The genera *Conocybe* and *Pholiotina* (Agaricomycotina, Bolbitiaceae) in temperate Asia

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Abstract: 44 taxa of *Conocybe* and *Pholiotina* are reported from Siberia, Georgia and some of the countries in Middle Asia mostly based on the authors own collections. Three of them are described as new species, viz. *C. semidesertorum* Hauskn. & Kalamees, *C. obliquopora* Hauskn. & Kalamees and *C. uralensis* Hauskn., Knudsen & Mukhin. A further two and a variety are probably also new but not validly described due to insufficient material. A number of species are new records for Asia, or for Siberia, or for one of the four countries, Georgia, Tadjikistan, Turkmenistan and Uzbekistan. A number of the species are rarely reported presumably due to their main distribution being in dry, grassy steppezones with soils of high pH values. This mycogeographical element includes e.g. *C. enderlei*, *C. graminis*, *C. herbarum*, *C. leporina* and *C. subxerophytica*, so far mostly or only known from the steppezone in eastern and central Europe through to Middle Asia. *Pholiotina altaica* and *P. procera* from Altaj are redescribed from the types. Several taxa are provided with macro- and/or microscopic data, taxonomic descriptions and drawings of microscopic features. The taxonomic reliability of the taxa presented in the literature up to the present time has been reviewed critically.

Kokkuvõte: Perekonnad *Conocybe* ja *Pholiotina* (Agaricomycotina, Bolbitiaceae) parasvöötmelises Aasias


INTRODUCTION

The saprotrophic agaric genera *Conocybe* and *Pholiotina* (Bolbitiaceae, Agaricomycotina) are wide-spread in temperate Asia, which, according to Brummitt (2001), consists of four biogeographic units (Transcaucasia, Middle Asia, Siberia and Russian Far East). Taxa of these genera are characterized by a very wide ecological amplitude. They have been recorded from open site types (grasslands, lawns, etc.) to forest and brushwood site types (mainly with deciduous trees and brushes), in parks and gardens, from damp places of rivers and brooks to dry grasslands on mountain slopes. They occur on a large variety of substrata: rich, often manured soils, humus, dung, rotten wood, sawdust, woody debris, herbaceous or leaf litter, compost heads, etc.

The biogeographic units mentioned above were parts of the former Soviet Union. At present, the areas under discussion belong to the Russian Federation (Siberia and Far East), to the republics of Middle Asia (Kazakhstan, Tadjikistan, Turkmenistan, Uzbekistan) and Transcaucasia (Georgia).

The genera *Conocybe* and *Pholiotina* were little studied in temperate Asia. The reason lies in insufficient taxonomic investigations, the lack of literature, high macromorphological similarity and variability between the fruit bodies of different taxa, etc., which made precise identification
of taxa almost impossible (see the „Species list reviewed from literature” presented below). However, it is noticeable that the genus *Conocybe* with a poorly known species composition up to now, is the most wide-spread genus of agarics in the semidesert and semisavanna site types of Middle Asia during the early spring raining period (March and April).

Hausknecht is responsible for the identifications and taxonomical notes to the material. The other authors of this paper have collected the material and made the field notes (cf. also Hausknecht, 2009).

**MATERIAL AND METHODS**

The 94 collections of *Conocybe* and *Pholiotina* treated in this paper was mainly collected by Estonian, Danish, Finnish and Slovakian mycologists in the above-mentioned regions of temperate Asia during field work in 1970–2008.

In Middle Asia (Kazakhstan, Tadjikistan, Turkmenistan, Uzbekistan), fungi were collected from March to June 1971–1990 by the Estonian mycologists (from Tartu) K. Kalamees, B. Kullman, I. Parmasto, A. Raitviir, L. Pihlik, M. Vaasma; in Russia (Siberia and Far East) from July to September 1970–1987 by K. Kalamees, B. Kullmann and M. Vaasma; in Transcaucasia (Georgia) in April 1977 by K. Kalamees.

The Finnish mycologist Y. Mäkinen (Turku) collected material from Uzbekistan in April 1992. In annual expeditions running from 1990 to 2006, „the Scandinavian-Russian Transsiberian Mycological Expeditions”, organized by V. Mukhin and H. Knudsen, the following mycologists made collections included in this paper: H. F. Gotzsche, H. Knudsen and T. Læssøe (Denmark), S.-Å. Hanson (Sweden) and U. Peintner (Austria).

The Slovakian mycologist S. Adamčík collected material in Russia, near Lake Bajkal in Siberia in August and September 1994, the German mycologist P. Karasch in Russia, Altaj in July 2008.

From the earlier material, the exsiccates of *Conocybe echinata*, *Pholiotina altaica* and *P. procera* collected by R. Singer and L. Vasil’eva or R. Singer from the Altaj from July to September 1937 were studied. The specimen of *Pholiotina vestita* from Ab’khazet’i (Georgia) by O. Terney 1986 was also included in the paper. In addition, the finds of *Conocybe semidesertorum* by P. Uotila in Afghanistan, May 1972, and of *C. halophila* by Gilli in Afghanistan in April 1951 were also studied.

Microscopical examination was performed with an Olympus BH-2 mikroskope, in ca. 5% KOH, ca. 25% ammoniac or for better visibility of outlines in preparation fluid L4K of Clémençon (with congored). Microscopical drawings were made with the help of a drawing apparatus with an enlargement of 1:2500 (spores) or 1:1000 (other microstructures) und subsequent reduction to 80%.

The geographical place names and administrative divisions of the countries correspond to those used in Comprehensive Atlas of the World (Anonymous, 2005). Russian geographical place names have been transliterated into English according to the rules established by Butcher (2004).

**SPECIES LIST REVIEWED FROM LITERATURE**

Some taxa of the genera *Conocybe* and *Pholiotina* are reported from the region considered in earlier literature, mostly without macro- or microscopical descriptions and therefore difficult to interpret. Nevertheless, we want to cite all the records known to us even though we have not examined them.

**Conocybe ambigua** (Kühner) Singer was listed from Russia, Siberia, Krasnoyarsk Terr. by Beglyanova (1972a) and from Far East, Sikhote-Alin’ by Azbukina et al. (1984) as well as from Turkmenistan, Kopetdag by Batyrova (1985). This species has very particular spores, so a confusion could be possible only with *C. bispora* (Singer) Hauskn., which has smaller and darker coloured spores in KOH and a different stipitipellis without lecythiform caulocystidia. Until now *C. bispora* has not been reported from Asia.

**Conocybe antipus** (Lasch) Fayod was reported by Beglyanova (1972a) and from Far East, Sikhote-Alin’ by Azbukina et al. (1984) as well as from Turkmenistan, Kopetdag by Batyrova (1985). This species has very particular spores, so a confusion could be possible only with *C. bispora* (Singer) Hauskn., which has smaller and darker coloured spores in KOH and a different stipitipellis without lecythiform caulocystidia. Until now *C. bispora* has not been reported from Asia.
Conocybe brunneola (Kühner) Kühner & Romagn. was reported by Nezdojminogo (1973) and Petrov (1991) from Russia, Siberia, Pribajkal’ye, and by Samgina (1985) from Kazakhstan. This taxon, currently known as C. microspora (Ve- len.) Dennis var. brunneola (Kühner & Watling) Singer & Hauskn., is easily recognizable by its small, phaseoliform spores. Outside Europe it is reported only from South America (Brazil).

Conocybe cryptocystis (G. F. Atk.) Singer was reported by Batyrova (1985) from Turkmenistan and by Melik-Khachatryan et al. (1985, s. n. C. eriptocystis) from Georgia. As Hausknecht et al. (2004) stated, the true C. cryptocystis is known only from USA, California, and it is different from C. subpubescens P. D. Orton and Galera tenera ss. Ricken (given as synonyms by Batyrova, 1985). We think that the present collections represent C. subpubescens.

Conocybe lactea (J. E. Lange) Métrod was reported by Azbukina et al. (1984), Beglyanova (1972a) and Stolyarskaya (1989) from Russian Far East, by Samgina (1985) from Kyrgyzstan and by Melik-Khachatryan et al. (1985) from Georgia. As Hausknecht (1998) stated, the taxon has to be named C. albipes (G. H. Otth) Hauskn. It is easily recognisable even macroscopically and has a world-wide distribution.

