

## The Species of the "Rubentes" Group in the Genus *Leucocoprinus*

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Several authors (KÜHNER—ROMAGNESI 1953; PILÁT 1953, 1955; DENNIS—ORTON—HORA 1960; DEMOULIN 1966; MOSER 1967; MALENÇON—BERTAULT 1970; BON—BOIFFARD 1972; JOSSE RAND 1974; etc.) have in the last two decades discussed a rather incompletely known species group, namely the European and North African fungi relegated to KÜHNER's group "Rubentes", characterized by a mostly rubescent flesh and turning usually green in ammonia fumes and by spores coloured metachromatically in cresyl blue.

Neither the systematic place (*Leucocoprinus*—*Leucoagaricus*—*Lepiota*) nor the homogeneity of the group are satisfactorily clarified, because the specific delimitations and revisions were made only recently or are still being done. I have no intention to occupy any definite standpoint in this regard and therefore follow MOSER's and BON—BOIFFARD's concepts as far as the species here discussed are concerned.

Owing to "fortunate circumstances", almost all fungi assigned to this group have been found in Hungary. In the present paper I propose to submit a brief description of the taxa, their range, and my own observations concerning their circumstances of occurrence on the basis of collectings in Hungary and as supplementary remarks to literature data. The herbarial material is preserved in the Botanical Department (PB) of the Hungarian Natural History Museum, Budapest.

On the basis of the colour of the exsiccates, the shape and size of the spores, as well as the observations concerning the discolouration of fresh materials, this species group allows rather good identification (Table 1).

### 1. *Leucocoprinus pilatianus* (DEM.) BON et BOIFF. (Fig. 1)

= *Lepiota pilatiana* DEM.; *Leucocoprinus pilatiana* (DEM.) MOS.; *Lepiota rufovelutina* VEL. sensu PILÁT.

DEMOULIN (1966) recognized that *L. rufovelutina* VEL. sensu PILÁT (PILÁT 1951, 1953; WICHANSKY 1960), published in painstaking details from Czechoslovakia, is not identical with *L. rufovelutina* VEL., and therefore separated PILÁT's fungus as a new species. DEMOULIN

Table 1

Comparison of taxa of the „Rubentes“ group occurring in Hungary, on the basis of fresh and herbarial specimens

Spore	Spore length below 9—(10) $\mu\text{m}$ ; without germ pore				Spore 8—12—(13) $\mu\text{m}$ long; with germ pore
	Spore ellipsoid-ovoid-slightly amygdaliform, not papillose	Spore amygdaliform		Spore ellipsoid-ovoid	
		strongly papillose	weakly papillose		
Discoloration or fresh fruitbodies when touched of after some time	browning	more or less intensely rubescent species turning red through yellow-orange, or turning immediately red			Turning winereddishbrown or lilac rosaceous through yellow-orange
Ammonia reaction + = greening	+	+	—	+	+
Colour of exsiccates fb. = fruit- body g. = gills	fb. various brown  g. ochre- (brownish- carneous), edge locally brown	fb. brown, dark brown  g. ochre- (brownish- carneous), edge brown	fb. brownish- winered  g. olive- greenish greyish- brown	fb. blackish brown, brownish- black  g. dirty brown, blackish- brown	fb. winereddish brown, oc- casionally brownish- winered  g. light dirty brown, ochreous brown, edge more or less darker  g. mostly maculately rosy lilac winered- ochreous- dirty whitish, edge more or less darker  flesh in stem base whitish with a wine- reddish tinge
Species	<i>L. pilatianus</i>	<i>L. pilatianus</i> var. <i>erubescens</i>	<i>L. jubilai</i>	<i>L. croceo- velutinus</i>	<i>L. badhamii</i>  <i>L. bresadolae</i>  <i>L. biornatus</i>

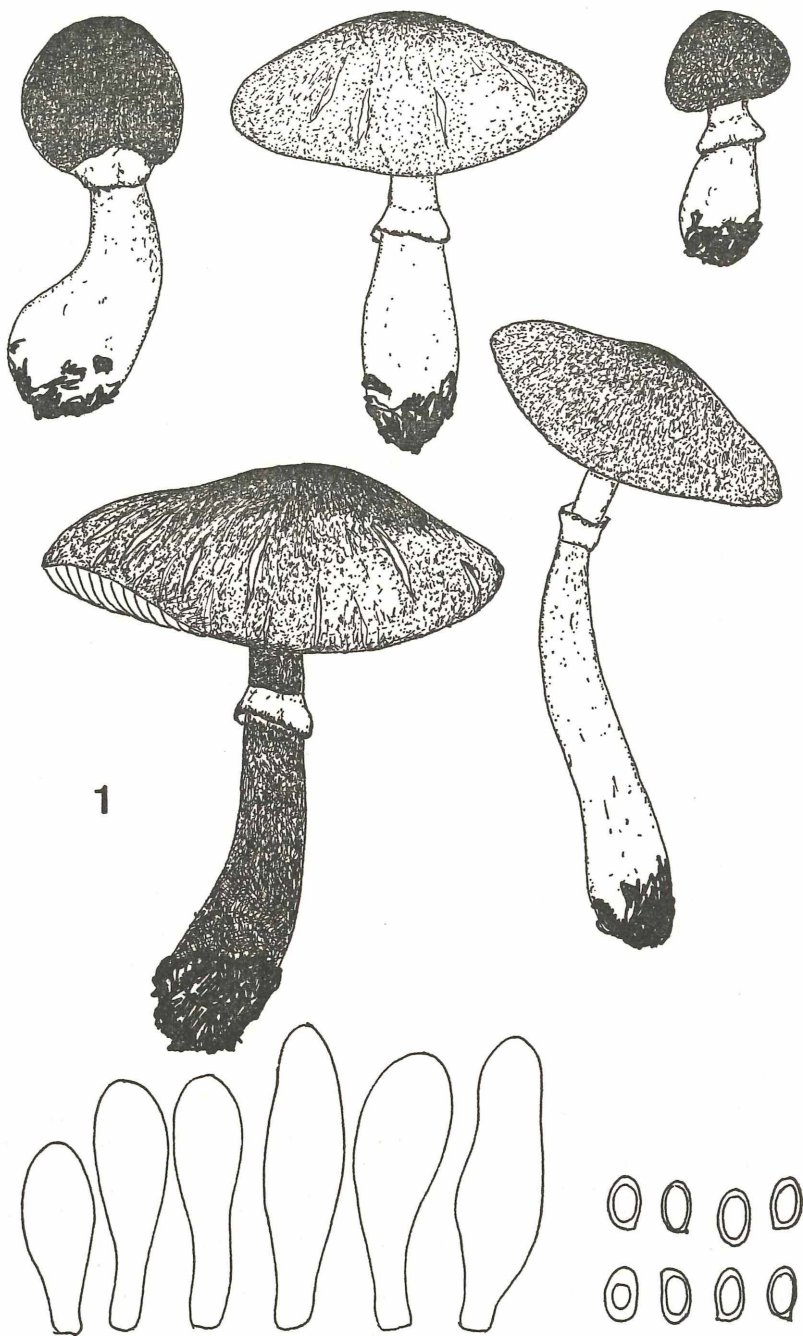


Fig. 1. *Leucocoprinus pilatianus* (DEM.) BON et BOIFF. Fruit bodies (natural size), spores and cheilocystidia ( $\times 1000$ )

remarks that except of VELENOVSKY's original description and its translations all references to „*L. rufovelutina*” refer in fact to *L. pilatianus*.

