

THE 'STERCORARIUS GROUP' OF THE GENUS *COPRINUS*

E. KITS VAN WAVEREN, M.D.
Amsterdam

(With Plate 6 and 55 Text-figures)

Forty collections, comprising all known European species of the 'stercorarius group' of the genus *Coprinus* except *C. radicans* Romagn., were examined, including the type specimens of *C. cinereofloccosus* P. D. Orton, *C. saccharomyces* P. D. Orton, and *C. martinii* P. D. Orton. A new species, *C. laanii* Kits van Wav. is described. A regrouping of and key to the 'stercorarius group' is given and mainly based on spore characters. It is argued that *C. cineratus* Quél. and *C. tuberosus* Quél. are conspecific with *C. stercorarius* as originally described by Fries and that *C. velox* Godey (= *C. stercorarius* Fr. sensu Kühn. & Romagn.) belongs to this group. *Coprinus saccharomyces* P. D. Orton was found to be identical with the 2-spored form of *C. stercorarius* (Scop.) ex Fr., which—as such—was hitherto unknown. The ultrasonic desintegrator helped to explain the nature of the black dots on the spores of *C. narcoticus* and *C. laanii*, which are believed to be caused by the wrinkling of the perispore sac. The terms sporogram, cystidiogram, and basidiogram are introduced.

From 1961 on we found almost every year and in widely separated areas of the 'Singraven' Estate of the late Mr. W. F. Laan a very characteristic and hitherto undescribed fungus, belonging to the 'stercorarius group' of the genus *Coprinus*, which drew our attention to this group and made us specially look out for its species in the field. The two most recent keys to the 'stercorarius group' are those of Kühner & Romagnesi (1953 : 385) and of Orton (1960 : 198). Our study of the species of this group led to a close scrutiny of both keys and showed that they needed revision. This had already been foreseen by Kühner and Romagnesi themselves, who in 1953 wrote that they considered the 'stercorarius group' "encore insuffisamment débrouillé." In the ensuing paper we hope to be able to clear up the still-existing taxonomical as well as nomenclatorial confusion in the group.

According to Kühner & Romagnesi (1953: 385) the following species belong to this group: *C. stercorarius* (sensu Kühn. & Romagn.), *C. cineratus*, *C. cineratus* var. *nudisporus*, *C. radicans*, *C. narcoticus* sensu Lange, *C. Martinii*. Orton (1960: 198), who calls this group the "*C. narcoticus* group," lists the following species: *C. martinii*, *C. saccharomyces*, *C. radicans*, *C. narcoticus*, *C. cinereofloccosus*, *C. cineratus*, *C. stercorarius* sensu Ricken, J. Lange, and *C. stercorarius* sensu Kühn. & Romagn. Our own list runs as follows: *C. stercorarius*, *C. martinii*, *C. velox*, *C. laanii*, *C. cinereofloccosus*, *C. narcoticus*, *C. radicans*.

The two most representative and longest known species of this group are *C. ster-*

corarius and *C. narcoticus*. The descriptions and interpretations of *C. narcoticus* are as unanimous as those of *C. stercorarius* are controversial and confusing. This confusion is due partly to Quélet's introduction of *C. cineratus* and *C. tuberosus*, both species — like we believe — conspecific with *C. stercorarius*, partly to Kühner & Romagnesi's different interpretation of *C. stercorarius*, which has been adopted by Moser (1967: 209) and Watling (1967: 48). Our study of a still comparatively small (40 in all) number of collections of species of this group revealed a great variability in regard to several macroscopical and microscopical characters. This made us again very much aware in general of the great need for examining several if not many collections of any species before we are entitled to give true and adequate descriptions of species, let alone describe a new species altogether. We are happy to be able to base our own new species, *C. laanii*, on no less than ten different collections.

Apart from Orton's type specimens and three collections of *C. velox* we found in 1967 in Wales, only Dutch material was examined. At present all our own collections are in our own herbarium, but the type specimens of *C. laanii* and *C. stercorarius* forma *diverticulatus* are in the Rijksherbarium at Leiden.

For the description of the colours of the cap, stem, gills, and flesh we used the American Munsell Soil Color Charts (abbreviation in text: M.) and the code designating its colours.

For finding facial and marginal cystidia, we strongly recommend the process of 'washing' the gills. Under the binocular high-power lens, a black gill is freed from its spores as much as possible by tapping it gently with a needle while it is floating in ammonia 10% or water. The fluid taking a brown colour from the vast number of floating spores is removed two or three times with filter paper and replaced by a fresh supply. It is further recommended to tear up the washed gill as much as possible into small pieces with the aid of needles before putting it under the coverslip and before tapping the latter with the object to break up the tissue. In this way especially the large facial cystidia but also the marginal cells become far better visible.

