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THE *COPRINUS DOMESTICUS* GROUP

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Summary. A historical study, considering the actual situation of the *Coprinus domesticus* group has been made. *C. domesticus* (Bolt.) Gray, *C. radians* (Desm.) Fr. and *C. xanthothrix* Romagn., are described macro and microscopically. The material from Germany, France and Spain is compared. A key is given. Photographs under the optical and S.E.M. are also added.

Resumen. Se realiza un estudio histórico, precisando la situación actual del grupo *Coprinus domesticus*. Se describen macro y microscópicamente *C. domesticus* (Bolt.) Gray, *C. radians* (Desm.) Fr. y *C. xanthothrix* Romagn. Se compara material procedente de Alemania, Francia y España. Se realiza un ensayo de clave. Se aportan fotografías al microscopio óptico y electrónico de barrido.

INTRODUCTION

Bolton (1788) described an *Agaricus domesticus* in his comprehensive work "An history of fungusses growing about Halifax". Although microscopical details are lacking, which was normal for 1788, it is probable that Bolton han before him the fungus which we determine these days as *Coprinus domesticus* (Bolton) Gray. His macroscopical description was fairly detailed and the figure added is reasonably fitting our today's concept, although we cannot exclude with certainty that Bolton had in hand *Coprinus radians* Desmazières, which is very similar macroscopically. Bolton used the name *domesticus* because he had found his fungus, among other things, in cellars, cold kitchens, etc., that is in a domestic surrounding.

Gray (1821) raised the taxon *Coprinus* to generic rank and combined Bolton's fungus with this genus.

40 years later, Desmazières (1828) described his *Agaricus radians* on which our today's concept of *Coprinus radians* (Desm.) Fr. is based. We are not quite sure whether Desmazières had in hand the fungus we determine today as *C. radians*. He does not mention lageniform cystidia, but only cylindric-ellipsoid ones which fit best those of *C. domesticus*. Moreover, he mentions a spore length of hardly 10 µm "a peine 1/100 mm", although he states the spores to be ovate with dark colour. To stabilize the nomenclature, however, we propose to conserve this name.

Berkeley & Broome's (1865) *Coprinus similis*, which has been placed in synonymy with *C. radians* by some authors, might equally be conspecific with *C. domesticus* or some other related species. The description is too short to allow a clear-cut decision.

Karsten's (1880) interpretation of *C. domesticus* points rather to *C. xanthothrix* Romagn., if the measured and described the spores correctly, "sphaeroideo-ellipsoideae, atrofuscae s.m. flavae, longit. 8-9 µm, crassit. 5-6 µm".

Penzig (1880) described *C. intermedius*, which most probably belongs to the domesticus group. The veil characters, ozonium, cystidia, spore length and width would fit *C. domesticus*, while the colour (dark brown) and shape (ellipsoid; phaseoliform overlooked?) of the spores and the colour of the stem (white or pale pink) would contradict this assumption.

Peck's (1895) *Coprinus laniger* is surely closely related to *C. domesticus* in view of the macroscopical and microscopical details given. Peck states the spores to be 7,6-10,1 x 4,1 µm.

Smith (1948), who examined the type, obviously found spores of 8-10,5 x 3,5-4,2 µm. They differ from typical *C. domesticus* by their slender shape and their very broad germ pore. It remains to be seen whether *C. laniger* is conspecific with *C. domesticus*. Smith (1948), in his study of dark-spored agaric types, placed another two species in the *domesticus (radians)* group: *Coprinus jalopensis* Murril, with tiny spores 6-6,3 x 3,1-3,6 µm which are stated as slightly bean-shaped (phaseoliform) in side view and subelliptic in face view, and *Coprinus pulchrifolius* Peck, with spores 7-8.4 x 4-4,2 µm and similar shape.

Jacobasch (1896), described his *Coprinus purpureophyllus* which might belong in the domesticus group and which could be identical with, or closely related to, *C. xanthothrix*. But in the absence of an illustration and microscopical details, except for the spore size, 7,47-8,64 x 5,5 µm, we abstain from further interpretation of this species.

Ricken's (1915) *C. domesticus* is rather unclear, among other things due to the short description given. Ricken mentions sooty cap colours and a chestnut cap centre and states the spores to be 8-9 x 5-6 µm. Obviously, Ricken had copied Saccardo's description.

Ricken's *C. similis* is also unclear. He states the spores as 8-9 x 5-6 µm and describe the cystidia (pleuro? cheilo?) as vesiculose, 30-36 x 15-25 µm. We do not know what Ricken had in hand, if he saw living specimens at all. The same is true of Ricken's *C. radians*. It does not reasonably fit any existing concept. He placed C. radians in the group of the "naked" *Coprini* with grainy-micaceous or slightly mealy cap veil, at best. We are at a loss to understand why the brilliant and busy *Agaricales* collector Ricken should not have encountered these widely distributed fungi.

C. tomentosus ss. Ricken could be *C. domesticus*, the more so, as he describen the spores as phaseoliform, stating a size of 8-10 x 5 µm. Bulliard's *Agaricus tomentosus* can no longer be interpreted. It could be a member of the domesticus group due to the patchy veil drawn by Bulliard.

Lange's (1915) description of *C. domesticus* is also unsatisfactory. He mentions "oval-ovate, gray brown spores measuring 7-8 x 4,5-5 µm, stating that globular

cystidia can be found on the edge of the gills only. He says his find is otherwise identical with Ricken's concept of *C. similis* which is unclear as stated above. We do not know what Lange had in hand at that time.

Rea (1922) copied his concept of *C. domesticus* largely from Lange (1915). It looks like a mixture. Rea's *C. radians* might be *C. domesticus* owing to the spore measurements. Nor is Rea's *C. similis*. The wording is largely copied from Ricken's description.

Vandendries (1925) investigated the sexual pattern of *Coprinus radians* concluding that it is heterothallic. The Scottish *Coprinus* geneticist Kemp (1980) contradicted this finding, indicating that *Coprinus radians*, as all other members of the *domesticus* group, are homothallic. Thus Vandendries must be either worked with a different species or he wrongly determined the mating system. Unfortunately, Vandendries did not give much details on the morphological characters and macroscopical features of the species studied by him. Therefore, his findings are of not much use taxonomically.

Lange's (1935-40) plate 159 G and his text of *C. domesticus* are perhaps a mixture. The narrow cylindrical veil hyphae and the fully expanded and delicate cap fit very well *C. xanthothrix*, while the spore size and shape of his fungus rather point at *C. domesticus*. Lange probably collected both species and mixed their characters in his description and illustration. Orton & Watling (1979), feel that Lange described and figured *C. domesticus*.

Romagnesi (1937a), was the first to describe in detail *C. radians* (as *C. similis* ss. Ricken) in the modern sense. Although referring his find to Ricken's *C. similis*, he states much larger spores of 8-11,5 x 5-6,5 µm fitting those of typical *C. radians*.

In the same year, Romagnesi (1937 b) gave a brief description with drawings of the veil and spores of his later *C. xanthothrix*, under the name of *C. domesticus*.

Metrod (1940) was the first to study in detail our "today's" *C. domesticus*, both macro and microscopically and fixed the concept of this species. It is in perfect agreement with our material, except for the cystidia which are much smaller in his material (35-40 x 25-32 µm). In his "observations" he refers however to a collection by André Bride, who had found cheilocystidia of 85-115 x 46-65 µm, matching our material.

Moreover, Metrod described a new species *C. hortorum* which was placed by subsequent authors in synonymy with *C. radians*. Métrod obviously had only seen vesiculous and ovoid cystidia mentioning no lageniform ones (overlooked?). But all other characters are more or less in agreement with *C. radians*. Métrod was aware of Romagnesi's (1937 a) description of *C. similis*, but evidently thought his species was distinct Furthermore, Métrod included in his paper a description of *C. domesticus* ss. Romagnesi (description received from H. Romagnesi) which later received a new name, *C. xanthothrix*.

Romagnesi took up the subject in 1941, writing a paper on the *domesticus* group. He revised the situation up to that time and proposed a new name (as

nomen nudum) for his 1937 domesticus, namely *C. xanthothrix*. Moreover, he dealt with the various concepts of *C. radians,* with or without ozonium, concluding that *C. radians*, *C. similis* and *C. hortorum* are at least closely related and might belong to one species, despite minor differences. This was perfectly alright in 1941, but today, as result of interfertility tests, *C. radians* looks as a collective species again. Further cultural work will be necessary to clarify this question. Moreover, Romagnesi (1941) stated that Bresadola's *C. truncorum* might be a member of the domesticus group, as today's concept of *C. truncorum* is different, particularly as regards spore size and shape. In this respect, we fully agree with Romagnesi.

Romagnesi (1945) gave a very detailed account of his *C. xanthothrix*, and provided a key to the *domesticus* group.

One year later, Smith & Hesler (1946) reported *C. domesticus* ss. Lange from North America, possessing a conspicuous brown ozonium at the stem base, phaseoliform spores 7-8,6 x3,7-4,2 µm and further characters fitting the European material. They pointed out, however, that Pennington's *C. domesticus* (in Kauffman 1918) does not belong to this series of *Coprini*. Interestingly, Smith and Hesler mention a basal annulus (marginate base) at the stem which Orton claims to be a typical character of *C. ellisii*. We ourselves often found typical domesticus carpophores with this feature.