Conocybe leucopus Kühner & Watling was reported by Batyrova (1985) from Turkmenistan. This taxon is only known from the type collection (Morocco) and from one Argentinean find by Singer (Hausknecht & Krisai-Greilhuber, 2006). Therefore, the report from Turkmenistan remains doubtful as long as no microscopical data are available.

Conocybe magnicapitata P. D. Orton was listed by Batyrova (1985) from Turkmenistan, Kopetdag. The current name is Conocybe juniana (Velen.) Hauskn. & Svrček and it is subdivided in three varieties. It is unknown which one of them has been collected in Kopetdag.

Conocybe mesospora Kühner & Watling was reported by Vasil’eva & Nazarova (1967), Vasil’eva (1973) and by Kharkevich (1978) from the Primorye Terr., Russian Far East, by Beglyanova (1972a) from Krasnoyarsk, Siberia, by Azbukina et al. (1986) from the Russian Far East, and by Melik-Khachatryan et al. (1985) from Georgia. The knowledge of this taxon was based on Küh- ner (1935), who distinguished several varieties, all of them now considered as independent species. Therefore, it is not possible to interpret the above records.

Conocybe microgranulosa Batyrova was described as new from Turkmenistan by Batyrova (1985). Unfortunately, it was not possible to get the holotype on loan to and study it. Following the Latin description, it is a member of sect. Conocybe. The microscopical data and the stipe basis (not rooting) as well as the habitat on bare soil lead to series Tenera, close to the group of C. tenera. The robust basidiocarps and the somewhat granulose pileus surface do not fit to one of the known taxa, but without microscopical examination nothing can be said on its true identity.

Conocybe pilaressa (Frt.) Kühner was reported twice from Russia, Far East by Azbukina et al. (1984, 1986). This species, microscopically easily recognizable by very small spores without germ-pore, has a nearly world-wide distribution.

Conocybe pubescens (Gillet) Kühner was reported from Russia, Siberia, Pribajkal’ye, by Nezdojminogo (1968, 1973) and Petrov (1991) and from Krasnoyarsk Terr. by Beglyanova (1972a). As most of dung inhabiting species in the past were determined as C. pubescens the identification of these finds remains doubtful.

Conocybe rickeniana Singer was reported from Russian Far East by Azbukina et al. (1986), from Georgia by Kanchaveli et al. (1986) and Melik-Khachatryan et al. (1985), from Turkmenistan by Batyrova (1985), and from Russia, Siberia, Pribajkal’ye by Petrov (1991). This member of sect. Conocybe series Magnicapitata, recognizable by its cheilo- and caulocystidia with very large capitu-la and small, thin-walled spores, has only been safely confirmed from Europe. It can easily be confused with small specimens of C. juniana (Velen.) Hauskn. & Svrček var. subsejuncta Hauskn. Differing by somewhat larger, thicker-walled spores which are also darker in KOH. The latter was collected in Georgia by Kalamees (see below).

Conocybe rickenii (Jul. Schäff.) Kühner. Two literature reports exist of this taxon from temperate Asia: Batyrova (1985) lists it from Turkmenistan and Vasil’eva & Nazarova (1967) from Russia, Far East, Primorye Terr. While collections from dung are easily recognizable it
is somewhat difficult to distinguish records on fertilised soils from *C. siliginea* (Fr.) Kühner – see also Hausknecht & Passauer (1997).

**Conocybe semiglobata** (Kühner & Watling) Kühner is listed by Azbukina et al. (1984) from Russia, Far East and by Batyrova (1985) from Turkmenistan. The taxa from the group of *C. semiglobata*- *C. tenera* are now taken in a more narrow sense and several new taxa are described since Kühner’s monograph (1935). It is therefore impossible to say which of the new taxa could be involved. The collections cited by Kalamees (1989) from Uzbekistan were restudied and they represent *C. semiglobata* in the current, narrower sense.

**Conocybe sienophylla** (Berk. & Broome) Singer was reported by Azbukina et al. (1984, 1986) from Russia, Far East and by Batyrova (1985) from Turkmenistan. Recent studies in this group (Hausknecht, 2005) resulted at least in three different and independent species formerly integrated in *C. sienophylla*. Therefore, an interpretation is impossible without microscopical data.

**Conocybe siliginea** (Fr.) Kühner is along with *C. tenera* the most frequently cited taxon of the genus in the literature from temperate Asia (e.g. Azbukina et al., 1985, 1986; Batyrova, 1985; Beglyanova, 1972a; Kharkevich, 1978; Melik-Khachatryan et al., 1985; Nazarova & Vasil’eva, 1974; Petrov, 1991; Shalapugina, 1974 and Vasil’eva & Nazarova, 1964, 1972). The interpretation of these collections is almost as impossible as in *C. tenera*.

**Conocybe spicula** (Lasch) Fayod was listed by Nazarova (1986) from Russian Far East. *C. spicula* ss. Kühner (1935) is now called *Conocybe rickeniana* P. D. Orton, while *Agaricus spiculus* Lasch in the original sense is a totally different fungus not belonging to the *Bolbitiaceae* (Watling & Gregory, 1981).

**Conocybe subovalis** (Kühner) Kühner & Romagn. was reported by Melik-Khachatryan et al. (1985) from Georgia and by Petrov (1991) from Russia, Pribajkal’ye. The collection reported by Kalamees (1989) from Uzbekistan, Zaamin National Park, was restudied and turned out to be *C. semiglobata*. The collection listed in Kalamees & Vaasma (1981) as *C. subovalis* ss. Moser turned out to be an undescribed taxon, *C. semiglobata* var. *campanulata* Hauskn. It will be published in Hausknecht (2009).

**Conocybe tenera** (Fr.) Kühner was reported from several areas in Russia, Kazakhstan, Kyrgyzstan, Turkmenistan, Armenia and Georgia by Samgina (1985) as well as by other authors (e.g. Azbukina et al., 1986; Batyrova, 1985; Beglyanova, 1972a, 1972b; Kanchaveli et al., 1986; Melik-Khachatryan et al., 1985; Nakhurstsrivili, 1964, 1975; Nazarova, 1976; Nezdojminogo, 1968, 1970; Perova, 1972; Petrov, 1991; Petrova, 1983 and Vasil’eva & Nazarova, 1977). However, since this taxon has been strongly redefined and now is taken much more narrowly, we think that these records cannot be considered here before restudying them. In the experience of Hausknecht more than ¾ of all determinations of *C. tenera* from before 1982 (Watling, 1982) are wrong.

**Conocybe tenera** f. minor J.E. Lange was reported by Batyrova (1985) from Turkmenistan. This is a later synonym of *Conocybe juniana* (Velen.) Hauskn. & Svřeček, a species now divided in three varieties. It is impossible to say which one was found in Turkmenistan.

**Galera siliginea** Fr. from Russia, Pribajkal’ye reported by Karsten (1909), most likely represents *C. fuscimarginata* (Murrill) Singer. A few collections from Finland determined by Karsten as *G. siliginea* and restudied by Hausknecht turned out to be *C. fuscimarginata*.

**Galera tenera** (Schaeff.) Fr. was reported by Karsten (1909) from Russia, Pribajkal’ye. Hausknecht studied altogether six collections from Finland determined by Karsten as *G. tenera*. They represent five different taxa of *Conocybe*, therefore it is impossible to know which one Karsten had from Russia.

**Galera teneroides** Pers. ss. Lange is reported by Nakhurstsrivili (1958) from Georgia. This is *Conocybe rickeniana* P. D. Orton – see above.

**Galerella plicatella** (Peck) Singer was reported by Nezdojminogo (1973) and by Petrov (1991) from Russia, Pribajkal’ye, by Batyrova (1985) from Turkmenistan, and by Melik-Khachatryan et al. (1985) from Georgia. In the interpretation of this taxon up to 2003 these collections represent probably *Pholiotina sulcata* Arnolds & Hauskn. (Arnolds & Hausknecht, 2003). The true *Galerella plicatella* as described from
North America has a more southern distribution and was found only once in Europe, in Italy (Hausknecht & Contu, 2003).

_**P. aberrans** (Kühner) Singer is reported by Kharkevich (1978) from Russian Far East. Following Hausknecht (2007) the correct name of the taxon is _P. filipes_ (G. F. Atk.) Singer. This species seems not to be rare in temperate Asia (see below).

