; pers. obs., Moënne-Loccoz & Reumaux, 1990 as *C. cyanobasalis*) and Switzerland. The Scandinavian localities are mainly from warm, coastal, boreo-nemoral regions.

*Collections examined (*including macrocharacters).* SWEDEN. Gotland: Bäl, CFP 1449* (holo.), TEB 176-93*; Kräklingbo, Torsburgen, TEB 136-93*; Follingbo, Klinte CFP 1037*; Sproge, Bosarve, *K. Soop* 29 ix 1995 (hb. K. Soop). Uppland, Älvkarleby, Biludden, CFP 399*. NORWAY. Aust-Agder: Tvedestrand, *I.L. Fonneland & T.H. Dahl*, TEB 149-94*; Grimstad, *I.L. Fonneland & T.H. Dahl*, TEB 16-95*. FRANCE. Doubs, Frasne, TEB 31-91*. Haute-Savoie, Ain(?), *P. Moënne-Loccoz* 693 (as *C. cyanobasalis*, hb. Moënne-Loccoz). SWITZERLAND. Schwuz, Spaetzern, Oberiberg, *O. Rohner*, TEB 34-96.

Comments: *C. violaceomaculatus* is characterized by the normally well-developed violaceous zone or spots on the stipe and in the periphery of the stipe context. Microscopically, the species is distinguished by the fairly small and pale spores, and the structure of the pileipellis. The cemented bundles of epicutis found in related species are here normally firmly connected to a hypoderm-like structure with slightly inflated hyphae.

The species seems to prefer calcareous, warm soils, where it occurs in large groups with a (sub)caespitose habit. In this habitat it can be mistaken only for *C. variecolor*, from which it differs in the lack of violaceous tinges on the pileus (margin) and lamellae, the presence of violaceous spots on the stipe, and by the presence of the microcharacters mentioned above. Except for the pileus colours, all these features also distinguish it from the closely related *C. spadicellus* and *C. patibilis*. For the evaluation of character differentiation from the neighbouring taxa in the *C. variecolor* complex, see Tables 2 and 5.

The species here treated is depicted in Moënne-Loccoz & Reumaux (1990: pl. 13) under the name *C. cyanobasalis*. Although not clearly stated, the plate of *C. cyanobasalis* consists of two different collections. The three specimens above (PML 693) appear to be conspecific with *C. violaceomaculatus* (Fig. 16), whilst the three specimens below (PML 399) were found to belong to *C. largus*, to which also the type material of *C. cyanobasalis* belongs. The spore sketch of *C. cyanobasalis* in Moënne-Loccoz (1990: 24) is taken from the former collection. The sketch shows spores with extremely variable size, and, according to my own examination of the material, only the small spores to the right represent mature spores that have been shed onto the stipe or pileus surface (see Fig. 16).

3. Cortinarius spadicellus (Mos.) G. Garnier, Bibl. Cortin.: 151 (1992). **Figs 16, 17.** Syn.: *Phlegmacium spadicellus* Mos., Gatt. Phlegm.: 357 (1961). Type: *M. Moser* 50/144 (holo. M).

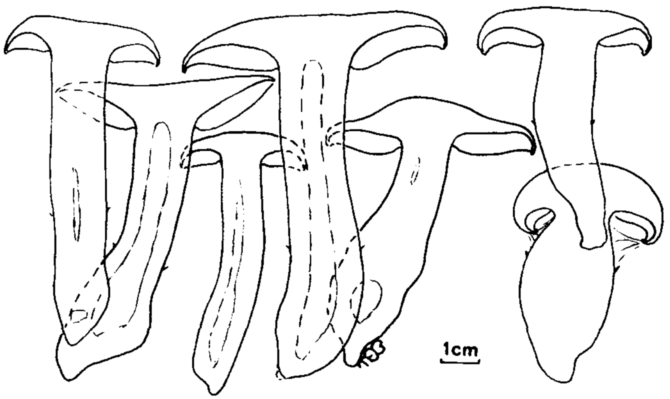

FIG. 15. *C. violaceomaculatus*. Holotype CFP 1249, TEB 31-91 (two specimens to the right).

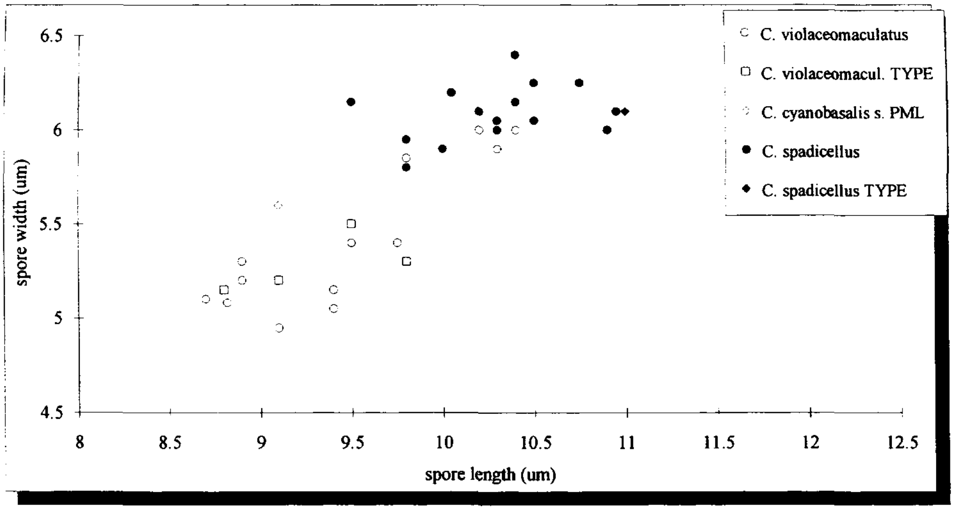

FIG. 16. Variation in spore size of *C. violaceomaculatus* and *C. spadicellus*. *C. cyanobasalis* sensu Moënne-Loccoz & Reumaux p.p. (*P. Moënne-Loccoz* 693) is conspecific with the former. Each symbol = MV of 10 spores measured per basidiocarp.

Cortinarius amigochrous Kühn. in Docum. mycol. 20(77): 110 (1989). *Cortinarius amigochrous* Kühn. in Bull. Soc. linn. Lyon 29: 52 (1960), nom. inval. Type: *R. Kühner* 55-30 (holo. G).

Icones: Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 16, f. 1 (as *C. spadiceus* Fr.); Mos. (1961), *Gatt. Phlegm.*: Pl. XVI 91; Soop (1992), *Jordstjärnan* 13: 57 (as *C. spadiceus* Fr.); Marchand (1982), *Champ. nord midi*, vol. 7: Pl. 689 (as *C. amigochrous*); Bidaud, Moënne-Locc. & Reum. (1995), *Atl. Cortin.* 7: Pl. 158 (?as *C. opimus*), 160 (?as *C. badiolatus*).

Pileus 4–8cm, (hemi-)spherical, then plano-convex, rarely broadly umbonate, glutinous when young, frequently persistently viscid-glutinous, cuticle normally fairly easy to separate, thick and pigmented; glabrous and usually coarsely rivulose-innately fibrillose or with hygrophanous spots, sometimes with a narrow, concentric hygrophanous zone near margin; homogeneous ochraceous brown to fulvous brown (P 47, 49, 57, 60), sometimes whitish brown at margin when (very) young. Universal veil remnants sparse and usually not distinguishable, sometimes with small, appressed scales at centre. *Lamellae*, L = 60–90, crowded, 3–7mm broad, pale violaceous blue to greyish white, bluish tinge most distinct towards pileus margin, edge even to slightly crenulate. *Stipe* 5–10 × 1–1.5(–2)cm, at base cylindrical to clavate (→2.5cm), sometimes attenuate, fibrillose to glossy, greyish white with a faint bluish tinge, often turning slightly brownish with age or when bruised. Universal veil remnants sparse, whitish, then brownish fibrillose or slightly girdled, cortina sparse, whitish. *Context* often fistulose to hollow in stipe; whitish, greyish white sometimes with a bluish tinge in stipe apex, frequently distinctly violaceous blue at the base of stipe, rarely with small, bluish green spots at the base, young basidiocarps turning slightly (vinaceous) brown when bruised. 2% KOH strongly yellow in pileus, somewhat paler in stipe. Guaiac instantly dark green. *Smell* faint, indistinct or somewhat yeast-like when cut.

Spores 9.5–11 × (5.5–)6–6.5µm (MV = 10.33 × 6.09µm), Q = 1.70 ± 0.07, (acutely) amygdaliform to slightly citriform, sometimes almost ellipsoid, (very) distinctly and sometimes coarsely verrucose. *Basidia* 8–9µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface fairly abundant, of 3–5 hyphal layers, fairly evenly distributed over the surface, hyphae normally narrow, 3–6(–10)µm wide, ±collapsed, filled with golden brown, granulate to oleiferous necropigment, sometimes forming a regular pattern of transversal bands. *Pileipellis* simplex (to slightly duplex). *Epicutis* fairly thick, of c.10–15 hyphal layers. At surface of 4–6µm wide hyphae, the outer c.2–5 segments normally gelatinous, loosely erect and sinuose, with ±brownish, thick walls, especially distinct with age, hyphae sometimes also finely, pale verrucose to zebra-striped, especially basally, a few (very) wide (→15µm), repent and straight, non-gelatinous hyphae with strongly yellow-brown, zebra-striped encrustations often intermixed. The basal part of epicutis of 5–10, parallel to slightly interwoven layers, tightly connected and often cemented, hyphae 4–8(–10)µm wide, in surface view sometimes forming subparallel, interconnected bundles in a rivulose pattern; hyphae with strong, brown zebra-striped encrustations and towards trama also thick, brownish walls, with some brown, oleiferous hyphae intermixed. Elements become slightly wider and shorter, up to 40 × 15µm towards trama, sometimes producing a slightly duplex pileipellis structure, elements embedded in a golden yellow to yellow-brown, refractive, diffuse, amber-like matrix. A pale yellow matrix can also be observed in the upper part of the trama.

Habitat: Boreal, boreo-nemoral and montane coniferous forests. Associated with *Picea* in mesotrophic-eutrophic forests, sometimes in younger plantations.

Distribution: Fairly rare and little known, but widely distributed, at least in N and

C Europe. Recorded from C and S Scandinavia (pers. obs.; Soop, 1987 as *C. amigochrous*; Soop, 1992 as *C. spadiceus* and *C. spadicellus* p.p.), S Germany and Switzerland (Krieglsteiner, 1991 as *C. amigochrous*), Austria (Moser, 1961, 1995), E and S France (Kühner, 1960 as *C. amigochrous*, and pers. obs.). In W Europe so far recorded in *Picea* plantations of the Inner Hebrides, Scotland (*Orton* 3454, 3455), but probably more widely distributed.

*Collections examined (*including macrocharacters).* NORWAY. Oppland: Lunner, CFP 163*, TEB 255-80*, 137-83, 116-84*; Søndre Land, TEB 9-86*. Akershus, Eidsvoll, TEB 351-78*. Buskerud, Nedre Eiker, TEB 53-94*. Aust-Agder, Øyestad, *T.H. Dahl*, TEB 275-87. SWEDEN. Småland, Götene, TEB 301-87*. GREAT BRITAIN. Scotland, Mull: Glen Aros, *P.D. Orton* 3454; Bailemeonach, *P.D. Orton* 3455 (both as *C. varius*, E). GERMANY. Baden-Württemberg, Black Forest, Igelsberg, TEB 693-80*. AUSTRIA. Innsbruck, Igls, Iglerwald, *Moser* 50/144 (holo. M). FRANCE. Haute-Savoie, Samoens, Le Grand Crêt, 20 ix 1955, *R. Kühner* 55-30 (holotype of *C. amigochrous*, G). France-Comté, Ain, Brenod, CFP 1117*. Languedoc, Herault, Bedarieux, TEB 228-83*.

Comments: *C. spadicellus* is characterized by its distinctly and fairly persistently viscid-glutinous pileus with uniform, ochraceous brown colours and the strongly encrusted pileipellis hyphae. These are also the differential characters towards the other species in the subsection. On bruising, the basidiocarps of this species turn less brownish than those of the other members of the subsection.

Moser (1961) and Soop (1992) treat *C. spadicellus* as here circumscribed as two species: *C. spadiceus* (Batsch) Fr. and *C. spadicellus*, the former being darker and more uniformly brown coloured (see Moser, 1995). However, this distinction has so far not been provided with convincing morphological evidence, and is not supported by the material studied here.

The species probably corresponds to *C. spadiceus* (Batsch) Fr. sensu Fr., but not to the original description and plate of *Agaricus spadiceus* Batsch (1783–1789: pl. 49). This type plate depicts one specimen with a blackish brown pileus and a bluish grey stipe, and an exact interpretation of this fungus seems at present impossible.

Although not very well known, this is one of the three most widespread species of sect. *Phlegmacioides* in coniferous forests of N and C Europe.

4. Cortinarius largus Fr., Epicr.: 259 (1838). **Figs 4b, 12b, 18, 19.**

Syn.: *Phlegmacium largum* (Fr.) Wünsche, Pilze: 133 (1877). Type: not indicated.

Cortinarius cyanobasalis R. Henry in Bull. Soc. mycol. Fr. 102: 80 (1986). *C. cyanobasalis* R. Henry in Bull. Soc. mycol. Fr. 73: 29 (1957), nom. inval. Type: *R. Henry* 1468 (holo. hb. Henry).

Cortinarius pseudolargus R. Henry in Docum. mycol. 17(68): 27 (1987). *C. pseudolargus* R. Henry in Bull. Soc. mycol. Fr. 74: 296 (1958), nom. inval. Type: *R. Henry* 70218 (holo. hb. Henry).

?*Cortinarius lividoviolaceus* R. Henry in Docum. mycol. 17(68): 28 (1987). *C. lividoviolaceus* R. Henry in Bull. Soc. mycol. Fr. 73: 46 (1957), nom. inval. Type: *R. Henry* 534 (1956) (holo. hb. Henry, n.v.).

?*Cortinarius nebularis* R. Henry in Bull. Soc. mycol. Fr. 73: 45 (1957), nom. inval. Type: *R. Henry* 304 ('holotype', hb. Henry, n.v.).

?*Cortinarius congeminus* Moënne-Locc. & Reumaux in Bidaud et al., Atl. Cortin. 7: 228 (1995). Type: *P. Moënne-Loccoz* 3422 (holo. G).

?*Cortinarius congeminus* Moënne-Locc. & Reumaux forma *cladestinus* Moënne-Loccoz & Reumaux in Bidaud et al. loc. cit. Type: *P. Moënne-Loccoz* 3448 (holo. G).

?*Cortinarius variegatulus* Reumaux in Bidaud et al. op. cit.: 231. Type: *P. Moënne-Loccoz* 3502 (G).

Misapplied name: *Cortinarius nemorensis* (Fr.) J.E. Lange sensu Lange, Fl. agar. dan. 3: 21 (1938).

Selected icones: Brandr. et al. (1992), *Cortin., Fl. Photogr.* 2: Pl. B59 (as *C. nemorensis*); Phillips (1981), *Mushr. Gr. Br. & Eur.*: 131 (as *C. nemorensis*); Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 15, f. 1 (as *C. lividoviolaceus*); Mos. (1961), *Gatt. Phlegm.*: Pl. XVII 94; Moënne-Locc. & Reumaux (1990), *Atl. Cortin.* 1: Pl. 13 (as *C. cyanobasalis* R. Henry); J.E. Lange (1938), *Fl. agar. dan.* 3: Pl. 88C (as *C. nemorensis*); Dähnke & Dähnke (1979), *700 Pilze*: 431 (as *C. nemorensis*); Marchand (1982), *Champ. nord midi* 7: Pl. 683, 686 (as *C. lividoviolaceus*).

Pileus 5–11(–14)cm, (hemi-)spherical, then plano-convex, viscid to glutinous when young, frequently persistently viscid, at least towards margin, cuticle often easy to separate, thick and pigmented, glabrous, with age sometimes faintly rivulose-innately fibrillose near margin, sometimes with hygrophanous spots, rarely appressed tomentose at centre; whitish blue to lavender or pale violaceous blue (as in *C. camphoratus*) towards margin, due mainly to cortina hyphae, the involute margin whitish to whitish grey; centre initially very pale greyish brown (M 70, 71, 75) to ochraceous brown (M 69, N 65), soon the entire pileus becomes (spotted with) greyish brown to ochraceous brown, sometimes with an olivaceous brown (M 77) tinge when viscid. Universal veil remnants sparse and difficult to distinguish, sometimes with small, appressed scales at centre. *Lamellae*, L = 90–140, crowded, 4–8(–10)mm broad, distinctly violaceous blue to lavender, especially towards pileus margin, soon more greyish blue, edge even or crenulate-serrulate. *Stipe* 5–10 × (1–)1.5–2.5cm, at base clavate (→4cm), fibrillose, whitish blue to almost white, sometimes violaceous blue at apex when young, greyish white towards base, brownish with age or when bruised; mycelial felt at base whitish to sometimes with a bluish tinge. Universal veil remnants sparse to fairly abundant, rendering the stipe slightly bluish girdled, more bluish than ground colour, soon discolouring to ochraceous white. Cortina sparse to fairly abundant, pale violaceous blue. *Context* when (very) young violaceous grey in stipe apex, distinctly and often persistently violaceous at base of stipe, bluish white in pileus, soon discolouring to whitish; young basidiocarps sometimes becoming slightly (vinaceous) brown when bruised. 2% KOH or 40% KOH slightly yellowish, at least in pileus, negative in mature basidiocarps. Guaiac ± instantly dark green. *Smell* indistinct or somewhat pleasant when young and cut, fruity or of mown grass.

Spores (9.5–)10–11.5 × 5.5–6.5µm (MV = 10.64 × 6.08µm), Q = 1.75 ± 0.06, acutely amygdaliform to slightly citriform, sometimes almost ellipsoid, distinctly to very distinctly and ±coarsely verrucose. *Basidia* 7–9µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface scattered and evenly distributed, of c.2–5(–7) layers, hyphae very narrow, 2–5(–7)µm wide, frequently collapsed, and then ±filled with golden yellow-brown, granulate to oleiferous necropigment. *Pileipellis* simplex (to slightly duplex). *Epicutis* fairly thick, of c.10–15(–20) hyphal layers. At surface of narrow, 2.5–4(–4.5)µm wide hyphae, forming a well-developed pellicle, the outer 3–6(–8) segments distinctly gelatinous, loosely erect-entangled to more repent, hyaline to pale yellow refractive; diffuse, bluish, probably cytoplasmatic pigment also sometimes observable, walls often finely, hyaline verrucose with KOH, hyphae sometimes difficult to distinguish from veil. The basal part of epicutis of 5–10(–15) layers, hyphae parallel to slightly interwoven, tightly connected and ±cemented, 3–6(–9)µm wide, in surface view often forming ±distinct, subparallel, interconnected bundles in a rivulose pattern, with c.20–50 hyphae in each bundle, hyphae often with pale to distinct yellow-brown zebra-striped encrustations and towards trama also with thick brownish walls, frequently with yellowish brown oleiferous hyphae intermixed, the oleifers becoming more strongly pigmented with age and exposure. Scattered, hyaline, extracellular, small granules present when (very) young. Elements become wider and shorter, up to 15(–20)µm wide towards trama, sometimes embedded in an amber-like, yellow matrix, not infrequently producing a slightly duplex pileipellis structure.

Habitat: Montane, boreo-nemoral, nemoral to mediterranean forests. Associated with a wide range of thermophilous, frondose trees, most frequently with *Fagus sylvatica* (probably also other *Fagus* spp.) in mesotrophic-eutrophic, more rarely calcareous forests. Sometimes in *Abies alba* forests as well, and sometimes in *Picea* plantations on sites formerly occupied by *Fagus* forests.

Distribution: One of the most frequent *Phlegmacium* species in temperate regions (Orton, 1955; Moser, 1961; Bertaux, 1966). Very widely distributed in Europe (Fig. 12b), from C Scandinavia (Brandrud, 1992 as *C. nemorensis*) to Italy, S France and S Spain (Chevassut, 1991; Ortega & Mahiques, 1995), and from Great Britain (S and W Scotland, England; Orton, 1955) to former Soviet Union (Nezdojminogo, 1983), recorded southeast to the lower Volga region in S Russia (Iwanow & Durandin, 1996). Also recorded in Morocco (Malençon & Bertault, 1970).