The opacity or lack of it and the colour of the spores under the microscope we studied on a suspension of spores in water as in ammonia coloured spores darken artificially and become more opaque. We designated the spore colour also with the Munsell Charts, using a rather strongly lit field of view and oil immersion. This is not an ideal way of assessing the spore colour, the colour depending partly on the intensity of the light used. Still, we preferred this way of assessing spore colours to describing them in words. Later we discovered that M. Lange (1952: 79) had used the same method. He examined the spores "through an oil immersion lens and with the diaphragm opened rather widely; the colours were matched with the standards of Séguier," which Lange, however, found rather unsatisfactory. Munsell's Charts indeed seem to serve this purpose much better.

All textfigures of microscopic structures have been drawn with the aid of a horizontal mirror, mounted on top of a monocular tube, which fitted the microscope at an angle of 45°. By using a strong light with proper adjustment of diaphragm and condensor, the microscopical picture in this way is projected on a piece of white paper

lying on the table and the cells can then very easily be drawn by just following their outlines with a pencil. By projecting a stage micrometer with a photographic scale of 2 mm divided in 200 parts in the same way, one obtains a scale on paper by which all cells, as they have been drawn, can be measured. The enlargement we obtained for facial cystidia, marginal cells, basidia, hyphae, and spherocytes of the veil was $1150\times$ and for spores $2425\times$ on paper. The measurements of the spores were taken by viewing the spores directly through the eyepiece, those of all other cells from the drawings.

All drawings were made on white firm cards, measuring 15×15 cm. Such cards can take some 20–40 spores (depending on their size) and usually some 10–30 cystidia, but only 2–3 of the very large facial cystidia of many *Coprinus* species. Jossierand (1952: 305) already having introduced the terms “sporographe” and “sporologue,” we have — while thinking of the terms cardiogram and encephalogram in medicine — introduced for ourselves and, as we hope, also for others, the concepts *s p o r o - g r a m*, *p l e u r o - , c h e i l o - , c a u l o - ,* and *p i l e o c y s t i d i o g r a m*, and *b a s i d i o g r a m* for these cards. A mere glance at these cards immediately reveals the average shape and size of the cells, and their variability and differences from similar cells, drawn on cards from other species or collections.

Spore sizes have been based on samples taken from the gills as in the majority of cases no sporeprints were available. Great care was taken only to measure ripe (that is, very dark coloured) spores.

The herbaria to which reference is made are abbreviated as follows: K (The Herbarium, Royal Botanic Gardens, Kew), KvW (the author's herbarium), L (Rijksherbarium, Leiden), PR (Botanické oddělení Národní Museum, Praha).

We extend our warmest thanks to the Director of the Rijksherbarium at Leiden, Prof. Dr. C. G. G. J. van Steenis, for the hospitality received in the Herbarium, and to Prof. Dr. C. Kroon, Director of the Histological Department, University of Amsterdam, for facilities extended.

In March 1966 we obtained from Dr. J. van Brummelen, Leiden, a large Petri-dish filled with sheep dung on which for many weeks numerous specimens of *C. velox* developed, showing a multitude of forms, sizes and stages, and for which we want to thank him very much. Through the courtesy of Dr. R. W. G. Dennis, Kew, we were enabled to study the type specimens of *C. cinereofloccosus*, *C. saccharomyces*, and *C. martinii*. For kindly making available some of his collections we wish to thank Dr. R. Watling, Edinburgh, and for one collection from the National Museum Dr. M. Svrček, Prague. We are greatly indebted to Mrs. E. van Maanen, Amsterdam, for her help in regard to the English and to Dr. E. Wichansky, Prague, for translating his own article on *C. velox* and Svrček's article. Finally we wish to express our profound gratitude to Dr. M. A. Donk, Dr. R. A. Maas Geesteranus, Mr. C. Bas, and Dr. J. van Brummelen (Leiden) for their very great help.