_**P. aporos** (Kits van Wav.) Clémençon is listed by Petrova (1983) from Uzbekistan. The combination of annulate stipe and spores without germ-pore is unique in the genus therefore we have no reason to doubt the correctness of the determination.

_**P. blattaria** (Fr.) Fayod is the most reported taxon of the genus in temperate Asia, e.g. Batyrova (1985), Beglyanova (1972a), Petrov (1991), Kanchaveli et al. (1986), Kharkevich (1978), Melik-Khachatryan et al. (1985) and Nezdojminogo (1970). If it is used in the sense of Cooke (1891), Ricken (1915), and Kühner (1935), these collections refer to _P. arrhenii_ (Fr.) Singer, a common species in the northern hemisphere. _Pholiotina blattaria_ ss. Fayod is now _P. vexans_ P. D. Orton, also a common species. This was reported by Singer (1931) from the Svanetiya (Georgia).

_**P. brunnea** (J. E. Lange & Kühner) Singer was reported by Kovalenko & Nezdojminogo (1989) from Russian Far East. This taxon is recognizable by its peculiar cheilocystidia reminding of a _Conocybe_ species, so there is no reason to doubt the identity of this collection.

_**P. Coprophila** (Kühner) Singer is reported by Melik-Khachatryan et al. (1985) from Georgia. There is no reason to doubt the identity of this easily determinable species.

_**P. cyanopus** (G. F. Atk.) Singer is reported by Azbukina et al. (1984) from Russia, Far East, Sikhote-Alin’ Mountains. This is the third collection known to us from East Asia (see below).

_**P. exannulata** (Kühner) Kühner & Romagn. was reported from Russian Far East by Kharkevich (1978), Azbukina et al. (1984, 1986) and Nazarova in Vasil’eva (1973) as well as by Batyrova (1985) from Turkmenistan. As this taxon is extremely rare and has been redefined recently in a narrower sense (Hausknecht, 2009), the Russian records are considered not interpretable.

_**P. fibrillosipes** (Watling) Singer was reported by Kovalenko & Nezdojminogo (1989) from Russian Far East. The taxon is considered to be a synonym of _P. brunnea_ (Watling) Bon by Hausknecht et al. (2004).

_**P. filaris** (Conocybe) was reported several times from temperate Asia, e.g. by Azbukina et al. (1984), Beglyanova (1972a), Kharkevich (1978) and Kovalenko & Nezdojminogo (1989). The current name of this species is _P. rugosa_ (Peck) Singer (following Arnolds, 2005), but it is also possible that _P. arrhenii_ (Fr.) Singer is included.

_**P. intermedia** (A. H. Sm.) Singer was listed by Azbukina et al. (1986) and by Kovalenko & Nezdojminogo (1989) from Russian Far East. The epithet “intermedia” was used in the past partly for an annulate taxon and also for a species with appendiculate veil. As no information is given about veil conditions, interpretation is impossible.

_**P. pygmaeoaffinis** (Fr.) Singer was reported by Melik-Khachatryan et al. (1985) and by Kanchaveli et al. (1986) from Georgia. The spores given in the key by the latter are 8.5–10×5.5×6 µm so we have no reason to doubt that this is _P. pygmaeoaffinis_ in the actual sense.

_**P. septentrionalis** (A. H. Sm.) Singer was reported by Azbukina et al. (1984), Nazarova in Vasil’eva (1973), Kharkevich (1978) and Melik-Khachatryan et al. (1985), probably based on Singer’s interpretation of the taxon in 1951. He (1951) distinguished several subspecies with annulate or appendiculate veil respectively. Two of these subspecies are currently distinguished at species level. As we do not know the veil conditions in the collections mentioned above no interpretation is possible.

_**P. subnuda** (Kühner) Singer was reported by Azbukina et al. (1984) from Russia, Far East, Sikhote-Alin’ Mountains. This taxon should now be called _P. dasypus_ (Romagn.) P.-A. Moreau (Moreau, 2005) and is known from Europe and Asia.

_**P. togularis** (Fr.) Fayod was reported by Vasil’eva et al. (1963), Kharkevich (1978), Bulakh (1984) and Azbukina et al. (1984) from...
Russian Far East, and by Beglyanova (1972a) from Siberia. If the epithet “togularis” is used in the sense of Kühner (1935), this is *P. vexans* P. D. Orton, but if not no actual interpretation is possible.

**Pholiota togularis** (Fr.) Fayod *f.* **Bispora** Singer is reported from Russian Far East by Azbukina et al. (1984) and Kharkevich (1978). This is *P. teneroides* (J. E. Lange) Singer in actual interpretation (Hausknecht, 2009) and was found once also in the Ural Mountains (see Hausknecht, 2009).

**Pholiota vestita** (Fr.) Singer was listed by Nazarova & Vasil’eva (1974) from Russia, Amur Prov. It is known to occur in Europe, Asia and Africa.

### SPECIES LIST FROM MATERIAL


**Conocybe Fayod**, Sect. Conocybe series Tenera

**Conocybe macrocephala** Kühner & Watling

This well defined species is common in Europe. Outside Europe, the only known records come from Uzbekistan.

Spore size, stipe covering and pileipellis fit well with material from Europe.


**Conocybe semiglobata** Kühner & Watling var. semiglobata

The species occurs frequently in open grassland, from lowland to alpine elevations. It is one of the most common taxa worldwide.

Some collections from Middle Asia have cystidia with a bit larger capitula than European material and absolutely negative ammonia reaction, but this is within the variability of this taxon.

**Material examined:** Russia. Siberian Federal Okrug, Tajmyr Peninsula, Bol’shaya Kheta, on debris and clay along a river, 2.8. 1992, H. Knudsen (C 17271).

Kazakhstan. Southern Kazakhstan, Shymkent, Stepenoye, in floodplain grassland with *Tamarix* and *Salix*, 20.4. 1982, K. Kalamees (TAAM 122310, 122313, 122315).

Tadjikistan. Gorno-Badakhshon, Darvoz Range, Qal’aikhum Pass, on alpine meadow, 3300 m s. m., 24.6. 1982, M. Vaasma (TAAM 114720).


Navoiy Prov., Aqtou Range, Langar, 1500 m s. m., on humid grassy slope, 14. 5. 1980, K. Kalamees (TAAM 121236), in garden, in grass, 15. 5. 1980, K. Kalamees (TAAM 121239).

**Conocybe semiglobata** Kühner & Watling var. campanulata Hauskn.

Fig. 1 a–d.

Pileus 20–30 mm wide, campanulate, yellowish brown, hygrophanous, translucently striate when moist. Lamellae adnate, moderately crowded, yellowish brown. Stipe up to 150 mm long, 1–2 mm wide, evidently not rooting in exciscatum, brighter yellowish brown than pileus, becoming darker brown near the base; surface completely pubescent. Exsiccatum: pileus, lamellae and stipe yellowish brown. Spores 13–17×6.5–9.5 µm, average 14.9–16.1×7.9–8.3 µm, Q=1.7–2.1, elongate ellipsoid, not lentiform, thick-walled with up to 2 µm broad germ-pore, red-brown in KOH. Basidia 4-spored, 21–31×12–16 µm. Clamp connections frequent. Cheilocystidia lecythiform, 15–22×6.5–10 µm, with 3–5 µm wide capitula. Ammonia reaction negative. Stipitipellis consisting of lecythiform caulocystidia similar to cheilocystidia (14–25×8–15 µm, with capitula 3.5–5.5 µm wide), in one collection intermixed with scattered cylindrical to ellipsoid non-lecythiform elements. Pileipellis hymeniform, consisting of sphaeropedunculate elements, no pileocystidia seen.

The macroscopical description is taken from TAAM 113018. This variety, described as new by Hausknecht (2009), differs from var. *semiglobata* by essentially larger, elongate ellipsoid spores and often also by a more campanulate pileus. It seems to have its centre of distribution in boreal Europe. The two collections from Kamchatka are the only known from outside of Europe and are microscopically nearly identical with the type collection from Germany.

**Conocybe subxerophytica** Singer & Hauskn. var. *subxerophytica*

Fig. 1 e–h.