*Collections examined (*including macrocharacters)*. NORWAY. Oppland: Lunner, TEB 72-93*, 73-94*; Østre Toten, TEB 106-84. Oslo, Hovedøya, TEB 87-85. Akershus, Frogn, Håøya, TEB 32-94*. Østfold: Kråkerøy, TEB 630-80; Kråkerøy, *W. Ramm* 8 x 1972 (O); Borge, Torsnes, *W. Ramm* 11 ix 1963, 14 ix 1965 (O); Halden, Tistedalen, TEB 288b-85. Vestfold: Brunlanes, TEB 297-80*, CFP 214; Våle, *P. Marstad*, TEB 102-93*. Telemark, Kragerø, TEB 219-85, 236-85, 250-85. Aust-Agder, Grimstad, *I.L. Fonneland*, TEB 71-94*. Hordaland: Stord, TEB 391-80*, 414-80*; Fana, TEB 311-80; Os, TEB 329-80. SWEDEN. Småland, Femsjö, TEB 139-79*, *G. Haglund & S. Lundell* 14 ix 1948 (as *C. purpurascens* Fr., S), *S. Lundell & J. Stordal* 2694 (as *C. nemorensis*, UPS). Västergötland, Medelplana, TEB 116-93*, CFP 204*, 372*, 373*; *S. Jacobsson* 77250 (as *C. nemorensis*, GB). Dalsland, Mellerud, *I. Kytövuori* 14 ix 1990 (O)*. Uppland: Uppsala, Kungsparken, *H. von Post* 28 ix 1897 (as *C. cyanopus* Fr., S). Uppland, Lövö, Drottningholm, *L. Romell* 29 viii 1922 (including painting as *C. coerulescens*, S), *G. Haglund* 28 viii 1951 & 30 viii 1951 (as *C. nemorensis*, S). Blekinge, Karlskrona, *S. Lundell* 26 ix 1946 (as *C. nemorensis*, UPS). Blekinge, Wämö, *S. Lundell* 9 ix 1946 (as *C. nemorensis*, UPS). Blekinge, Förlkarla, *S. Lundell* 30 ix 1946 (as *C. nemorensis*, UPS). Gotland, Sproge, Solsänge, TEB 41-90. GREAT BRITAIN. Scotland: Perthshire, Glen Lyon, TEB 175-83; Mull, Salen Wood, *P.D. Orton* 3822 (E). England: Hampshire, New Forest, *P.D. Orton* 3824 (as *C. nemorensis*; E); Surrey, Mickleham, *P.D. Orton* 140 (as *C. nemorensis*; E); Yorkshire, Fewston, Washburn Valley, *R. Watling* 13769 (as *C. balteatocumatilis*; E). GERMANY. Hessen, Taunus, Kronbergen, *R. Kärcher*, TEB 103-94 (FR). Baden-Württemberg: Black Forest, Freudenstadt, *E. Bendiksen*, TEB 181-93*; Baar, Flözlingen, TEB 42-96. AUSTRIA. Wesenaurachtal, Salzkammergut, *R. Kärcher*, 1973 (FR). FRANCE. Doubs, *R. Henry* no XX, *R. Henry* 1468 (holotype for *C. cyanobasalis*), *R. Henry* 70218 (holotype for *C. pseudolargus*; all Doubs coll. hb. Henry). Ain, Ordonnaz, TEB 37-91*, 56-91*, CFP 1085*. Isère, Chartreuse, *G. Gulden* 595/79 (O). ?Ardennes, Belval, *P. & F. Reumaux*, *P. Moënne-Loccoz* 3422 (holotype for *C. congeminus*, G), 3423 (as *C. congeminus*, hb. Moënne-Loccoz). ?Loiret, Barres, *Le Meur*, *P. Moënne-Loccoz* 3450 (as *C. congeminus*, hb. Moënne-Loccoz). ?Ile-de-France, Sénart, *J. Relier*, *P. Moënne-Loccoz* 3502 (holotype for *C. variegatulus*, G). ITALY. Emilia-Romagna, Parma, Borgotaro, TEB 391-81*, 392-81*. HUNGARY. Börzsöny, Magas-hegy, TEB 224-94*.

Comments: *C. largus* (= *C. nemorensis* sensu J.E. Lange, *C. lividoviolaceus* sensu auct.) is together with *C. balteatocumatilis* (q.v.) the most widespread and well-known deciduous forest taxon in sect. *Phlegmacioides*, following thermophilous, frondose forests all over Europe (Fig. 12b). The species is characterized when young by its fairly glutinous and glabrous, pale ochre grey pileus with bluish margin, distinctly violaceous lamellae and context (especially base of stipe) at first, absence of an earth-like smell as well as the weak to absent KOH reaction. By these characters *C. largus* can be separated from *C. variecolor* which can also occur in deciduous forests ('f. *nemorensis*'), but has a darker, more fibrillose and coarsely rivulose pileus. Microscopically, *C. largus* is clearly distinguished by the well-developed gelatinous epicutis of very narrow hyphae (Fig. 8). The spores of the two taxa are similar (Figs 4a,b, 14, 19; Table 6). According to the number of distinguishing characters (Fig. 1), *C. largus* is most closely related to *C. coalescens* and *C. patibilis*, but is recognized by its more viscid pileus with a distinctly bluish margin.

There has been much confusion about name use and delimitation of the taxon described here towards the deciduous forest variant of *C. variecolor* ('f. *nemorensis*'). Many authors have used the name *C. nemorensis* for the present taxon, and many have apparently used the name in a broad sense, covering all variants in deciduous forest with a bluish pileus margin. Most floras seem to apply one of these two concepts (Lange, 1938; Orton, 1955; Pilát & Usák, 1961; Dähnke & Dähnke, 1982; Ryman & Holmåsen, 1984; Brandrud, 1992; Brandrud et al., 1992). The name *C. largus* has mainly been used by French authors (see Kühner & Romagnesi, 1953; Henry, 1958; Marchand, 1982) and Moser (1961, 1983), but frequently in a narrower sense than here applied. The present concept of *C. largus*, however, is well in accordance with Henry (1935, 1936), who gave a precise description of the two deciduous forest taxa *C. largus* and *C. variecolor* 'f. *nemorensis*'.

The name *C. largus* was introduced by Fries (1838), and the protologue includes most essential characters for the present species: a viscid, appressed fibrillose, grey-brownish pileus with bluish tinges, more or less persisting at the margin, and fugacious violaceous colours on the stipe and in the context. The habitat description ('in pinetis') is the character that is in most serious conflict with the present species. However, the locality indicated (Kungsparken, Uppsala) is a park-like forest and, although it is dominated by large pines, deciduous trees such as *Corylus* are also present, and *C. largus* as here interpreted was collected in Kungsparken by H. von Post in 1897. The unpublished plate deposited in the Swedish Museum of Natural History, Stockholm (no. S 0340; see Strid, 1994) also fits with the present concept.

The name *C. nemorensis* was also introduced by Fries (1838), but as a variety of *C. variecolor*, and it was kept as a variety also in his later works. This indication of a very close affinity to *C. variecolor*, as well as the fairly dark brown, rivulose pileus described by Fries (1838), makes the deciduous forest variant of *C. variecolor* the most suitable candidate for this name. Furthermore, the unpublished Friesian plate at Uppsala (no. U 0728; see Strid, 1994) also corresponds to this concept. The name *C. nemorensis* is therefore rejected for the species discussed here.

Cortinarius lividoviolaceus R. Henry sensu Moser (1961, 1983) is a synonym for *C. largus* as here circumscribed, covering variants with vividly violaceous tinges. *C. lividoviolaceus* in its original sense is very probably also synonymous, but unfortunately type material has not been available for examination. According to the protologue (Henry, 1986) and a study of the type material, *C. cyanobasalis* is also a synonym for *C. largus* (see Fig. 19). *Cortinarius cyanobasalis* depicted in Moënne-Loccoz & Reumaux (1990: pl. 13) shows two different collections belonging to two different species. The specimens above appear to belong to *C. violaceomaculatus* (see comments under this species), whilst the specimens below are in correspondence with *C. largus*, showing the characteristic, rather strong violaceous tinges in pileus context, and with conforming microcharacters.

Cortinarius congeminus Moënne-Locc. & Reumaux and *C. variegatulus* Reumaux seem, according to the microcharacters of the type material, to belong to *C. largus*. The two plates of *C. congeminus* (incl. *C. congeminus* forma *cladestinus*) in Bidaud et al. (1995: pl. 168) show old and very tall and slender specimens, and the descriptions are also apparently based on mature specimens ('Lames . . . fauve ochracé'). Except for the tall stipe (which could be habitat-dependent), the depicted specimens look like normal *C. largus*. *Cortinarius variegatulus* is described in Bidaud et al. (1995) based on a quite abnormal type material having a peculiar eroded-lobed pileus margin. This phenomenon probably indicates a drought effect, which also might explain the almost lack of bluish tinges. Further documentation on the characters of this variant is needed.

5. Cortinarius coalescens Kärcher & Seibt in Z. Mykol. 54: 78 (1988). Type: *R. Kärcher & D. Seibt* 13 ix 1977, no F 300 (holo. FR). **Fig. 19.**

Syn.: ?*Cortinarius pseudocyanopus* R. Henry in Bull. Soc. mycol. Fr. 73: 27 (1957), nom. inval. Type: *R. Henry* 346 ('holotype', hb. Henry, n.v.).

?*C. ochroclarus* R. Henry in Bull. Soc. mycol. Fr. 74: 288 (1958), nom. inval. Type: not indicated.

?*Cortinarius pardinus* Reumaux in Bidaud et al., Atl. Cortin. 7: 230 (1995). Type: *P. Moënne-Loccoz* 3432 (holo. G).

Icones: Kärcher & Seibt (1988, 1991), *Z. Mykol.* 54: 89; 57: 256; (?)Bidaud et al. op. cit.: Pl. 166 (as *C. pardinus*).

Pileus 4–9cm, (hemi-)spherical, then plano-convex, viscid to glutinous when young, at least towards margin, dry with age, cuticle separable, glabrous, with age slightly innately fibrillose or not; pale ochraceous to greyish brown (P-N 67–69, M 71,75,77), sometimes with a faint olivaceous ochre tinge, whitish to pale (greyish) ochre towards margin, later ochraceous brown (M 69, N 65). *Lamellae*, L = 60–70, moderately crowded, 4–6mm broad, distinctly violaceous blue to lavender, soon more bluish grey, edge even to serrulate. *Stipe* 5–8 x 1.2–2cm, clavate at base (→2.5cm), fibrillose, whitish blue, bluish tinge distinct in apex when young, greyish white towards base, brownish with age or when bruised. Universal veil remnants sparse, ochraceous white. *Context* bluish white when young, bluish tinge most distinct in pileus and stipe apex, sometimes also distinct bluish spots in stipe base; young basidiocarps sometimes become slightly (vinaceous) brown when cut or bruised. 2% KOH or 40% KOH (pale) yellowish, sometimes negative when mature. Guaiac strongly bluish green. *Smell* indistinct or somewhat pleasant, with a yeast-like component.

Spores 10–11.5 x 5.5–6.5µm (MV = 10.60 x 6.02µm), Q = 1.77 ± 0.08, amygdaliform, sometimes slightly citriform, (very) distinctly and fairly densely verrucose. *Basidia* 7–9µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface scattered, of c.2–3 layers, hyphae 3–5(–7)µm wide, frequently collapsed, with ± brownish content. *Pileipellis* simplex. *Epicutis* fairly thick, of c.10–15(–20) hyphal layers. At surface of 3.5–5µm wide hyphae, the outer 2–5 segments gelatinous, loosely erect-entangled to more repent, hyaline or with pale yellow refractive content, walls often finely, hyaline verrucose with KOH. The basal part of epicutis of 5–10(–15) layers, hyphae parallel to interwoven and tightly connected, 5–8(–12)µm wide, with distinct, yellow-brown zebra-striped encrustations and towards trama also with thick brownish walls, frequently with yellowish brown oleiferous hyphae intermixed. Elements towards trama sometimes embedded in an amber-like, yellow matrix.

Habitat: Nemoral to boreo-nemoral deciduous forests. Associated with *Castanea*, *Quercus* and *Fagus* on mesotrophic-eutrophic soil.

Distribution: Very rare. Known from the Frankfurt area in W Germany (type locality), N Spain (Kärcher & Seibt, 1988), Norway, (pers. obs.), N France (Bidaud et al., 1995 as *C. pardinus*) and according to Kärcher & Seibt (1991) probably also occurring in N Italy.

*Collections examined (*including macrocharacters).* NORWAY. Aust-Agder: Arendal, *T.H. Dahl*, TEB 164-94*; Grimstad, *I.L. Fonneland*, TEB 72-94*. GERMANY. Hessen, Taunus, Kronbergen, *R. Kärcher & D. Seibt* 13 ix 1977, no F 300 (holo. FR, iso. O), *D. Seibt* ix 1987 (FR, O). FRANCE. Ardennes, Belval, *P. & F. Reumaux*, *P. Moënne-Loccoz* 3432 (holotype for *C. pardinus*, G). Ardennes, Semuy, *P. Reumaux*, *P. Moënne-Loccoz* 2927 (as *C. pardinus*, hb. Moënne-Loccoz).

Comments: *C. coalescens* is characterized by its fairly pale ochraceous to greyish brown pileus, its distinctly lavender bluish lamellae, and its habitat in deciduous forests. Except for the absence of bluish colours at the pileus margin, it is very similar to *C. largus* (= *C. lividoviolaceus*). The species seems to occupy an intermediate position between *C. largus* and the coniferous forest species *C. patibilis*. The latter differs in having less distinctly lavender lamellae, more strongly brownish staining reaction, more bright yellow KOH reaction and less ornamented spores.

The description of macromorphological characters above is based on fresh material from Norway. All essential macrocharacters in this material seem to correspond with the protologue. Kärcher & Seibt (1988) originally described the lamellae as bluish grey to vividly bluish violet, but in a later contribution (Kärcher & Seibt, 1991) this was changed to more pinkish lilac. My observations correspond with the former colour description, whereas the apparently conspecific *C. pardinus* Reumaux is described with more lilac lamellae. The microcharacters of the Norwegian material are similar to those of the type material of *C. coalescens*, except that the spores are slightly more amygdaliform.

6. Cortinarius patibilis Brandrud & Melot in Bull. Soc. mycol. Fr. 99: 228 (1983). Type: *T.E. Brandrud* 213-78 (holo. O).

6.1. Cortinarius patibilis var. **patibilis. Figs 4d, 12c, 17, 20.**
Misapplied name: *Phlegmacium spadiceum* (Fr.) Blytt sensu Mos., Gatt. Phlegm.: 247 (1961).

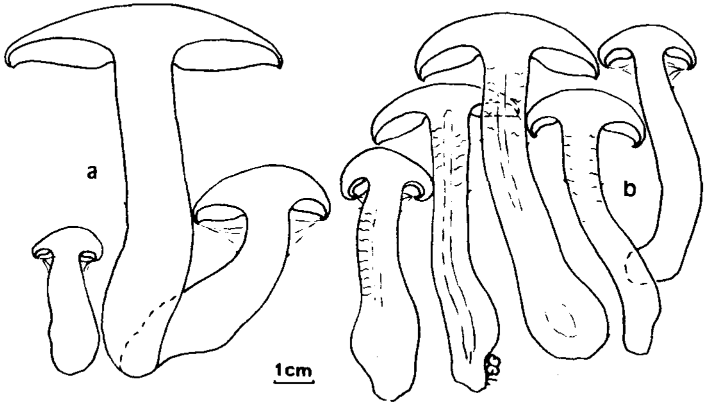

FIG. 17. (a) *C. spadicellus*. TEB 116-84 (two specimens to the left), TEB 255-80; (b) *C. patibilis* var. *patibilis*. TEB 95-87.

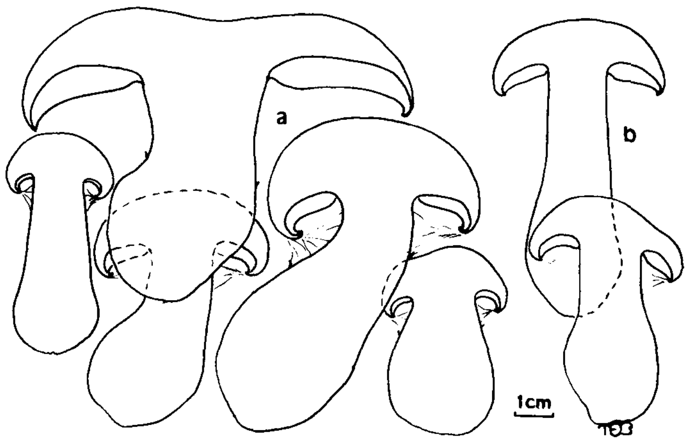

FIG. 18. (a) *C. largus*. TEB 37-91 (left), TEB 297-80 (above), TEB 391-81 (three specimens to the right); (b) *C. patibilis* var. *scoticus*. Holotype TEB 161-83.

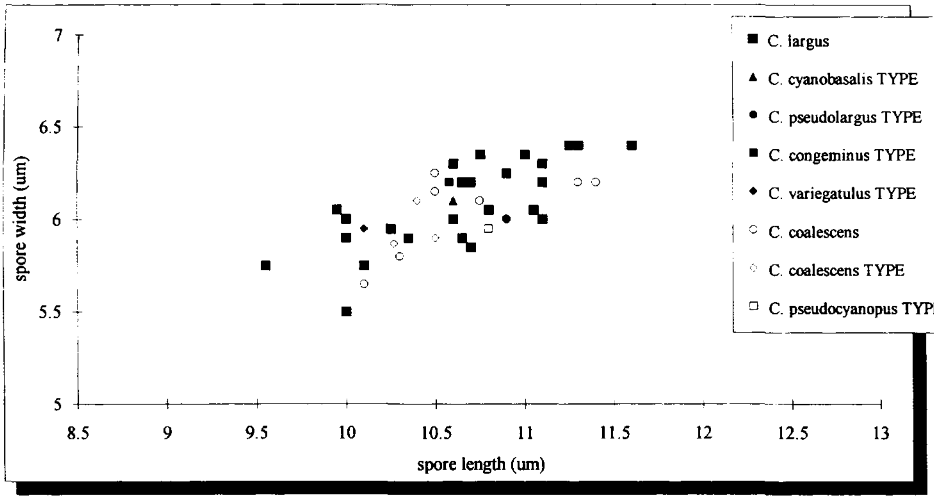

FIG. 19. Variation in spore size of *C. largus* (= *C. cyanobasalis*, *C. pseudolargus*, ?*C. congeminus*, ?*C. variegatulus*) and *C. coalescens* (= *C. pseudocyanopus*?). Each symbol = MV of 10 spores measured per basidiocarp.

Icones: Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 16, f. 2; Mos., op. cit.: Pl. XVII 97; Soop (1992), *Jordstjärnan* 13: 1 (as *C. spadicellus*).