A coloured illustration is to be found in PILÁT's work [1953, Tab. 2; he also submitted photographs (1951, Fig. 280/a, 611/2, 612, 613; 1953, Figs. 12—19, 23)].

It was collected in Czechoslovakia in a park, on humus below deciduous trees (PILÁT 1953). In France (BON-BOIFFARD 1972), it grew on seaside sand dunes below *Pinus* and *Quercus*. In North Africa (Algeria, Morocco), it was found under *Acacia horrida* (KÜHNER—MAIRE 1937), and on littoral sand (MALENÇON—BERTAULT 1970). The Hungarian localities are similar: as is to be seen in the herbarial data, it grew in masses on calcareous sand soil, in mixed woods of *Robinia pseudo-acacia*, *Quercus robur*, *Pinus nigra*, *Populus* sp.

According to the descriptions of the authors cited above, the cap of *L. pilatianus* is velutinous, its surface radiately disrupting towards the margin; reddishbrown, castaneous, or lighter, rosy brown to rosy ochreous; turning to brown. Gills white to whitish, locally or in older specimens slightly rosy brownish. Edge of gills usually not darkening, or locally slightly browning. Gills without or with a weak collarium. Stem more or less clavate, often curved; white, tending to brown, finally brown. Ring white, marginally mostly brown; infundibuliform or pendulous.

Diameter of caps in examined material 3—8 cm, stem 3—12 × 0,3—0,9 cm above and 0,6—2 cm below. Spores ovoid, slightly amygdaliform, (5,7)—6,2—8 × (3,2)—3,5—4,5 μm. Cheilocystidia clavate, without appendage, at most some cystidia with a minute appendage; 23—42—(62) × 8—15 μm; hyaline, but finely coloured on slightly browned gill edges and internally with some more or less brown inclusions. Hairs of stem colourless or weakly coloured, their thickness usually below 10 μm.

Cap of exsiccates varying brown, stem brown, gills ochre-ochreous brownish, flesh coloured, edges locally brown, flesh light brown.

#### Herbarial data:

Balatonszemes, Com. Somogy, in *Pinus nigra* afforestation, 6. X. 1943, leg.: G. BOHUS, det.: M. BABOS; Mts. Pilis, Com. Pest, X. 1949, leg.: G. BOHUS, det.: M. BABOS; Budapest: Budafok, in garden, 11. VII., 3. X. 1949, leg.: Z. KALMAR, det.: M. BABOS; Bugac, Com. Bács-Kiskun, in mixed woods (*Pinus*, *Populus*, *Robinia*), on sandy soil, in masses, 8. X. 1968, leg.: M. BABOS—E. VÉSSEY, det.: M. BABOS; Szentendrei-island: Horány, Com. Pest, in deciduous forest (*Robinia pseudo-acacia*, *Quercus robur*, *Populus alba* — *canescens*, etc.), on calcareous sandy soil, in masses, 19. X. 1974, leg. et det.: M. BABOS.

When clarifying *Lepiota rufovelutina* VEL. sensu PILÁT, DEMOULIN accepted in 1966 the variety *subrubens*, separated by WICHANSKY (1960), as a variety of *Lepiota pilatiana*. Both consider it identical

with *Lepiota rubens* (KÜHNER—MAIRE 1937), described from North Africa, but the later name, given by WICHANSKY, is the valid one, since *L. rubens* is a "nomen nudum"

According to the descriptions, var. *subrubens* differs by its smaller stature and spores from the species. On the basis of his own and of other collections as well as by the examination of the type-material, DEMOULIN (1966) averred that the two forms cannot be separated microscopically from each other. This statement is corroborated also by the spore measurement data submitted in literature.

KÜHNER—MAIRE 1937	<i>Lepiota rubens</i>	5—7 × 3—4 μm
WICHANSKY 1960	<i>Lepiota rufovelutina</i> var. <i>subrubens</i>	6—7 × 3—3,5 μm
DEMOULIN 1966	WICHANSKY's type-material	6—7 × 3,3—4,3 μm
PILÁT 1953	<i>Lepiota rufovelutina</i> ss. PILÁT (= <i>L. pilatianus</i> )	6,5—7,5 × 3,6—3,8 μm

WICHANSKY made no mention of the cheilocystidia in the original description. DEMOULIN (1966) found the cheilocystidia of both *L. pilatianus* and of var. *subrubens* of similar size, and writes as follows: "Cheilocystides incolores et dépourvues de prolongement"

Perhaps even the smaller stature is not a constant character: when collecting larger materials, considerable differences can be observed in the size of the fruitbodies also within the species.

I do not contend the existence of var. *subrubens*, and only consider its separation from *L. pilatianus* as problematic. Similar considerations may have induced BON—BOIFFARD (1972) to write as follows in the identification key:

"Rougisement peu accentué, cellules marginales non appendiculées: *L. pilatianus* (DEM.) n. comb. (= *L. rufovelutina* VEL. ss. PILÁT (inclus var. *subrubens*); = *L. rubens* KÜHN.—MAIRE"

Rectifications concerning the Hungarian material published as „*Lepiota rufovelutina* VEL. var. *subrubens* WICH.” (BABOS 1961) are to be found in the discussion of the next taxon.

#### 1a. *Leucocoprinus pilatianus* (DEM.) BON et BOIFF.

var. *erubescens* n. var. (Fig. 2, Photo 1).

= *Lepiota rufovelutina* VEL. var. *subrubens* WICH. sensu BABOS, Ann. Hist.-nat. Mus. Nat. Hung., (1961), 53, p. 198.

A typo differt: Pileus superficiei albido-ochracea pilis tenuissimis rosaceo-brunneis cooperta, in medio rosaceo-brunneus. Pileus, acies laminarum et stipes tactu primo vivide rubescens, deinde brunnescens. Caro parum erubescens, cum NH<sub>3</sub> viridescens. Cheilocystidia pallide rosaceo-brunnea, clavata, fusiformia, plerumque appendiculis variabiliter efformatis. Typus: 32.209.