Spores 10–12×6.5–7.5×6–6.5 µm, average 11.0×6.8×6.2 µm, Q=1.6–1.8, ellipsoid, ovoid-ellipsoid, not angular or hexagonal, slightly to distinctly lentiform, thick-walled with up to 1.5 µm wide germ-pore, orange-rubiginous in KOH.

Basidia 4-spored, 15–20×8–11 µm. Clamp connections present. Cheilocystidia lecythiform, 15–21×7–10 µm, with 3–5.5 µm wide capitula. Ammonia reaction negative. Stipitipellis consisting of lecythiform caulocystidia (14–20×7–10 µm, with capitula up to 4 µm wide). Pileipellis hymeniform, consisting of sphaeropedunculate elements; pileocystidia similar to cheilocystidia present.

The single small basidiocarp of *C. subxerophytica* was isolated from collection TAAM 143561, therefore no macroscopical description is available. The exsiccatum with small basidiocarp, greyish-beige pileus, quite distant lamellae and brownish stipe fit well with material from Austria, and the microscopical characters are also similar, except that the spores are less distinctly lentiform.

*C. subxerophytica* is a species of dry meadows, south-exposed loess slopes or semi-steppes on sandy or gravelly soil. It is known from Europe, South America and now from Siberia.


**Conocybe obliquopora** Hauskn. & Kalamees sp. *nova*

Fig. 3 f–j.

Species sectionis Conocybe, seriae Tenera prope Conocybem subxerophyticam var. *subxerophytica* vel var. *brunnea* ab eis sporis 8.5–12×6.5–8×5–6.5 µm, in medio 10.9×7.4×6.2 µm, Q=1.3–1.6, poro germinativo distinete excentrico munitis habitationeque in silvis differt.


Pileus 5–10 mm wide, convex to campanulate, yellowish rusty brown when dry, surface radially wrinkled. Lamellae adnate, distant, rusty brown. Stipe 50 mm long, up to 1 mm thick, cylindrical, filiform, with bulbous base with white mycelial tomentum, yellowish rusty brown, completely fine pubescent. Exsiccatum: pileus and stipe yellowish brown, lamellae distinctly darker, ferrugineous. Spores 8.5–12×6.5–8×5–6.5 µm, average 10.9×7.4×6.2 µm, Q=1.3–1.6, ellipsoid, distinctly lentiform, thick-walled with distinctly eccentric germ-pore, rusty brown in KOH. Basidia 4-spored, 20–23×10–13 µm. Clamp connections numerous. Cheilocystidia lecythiform, 14–18×7.5–11 µm, with capitula 3–4 µm wide. Ammonia reaction negative. Stitipellis consisting of only lecythiform caulocystidia similar to cheilocystidia present.

This taxon with its stipitipellis consisting of only lecythiform caulocystidia, large, distinctly lentiform and dark coloured spores is placed in sect. *Conocybe* series *Tenera*, near *Conocybe subxerophytica*. The taxon differs from *C. subxerophytica* in having spores with eccentric germ-pore, darker coloured pileus and stipe, and the habitat in deciduous forests. *Conocybe subxerophytica* var. *brunnea* has the colours of pileus and stipe in common with the new species, but differs in lamellae being less distant, more stout basidiocarps, habitat and above all in the distinctly eccentric germ-pore. Since an eccentric germ-pore is considered a decisive discriminating character in *Conocybe*, similar to *Coprinus*, we decided to describe the Uzbekistan collection as a new species.

**Conocybe sp. 1**

Fig. 1 i–l.

Spores 11.5–14×7–8.5×6.5–7.5 µm, average 12.8×7.8×7.2 µm, Q=1.5–1.7, irregularly ellipsoid, often subcylindrical or angular, slightly lentiform, thick-walled with wide germ-pore, reddish brown in KOH. Basidia 4-spored, 25–32×10–13 µm. Clamp connections present. Cheilocystidia lecythiform, 16–21×6.5–9 µm, with capitula 3–4.5 µm wide. Ammonia reaction negative. Stitipellis with lecythiform caulocystidia (20–32×7–10 mm, with capitula
3–4.5 µm wide), not mixed with hairs or non-lecythiform elements. Pileipellis hymeniform, composed of sphaeropedunculate elements. No pileocystidia seen.

Examined collection has much similarity to *C. subxerophytica*, except for the subcylindrical or angular spores never observed in that species. Also, the colour of the exsiccatum is different. This could be an undescribed taxon, but the material is too poor to be used as type material.


Sect. *Conocybe* series *Leucopus*

**Conocybe ammophila** M. Lange

This species, originally described from Greenland, was discovered 2005 in Central Asia, Mongolia, by P. Karasch (see Hausknecht & Karasch 2008). A recent find was recorded by the same collector in the Altaj Republic in Russia, too.

*C. ammophila* is one of the largest and stoutest members of the genus and evidently extremely rare. Up to now, it is only known from Greenland, Mongolia and now from Russia.


Sect. *Conocybe* series *Mesospora*

**Conocybe microspora** (Velen.) Dennis

Pileus 10 mm wide, yellow, surface with salt layer, evidently desiccated, no striation visible. Lamellae decurrent with a tooth, dark yellow. Stipe 40×1 mm, light yellowish white. Exsiccatum beige yellow. Spores 5–7.5×3–4.5 µm, average 6.2×3.9 µm, Q=1.3–1.8, ellipsoid, thick-walled without any germ-pore or callus, brownish orange in KOH. Basidia 4-spored, ca. 25×10 µm. Clamp connections present. Cheilocystidia lecythiform, 16–22×7.5–9 µm, with capitula 4–5 µm wide. Ammonia reaction negative. Stipitipellis made up of lecythiform caulocystidia similar to cheilocystidia, 10–20×7–9 µm, with capitula 3.5–5 µm wide. Pileipellis hymeniform consisting of sphaeropedunculate elements; pileocystidia absent.

The spore size of the Tigrovaya Balka collection is somewhat aberrant being in average about 1 µm larger than in European material. As all other characters are in concordance, there is no doubt that this is *C. enderlei*.

This rare taxon is known from Europe and from two collections from Asia (Afghanistan, Tadjikistan). No collections are known from other continents.


Sect. *Conocybe* series *Enderlei*

**Conocybe enderlei** Hauskn. var. *enderlei*

Fig. 2 a–d.

Pileus 10 mm wide, yellowish brown, darker in centre, conical, completely covered with salt layer, no striation seen. Lamellae adnate, light brown. Stipe cylindrical with slightly curved base, light yellowish brown. Exsiccatum brownish (bad condition). Spores 7.5–9.5×4.5–5 µm, average 8.4×4.9 µm, Q=1.5–1.8, ellipsoid, thick-walled without any germ-pore or callus, brownish orange in KOH. Basidia 4-spored, ca. 25×10 µm. Clamp connections present. Cheilocystidia lecythiform, 16–22×7.5–9 µm, with capitula 4–5 µm wide. Ammonia reaction negative. Stipitipellis made up of lecythiform caulocystidia similar to cheilocystidia, 10–20×7–9 µm, with capitula 3.5–5 µm wide. Pileipellis hymeniform consisting of sphaeropedunculate elements; pileocystidia absent.

The spore size of the Tigrovaya Balka collection is somewhat aberrant being in average about 1 µm larger than in European material. As all other characters are in concordance, there is no doubt that this is *C. enderlei*.

This rare taxon is known from Europe and from two collections from Asia (Afghanistan, Tadjikistan). No collections are known from other continents.


Sect. *Conocybe* series *Magnicapitata*

**Conocybe echinata** (Velen.) Singer

Within the holotype material of *Conocybe albocinernea* Singer (doubtful species, see Hausknecht 1998, 2009) there was one basidiocarp with the typical characters of *C. echinata*. Typical for it are the sordid brown colours of the basidiocarps and the large cheilo- and caulocystidia with very wide capitula.
**Material examined:** Russia. Siberian Federal Okrug, Altaj Rep., Altaj Mts., Kuraj, 9. 8. 1937, R. Singer (LE 17609II, part of holotype of *Conocybe albocinerea*).