Pileus 3–8(–9)cm, (hemi-)spherical, then plano-convex, viscid and glabrous, but soon drying out and then fibrillose and appressed tomentose at centre, often coarsely rivulose-innately fibrillose with age, cuticle usually difficult to separate; pale ochraceous brown (M 69, N 65) or greyish clay brown (L 75, M 70, 71) when young, margin initially whitish or faintly bluish tinged from veil; soon spotted with brown,

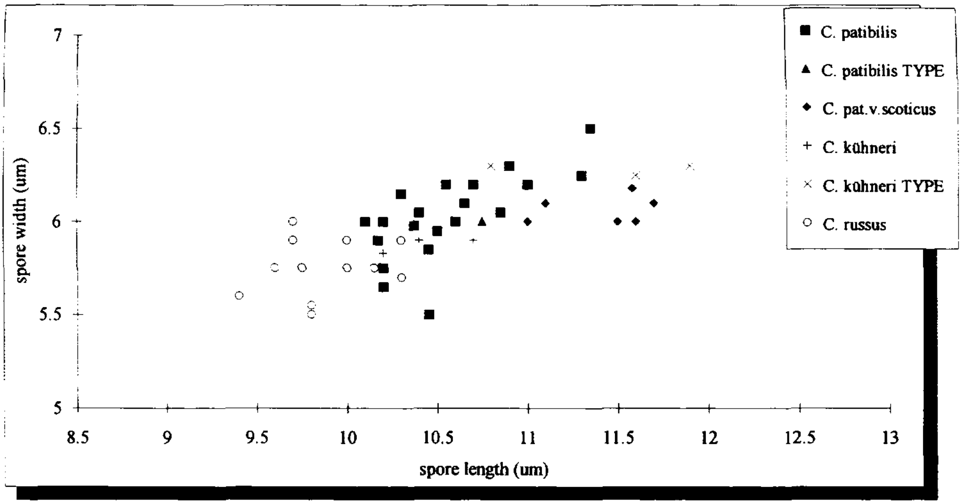

FIG. 20. Variation in spore size of *C. patibilis* var. *patibilis*, *C. patibilis* var. *scoticus*, *C. kuehneri* and *C. russus*. Each symbol = MV of 10 spores measured per basidiocarp.

finally uniformly grey-brown to umber (N 67, P 65, 67). Universal veil remnants sparse and usually not distinguishable, sometimes with small, appressed scales at centre. *Lamellae*, L = 55–80, crowded, 3–7mm broad, pale violaceous blue to greyish white, bluish tinge most distinct towards pileus margin, edge crenulate-serrulate or not. *Stipe* 5–10(–12) × 0.8–1.5cm, at base cylindrical to clavate (→2cm), fibrillose, whitish blue to (almost) whitish grey, brownish with age, young basidiocarps turn (very) distinctly red-brown to vinaceous clay-brown when bruised. Universal veil remnants sparse, bluish then brownish fibrillose, cortina sparse, whitish. *Context* often fistulose to hollow in stipe; bluish white to greyish white, rarely with small, bluish green spots at the very base of stipe, young basidiocarps turning slightly (vinaceous) brown when cut, very distinctly so when bruised. 2% KOH, 40% KOH or 10% NH_4OH strongly yellow in pileus, somewhat paler in stipe. Guaiac instantly dark green. *Smell* faint, indistinct.

Spores 10–11.5 × 5.5–6.5μm (MV = 10.60 × 6.02μm), Q = 1.76 ± 0.05, amygdaliform with a broad apex, and frequently with a subapical depression, finely to distinctly and densely verrucose. *Basidia* 7.5–9μm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface scattered, of 2–3 hyphal layers, hyphae narrow to rarely wide, 3–6(–13)μm wide, ±collapsed, filled with golden yellow-brown to dark brown, granulate to oleiferous necropigment, wider hyphae sometimes with brown, thick walls. *Pileipellis* simplex. *Epicutis* fairly thick, of c.10–15(–20) hyphal layers. At surface of (2.5–)3–5μm wide hyphae, the outer c.2–5 segments gelatinous or not, loosely erect and sinuose to repent and sometimes collapsed; hyaline with granular contents, often pale yellow refractive with KOH, sometimes with slightly thickened, pale brownish walls, especially with age, hyphae sometimes also finely, pale verrucose to zebra-striped with KOH, especially basally on repent segments; repent hyphae sometimes also with large, hyaline, epiparietal granules. The basal part of epicutis of 5–12(–15) parallel to slightly interwoven layers, tightly connected and cemented except for 1–2 layers above, hyphae 4–10(–12)μm wide, in surface view sometimes forming subparallel, interconnected bundles in a rivulose pattern; hyphae with thick, brownish walls, or weak to distinct, brown zebra-striped encrustations, with (dark) brown, oleiferous hyphae intermixed. Towards trama elements often embedded in a golden yellow to yellow-brown, refractive, diffuse, amber-like matrix. A pale yellow matrix can also be observed in the upper part of the trama.

Habitat: Boreal and montane coniferous forests. Associated with *Picea abies* in oligotrophic, often moist forests with acid raw humus. Frequently on seasonally moist slopes with patches of *Sphagnum*, but never in bog rims with stagnant water.

Distribution: Rare, and mainly in N Europe. Fairly widespread in Scandinavia, preferentially in suboceanic areas (Brandrud & Melot, 1983; Soop, 1989; Brandrud, 1992; Hallingbäck, 1994; Soop, 1992 as *C. spadicellus* p.p.). Distribution in C Europe little known, but probably considerably rarer than in N Europe. Recorded from Austria (Moser, 1961 as *C. spadiceus*) and from a few sites in SW Germany (Brandrud & Melot, 1983; Krieglsteiner, 1991) (see Fig. 12c). Fruiting fairly early, in N Europe from late July (pers. obs.; Soop, 1989).

*Collections examined (*including macrocharacters).* NORWAY. Akershus: Hurdal, TEB 213-78 (holo.)*, 212-78*, 296-79; *M. Moser* 81/340 (depicted in *Atl. Basidiomyc.*, IB)*; Nittedal, Gjelleråsen, TEB 12-84*. Oslo: Sognsvann, TEB 67-79*; Nordmarka, *K. Høiland* 19 viii 1979 (O). Oppland: Lunner, TEB 16-88*, 33-88*, 1-91*, 6-91*; Søndre Land, *G. Gulden* 311/84 (O); Biri, TEB 99-85*. Aust-Agder: Gjerstad, TEB 95-87*, 96-87*, 16-88*, 21-88, TEB 23-94*; Arendal, TEB 3-95*, 4-95*, 5-95* (all 3 coll. leg. *T.H. Dahl & I.L. Fonneland*). SWEDEN. Ångermanland: Häggdånger, CFP 1193*; Säbrå, CFP 582, 753*. Närke, Kilsbergen, *K. Soop* 5 viii 1995 (hb. Soop). GERMANY. Baden-Württemberg, Calw-Oberreichenbach, *A. Gminder* (O, M).

Comments: *C. patibilis* may look like *C. anomalus*, but differs in brownish spots and a bright yellow KOH reaction. The species is distinguished from the rest of subsect. *Variecolores* by its slender habit (see Fig. 17, Table 3), habitat in acid, moist forests and (except var. *scoticus*) the slightly irregular and finely verrucose spores (see Fig. 4d). According to present knowledge, the species seems to be most closely related to the more glabrous, viscid-glutinous and less brown-staining *C. coalescens*, but also shows a close affinity to all the other taxa in the subsection, and its exact, taxonomic position within the subsection is uncertain.

Specimens with and (almost) without bluish tinges on the lamellae and stipe can sometimes be found in the same sites at the same time, and may reflect some genetic differentiation. However, this colour difference is regarded as too fugacious and too subtle to allow taxonomic recognition. Specimens (almost) without bluish tinges resemble *C. russus*, but differ in habitat, spores and a thin, hyaline, more or less gelatinous surface hyphae of pileipellis. The habitat and sometimes lack of bluish colours indicate an affinity to the oligotrophic species of subsect. *Balteati*. These, however, lack the brown staining reaction and usually have more distinctly encrusted hyphae of the pileipellis.

6.2. Cortinarius patibilis var. **scoticus** Brandrud in Edinb. J. Bot. 54: 114 (1997). Type: *T.E. Brandrud* 161-83 (holo. E, iso. O). **Figs 12c, 18, 20.**

Pileus 4–8cm, distinctly and fairly persistently viscid and glabrous, only faintly tomentose at centre, pale ochraceous brown to clay brown with darker centre, then more fulvous brown and umber at centre. *Lamellae*, L = 60–80, crowded, 3–8mm broad, pale violaceous blue. *Stipe* 5–8 × 1–1.8cm, clavate at base (→3cm), greyish white, bluish white at apex, soon pale brownish from base and when bruised. *Context* not fistulose; whitish, when (very) young violaceous blue in pileus and stipe apex, sometimes in entire context, turning slightly brownish when bruised, and sometimes also when cut. 2% KOH distinctly to strongly yellow. Guaiac instantly bluish green.

Spores 11–12 × 5.5–6.5μm (MV = 11.41 × 6.06μm), Q = 1.88 ± 0.05, amygdaliform to slightly citriform, (very) distinctly and densely verrucose. *Basidia* 8–9μm wide, 4-spored. *Lamella edge* fertile. *Pileipellis* simplex. *Epicutis* at surface of fairly wide, 4–5μm, hyaline to finely verrucose hyphae, the outer c.2–5 segments gelatinous; the basal part of epicutis of 5–10μm wide hyphae with distinct to strong, brown zebra-striped encrustations or sometimes with thick, brown walls.

Habitat: Subalpine deciduous forests. Associated with *Betula pubescens* in oligotrophic-mesotrophic forests of *Vaccinium myrtillus* type.

Distribution: Very rare, hitherto known only from two (possibly three) stations in Scotland (Watling, 1984 as *C. patibilis*) (Fig. 12c).

*Collections examined (*including macrocharacters).* GREAT BRITAIN. Scotland, Perthshire: Calvine, Struan Wood, TEB 161-83 (holo.)*; *R. Watling* 14455 (as *C. largus*; E); Glen Lyon, TEB 174-83*. ?Rannoch, *P.D. Orton* 4238 (as *C. largus*; E).

Comments: *C. patibilis* var. *scoticus* differs from var. *patibilis* in its more viscid and glabrous pileus, larger, more ornamented spores, more encrusted epicutis hyphae and the habitat in *Betula* forests. Owing to limited knowledge of the character variation of this taxon, its circumscription, taxonomic rank and position must be regarded as tentative. This taxon seems to be very close also to *C. coalescens* and *C. largus*.

7. Cortinarius kuehneri Mos. in Bull. Soc. linn. Lyon, num. spec.: 285 (1974) (Fig. 20). Type: *M. Moser* 65/42 (holo. IB).

Icon: Mos. & Jülich (1985–1994), *Farbatl. Basidiomyc.*: Pl. Cort. 59, f. 1.

Pileus 2–6cm, convex to umbonate, viscid, glabrous and slightly innately fibrillose, soon non-viscid and tomentose-fibrillose, pale ochraceous, ochraceous red-brown, then hazel brown. *Lamellae* 3–8mm broad, greyish white to bluish. *Stipe* 4–8 × 0.5–1cm, clavate at base (→1.5cm), normally pale violaceous blue, becoming ochraceous or vinaceous brown from base, especially when bruised. *Context* whitish to pale bluish, brownish when bruised, KOH yellow or with a yellow ring. *Smell* strong, earth-like.

Spores 10–11.5(–12) × 5.5–6.5µm (MV = 10.93 × 6.08µm), Q = 1.80 ± 0.07, amygdaliform to slightly citriform, (very) distinctly and densely verrucose. *Basidia* 7.5–9µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface of 3–5(–10)µm wide hyphae, ± filled with golden yellow-brown, granulate to oleiferous necropigment, sometimes with brown, thick walls. *Pileipellis* simplex. *Epicutis* fairly thick, of c.10–15(–20) hyphal layers. At surface of (2.5–)3–5µm wide hyphae, the outer c.2–5 segments gelatinous, loosely erect and sinuose; hyaline, below this repent, often pale verrucose to zebra-striped hyphae. The basal part of epicutis of slightly interwoven layers, tightly connected and cemented, hyphae 4–10µm wide, towards trama elements shortened and embedded in a golden yellow to yellow-brown, refractive, diffuse, amber-like matrix, also with some yellow to brown oleifers.

Habitat: Montane to subalpine deciduous forests. Associated with *Alnus viridis*, in mossy, rich mull soil.

Distribution: Very rare, so far recorded only from a few stations in the Austrian and French Alps (Moser, 1974) as well as one station in the Black Forest (leg. & det. D. Laber).

Collections examined. AUSTRIA. Tyrol, Oetztal, Königsbachgraben bei Untergurgl, *M. Moser* 65/42 (holo. IB). GERMANY. Baden-Württemberg, Black Forest, Yach/Elzach, Rauchengrund, *D. Laber* 16 x 1994 (*A. Bollman* 94/47; O).

Comments: *C. kuehneri* is characterized by its small, slender basidiocarps, its fibrillose-tomentose, darkening pileus and its special association with *Alnus viridis*, which implies a restricted distribution in C Europe. The species is never found in association with *Alnus incana* or *A. glutinosa.* This specialization deviates from most other *Alnus*-associated *Cortinarius* species, such as *C. bibulus* Quél. and *C. helvelloides* (Fr.: Fr.) Fr. I have not seen this species in fresh conditions, and the brief description of macrocharacters is based on the protologue (Moser, 1974) and plate in Moser & Jülich (1985–1995: Cortin. 59), as well as slides and notes by A. Bollman, Stuttgart. The species seems to be closely related to *C. patibilis*, from which it differs in its small basidiocarp size, coarser pileus surface structure, strong earth-like smell, different spore morphology and habitat.

The yellowish encrusted sterile cells on the lamella edge ('cheilocystidia') described in the protologue (Moser, 1974) were not observed in the presently studied material, not even in the type material. Most probably the yellow colour of the lamella edge described in the protologue resulted from necropigment developing with age or where the edge had been damaged.

8. Cortinarius russus Fr., Epicr.: 261 (1838). **Fig. 20.**
Syn.: *Phlegmacium russum* (Fr.) Blytt in Skr. Vidensk.-Selsk. Christiania, math.-Naturvidensk. Kl. 6: 71 (1905). Type: not indicated.

Icones: Brandr. et al. (1995), *Cortin., Fl. Photogr.* 3: Pl. C35, C44; Soop (1990), *Jordstjärnan* 11(1): 86.

Pileus 3–8(–9)cm, (hemi-)spherical, then plano-convex, usually slightly viscid when (very) young, but soon drying out, dull fibrillose to appressed tomentose, centre frequently diffracted to scaly with age, cuticle not separable; ochraceous (grey) brown (M 70, N 67) when young, involute margin whitish; soon spotted with brown, especially when bruised, uniformly leather brown to umber, chestnut to red-brown (P 55, 57, 60, 65) when expanded. Universal veil remnants sparse and hardly distinguishable except some ochraceous white fibrils at margin. *Lamellae*, L = (60–)70–100, crowded, 4–8mm broad, brownish white when young, very soon brown, edge even to slightly crenulate. *Stipe* 5–10(–12) × 0.8–2cm, at base clavate (→3cm), frequently attenuate, fibrillose, whitish, soon spotted with brown, young basidiocarps turn very distinctly vinaceous brown to reddish clay brown when bruised. Universal veil remnants sparse, whitish then brownish fibrillose, cortina sparse, whitish. *Context* white, young basidiocarps turning (vinaceous) brown when cut, very distinctly so when bruised. 2% KOH, 40% KOH or 10% NH_4OH strongly yellow in pileus, somewhat paler in stipe. Guaiac instantly dark green. *Smell* faint, indistinct.

Spores 9–10.5 × 5.5–6µm (MV = 9.91 × 5.78µm), Q = 1.72 ± 0.06, acutely amygdaliform to slightly citriform, sometimes with broad apex and a faint subapical depression, very distinctly and fairly coarsely verrucose. *Basidia* 7.5–9µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus of 2–3 hyphal layers, hyphae narrow to wide, 3–8(–10)µm, frequently collapsed, filled with golden yellow-brown to dark brown, granulate to oleiferous necropigment. *Pileipellis* slightly duplex. *Epicutis* thin, of c.(3–)4–7 hyphal layers. Gelatinous hyphae usually absent, hyphae repent and parallel, but at surface usually with 1–2, erect, irregular terminal segments/pileocystidia, 4–7µm wide, sometimes capitate and with (very) thick, brown walls; repent hyphae tightly connected except for 1–2 surface layers, hyphae 5–10(–12)µm wide, with (very) strong, crustulose to zebra-striped, brown pigmentation, sometimes also with smooth, thick, brown walls, with (dark) brown, oleiferous hyphae intermixed. When mature, surface hyphae usually collapsed and epicutis diffracted-scaly, oleifers then abundant and dark. *Hypoderm* of comparable thickness to epicutis, ± subcellular, elements up to 20(–25)µm wide, tightly cemented, with thick, brown walls, frequently crustulose, and with thicker lenses or clumps in corners between the elements, dark oleifers also intermixed.

Habitat: Boreal and boreo-nemoral coniferous forests. Associated with *Picea abies* in eutrophic to sometimes calciphilous, mossy forests in continental areas.

Distribution: So far known with certainty from E and NE Scandinavia (Soop, 1989; Brandrud et al., 1990–95), and from one locality in SW Germany (J. Melot, pers. obs.).

*Collections examined (*including macrocharacters).* SWEDEN. Medelpad, Borgsjö, TEB

81-83*. Jämtland, Östersund, Andersön, CFP 616*, 696, *H. Lindström* & TEB 86-87. Ångermanland: Häggdånger, Torrom, CFP 810*, 947*; Säbrå, Överdal, CFP 923*, 941*.

Comments: *C. russus* may easily be mistaken for a *Telamonia* because of its frequently dry, fibrillose, dull brown pileus, context which becomes brownish and initially pale brown lamellae. The last feature is an extraordinary character in *Phlegmacium*. The (vinaceous) brown staining, the strongly yellow KOH reaction and several microcharacters, however, show that the species belongs to sect. *Phlegmacioides*. The pileipellis is characterized by its wide, non-gelatinous surface hyphae with distinctly brown walls, and presence of a more or less distinct hypoderm. The pileipellis structure and the complete lack of bluish pigments distinguish this species from the other members of subsect. *Variecolores*. The species is closely related to *C. patibilis*, but the latter is usually bluish tinged, has less ornamented spores, and a different pileipellis structure, composed of narrow, hyaline surface hyphae, and only slightly encrusted hyphae of deeper layers.

Cortinarius russus has been variously interpreted in the literature. Most frequently the name is applied to a species with yellow lamellae, yellow context, copper-red pileus and a clavate stipe (Moser, 1961), or even an abruptly bulbous stipe (see Trescol, 1992). *Cortinarius russeus* (Henry, 1963) and *C. russeoides* (Moser, 1961) are supposed to be closely related. However, yellowish lamellae or context are not indicated in the protologue (Fries, 1838). On the contrary, the lamellae are described as red-brown to rust ('rufo-ferrugineis'; Fries, 1838), and the context as reddish white ('rubello-alba'; Fries, 1838) to pale flesh-coloured ('carneo-albida'; Fries, 1851), features which correspond with the interpretation accepted here. Furthermore, Fries placed the species close to *C. spadiceus*. The present interpretation is also supported by the unpublished Friesian plates at Stockholm and Uppsala (no. S 0381, U 0712; see Strid, 1994), featuring a rather *Telamonia*-like ('inolomatoid'), dark red-brown species. This interpretation of *C. russus* was introduced by Melot (1986a), and has subsequently been adopted by Scandinavian authors (Soop, 1987, 1989; Brandrud et al. 1990–95). Melot (1986a) and Soop (1989) mention a slightly disagreeable taste, a feature which is also mentioned by Fries (1838); this taste was not recorded in the fresh material examined for the present study.

The species seems to be widespread in E and N Sweden, and probably has a northeastern distribution in Europe.

Cortinarius subsect. **Balteati** Brandrud & Melot in Nord. J. Bot. 10: 535 (1990). Type: *C. balteatus* (Fr.) Fr.
Misapplied name: *Cortinarius* subsect. *Crassi* Moënne-Locc. & Reumaux, Atl. Cortin. 1: 16 (1990). Type: *C. crassus* Fr.

Pileus viscid to dry, rarely glutinous, ±innately tomentose to fibrillose, rarely glabrous, margin sometimes persistently involute, whitish, (pale) ochraceous brown to fulvous or leather brown, rarely greyish brown or umber brown, sometimes with violaceous or lilac tinges towards margin, veil normally not distinguishable; lamellae greyish white; stipe clavate-bulbous, whitish, veil sparse to abundant, whitish or with a violet tinge when young; context whitish. KOH reaction (pale) yellowish to negative. Spores normally amygdaliform to slightly citriform; surface hyphae of pileipellis often weakly or not gelatinous, fairly wide, with thick, brown walls, subsurface hyphae often strongly zebra-striped encrusted.

9. Cortinarius balteatus (Fr.) Fr., Epicr.: 257 (1838). **Figs 2, 3, 4e, 5, 7, 21, 22.** Syn.: *Agaricus balteatus* Fr., Syst. mycol. 1: 225 (1821). *Phlegmacium balteatum* (Fr.) Blytt in Skr. Vidensk.-Selsk. Christiania, math.-Naturvidensk. Kl. 6: 68 (1905). Type: not indicated.

Cortinarius subbalteatus Kühn., Bull. Soc. linn. Lyon 24: 40 (1955). Type: not indicated.

Cortinarius eubalteatus R. Henry in Bull. Soc. mycol. Fr. 74: 297 (1958), nom. inval. Type: not indicated.

?*Cortinarius crassoides* Moënne-Locc. & Reumaux in Bidaud et al., Atl. Cortin. 7: 228 (1995). Type: *P. Moënne-Loccoz* 363 (holo. G).

