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Dedicated to Professor Alina Skirgiełło on the occasion of her ninety-fifth birthday

New records of the annulate *Pluteus* in European and Asian Russia

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New records of the annulate *Pluteus* were made by the authors in Central Russia (Zhigulevsky Nature Reserve) and Western Siberia (Yugansky Nature Reserve). The description of the species based on these records is presented. The taxonomic value of such features as the presence of velum and the color of lamellae edge as well as the similarity between *Chamaeota* and *Pluteus* are discussed and the new combination *Pluteus fenzlii* is proposed.

Key words: *Chamaeota, Pluteaceae, Pluteus fenzlii*, Central Russia, Western Siberia, nature reserves

INTRODUCTION

For more than 100 years the generic name *Chamaeota* (W.G. Sm.) Earle has been in use for designation the *Pluteus*-like species with annulus.

The genus *Chamaeota* is one of the poorly investigated taxa of agaricoid fungi. At present the volume of the genus is uncertain. It totals 9 species according the Index Fungorum (http://www.indexfungorum.org), as soon as only two species on the data of the last issue of the Dictionary of Fungi (Kirk et al. 2001). The species distribution, ecology and morphology remain unknown because this genus was not studied on a global scale. There are some information about records of the species of *Chamaeota* in Europe, Asia, Northern and Central America (Singer 1978; Ying 1995; Minnis et al. 2006). Probably, the genus as a whole is cosmopolitan (Singer 1978) and its species grow on all continents, except for Antarctica, though the records are very rare. Till now the representatives of *Chamaeota* has been recorded on the territory of Russia (the Caucasus) only once by Singer (1978). Unfortunately, those specimens were not kept. The species of this genus inhabit usually large fallen trunks and rotten wood of deciduous trees.

For the first time *Chamaeota* was separated as a subgenus from the large genus *Agaricus* L.: Fr. by W.G. Smith in1870. F. Earle has risen the taxon to the generic rank in 1909.

The taxonomic position of *Chamaeota* was changed repeatedly because of the reformation of the system of *Agaricales*. It was initially considered (together with *Pluteus* Fr. and *Volvariella* Speg.) within *Agaricaceae* Chevall., then within *Amanitaceae* R. Heim ex Pouzar, and after the segregation of *Pluteaceae* Kotl. et Pouzar in 1972 up to the present - within *Pluteaceae*. The basic criteria used to distinguish the genus remain constant. The character of velum is recognized as the main of them. However the problem of relevance of the genus and its similarity to *Pluteus* was repeatedly raised. So Singer (1975) noted strong resemblance of *Chamaeota* species known to him (*Ch. mammillata* (Longyear) Murrill, *Ch. sphaerospora* (Peck) Kauffm. and *Ch. fenzlii* (Schulzer) Singer) to the representatives of *Pluteus* (section *Hispidoderma* Fayod) by the micromorphological characteristics. In his earlier papers (Singer 1958) he emphasized that character of velum, as well as its presence or absence, are not the sufficient criterion for delimitation of genera in many groups of agaricoid fungi. He gave as an instance the genus *Russula* Pers. that was remained stable despite of inclusion of several tropical species with the velum. Besides, annulate *P. atroavellaneus* Murrill was described from South America. Singer has also described two South-American species of *Pluteus* with rudimental volva (*P. stephanobasis* Singer, *P. circumscissus* Singer) in cited paper. It confirms his position in this problem. However, he refrained from any nomenclatural changes concerning the genus *Chamaeota* because of scarcity of the available descriptions, absence of the type material, rarity of records.

The taxonomic value of such feature as velum is considered in detail by Gorovoj (1990). He has studied ontogenesis of many agaricoid taxa and has made a conclusion about low taxonomic weight of the features of the basidiocarp development and covering structures. These features are subject substantially to parallel variability in many related and phylogenetic remote groups. Moreover detailed study of ontogenesis of *Pluteus* species (Reijnders 1963; Gorovoj 1990) has shown that pilangiocarpous and stipitangiocarpous types of basidiocarp development are attributes of several species (*P. admirabilis* Peck, *P. chrysophlebius* (Berk. et Ravenel) Sacc). The new data basing on the molecular research are the most serious reason for the instability of the genus *Chamaeota* concept. According to the recent paper devoted to the study of the American species with application of the molecular methods (Minnis et al. 2006), *Chamaeota* does not form an independent clad, as against *Volvariella*, but is nested inside *Pluteus* clade. Species *Ch. mammilata* studied occupies a very close position to *P. ephebeus* (Fr.: Fr.) Gillet on cladogram. Moreover both species are very similar to each other in their micromorphological characteristics. Therefore new combination *P. mammilatus* (Longyear) Minnis, Sundb. et Methven seems reasonable to us. The further morphological studies of *Chamaeota* species (especially of those with cellular pileipellis) supported by the molecular data, could clear their taxonomic position as well as volume of the genus.