Kühner *al.* (1947) reported on cultural testex in the section *Micacei finding* that several "races" exist in both the micaceus and the radians-domesticus group. From these studies evolved, among other things, *Coprinus bipellis* Romagn., which we have never encountered in the field so far.

In their monumental "Flore Analytique", Kühner & Romagnesi (1953) keyed out and described under the "Group de *C. radians*" 5 species including *C. bipellis* and *C. flocculosus* DC ss. Romagn., the latter standing somewhat isolated microscopically by its large blackish-brown spores with a markedly excentric germ pore and veil cells consisting of more than two types. *C. bipellis* Romagn. was included as a nomen nudum, characterized, among other things, by its veil disrupting into patches like the volva of *Amanita* species and consisting of elongate chain-like cells with no or only a few sphaerocysts.

Derbsch (1954) was the first to introduce *C. domesticus* in German mycological literature by a short but fully satisfactory description. He concluded, that Ricken's concepts of the members of this group is unworkable and that, in any case, microscopical examination is necessary to separate the various members of this group.

Locquin (1955) described *Coprinus albidofloccosus* belonging to the *radians-domesticus* group and being characterized by a very pale, almost whitish cap and small phaseoliform spores, 7.5-8.5 x 3-4 µm, exhibiting a markedly broad germ pore. For the time being, we include this taxon in the concept of *C. domesticus*. On account of its small and narrow spores and its bulbous stipe base with a

floccose, volva-like zone, it could be referred to Orton's *C. ellisii*. Should *C. ellisii* turn out to be a distinct species, *C. albidofloccosus* would be very closely related or even be an carlier name.

Orton (1960) described his *C. ellisii* as mentioned above, "distinguished from *C. domesticus* and its allies by shorter, narrower cylindric-phaseoliform spores (6-8.5 x 3-3.75 µm) and veil often appearing volvate at the stem base". We made a few collections fitting Orton's description to a large extent, but tended so far to place them in the variability range of *C. domesticus*. There will probably be no solution to this problem, unless some method will be found by cultural mycologists to demonstrate interfertility or sterility with *C. domesticus*. In his key to the domesticus group, Orton (1960) does not mention a volva-like stem base for *C. domesticus*, which we often saw in typical domesticus. Moreover, Orton & Watling (1979), in ther British *Coprinus* Flora, extended the spore range of *C. ellisii* to 6.5-8.5 (9) x 3-4.5 (5), which is then almost identical with that of *C. domesticus*. *C. xanthothrix* and *C. radians* are easily determined by Orton's (1960) key.

Winchanský (1961) described *C. micaceoides* with globose veil elemnts, no cheilocystidia, vesiculose facial cystidia measuring 65-75 x 60µm, and phaseoliform spores 8-9 x 4-5µm. Considering all details given by the author, we have to believe that it is a distinct species, although is almost unbelievable that it should not possess cheilocystidia (deliquesced?), nor thickwalled, brownish elongate veil elements in the presence of phaseoliform spores. It may well be that Wichanský, had fully mature or overripe fruitbodies of *C. domesticus* in hand, where the cheilocystidia had already deliquesced and the elongate brownish veil elements had been washed off. But this is hypothetical. Kemp (personal communication) thinks that *C. micaceoides* could be a distinct species. He made a collection fitting reasonably well the description by Wichanský, except for the spore shape.

When comparing Romagnesi's (1961) coloured plates of *C. radians* and *C. domesticus*, one can readily see that both species are very similar in appearance. The plates show *C. radians* with an ozonium which could equally have been painted for *C. domesticus* in which we observed it many times. Microscopically, Romagnesi (1961, 1967) states that the cystidia of *C. domesticus* are identical with those of *C. radians* which is not quite in agreement with our findings. We never found typical *C. domesticus* with lageniform cheilocystidia. In more than 100 finds, we very rarely observed lageniform cystidia on the gill edge of *C. domesticus*, and when some were present, that they had detached perhaps from the stipe in the course of fruitbody development.

Imazeki & Hongo (1962) illustrated and described *C. radians* fron Japan, giving spores of 6.5-8.5 x 3.5-4.5 µm. This is surely not in agreement with the European material. In addition, they drew non-phaseoliform spores. We do not know what species is concerned, but surely not the European *C. radians*.

In 1969, Singer reported *C. radians* fron South America, which demonstrates its wide distribution.

Malençon & Bertault (1970) reported *C. radians* and *C. xanthothrix*, but not *C. domesticus*, from Marocco. Their description of *C. radians* fits, macroscopically and microscopically, the present concept, except for the spores which they give as only (6.6) 7.7-9.2 x (4.5) 5-5.7 µm However, in their "Observations" they mention a find with larger spores which is more, but not completely, in agreement with typical *radians*. Perhaps their small-spored collection belongs to an undescribed taxon related to *C. radians*. They mention fasciculate growth in contact with or near decaying wood stumps, stem base being attached to an ozonium, and somewhat largar spores (9-10 x 5.5-6 µm) than typical xanthothrix. Unfortunately, they do not mention at all the shape and size of the cheilo and pleurocystidia.

Pegler & Young (1971) studied and figured the spores of *C. domesticus* stating that "the spores appear slightly curved due to the concave adaxial surface and measure 6.5-10 x 3.5-5 µm." When naturally liberated spores fall down, they always land abaxially.

Babos (1972) investigated the spore germination of *Coprinus radians*. According to the spore characters given, we feel she rather dealt with *C. domesticus*, although cystidial details do not fit well. In the course of her experiments she found that spores began germinating after 2 hour already. The rate of germination was unaffected by the age of the spore: fresh spores germinated jus as rapidly as 6 week old one, but obviously she used no older ones. The optimun germination temperature was found to be 24ºC, but spores germinated also at 3-4ºC. Her investigations covered also the drought resistance of the ozonium. Wood bits interwoven with mycelia were dry-stored for 6 and 16 months. When placed in humid condition the ozonium revived rapidly and the fruitbodies appeared in 3 and 51 days, respectively.

Chapman & Fergus (1973) studied the effect of light on basidiocarp formation of *C. domesticus*, proving that *C. domesticus* in particular, and many other fungi in general, although being nonphotosyntethic and unable to use light for synthesis of food, are affected by light to a greater or lesser degree, especially as regards the formation of the primordia and basidiocarps.

Van de Bogart (1975), in his doctoral thesis, investigated also the radians group as present in the State of Washington (USA), distinguishing no less than 8 provisional varieties in the case of *C. radians*, distinguished mainly by veil element characters (degree of encrustation, thickness of veil cell walls), presence or absence of caulocystidia and clamp connections, shape of the caulocystidia, properties of basidial sterigmata, etc. In his observations under the typical variety (*C. radians* var. *radians*), he mentions however that he did not find any clearcut distinctions that correlate well enough to justify the creation of taxa above varietal rank. He expressed the hope that interfertility tests might help to define the limits of the species and clarify the actual relationships of the numerous varieties provisionally described by him.

Romagnesi (1976) once more discussed in detail the characters of the *Micacei* with stirps *Radians* and *Micaceus*. Moreover, he now validly published his *Copri-*

nus bipellis given in the "Flore" as a nomen nudum, characterized by a dense, coherent veil on the cap, similar to *C. picaceus*, smaller spores: 8.5-10.5 x 4.5-5.2 µm, than in typical *C. radians*, large globose to ellipsoid pleurocystidia, cheilocystidia not noted, coloured veil elements with very rare (hyaline?) sphaerocysts, etc. Obviously, Romagnesi had not recollected this species since 1953, as he based his validating description on the type specimen alone, from which some characters could no longer be demonstrated (e.g. cheilocystidia, caulocystidia). According to Romagnesi, Kühner &Yen had cultured *C. domesticus, C. radians, C. xanthothrix* and *C. bipellis,* revealing different mycelial characters for these 4 taxa. In Romagnesi's key to the members of *Micacei*, one can reach fairly well the different taxa.

Patrick (1977) rose Singer's subsection *Domestici* to sectional rank pointing out that it is presently considered distinct as is section *Micacei* (Fr.) Pennington in Kauffman 1918, where the micaceus group is placed.

Cetto's (1978) plate no. 420, *C. radians*, could be this species or also *C. domesticus*, but his plate no. 417, *C. truncorum*, is surely not this species, but rather a member of the *domesticus* group.

Orton & Watling (1979) published their comprehensive British Coprinus Flora describing a large number of species in detail and givin a workable key to sections, stirps and species. Although they stressed that this can be no more than a preliminary account of the genus *Coprinus* in Britain, it will surelly be the basic monograph for future work in this difficult genus.

Jahn (1979) in his beautiful and most instructive book on wood-inhabiting fungi presented a good colour photograph and description of *C. radians* (no. 201).

Chapman & Barankovich (1979) studied the germination of basidiospores and oidia of *C. domesticus* in culture.

Watling & Gregory (1980) reported *C. radians* from Kashmir (India) evidencing its wide distribution.

Paccioni (1980) published a colour photograph and description of *C. radians* which could equally be *C. domesticus*. Obviously, he had used the ozonium as main character for determination, not knowing or considering that *C. domesticus* may also, perhaps more often, grow from an ozonium.

Phillips (1981), in his brilliant fungus book, gave a short, but convincing description of *C. domesticus* adding a colour photograph of typical specimens.

In Moser's (1983) "Kleine Kryptogamenflora", the members of the domesticus group are keyed out quite well.

In Germany's "handbook for mushroom friends", Kreisel (Michael, Hennig & Kreisel, 1981) also included *C. xanthothrix* (no. 308) and *C. domesticus* (no. 309), giving adequate descriptions and colour plates of these two species.