**Conocybe juniana** (Velen.) Hauskn. & Švrček var. *subsejuncta* Hauskn.

Pileus 15 mm wide, acutely conical, completely yellowish brown when dry. Lamellae adnate, light brown. Stipe 100×2 mm, brownish in exsiccatum, surface completely pubescent. Exsiccatum: pileus and stipe pale rusty brown, stipe brownish, not radicant. Spores 7.5–10.5×4–6 µm, average 9.0–9.3×4.8–5.6 µm, Q=1.5–1.9, ellipsoid, not lentiform, thick-walled with distinct germ-pore, ochre-yellow to ferrugineous in KOH. Basidia 4-spored, 15–20×8.5–11 µm. Clamp connections present. Cheilocystidia lecythiform, 15–30×8–16 µm, with capitula 5–9 µm wide. Ammonia reaction negative. Stipitipellis with exclusively lecythiform caulocystidia (22–36×12–20 µm, with capitula 5.5–10 µm wide). Pileipellis hymeniform, consisting of sphaeropedunculate elements. Pileocystidia similar to cheilocystidia present.

Macroscopical description is taken from TAAM 83570. The material from Tadjikistan fits perfectly with European collections. The material from Georgia has narrower, often sub-cylindrical, not so distinctly thick-walled spores that are also dark coloured in KOH. The spore characters and also the colour of the exsiccatum (pale rust brown) exclude conspecificity with the closely related *C. echinata*, but there are some resemblances in size of basidiocarps with *C. rickeniana*.

**Material examined:**


**Conocybe graminis** Hauskn.

Pileus 10–13 mm wide, broadly conical, campanulate to convex, ochre-yellow to yellowish brown, hygrophanous, translucently striate or not when moist, surface glabrous. Lamellae slightly distant in exsiccatum, narrowly adnate, slightly decurrent along the stipe, bright brown. Stipe 30–50×1–2 mm, pale, whitish to dirty brown, in exsiccatum distinctly radicant, completely granular-pubescent, especially at the top. Exsiccatum: pileus and stipe ochre yellow, lamellae ferrugineous, moderately distant. Spores 7–10×4–7 µm, average 8.1–9.0×5.0–5.7 µm, Q=1.5–1.8, ellipsoid to sublimoniform, not lentiform, with distinct germ-pore, orange yellow to yellow in KOH. Basidia 4-spored, 15–20×8.5–11 µm. Clamp connections present, but often rare. Cheilocystidia lecythiform, 18–25×7–9 µm, with 2.5–4.5 µm wide capitula. Ammonia reaction negative. Stipitipellis predominately with lecythiform caulocystidia similar to cheilocystidia, but near the apex mixed with ellipsoid to elongate-ellipsoid elements. Pileipellis hymeniform, composed of sphaeropedunculate elements, without pileocystidia.

Description is taken from C 45276. In Europe, *C. graminis* is a species of poor and dry meadows, exposed loess slopes, on gravelly, sandy or loess underground. It was found also in North Africa (Hausknecht 2009). Most of the European collections come from the eastern and south-eastern Europe with a continental climate. Therefore, its discovery in Central Asia is not a big surprise and this may well be the true centre of its distribution.

The Asian material is typical in all characters. The pseudorrhiza is sometimes lacking when the basidiocarp rises directly from grass roots. In the Uzbekistan material, a pseudorrhiza is distinctly visible also in the exsiccatum.

**Material examined:**


**Conocybe herbarum** Hauskn.

Fig. 2 i–m.

Pileus 8–20 mm wide, broadly conical, campanulate to convex, ochre-yellow to yellowish brown, hygrophanous, translucently striate or not when moist, surface glabrous. Lamellae slightly distant in exsiccatum, narrowly adnate, slightly decurrent along the stipe, bright brown. Stipe 30–50×1–2 mm, pale, whitish to dirty brown, in exsiccatum distinctly radicant, completely granular-pubescent, especially at the top. Exsiccatum: pileus and stipe yellowish brown, lamellae slightly darker. Spores 7.5–10×5.5–6.5 µm, average 8.1×5.9 µm, Q=1.4–1.6, broadly ellipsoid to almond shaped, not lentiform, with thick wall.
and small, sometimes indistinct, central germ-pore, orange yellow in KOH. Basidia 4-spored, 18–25×9–12 µm. Clamp connections present. Cheilocystidia lecythiform, 17–22×6.5–8.5 µm, with 3–4.5 µm wide capitula. Ammonia reaction negative. Stipitpellis with lecythiform caulocystidia (15–22×5–8 µm, with capitula up to 4 µm), at the apex of the stipe mixed with scattered hair-like elements (up to 30×4 µm). Pileipellis hymeniform made up of large sphaeropedunculate elements (35–65×17–26 µm), without pileocystidia.

**Conocybe herbarum** is a very rare species up to now found only in Austria and France. The Turkmenistan material differs microscopically only in spore characters (the germ-pore is smaller, often indistinct). Macroscopically, the deeply radicant stipe (also in the exsiccatum) is typical.


**Conocybe semidesertorum** Hauskn. & Kalamees sp. nova

Fig. 3 a–e.

Ad Conocybem graminis Hauskn. vel Conocybem herbarum Hauskn. accedens sed ab eis sporis majoribus (7–11.5×5–7.5 µm, medio 8.3–10.2×6.1–6.9 µm, Q=1.3–2.1), crassetunica tis poro germinativo distincte eccentrico differt. Habitatio in apertis, praecipue savannis desertica, 18–25 mm long (without pseudorrhiza), with distinct, often eccentric germ-pore, brownish yellow to orange-brown in KOH. Basidia 4-spored, 15–25×8.5–12 µm. Clamp connections present. Cheilocystidia lecythiform, 15–24×6–10 µm, with 2.5–5 µm wide capitula. Ammonia reaction negative. Stipitpellis with predominantly lecythiform caulocystidia similar to cheilocystidia (15–25×4–12 µm, with capitula 2–6 µm), in between also few non-lecythiform, subcylindrical to hair-like elements present. Pilepellis hymeniform, composed of sphaeropedunculate to subpyriform elements (25–45×13–20 µm), without pileocystidia.

The combination of a radicant stipe (well visible in herbarium material of many collections) together with a stipitpellis of sect. Conocybe and spores with eccentric germ-pore is unique in the genus. **Conocybe halophila** with an equally eccentric germ-pore was recorded also from Middle and Central Asia, but it is a species of sect. Pilocepspsceae with a totally different stipitpellis. The closely related *C. graminis* and *C. herbarum* differ by smaller, somewhat differently sized spores with a central germ-pore.

**Material examined:**


Tadjikistan. Gorno-Badakshon, Pamir Mts., Vanj, Qamolzon, in Vanj River valley near Medvezhye glacier, 3200 m s. m., in grassy area with *Ferula* and *Prangos*, 10. 6. 1978, A. Raitviir, I. Parmasto & M. Vaasma (TAAM 95930, 95931).


Pileus in exsiccatum 6–12 mm wide, up to 6 mm high, always semiglobose to broadly convex, without umbo, pale yellowish brown, ochre brown to pale greyish brown; no information about hygrophanity and striation. Lamellae adnate, moderately distant, often darker than pileus and stipe in exsiccatum. Stipe in exsiccatum 18–25 mm long (without pseudorrhiza), about 1 mm thick, pseudorrhiza up to 12 mm long; pale brownish to greyish brown in exsiccatum. Smell and taste not recorded. Spore print rusty brown. Spores 7–11.5×5–7.5 µm, average 8.3–10.2×6.1–6.9 µm, Q=1.3–2.1, ellipsoid, broadly ellipsoid, not or only indistinctly lenticiform, sometimes subphaseoliform, thick-walled with a central germ-pore.

This common and widespread species is known from all continents except Australia. It is easily recognized by a stipitpellis with numerous lecythiform elements mixed with hairs, and spores in average up to 14×8 µm.

**Material examined:**

Russia. Far East Federal Okrug, Khabarovsk Terr., Arsen’evo, in mixed forest with *Picea*, *Pinus sibirica*

Conocybe subpubescens P. D. Orton

This common and widespread species is known from all continents except Australia. It is easily recognized by a stipitpellis with numerous lecythiform elements mixed with hairs, and spores in average up to 14×8 µm.

**Material examined:**

**Conocybe pulchella (Velen.) Hauskn. & Svrček**
This is a quite rare member of sect. Mixtae, differing from the former by smaller, more slender basidiocarps with often campanulate to timble-shaped pileus and larger spores. It prefers grassland or grassy sites and is known from Europe and one collection from higher altitudes in Africa. This taxon was reported also from Kazakhstan by Samgina (1985) as C. pseudopilosella (Kühner) Kühner & Romagn.