Morphology

MACROSCOPICAL CHARACTERS. — Apart from the very small (unexpanded cap 5–15 mm high, 2–10 mm broad, expanded cap diameter 10–20 mm), and in its early stages strikingly white *C. velox*, all other species of this group are macroscopically very much alike, of medium size and grey to brownish-grey. The young caps are ovoid, ellipsoid, subcylindrical or grenade-shaped. The cap-surface shows a mealy-pulverulent coating (the veil), consisting chiefly of whitish-hyaline, later on slightly brownish cells that are just visible with a lens. This coating increases in thickness towards the centre of the cap, towards which the cells cluster to brownish flocculose warts, protruding on the cap-surface. As the carpophores ripen, the caps expand and become conical-campanulate, finally plane, splitting radially and often with an upturned revolute margin. In the young stages the cap is often slightly striate near the margin but definitely striate under the veil. In the ripe stages the cap surface is conspicuously sulcate, with black grooves to near the apex, corresponding with the gills, and grey to greyish-brown, mealy-pulverulent ridges between the grooves. The gills are lanceolate, strongly ascendant, free, but edge in the early stages touching the stem along its entire length; at first white, then black, finally deliquescing; in the final stages the remnants of the gills form thin brownish-black lines against the light grey to dirty brownish-grey undersurface of the cap. In the young stages the edge of the gills is white and minutely granular, and a fine white fibrous mass, particularly strongly developed in the area of the margin of the cap, connects the entire edge with the stem. The stems are dingy whitish usually somewhat greyer at the base, fairly thickset in the beginning, later thin and long, hollow, slightly attenuated upwards and thickened at the base. In young specimens, their caps still closed, the upper part of the stem tapers conspicuously within the cap. At first the stems outside the cap are densely covered with a woolly-hairy fibrous coating (veil), especially at the base. The carpophores ripening and the stems lengthening, this coating finally can only be found on the lower half of the stem or even only near its base and even there it disperses and often largely disappears. The upper half of the stems then only bears a sparse covering of the small white fibres, which in the younger stages connected the edge of the gills with the stem.

The presence or absence of a root is of very little taxonomic importance in this group of Coprini. Practically all authors believe *C. stercorarius* to be a rooting species and the literature provides pictures of distinctly rooting specimens (J. E. Lange, 1939: pl. 159 A; Ricken, 1915: pl. 2, fig. 7; Möller, 1945: 165). Furthermore it is often stated that specimens of this species frequently spring from a sclerotium (compare p. 169). According to Romagnesi (1951: 122) the presence of a long root is characteristic of *C. radicans* and Wichanský (1966: 32) depicted rooting specimens of *C. velox*. Of none of the other species has it been said that the stem may be rooting. But in one of the collections of *C. narcoticus* examined one specimen has a beautifully rooting stem while two others have a small root. Only one of the specimens of *C. velox* among the large number collected for many weeks from sheep dung was found to be clearly rooting, but some of the specimens of another collection (*Bas 1433*) were distinctly rooting

(see Fig. 6). The three specimens of our find of *C. laanii* of 26 July 1968 also were slightly but distinctly rooting. Apparently carpophores of the species of the 'stercorearius group' may easily develop a root when they have to rise from the depths of mixtures of dung and compost or from deep in dung or earth. We observed the same in specimens of other *Coprinus* species, which are supposed to be non-rooting, also in some species of the closely related genus *Psathyrella*. The stems carry neither a ring nor a volva.

A very conspicuous smell (resembling the smell of gas, scatol, *Tricholoma sulphureum*) is produced by *C. narcoticus*, *C. radicans* and *C. velox*, but in the latter the smell usually passes unnoticed, the carpophores being so small, that it is necessary to squeeze a number of caps for the smell to become noticeable.

MICROSCOPICAL CHARACTERS. — Some of the microscopical characters of the 'stercorearius group' here listed need special discussion, while others will be described here in order that a detailed description can be omitted in the descriptions of each of the species.

Spores. — Neither in Kühner & Romagnesi's (1953: 385) nor in Orton's (1960: 198) key to the species of the 'stercorearius group', nor again in their descriptions of the species of this group is any mention made of the very curious shape of the base of the spores and the apiculus in some of the species. This shape, thus far a neglected character, shows two very characteristic types in the 'stercorearius group', so that it can serve as the main key character. The spores of *C. narcoticus*, *C. radicans*, *C. laanii*, and *C. cinereofloccosus* narrow at their base into an elongation that runs into a large and broad apiculus from which it cannot be clearly distinguished. The spores of *C. stercorearius*, *C. velox*, and *C. martinii* on the other hand have a nearly rounded base, their apiculus is very small, and their perispore is much less strongly developed, in many spores often hardly visible or even absent. Only Kühner (1934: 95), Locquin (1944: 43) and Kühner & Romagnesi (1953: 385) have given illustrations of the spores of *C. narcoticus* and its peculiar sporal base in their attempts to analyse the structure of the perispore sac. But Kühner & Romagnesi failed to make use of this important characteristic in their key. Both J. E. Lange (1939: pl. 159 D), who gave coloured illustrations of the spores of *C. narcoticus*, and Orton (1960: 411, fig. 247), who depicted spores of his *C. cinereofloccosus*, apparently failed to notice the characteristic base of these spores and Orton's illustrations are too small to show such details even if they had been noticed. The spores of the species of this group have a flattened adaxial face and an excentric apiculus, except in *C. laanii*.