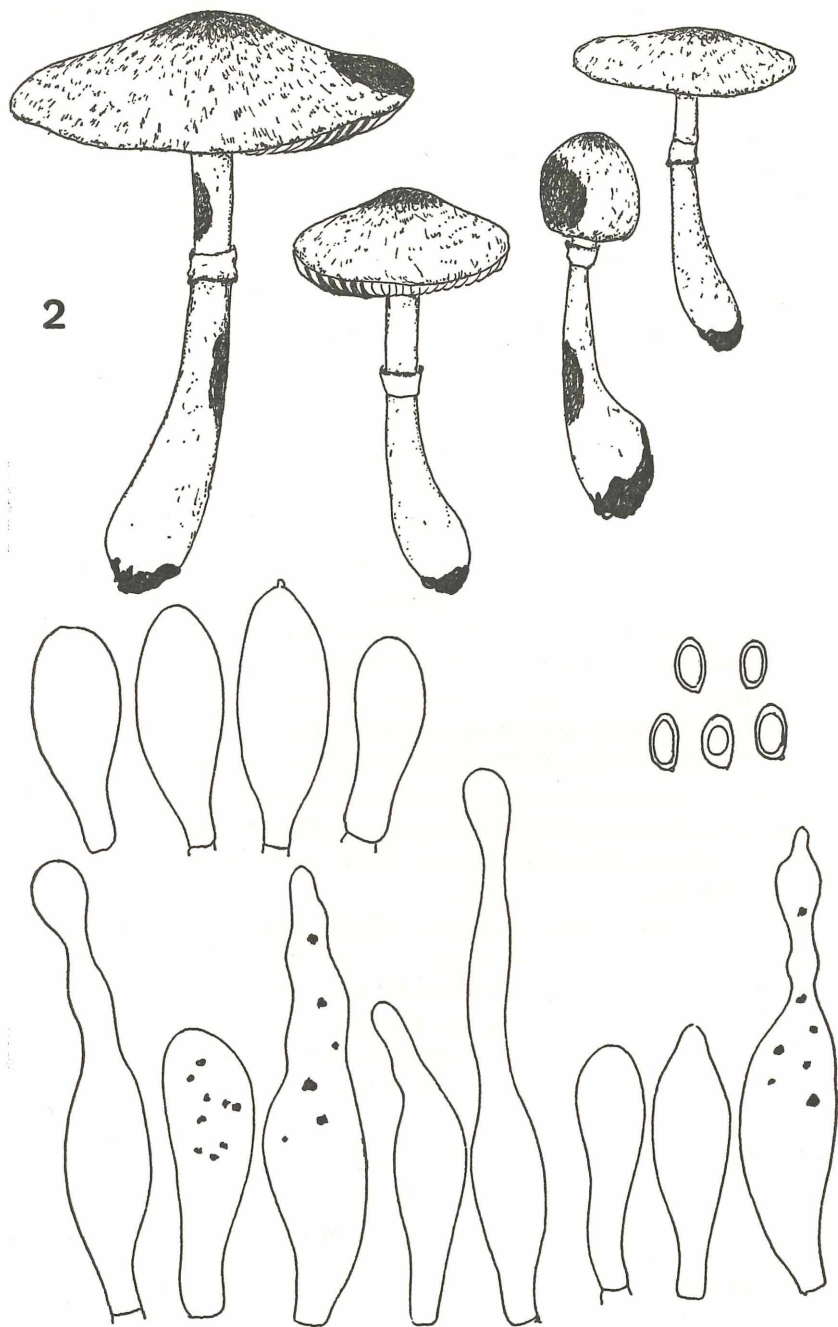


Fig. 2. *Leucocoprinus pilatianus* (DEM.) BON et BOIFF. var. *erubescens* n. var.  
Fruit bodies (natural size), spores and cheilocystidia ( $\times 1000$ )

BABOS published (1961) under the name *Lepiota rufovelutina* VEL. var. *subrubens* WICH. an intensely rubescent material of her own collection, identified by E. WICHANSKY. In the course of the present revision, when comparing the features of the Hungarian specimens to the descriptions of *L. rufovelutina* var. *subrubens* (WICHANSKY 1960) and its synonym *Lepiota rubens* (KÜHNER—MAIRE 1937), in addition to the similarities also some striking differences could be established: the cap, gills and stem of our fungus turned a vivid red when touched, and then became brown.

The brief description of the material collected in 1960 is as follows: Cap 2—6 cm; basic colour whitish-ochreous, covered with fine rosy brown hairlets; centre rosy brown. Gills whitish to pale creamy; distant from stem, uniting into a weak collarium. Stem 4—8×0,3—0,6 cm above/0,4—1,3 cm below; clavate; white to whitish. Ring when young erect infundibuliform. Cap, edge of gills and stem intensely reddening when touched, then discolouring through orange to brown. Flesh when cut slightly rubescent in cap, then becoming paler. Spores (according to BABOS 1961, s. n. var. *subrubens*) ovoid, (5,5)—6,7—7,5×3,5—3,8—(4,2)  $\mu\text{m}$ ; according to some new measurements rarely also 7,8  $\mu\text{m}$  long, its width 3,2—4,7  $\mu\text{m}$ . Cheilocystidia clavate, fusiform, mostly without appendages (20—39×7,8—17  $\mu\text{m}$ ), but also with appendage; length and form of appendage varying, its length extending from some  $\mu\text{m}$  to occasionally 80  $\mu\text{m}$ , its width 3—7—(9,3)  $\mu\text{m}$ . Cheilocystidia in water hyaline or pale reddishbrown, internally with more or less and smaller to larger brown inclusions. Width of stem hairs below 10  $\mu\text{m}$ .

When fresh, it can be well separated from *L. pilatianus* by its lighter cap, the not velutinous but fine shortly haired cap surface and the intense rubescence. On the other hand, the herbarial specimens are very similar to each other, even the dry flesh has the same colour (light brown), and only the browning of the gills edge is more constant. I do not consider the shape of the cheilocystidia or the presence of the appendages as a good separating character, it is, however, a fact that beside the clavate cheilocystidia without an appendage there are also many bearing an appendage.

From the intensely rubescent *Leucocoprinus* species, var. *erubescens* is well separable: in *L. badhamii* the hairs of the stem are thicker and the fungus becomes blackishbrown — brownishblack when desiccated; in *L. croceovelutinus* the spores show a different form and the fruitbody does not turn green in ammonia fumes.

#### Herbarial data:

Type material: 32.209 Mende, Com. Pest, in robinieto arenoso (*Robinia pseudo-acacia*, *Sambucus nigra*), 22. Oct. 1960, leg.: M. BABOS—G. BOHUS—I. KONECSNI. — Mende, Com. Pest, on sand, in locust-tree woods and in oak-woods mixed with *Robinia pseudo-acacia*, 27. X. 1960, leg.: M. BABOS—G. BOHUS,

det.: M. BABOS; 17. IX. 1968, leg.: M. BABOS—G. BOHUS—I. FERENCZ—F. VÉSSEY, det.: M. BABOS; Szentendrei-island: Horány, Com. Pest, in mixed wood on sand (*Pinus silvestris*, *Populus alba*, etc.), 18. IX. 1976, leg. et det.: M. BABOS; Kajdacs, Com. Tolna, in locust-tree wood on sand, 29. IX. 1927, leg. et det.: L. HOLLÓS (s. n. *Lepiota georginae* SMITH), rev.: M. BABOS.