**Conocybe pubescens (Gillet) Kühner**
This is a world-wide distributed and widespread dung-inhabiting taxon. It has larger spores than the two former and 4-spored basidia, differing in this respect from *C. macrospora*.


**Conocybe macrospora (G. F. Atk.) Hauskn.**
This taxon, formerly known as *C. rubiginosa* Watling, is as widespread as *C. pubescens*. It differs from *C. pubescens* in the presence of 2-spored basidia and larger spores with central germ-pore.

**Material examined:** Russia. Siberian Federal Okrug, Irkutsk Prov., by Baykal Lake, Burtuj, on horse dung, 3. 9. 1994, S. Adamčík (BRA CR 8823); – Svjatoj Nos, on horse dung, 8. 8. 1994, S. Adamčík (BRA CR8822).

**Sect. Mixtae series Ambigua**

**Conocybe uralensis Hauskn., Knudsen & Mukhin sp. nova**
Fig. 4 a–e.

**Holotype:** Russia, Ural Federal Okrug, Yamalo-Nenets Aut. Okrug, Labytnangi, in mosses on clay and sand and along gravelly road, 29. 7. 1990, H. Knudsen (C 16287).

Pileus 9–15 mm wide, campanulate without or with broad, low umbo, up to 8 mm high, greyish, whitish with ochre tinge, hygrophanous, striate when wet, surface smooth. Lamellae adnate, moderately distant, rusty brown. Stipe 30–40×1 mm, cylindrical to filiform, base in one specimen slightly bulbous, pale brown to greyish brown, pubescent with long hairs. Smell and taste not recorded. Exsiccatum: pileus in both collections greyish ochre, cream to whitish, stipe darker up to rubiginous.

Spores 12–17×7–9 µm, average 14.2–14.3×7.9–8.4 µm, Q=1.7–2.0, ellipsoid, not lentiniform, not angular or hexagonal, thick-walled with up to 2.5 µm wide central germ-pore, orange brown in KOH. Basidia 4-spored mixed with a few 2- or 3-spored, 22–25×10–14 µm. Clamp connections not observed. Cheilocystidia lecythiform, 14–25×5–11 µm, with capitula 2.5–5 µm wide. Ammonia reaction negative. Stipitipellis a mixture of small lecythiform caulocystidia, numerous at stipe apex (15–25×3–6 µm, with capitula only 2–3 µm wide) and long hairs up to 60×2.5 µm, sometimes with slightly enlarged top with slime caps, situated merely in the middle and on the base of the stipe. Pileipellis hymeniform, composed of sphaeropedunculate elements (28–60×16–25 µm), with scattered hair-like pileocystidia in between.

The new species can be placed in sect. Mixtae series Ambigua, due to the specific pattern of
the caulocystidia. They differ from *C. ambigua* by partly 3- or 4-spored basidia and thicker-walled, differently sized spores which are also darker in KOH. The small caulocystidia with very small capitulum also resembles a species group around *C. alboradicans* Arnolds, but they all have a radicant stipe and no hair-like caulocystidia, furthermore, the basidia are strictly 2-spored. *Conocybe lobauensis* Singer & Hauskn. has evenly 2-, 3- or 4-spored basidia and the stipitipellis of sect. *Mixtae*, but its spores are distinctly smaller and lack a distinct germ-pore. The South American *C. alba* Singer differs in colours (totally white), and smaller, thinner-walled, lentiform spores. Another taxon of this group, *C. acutoconica* Watling from Zaire, has strictly hexagonal spores arising from 4-spored basidia. Finally, also *C. siligineoides* R. Heim, found on a living trunk in Mexico, differs by colours, smaller, partly angular spores arising from 2-spored basidia and a different pattern of the caulocystidia.

**Material examined:** Russia. Ural Federal Okrug, Yamalo-Nenets Aut. Okrug, Labytnangi, in mosses on clay and sand and along gravelly road, 29. 7. 1990, H. Knudsen (C 16286, 16287, holotype).

**Sect. Pilosellae series Sienophylla**

**Conocybe rostellata** (Velen.) Hauskn. & Svřék

This taxon was for a long time misinterpreted as *C. sienophylla* (Berk. & Broome) Singer. It is the most frequent representative of the series in Europe and known also from America and Africa, differing from the true *C. sienophylla* by thinner-walled, paler, more amygdaliform spores.


**Conocybe halophila** Singer

Fig. 3 k–n. Pileus up to 30 mm broad in exsiccatum, plane-campanulate to conico-campanulate, brownish yellow to greyish yellow, hygrophanous, drying to nearly whitish, very often covered by a thick salt layer. Lamellae adnate, greyish yellow to brownish. Stipe 30–50 mm long, 3–5 mm wide, with bulbous base in exsiccatum, yellowish grey to greyish, pubescent and often covered by a salt layer. Exsiccatum ochre-beige to pale yellow, only lamellae more brownish. Spores 8.5–10.5×6–7×5.5–6.5 µm, average 9.3–9.7×6.5–6.6×5.9–6.0 µm, Q=1.4–1.7, broadly ellipsoid, with distinct, often eccentric germ-pore, thick-walled, ochre yellow in KOH. Basidia 4-spored, 17–20×9.5–11 µm. Clamp connections not seen. Cheilocystidia lecythiform, 14–18×6–8.5 µm, with capitula 3–4 µm wide. Ammonia reaction negative. Stipitipellis mostly collapsed, in one specimen well differentiated hair-like caulocystidia (up to 40×5 µm) present, lecythiform elements on stipe not seen. Pileipelis hymeniform, composed of sphaeropedunculate elements; pilocystidia absent.

Very rare taxon, restricted to salt habitats and to now known from Middle and Central Asia and Italy. It is the only representative of sect. *Pilosellae* with eccentric germ-pore and was described from Italy as *C. juncicola* Hauskn. (Hausknecht 2001), but later it became clear that the Italian collections are conspecific with *C. halophila* from Afghanistan (Hausknecht 2005).

**Material examined:**


**Conocybe ochrostriata** Hauskn.

Like *C. rostellata*, it was for a long time misinterpreted as *C. sienophylla* in Europe. It differs from the latter in the larger spores and is known from all continents except Australia.

**Material examined:**


**Conocybe moseri** Watling

This taxon is characterised by having a dark, sordid pileus colour, spores of medium size from 4-spored basidia, stipe covering of sect. *Pilosellae* and the exsiccatum is distinctly bi-coloured (pileus greyish, stipe with distinct wine-red hue). It is not uncommon in Europe, but very rare elsewhere.

Conocybe sp. 2
Fig. 5 a–d.
Pileus in exsiccatum less than 10 mm broad (fragments), in the material dark brown in dry condition, surface smooth. Lamellae adnate, rusty cinnamon-brown. Stipe (in exsiccatum) about 20 mm long and 2 mm wide, dark brown, pubescent at places. Fragments of exsiccatum dark brown.

Spores 8–11×5–6.5 µm, average 8.9–9.5×5.5–5.9 µm, Q=1.5–2.0, ellipsoid, not lentiform, with slightly double wall and central, small, but distinct germ-pore, orange yellow in KOH. Basidia 4-spored, 20–24×8.5–10 µm. Clamp connections present. Cheilocystidia lecythiform, 15–22×7–9 µm, with capítula 2.5–5.5 µm wide. Ammonia reaction negative. Stipitipellis with numerous hairs and non-lecythiform elements, mixed with about 10–20% lecythiform caulocystidia similar to cheilocystidia. Pileipellis hymeniform, made up of sphaeropedunculate elements (mostly collapsed); no pileocystidia seen.

In the definition of Watling (1982) and later Hausknecht (2003), the number of lecythiform elements is too small to insert this record in sect. Mixtae. In nearly all the microscopical characters the material is close to Conocybe sienophylla, but with a too high number of lecythiform caulocystidia (in Conocybe sienophylla, lecythiform caulocystidia are absent or only present sporadically on the top of the stipe). Also the colours of the pileus and stipe are too dark compared to Conocybe sienophylla.

As the material is too scarce and in bad state, further investigations are needed to decide the true status of the two Tadjikistan collections.