Selected icones: Brandr. et al. (1995), *Cortin.*, *Fl. Photogr.* 3: Pl. C60; Bidaud et al., op. cit.: Pl. 156 (as *C. subbalteatus*); Mos. (1961), *Gatt. Phlegm.*: Pl. VIII 40, 41 (as *Phlegm. subbalteatus*); Rym. & Holm. (1984), *Svampar*: 501; Cetto (1981), *Gr. Pilzf.* 2: 465; Pilát & Usák (1961), *Mushr. and other fungi*: Pl. 100.

Pileus 5–12(–18)cm, (hemi-)spherical, then plano-convex with strongly and fairly persistently involute margin, when young viscid at margin, dry at centre, soon completely dry, dull and appressed tomentose, involute margin tomentose, often finely diffracted towards centre and sometimes with hygrophanous patches, cuticle hardly separable; (very) pale ochraceous brown to leather brown (M 69–70, L 50, N-P 65, P 60), centre slightly darker (P 65–67), when young bright to very pale lilac-blue towards margin, primordia sometimes completely lilac, involute margin initially lilac to almost greyish white; with age often hygrophanous umber brown (P 55) at centre. Universal veil remnants sparse, when very young with some ochraceous white fibres at margin, otherwise not distinguishable. *Lamellae*, L = 110–140, (very) crowded, (3–)4–8(–10)mm broad, greyish white, edge even to slightly crenulate. *Stipe* 5–9 × 1–3cm, cylindrical with a ±bulbous base (→3.5cm), sometimes almost abruptly bulbous, fibrillose, whitish, then pale ochraceous brown from base. Universal veil remnants sparse, whitish then pale ochraceous brown fibrillose, rarely forming indistinct girdles. Cortina fairly abundant, whitish. *Context* thick and compact in pileus; whitish, with a greyish tinge in stipe apex. KOH (2% or 40%) normally with a yellow ring in pileus or on the lamellae of young basidiocarps, otherwise negative, 10% NH_4OH distinctly yellow. Guaiac bluish green after c.1 minute. *Smell* faint, somewhat yeast-like.

Spores 9.5–11.5 × 5–6.5µm (MV = 10.47 × 5.81µm), Q = 1.80 ± 0.08, acutely amygdaliform to slightly citriform, basidiocarps from pine forests sometimes with more narrowly amygdaliform spores (10.5–11.5 × 5.5–6µm); distinctly and fairly densely verrucose. *Basidia* 7–9µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface sparse, of 1–2(–3) hyphal layers, hyphae narrow, 3–8µm wide, frequently collapsed, filled with refractive pale yellow to brown, granular to oleiferous necropigment, sometimes also with thick, brown walls. Universal veil on stipe surface of c.10–15 layers near apex (primordial), hyphae (2–)3–7(–12)µm wide, hyaline, collapsed hyphae with some yellow, oleiferous necropigment. *Pileipellis* simplex. *Epicutis* thick, of c.10–20 layers, with a complex and variable, normally loosely entangled structure, due to a mixture of irregularly erect-sinuose and repent, parallel hyphae. Erect-sinuose hyphae (3–)4–6(–8)µm wide, usually representing the outer 2–5 segments of otherwise repent hyphae, arising from different levels, but often most frequent in central part of epicutis, sometimes at surface, often arising from small, cemented clusters; slightly gelatinous, at least when young, hyaline or (with KOH) pale yellow refractive, but occasionally with distinctly brownish, thick walls, especially with age, hyphae sometimes also finely, pale verrucose to zebra-striped; near pileus margin with cytoplasmatic, diffuse bluish pigment when young; near margin the gelatinous hyphae are generally more developed (c.4–7 segments) and usually form a more distinct surface tissue. Parallel, repent hyphae 4–10(–15)µm wide, elements sometimes extremely inflated, up to 40µm wide; occurring scattered, but at or near the surface frequently forming small bundles of tightly connected, sometimes cemented hyphae, equivalent to the basal part of epicutis in related species; hyphae pale yellow zebra-striped to dark brown, very strongly and coarsely crustulose to zebra striped. Basally the hyphae may be shortened and cemented in a pale yellow, refractive, amber-like matrix. Yellowish to dark brownish oleifers may also be intermixed, especially in the basal layers.

Habitat: Boreal, montane, subalpine and (rarely) boreo-nemoral coniferous forests. Associated with *Picea*, *Pinus* and *Larix*, with *Picea* mainly in mesotrophic-eutrophic forests, with *Pinus* mainly in sandy, mossy, oligotrophic forests. Often in young *Picea* plantations (>30 years old).

Distribution: One of the most frequent *Phlegmacium* species in Fennoscandia (pers. obs.; Ulvinen et al., 1981; Ryman & Holmåsen, 1984), recorded also in W and N Russia (Nezdojminogo, 1983 as *C. subbalteatus*). Widespread but fairly rare in C Europe (Pilát & Usák, 1961; Krieglsteiner, 1991), probably most frequent in the subalpine areas (see Moser, 1961 as *Phlegm. subbalteatum*). Not reported from the lowlands of W Europe, except older reports from Great Britain (Orton, 1955), but some records of *C. durus* from *Pinus sylvestris* forests in the Scottish Highlands might include this (Orton 1960, 1986). Reaching ± to timberline in the Alps (1950m a.s.l.; Favre, 1960) and in C Scandinavia (1000m a.s.l.; pers. obs.). Fruiting from as early as June in C Europe (Moser, 1961: 30; Pilát & Usák, 1961), in N Europe from July (pers. obs.). Recorded also from montane parts of W North America (Kauffman, 1932).

*Collections examined (*including macrocharacters)*. NORWAY. Oppland: Lunner, TEB 243-77*, 244-77*, 346-77*, 252-80*, 43-81*, 37-83*, 27-85; Gran, Øståsen, TEB 24-79*; Østre Toten, TEB 28-83; V. Gausdal, Ormtjernskampen, TEB 104-84; Ringebu, TEB 5-94*.

Akershus, Asker, TEB 449-80. Buskerud: Ringerike, TEB 8-84; Kongsberg, TEB 61-85; ?Hol, Skurdalen, TEB 25-84. Hedmark: Våler, Braskereid, TEB 94-92; Ringsaker, Brumunddal, TEB 172-80; Ringsaker, Nes, TEB 72-92; Storelvdal, Atna, TEB 54-83; Folldal, TEB 85-80*, 134-80. Aust-Agder: Gjerstad, TEB 25-94; Valle, TEB 317-85, 47-88. Hordaland, Os, Lysekloster, TEB 331-80. Møre og Romsdal, Bjørkedalen, *I.J. Furevik*, TEB 188-92. Sør-Trøndelag: Melhus, *Ø. Weholt* C5/83 (O)*; Orkanger, Ingdalen, TEB 124-80. Nordland: Rana, TEB & EB 306-83*; Evenes, TEB 235-81. SWEDEN. Småland, Femsjö, *L. Romell* 28 viii 1890, 9 ix 1890 (det. *R. Fries* as *C. crassus*, S). Småland, Femsjö, TEB 300-87 (O). Västergötland, Skepplanda, *S. Jacobsson* 8 viii 1979 (S). Uppland, Uppsala, Kungsparken, *H. von Post* 29 ix 1903 (as *C. rapaceus*, S). Jämtland: Offerdal, TEB 28-82*; Välliste, TEB 35-82*. Medelpad, Attmar, Sörfors, *S. Muskos* 4029 (O). Ångermanland, Säbrå, CFP 924*, 303*, 940*. Västerbotten, Jörn, CFP 939*. Norrbotten, Gällivare, TEB 178-81, 179-81. FINLAND. Koillismaa, Kuusamo, Oulanka, *Imby & Å. Strid* 15386 & 15402 (as *C. subbalteatus*, S). FRANCE. Savoie, St. Bon, Tarentaise, *R. Kühner* 20 viii 1927 (syntype of *C. subbalteatus*, G). ?Haute-Savoie, Aravis, *P. Moënne-Loccoz* 363 (holotype for *C. crassoides*, G).

Comments: *C. balteatus* is characterized by its appressed tomentose, fleshy pileus with completely dry centre, viscid marginal zone and strongly involute margin when young. Normally the species has a beautiful, pale lilac bluish tomentose margin when young. Variants with very pale and fugacious bluish tinges occur, most frequently in dry, open, pine forests. Because of a high variability the species is sometimes difficult to distinguish from closely related taxa: *C. durus* and *C. vacciniophilus* differ in more slender basidiocarps, an initially more viscid, glabrous to finely fibrillose pileus and larger spores. The former is initially much paler, without bluish tinges and is normally associated with *Betula*. *Cortinarius balteatoalbus* is very similar in habit, but is paler, without bluish tinges and has deviating microcharacters. *Cortinarius balteatotomentosus*, treated by some authors as a form of *C. balteatus* (Bidaud et al., 1995), differs in violaceous blue tinges on the lamellae and in the context, an initially more viscid pileus and larger spores.

Cortinarius balteatus is often confused with the deciduous forest species *C. balteatocumatilis*, but is easily distinguished by its tomentose, dry pileus (centre) and the lack of a well-developed, violaceous universal veil. *Cortinarius crassus* of subgen. *Cortinarius* is also similar, but has a completely non-viscid, fibrillose, more uniformly warm ochraceous pileus, negative KOH reaction, prominent cystidia and small, almost smooth spores (see nomenclatural discussion of *C. crassus* below).

Microscopically, *C. balteatus* is well characterized by its complex epicutis structure, with a mixture of repent and erect-sinuose (gelatinous) hyphae more or less throughout the pileipellis, sometimes with a distinct subsurface gelatinous layer in young basidiocarps (Fig. 7). This mixture is also responsible for the characteristic appressed tomentose surface structure. This kind of pileipellis is not seen in any other *Phlegmacium* species. The pigmentation of the pileipellis is extremely variable in *C. balteatus*; specimens with pale yellow hyphae and with strongly brownish encrusted hyphae can even be found within the same collection.

Moser (1961), Kühner & Romagnesi (1953) and Henry (1958) distinguished between *C. subbalteatus* Kühn. (pale pileus colours) and *C. balteatus* (= *C. eubalte-*

atus R. Henry nom. inval.). It is possible that pale and dark variants are genetically different, since specimens from certain habitats are frequently paler than normal. However, all transitions occur, and the variation is therefore not considered taxonomically relevant.

Cortinarius balteatus in Fries (1821, 1838) probably includes both the species discussed here and the deciduous forest species *C. balteatocumatilis* (= *C. balteatus* sensu J.E. Lange, 1938; Lundell & Nannfeldt, 1979). However, there are strong indications that *C. balteatocumatilis* was included also in *C. cumatilis* Fries (1838), and therefore the name *C. balteatus* is emended to cover the coniferous forest species, and not the deciduous forest species (Brandrud et al., 1995). This is also in accordance with current usage.

The name *C. crassus* Fries (1838) has also been used for the species treated here, for example by the Swedish mycologists R. Fries and L. Romell (see collection list), indicating a tradition from the times of E. Fries (see also Melot, 1986a). However, because the protologue of *C. crassus* lacks essential characters, for example a lilac-blue pileus margin, the name *C. crassus* should rather be applied in the sense of Moser (1983) (= *C. pseudocrassus* Josserand ex Orton). Although superficially resembling *C. balteatus*, *C. crassus* sensu Moser most probably belongs to subgen. *Cortinarius* (see Brandrud et al., 1991). For further nomenclatural discussion of *C. crassus*, see under *C. balteatoalbus*.

10. Cortinarius durus P.D. Orton in Trans. Brit. mycol. Soc. 43: 209 (1960). Type: *P.D. Orton* 1736 (holo. K, iso. E).

10.1. Cortinarius durus var. **durus. Figs 12d, 22, 23.**

Syn.: *Cortinarius errabundus* Melot in Acta Bot. Islandica 11: 109 (1992). Type: *J. Melot* 90-2 (holo. hb. Melot).

?*Cortinarius hoplites* Melot in Acta Bot. Islandica 12: 91 (1995). Type: *J. Melot* 91-3 (holo. hb. Melot, n.v.).

Misapplied name: *Cortinarius balteatus* (Fr.) Fr. sensu Brandrud p.p., in Hansen & Knudsen (1992), Nord. Macromyc. 2: 292.

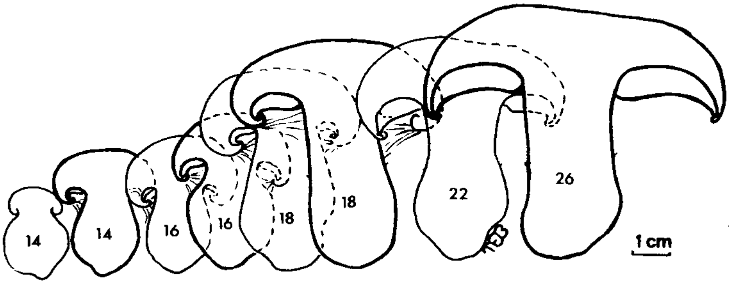

FIG. 21. *C. balteatus*. TEB 37-83. Collected from a single site during the period 14–26 viii 1983, showing a 12-days development from (large) primordia to expanded basidiocarps.

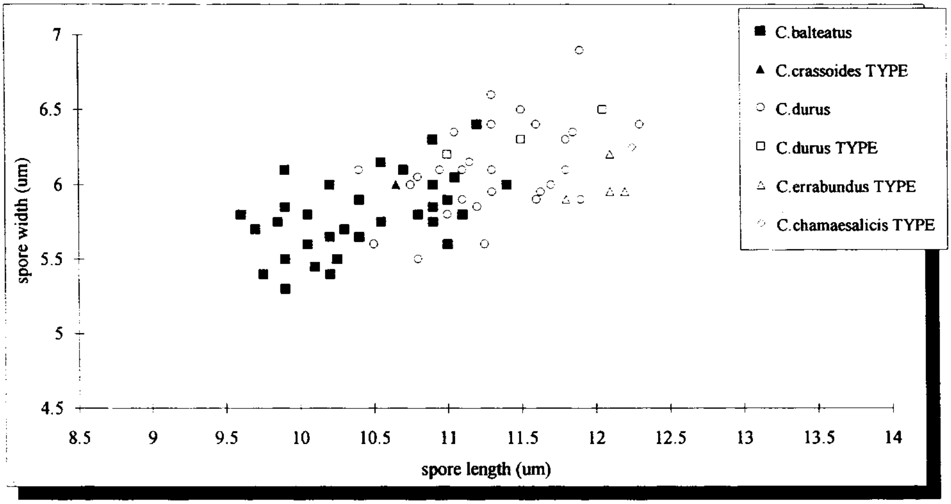

FIG. 22. Variation in spore size of *C. balteatus* (= *C. crassoides*?) and *C. durus* var. *durus* (= *C. errabundus*) including the type of var. *chamaesalicis* (= *C. chamaesalicis*). Each symbol = MV of 10 spores measured per basidiocarp.

Pileus 5–12(–16)cm, (hemi-)spherical, then plano-convex, when young distinctly viscid, but often drying out soon, dull, glabrous to finely fibrillose, sometimes coarsely rivulose on glabrous parts, later becoming appressed tomentose to fine scaly from centre, thick and pigmented cuticle ±separable; colour highly variable dependent on age and exposure, initially whitish to whitish brown, at least towards margin, then pale ochraceous brown (K 71, M 69, N 65), becoming umber brown from centre (P 60, 65, R 49, P 67). Universal veil remnants sparse to sometimes fairly abundant, as silvery white patches near margin, sometimes also small, appressed scales near centre. *Lamellae*, L = 60–100, crowded, 4–7(–10)mm broad, greyish white, edge even to slightly crenulate, with age sometimes serrulate. *Stipe* 6–15 × 1–2.5(–3)cm, cylindrical or clavate at base (→3.5cm), whitish, greyish white and glossy at apex, becoming ochraceous brown from base. Universal veil remnants fairly sparse, sometimes more prominent, usually forming thin, whitish girdles contrasting with the ±ochraceous ground colour, but sometimes turning brownish; cortina sparse, whitish. *Context* firm, sometimes fistulose in stipe, whitish, with pale ochraceous grey hygrophanous streaks in stipe apex. 2% KOH, 40% KOH pale yellowish with a more distinct yellow ring, sometimes negative. Guaiac bluish green. *Smell* faint, pleasant, reminiscent of corn or somewhat yeast-like when cut, with age developing an earth-like smell (like that of *C. variecolor*) on surfaces.

Spores 10.5–12.5 × 5.5–6.5μm (MV = 11.42 × 6.11μm), Q = 1.87 ± 0.10, (narrowly) amygdaliform to citriform, (very) distinctly and fairly densely verrucose. *Basidia* 8–9.5μm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface sparse and scattered, of 1–2(–3) hyphal layers, hyphae narrow, 3–8μm wide, frequently collapsed, filled with pale yellow, refractive to brown, granulate to oleiferous necropigment, sometimes also with thick, brown walls. *Pileipellis* simplex. *Epicutis* moderately thick, of c.7–15 layers. At surface or near surface with abundant to scattered erect-sinuose hyphae 3–6(–8)µm wide, usually representing the outer 2–5 segments of repent hyphae, distinctly gelatinous, at least when young, hyaline or (with KOH) pale yellow refractive, sometimes with distinctly brownish, thick walls, especially with age. Parallel, repent hyphae 4–8(–10)µm wide, usually forming 2–5 layers of hyaline to (pale) yellow-brown zebra-striped hyphae at or near surface, and 3–5 tightly connected to cemented layers basally, basal hyphae pale yellow to distinctly yellow-brown zebra-striped. Hyphae shortened towards trama, sometimes subcellular and cemented in a pale yellow, refractive, amber-like matrix. Yellowish to dark brownish oleifers occur intermixed, especially in the basal layers, often frequent with age.

Habitat: Subalpine, subarctic and (more rarely) boreal deciduous (and coniferous?) forests as well as low alpine and arctic heaths. Associated with *Betula pubescens*, *B. glandulosa* and *B. nana*, and probably also *Pinus sylvestris* (Scotland), mainly in mesotrophic-eutrophic low herb vegetation.

Distribution: Widely distributed and not rare in subalpine-subarctic birch forests of Scandinavia (pers. obs.) and Iceland (Melot, 1992 as *C. errabundus*), and in pine–birch forests of the Scottish Highlands (see Orton, 1960, 1986) (Fig. 12d). There are a few records from the alpine zone in C Scandinavia, and it has been collected in arctic heaths in Greenland. This type variety is not known from the Alps.

*Collections examined (*including macrocharacters).* GREAT BRITAIN. Scotland: Inverness-shire: Rothiemurchus, *P.D. Orton* 1736 (holo. K, iso. E); Abernethy, *P.D. Orton* 6063 (E); ?Guisachan, Plodda, *P.D. Orton* 973 (as *C. crassus* sensu Bres.; E). ?England, Hampshire, New Forest, *A. Bolton, P.D. Orton* 5478 (E). NORWAY. Hedmark, Folldal, TEB 83-80*, 84-80*. Buskerud, Hol, Flatåker, TEB 24-84. Sør-Trøndelag: Dovre, Kongsvoll, TEB 138-80; Dovre, Knutshø, TEB 139-80; Dovre, Råtåsjøhø, TEB 100-80, 101-80; Oppdal, TEB 106-80. Nordland: Rana, TEB & EB 266-83*; Narvik, TEB 205-81. Troms, Skibotn, *E. Bendiksen*, 1991 (O). SWEDEN. Jämtland: Ragunda, Böle, TEB 11-93*, CFP 912*, 930*; Välliste, TEB 35-82; Åre, Ullådalen, CFP 208*. Ångermanland, Graninge, Viksmon, CFP 461a. Norrbotten, Gällivare, TEB 121-81*, 122-81*. Torne Lappmark: Jukkasjärvi, *L. Romell* 10 viii 1916, 22 viii 1916, 24 viii 1916 (all as *C. crassus*, S); *L. Romell* 12 viii 1916, 14 viii 1916 (as '*C. inolens*', S); Abisko, *P. Marstad*, TEB 9-95*; Vassijaure, *K. Soop* 4 viii 1995 (hb. K. Soop). FINLAND. Oulun Pohjanmaa, Ylikimiinki, Vepsä, *M. Kaukonen* 12 ix 1991 (OULU). ICELAND. Reykjavik, Brekkuskógur, *J. Melot* 90-2 (holotype for *C. errabundus*, hb. J. Melot). GREENLAND. Grønnedal, *T. Borgen* 91.203 & 91.204 (C). Paamiut, Equaluit, *T. Borgen* 82.98 (C).