The above is a chronological account of the *Coprinus domesticus* group. Unless some cultural methods will be found to distinguish closely related taxa, we prefer

Errata

Correction of main errata in paper "The Coprinus domestic Group", Bol.Micol.Castellana (Spain), 1985

Page 103, 4th line: .... Leipheim-Riedheim ...
Page 104, 6th line: ..... would fit C. domesticus or perhaps C. radians while ...
Page 105, 6th line: ..... Nor is Rea's C. similis of much use. The wording ...
11th line: ..... Thus Vandendries must have either worked ...
Page 106, 21st line: ..... Kühner et al. (1947) reported on cultural tests ...
Page 107, 8th line from below: ..., and assumed, when some were present that ...
Page 108, 7th line: ..... related to C. radians. Their interpretation of C. xanthothrix is not quite satisfactory. They mention ...
Page 110, 7th line from below: ... ellipsoid, 7,3-9 x 4,6-5,8 µm...
Page 114, 8th line: ..... Rev.Mycol. 6: 127(1941)

to interpret the hitherto known and accepted species in a rather broad sense. According to Dr. Roger Kemp (personal communication), cultural problems exist in this group as all species are homothallic without clamp connections. However, most of them produce oidia which may be used for homing and lethal reaction studies.

METHODS

The photographs under the optical microscope were made in a microscope Nikon model Optiphot and those under S.E.M. in a microscope ISI model SX-25.

KEY TO MEMBERS OF THE *DOMESTICUS* GROUP

1.- Veil cells monomorphic, consisting of globosse, ovoid or broadly ellipsoid, thin walled, hyalin cells ..... **Micaceus** group

1.- Veil cells dimorphic, consisting of the above mentioned cells and of cylindric, elongate, pyriform or else swollen cells which are mostly pale to distinctly brown and not to distinctly encrusted . 2 **Domesticus** group

2(1).- Spores large and dark-coloured (spore print blackish), 11-16 x 6.5-9.5 µm, with distinctly eccentric germ pore ..... **C. flocculosus** DC.: Fr.

2.- Spores smaller and mostly paler, with ± central germ pore, spore print in mass dark chocolate brown with purplish tint 3

3(2).- Spores 8.5-10.5 x 4.5-5.2 µm, ellipsoid to ovate, ocassionally slightly phaseoliform in side view, veil coherent, thick and patch-like ..... **C. bipellis** Romagn.

3.- Not as above; spores either not exceeding 5 µm width and then often phaseoliform in side view, or more than 5.2 µm broad; veil more floccose at least on expanded cap 4

4(3).- Spores not exceeding 5 µm in width, often phaseoliform in side view, cheilocystidia broadly ellipsoid 5

4.- Spores exceeding (5)5.2 µm in width, rarely phaseoliform in side view, cheilocystidia mostly lageniform (with intermixed ellipsoid or subglobose cystidia) 6

5(4).- Spores 7-10 x 4-5 µm, stem base with or without a volva-like zone ..... **C. domesticus** (Bolt.) Gray

5.- Spores somewhat shorter and narrower, 6.5-8.5(9) x 3-4.5(5) µm, stem base always (?) with volva-like veil zone (see our remarks under *C. domesticus)* ..... **C. ellisii** P.D. Orton

6(4).- Spores predominantly ovoid to broadly ellipsoid, 7, 3-9 x 4.6-5, 8 µm, brown-coloured veil elements mostly slender, ± cylindric to moderately expanded ..... **C. xanthothrix** Romagn.

6.- Spores predominantly ellipsoid to ovoid, 8, 5-11 (12.5) x 5-6,3 µm, brown-coloured veil elements (particulary end cells) mostly broader, often distinctly expanded, broadly conical, pyriform, vesiculose ..... **C. radians** (Desm.) Fr.

DESCRIPTION OF SPECIES FOUND BY THE AUTHORS

Coprinus domesticus (Bolt.) Gray. A natural arrangement of British plants 1:635 (1821).

≡ *Agaricus domesticus* Bolt. An history of fungusses growing about Halifax:26 (1788).

Cap at first ellipsoid-ovoid, glandiform, 10-20 x 6-15 mm, almost completely covered with whitish-ochraceous veil with often reddish-brow colour in the centro; cap centre often with pyramidal veil agglomerations; veil breaking up into ± fine floccules as cap expands; cap later convex or campanulate, finally expanding, 25-60(70) mm Ø, up to 30(40) mm high, with revolute and often splitting margin, pale ochraceous or pale creme with darker centre which may be ochraceous to pale yellowish-brow; centro often slightly lubricus in wet wheather; caps becoming ochraceous-greyish to grey towards the margin, extreme margin finally blackish as a result of deliquescence of the cap from the margin inwards; cap of adult specimens mostly covered with sordid whitish to ochraceous veil floccules and below these densely sulcate-striate almost to centre; cap margin of young specimens mostly irregularly wavy.

Gills whitish-creme in very young stage, then from margin inwards grey-brown, chocolate brown to dark chocolate brow with purplish tint, finally blackish-brow as the gills deliquesce; gill margins remaining paler fimbriate from cystidia, deliquescing gills with concolorous margins; very crowded to crowded (often somewhat distant in small or terrestrial forms), 4-8(10) mm broad; gill colour often reminding of that of certain Agaricus species.

Stem 3-10(12) cm long, 0.3-0.9 cm Ø, attenuating towards apex, base, swollen to ± bulbous (-1.4 cm Ø) and often pale yellowish or with minute veil remnants (shape of cells of these remnants similar to thickwalled veil elements) at stem base which may give the base an obscurely volvate or emarginate appearance; stem colour silky white to whitish; smooth or minutely to distinctly grooved over length, minutely pruinose (lens), hollow; stem base often attached to a reddish-brow ozonium.

Smell indistinct. Taste mild

Microscopical details: Spores (6.6)7-9(10) x (3.5)4-4.7(5) µm, with central and often broad germ pore length-width ratio 1.7-2.1; ochraceous, pale to medium brown in water under the microscope; cylindric phaseoliform (slightly bean-shaped) in side view, ellipsoid in face view (Figs. 1, 5-11). Spore print: dark chocolate brown with slight purplish tint in dense print.

Basidia for example 25 x 8.3 µm, 4-spored, at least dimorphic, most probably trimorphic (Fig. 3).

Cheilocystidia ellipsoid, subglobose, vesiculose or ovate, thin walled very rarely a few lageniform cystidia intermixed (perhaps these are detached from the stipe when the pileus expands), (35)50-100(160) x (25)30-50(65) µm (Fig. 1).

Pleurocystidia similar to cheilocystidia, but larger on average, (45)55-150(210) x (35)40-65(80) µm (Fig. 2).

Caulocystidia lageniform, mostly with long neck, thinwalled, hyalin, sometimes forked, (60)70-120(140) x 18-28(32) x 5-7 µm, base mostly subglobose (Fig. 3).

Pileipellis (cap cuticle): cells in squash mount mostly appearing ± isodiametric, (7) 10-25(30) µm (Fig. 1).

Stipitipellis (hyphae of stem cortex) hyalin, thinwalled, (6)10-28 µm thick.

Veil dimorphic, consisting of two types of cells:
a) globose or ellipsoid, smooth, hyaline, thinwalled cells, (15)30-70(100) µm diameter or length, in the squash mount (under microscope) these cells often show creases, folds or lines on the surface; in Melzer's reagent one can sometimes observe an amorphous yellowish body inside these cells (Fig. 4).
b) pale to distinctly brownish, thin to thickwalled, cylindrical, expanded, broadly fusoid or clavate cells with mostly broader end cells; these cells are not to distinctly encrusted; individual cells (20)30-60(80) x (8)10-35 µm, walls 0.5-1.5µm thick. These cells are mostly connected in chains, but may disrupt into individual cells or chain fragments. In the veil of *C. domesticus* the brownish elements seem to dominate (Fig. 4).

Habitat: On stumps, branches or twigs of deciduous trees, rarely on soil, singly or in small groups; often early in the season.
Observations: This species may be recognized mainly by its narrow (-5 µm) distinctly phaseoliform spores (in side view). Macroscopically, it is often impossible to distinguish it in the field from *C. radians* or even from *C. xanthothrix*. But *C. domesticus* may build the largest fruitboides of the three. Any large fleshy fruitbody found is most likely *C. domesticus*. But there are also slender and delicate forms which can only be determined microscopically. Whether *C. ellisii* is a distinct species remains to be seen. For the time being,we include it in our broad concept of *C. domesticus* (see also remarks in introductional text). According to Ø. Weholt (personal communication), *C. domesticus* seems to be very rare in Scandinavia, while *C. radians* and *C. xanthothrix* seem to be more frequent there. In Germany and Spain the situation seems to be viceversa.

Coprinus radians (Desm.) Fr., Epicr. Syst. Mycol.: 248 (1838).

≡ *Agaricus radians* Desm., Ann. Sci. Nat. 13: 214 (1828).
= *C. similis* Berk. & Broome, Ann. Mag. Nat. Hist. ser. 3, 15: 317 (1865).
= *C. hortorum* Métrod, Rev. Mycol. 5: 80 (1940).