Coprinus narcoticus, *C. radicans*, *C. laanii*, and *C. cinereofloccosus* present a strongly-developed perispore, surrounding the entire spore and staining slightly dirty brown in 10% ammonia. It has the shape of a strongly wrinkled sac, showing many folds and crevices except in a small area at the apex and base of the spore. The thickness of the perispore in 10% ammonia measured from the epispore to the outline of the perispore varies from 0.5–2.5 μ . There seems to be considerable confusion and divergence of opinion about the naming of the various layers of the spore wall, especially the layers outside the epispore. Recently Singer (1962: 72) gave the following clear

survey of the present-day terminology, to which we will also adhere: "in the most complex spores one has to distinguish between the internal and external endosporium, the episporium (with some authors: exosporium), the exosporium and the perisporium." The latter, according to Singer, is "a loosely attached non-pigmented layer that envelopes the spore as a bag, or a closely attached but fugacious layer that is usually destroyed by dissolution or fragmentation in an early stage of the spore development."

Kühner (1934: 95) distinguished in *C. narcoticus* between two layers of perisporium, one internal and one external ("périspore interne et externe"). Both from his description and his pictures it is clear that he believed having seen on these spores a non-undulating outline running parallel with and at rather a distance from the episporium and an undulating line running midway between episporium and external perisporium and representing the internal perisporium. Whereas the external perisporium was seen to run around the entire spore, inserting only at the extreme end of the apiculus, the internal perisporium was seen to insert at the apex of the spore around the edge of the germ pore and at the base at the delimitation between the body of the spore and its basal elongation. Kühner also saw wart-like inclusions (1953: 385, "inclusions imitant des verrues" and "verruës intrapérisporigues") on the external surface of the internal perisporium, which "paraissent indépendantes de la membrane externe dans de nombreux cas, mais qui semblent aussi parfois rattacher les deux membranes l'une à l'autre."

According to Locquin (1944: 43) the spores of *C. narcoticus* possess an exospore (outside the episporium) which is very thick in some, but pellicle-like in other places, slightly coloured, and has irregular outlines. He believed this exospore to be identical with what Kühner (1934: 95) had named internal perispore. The name internal perispore, however, Locquin applied to the fluid-filled space ("espace fluide") between his exospore and the external perispore. The latter name was applied both by Locquin and Kühner to the outermost layer of the spore. Locquin assumed the presence of yet another but also coloured layer ("voile pigmenté irrégulier") that develops only in places and on the surface of what he designated as exospore. This layer, he said, forms warts ("globules") which—in order to reach the external perispore—traverse what he named the internal perispore.

When the microscope is focussed on the surface of the spores of *C. narcoticus* and *C. laanii* (and, according to Romagnesi, also of *C. radicans*) one notices a number of thick blackish dots and short thick lines except in a small area near the apex and another near the base. These, we think, are not caused by Kühner's "inclusions" or Locquin's "globules," although such structures do exist as we shall presently see. Our own observations led to the conclusion, that there is just one perisporial sac and that the dots and short black lines are caused by the cavities and folds in the wrinkled perisporial sac. The dots and lines are particularly conspicuous in *C. laanii*, where the folds are numerous and deep and where they largely remain after the spores have been mounted in concentrated sulphuric acid, which causes the perispores to swell. In the region between the apical and basal area the perispore swells least and

here some crevices remain and some even reach the episore to which they seem to adhere. By manoeuvring the focussing of the microscope on the spores the black lines are sometimes seen to continue outside the outline of the episore in the lines formed by folds of the perispore sac. This phenomenon is particularly distinct when the spores are mounted in H_2SO_4 . The perispore sac in *C. narcoticus* is slightly less developed and less wrinkled than in *C. laanii*, consequently the black dots and lines are slightly less distinct and less numerous. If these spores are put in H_2SO_4 the perispore swells somewhat more than in *C. laanii* so that most folds largely or completely disappear, most dots and lines disappearing also. By first mounting the spores in water and then bringing concentrated H_2SO_4 under the coverslip at one end and bringing it towards the other end with filter paper, we were able to observe these changes very clearly. The perispore sac in *C. cinereofloccosus*, although about equally distinct, is even less wrinkled and in these spores neither Orton nor we saw the blackish lines and dots!

In one more way we were able to demonstrate that the dots and lines are caused by wrinkling of the perispore sac. At the suggestion of Dr. J. H. Wisse of the Histological Laboratory of the University of Amsterdam we submitted the spores of *C. laanii* and *C. narcoticus* to the action of the ultrasonic desintegrator. For three minutes about 1 ml of an emulsion of spores was treated by the desintegrator and a small drop of the emulsion was then brought under a coverslip and studied under the microscope. Many spores appeared to have completely lost their perispore sac, others had lost only part of it. Many isolated perispore sacs, separated from their spores, were floating in the emulsion and most of them still showed their folds! From the 'naked' spores, which thus had been deprived of their perispore, the black dots and lines had vanished and the spores showed a smooth surface! On very close examination, however, the surface of these spores turned out to carry a very small number of minute pin-point-like warts, which were so small that they cannot possibly cause the aforementioned much larger dots and lines.