The given morphological study of the European species *Ch. fenzlii* very closed to *P. mammilatus* also has permitted to find out the features of its similarity with the representatives of the genus *Pluteus* and to classify it as the *Pluteus*.

MATERIALS AND METHODS

The study was based on the material collected by the authors in 2000-2006 in the territory of two nature reserves: the Zhigulevsky (3 collections) and the Yugansky (4 collections).

The Zhigulevsky Nature Reserve occupies the central part of the Zhiguli - a broken highland in East of Privolzhskaya plateau, on the right bank of Volga River (Samara region). The Zhiguli consists of exposed carbonate rocks covered by loam layer in lower part. The climate is continental with annual precipitation 500 mm. The natural vegetation over the hills is represented by open pine forests (*Pinus sylvestris* L.) in combination with steppes, in ravines - by broad-leaved forests of *Tilieto-Nemoreta* type (Kleopov 1990). In stands *Tilia cordata* Mill., *Acer platanoides* L., *Quercus robur* L., *Ulmus glabra* Huds., *Corylus avellana* L. are predominate.

The Yugansky Nature Reserve is located in the basin of Bolshoy Yugan River (Tumen region). The geological structure is formed by the Quaternary deposits, mainly by the Pleistocene ones covered with loamy and clay soils. The climate of this area is moderately continental. The annual precipitation totals 650 mm. The main types of vegetation are coniferous forests (*Pinus sibirica* Du Tour, *Abies sibirica* Ledeb., *Picea obovata* Ledeb.) and secondary deciduous-coniferous forests (with *Populus tremula* L. and *Betula pendula* Roth) with mossy or grassy cover. The different types of swamps occupy 20-30% of the territory.

The collections were made, documented and preserved with standard methods (Bondartsev, Singer 1955). Macroscopic description is based on the study of the material in fresh and dried condition as well as the analysis of the photos. The dried material was examined using standard microscopic techniques. Spores, basidia and cystidia were observed in squash preparations of small parts of the lamellae in 5% KOH. The pileipellis was examined in the preparation of the radial section of the pileus. Microscopic measurements and drawings were made at 600x with Micmed 2-2 microscope. Basidiospore dimensions are based on observation of 30 spores per each of 8 collections, cystidia dimensions - on observation of at least 10 structures per collection. Spore length to width ratios are reported as Q. Mean values for Q are designated as Q*.

The collected material is deposited in Mycological Herbarium of the Komarov Botanical Institute (LE).

RESULTS AND DISCUSSION

Below we propose a new combination. The description of the species is based on the study of specimens collected by the authors in the territory of Central Russia and Western Siberia.

Pluteus fenzlii (Schulzer) E. Malysheva, Morozova et Zvyagina comb. nov.

Basionym: *Agaricus fenzlii* Schulzer, Verh. Zool.-Bot. Ges. Wien 16: 49. 1866.

Synonyms: *Annularia fenzlii* (Schulzer) Gillet, 1876; *Chamaeota fenzlii* (Schulzer) Singer, 1978.

Pileus 17-70 mm in diam., initially obtuse-conical to become campanulate-convex, convex and flattened, usually with broad umbo, with entire, involute at first margin, sometimes cracked when old, not hygrophanous, translucently striate at the

margin only, dry, vividly yellow or with orange tinge, slightly darker at centre, radially fibrillose sometimes becoming rimose at margin (with visible white background), covered by distinct yellow to brownish appressed squamules or hairs, erected over the center. Appearance of pileus looks like ones of *Volvariella* species (Figs 1, 2). Lamellae free, crowded to subdistant (approximately 12 on centimeter near margin), with lamellulae, thin, ventricose, ap to 5 mm broad, pale pink to grayish pink, with entire edge which can be concolorous, white or distinctly yellow (yellow hue can disappear with age) (Fig. 3). Stipe 25-50 × 4-10 mm, central to slightly excentric, cylindric, slightly broadened towards base but without basal bulb, smooth, whitish to pale yellow above a ring zone, with longitudinal yellow to brown-yellow fibrils in the lower part, with white basal tomentum. Annulus entire, sheathing, fluffy or flake like, but often fragmentary and evanescent, remains as a ring zone, white to yellowish white, disposed on central or lower part of stipe. Flesh of pileus and stipe solid, white, slightly yellow under pileus cuticle. Odor and taste not distinctive.