Comments: *C. durus* is characterized by its normally large and firm basidiocarps with initially pale, then darkening pileus and habitat preferentially in subarctic-subalpine habitats. The size and shape of the basidiocarps vary depending on the habitat; the species is often very large and slender when growing in subalpine birch forests, whereas it has a moderate size with shorter stipes when growing in exposed, arctic-alpine *Betula nana* and *B. glandulosa* heaths. It resembles *C. balteatus* and *C. baltea-*

toalbus, but has a more slender habit and a more viscid pileus. Furthermore, it differs from the former in its initially pale, glabrous-fibrillose pileus without any lilac-blue tinges at the margin and slightly larger spores, from the latter by much larger spores and more narrow and less pigmented pileipellis hyphae. The taxon differs also from *C. balteatus* by its thinner and normally less encrusted pileipellis, with gelatinous hyphae concentrated to the surface layers. The pileipellis structure of *C. durus* is more or less intermediate between *C. balteatus* and the other species in the subsection.

Cortinarius durus is one of the most frequent *Phlegmacium* species in subalpine-subarctic *Betula pubescens* forests, and is one of very few Phlegmacia in arctic-alpine *Betula glandulosa–B. nana* heaths. The species probably follows *Betula* spp. in its circumpolar distribution (see Fig. 12d). In Scandinavia the species has formerly been included in a wide concept of *C. balteatus* (= *C. crassus* sensu L. Romell) (see Brandrud, 1992). *Cortinarius durus* is represented in the Alps by the *Salix*-associated var. *chamaesalicis* (see below).

According to the protologue, *C. durus* is a species of *Pinus sylvestris* forests (Orton, 1960), and this seems to be the prevailing opinion amongst Scottish mycologists as well (Orton, 1986; R. Watling, pers. comm.). Assuming that the interpretation applied here is correct, this can indicate that *C. durus* has a wider ecology in Scotland than in Fennoscandia, but it can also indicate that the name *C. durus* has been used in a wider sense in Scotland, including variants of *C. balteatus* in pine forests with no or very few bluish tinges. The frequent *C. balteatus* very probably occurs in the Scottish pine forests, but is not indicated for this or any other Scottish habitats by Orton (1986). On the other hand, *Betula pubescens* often occurs intermixed in damper sites of the *Pinus sylvestris* forests in the Scottish Highlands.

The type material of *C. durus* is not in an optimal condition, but fits the here discussed species and not *C. balteatus*, for example in spore and pileipellis characters. It was collected in pine forest at Rothiemurchus Nature Reserve in Inverness-shire, and only pine litter can be seen on the exsiccatum. However, patches of *Betula pubescens* are present in the forest (R. Watling, pers. comm.), and species confined to deciduous forest trees have been collected there (e.g. the type of *C. balteatocumatilis*). In other words, an association with *Betula* for *C. durus* at Rothiemurchus is not probable, but cannot be ruled out. Another collection of *C. durus* from Inverness-shire (Abernethy, *Orton* 6063; E) includes optimal material typically representing the species discussed here. This material was taken from a birch forest. A third, P.D. Orton collection labelled *C. durus* from S England was also taken from a deciduous forest (birch and oak?), but the identity of this material is less certain.

The type material of *C. errabundus* Melot (1992) conforms with the species treated here. According to J. Melot (pers. comm.), the protologue of *C. errabundus* includes two variants: the present one (yellow-brown to leather brown pileus, large and robust basidiocarps), and one with bluish tinges at the pileus margin, lamellae, stipe and context. *Cortinarius hoplites* Melot (1995) is probably also conspecific, although described with hygrophanous streaks or drops on the pileus and more abundant veil on the stipe.

10.2. Cortinarius durus var. **chamaesalicis** (Bon) Brandrud in Edinb. J. Bot. 54: 114 (1997). **Figs 12d, 22.**
Syn.: *Cortinarius chamaesalicis* Bon in Bull. Féder. Mycol. Dauphiné-Savoie 97: 26 (1985). Type: *M. Bon* 84111 (holo. hb. Bon).

Icon: Bon l.c.: 16.

Pileus 4–6cm, convex, slightly viscid, glabrous to slightly fibrillose towards margin, centre ±diffracted; pale ochraceous brown, centre slightly darker fulvous ochre, margin whitish. *Lamellae* moderately dense, fairly wide, greyish white, fairly persistently pale, edge slightly serrulate. *Stipe* 3–4 x 1–1.5cm, clavate at base (→2cm) and slightly attenuate below, persistently whitish. Universal veil fairly abundant, forming one (or two) whitish to brownish girdles. *Context* whitish, KOH negative. *Smell* faint, indistinct.

Spores 11.5–13 x 6–6.5µm (MV = 12.25 x 6.25µm), Q = 1.96, amygdaliform, some with a slight subapical depression, finely and densely verrucose. *Basidia* 9–11µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface sparse, 0–2 layers, hyphae narrow, 3–6µm wide, frequently collapsed, filled with yellow-brown, oleiferous necropigment. *Pileipellis* simplex. *Epicutis* moderately thick, of c.10 layers, of (sub)parallel, repent hyphae, a few apparently gelatinous hyphae at surface ±collapsed; hyphae (3–)4–7(–10)µm wide, with distinct but pale yellow-brown, zebra-striped encrustations, some brown oleifers also intermixed, in places with abundant, extracellular, hyaline-refractive granules, towards trama hyphae shortened and slightly inflated, up to 15–20µm wide, sometimes subcellular and cemented in a pale yellow, refractive, amber-like matrix.

Habitat and distribution: Alpine heaths. Associated with dwarf *Salix* (*S. reticulata*, *S. retusa*, *S. herbacea*) in eutrophic-calciphilous vegetation with *Carex capillaris*. So far known only from the French Alps (2400m a.s.l.).

Collection examined. FRANCE, Isère, Col de l'Iseran, *M. Bon* 84111 (holo. hb. Bon).

Comments: The above description of macrocharacters is based on the protologue (Bon, 1985), and the description of microcharacters based on examination of the type. According to this, *C. chamaesalicis* is mainly characterized by its alpine habitat with *Salix* spp. and its fairly small, persistently pale basidiocarps, superficially similar to *C. argutus*, but with microcharacters of sect. *Phlegmacioides*.

Too little material of var. *chamaesalicis* has been seen to get an impression of the morphological differentiation between this and var. *durus*. The type of var. *chamaesalicis* deviates slightly from typical *C. durus* in a number of features, but apart from habitat it still seems to be within the character variation of the latter. Therefore, these taxa are here, somewhat tentatively, treated as varieties. However, more material of var. *chamaesalicis* and of alpine specimens of var. *durus* is needed to see whether or not the character deviations are constant.

Based on the original description and the type material, var. *chamaesalicis* seems to deviate from typical var. *durus* mainly by its not darkening pileus surface, stipe with fairly distinct veil girdle(s) and pale pigmentation of pileipellis hyphae. The type of var. *chamaesalicis* is slightly smaller than alpine specimens of var. *durus*, but this may be a result of the more extreme, exposed habitat of the former, since the latter grows in sheltered *Betula nana* heaths and since *C. durus* is extraordinarily variable in basidiocarp size.

From the habitat indications in the protologue (Bon, 1985), it seems very likely that var. *chamaesalicis* forms mycorrhiza with *Salix* spp. This is extraordinary in the subgenus, because an association with *Salix* spp. is so far not known for any species of *Phlegmacium* in *Salix*-rich areas such as N Europe (pers. obs.) or Great Britain (Watling, 1992; Orton, 1986).

11. Cortinarius balteatotomentosus R. Henry in Bull. Soc. mycol. Fr. 101: 4 (1985). **Fig. 26.**

Syn.: *Cortinarius balteatotomentosus* R. Henry in Bull. Soc. mycol. Fr. 74: 298 (1958), nom. inval. *C. subbalteatus* Kühn. f. *balteatotomentosus* (R. Henry) Bidaud, Moënne-Locc. & Reumaux, Atl. Cort. 7: 231 (1995). Type: *R. Henry* '306' (number incorrect?), (holo. hb. Henry, n.v.).

?*Cortinarius tomentosus* R. Henry in Bull. Soc. mycol. Fr. 101: 12 (1985). *C. tomentosus* R. Henry in Bull. Soc. mycol. Fr. 74: 294 (1958), nom. inval. Type: *R. Henry* 306 (holo. hb. Henry).

Icones: Moënne-Locc. & Reumaux (1990), *Atl. Cortin.* 1: Pl. 24; Bidaud, Moënne-Locc. & Reum. (1995), *Atl. Cortin.* 7: Pl. 157, 167 (?as *C. tomentosus*).

Pileus 4–8(–10)cm, (hemi-)spherical, then plano-convex with rather persistently involute margin, when young distinctly viscid to (rarely) glutinous, but soon dry and then fibrillose to appressed tomentose, centre often diffracted-scaly with age; ochraceous brown, fulvous to leather brown (N 65, P 65), towards margin ochraceous white when young, sometimes with a pale violaceous blue tinge at margin, with age concolorous leather brown. Universal veil remnants fairly sparse, but often visible as scattered, dark brown fibres or diffuse, appressed scales at centre. *Lamellae* pale violaceous lilac, especially towards pileus margin, edge even to ±crenulate. *Stipe* 4–8 × 1–2(–2.5)cm, clavate-bulbous, base →3cm, whitish, apex greyish white to fugacious violaceous blue, becoming ochraceous brown from base. Universal veil remnants sparse, whitish, then ochraceous brown fibrillose. *Context* whitish, pale and fugacious violaceous blue in stipe apex and pileus, sometimes persistently bluish in pileus, becoming ochraceous brown from base. Ammonia and KOH negative (brownish) in pileus and bulb, when young yellowish or with a yellow ring in stipe. Guaiac bluish green. *Smell* faint, pleasant and fruit-like or somewhat earth-like.

Spores 10.5–12 × 5.5–6.5µm (MV = 11.33 × 6.08µm), Q = 1.86 ± 0.08, amygdaliform to citriform, distinctly and densely verrucose. *Basidia* 8–10µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface in patches of 2–5 layers, hyphae 4–6µm wide, with intracellular yellow-brown granular to oleiferous necropigment and often brownish, thick walls. *Pileipellis* simplex. *Epicutis* fairly thick, of c.10–15 layers, at surface of 5–7µm wide, ±gelatinous erect-sinuose hyphae with brownish, thick walls; below these, loose to sometimes tightly connected bundles of 4–10(–12)µm wide, parallel hyphae with strong (yellow) brown, parietal to encrusting, zebra-striped pigment; hyphae often shortened towards trama, with up to 15(–20)µm wide and almost subcellular elements, often cemented in a pale yellow, refractive, amber-like matrix; yellowish to dark brownish oleifers sometimes occur intermixed, especially in the basal layers.

Habitat: Nemoral, boreal to montane coniferous plantations. Associated with *Picea* spp. and possibly also deciduous trees, mainly in culturally influenced, richer soils, including former grasslands.

Distribution: Very rare, hitherto reported from a few stations in Norway, Sweden (pers. obs.) and France (Henry, 1958; Moënne-Loccoz & Reumaux, 1990; Bidaud et al., 1995).

Collections examined. FRANCE. Haute-Savoie: Aviernoz, *P. Moënne-Loccoz* 008, 2197; ?Semine, *P. Moënne-Loccoz* 3675 (as *C. tomentosus*). ?Doubs, *R. Henry* 306 (holotype for *C. tomentosus*, hb. Henry). ?Ardennes, Semuy, *P. Reumaux, P. Moënne-Loccoz* 2933 (as *C. tomentosus*). (All coll. in hb. Moënne-Loccoz). NORWAY. Oslo: Sørkedalen, TEB 14-84*. SWEDEN. ?Ångermanland, Säbrå, Hårsta, CFP 1175*, 1290*.

Comments: *C. balteatotomentosus* is characterized by its initially viscid, then dry and fibrillose-tomentose pileus, its fugaciously bluish lamellae and sometimes persistently bluish pileus context. This is the only species of subsect. *Balteati* with bluish colours of lamellae and context. The character variation of the species is not fully known, but the habit, pileipellis structure and large spores indicate a close affinity to *C. durus* and *C. vacciniophilus*.

The type of *C. balteatotomentosus* has not been available for examination, but the original description (Henry, 1958) and later descriptions and plates accepted by Henry (Moënne-Loccoz & Reumaux, 1990; Bidaud et al., 1995) correspond with the present concept. From a study of the type, *C. tomentosus* seems to be conspecific, but the species is described paler and more slender, with habitat in deciduous forests (Henry, 1958; Bidaud et al., 1995). In the plate of *C. tomentosus* in Bidaud et al. (1995: pl. 167) no young material is depicted, and it is difficult to get an impression of the macrocharacter differentiation between this and *C. balteatotomentosus*. Microscopically, these seem to be quite alike.

12. Cortinarius balteatoalbus R. Henry in Bull. Soc. mycol. Fr. 101: 4 (1985).
Syn.: *Cortinarius balteatoalbus* R. Henry in Bull. Soc. mycol. Fr. 74: 361 (1958), nom. inval. Type: *R. Henry* 81.37 (holo. hb. Henry).

12.1. Cortinarius balteatoalbus var. **balteatoalbus. Figs 12d, 23, 24.**
Syn.: *Cortinarius concrescens* Bidaud, Moënne-Locc. & Reumaux, Atl. Cortin. 7: 228 (1995). *Agaricus concrescens* Secretan, Mycogr. Suisse: 228 (1833), nom. inval. Type: *P. Moënne-Loccoz* 3578 (holo. G).

Cortinarius crassorum R. Henry in Docum. mycol. 19(73): 66 (1988). *C. cras-*

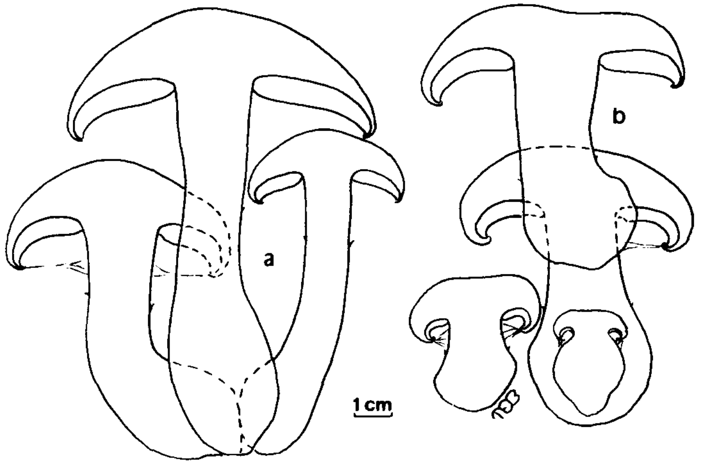

FIG. 23. (a) *C. durus* var. *durus* CFP 930; (b) *C. balteatoalbus* var. *balteatoalbus* CFP 1083.

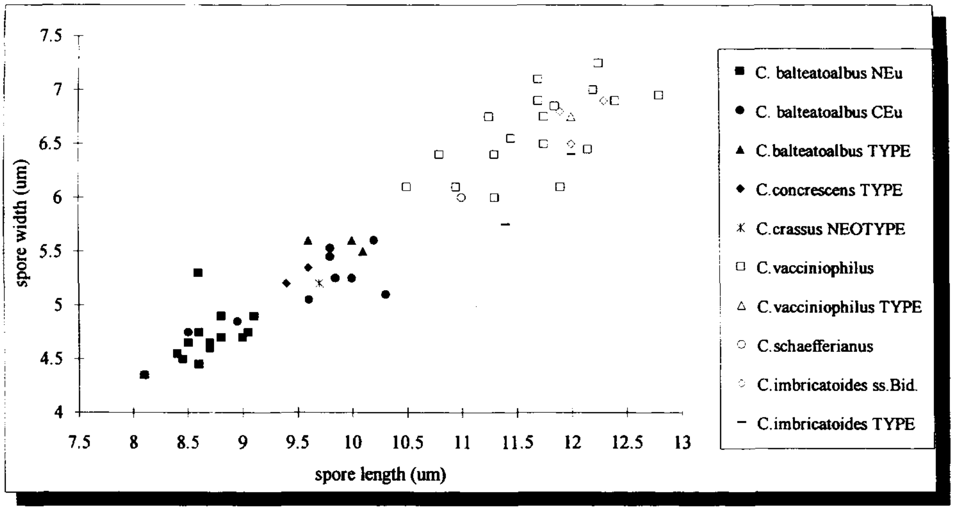

FIG. 24. Variation in spore size of *C. balteatoalbus* var. *areni-silvae* ('C. balteatoalbus NEu'), *C. balteatoalbus* var. *balteatoalbus* ('C. balteatoalbus CEu') and *C. vacciniophilus*.The holotype of *C. concrescens* and the neotype of *C. crassus* designated in Bidaud et al. (1995) belong to var. *balteatoalbus* as here circumscribed; material of *C. schaefferianus* nom. inval. (*M. Moser* 50/26), and *C. imbricatoides* sensu Bidaud et al. (*P. Moënne-Loccoz* 2330, 2348), probably belong to *C. vacciniophilus*. The type of *C. imbricatoides*, with uncertain affinity, is also included. Each symbol = MV of 10 spores measured per basidiocarp.

sorum R. Henry in Bull. Soc. mycol. Fr. 74: 288 (1958), nom. inval. Type: *R. Henry* 87.127 (holo. hb. Henry).

?*Cortinarius subconcrescens* R. Henry in Bull. Soc. mycol. Fr. 99: 60 (1983).

Misapplied name: *Cortinarius crassus* Fr. sensu J.E. Lange (1938), Fl. agar. dan. 3: 21.

Selected icones: Henry (1977), *Bull. Soc. mycol. Fr.* 93: Atl. Pl. 205; Bidaud, Moënne-Locc. & Reum. op. cit.: Pl. 159 (as *C. concrescens* and *C. subconcrescens*), 162, 163 (as *C. crassus*); J.E. Lange op. cit.: Pl. 88A.

Pileus 4–10cm, (hemi-)spherical, then plano-convex, with a strongly and fairly persistently involute margin, when (very) young slightly viscid but soon dry, dull, glabrous to slightly silky fibrillose, later more distinctly fibrillose, involute margin distinctly tomentose, centre becoming appressed tomentose, thick and pigmented cuticle can normally be separated; when (very) young whitish, then whitish brown to pale ochraceous grey brown (L 70, M 69) becoming darker ochraceous brown from centre (N 65), sometimes with umber brown spots (N-P 67) with age, involute margin initially (ochraceous) white. Universal veil remnants sparse, leaving a very thin, silky cover when very young. *Lamellae*, L = 80–120, crowded, 4–7mm broad, greyish white, edge even to slightly crenulate. *Stipe* 4–7 x 1–3cm, at base bulbous to often slightly abruptly bulbous (→3.5cm), fairly glossy, fine fibrillose and pruinose at apex, white, becoming pale brownish from base. Universal veil remnants fairly sparse, whitish fibrillose, cortina moderately abundant, whitish. *Context* whitish, with faintly greyish, hygrophanous streaks in stem apex. 2% KOH pale yellowish or with a yellow ring. Guaiac bluish green. *Smell* faint, somewhat yeast-like when cut, slightly earth-like (smell of *C. variecolor*) on surface.

Spores 9–10.5 × 5–5.5(–6)µm (MV = 9.69 × 5.29µm), Q = 1.84 ± 0.07, narrowly amygdaliform, sometimes faintly citriform or slightly skew with a subdistal depression, fairly pale, finely and densely verrucose. *Basidia* 7–8µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface of 2–3(–4) hyphal layers, hyphae often fairly wide, 3–8(–12)µm, but frequently collapsed, hyaline to pale yellow or with brownish content, especially towards centre. *Pileipellis* simplex. *Epicutis* thick, of c.15–25(–30) parallel layers. At surface hyphae 5–7(–8)µm wide, the outer c.1–3 segments oblique or erect and sinuose, slightly gelatinous or not, with ± brownish, thick walls, pigment distinct with age, terminal hyphae sometimes cystidium-like; hyphae below often very wide ((5–)6–12(–15)µm), with thick, yellow-brown walls and, especially the wider hyphae in upper part, also with distinct, yellow-brown, zebra-striped to crustulose encrustations, some hyphae filled with (dark) brown, oleiferous pigment.

Habitat: Nemoral-montane deciduous forests and coniferous plantations. Associated with *Picea abies* and deciduous trees (*Fagus*, *Quercus*, possibly also others) in mesotrophic to eutrophic soils, typically in spruce plantations on former deciduous forest land.