The spores of *C. stercorearius* and *C. martinii* have a very much less developed perispore, which is seen as a thin (0.9–1.6 μ or even less), uninterrupted colourless layer with either fairly straight or else irregular outlines, or as isolated frills or droplets on the surface of the spore, often only at or near the apical germ pore and rather looking like a hyaline gelatinous layer (Singer: "fragments of a hyaline covering"). But here also, concentrated sulphuric acid causes swelling of the perispore.

In our material of *C. stercorearius* and far more so of *C. velox*, we found that one very easily overlooks the perispore. Kühner & Romagnesi (1953: 385) also warned against this danger: "il ne faut utiliser qu'avec prudence la présence ou l'absence du sac périsporique, car certaines formes dont les spores en possèdent un très évident avant leur maturité le perdent complètement une fois mûres ou lorsque le carpophore se liquéfie." We should like to stress this point particularly in regard to *C. stercorearius*. Young, almost round and colourless spores of this species seem to have no perispore, but in slightly older and fairly brown and elongated spores, the perispore is already present to some extent. It is fully present in ripe, dark brown spores obtained from

black gills of young specimens, whose caps, however, are still closed, but again very much less distinct in spores obtained from deliquescent gills and from spore deposits on stems!

Still, despite their own warning, Kühner & Romagnesi (1953: 385) described the spores of their *C. stercorarius* (= *C. velox*) as “ne montrant de périspore ni sur le frais dans l'eau, ni sur matériel sec traité par l'ammoniaque.” This statement we found to be incorrect. Although often only after a careful search or only after examining spores from caps in various stages of ripening, we were able to find perispores or remnants thereof in all our collections of *C. velox* in at least a small number of spores. For similar reasons we do not believe in the taxonomic value of *C. cineratus* (= *C. stercorarius*) var. *nudisporus* Kühner (1957: 3), a variety also mentioned in the ‘Flore’. On the one hand it is said of this variety that the spores “ne montrant quand on les examine sur le frais et dans l'eau, aucun sac périsporique évident,” while on the other hand that “seules quelques spores montrent çà et là une verrue hyaline, indice d'une périspore \pm ondulée, mais appliquée, que l'acide sulfurique gonfle en sac énorme.” In the Rijksherbarium at Leiden we found specimens labelled *C. cineratus* var. *nudisporus* (Bas 1432), about which the collector had entered in his notes that here and there the spores had vague hyaline droplets and that in sulphuric acid they had a large swollen perispore. We studied these spores again and found that many of them showed droplets or deposits of some length or frills of perispore on their walls. The specimens were relabelled *C. stercorarius*. Moser (1967: 395 fig. 260) depicts even spores of *C. narcoticus* without a perispore! In all species of the ‘stercorarius group’ one comes across sets of two spores (very rarely three or even four) enveloped in one common perispore. This phenomenon is depicted by Kühner (1934: 95), J. E. Lange (1939: pl. 159 D), and Watling (1967: 46).

The spore sizes we measured excluding the perispore. The length of the spores of *C. narcoticus*, *C. laanii*, *C. radicans*, and *C. cinereofloccosus* has to be measured from the apex to the extreme end of the indistinctly delimited apiculus. In the other species our measurements excluded the small apiculus. These spore sizes vary; they are decidedly small in *C. velox*, while the largest spores are those of *C. martinii* and of the 2-spored form of *C. stercorarius*.

The colour of the spores in water is dark reddish-brown, those of *C. velox* are of a lighter shade. The spores of *C. velox* and *C. stercorarius* are opaque, those of the other species not opaque or sub-opaque. The spores have a conspicuous apical germ-pore and a fairly thin wall.

B a s i d i a. — These are dimorphic: they either have a fairly long and narrow stalk and a ventricose cell body, slightly constricted in the middle, or they are more thickset with a short, broad stalk passing gradually into a non-constricted cell body. Both types are well depicted by Favre (1937: 286) in his description of *C. martinii*.

The basidia are almost always 4-spored, but since in the genus *Coprinus* 2-spored basidia frequently occur, the presence of such 2-spored forms was to be expected. These were indeed found (see *C. stercorarius* and *C. cinereofloccosus*). This is why we believe *C. saccharomyces* P. D. Orton (1960: 202) not worth specific delimitation.