Spores 4.2-7.6 × 4.0-6.5 μm, Q = 1.00-1.33 (Q^* = 1.17), broad-ellipsoid to subglobose to slightly ovate in profile and face views, with a small hilar appendix and single large central oil drop, sometimes with granular contents (when oil drops are numerous), smooth, thin-walled to slightly thick-walled, hyaline to pale yellow in KOH, non-amyloid. Basidia 4-spored, 16-25 × 6.5-10 μm, clavate, often with tapering apex, hyaline, thin-walled. Cheilocystidia 22-73 × 8-31 μm, very abundant, often aggregated to continuous layer, variable in appearance, clavate, narrow-fusoid to clavate-ventricose, fusoid-ventricose and broad-lageniform, with short or slightly lengthened necks, narrow at base, hyaline in KOH, thin-walled or thick-walled, usually with granular yellow contents and drops on apex. Pleurocystidia 32-81 × 10-32 μm, abundant, mainly lageniform, rarely fusoid-ventricose, strongly inflated, with short or long (to 20 μm length and 8 μm wide) necks, narrow at base, hyaline in KOH, thin-walled, with oil drops on apex. Lamellae trama inverse. Pileipellis is plagiotrichoderm consisting of periclinal basal cylindrical hyphae (5.5-8 μm wide) with obliquely to fully erect hyphal ends. Basal hyphae thin-walled, containing yellow-brown intracellular or slightly incrusting pigment. Superficial hyphal ends consist of chains of short or lengthened inflated (up to 12 μm) cells, thin-walled, with brown intracellular pigment. These hyphae dispose in bundles forming squamules (Fig. 4). Stipitipellis a cutis consisting of cylindrical hyphae, parallel to a surface, thin-walled, 5.5-8 μm wide, with or without brown intracellular pigment. Clamp connections absent.

Habitat on wood of deciduous trees, particularly on *Tilia*, *Acer* and *Betula*, solitary or in small groups.

SPECIMENS EXAMINED: CENTRAL RUSSIA, Samara region, Zhigulevsky State Nature Reserve: Vicinities of Bakhilova Polyana village, in *Tilia cordata-Acer platanoides* forest, on fallen trunk of *Tilia*, 27 VIII 2000, coll. and det. E. F. Malysheva (LE 246082). – Vicinities of Shiryaevo village, Shiryaevskaya valley, in *Tilia cordata-Acer platanoides* forest, on fallen trunk of deciduous tree, 17 VIII 2004, coll. and det. E. F. Malysheva (LE 246085). – Vicinities of Bakhilova Polyana village, in *Tilia cordata-Acer platanoides* forest, on fallen trunk of deciduous tree, 18 VIII 2004, coll. O. V. Morozova, det. E. F. Malysheva (LE 246083) (Fig. 2). SIBERIA, Tumen region, Surgut district, Yugansky Nature Reserve: Bank of lake, in swamp *Betula pendula* forest, on fallen trunk, 18 VII 2006, coll. E. A. Zvyagina, det. E. F. Malysheva

Fig. 1(a, b). *Pluteus fenzlii* (LE 246084).

Fig. 2. *Pluteus fenzlii* (LE 246083). Phot. A. E. Kovalenko.