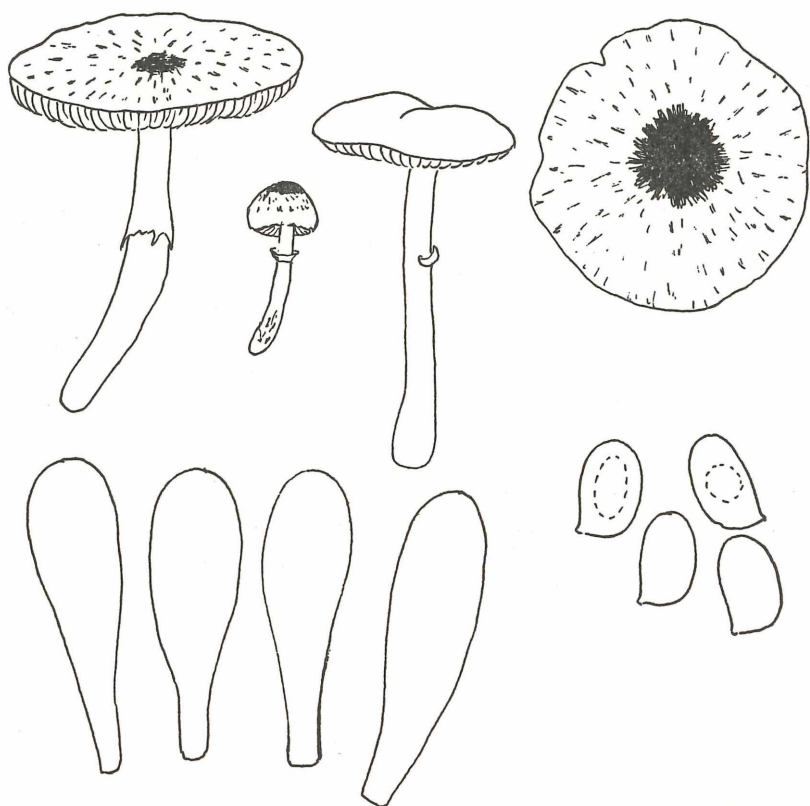
Since the specimen collected in an locust-tree wood on sand and identified as *Lepiota georginae* by L. HOLLÓS proved in the course of revision to be *L. pilatianus* var. *erubescens*, therefore the earlier record (HOLLÓS 1899) published as *L. georginae* but unsupported by a herbarial specimen may also be regarded as var. *erubescens*. HOLLÓS wrote of this fungus as follows (a translation): “there appear sanguineous red spots on this snow white fungus when touched. When drying, it becomes brown except the gills. I found it in an oakwood at Felsőnyáregyháza, at the end of September.” At the end of the nineteenth century HOLLÓS could in fact not have thought of anything else than the fungus illustrated by COOKE (1881—1891, Pl. 132), because no other species of such character had been separated at that time in Europe. KONECSNI (1952—1953) published the same fungus from the neighbourhood of Gyömrő, under the name “*Lepiota meleagris* CKE” He collected it along a forest path in a *Robinia* wood in October. According to his remarks “the caps, 2—4 cm in diameter, had initially been white, then became strongly rubescent. Its white gills as well as its flesh turned red” When, on a common collecting trip in 1960, we found var. *erubescens* in larger quantities at Mende, some kilometres away from the Gyömrő area, it became clear that the species was identical with his material.

MALENÇON—BERTAULT (1970) published from Morocco a fungus of similar colour which turned sanguineous red when touched (s. n. *Lepiota rufovelutina* VEL. ss. PILÁT), whose spores were of a similar shape but slightly larger (“7—9—(10)×5—6  $\mu$ , le plus souvent: 8×5,2  $\mu$ ”). Despite this small difference, this fungus collected under *Acacia* sp. on sand may be identical with var. *erubescens*.

## 2. *Leucocoprinus jubilaei* (JOSS.) n. c. (Fig. 3)

(= *Lepiota jubilaei* JOSS., numéro spécial du Bull. de la Soc. Linnéenne de Lyon, 15 février 1974, p. 214—216.)

JOSSERAND was kind enough to send me a specimen of his *Lepiota jubilaei*, described in 1974, supplementing it with a figure illustrating the discoloration of the fresh fruitbody. The colour of the exsiccatum nearly wholly agrees with that of the Hungarian material. Although I received the single specimen collected at Tápiószecső already in a dry state and without a detailed description, but according to I. KONECSNI's note, taken at the time of the collection, the cap of the fungus was of a whitish colour, and centrally lilac-brownish or dark purplish red. JOSSERAND's description (1974) agrees:



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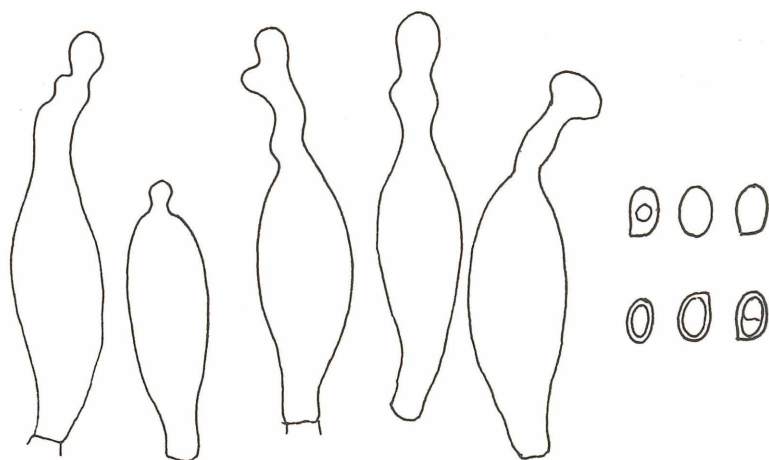


Fig. 3. *Leucocoprinus jubilaei* (Joss.) n. c. Above: Fruit bodies (natural size), spores ( $\times 2000$ ), and cheilocystidia ( $\times 1000$ ) after Jossierand (1974). Below: Cheilocystidia and spores ( $\times 1000$ ) on the basis of Hungarian material

"le centre est uni et mollement feutré, fortement teinté de bistre-(purpuracé), de brun-(améthyste) et alors de la teinte de *Psalliota amethystina* Q., parfois aussi simplement brun-bistré." Even the form of the spores agrees, they are ellipsoid-ovoid, weakly amygdaliform; according to JOSSERAND they are  $6-6,5-7,8 \times 3,7-4,4 \mu\text{m}$ , the Hungarian material  $5,9-7,8 \times 3,7-4,7 \mu\text{m}$ .

The cheilocystidia show a certain difference. They are, according to JOSSERAND: "hyalines, claviformes, rarement cylindracées ou obtusément fusiformes" The cheilocystidia of the Hungarian material are coloured, in water brownish; often with appendages, the shape and size of the appendages varying, even  $54 \mu\text{m}$  in length. This contradiction may be explained by the fact that this group is generally characterizable by cheilocystidia having appendages, but their development may be connected with the state of maturity of the fruitbodies.

The exsiccatum most resembles *L. croceovelutinus*, but they are well separable by the form of the spores: the spore of *L. croceovelutinus* is papillosely amygdaliform. In the case of fresh exemplars, the ammonia reaction may be of help: *L. jubilaei* gives a green reaction, even if of varying intensity, while *L. croceovelutinus* does not turn green. This holds good also for the microscopic preparation made of the exsiccate. The cheilocystidia of *L. jubilaei* are brownish-olive brownish in ammonia, while those of *L. croceovelutinus* remain brownishred also in  $\text{NH}_3$ .

JOSSERAND gave an india-ink illustration of the species (1974, Fig. 5).

Herbarial datum: Tápiószecső, Com. Pest, in a grassy-mossy site on sand, 28. X. 1960, leg.: I. KONECSNI, det.: M. BABOS.

### 3. *Leucocoprinus croceovelutinus* BON et BOIFFARD (Fig. 4)

The authors described this species on the basis of three data in 1972. A specimen each had also been collected in Hungary in 1966, 1969, 1970. Owing to the meagre material, the fungus could not be described as new, but it was evident that it did not agree with the known, intensely reddening *Leucocoprinus* species, although, when fresh it is difficult to distinguish it macroscopically from these congeners.

It was probably from this cause that BON—BOIFFARD (1972) called PILÁR's photographs (1955, Figs. 11—12, s. n. *L. rufovelutina* var. *sanguinescens*), made from *Leucocoprinus badhamii* ss. ORTON, as correct illustrations, with the remark that the former gives a green reaction with ammonia, while the fungus described by them does not turn green in ammonia fumes.