Facial cystidia.—The facial cystidia of the species of the 'stercorearius group' are fairly numerous and—with the exception of those of *C. velox*—so large that in young specimens having black gills but whose caps are still closed, they can be seen with a lens. They have very thin walls (gentle tapping on the coverslip causes most of them to break or collapse) are colourless, do not bear crystals or mucous and their stalk is extremely small and short. They disappear as the carpophores ripen and may even have disappeared already from black gills of caps that are still closed. They are always quite easy to find on white gills of young specimens, but then they may not have reached their ultimate size: in *C. stercorearius* $50\text{--}75 \times 20\text{--}25 \mu$ on white gills, $55\text{--}90$ ($120\text{--}130$) $\times 20\text{--}40 \mu$ on ripe gills; in *C. velox* $20\text{--}35 \times 10\text{--}14 \mu$ on white gills, and $30\text{--}50 \times 15\text{--}25 \mu$ on black gills. The facial cystidia are ellipsoid, ovoid, sub-cylindrical, sometimes obovoid. Their shape varies somewhat in the different species and so may have some taxonomic significance. In all four collections of *C. narcoticus* that we were able to study, they are very broad, ovoid, almost globose, those of *C. velox* are smaller than those of the other species and they have a longer stalk. Characteristic are many facial cystidia of *C. laanii* in that they are slightly constricted just below the apex and therefore utriform.

Marginal cells.—Deliquescence of the gills proceeds from the edges of the gills towards their base. Consequently, the marginal cells very soon disappear and they can usually be found only on white gills or on gills which have quite recently turned black, in caps still closed. The edge of the gills is sterile, lined with great numbers of large, more or less globose or slightly elongate to clavate or somewhat irregularly-shaped, vesiculose spherocytes¹ with smooth and very thin walls and usually a fairly short stalk which, however, is longer than that of the spherocytes of the veil. Between these cells there are almost always larger cells, resembling the facial cystidia.

To our great surprise we found in two of our collections of *C. stercorearius* the marginal spherocytes covered with diverticula, identical with those of the spherocytes of the veil. These diverticulate cells were found along the entire edge of the gills and not only near its margin! Being proper marginal cells, they were colourless and—contrary to the very short-stalked spherocytes of the veil, for which they might have been mistaken—they had distinct stalks. In some parts of the gill edge all marginal cells were densely covered with diverticula. In other parts marginal cells covered only sparsely or very sparsely or only on one side or only at the top with diverticula were found among the densely diverticulate cells. Again in other parts many cells had no diverticula at all and in some places these even far outnumbered the diverticulate cells. These two collections we have described as *C. stercorearius* forma *diverticulatus* (see p. 167).

On top of the marginal cells there are, either isolated or united in small groups or

¹ As these structures are regarded as proper cells (cytes) and not cysts (= sac or cavity, according to the definition given by Snell & Dick, 1967), we prefer calling them spherocytes, not spherocysts.

even fairly dense networks, almost always a number of thin, 1.6–6.4 μ , rather long and branching hyphae, running an erratic course, possessing few septa and a number of small protuberances and sometimes large diverticula. They are identical with the thin hyphae of the veil on the cap, their number and thickness increase towards the margin of the cap and they form the fibrous mass, connecting the edge of the gills with the stem, on the surface of which they are also present.

Universal veil. — The microscopical picture of the veil on the cap is dominated by large numbers of more or less globose, thin-walled, very short-stalked, vesiculose spherocytes, of which the surface is, as a rule, densely covered with very small warty protuberances, which, being diverticula, do not disappear in 10 % HCl (like the protuberances of the velar cells in *C. Patouillardii* Quél., *C. poliomallus* Romagn., *C. cortinatus* J. E. Lange). The diverticula are irregularly spread over the surface of the cell and unequal in length and width, but for the moment we prefer ignoring these possible differences. As the carpophores grow older the spherocytes become slightly brown, due mainly to membrane-pigment to which some encrusting pigment may be added.

In all species of the 'stercorarius group' we came across spherocytes (usually only a few, rarely none, but sometimes in rather greater numbers) bearing only a very small number of diverticula or even none at all. Also we repeatedly found both in the veil on the cap and in that of the stem, strikingly small or strikingly elongate, or both small and elongate cells which almost invariably had only a few diverticula that quite often were exceptionally long (sometimes up to 8 μ !). Irregularly shaped locally inflated hyphae with a few large diverticula were seen now and then in several species, particularly in the stem. Orton already expressed doubts as to whether these cells are specific for *C. cinereofloccosus*, but we believe the taxonomic significance of these cells to be nil. We also found these cells in some of the other species, particularly in the type specimens of *C. martinii*, and we have therefore concluded that neither their presence nor their absence is of any significance taxonomically.

The spherocytes of the veil on the stem are identical with those on the cap, but their number is very much smaller and in ripe specimens can only be found in the lower half of the stem or only near its base. All spherocytes are fixed on a system of thin hyphae, 1.6–6.4 μ , which under the microscope are very inconspicuous and in the preparation of the veil on the cap are seen mainly in the immediate proximity of the spherocytes. The shape and course of these hyphae are very erratic, they branch quite arbitrarily and bear a small number of blunt, sometimes more diverticulum-like bulges ("bourgeonnant"), spread irregularly along their wall.