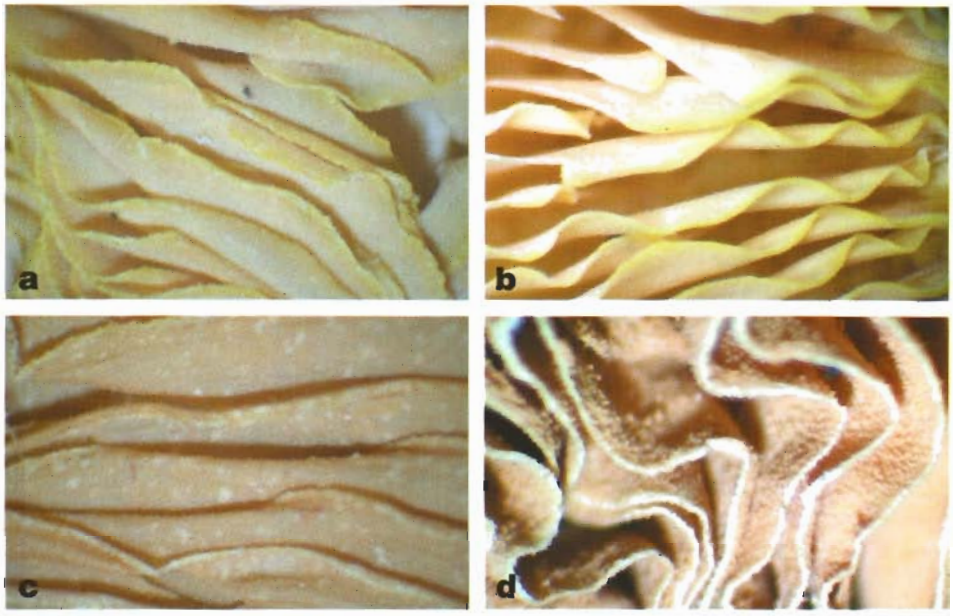

Fig. 3. The variation of the lamella edge color in the different specimens of *Pluteus fenzlii*. (a, b) The lamellae with yellow edge in the mature (a) and the young (b) basidiocarps (LE 246083). (c) The lamellae with concolorous with side or slightly yellowish edge (LE 246085). (d) The lamellae with white edge (LE 246084).