However, the colour of the exsiccates differ considerably from each other: *L. badhamii* ss. ORTON is blackishbrown to brownishblack

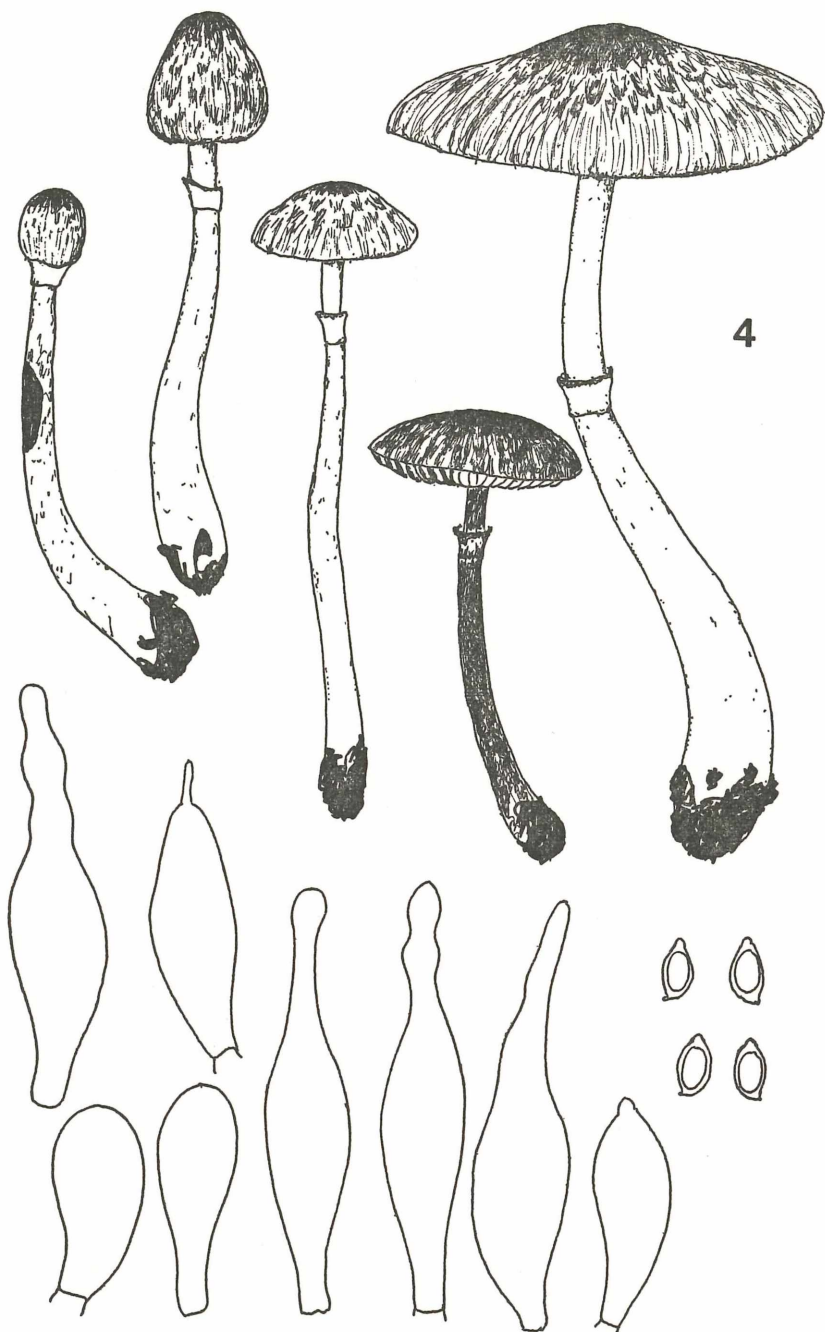


Fig. 4. *Leucocoprinus croceovelutinus* BON et BOIFF. Fruit bodies (natural size), spores and cheilocystidia ( $\times 1000$ )

when dry, whereas *L. croceovelutinus* is brownish bloodred to blackish-winered, and the colour of its gills is a mixture of olivegreyish-winered-brown (by the naked eye); its flesh in the cap is winered, in the stem cortex blackishwinered, in its pith light winereddish-brown.

BON—BOIFFARD collected it near the seashore, in deciduous forest (*Quercus*, *Robinia*, *Ligustrum*) and mixed with *Pinus*. The species appeared also in a similar habitat in Hungary: in a sandy wood on one of the islands of the Danube near Budapest, in masses for two weeks in October 1974. On the basis of this material, I submit the following supplementary remarks on measurement and other characteristic data:

Cap 1,8—6 cm in diameter; variations of its shape as in Fig. 4; in the middle contiguous, towards margin disrupting into fine, adscumbent flocci to squamules to fibrillose squames, eventually also radiately disrupting; colour initially white then squamae reddening, when touched or by some time vivid red, brownish winered (entire fungus turning red even in situ); margin of cap not ribbed. Gills white to whitish, when touched immediately rubescent, by next day dark (a mixture of olivegrey—winered—brown); no or merely a weakly developed collarium present. Stem (3,5)—6—12—(15) × 0,2—0,6 cm above, (0,4)—1,2 cm below; slender, cylindrical, more or less incrassate downwards, slightly clavate, usually curved; white, immediately rubescent when touched; very fragile, especially base. Ring infundibuliform, erect, membranous, at middle or in upper one-third of stem, white, marginally winered, turning to red. Flesh thin in cap, loose in stem, discolouration intense: turning to red through yellow to orange red. Not turning green in ammonia fumes.

Spores amygdaliform, papillose; (6,2)—7—8,5 × 3,9—4,7 μm; without germ pores. Colour of cheilocystidia, basidia, cap hairlets and stem hairs lighter to darker brownishred or reddishbrown in both water and ammonia. Cheilocystidia clavate, ventricose, without appendage or with appendages of various size and shape; 20—30—(54) × 8—16 μm + appendage (3)—14—30—(39) × 3—6 μm. Shape of cap hairs varying, more or less clavate, fusiform or cylindrical, terminally rounded or minutely acute; of varying lengths (rarely even 200 μm), their width (6,2)—10—15,6—(26) μm. Hairs of stem clavate, (7,8)—10—20—(30) μm wide.

#### Herbarial data:

Üllö, Com. Pest, on heap of decaying maizestems at edge of locust-tree wood, 4. X. 1966, leg.: M. BABOS—E. VÉSEY, det.: M. BABOS; Budapest: Péterimajor, in forest zone on sand (*Robinia pseudo-acacia*, *Populus alba*), 21. IX. 1969, leg. et det.: M. BABOS; Csévharaszt, Com. Pest, in locust-tree wood on sand, 19. IX. 1970, leg.: M. BABOS—G. BOHUS—S. SUNHEDE, det.: M. BABOS; Szentendrei-island, HORANY, Com. Pest, on calcareous sandy soil, in shrubby site in mixed forest (*Quercus robur*, *Pinus nigra*, *Pinus silvestris*,

*Robinia pseudo-acacia*, *Ligustrum vulgare*, *Crataegus monogyna*, etc.), many specimens, 12. X., 19. X. 1974, leg. et det.: M. BABOS.

4. *Leucocoprinus badhamii* (BERK. et BR.) MOSER 1967 (Fig. 5)

= *Lepiota badhamii* (BERK. et BR.) ss. PAT., BOUD., REA, ORTON, DEMOULIN; *Lepiota rufovelutina* VEL.; *Lepiota rufovelutina* VEL. var. *sanguinescens* PILAT; *Lepiota meleagroides* HUIJSMAN nom. nud.

The species, confused with *L. bresadolae*, was clarified, on the basis of an examination of the type-material, by ORTON (in: DENNIS—ORTON—HORA 1960), while subsequently DEMOULIN (1966) discussed in detail nomenclatorial and taxonomical problems.