The veil on the stem is composed chiefly of the same hyphae but also of many broader hyphae (up to 20 μ). With increasing width the hyphae have fewer protuberances and bulges, the broader hyphae not having these at all. The broad hyphae are often slightly brown (membrane-pigment) and in rare cases bear very small encrustations.

The cap surface is not cellular, the veil resting directly on the very thin top layer of the flesh, formed by only a few thin hyphae running parallel to the surface of the cap.

Clamps. — Clamps were sometimes seen (for instance in two of our collections

of *C. stercorearius*) both on the thin hyphae of the veil on the top and the thin hyphae between the gill edge and the stem. It seems very doubtful whether they are of any taxonomic importance. Orton (1960: 198) does not mention clamps at all and Kühner & Romagnesi (1953:385) found clamps to be not consistently present in the mycelium of cultured specimens of their *C. cineratus* (= *C. stercorearius*) and absent on the hyphae of the mycelium of cultured specimens of their *C. stercorearius* (= *C. velox*).

Habitat, frequency. — Apart from *C. velox*, the species of this group often grow somewhat caespitose. *Coprinus laanii* was always found on old cut surfaces of trees, cut close to the ground. *Coprinus martinii* occurs on the stems and debris of *Carex*, *Scirpus*, and *Juncus*. *Coprinus velox* is the only species of this group to grow exclusively on dung (horse, rabbit, cow, deer). The remaining species occur either on or near dung or in grass, parks, meadows. The species of this group may be found from spring to autumn, even as late as November.

It is very difficult to assess the rarity of the species of the 'stercorearius group'. *Coprinus velox*, we think, is quite common but because of its very small size probably very often overlooked. We found *C. stercorearius* on eleven occasions and in quite different places in the Netherlands so that this species must be common too. *Coprinus laanii* can hardly be very rare in the Netherlands either, as we found this species almost every year in different localities. *Coprinus narcoticus* on the other hand, we consider to be rare, having found it only once. So far, *C. radicans*, *C. martinii*, and *C. cinereofloccosus* have not been recorded for the Netherlands.

COPRINUS (Pers.) ex S. F. Gray 'stercorearius group'

Coprinus, groupe de *C. stercorearius* Kühn. & Romagn., Fl. anal. Champ. sup. 385. 1953.

The universal veil, covering the entire surface of the cap consists of a dense coating of large globose cells — spherocytes — supported by a system of very thin hyphae. The number of spherocytes and therewith the thickness of the coating increases towards the apex of the cap, towards which the cells also amass, forming warty brownish clusters. On the stem the veil consists of a dense woolly-hairy network of hyphae, enclosing a small number of spherocytes. The outer surface of the spherocytes is covered with numerous small diverticula. Numerous thin hyphae of the veil have short protuberances. The veil does not rest on a cellular epithelium but directly on the long, very thin hyphae of the flesh of the cap. Neither the surface of the cap, nor that of the stem bears cystidia or setulae. The spores have a perispore sac, which in some species is very conspicuous, and an apical germ-pore. The gills have facial cystidia, a sterile edge, lined with large spherocytes and a hyaline colourless trama.

KEY TO THE SPECIES

1. Spores with narrowing elongated base gradually passing into a large and broad apiculus, perispore strongly developed.

2. Smell of gas.
 3. Spores $10.8-13.5 \times 5.4-6.8 \mu$, stem usually non-rooting *C. narcoticus*
 3. Spores $12-15 \times 6-8 \mu$, stem rooting *C. radicans*
2. No smell of gas.
 4. Apiculus excentric; on soil or in grass; basidia 2-spored . . . *C. cinereofloccosus*
 4. Apiculus in longitudinal axis of the spore; on cut surfaces of trees, cut close to the ground; basidia 4-spored *C. laanii*
1. Spores with rounded base, apiculus abrupt and very small, perispore little or barely developed.
 5. Spores $6.8-7.7(-8.1) \times 4.1-4.5 \mu$; very small and in the early stages white species
C. velox
 5. Spores $9-13.5 \times 5.4-7.2 \mu$ or even larger; medium-sized and grey species.
 6. On stems of *Carex*, *Juncus*, *Scirpus*; spores $13.5-14.9 \times 7.7-8.6 \mu$. . . *C. martinii*
 6. On or around dung or in grass or in soil; spores $9-13.5 \times 5.4-7.2 \mu$ (2-spored forms: $13.5-16.2(-17.1) \times 7.7-9 \mu$
 7. Cheilocystidia smooth (no diverticula) *C. stercorarius* f. *stercorarius*
 7. Cheilocystidia diverticulate *C. stercorarius* f. *diverticulatus*

1. COPRINUS NARCOTICUS (Batsch ex Fr.) Fr.

Agaricus narcoticus Batsch, Elench. Fung. Cont. 1: 79, pl. 16 fig. 77 a-d. 1786; ex Fr., Syst. mycol. 1: 511. 1821. — *Coprinus narcoticus* (Batsch ex Fr.) Fr., Epicr. 250. 1836; Summa Veg. Scand. 198. 1849; Monogr. Hym. Suec. 465. 1857; Hym. europ. 329. 1874.
Coprinus inamoenus P. Karst. in Grevillea 7: 63. 1878.