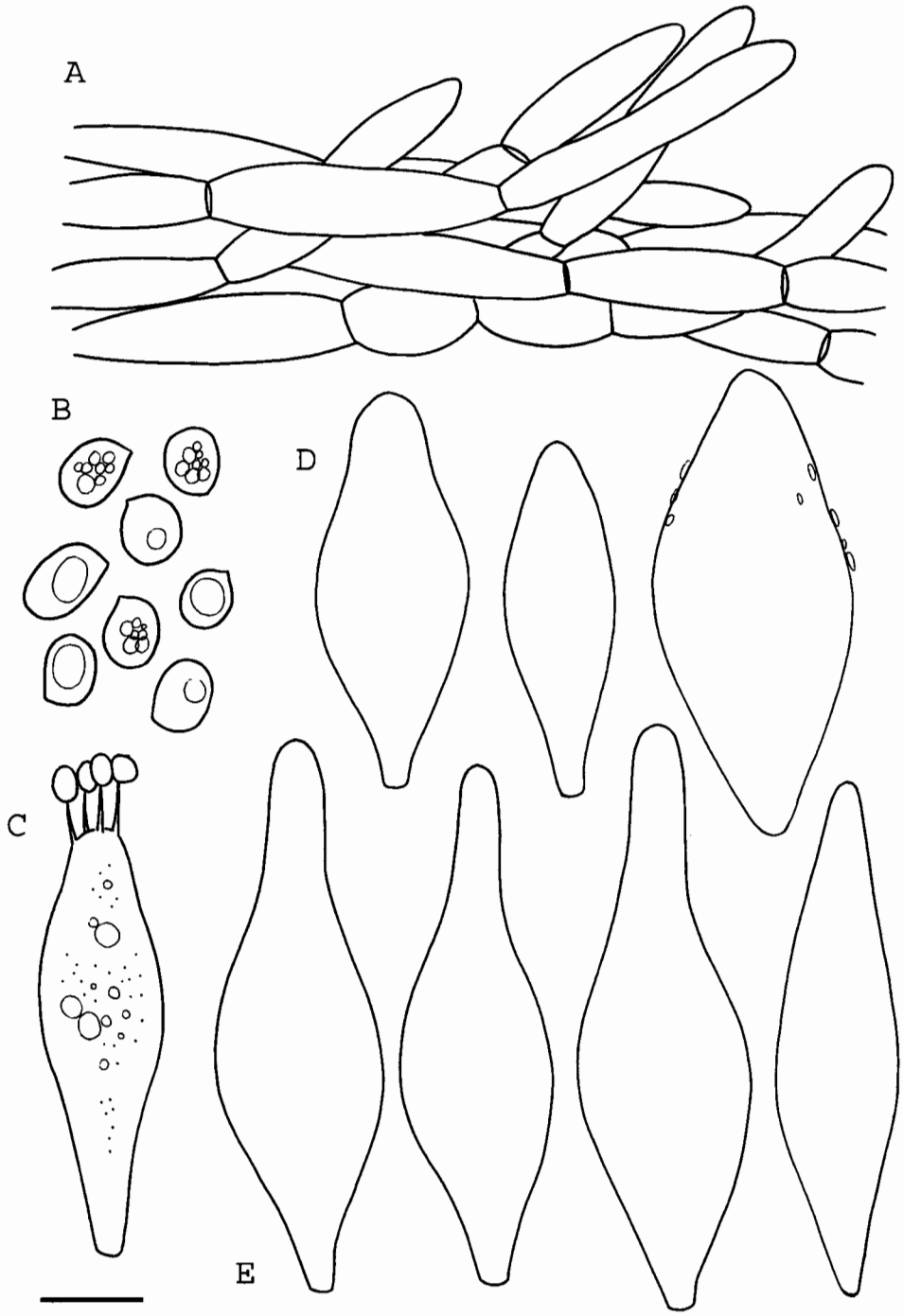

Fig. 4. *Pluteus fenzlii* (LE 246083): A – pileipellis, B – basidiospores, C – basidium, D – cheilocystidia, E – pleurocystidia; scale bars A-C = 10 µm, D-E = 15 µm.

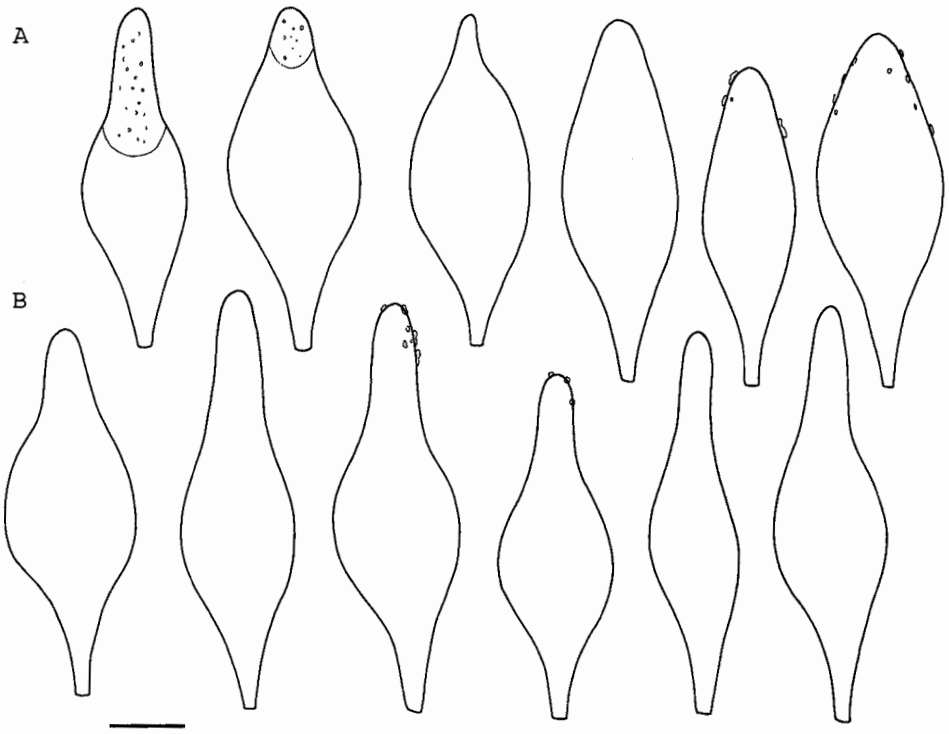

Fig. 5. *Pluteus fenzlii* (LE 246083): A – cheilocystidiogram, B – pleurocystidiogram; scale bar = 10 μm.