Distribution: The taxon seems to have a mainly C European distribution (Fig. 12d). Known from Denmark (Lange, 1938), Austria, Switzerland (Moser, 1961) and E and C France where the species is rare but fairly widespread (A. Bidaud, pers. comm.; see also Bidaud et al., 1995).

*Collections examined (*including macrocharacters).* FRANCE. Doubs: *R. Henry* 81.37 (holo. hb. Henry); *R. Henry* 87-127 (holotype for *C. crassorum*, hb. Henry); Ain, Ordonnaz, CFP 1083*, TEB 34-91*. Ile de France, Versailles, *P. Moënne-Loccoz* 834 (as *C. crassus*, hb. Moënne-Loccoz). Haute-Savoie: Semine, *R. Fillion, P. Moënne-Loccoz* 1730 (as *C. crassus*, selected as neotype in Bidaud et al., 1995; G); St-Jean-de-Sixt, *M. Mugnier, P. Moënne-Loccoz* 3578 (holotype for *C. concrescens*, G); Grand-Bornard, *P. Moënne-Loccoz* 717 (as *C. subconcrescens*, hb. Moënne-Loccoz). SWITZERLAND. Neuchatel, TEB 2-97.

Comments: *C. balteatoalbus* is well characterized by its initially pale, later darkening, fibrillose pileus, the (abruptly) bulbous stipe and its comparatively small and slightly ornamented spores. Superficially, the species is reminiscent of *C. corrosus* Fr. in sect. *Calochroi* (see Bidaud et al., 1995: pl. 162). It has the pale, fibrillose pileus in common with *C. durus*, but *C. durus* is normally more slender, has much larger spores and narrower, less pigmented pileipellis hyphae. *C. balteatoalbus* resembles *C. balteatus* in habit (Figs 21, 23), but the pileipellis structure is different. *Cortinarius balteatoalbus* lacks the mixture of gelatinous and non-gelatinous hyphae found in *C. balteatus*, and the pileipellis hyphae are wider and more strongly pigmented, and rarely gelatinous, a feature clearly separating it from pale variants of *C. balteatocumatilis*. The pileipellis structure of *C. balteatoalbus* is reminiscent of that of certain tomentose-scaly species of subgen. *Cortinarius* sensu Brandrud et al. (1990–95), sections *Crassi* and *Leprocybe*.

Two varieties of *C. balteatoalbus* are distinguished in the present study: var. *balteatoalbus* occurring in deciduous forests and conifer plantations in C Europe and Denmark, and var. *areni-silvae* occurring in sandy coniferous forests and plantations in N Europe. According to the limited material seen, these seem quite alike macroscopically, although the former is apparently initially somewhat paler, but var. *areni-silvae* has significantly smaller spores. The taxa seem to have an almost non-overlapping distribution (Fig. 12d), but they are very rare throughout Europe, and yet too little is known about their ecogeographical differentiation to treat them as subspecies.

Cortinarius balteatoalbus var. *balteatoalbus* as here circumscribed was treated as four species belonging to two different stirps by Bidaud et al. (1995): *C. concrescens* and *C. subconcrescens* of stirps *Subconcrescens* and *C. balteatoalbus* and *C. crassus* sensu Bidaud et al. in stirps *Crassi*. A caespitose growth is the only character indicated to distinguish the former from the latter stirps. In the present study, the feature caespitose growth was found to be of little taxonomic value. In fact, most species of *Phlegmacium* can grow caespitose in the manner illustrated for *C. concrescens* in Bidaud et al. (1995: pl. 159) if the genets (individual mycelia) are vigorous and produce many basidiocarps. In the protologue, *Cortinarius concrescens* is distinguished from *C. subconcrescens* by more firm, compact and heavy, basidiocarps with darkening pileus. The darkening pileus of *C. concrescens* is well demonstrated by the plate in Bidaud et al. (1995: pl. 159), but it appears that the circumscription of the species is based on this sole collection. Judged from the plate, this material had been considerably handled or exposed to heavy weather before painting, since even the young basidiocarps have brownish stains on all parts. I have seen such darkening basidiocarps of *C. balteatoalbus* in exposed habitats, but I do not consider this feature as taxonomically relevant. The value of the very subjective character firmness/compactness is also dubious, especially when based on limited material. In my opinion all the thick-fleshed, robust species in the group, viz. *C. balteatoalbus*, *C. balteatus* and *C. balteatocumatilis*, are characterized by firm, compact and heavy basidiocarps.

In stirps *Crassi* sensu Bidaud et al. (1995), *C. balteatoalbus* is distinguished from *C. crassus* sensu Bidaud et al. by a white veil cover on the pileus and the habitat (coniferous versus deciduous forests). However the veil is generally thin in the species treated here (c.2–3 layers on pileus surface). According to the painting by P. Moënne-Loccoz of *C. balteatoalbus* sensu Bidaud et al. (1995: pl. 162), the veil is very thin here too, even on young and very fresh material. The initial very pale colour is due not only to the veil, but also to the initially very pale encrustrations of the pileipellis hyphae. When comparing the almost identical paintings and descriptions of *C. balteatoalbus* and *C. crassus* in Bidaud et al. (1995) it is hard to understand why these are treated as separate species. Even Henry (1989), who elaborates with a high number of taxa in this group, accepts the conspecificity of *C. balteatoalbus* and *C. crassus* sensu Lange. Furthermore, the difference in habitat between these two variants is questionable. In SW Europe *C. balteatoalbus* is mainly recorded in temperate-nemoral areas in first-generation *Picea* plantations which formerly have been occupied by deciduous forest (Bidaud et al., 1995; pers. obs.). It is probable that the species in these sites formerly belonged to the deciduous forests. The typical deciduous forest species *C. largus* is found in the same *Picea* plantations of the area (pers. obs.).

The interpretation of *C. crassus* in Bidaud et al. (1995) follows that of Lange (1938) and Henry (1958). However, Bidaud et al. (1995) applied a very narrow species concept to *C. crassus*, and their neotypification of the species creates considerable nomenclatural problems:

1. It is improbable that Fries ever included *C. crassus* sensu Bidaud et al. (1995) or any other element of *C. balteatoalbus* as here circumscribed in his concept of *C. crassus*. *C. balteatoalbus* sens. lat. is very rare in Sweden, and is never found in the well-studied surroundings of Femsjö from where Fries collected his species (see Fries, 1851).

2. If Fries included *C. balteatoalbus* as here circumscribed, it is most probable that he referred to the northern *C. balteatoalbus* var. *areni-silvae* from coniferous forests. Material from thermophilous, deciduous forests (= *C. crassus* sensu Bidaud et al., 1995) is not known with certainty from Sweden.

3. *Cortinarius crassus* in the original sense probably included *C. pseudocrassus* (= *C. crassus* sensu Moser, 1983; Brandrud et al., 1990–95) and pale (non-bluish) variants of *C. balteatus* (= *C. subbalteatus*, *C. crassus* sensu Melot, 1986a). The latter is very

rare at Femsjö, whilst the former is more widespread. The latter is furthermore included as a major element in the collective species *C. balteatus* in Fries (1838, 1851; see discussion under *C. balteatus*). Thus it is most probable that *C. pseudocrassus* constitutes the major element in the protologue of *C. crassus*, although the plate in *Icones selectae* (Fries, 1867–1875) is not quite typical (resembles *C. balteatus*).

4. The diagnostic macrocharacters of *C. balteatoalbus* as here circumscribed (initially whitish, silky, later fibrillose and darkening pileus, (almost) abruptly bulbous stipe) is not in correspondence with the protologue, and one of the diagnostic characters mentioned by Fries (1838, 1851; pileus innately fibrillose) is rather in contradiction with our *C. balteatoalbus*. It is more probable that *C. balteatoalbus* is included in the protologue of *C. corrosus* Fries (1838).

Consequently, the neotypification of *C. crassus* Fr. by Bidaud et al. (1995) should be rejected, and the name *C. crassus* used in the sense of Moser (1983) (=*C. pseudocrassus*). Alternatively the name *C. crassus* should be regarded as a nomen ambiguum, and formally rejected.

12.2. Cortinarius balteatoalbus var. **areni-silvae** Brandrud in Edinb. J. Bot. 54: 114 (1997). Type: Cortinarius, Flora Photographica no. 461b (holo. S, iso. O). **Figs 4g, 12d, 24.**

Icon: Soop (1996), *Jordstjärnan* 17(1): 65 (as *C. balteatoalbus*).

Pileus 4–9cm, when (very) young slightly viscid to completely dry, fibrillose to soon appressed tomentose, when (very) young whitish, at least towards margin, with age sometimes hygrophanous and then completely umber brown. (Characters otherwise as in var. *balteatoalbus*.)

Spores small, 8–9.5 × 4.5–5µm (MV = 8.67 × 4.70µm), Q = 1.85 ± 0.08, narrowly amygdaliform to fusiform, sometimes more ellipsoid, pale, finely and densely verrucose. *Basidia* 6.5–7.5(–8)µm wide.

Habitat: Nemoral to boreal coniferous forests. Associated with *Pinus sylvestris*, *Picea sitchensis* and possibly also *Picea abies* and *Betula pubescens* in oligotrophic, sandy soils, including dry *Cladonia* pine heaths and spruce plantations on former heathlands. Also recorded in a park with *Pinus* and on sandy soil close to seashore.

Distribution: Very rare and known only from N Europe (Fig. 12d). Recorded from sandy plantations in W Denmark (Jutland), mainly from pine heaths in S Norway and N Sweden (see Soop, 1996), probably also from E Sweden and N Finland.

*Collections examined (*including macrocharacters).* SWEDEN. Ångermanland, Graninge, Viksmon, CFP 461b* (holo.). Lycksele Lappmark, Storuman, *K. Soop* 633 (hb. Soop). ?Södermanland, Tullinge, *L. Romell* 117-30 (as *C. corrosus*, S). NORWAY. Hedmark, Rendalen, Søre Osa, TEB 11-90*. Aust-Agder, Grimstad, *I.L. Fonneland*, TEB 86-94*. FINLAND. Pohjois-Pohjanmaa, Kiiminki, *E. & M. Ohenoja* 19 vii 1970 (OULU). DENMARK. Jutland, Emborg Vestermark, *J. Vesterholt* 85-850, 86-694 (as *C. crassus* sensu Lange) (C). Jutland, Rønhøj plantation, *T. Borgen* 27 ix 1975 (O).

Comments: *C. balteatoalbus* var. *areni-silvae* has been seen fresh only once, and the observations on macrocharacters are partly based on the colour photograph in Soop (1996) and slides by H. Marklund (CFP461b) and J. Vesterholt (J.V. 85-850, 86-694). Because of the limited material available, the degree of character differentiation is not fully known, and the proposed taxonomic rank must be regarded as preliminary. Var. *areni-silvae* differs from var. *balteatoalbus* mainly in significantly smaller spores and different habitat and distribution. In addition, the former seems to have a paler and somewhat more silky-glabrous pileus when young as well, but more material is needed to confirm these differences. Both varieties have the same, characteristic, very wide and encrusting pileipellis hyphae.

13. Cortinarius vacciniophilus Brandrud in Edinb. J. Bot. 54: 114 (1997). Type: TEB 17-88 (holo. O). **Figs 2, 3, 4f, 24, 25.**
Syn.: ?*Phlegmacium schaefferianum* Mos., Gatt. Phlegm.: 253 (1961), nom. inval. *Cortinarius schaefferi* Mos., Sydowia 6: 38 (1952), nom. homon., non *C. schaefferi* Bres., Ic. mycol.: 648 (1930). Type: not indicated.
Misapplied names: *Phlegmacium latum* (Pers.) F. Kaufm. sensu Mos., Gatt. Phlegm.: 251 (1961). ?*Cortinarius imbricatoides* R. Henry sensu Bidaud, Moënne-Locc. & Reum., Atl. Cortin. 7: 301 (1995).

Icones: Mos. op.cit.: Pl. VII 33 (as *Phlegm. latum*); ?Bidaud, Moënne-Locc. & Reum., op. cit.: Pl. 165.

Pileus 4–10cm, (hemi-)spherical, then plano-convex, sometimes slightly umbonate, when young distinctly viscid to (rarely) glutinous, viscosity sometimes fairly persistent especially towards margin, dull, glabrous and slightly rivulose towards margin, centre appressed scaly (from veil) to tomentose, becoming more scaly with age, and

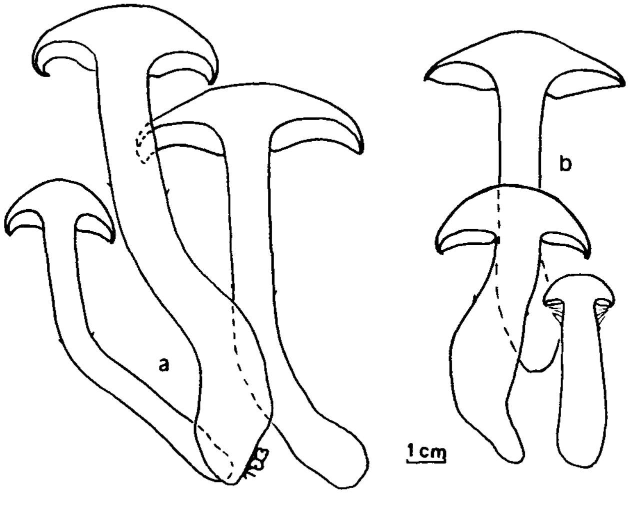

FIG. 25. (a) *C. vacciniophilus*. Holotype TEB 17-88; (b) *C. acidophilus*. Holotype TEB 61-79.

then slightly fibrillose-squamulose towards margin, involute margin glabrous to faintly tomentose, cuticle thick, brown and ±separable; pale ochraceous brown (N 65, 67, 69) with (ochraceous) white margin (pale M 69), soon warm ochraceous to fulvous brown (M 60, N 60, 65, P 60, 65), centre slightly darker (P 67, R 67) when very young sometimes with lavender blue patches near margin due to veil remnants. Universal veil remnants sparse to fairly abundant, with small (dark) brown, appressed scales/patches at centre, sometimes also whitish or bluish fibres or patches near margin. *Lamellae*, L = 70–90, crowded, 3–7(–10)mm broad, greyish white, edge even to slightly crenulate. *Stipe* 6–11(–13) × 0.8–1.5(–2)cm, clavate at base (→2.5cm), whitish, becoming (pale) ochraceous brown from base. Universal veil remnants sparse, fibrillose, white, often turning ochraceous brown, cortina sparse, whitish. *Context* whitish, with slightly greyish hygrophanous streaks in stipe apex, turning brownish where damaged. 2% KOH, 40% KOH strongly yellow at least in pileus when young, later paler yellow, sometimes with yellow ring. Guaiac bluish green after c.2 minutes. *Smell* faint, pleasant and fruit-like or somewhat yeast-like when cut.

Spores 11–12.5 × 6–7µm (MV = 11.68 × 6.62µm), Q = 1.76 ± 0.08, acutely amygdaliform to slightly citriform, distinctly and fairly densely verrucose. *Basidia* 8–10µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface scattered to fairly abundant, frequently of 2–5 hyphal layers, hyphae narrow, more rarely wide, 3–6(–12)µm wide, frequently collapsed, and then filled with strongly brown, granulate to oleiferous necropigment, sometimes also with thick, brown walls. *Pileipellis* simplex. *Epicutis* fairly thick, of c.10–15 layers. At surface (3–)4–6(–7)µm wide hyphae, the outer c.2–5 segments fairly distinctly gelatinous, loosely erect and sinuose, with ±brownish, thick walls, especially distinct with age, hyphae sometimes also finely, pale verrucose to zebra-striped, sometimes with intracellular to epimembranal, hyaline to pale yellow granules; a few (very) wide (→15µm), repent and straight hyphae with strongly yellow-brown, zebra-striped encrustations, often intermixed. The basal part of epicutis of c.5–10 tightly connected and parallel layers, hyphae 4–10(–12)µm wide, usually with very strong, crustulose to zebra-striped, yellow-brown pigmentation, towards trama some elements cemented by amber-like yellow-brown pigment; some hyphae filled with (dark) brown, oleiferous pigment.

Habitat: Boreal, subalpine to montane (rarely boreo-nemoral) coniferous forests. Associated with *Picea abies* (and *Abies alba*?) in oligotrophic (to mesotrophic) forests with ±acid raw humus, often on slightly seasonally moist slopes, sometimes in patches of *Sphagnum*, but normally with *Vaccinium myrtillus* and *Dicranum* mosses, preferentially in mature, natural forests.

Distribution: Rare and little known. Hitherto recorded from S and SE Norway, mainly at higher altitudes (400–800m a.s.l.) and from the Swiss Alps (c.1500–1600(–1800?)m a.s.l.; Favre, 1960 as *C. latus*). Records from the French Jura and Haute Loire (900–1100m a.s.l.; Bidaud et al., 1995 as *C. imbricatoides*) probably also belong here.

*Collections examined (*including macrocharacters).* NORWAY. Oppland: Lunner, TEB

17-88*, 18-88*, 19-88*, 20-88*, 1-91, 2-91*, 8-95*, 10-95*; Gran, TEB 12-90*. Oppland, Ringebu, Venabygd, TEB 4-94*. Oslo: Maridalen, TEB 301-80. Aust-Agder: Gjerstad, TEB 39-94*; Arendal, *I.L. Fonneland*, TEB 29-94*. SWEDEN. Jämtland: Sällsjö, Mörsil, *H. Lindström*, TEB 85-87; Sunne, Andersön, CFP 696b. AUSTRIA. ?Tyrol, Kienberg, *M. Moser* 50/26 (as *C. schaefferianus*; M). FRANCE. ?Haute-Loire, Monts du Forez, *A. Bidaud, P. Moënne-Loccoz* 2330. ?Ain, Meyzieu, *P. Moënne-Loccoz* 2348 (both French coll. hb. Moënne-Loccoz as *C. imbricatoides*).

Comments: *C. vacciniophilus* is characterized by its slender habit, distinctly viscid pileus with ochraceous brown colours and small patches of veil at centre, large spores and its habitat preferentially in boreal, oligotrophic spruce forests of *Vaccinium myrtillus* type. In such boreal spruce forests this is a fairly well-defined, hitherto anonymous, species which mainly resembles *C. patibilis* (habit) and *C. balteatus* (colours). The former, which is often co-occurring, differs in bluish tinges, a brown staining reaction and smaller, paler spores. The latter is distinguished by its tomentose (never veil-covered) pileus with lilac, strongly involute margin, more robust and thick-fleshed basidiocarps (see Figs 2, 3, 24, 25), smaller spores and not so strong, zebra-striped encrustations of pileipellis hyphae. The pileipellis of *C. balteatus* moreover has a more complex structure than that of *C. vacciniophilus*. The large-spored, *C. balteatotomentosus* differs in bluish tinges on the lamellae and in the context. *Cortinarius vacciniophilus* differs from *C. acidophilus* mainly by its paler, more ochraceous colours, the lack of bluish veil girdles and larger spores, and from *C. hysginus* by wider and less gelatinous surface hyphae of pileipellis, more distinctly encrusting pigment and larger spores.

The stipe surface and veil of *C. vacciniophilus* often turn ochraceous brown, and with a warm brown pileus with veil patches and slender habit, such specimens may resemble *C. saginus* of sect. *Phlegmacium*. The latter, however, does not react yellow with KOH, has smaller spores and has a more abundant veil which is brown already when very young.

The plate of *C. imbricatoides* R. Henry in Bidaud et al. (1995: pl. 165) seems to illustrate well the species treated here, and a probable conspecificity is also indicated by the microcharacters. However, there are some deviating features in the description of macrocharacters, and the variation between *C. vacciniophilus* as here circumscribed using N European material and the C European populations named *C. imbricatoides* needs further study. The main diagnostic character given by Bidaud et al. (1995) for *C. imbricatoides* (scaly-fibrillose pileus resembling *Tricholoma imbricatum*) is clearly contradictory to that of *C. vacciniophilus*. This contradiction is even more pronounced in the original description of *C. imbricatoides* (Henry, 1958), where the pileus is described as completely dry (non-viscid) and tomentose-fibrillose. With this diagnosis, the name *C. imbricatoides* cannot be applied to the new species. The type material of *C. imbricatoides* (*R. Henry* 395) is furthermore in too poor a condition to allow interpretation of the diagnostic character(s) of the pileipellis.

Cortinarius schaefferianus (Mos.) Mos. nom. inval. is probably a synonym, although the description in Moser (1961) and the material seen deviate somewhat from typical *C. vacciniophilus*.