Cap at first glandiform, cylindric-ellipsoid, 1-2.5 cm high, 1-1.5 cm broad, then campanulate, finally expanding, 1.5-3.5 cm Ø, deliquescing caps with revolute margin which often splits radially, young caps with ochraceous-yellowish to golden brown cap centre, paler towards margin, covered by a conspicuous layer or patches of whitish to sordid whitish or creme, mealy-floccose veil which may often be reddish-brown in the cap centre; expanded caps greyish towards the

margin, rarely with an olivaceous tinge, sometimes with a slightly violet tint in the marginal area, adult caps with tiny whitish to creme or ochraceous veil floccules; cap densely plicate-striate almost to centre; cap margin often slightly undulated (wavy).

Gills very crowded, with numerous short gills, these are free to adnate, young whitish to pale creme, the purplish brown, finally chocolate purplish to dark brown or blackish; margin paler, fimbriate until deliquescence; gills up to 4 mm broad, soon deliquescing.

Stem slender, 4-8 cm long, 0.3-0.5 mm Ø, attenuating towards apex, base almost equal to slightly expanded; white to dingy white, minutely pruinose, fragile, hollow; stem base sometimes attached to a fuscous, reddish-brow ozonium, sometimes whitish strigose.

Smell indistinct, taste mild.

Microscopical details: Spores (8)8.5-11(12.5) x (4.7)5-6.3(6.8) µm, lenght/width ratio 1.50-1.95; ripe spores in water under the microscope amber, medium to dark brownish, with central and often broad germ pore (rarely slightly excentric); ellipsoid or ovoid in face view, ellipsoid or rarely phaseoliform in side view (Figs. 12, 15-19). Spore print: similar to that of *C. domesticus*.

Basidia 4-spored, for example 24-33 x 8-9 µm, probably trimorphic (Fig. 12).

Cheilocystidia lageniform, (26)30-56(62) x (11)13-19(21) x 5-8(10) µm, between these are some vesiculose cystidia, 28-50 µm Ø (Fig. 12).

Pleurocystidia subglobose to ellipsoid, (28)40-100(125) x (15)30-65 µm, sometimes with amorphous body inside (Fig. 13).

Caulocystidia lageniform, thinwalled, hyalin, 35-90(110) x (10)13-24(27) x 7-11(14) µm, sometimes with amorphous contents (Fig. 13).

Pileipellis (cap cuticle): cells in squash mount appearing mostly ± isodiametric, 7-25(35) µm Ø (Fig. 13).

Stipitipellis (hyaphae of stem cortex) hyalin, thinwalled, up to 24(36) µm thick.

Veil dimorphic, consisting of two types of cells:

a) globose or ellipsoid, hyaline, thinwalled cells, the globose ones up to 80 µm Ø, the ellipsoid cells 20-80 x 18-55 µm, often with folds or lines on the surface when viewed under the microscope; these hyaline cells seem to dominate in the veil of *C. radians* (Fig. 14).

b) pale to distinctly brownish, thin to thickwalled, cylindrical, expanded, brodly fusoid or clavate cells with mostly broader end cells; cells smooth to strongly encrusted; mostly connected in chains, but easily disrupting into individual cells or chain fragments; individual cells 15-60 x 15-28 µm; wall 0.5-1.2 µm thick (Fig. 14).

Habitat: singly or several fruitbodies loosely associated on logs, branches or

mossy trunks of deciduous trees, rarely on soil (mycelium attached to nearby wood?); often appearing early in the season.

Observations: *C. radians* is distinguished from the other members of the domesticus group by the large, relatively dark spores. There seems to be a great deal of variation (e.g. spore size) in some of its features. Cultural tests and further field observations will be necessary to prove whether deviating forms (including *C. similis* Berk., *C. hortorum* Métrod, etc.) are really distinct.

Coprinus xanthothrix Romagn., Rev. Mycol. 6: 12 (1941).

Cap at first ellipsoid, glandiform or conico-ellipsoid, on average 1.5 x 1 cm, then campanulate often with small obtuse umbo, finally expanded to almost flat, 20-35(45) mm Ø, margin revolute before or when deliquescing; closed caps pale creme, ochraceous, ivory, centre slightly darker; expanding caps with ochraceous to ochraceous-yellowish-brownish centre, towards margin ochraceous-grey to grey, slightly to distinctly plicate-striate almost to centre, greyish between plicate ribs (in grooves), with scattered granular to floccose-scurfy scales which may exhibit brownish tips, at least in cap centre; cap relatively thin and delicate.

Gills crowded (about 6-7 gills per 5 mm of expanded cap margin), with shorter gills, at first pale, creme coloured, then ± chocolate brown with paler margin or (later) darker margin; narrow; deliquescing.

Stem 35-80 cm long, in centre 2-3 mm Ø, attenuating towards apex, base swollen to bulbous and often minutely scaly (with elements like in veil - brownish and thickwalled), once seen with a slight ridge; pure white to whitish, minutely pruinose when fresh, hollow, rarely with a reddish-brown ozonium at the stem base.

Smell: indistinct; taste not noted.

Microscopical details: Spores (6.6)7.3-9.2(9.8) x (4.3)4.6-5.8(6.2) µm, length/width ratio 1.35-1.75, predominantly ovoid to ellipsoid, a few slightly phaseoliform in side view, with central and distinct germ pore, 1.5-3 µm broad and minute, barely visible apiculus, rather pale in colour, similar to spore colour of *C. domesticus*, but clearly paler than that of *C. radians*, ochraceous to pale brownish in water under the microscope (Figs. 20, 24-29).

Basidia 4-spored, 20-37 x 8-10.5 µm, trimorphic (Fig. 20).

Cheilocystidia dimorphic, consisting of 2 types: bottle-shaped (lageniform to utriform), thinwalled, hyalin cystidia, and globose to cylindric-ovoid cystidia. Bottle-shaped cystidia: 33-50(60) x 12-18(23) x 4-6.5(8) µm. Globose, cylindric-ovoid cystidia: 25-60(70) µm Ø or 28-70 x 22-60 µm (Fig. 21).

Pleurocystidia subglobose, vesiculose, broadly ellipsoid, sphaeropendunculate, thinwalled, hyalin, (50)60-100(110) x 39-72 µm (Fig. 20).

Caulocystidia lageniform with long neck, thinwalled, hyalin, (24)50-80(100) x 11-22 x (3)5-7(8) µm (Fig. 22).

Pileipellis (cap cuticle): cells in squash mount appearing mostly isodiametric, 10-30(40) µm ϕ (Fig. 20).

Stipitipellis (hyphae of stem cortex) hyalin, thinwalled, 12-33 µm thick.

Veil dimorphic, consisting of two types:

a) globose to ellipsoid, hyalin, thinwalled cells (which seem to be rarer than the brown cells mentioned below), 24-50(55) µm ϕ, in squash mount under microscope often with folds and lines on the surface (Fig. 23).

b) pale to distinctly brownish, ± thickwalled, elongate, ± cylindric to slightly expanded cells, end cells sometimes broader (but not as broad as in *C. domesticus* or *C. radians*), clavate, fusiform or conical, with no or only slight encrustations; cells connected in chains, but often disrupting in individual cells or chain fragments; individual elements mostly 10-40(55) x (6)9-11(14) µm, walls 0.8-1.5(2) µm thick (Fig. 23).

Habitat: From June to October, mostly in deciduous woods, with preference for *Fagus*, on soil among leaves, sometimes attached to small twigs; very rarely under *Picea* on calcerous soil. It is a rare species in Spain, fruiting mainly on pieces of wood of *Quercus* and *Fagus*, lither on acid or basic soil.

Observations: This is a delicate species characterized by relatively short and broad spores, mostly cylindrical brownish veil elements and growth predominantly on soil or on small twigs (mostly in woods). It seems to be less variable than *C. domesticus* and *C. radians* and fully deserves specific rank. Lange's plate L 159 G most probably features fruitbodies and veil elements of *C. xanthothrix*, although Lange states the spores to be 7-8 x 4.5-5 µm with oval to subphaseoliform shape which would fit *C. domesticus*. We believe that he either mixed the characters of these two species or did not perfectly measure the spore width. The pale cap colour as stated by Romagnesi (1945) may also be present in some forms de *C. domesticus*.

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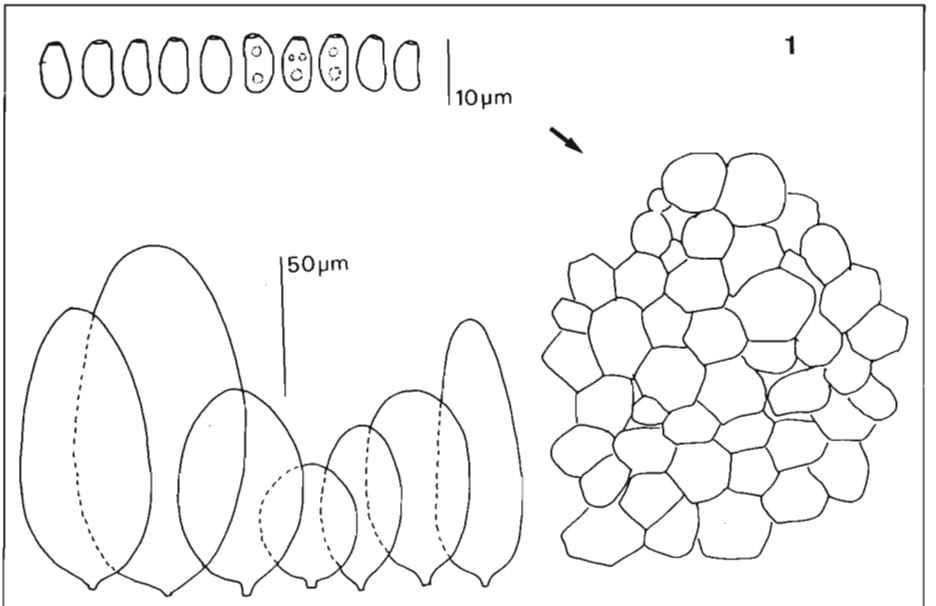


Fig. 1.- *Coprinus domesticus:* spores, cheilocystidia and pileipellis.