Sect. Pilosellae series Anthracophila

Conocybe velutipes (Velen.) Hauskn. & Svět

This taxon with preference for poor soil in deciduous and coniferous forests, in grassy habitats, in meadows and in dry grassland is not uncommon in Europe. It also occurs in all other continents except Australia. The Asian collections fit perfectly with European material. Conocybe velutipes is distinguished from closely related taxa by the relatively large, thick-walled, lentiform but not hexagonal spores.


Sect. Pilosellae series Microrhiza

Conocybe leporina (Velen.) Singer

Fig. 4 f–i.

Spores 9.5–13×7–8 µm, average 11.1×7.4 µm, Q=1.3–1.7, in frontal view ellipsoid, in lateral view distinctly fusiform-limoniform, with double wall and relatively small germ-pore, not lentiform, ochre yellow in KOH. Basidia 2-spored, 22–30×9–12 µm. Clamp connections not seen. Cheilocystidia lecythiform, 14–22×7–9 µm, with capítula 2.5–5 µm wide. Ammonia reaction negative. Stipitipellis only with hair-like to elongate-fusiform or lageniform elements (up to 40×10 µm), lecythiform caulocystidia not observed. Pileipellis hymeniform made up of sphaeropedunculate elements (up to 40×20 µm), no pileocystidia present.

The Russian collection differs from the type in presence of only 2-spored basidia and lack of scattered lecythiform caulocystidia on the top of the stipe, but the presence of a pseudorrhiza and the size and shape of the spores from 2-spored basidia are typical.

Conocybe leporina is one of the rarest species in the genus, known up to now only from the type locality in the Czech Republic, one locality in Hungary and from three collections from Austria. One of the Austrian collections is also only 2-spored.


Sect. Pilosellae series Siliginea

Conocybe fuscimarginata (Murrill) Singer

This almost cosmopolitan species from dung or fertilized soils is one of the most common representatives of the genus, distinguished from the two following taxa by smaller spores from 4-spored basidia.

Material examined: Uzbekistan. Navoiy Prov., Aqtau Range, Langar, 1500 m s. m., in garden, in clayey
grassy shore of a stream, 16. 5. 1980, K. Kalamees (TAAM 121262).

**Conocybe siliginea (Fr.) Singer**

*C. siliginea* has a world-wide distribution, but prefers poorer soils and has smaller basidiocarps than *C. rickenii* with a different colour of pileus in young stages.

**Material examined:**


Uzbekistan. Navoiy Prov., Aqtau Range, Langar, 1500 m s. m., on humid grassy slope of a river, 14. 5. 1980, K. Kalamees (TAAM 121280). 1300 m s. m., on humid grassy slope of a river, on ground and on dung, 17. 5. 1980, K. Kalamees (TAAM 121280).

**Conocybe rickenii** (Jul. Schäff.) Kühner

This is one of the most frequent fimicole species of the genus with world wide distribution. It is distinguished from the equally frequent *C. pubescens* by the non-striate, paler pileus and the structure of the stipitipellis.

**Material examined:**

Turkmenistan. Mary Prov., Kala-I-Mor, Badkhyz Nature Reserve, Pinkhamchesme, in semisavanna with *Pistacia*, 10. 4. 1971, K. Kalamees (TAAM 79510). Uzbekistan. Navoiy Prov., Aqtau Range, Langar, 1500 m s. m., on humid grassy slope of a river, 14. 5. 1980, K. Kalamees (TAAM 121217), 1300 m s. m., on humid grassy slope of a river, on ground and on dung, 17. 5. 1980, K. Kalamees (TAAM 121280).

**Conocybe sp. 3**

Spores 12.5–17×7.5–9.5 µm, average 14.9×8.5 µm, Q=1.6–1.8, ellipsoid, not lentiform, thick-walled with wide, central germ-pore, rusty orange in KOH. Basidia 2-spored, mostly collapsed. No clamp connections seen. Cheilocystidia lecythiform, 15–19×6–9 µm, with capilula 3–4 µm wide. Stipitipellis only with hair-like elements, 20–40×3.5–5 µm. Pileipellis hymeniform, composed of sphaeropedunculate elements. No pileocystidia seen.

The collection is microscopically indistinguishable from *C. siliginea*, but the colour of the exsiccatum is totally different (cap greyish brown, stipe fuliginous). It is possible that this discoloration is caused by inappropriate drying of the basidiocarps.

**Material examined:**


Sect. *Pilosellae* series Murinacea

**Conocybe singeriana** Hauskn.

Although this taxon was described only ten years ago, it seems to be one of the most common representatives of the series *Murinacea*. *Conocybe singeriana* is known from all continents except America. The species grows mostly directly on dung, but also on compost or fertilized soils or rotting leaf litter.

**Material examined:**


**Conocybe magnispora** (Murrill) Singer

Fig. 5 e–h.

Pileus in exsiccatum 7–11 mm broad, hemispherical, yellowish brown. Lamellae adnate, yellowish brown. Stipe in exsiccatum 30–45 mm long, up to 1 mm wide, base cylindric, not bulbous, in fresh condition yellowish brown. Exsiccatum: all parts pale ochre-brown. Spores 13–18.5×8–10 µm, average 16.2×8.3 µm, Q=1.6–1.8, ellipsoid, neither lentiform nor hexagonal, thick-walled with up to 2.5 µm wide, predominantly central germ-pore, fuliginous in KOH. Basidia 4-spored, 22–30×13–16 µm. Clamp connections present. Cheilocystidia lecythiform, 16–21×9–12 µm, with capilula 3–4 µm wide. Ammonia reaction negative. Stipitipellis only with hair-like caulocystidia (up to 40×6 µm). Pileipellis hymeniform, composed of pyriform to sphaeropedunculate elements up to 35×20 µm; no pileocystidia seen.

*C. magnispora* grows mostly directly on dung, but also on fertilised soils. This taxon, described from North America, was only recently discovered in Europe (Arnolds & Hausknecht 2003). It seems that it was often misinterpreted in the past as one of the other dung-inhabiting, large-spored taxa.

The present collection fits well with the type material and European records. The germ-pore in nearly all spores is central, but there are also few spores with slightly eccentric germ-pore. For the moment, no taxonomic value is given to this aberrant character.

The only representative of series *Murinacea* with eccentric germ-pore is *C. gigasperma* (see
below), but this taxon has considerably larger spores from 2-spored basidia.

**Material examined:** Russia. Far East Federal Okrug, Khabarovsk Terr., Arsen'evo, in meadow, 18. 9. 1979, K. Kalamees (TAAM 120954).

**Conocybe gigasperma** Enderle & Hauskn.  
This species is easily recognised by the olive tints of the young pileus and the largest spores in the genus. It is known only from Europe and Asia.

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**Sect. Pilosellae series Lenticulospora**

**Conocybe brunneidisca** (Murrill) Hauskn.  
In literature, *C. brunneidisca* is better known as *C. lenticulospora* Watling. It is a widespread species occurring in Europe, America and Northern Asia. Conspecificity of *C. brunneidisca* with *C. lenticulospora* was proposed by Hausknecht & Contu (2007).

**Material examined:** Russia. Far East Federal Okrug, Kamchatka Prov., Mil’kovo, Kimitino, near *Larix*, 27. 7. 1978, K. Kalamees, B. Kullman & M. Vaasma (TAAM 113003).

**Pholiota gigapora** Fayod  
Sect. **Piliferae series Filipes**

**Pholiota filipes** (G. F. Atk.) Singer  
In the past the taxon was mainly known as *P. sulcatipes* (Peck) Bon or *P. aberrans* (Kühner) Singer. For the correct nomenclature, see Hausknecht 2007.


**Pholiota micropora** Fayod  
Sect. **Verrucisporae series Utriformis**

**Pholiota dasypus** (Romagn.) P.-A. Moreau  
The species is easily recognised by spores with somewhat uneven, verrucose wall in LM as well as utriform cheilocystidia.


Sect. *Vestitae* series *Vestita*

**Pholiota vestita** (Fr.) Singer

The exsiccatum in C with remnants of an appendiculate veil on pileus margin and small, thin-walled spores without germ-pore could easily be determined as *P. vestita*. Only the habitat, an old fire place, is a bit uncommon. It is the only known collection from the Asian continent.

Material examined: Georgia. Ab’khażeti, Gagra, by Ritsa Lake, on old fire place, 30. 9. 1986, O. Terney (C).