The species was known in Western Europa from Great Britain, France, Holland, Belgium, and Switzerland. According to BRESINSKY—HAAS (1976), it was found also in Germany. It was published in Central Europa from Czechoslovakia (VELENOVSKY 1920; PILÁT 1955; WICHANSKY 1956), and later collected in Hungary (BABOS 1958) and Roumania.

KONRAD—MAUBLANC (1948; s. n. *L. meleagroides*) and DEMOULIN gave a detailed list of the colour illustrations; that these figures show diverse fungi is explained by the variability of the species and mainly the varying state of the specimens. PATOULLARD's water-colour (1925, Pl. I.) excels by the vivid red discolouration, and it also resembles best the black-and-white photographs published by PILÁT (1955, Figs. 11—12). BARLA's (1888, Tab. 12, Figs. 8—11) stylized figures agree in certain characteristics well with PILÁT's photos. I also saw browned specimens with brownly squamose caps agreeing with those illustrated by COOKE (1881—1891, Pl. 25) and BOUDIER (1905—1910, Pl. 11). In one of our collections, the untouched white gills (cf. COOKE, Pl. 25) show an interesting contrast to the caps and stems which, owing to their manifold handling became browned. According to DEMOULIN's remark, the stems of the older illustrations cited above (COOKE, BOUDIER, BARLA, PATOULLARD) are so glabrous that he would rather consider them as *L. pilatianus*. I have to contend this. Not because there appears some fibrillosity on the stem in COOKE's illustration, but because the cap of *L. pilatianus* is finely velutinous and not squamose, and its flesh turns brown only in the stem cortex.

*L. badhamii* is well recognizable by herbarial specimens: the exsiccatum is blackishbrown to brownishblack. Among its microscopical characteristics, an important feature of identification is the thickness of the stem hairs: they are thick (above 10  $\mu\text{m}$ ) and with a red content. The colour of the cheilocystidia is also red in water; their appendages of various shape and size. In addition to the habitus figure, DEMOULIN (1966) and JOSSEAND (1974) also published drawings of the microscopical features.

In October, 1974, a rich and diverse material was found nearly synchronously in the environs of Budapest, in contrast to the sporadic

findings of one specimen per occasion. On the basis of this material, a brief characterization may be given as follows:

Cap 3—8 cm; hemispherical, convex, expanding, centrally more or less gibbous; felty-squamulose-squamose-fibrillososquamose or radiately disrupted, occasionally nearly smooth; when young white, only squamules light brown, frequently browned already in situ or maculately brown; when touched turning immediately vivid red and then brown. Margin of cap often not ribbed. Gills white to creamy; when touched reddening (rubescence either through orange or immediately vivid red); distant from stem, with a weak collarium; edge flocculose. Stem 3,5—11 × 0,3—0,9 cm above/0,5—1,5 cm below; cylindrical, more or less clavate, often curved; white, when touched turning red then brown; below ring ornamented with fibrilles (some specimens less striking fibrillo-velutinous, others more so), above ring finely floccose. Ring about upper  $\frac{1}{3}$  of stem; white, margin brown. Flesh fragile, especially at base of stem. Turning intensely green in ammonia fumes.

Spores amygdaliform, also slightly papillose, 6,2—7,8—(8,5) × 3,9—4,7—(5,4)  $\mu\text{m}$ . Cheilocystidia clavate, with appendages of various size and shape; 23—45 × 9,3—14—17—23  $\mu\text{m}$  + appendage 3—28 × 3—5—7  $\mu\text{m}$ ; brownishred in water, locally with more or less and smaller to larger brown inclusions. Stem hairs clavate, 10—23—(28)  $\mu\text{m}$  wide; coloured as the cheilocystidia.

Exsiccatum blackishbrown—brownishblack; subsequent to browning through red, the material becomes quite dark more or less rapidly. The flesh in the base of the stem does not turn quite dark, remaining a dirty brown. In some specimens, there is a slight purplish tinge in the cap and in the loose flesh within the stem.

The sites published in literature and those where the species occurred in Hungary are similar; it grows mostly in deciduous woods, but it was found also in deciduous woods mixed with *Pinus nigra*.

#### Herbarial data:

Budapest: Mt. Hársbokorhegy, 21. X. 1951, leg. et det.: G. BOHUS. The material perished, and there is only a watercolour sketch in the collection. Budapest: Mt. Szarvashegy, Fageto-Ornetum, 15. X., 29. X. 1955, leg. et det.: G. BOHUS—M. BABOS, rev.: A. PILÁT. The material is in the Herbarium of the National Museum, Prague. Budakeszi (environs), 2. X. 1952, leg.: Z. KALMÁR, det.: M. BABOS; Budapest: Mt. Csűcshegy, in mixed woods, X. 1955, leg. et det.: G. BOHUS—M. BABOS, rev.: A. PILÁT; Budapest: Fenyőgyöngye, XI. 1964, leg.: I. FERENCZ, det.: M. BABOS, rev.: V. DEMOULIN; Budapest: between Mt. Hármashatárhegy and Óbuda, 1. X. 1974, leg.: M. VIRÁG, det.: M. BABOS; Budapest: Kamaraerdő, in deciduous forest (*Fraxinus*, *Robinia*), 23. X. 1974, leg.: G. BOHUS—E. VÉSSEY, det.: M. BABOS; same locality, 30. X. 1974, leg. et det.: M. BABOS—G. BOHUS; Szentendre-island: Horány, Com. Pest, in deciduous woods (*Quercus robur*, *Populus alba* — *canescens*, *Robinia pseudoacacia*) and in mixed forest (with *Pinus nigra*, *Pinus silvestris*), on calcareous sandy soil, 19. X., 27. X. 1974, leg. et det.: M. BABOS; Roumania:

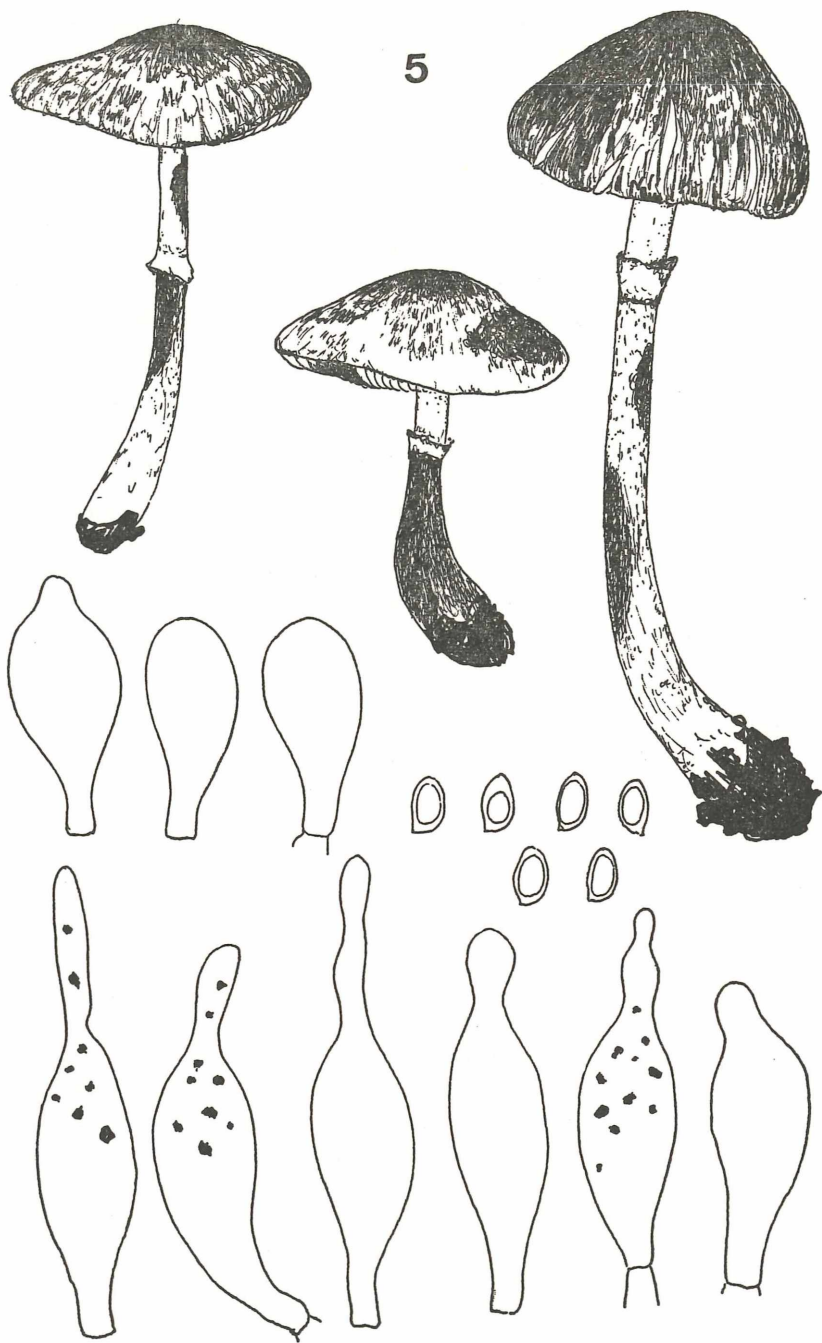


Fig. 5. *Leucocoprinus badhamii* (BERK. et BR.) MOSER. Fruit bodies (natural size), spores and cheilocystidia ( $\times 1000$ )

Brasov, in mixed forest (*Pinus nigra*, *Fagus silvatica*, *Corylus avellana*), 13. VIII. 1964, leg.: M. BABOS—K. LÁSZLO—G. SILAGHI, det.: M. BABOS, rev.: V. DEMOULIN.

5. *Leucocoprinus georginae* (W. G. SMITH) BON et BOIFF.

= *Lepiota georginae* W. G. SMITH.

I had no occasion to collect or to study personally this fungus of small stature. According to literature data, it is a rare Atlantic species (KONRAD—MAUBLANC 1948).

On the basis of the macroscopic and microscopic characteristics, published in the longer to shorter descriptions, the species belongs, according to BON—BOIFFARD (1972) in this group. MOSER discusses it among the *Leucocoprinus* (1955) then among the *Lepiota* (1967) species. SINGER (1975) reallocated the Section Piloselli, and thereby also *L. georginae*, from the genus *Lepiota* to the genus *Leucoagaricus*.

The fragile fungus, with a cap measuring 1—2 cm and ornamented on white ground with fine brown fibrilloso-pruinosity, turns a vivid red when touched. The stem is also covered with hairlets. The species turns green in ammonia fumes. The herbarial material is blackish (according to KONRAD—MAUBLAC 1948; PILÁT 1951). Apart from the small size, these characteristics are similar to those of *L. badhamii*, but some authors describe the cap and stem of *L. georginae* as being slightly viscous. On the other hand, MAIRE (1908) collected a not viscous *L. georginae* under an oaktree; on the basis of the description, his fungus can be distinguished only by its small stature from *L. badhamii*.

A coloured illustration has been published by COOKE (1881—1891, Pl. 132).

6. *Leucocoprinus bresadolae* (SCHULZER) MOSER

This species of large stature, striking appearance and characteristic growth in groups, was mostly published as *Lepiota badhamii* (BERK. et BR.) QUÉL. (*Leucocoprinus*, *Leucoagaricus*, *Macrolepiota*, etc.) in earlier literature. However, ORTON (DENNIS—ORTON—HORA 1960) established the fact that the spore measurements of the type-material of "*badhamii*" are  $6-8 \times 3,5-4,5 \mu\text{m}$ , while most of the authors (KONRAD—MAUBLANC, KÜHNER—ROMAGNESI, LOCQUIN, SINGER, MOSER, PILÁT, MELZER, WICHANSKY, BABOS, SCHWÖBEL, etc.) discuss a fungus with considerably larger spore dimensions ( $8-12 \times 6-8 \mu\text{m}$ ). This latter species is *Lepiota bresadolae* SCHULZER, placed under this name by MOSER (1967) in the genus *Leucocoprinus*, substantiated also by SINGER (1975). The enumeration of its synonyms in this sense can be found in the works of DENNIS—ORTON—HORA (1960) and JOSSERAND (1974).

Besides the known earlier occurrences in West and South Europe, CAMARA recorded it from Portugal (1956). Lately a number of occurrences became known also from Central Europa (MELZER 1959; WICHANSKY 1964; BABOS 1961; BRESINSKY—HAAS 1976, etc.), while VASSILIEVA (1975) published it from Asia: from the far eastern region of the Soviet Union.

KONRAD—MAUBLANC (1948) could only refer to GILLET's (1874) and to their own illustrations (1924—1930, Pl. 11), in addition to BRESADOLA's own excellent figure (1892, Tab. 196). In later literature, a fine watercolour was published by ROMAGNESI (1961, Pl. 195), a black-and-white photo by WICHANSKY (1964; young specimens; their stems cracked probably owing to the dry weather prevailing), and good india-ink drawings by SCHWÖBEL (1966, Fig. 1) and by JOSSE RAND (1974, Figs. 1—3). Several of these authors also submitted detailed descriptions, therefore I give here only some supplementary remarks.

In Hungary, the species grew in all known localities on decaying sawdust, fragments of tree-bark, locally in very large groups. Mass occurrences were observed especially at Isaszeg, with many hundreds of specimens found on every occasion.

Some authors regard it as poisonous or suspicious. The material collected at Isaszeg was tasted as food by G. BOHUS, E. VÉSSEY and E. TÓTH; they found no toxic effect of the well cooked mushroom, indeed it proved to be rather tasty.

Spores (of the material studied) ellipsoid-ovoid;  $(7,2) - 8 - 12 - (13) \times (5,4) - 6 - 8,5 \mu\text{m}$ ; slightly coloured, of a stramineous rosy tint; metachromatically coloured with cresyl blue; with germ pore. Cheilocystidia clavate, fusiform, with appendage;  $(30) - 40 - 65 \times (8,5) - 14 - 23 \mu\text{m} + \text{appendage } 3 - 70 \times 3 - 7 \mu\text{m}$ ; in water hyaline, brownish to brown, locally with more or less brown inclusions.

#### Herbarial data:

Isaszeg-Szentgyörgypuszta, Com. Pest, in masses on decaying sawdust, 21. VII. 1966, leg.: I. FERENCZ—E. VÉSSEY, det.: M. BABOS—G. BOHUS; 20. IX. 1966, leg. et det.: M. BABOS—E. VÉSSEY; 31. X. 1966, leg. et det.: M. BABOS—G. BOHUS; Mts. Visegrád: Dömös, Com. Pest, on highly decaying sawdust, 29. V. 1968, leg.: J. GERENCSÉR, det.: M. BABOS; 23. VII. 1968, leg. et det.: M. BABOS; Tatabánya, Com. Komárom, 28. VII. 1966, leg.: ? det.: M. BABOS; Sopron, Com. Győr-Sopron, on decaying sawdust, 6. VIII. 1968, leg.: J. AGOCS, det.: M. BABOS; Komoró-Tuzsér, Com. Szabolcs, in a timberyard, 18. VI. 1969, leg.: I. JUHÁSZ, det.: M. BABOS; Mátészalka, Com. Szabolcs, in a timberyard, VII. 1974, leg.: Gy. KOMLOSSY, det.: M. BABOS; Budapest: on the market, from an unknown locality, 3. VIII. 1959, 17. IX. 1964, leg.: ? det.: M. BABOS; Budapest: Váci-út, on decaying sawdust, 21. IX. 1969, leg.: T. KÉKEDI, det.: M. BABOS; Budapest: city dump (district XIII.), IX. 1970, leg.: ? det.: M. BABOS.