(LE 246084) (Fig. 1). – Bank of Entl'turyah river, in *Populus tremula* forest, on fallen trunk of *Betula*, 16 VIII 2006, coll. and det. E. A. Zvyagina (LE 235471). – Basin of Entl'turyah river, in *Populus tremula-Betula pendula* forest (with *Picea obovata* and *Abies sibirica*), on fallen trunk of *Betula*, 17 VIII 2006, coll. and det. E. A. Zvyagina (LE 235470). – Bank of Kolkochenyagun river, in swamp *Betula pendula* forest, on fallen trunk of *Betula*, 18 VII 2006, coll. and det. E. A. Zvyagina (LE 235469).

Pluteus fenzlii is similar to the American annulate species *P. mammilatus* in its habitus, pileus color, type of pileipellis and form of cheilocystidia. It differs from the latter only by presence of yellow lamellae edge. The similarity of these species has been mentioned by Singer (1975).

One more species – *Pluteus leoninus* (Schaeff.: Fr.) P. Kumm. – has some morphological resemblance to *P. fenzlii.* It differs by absence of annulus, by less squamulouse pileus and by possessing of pleurocystidia with excrescences. In the case of *P. fenzlii* with the reduced annulus these species can be confused in the field.

All specimens of *P. fenzlii* examined in the present work showed considerable variation of most important diagnostic features, even within a single specimen (Tab. 1). So, the annulus can be fugacious, fibrillose, presenting in the mature basidiocarp only as a poor visible ring zone, or well differentiated, almost membranous, at first entire, later breaking into patches. The yellow color of the edge of lamellae can be differently distinct – from almost invisible (located only in the edge of pileus or

Table 1
The variation of the macro- and microscopic features in different *Pluteus fenzlii* specimens

Specimens	Spores				Annulus	Color of lamellae edge	Cheilo-cystidia	Pleurocystidia
	length min–max (mean)	width min–max (mean)	Q	Q*				
LE 246083	4.8–7.6 (6.4)	4.6–6.5 (5.5)	1.00–1.31	1.17	fibrillose	yellow	22–60 × 8–27	32–67 × 12–27
LE 246085	5.1–7.0 (6.2)	4.8–6.2 (5.5)	1.00–1.29	1.13	ring zone	concolorous with side (initially pale yellow)	32–54 × 12–20	55–62 × 13.5–21
LE 246082	5.5–7.8 (6.5)	4.4–5.5 (5.0)	1.06–1.49	1.28	ring zone	yellow	38–73 × 8–31	50–80 × 16–20
LE 246084	4.2–7.6 (6.5)	4.0–6.2 (5.6)	1.00–1.30	1.16	well developed, almost membranous	white, pink, yellowish near of pileus margin	27–65 × 12–22	40–81 × 10–32
LE 235471	4.6–7.4 (5.9)	4.0–6.0 (5.1)	1.00–1.42	1.16	fibrillose, fugacious	yellow	31–115 × 9–41	43–67 × 10–20
LE 235470	4.8–6.8 (6.0)	4.4–6.7 (5.2)	1.00–1.35	1.15	fibrillose, fugacious	white, pink	38–77 × 9–27	25–52 × 7–23
LE 235469	4.6–7.0 (5.7)	4.0–5.6 (5.0)	1.00–1.42	1.16	fibrillose, fugacious	concolorous with side (initially pale yellow)	44–57 × 8–16	47–62 × 10–21

Explanations: Microscopic dimension of basidiospores are based on observation of 30 spores. All other dimensions are based on observation of 10 structures. Q – length/width; Q* – mean meaning of Q.

in a few lamellae) to entirely clear and vivid, especially in the young basidiocarps. The micromorphological characteristics are varying too. The size of spores, the form and the size of cheilo- and pleurocystidia strongly variate in the single basidiocarp (Fig. 5). A range of intermediate states is characteristic for analyzed features as well as there isn't any correlation between these states.

Polymorphism of cystidia size and lamellae pigmentation shows that these features have little value by themselves for delimitation of the species. So, the low taxonomic value of the lamellae color for *Pluteus* species has been demonstrated by Vellinga (Vellinga 1990), who considered *P. luteomarginatus* Rolland with the yellow-marginate lamellae as a synonym of *P. leoninus*.

Taking into account all of this, it can be supposed that *P. fenzlii* and *P. mammilatus* are the same species. However, the populations growing in the different continents can possess some genetic differences. The additional genetic studies could answer to the question about similarity of the American and the European species of annulate *Pluteus*.

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