Sect. *Vestitae* series *Appendiculata*

**Pholiota velata** (Velen.) Hauskn.

Although no veil was seen in the exsiccatum, the small spores with indistinct double wall and distinct germ-pore as well as the lageniform cheilocystidia with cylindrical, often undulate neck exclude all known taxa with veil or annulus and points to this collection as *P. velata*. It is the first record in Asia.


Sect. *Pholiotina* series *Vexans*

**Pholiota vexans** (P. D. Orton) Bon

Arnolds (2005) demonstrated that the correct name of the fungus called *Pholiotina blattaria* ss. Kits van Waveren has to be *P. vexans*. It is a common annulate species in Europe, but rare elsewhere.


Sect. *Pholiotina* series *Teneroides*

**Pholiota teneroides** (J. E. Lange) Singer

This taxon is easily recognised by the combination of 2-spored basidia, large spores and utriform cheilocystidia. It is the only known collection from Asia.


**Pholiota altaica** Singer

Fig. 6 a–d.

Pileus ochraceous, somewhat darker (fuscous) centrally, hygrophanous, slightly slimy, in the dry state it varies from buff to pallid, in exsiccate it is ochraceous with a fuscous centre; in the humid state it is somewhat striate, 10–19 mm in width, cone-shaped, then convex or flat, but umbonate. Gills rusty-coloured with a pale-coloured margin, crowded, less often almost sparse, narrow (almost to 2 mm in width), less often fairly wide (3–4 mm), adnate. Stipe at the top whitish or of the same colour as pileus; below the annulus it is fibrous and commonly ranges from fuscous to brown; it is cylindrical, 30–60/1–4 mm. Annulus on the upper side gently sulcate, whitish, pendent, easily falling off, thick, but not double. Thin-fleshed. The flesh has a faint farinaceous odour and is sweetish.

Spores 9–14×5–7.5 µm, average 11.6×6.0 µm, Q=1.7–2.2, ellipsoid, sublimoniform, with double wall and large, central germ-pore, rusty brown in KOH. Basidia 2(–4)-spored, 20–22×9–10 µm. Clamp connections present. Cheilocystidia 22–45×8–15 µm, thin-walled, versiform, from fusiform-cylindrical to subutriiform, some with distinct undulate long neck, at the top partly with crystals (similar to *Inocybe* species). Stipitipellis above the annulus with very scattered caulocystidia similar to cheilocystidia. Pileipellis hymeniform, composed of sphaeropedunculate elements (40–65×20–35 µm), pileocystidia not seen.

The above macroscopical description is taken from Singer (1951, translated from Russian) and the microscopical data are from the examination of the type material by Hausknecht. Singer’s data of microscopical characters differ hardly from the observations of Hausknecht. The collection LE 11274 is not included in the microscopical description, because this collection differs in having only 4-spored basidia and smaller spores.

The presence of cheilocystidia with crystals on the top is unique in the genus. Furthermore, *P. altaica* differs from the similar *P. teneroides* by considerably more variable cheilocystidia.

**Pholiotina procera** Singer

Fig. 6 e–h.

Pileus aqueous-ferruginous to honey-coloured, smooth, naked, gently tuberculate or free of umbo, finely transparent-striated in the humid state, convex, about 50 mm in width. Gills somewhat fuscous, markedly emarginated, moderately broad (5.5 mm). Stipe sordid yellow-fuscous, shining, somewhat expanded at the bottom or subcylindrical; it ultimately grows hollow and is close to 70/6–7 mm. Flesh pale fuscous-yellow, at the base of the stipe it is dark fuscous; it is moderately fragile, with a faint farinaceous odour.

Spores 9.5–11.5×5–6.5 µm, average 10.7×5.8 µm, Q=1.7–1.9, ellipsoid to subcylindrical-ellipsoid, not lentiform, with slightly double wall and small, but distinct germ-pore, yellow in KOH. Basidia 4-spored, 22–30×7–10 µm. Clamp connections present. Cheilocystidia 27–45×10–18 µm, of two types: predominantly vesiculose or elongate-ellipsoid, mixed with scattered claviform, fusiform to subutriform elements. Caulocystidia not found. Pileipellis hymeniform, made up of sphaeropedunculate elements (25–35×13–21 µm), pileocystidia absent.

The above macroscopical description is taken from Singer (1951, translated from Russian). The microscopical data were obtained by examination of the type material by the Hausknecht and are in concordance with the data given by Singer (1951).

*Pholiotina procera* is close to *P. utricystidiata* Enderle & Hübner with the following differences: the basidiocarps are larger, the spores are paler in KOH with a somewhat thinner wall. The most important difference lies in the size of the cheilocystidia: mostly utriform in *P. utricystidiata*, versiform with predominantly vesiculose elements in *P. procera*. *Pholiotina indica* K. A. Thomas, Hauskn. & Manim., described from Kerala, India (Thomas et al., 2001) has a similar pattern of cheilocystidia, but differs in much smaller basidiocarps, smaller, sublentiform spores and growing on elephant dung.

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**MYCOGEOGRAPHICAL IMPLICATIONS**

Although many papers published in recent years have brought much new evidence concerning the taxonomy of *Conocybe* and *Pholiotina* and also partly the distribution of many species, the genera are still among the less investigated in many parts of the world. Thus, drawing too many conclusions from the material presented here would be premature. However, some features are so distinctive that they should be emphasized as a basis for further research. First, it is obvious that the genus has many representatives in the dry, grassy, savanna- and steppe-like vegetation areas in Middle Asia. Due to the low rainfall and high temperatures the soils are often rich in alkaline salts resulting from the high evaporation from the soil surface. In Europe many species also occur in soils with a high pH, either being naturally calcareous or clayey or in mull-rich forests. Thus, the general preference of species in the genus to prefer soils with a high pH value is strengthened by the records from the dry, open areas of different types in Middle Asia. A few species, *C. semidesertorum* and *Conocybe* sp. 2 are so far only known from Middle Asia, and *C. halophila* only from Middle Asia and mediterranean Italy, but the following group of species have their main, known distribution ranging from eastern Europe (Czech Rep., Hungary, Austria) to Middle Asia: *C. enderlei*, *C. graminis* (also in northern Africa), *C. herbarum*, *C. leporina* and *C. subxerophytica*. **Material examined:** Russia. Siberian Federal Okrug, Altaj Rep., Ojrotiya, Artybash, at the base of a trunk outside of forest, 17. 9. 1937, R. Singer (LE 17690, holotype).
Fig. 1. *Conocybe semiglobata* var. *campanulata* (a – spores, b – basidia, c – cheilocystidia, d – stipitipellis), *Conocybe subxerophytica* (e – spores, f – basidium, g – cheilocystidia, h – stipitipellis), *Conocybe* sp. 1 (i – spores, j – basidium, k – cheilocystidia, l – stipitipellis). Bar – 25 µm, 10 µm for spores.
Fig. 2. Conocybe enderlei (a – spores, b – basidium, c – cheilocystidia, d – stipitpellis), Conocybe graminis (e – spores, f – basidia, g – cheilocystidia, h – stipitpellis), Conocybe herbarum (i – spores, j – basidia, k – cheilocystidia, l – stipitpellis, m – pileipellis). Bar – 25 µm, 10 µm for spores.
Fig. 4. *Conocybe uralensis* (a – spores, b – basidia, c – cheilocystidia, d – stipitpellis, e – pileipurpilis with hair-like pileocystidium), *Conocybe leporina* (f – spores, g – basidia, h – cheilocystidia, i – stipitpellis). Bar – 25 µm, 10 µm for spores.
Fig. 5. *Conocybe* sp. 2 (a – spores, b – basidium, c – cheilocystidia, d – stipitpellis), *Conocybe magnispora* (e – spores, f – cheilocystidia, g – basidia, h – stipitpellis), *Pholiotina cyanopus* (i – spores, j – basidium, k – cheilocystidia, l – stipitpellis). Bar – 25 µm, 10 µm for spores.
Fig. 6. Pholiotina altaica (holotype) (a – spores, b – basidia, c – cheilocystidia, d – pileipellis), Pholiotina procera holotype (e – spores, f – basidia, g – cheilocystidia, h – pileipellis). Bar – 25 µm, 10 µm for spores.
REFERENCES