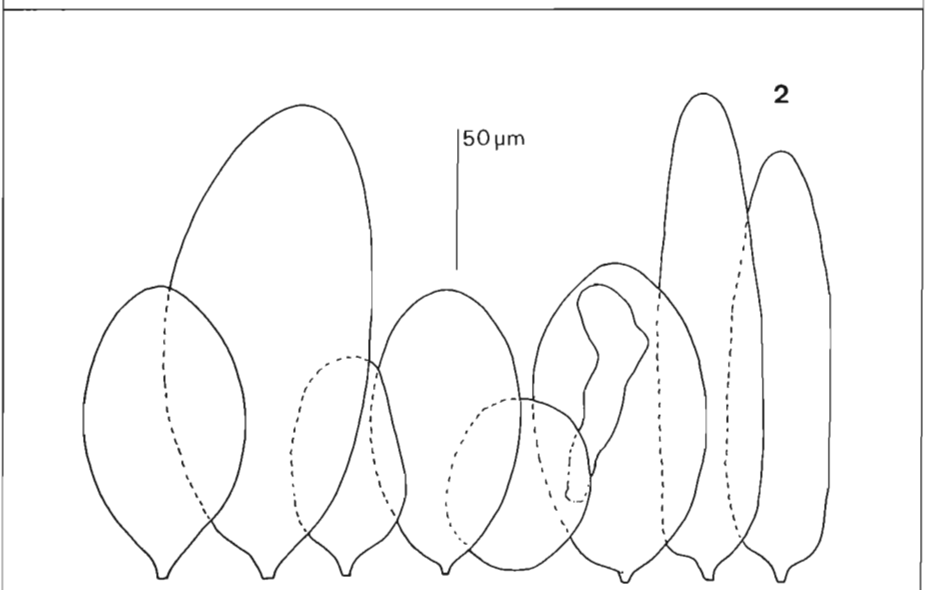


Fig. 2.- *Coprinus domesticus:* pleurocystidia.

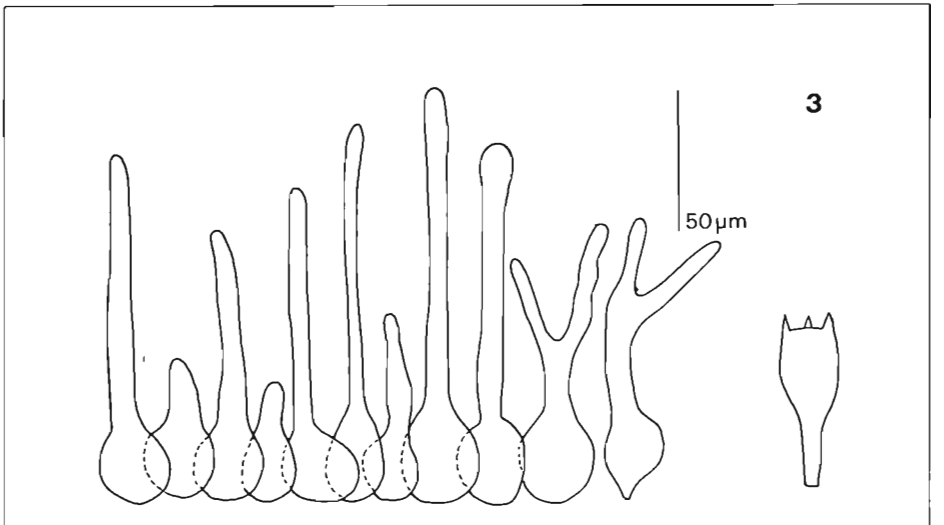


Fig. 3.- *Coprinus domesticus:* caulocystidia and basidium.

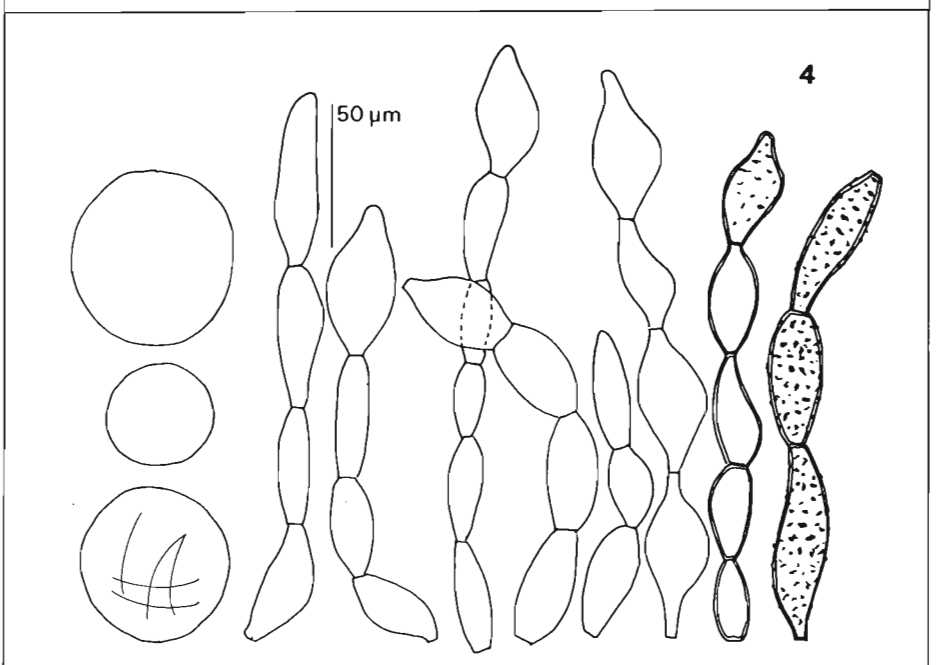
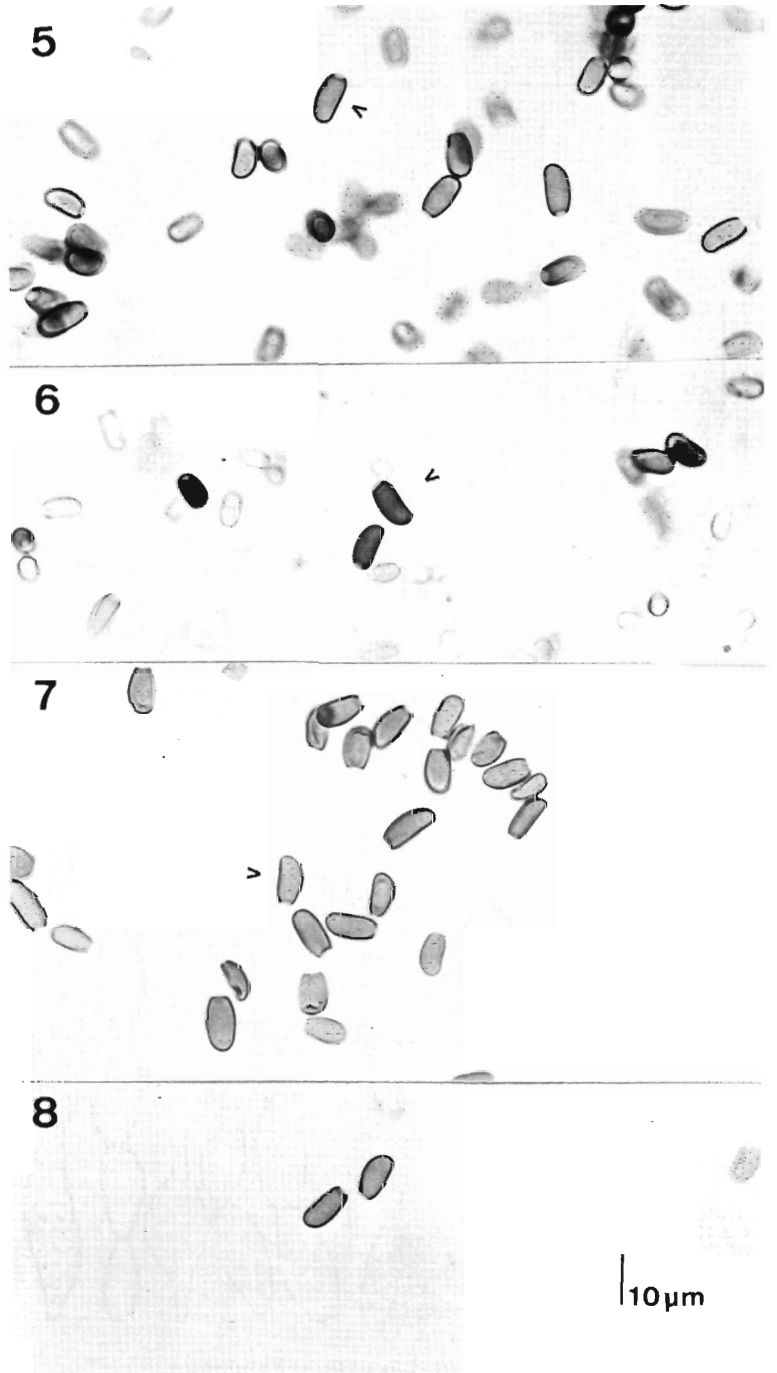
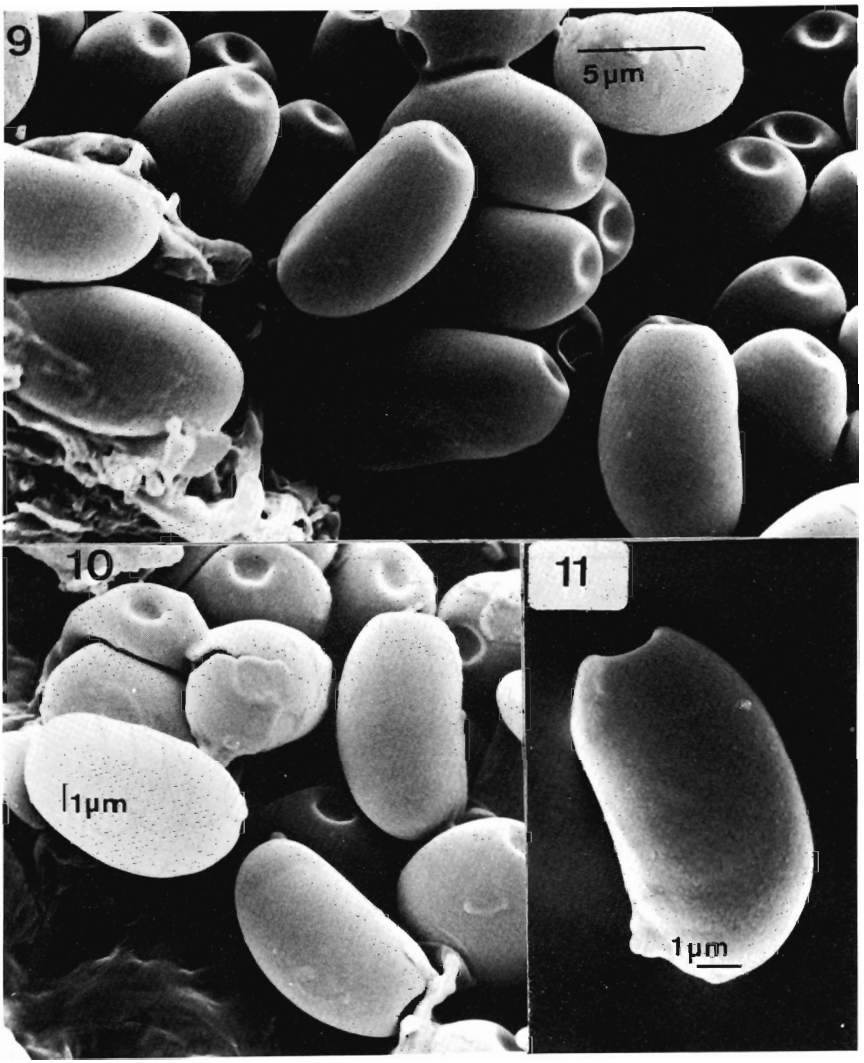