14. Cortinarius acidophilus Brandrud in Edinb. J. Bot. 54: 114 (1997). Type: TEB 61-79 (holo. O). **Figs 25, 26.**

Pileus 3–7cm, (hemi-)spherical, then plano-convex, when young viscid to glutinous, especially outer half, but normally soon drying out, dull, (coarsely) fibrillose, centre appressed tomentose to fine scaly-diffracted, thick cuticle normally separable; centre greyish brown to umber brown (N 49, P 67), initially violaceous to lavender blue towards margin (due mainly to the veil), soon uniformly umber brown, involute margin whitish grey. Universal veil remnants fairly abundant, fibrillose-scaly, producing a ±continuous bluish zone in outer half or near margin when young, later leaving ochraceous white patches or scales. *Lamellae*, L = 50–70, crowded, 3–6mm broad, greyish white or tinged with bluish towards pileus margin, edge even to crenulate. *Stipe* 4–7(–9) × 0.8–1.2cm, clavate at base (→2cm), whitish with a greyish, sometimes even bluish tinge at apex, becoming pale ochraceous brown from base, young basidiocarps slightly brownish when bruised. Universal veil remnants often fairly abundant, forming 1–2 pale violaceous blue, then whitish to pale brownish girdles. Cortina sparse, whitish to bluish on pileus margin. *Context* whitish, when very young sometimes with a bluish tinge in stipe apex and below pileus cuticle. 2% KOH, 40% KOH ±yellowish, 10% NH_4OH distinctly yellow. Guaiac bluish green. *Smell* faint, pleasant or somewhat yeast-like.

Spores 10–11.5 × 5.5–6.5μm (MV = 10.78 × 6.06μm), Q = 1.78 ± 0.05, acutely amygdaliform to slightly citriform, distinctly and fairly densely verrucose. *Basidia* 7.5–8.5μm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface fairly abundant, of 1–4 hyphal layers, hyphae narrow, or rarely wide, 3–6(–10)μm, frequently collapsed, and then filled with strongly brown, granulate to oleiferous necropigment. *Pileipellis* simplex. *Epicutis* fairly thick, of c.10–15 layers. At surface (2.5–)3–6μm wide hyphae, the outer c.2–5 segments fairly distinctly gelatinous, loosely erect and sinuose, hyaline or often with brownish, thick walls, especially with age, hyphae sometimes also finely, pale verrucose to zebra-striped, sometimes with intracellular to epiparietal, hyaline to pale yellow granules; wider (→10μm) and zebra-striped encrusted, repent hyphae sometimes intermixed. The basal part of epicutis of c.5–10 tightly connected and parallel layers, hyphae 4–8(–12)μm wide, usually strongly crustulose to zebra-striped, brown pigmented, some hyphae filled with (dark) brown, oleiferous pigment, towards trama some elements (→15μm) cemented by amber-like yellow-brown pigment.

Habitat: Boreal coniferous forests. Associated with mature *Picea abies* in oligotrophic, natural forests with acid, moist raw humus, mainly amongst *Sphagnum*.

Distribution: Very rare. Known only from C Scandinavia.

*Collections examined (*including macrocharacters).* NORWAY. Oppland, Lunner, TEB 61-79 (holo.)*, *E. Bendiksen* 875/80 (O)*. Oppland, Søndre Land, TEB 108-84*. Akershus, Hurdal, TEB 266-81/*E. Bendiksen* 741/81*. SWEDEN. Jämtland, Ragunda, TEB 20-93*.

Comments: *C. acidophilus* is a fairly small species, characterized by its umber brown pileus, when young with a violaceous margin caused by the veil. It is reminiscent of a small, dark, fibrillose *C. variecolor*, but the latter has violaceous pigment also in the pileipellis, as well as in the lamellae and context, and grows in more eutrophic forests. *Cortinarius acidophilus* is distinguished from *C. vacciniophilus* mainly by its darker and less warm pileus colour, more developed and violaceous blue universal veil, less encrusted pileipellis hyphae, and smaller spores.

Cortinarius acidophilus, together with some related species, belongs to a formerly almost unknown and little studied boreal-subalpine, oligotrophic spruce forest element, with its optimal habitat in N Europe. This kind of oligotrophic, acid spruce forest is frequent in Fennoscandia, yet this species seems to be very rare, and always occurs in low numbers.

15. Cortinarius balteatocumatilis R. Henry ex P.D. Orton in Trans. Brit. mycol. Soc. 43: 207 (1960). Type: *P.D. Orton* 1356, 14 ix 1957 (holo. K). **Figs 12b, 26, 27.**
Syn.: *Cortinarius balteatocumatilis* R. Henry in Bull. Soc. mycol. Fr. 55: 187 (1939), nom. inval.

Cortinarius violaceocinctus P.D. Orton l.c.: 213. Type: *P.D. Orton* 1743, 5 ix 1958 (holo. K).

Phlegmacium balteatocumatile (R. Henry) nom. inval. var. *laetum* Mos., Gatt. Phlegm.: 358 (1961), nom. inval. Type: not indicated.

Selected icones: Phillips (1981), *Mushr. Gr. Br. & Eur.*: 129; Kärcher & Seibt (1990), *Z. Mykol.* 56: 48; Mos. (1961), *Gatt. Phlegm.*: Pl. VIII 42; J.E. Lange (1938), *Fl. agar. dan.* 3: Pl. 87D (as *C. balteatus*); Marchand (1982), *Champ. nord midi*, vol. 7:

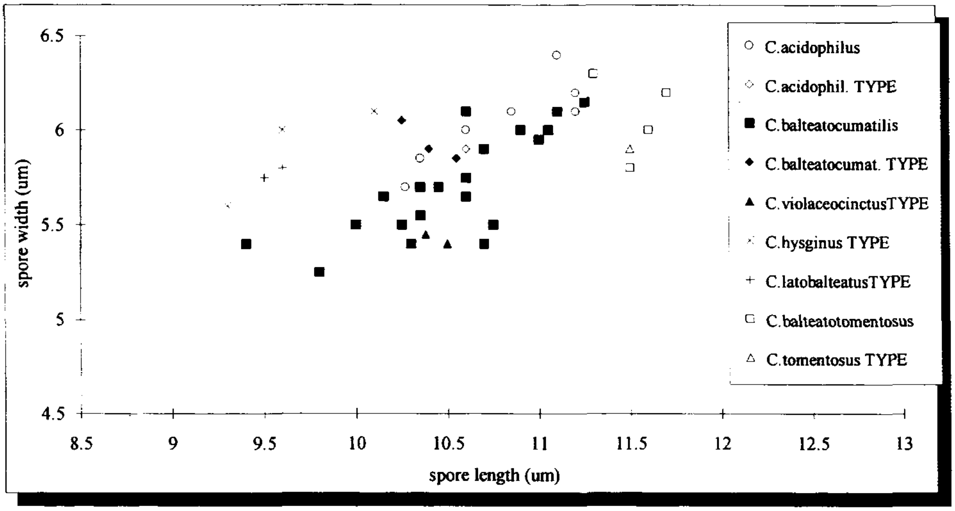

FIG. 26. Variation in spore size of *C. acidophilus*, *C. balteatocumatilis* (= *C. violaceocinctus*), *C. hysginus* (= *C. latobalteatus*) and *C. balteatotomentosus* (= *C. tomentosus*?). Each symbol = MV of 10 spores measured per basidiocarp.

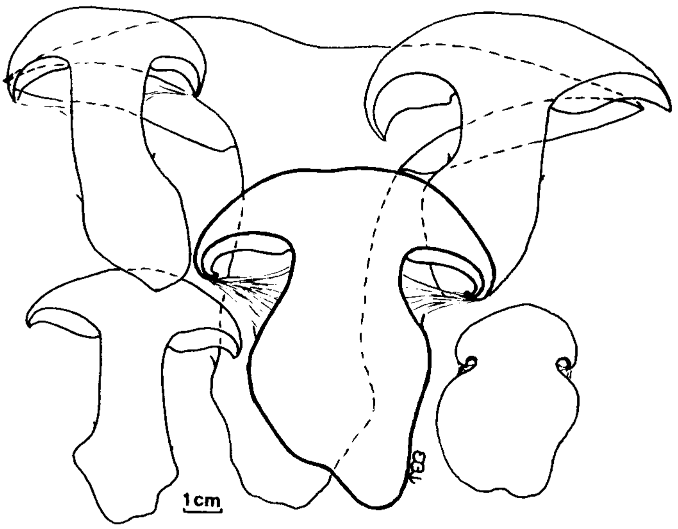

FIG. 27. *C. balteatocumatilis*. TEB 36-93 (upper left), TEB 188-85 (lower left), TEB 23-93 (centre and lower right), TEB 94-82 (upper right).

Pl. 685 (as *C. nemorensis*), 690, 691, 692 (as *C. balteatus*); Rym. & Holm. (1984), *Svampar*: 500.

Pileus 6–15(–20)cm, (hemi-)spherical, then plano-convex, often with fairly persistently involute margin, (very) distinctly glutinous, slightly fibrillose to glabrous, involute margin tomentose; coarsely rivulose when expanded, with age fibrillose-tomentose to fine scaly from centre, cuticle easily separable, thick and pigmented; when young (grey) brown to purplish brown at centre and (pale) violaceous grey to deep violaceous blue towards margin, sometimes entire pileus violaceous, involute margin greyish white, rarely bluish (M 70–71); pileus soon fading via purplish brown (R 27) to uniformly fulvous to umber brown (R 33, N-P-R 49). Universal veil remnants usually sparse, fibrillose-patchy, violaceous to whitish, often difficult to distinguish from cortina and pileipellis. *Lamellae*, L = 80–130, crowded, (4–)6–10(–12)mm broad, greyish white, edge even to slightly crenulate. *Stipe* 5–9 × 1.5–4cm, cylindrical with a ±bulbous base (→5cm), sometimes almost abruptly bulbous, fibrillose, pruinose at apex, greyish white, slightly ochraceous brown from base with age, very young basidiocarps turn slightly brownish when bruised. Universal veil remnants fairly abundant, peronate or volva-like, terminating 1–2cm above the bulb in a slightly viscid girdle or ring-zone, normally ±violaceous blue when young, but (very) soon discolouring to brownish. Cortina abundant, initially bluish. *Context* white with a greyish ochre tinge in stipe apex. 2% and 40% KOH with distinctly yellow ring, 10% NH_4OH distinctly yellow. Guaiac bluish green. *Smell* ±distinctly yeast-like.

Spores 9.5–11 × 5–6µm (MV = 10.49 × 5.71µm), Q = 1.84 ± 0.07, acutely amygdaliform to slightly citriform, (very) distinctly and fairly densely verrucose. *Basidia* 7.5–8.5µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface scattered to fairly abundant, frequently of 3–6 hyphal layers, hyphae narrow, 2.5–5(–8)µm wide, frequently collapsed, surface hyphae ±filled with brown, granulate to oleiferous necropigment, often restricted to narrow bands or zones in the hyphae, sometimes also with thick, brown walls; with a bluish reflex when very young. Universal veil on stipe surface of 2–5(–8)µm wide, surface hyphae often gelatinous when young, soon collapsed, hyaline or with yellow, oleiferous necropigment. *Cortina* of 30–40 layers on pileus margin when very young, hyphae 3–5µm wide, with diffuse, bluish pigment. *Pileipellis* simplex. *Epicutis* thick, of c.20–25(–30) hyphal layers. At surface 5–15 layers of gelatinous, repent, oblique or erect-sinuose hyphae, 2.5–5(–6)µm wide, hyaline or with pale verrucose walls, sometimes with intracellular to extracellular, hyaline, strongly refractive granules, hyphae with a bluish reflex when young. The basal part of epicutis of c.10–15 tightly connected and parallel layers, hyphae 3–10(–12)µm wide, some hyphae with pale yellow-brown zebra-striped encrustation, some with refractive granules, the 5–10 basal layers cemented by amber-like yellow-brown pigment, often forming subparallel bundles (of c.50 hyphae in each); some hyphae filled with (dark) brown, oleiferous pigment.

Habitat: Boreo-nemoral, (rarely boreal-montane), nemoral to mediterranean frondose forests. Associated mainly with *Quercus* spp. (including evergreen species), but also *Betula pendula*, *Corylus avellana*, *Fagus sylvatica*, *Tilia cordata* and *T. vulgaris*, very rarely also with *Abies alba*. Occurring in mesotrophic-eutrophic, sometimes calcareous, frequently grassy forests, open woodlands or parks. In S Europe mainly on siliceous soils. Association with *Betula* is mainly observed in the outpost areas of N and NW Europe (pers. obs.; Orton, 1960) and the steppe forests of SE Europe (Iwanow & Durandin, 1996).

Distribution: Fairly rare to locally more frequent. Distributed almost all over Europe (Fig. 12b), but mainly in the lowlands (Moser, 1961; Kärcher & Seibt, 1990), occurring from C Scandinavia (Brandrud, 1992; Hallingbäck, 1994) via C and W Europe (Orton, 1955, 1960; Moser, 1961; Kärcher & Seibt, 1990; Krieglsteiner, 1991; Rimóczi & Albert, 1992; Keizer, 1993 and Keizer & Arnolds, 1994 as *C. balteatoalbus*) and S Europe (Kärcher & Seibt, 1990; Chevassut, 1991; Ortega & Mahiques, 1995) to Morocco (Malençon & Bertault, 1970). Recorded east to Estonia and Russia (Nezdojminogo, 1983), including the steppe forests of S Russia (Iwanow & Durandin, 1996). Included in red data lists in a number of countries.

*Collections examined (*including macrocharacters)*. NORWAY. Oppland: Lunner, TEB 23-93*, 71-93*; Gran, Brandbu, TEB 101-93. Oslo: Bygdøy, TEB 462-80*, 203-82*, 188-85*, 56-93*; Vestre Gravlund, TEB 498-80, 607-80, 94-82*. Akershus: Bærum, Høvik, TEB 95b-93; Asker, TEB 138-85; Enebakk, *H. Eeg* 25 viii 1982 (O); Frogn, Håøya, TEB 31-94. Østfold: Moss, *Ø. Weholt*, TEB 609-80; Fredrikstad, TEB 78-85; Kråkerøy, TEB 160-79, *W. Ramm* 23 ix 1979 (O); Onsøy, *W. Ramm* 14 ix 1967 (O); Halden, TEB 291b-85. Vestfold: Tjøme, TEB 82-82*; Larvik, CFP 209*. Telemark: Bamble, Valle, *P.J. Schei*, TEB 63-84; Kragerø, TEB 115-92*, TEB 237-85. Aust-Agder, Grimstad, *T.H. Dahl*, *I.L. Fonneland*, TEB 85-94, 17-95. Rogaland, Sola, TEB 98-82*. SWEDEN. Dalsland, Mellerud, *K. & E. Bendiksen* 12 ix 1990 (O)*. Göteborg: Slottsskogen, *Fungi Exsiccati Suecici* 2808 (as *C. balteatus*, S); Botaniska Trädgården, *Karlvall* 13477 (as *C. balteatus*, S). Uppland: Vaksala, *Fungi Exsiccati Suecici* 2807 (as *C. balteatus*, S); Älvkarleby, Billudden, *P. Printz* 30 viii 1974 (UPS); Gryta, *S. Ryman* 4341 (UPS); Bondkyrka, *S. Ryman* 3059, 3117 (UPS). FINLAND. Pohjois Savo, Kuopio, *J. Vauras* 1587 F*. Varsinais-Suomi, Turku, *J. Vauras* 1460 F (O)*. Tampere, *U. Söderholm* 18 ix 1984 (O). GREAT BRITAIN. Scotland: Inverness-shire, Rothiemurchus, *P.D. Orton* 1356 (holo. K, iso. E), *P.D. Orton* 1743 (holotype of *C. violaceocinctus*, K, iso. E); Perthshire, Kindrogan, *R. Watling* 13403 (E). THE NETHERLANDS. Drenthe, Zwiggelte, Oranjekanaal, *P.-J. Keizer* 87138 (as *C. balteatoalbus*), *T.W. Kuyper* 3087 (as *C. balteatoalbus*), & 3269 (WAG-W). GERMANY. Baden-Württemberg: Stuttgart, Schönbuch, *A. Bollman* 95/2 (O); Stuttgart, Neuer Friedlhof, *A. Bollman* 95/20 (O); Black Forest, Schramberg, *A. Bollman* 95/17, 95/18 (O). CZECH REPUBLIC. Havlikuv, Brod, Radnov, TEB 214-94*. HUNGARY. Börzsöny, Magashegy, TEB 223-94*. ITALY. Emilia-Romagna, Parma, Borgotaro, TEB 407-81.

Comments: *C. balteatocumatilis* is one of the largest and most robust *Phlegmacium* species. It is well delimited and well characterized by its distinctly and fairly persistently glutinous, initially violaceous pileus, an almost volva-like, universal veil, and occurrence in open forests or woodlands. It is one of very few *Phlegmacium* species that occur also in city parks. It resembles the coniferous forest species *C. balteatus* in habit, but the universal veil is much more pronounced in the former, and the pileus surface structure is quite different (glutinous-glabrous versus almost dry and tomentose). Furthermore, the former is more violaceous when young.

Cortinarius balteatocumatilis is sometimes confused with *C. largus*, which occurs in similar habitats. However, the former is distinguished by its greyish white lamellae and more or less bluish, volva-like veil girdle. *Cortinarius serarius* also shares some similar characters, especially the glutinous, more or less violaceous tinged pileus. However this species differs in a quite different habit, with smaller and more slender basidiocarps (see Figs 27, 28), a less developed veil, larger spores, and an association with *Picea*.

Cortinarius balteatocumatilis has a characteristic, thick pileipellis with narrow hyphae and a well-developed gelatinous layer of hyaline hyphae. These features make the species easy to distinguish from its relatives in subsect. *Balteati*, except for *C. hysginus*, which is distinguished by the lack of violaceous colours, smaller spores and its habitat in coniferous forests.

According to Kärcher & Seibt (1990), the spore shape and ornamentation of *C. balteatocumatilis* are fairly variable, and they found that the type material had broader spores than normal for the species. However, the type material is still within the variation spectrum of the spore shape encountered in the present study (Fig. 26), and the Q-values of *C. balteatocumatilis* show a normal range of variation (SD = 0.07; see above). The spore shape was used as a diagnostic character for *C. violaceocinctus* P.D. Orton, distinguished from *C. balteatocumatilis* by its less bluish colours and narrower spores (Orton, 1960). Although the type material of *C. violaceotinctus* has narrower spores than normal, it is still within the variation of spore shape found in *C. balteatocumatilis* (Fig. 26), and no correlation between spore shape and degree of violaceous colours has been found.

The violaceous colour of *C. balteatocumatilis* is fugacious and inconstant. Sometimes the entire pileus is deep violaceous (brown) when very young, sometimes only greyish blue in the outer part. In exposed habitats the pileus can sometimes be completely without bluish tinges even when fairly young. Such variants have been treated under various names, such as *C. violaceocinctus* (Orton, 1960) and *C. balteatoalbus* sensu Keizer & Arnolds (1994), possibly also *C. latus* Fr. sensu Soop (1996). A variant with deep violaceous colours was described by Moser (1961) under the name *Phlegm. balteatocumatile* var. *laetum* Mos. (nom. inval.). According to Kärcher & Seibt (1990), who made an extensive study of the species, this colour variation has no taxonomic value, and I agree with their conclusion.

16. Cortinarius hysginus (Mos.) Mos., Röhr. Blätt., Bd. IIb/2, in Kl. Kryptog. Fl., 3rd ed.: 301 (1967). **Fig. 26.**

Syn.: *Phlegmacium hysginum* Mos., Gatt. Phlegm.: 358 (1961). Type: *M. Moser* 51/151 (holo. M).

Phlegmacium latobalteatum J. Schäffer in Mos., Gatt. Phlegm.: 358 (1961). *Cortinarius latobalteatus* (J. Schäffer) Mos., Röhr. Blätt., Bd. IIb/2, in Kl. Kryptog. Fl., 3rd ed.: 301 (1967). Type: *M. Moser* 50/75 (holo. M).

?*C. subopimus* Bidaud in Bidaud et al., Atl. Cortin. 7: 231 (1995). Type: *P. Moënne-Loccoz* 3477 (holo. G).

?*C. hysginicolor* Bidaud in Bidaud et al., op. cit.: 229. Type: *P. Moënne-Loccoz* 2955 (holo. G).