7. *Leucocoprinus biornatus* (ss. COOKE) LOCQUIN (non BERK. et BR., REA) (Fig. 6)

(= *Agaricus* (*Lepiota*) *biornata* ss. COOKE; *Lepiota badhami* BK. var. *biornata* BK. et BR. ss. KÜHNER—ROMAGNESI).

The fungus illustrated by COOKE (1881—1891, Pl. 37) was considered as a good species or variety by the French authors (LOCQUIN 1945, 1951; KONRAD—MAUBLANC 1948; KÜHNER—ROMAGNESI 1953).

We have found specimens, corresponding to their conceptions, which, though in a fresh state actually resembling *L. bresadolae* as to habitus and colour, differ by the following features:

Surface of stem disrupting, ornamented with squamules — squames — fibrilles. Ring white, with a dark brownishrosy margin, on the underside lighter brownishrosy. Gills often of pale sulphureous yellow; not uniting into a collarium. Flesh white, not coloured inside of stem, turning yellow then orange red only in cap, in upper part and in cortex of stem.

Herbarial specimens vivid rosaceous lilac, lilac rosaceous, rosy winereddish, only squamae of cap brown, or lighter to darker rosy-brown. Gills when dry rosy lilac, winered, ochreous, dirty white, their edges more or less darker; usually maculately discolouring. Flesh in cap, in upper part and cortex of stem rosaceous lilac, but remaining nearly white in lower part of stem. (An observation holding for all four occasions of collection.) The colour of *L. bresadolae*, treated by the same method, is brownish wine red — wine reddish brown. BERKELEY — BROOME (1871) and REA (1922) remarks (“The whole plant becomes dark in drying”) do not agree with the colours of the exsiccates of the Hungarian materials.

In the illustration of “*Lepiota badhami*” by CETTO (1976, Pl. 22), the nice vivid colour, characteristic of our *L. biornatus*, is also observable on the margin of the cap, and the stem of the young specimens displays an irregularly zonate fine ornamentation. Could also this photo represent COOKE’s species?

COOKE (1881—1891) has it as a fungus collected in greenhouses. According to LOCQUIN (1951), it was found on compost. The Hungarian material has grown, similarly to *L. bresadolae*, on more or less decaying sawdust and wooden fragments. Owing to the process of decomposition, the sawdust was invariably warm.

Though the habitus of the fungus, the form, measurements, etc. of the spores and cheilocystidia, the greening of the fruitbody in ammonia fumes and the site are all identical with those of *L. bresadolae*, it still, differs to such an extent by the characteristics outlined above that we have to consider it a distinct taxon.

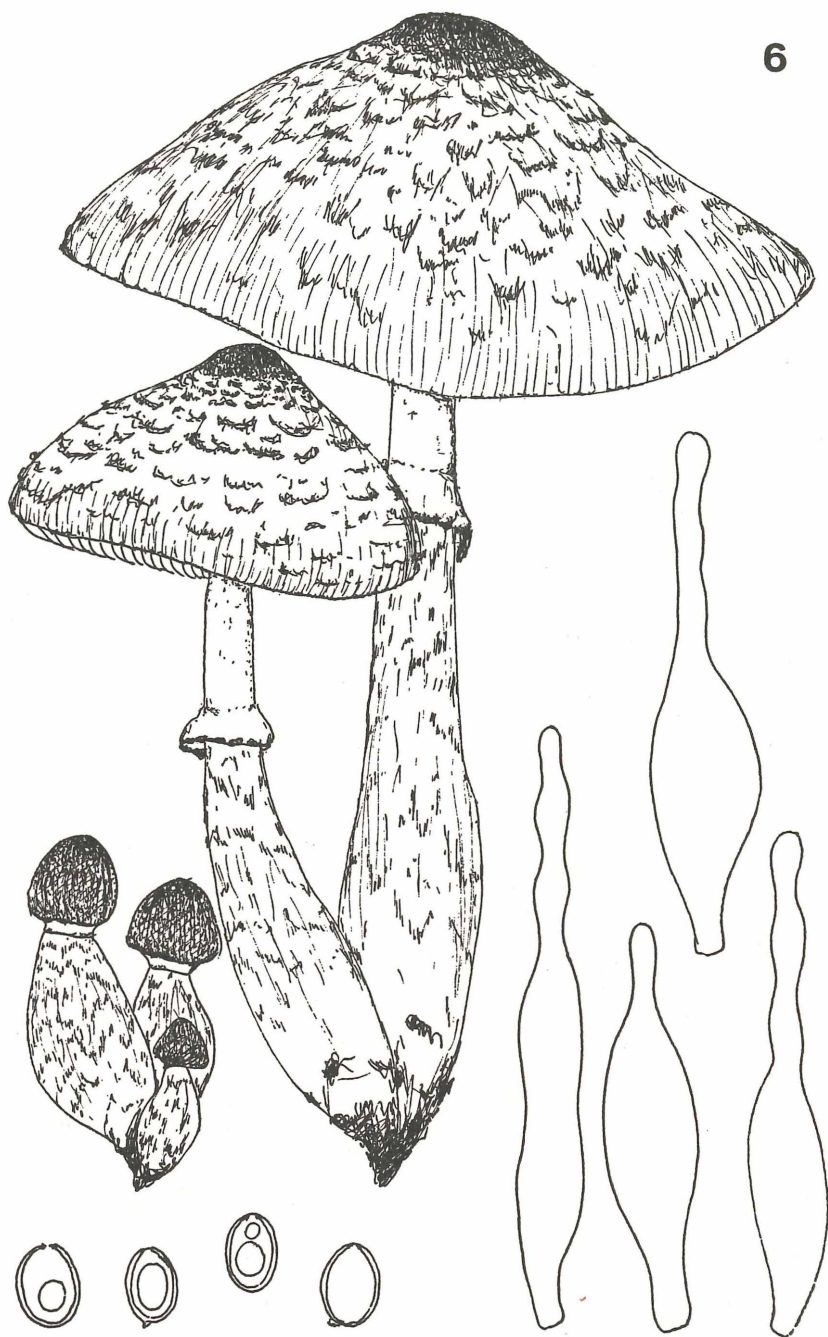


Fig. 6. *Leucocoprinus biornatus* (ss. COOKE) LOCQUIN. Fruit bodies (natural size), spores and cheilocystidia ( $\times 1000$ )

## Herbarial data:

Near Szár, Com. Komárom, on heaps of sawdust in forest, 18. VII. 1976, leg.: M. VIRÁG—I. ZIRKELBACH; 8. VIII. 1976, leg. I. ZIRKELBACH; 11. VIII. 1976, leg.: M. BABOS—G. BOHUS—M. VIRÁG, det.: M. BABOS—G. BOHUS; Budapest: on the market, from unknown locality; 30. VIII. 1976, leg.: ? det.: M. BABOS.

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