Fig. 4.- *Coprinus domesticus:* veil elements.



Figs. 5-8.- *Coprinus domesticus:* spores, 5-6 Germany, leg. Enderle, 7-8 Spain, leg. Moreno.



Figs. 9-11.- *Coprinus domesticus:* spores, Germany, leg. Enderle.

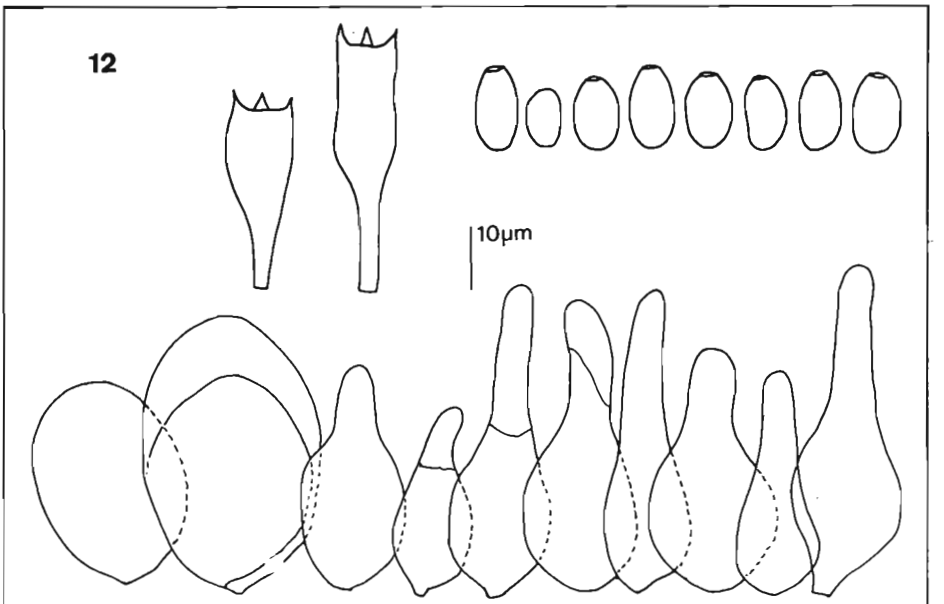


Fig. 12.- *Coprinus radians:* spores, basidia, cheilocystidia.

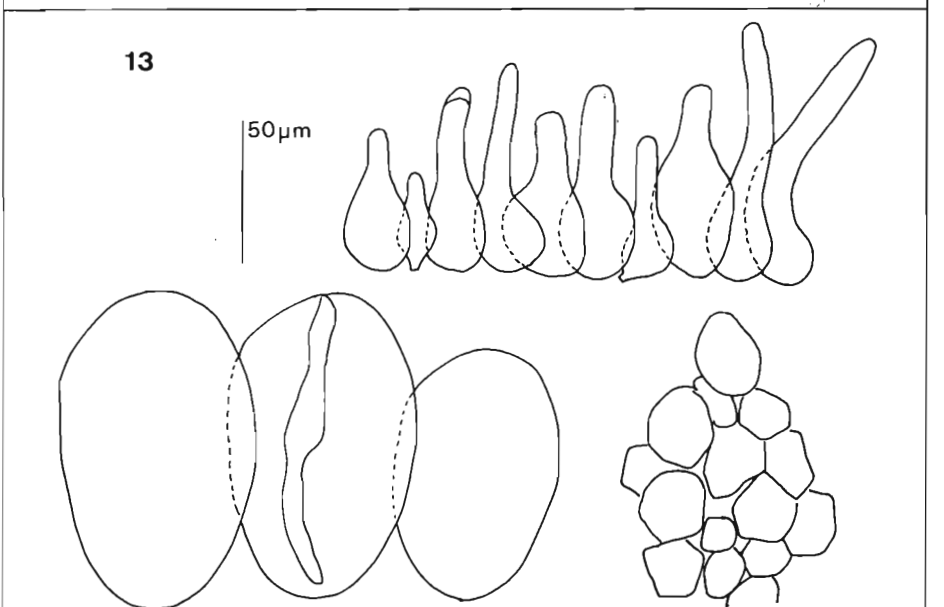


Fig. 13.- *Coprinus radians:* caulocystidia, pleurocystidia and pileipellis.