Selected icones: Mos. (1961), *Gatt. Phlegm.*: Pl. VII 36, Pl. VIII 38 (as *Phlegm. latobalteatum*).

Pileus 3.5–7cm, (hemi-)spherical, then plano-convex, with fairly persistently involute margin, viscid to distinctly glutinous, glabrous, often innately fibrillose, cuticle easily separable, ochraceous yellow to red-brown, centre darker brown. Universal veil remnants sparse, fibrillose-patchy, whitish to pale ochraceous yellow. *Lamellae*, L = 80–100, crowded, 3–5mm broad, greyish white, edge uneven to slightly crenulate. *Stipe* 3.5–7 × 1.5–2.5cm, cylindrical or with a slightly bulbous base (→3cm), fibrillose, greyish white, slightly ochraceous brown from base with age. Universal veil remnants fairly abundant or not, rendering the stipe girdled to fibrillose, whitish, then brownish. *Context* white, sometimes with a greyish tinge in stipe centre. KOH yellowish or with distinctly yellow ring. Guaiac green to greenish blue. *Smell* indistinct.

Spores 9–10 × 5.5–6µm (MV = 9.62 × 5.85µm), Q = 1.65 ± 0.03, amygdaliform to slightly ellipsoid, finely to distinctly and densely verrucose. *Basidia* 7.5–9µm, 4-spored. *Lamella edge* fertile. *Pileipellis* simplex. *Epicutis* thick, of c.20 hyphal layers. At surface 5(–10) layers of gelatinous, repent, oblique or erect-sinuose hyphae, 2.5–4µm wide, hyaline or with pale yellow, refractive content (probably necropigment); the basal part of epicutis of c.10–15 tightly connected and parallel layers, hyphae 3–8(–10)μm wide, some hyphae with pale yellow-brown zebra-striped encrustation, some with refractive content, sometimes cemented by amber-like yellow-brown pigment, some hyphae filled with yellow-brown, diffractive pigment.

Habitat: Montane and probably boreal coniferous forests. Associated with *Picea abies* in areas with dolomitic or granitic rocks, including grassy, apparently slightly richer forests of mull soil type.

Distribution: Rare. Recorded mainly from the Alps and Prealps. Known from Austria (Tyrol), S Germany (Bavaria), Switzerland and England (Moser, 1961), possibly also France (Bidaud et al., 1995 as *C. hysginicolor* and *C. subopimus*). One record from Femsjö, Sweden probably also belongs here (M. Moser, pers. comm.).

*Collections examined (*including macrocharacters)*. AUSTRIA. Tyrol: Raitisertal ober Nockhof, *M. Moser* 51/151 (holo. M), *M. Moser* 50/75 (holotype for *C. latobalteatus*, M); Vikartal, *M. Moser* 50/58 (as *C. latobalteatus*, M). FRANCE. ?Haute-Savoie, Dran, Les Glieres, *P. Moënne-Loccoz* 2837 (holotype for *C. subopimus*, G). ?Ain, Innimont, *A. Bidaud, P. Moënne-Loccoz* 2955 (holotype for *C. hysginicolor*, G).

Comments: I have not seen this species fresh, and the above brief description of macrocharacters is based on the protologues of *C. hysginus* and *C. latobalteatus* (Moser, 1961), whereas the description of microcharacters is based on examination of the types of *C. hysginus* and *C. latobalteatus*. This examination revealed almost identical microcharacters in the two types, indicating that they belong to the same taxon (see Fig. 26). The two names were validated in the same publication (Moser, 1961), and the name *C. hysginus* is chosen here since it has alphabetic priority. Furthermore, it seems advantageous to avoid the name *C. latobalteatus*, since it is easily confused with epithets such as *C. balteatoalbus* and *C. badiolatus* (Mos.) Mos.

Cortinarius hysginus seems to be fairly well delimited by the following character combination: (i) viscid-glutinous pileus without bluish tinges, (ii) fleshy, robust basidiocarps ('balteatus-habit'), (iii) fairly small spores, (iv) a well-developed pellicle of narrow hyphae, and (v) basal epicutis with pale encrustrations. The species is probably most closely related to *C. balteatocumatilis*, as they have very similar microcharacters. The latter, however, differs in habitat (frondose forests), larger basidiocarps and in the presence of violaceous pigment. *C. balteatus* is also similar, but differs in the structure of the pileipellis. *C. vacciniophilus* has a different habit and larger spores.

According to the type material, plate and description in Bidaud et al. (1995), *C. subopimus* seems to be synonymous with *C. hysginus*. *C. hysginicolor* appears macroscopically identical, but differs in having larger spores. Its taxonomic position is not further considered in the present study, since the diagnosis seems to be based on two mature specimens only.

17. Cortinarius borgsjoeensis Brandrud in Brandrud et al., Cortin., Fl. Photogr. 2 (Swedish version): 33 (1992). Type: Cortin, Fl. Photogr. no 728 (holo. O, isotypus in S). **Figs 4h, 12c, 28, 29.**

Icon: Brandr. et al., op. cit.: Pl. B26.

Pileus 2.5–6cm, hemispherical, very soon plano-convex, rarely slightly umbonate, margin hardly involute, even when very young; viscid but soon dry, initially glabrous and coarsely innately fibrillose-rivulose, sometimes slightly micaceous, with age fibrillose to sometimes squamulose, cuticle difficult to separate, fairly thin to thick and pigmented; pale brownish grey (M 50–51, 70–71, 75, N 69), then pale ochraceous brown (P 65, N 67, M-N 77, L 77). Universal veil fairly sparse, visible as small, bluish scales or patches near margin when young. *Lamellae*, L = 50–70, crowded to often rather distant and distinctly emarginate, 4–8(–10)mm broad, greyish white to ochraceous white when young, edge even to crenulate. *Stipe* 4–10 × 0.5–1.5cm, flexuose, at base ±clavate (→2cm), sometimes attenuate, pruinose at apex, white, with age often ochraceous tinged. Universal veil remnants rather sparse, forming one or more bluish girdles. *Context* whitish. KOH negative, guaiac slightly positive, ±bluish green after 2–5 minutes. *Smell* honey-like when cut or bruised.

Spores 11.5–13.5 × 6.5–7.5µm (MV = 12.62 × 7.00µm), Q = 1.80 ± 0.06, amygdaliform with broad apex, to sometimes more ellipsoid, often with a subdistal depression, suprahilar plage indistinct. *Basidia* 8–10µm wide, 4-spored. *Lamella edge* fertile. *Universal veil* on pileus surface scattered to fairly abundant, frequently of 2–3 hyphal layers, hyphae narrow, 2–5(–7)µm, frequently collapsed, often with golden yellow, granular contents. Universal veil on stipe of 2–7(–8)µm wide hyphae, at surface 2–5µm wide, hyaline-granulate, sometimes pale yellow when collapsed. *Pileipellis* ±duplex. *Epicutis* thin (if not hypoderm-like elements are included), of c.5–8 layers. At surface 2–3 repent, parallel layers of 2.5–4µm wide, hyaline, gelatinous hyphae, hyphae below similar but more erect-sinuose, sometimes intermixed with bands of wider (→8µm), pale zebra-striped hyphae. Basal part of epicutis composed of a few loose, narrow, 3–6µm hyphae with hyaline warts or zebra-stripes, below these shortened, pale yellow zebra-striped hyphae, forming some tightly cemented transition layers to hypoderm. *Hypoderm* ± distinguishable from epicutis, of c.5–8 layers, of shortened and gradually wider hyphae, 30–40 × 8–12µm, up to 15(–20)µm wide basally, elements tightly interwoven and embedded in a (pale) yellow, refractive, glass- or amber-like matrix, with a very gradual transition into less pigmented and less cemented trama.

Habitat: Boreal coniferous forests. Associated mainly with *Picea*, but also *Pinus* in mossy, oligotrophic forests with acid, raw humus. Mostly solitary or with few basidiocarps.

Distribution: Known only from N and C Scandinavia, rare, but in certain years locally rather frequent (Brandrud et al., 1992).

*Collections examined (*including macrocharacters)*. SWEDEN. Medelpad: Borgsjö, TEB 54-82*, 65-82 (CFP 51)*; Alnö, Ås brygga, CFP 529. Jämtland: Ragunda, CFP 728 (holo.)*, TEB 18-93*; Häsjö, Östansjö, CFP 692*, 720*; Sällsjö, TEB 84-87*. Ångermanland, Häggdånger, Sjö, CFP 735*. NORWAY. Hedmark, Storelvdal, Atna, TEB 120-83*. Oppland: Vest Torpa, TEB 141-83*, 142-83*, 92-84*; Gjøvik, Vardal, TEB 97-85*. Aust-Agder, Åmli, TEB 285-87*. Sør Trøndelag, Ålen, TEB 112-83. Nordland, Rana, TEB & EB 296-83*. FINLAND. Pohjois-Häme, Saarijärvi, Pyhä-Häkki National Park, TEB 4-86.

Comments: *C. borgsjoeensis* is a northern species (Fig. 12c), well characterized by its small and slender basidiocarps, pale grey-brown, (innately) fibrillose pileus, pale bluish veil girdles and weak macrochemical reactions. The species is also well distinguished by its microcharacters, including large spores, narrow and almost hyaline epicutis hyphae, and a more or less developed hypoderm with a pale, amber-like parietal pigment. Distinct encrustations are never observed. It can hardly be mistaken for any other of the species in subsect. *Balteati*. *Cortinarius borgsjoeensis* seems to occupy a fairly isolated position, possibly most closely related to the much darker *C. acidophilus*. It may also be related to *C. patibilis*, which is greyish brown when young, and has spores with a quite similar shape. However, *C. patibilis* turns brownish, and has a simplex, more encrusted pileipellis as well as smaller spores. Superficially, *C. borgsjoeensis* can resemble *Telamonia* species in sect. *Malachii* Melot.

Cortinarius subsect. **Serarii** Brandrud in Edinb. J. Bot. 54: 115 (1997). Type subsection: *C. serarius* Fr.

Pileus glutinous, glabrous, violaceous grey, then incarnate to umber brown from centre; lamellae whitish grey; stipe clavate whitish grey; context white with a greyish tinge in stipe apex. Spores amygdaliform to more ellipsoid, distinctly and densely verrucose; pileipellis simplex.

18. Cortinarius serarius Fr., Epicr.: 269 (1838). Type: not indicated. **Figs 4i, 28, 29.** Syn.: *Cortinarius eulepistus* Bidaud, Moënne-Locc. & Reumaux, Atl. Cortin. 6: (1994). Type: *P. Moënne-Loccoz* 2301 (holo. hb. Moënne-Loccoz).

Icones: Brandr. et al. (1995), *Cortin., Fl. Photogr.* 3: Pl. C25. Bidaud, Moënne-Locc. & Reumaux, loc. cit.

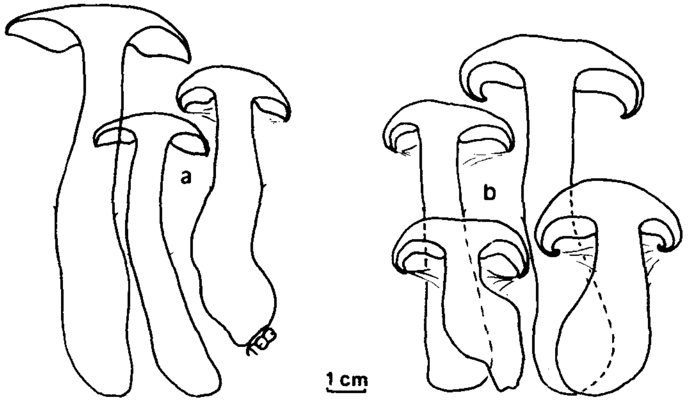

FIG. 28. (a) *C. borgsjoeensis*. Holotype CFP 728; (b) *C. serarius*. TEB 91-83.

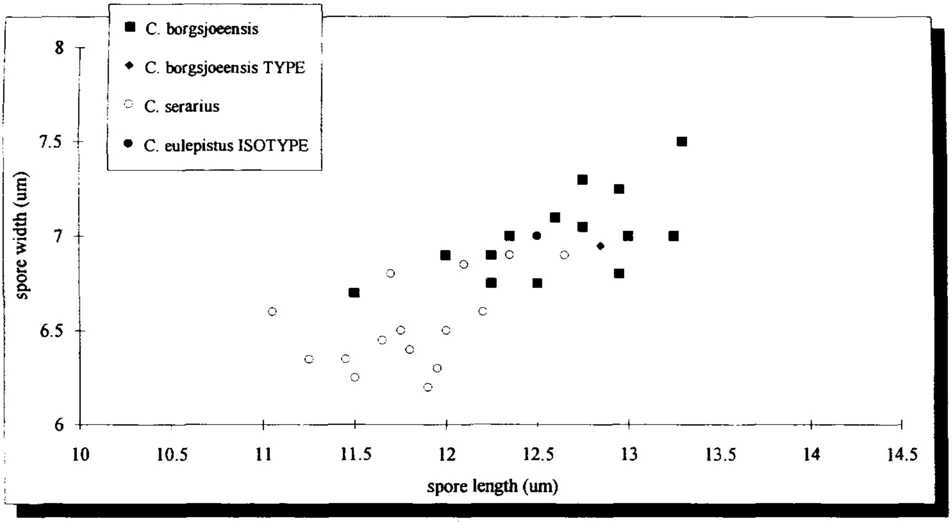

FIG. 29. Variation in spore size of *C. borgsjoeensis* and *C. serarius* (= *C. eulepistus*). Each symbol = MV of 10 spores measured per basidiocarp.

Pileus 4–9cm, (hemi-)spherical, then plano-convex to broadly umbonate, sometimes with a concentric depression near margin, often with fairly persistently involute margin, very distinctly and persistently glutinous, glabrous, often rivulose-innately fibrillose with age, cuticle easy to separate, thick and pigmented; when (very) young violaceous grey with more purplish grey-brown centre, then (ochre) greyish brown (N-P 65, N 70, M 33) with (purplish) red-brown, incarnate to umber brown centre (S-T 35, P 49, 50, N 55, N-P 57, R 33); frequently with paler ochraceous brown spots (L 50), involute margin bluish grey-white. Universal veil remnants sparse and not distinguishable. *Lamellae*, L = 60–80, (fairly) crowded, 4–8mm broad, grey to greyish white, edge frequently crenulate-serrulate. *Stipe* 5–9 x 0.8–1.3cm, irregularly clavate at base (→2cm), dull fibrillose, greyish white, or with a faint violaceous blue tinge, often slightly ochraceous yellow at base with age. Universal veil remnants fairly sparse, ochraceous white, often forming a faintly viscid girdle in lower part. Cortina fairly sparse, whitish. *Context* white with a greyish tinge in stipe apex. KOH negative. Guaiac slightly positive, ± bluish green after c.5 minutes. *Smell* distinct, pleasant, fruity or of corn or mown grass when young, later more yeast-like.

Spores 11–12.5(–13) x 6–7µm (MV = 11.86 x 6.60µm), Q = 1.80 ± 0.06, amygdaliform with broad apex to more ellipsoid, sometimes faintly citriform, finely to distinctly and densely verrucose, suprahilar plage often distinct. *Basidia* 8.5–10µm wide, 4-spored. *Lamella edge* ± sterile, of clavate-cylindrical sterile cells. *Universal veil* on pileus surface scattered to fairly abundant, frequently of 2–4 hyphal layers, hyphae narrow, 2–5(–7)µm, frequently collapsed, hyaline to (pale) yellowish, bluish reflex when very young. Universal veil on stipe surface of narrow hyphae, 3–6µm, sometimes slightly gelatinous, hyaline-granulate, rarely yellowish when collapsed.

Pileipellis simplex. *Epicutis* thick, of c.(15–)20–25 hyphal layers, and well delineated towards trama. At surface 5–10 layers of persistently gelatinous, repent, oblique or erect-sinuose hyphae, 2–4(–5)µm wide, hyaline or with pale verrucose walls, sometimes with intracellular to extracellular, hyaline, strongly refractive granules, hyphae with a bluish reflex when very young. The basal part of epicutis of c.10–15 layers of entangled, ±cemented hyphae, often forming small subparallel bundles, hyphae 3–7(–8)µm wide, with pale yellow-brown, thick walls or, especially towards surface, with pale yellow-brown, zebra-striped encrustations, some hyphae with refractive granules, some hyphae filled with (dark) brown, oleiferous pigment.

Habitat: Boreal-subalpine to rarely boreo-nemoral coniferous forests. Associated with *Picea abies* in oligotrophic-eutrophic, sometimes moist forests. In C Scandinavia occurring up to c.750m a.s.l. (near *Picea* forest limit).

Distribution: Rare but fairly widespread in N Europe. Very rare in C Europe, but recorded in E France (Bidaud et al., 1994a as *C. eulepistus*).

*Collections examined (*including macrocharacters).* NORWAY. Oppland: Lunner, TEB 167-87*, 313-87, 32-88*, 3-91, *M. Moser* 81/357 (IB, O)*; Jevnaker, TEB 185-85; Aust Torpa, TEB 80-84*; Søndre Land, TEB 107-84; Ringebu, Venabygd, TEB 3-94. Oslo, Sognsvann, TEB 86-85. Akershus, Nittedal, Gjelleråsen, TEB 91-83*, 10-84*, 11-84, *J. Melot* 85-1 (hb. Melot)*, CFP 599*. Aust-Agder: Gjerstad, TEB 22-94*; Arendal, *I.L. Fonneland*, TEB 28-94*, 7-95. SWEDEN. Västmanland, Arboga, *K. Soop*, 8 viii 1987 (S)*. Ångermanland: Häggdånger, Torrom, CFP 943*, 959*, *H. Marklund* 29 viii 1993 (O); Häggdånger, Barsviken, *H. Marklund* 23 viii 1993 (O); Säbrå, Överdal, *H. Marklund* 17 viii 1990, 27 viii 1993 (O). Västerbotten, Boliden, TEB 338-81*. FRANCE. Haute-Savoie, Ain, Arlod, Semine, *P. Moënne-Loccoz* 3479 (isotype *C. eulepistus*, hb. Moënne-Loccoz).

Comments: *C. serarius* has a characteristic violaceous grey to purplish brown pileus colour when young, sometimes reminiscent of that of *Gomphidius glutinosus* (Schaeff.) Fr. When very young the species can be mistaken for *C. cumatilis*, but the violaceous colours of *C. serarius* are always more diluted and soon fade. Furthermore, *C. serarius* lacks the volva-like, abundant, bluish universal veil of *C. cumatilis*, and has quite different microcharacters (thick, simplex pileipellis). The habit and mature pileus colours resemble those of *C. papulosus* of sect. *Elastici*, but *C. papulosus* is never bluish, has a brown veil and smaller spores. *Cortinarius serarius* also resembles *C. delaportei* R. Henry of the *C. napus* group, but this has a more or less abruptly bulbous stipe.

The pileipellis structure shows similarities to that of *C. balteatocumatilis* and to some degree *C. largus*, but the gelatinous stratum is more prominent and persistent. This is an untypical structure for the section *Phlegmacioides*, and is more similar to the structure found in the *C. napus* group or *C. papulosus–C. olidus* group. However, the species of the last groups differ in a number of other important characters, such as shape of bulb and veil colour. For the moment it seems most correct to place this isolated species in sect. *Phlegmacioides*.

Cortinarius serarius is a Friesian species (Fries, 1838), but the epithet has been little used. It was interpreted by Henry (1963) as a taxon in the *C. papulosus–C.*

olidus group (sect. *Elastici*), probably a variant of *C. papulosus*. However, the protologue of *C. serarius* lacks important, diagnostic characters for that group, such as a finely diffracted-granulate pileus centre and brown veil girdles. On the other hand, the presently treated species shows clear resemblance to the species of sect. *Elastici*. The protologue of *C. serarius*, although vague, fits with the species described here, except that the initially bluish tinges on the pileus are not mentioned. *Cortinarius serarius* was placed by Fries (1838) next to the violaceous *C. cumatilis*, which in many respects is reminiscent of the present species. The pileus colours indicated by Fries (red-brown or flesh-coloured) fit well with the colour of mature pilei of the species described here. The unpublished, Friesian plate at Uppsala (no. U 0713; see Strid, 1994) is also in correspondance with this concept.

Cortinarius serarius is probably a more or less northern species, hitherto known mainly from N Europe, and after Fries apparently not mentioned in the mycological literature until it was recently treated by Bidaud et al. (1994a) under the name *C. eulepistus*.

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