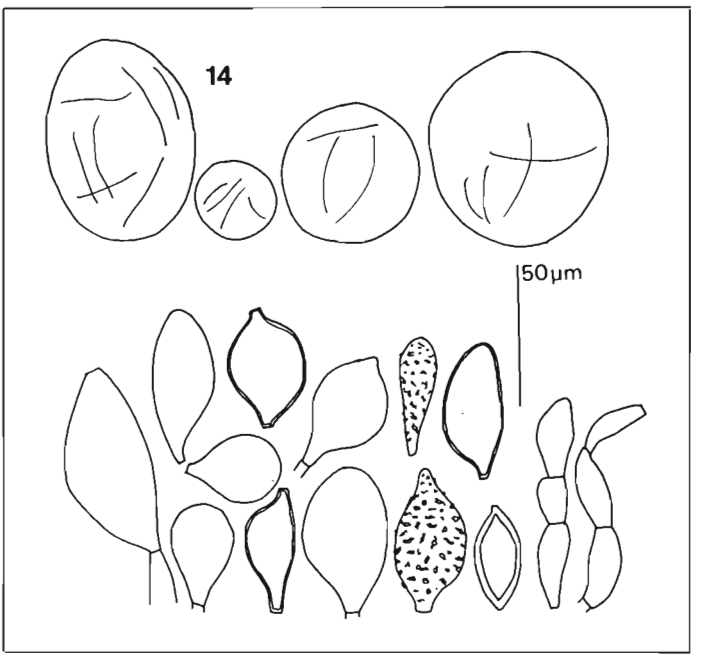
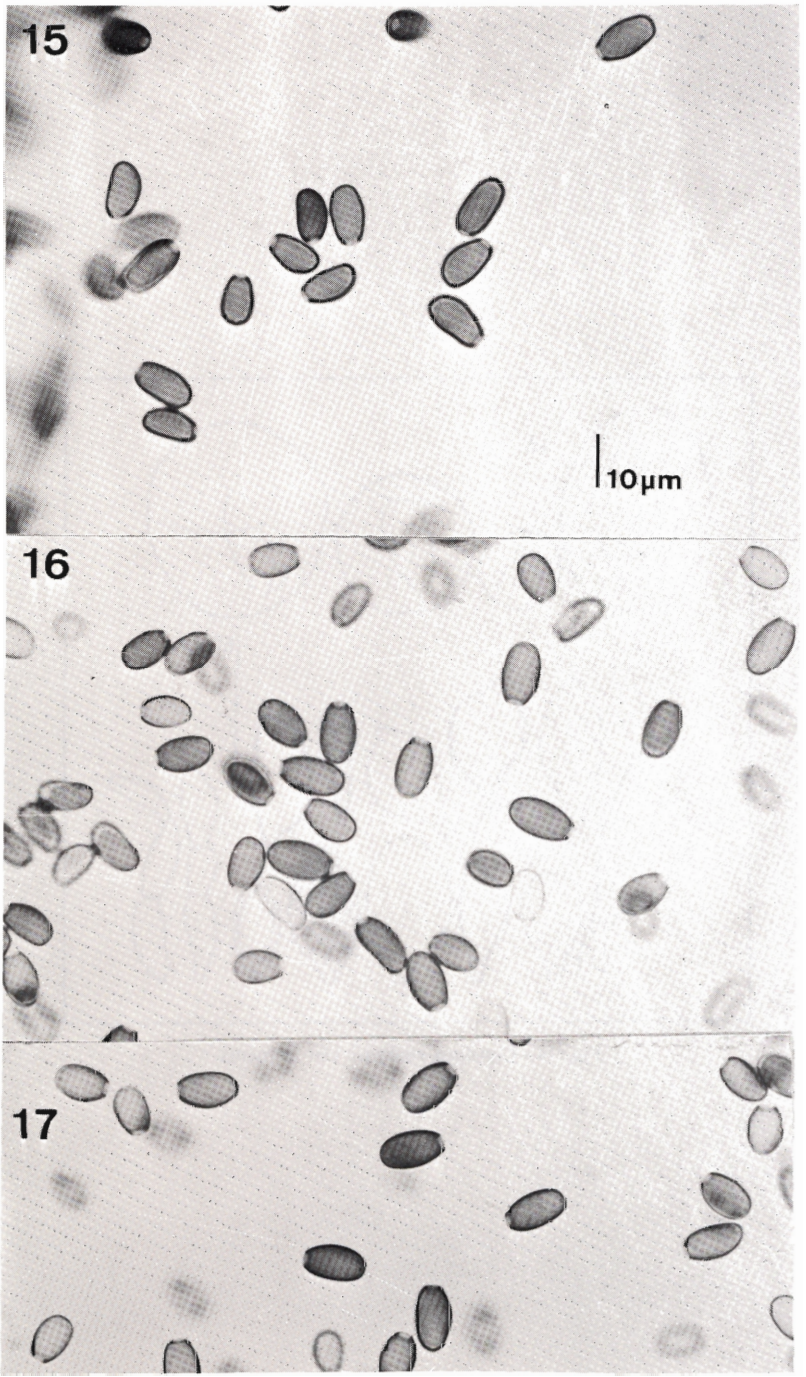
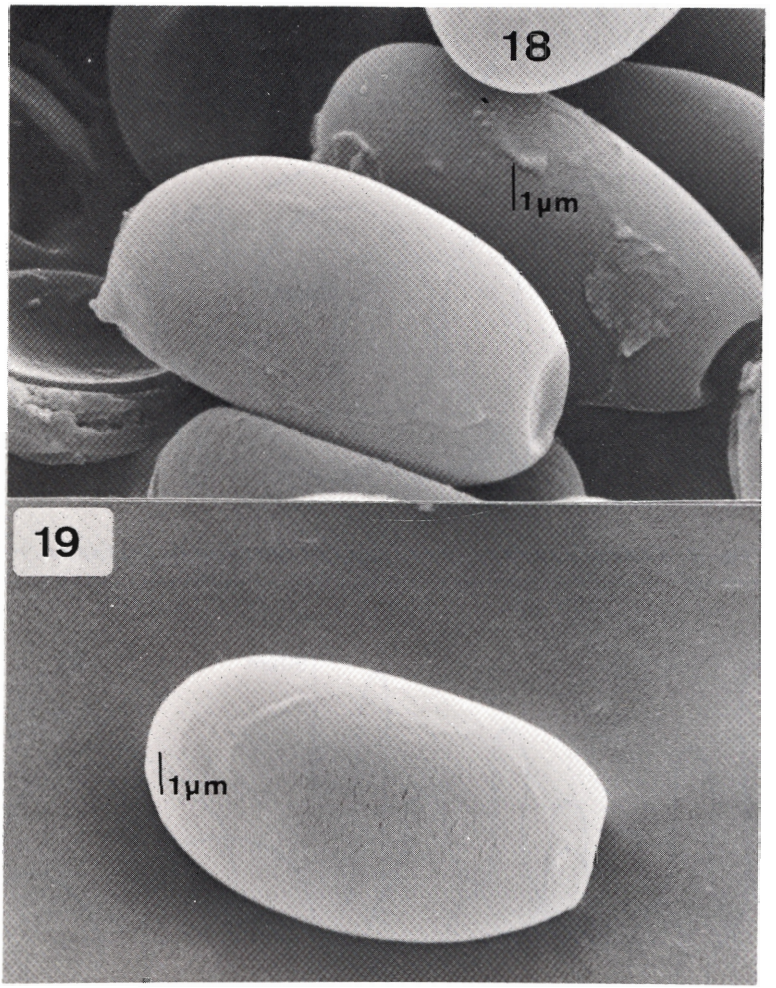


Fig. 14.- *Coprinus radians:* veil elements.



Figs. 15-17.- *Coprinus radians:* spores. 15 France, leg. & det. Romagnesi. 16-17 Germany, leg. Enderle.



Figs. 18-19.- *Coprinus radians:* spores, Germany, leg. Enderle.

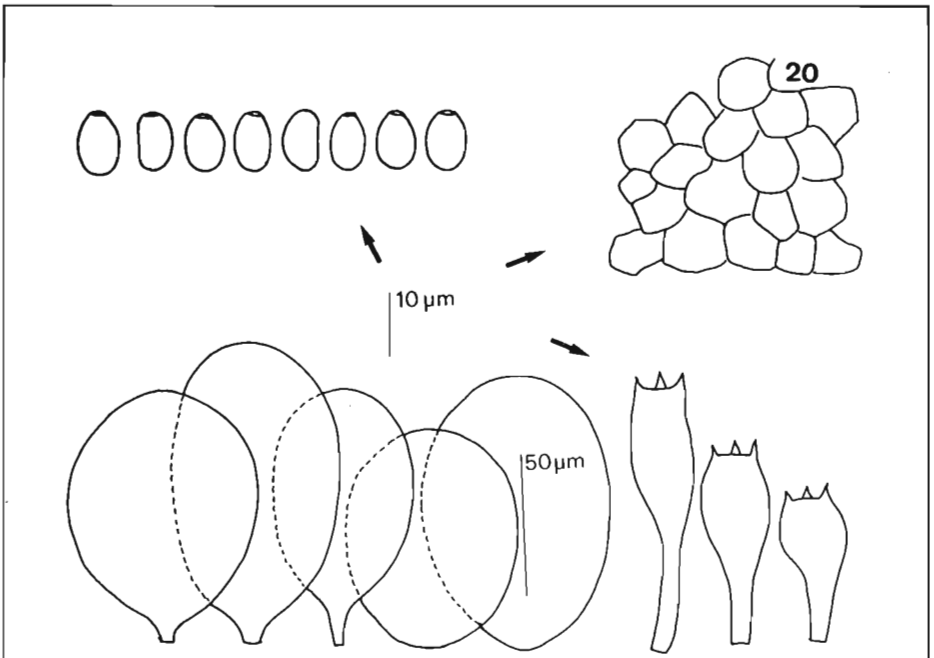


Fig. 20.- *Coprinus xanthothrix:* spores, pileipellis, pleurocystidia and basidia.

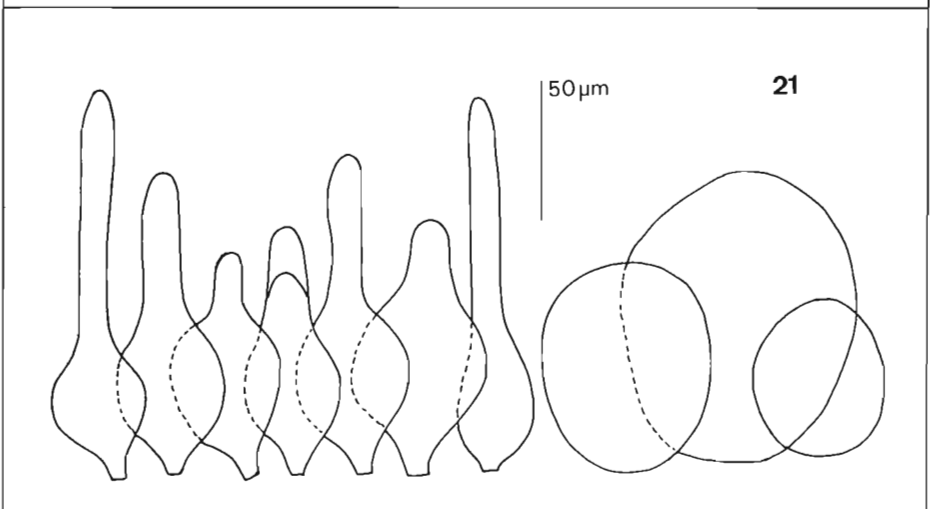


Fig. 21.- *Coprinus xanthothrix:* cheilocystidia.

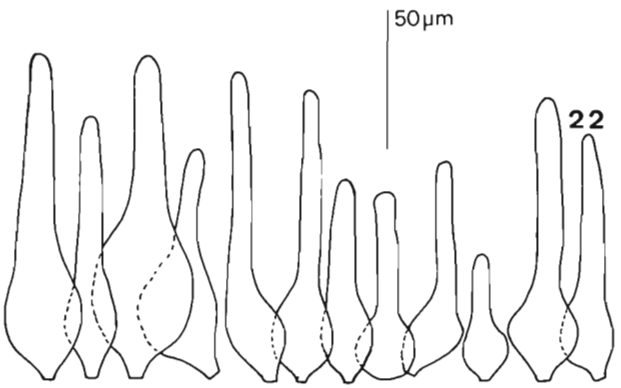


Fig. 22.- *Coprinus xanthothrix:* caulocystidia.

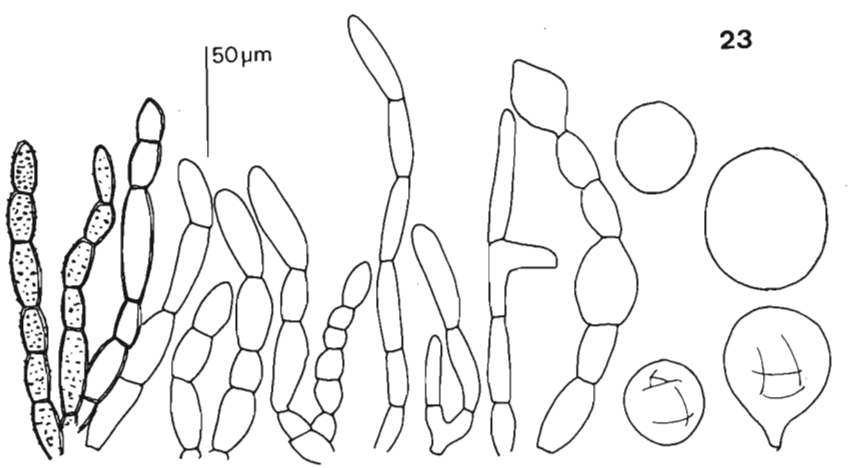
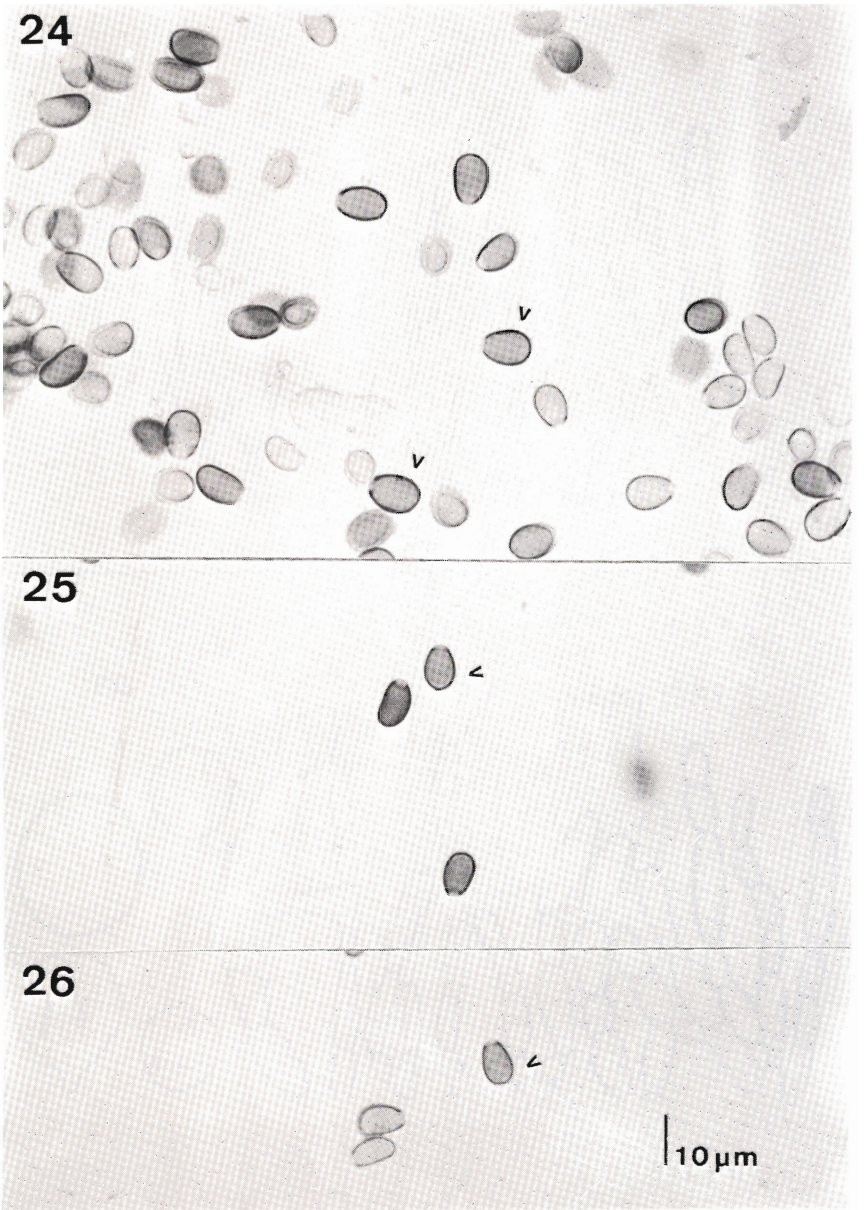
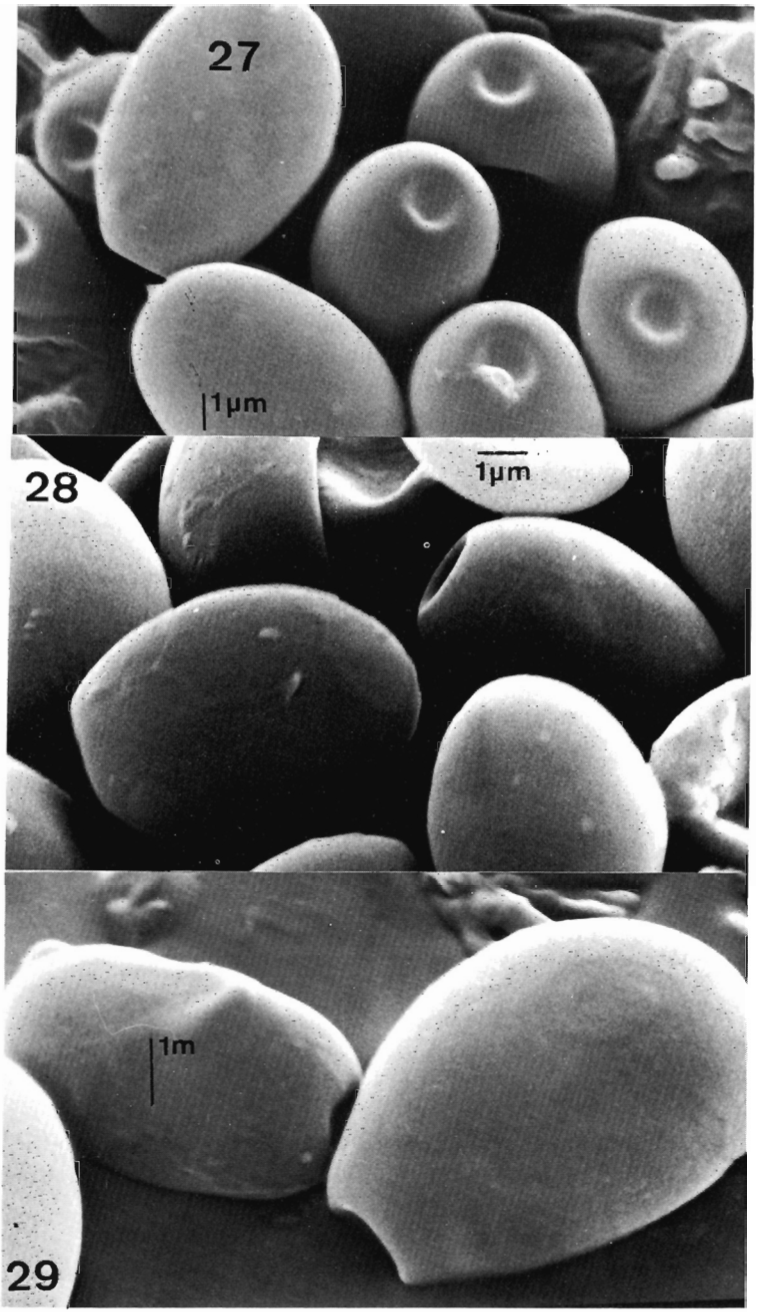


Fig. 23.- *Coprinus xanthothrix:* veil elements.



Figs. 24-26.- *Coprinus xanthothrix:* spores, 24, 26 France, leg. & det. Romagnesi, 25 Germany, leg. Enderle.



Figs. 27-29.- *Coprinus xanthothrix:* spores, Germany, leg. Enderle.

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