SELECTED DESCRIPTIONS AND ILLUSTRATIONS. — Cooke, Ill. Brit. Fungi pl. 668 (680). 1886; Konr. & Maubl., Icon. sel. Fung. 1: pl. 36 fig. 2. 1930; J. E. Lange, Fl. agar. dan. 4: 114, pl. 159 fig. D. 1939; Kühn. & Romagn., Fl. anal. 385. fig. 536. 1953; Ricken, Blätterp. 59. 1915.

CHIEF CHARACTERISTICS. — Medium size; young, unexpanded cap 8–15 mm high, 5–10 mm broad; strong smell of gas; spores $10.8-13.5 \times 5.4-6.8 (-7.2) \mu$; base of spore narrowing and elongated, passing gradually and at a fairly distinct angle into a large excentric apiculus; perispore very conspicuous.

MACROSCOPICAL CHARACTERS. — Cap at first almost globose, broad ovoid ellipsoid, conical-ovoid, 8–15 mm high, 5–10 mm broad, very light grey to mouse-grey, not striate. Surface of cap mealy-pulverulent, densely coated with whitish, in the end slightly brownish granules which, as the carpophores ripen, cluster increasingly from halfway up the cap towards the apex into brownish warty lumps. Cap later expanding, conico-campanulate (up to 30 mm high!), finally plane (diam. 20–25 mm), striate and ultimately deeply grooved by black grooves, alternating with broad ridges which in the periphery are grey, towards the apex more grey-brownish. In the final stages margin revolute and splitting radially.

Stem in the early stages outside the closed cap cylindrical, thickset, $2-15 \times 1-3$ mm, white, densely covered with a woolly-hairy white coating; inside the cap tapering towards the apex. Later $15-60 (-75) \times 1.5-3$ mm, minutely striate, whitish, hollow, as a rule non-rooting, more or less covered with white woolly hairs, densest at the sometimes swollen base.

Gills lanceolate, 1–2 mm broad, ascending, free, at first white, later grey, finally black with white minutely granular-floccose edge, deliquescent, edge connected with the stem by a white minutely fibrous mass, particularly strongly developed at the margin of the cap.

Flesh very thin, whitish to grey both in cap and stem.

Smell strong of gas (or scatol, *Tricholoma sulphureum*).

MICROSCOPICAL CHARACTERS. — Spores ellipsoid, adaxially flattened, apex rounded, base narrowing into an elongation, which passes gradually and at a fairly distinct angle into a broad ($\pm 1 \mu$) and rather long (0.5–0.9 μ) excentric apiculus on the adaxial face, 10.8–13.5 \times 5.4–6.8 (–7.2) μ , dark reddish-brown (M. 2,5 YR 3/4, 3/6; 5 YR 3/3, 3/4), opaque to sub-opaque, germ-pore very distinct ($\pm 1.8 \mu$). Perispore very conspicuous, always present, surrounding the entire spore, sometimes rather thin (0.5 μ or less) and less distinct, as a rule much thicker, 1–1.5 (–2) μ , light brown in NH₄OH 10%, outlines erratic and undulating, a number of blackish dots and short thick lines on the surface of the spore.

Basidia 4-spored; dimorphic, 24–33.6 \times 8–11.2 μ and thickset basidia, 19.2–20.8 \times 9.6–11.2 μ .

Facial cystidia fairly numerous, very broad-ellipsoid or ovoid-ellipsoid to sometimes almost globose, with very short and narrow stalk, 50–105 \times 35–50 (–65) μ , as a rule thin-walled, colourless, without mucus or crystals.

Marginal cells closely packed, vesiculose, globose to slightly elongate, colourless, thin-walled, spheropedunculate, with short small stalks, 30–80 \times 20–50 μ ; among them larger and more elongate cells, transitions to the facial cystidia or similar to these. Thin hyphae (1.6–6.4 μ) isolated or in small groups or even networks on the gill edge, increasing in number towards the margin of the cap and bearing a number of blunt protuberances.

Universal veil on the cap consisting of large numbers of globose to slightly elongated, vesiculose, thin-walled, colourless or slightly brown spherocytes, measuring 40–112 μ , with very short and narrow stalk, fairly densely covered with diverticula, 0.9–1.8 (–2.7) μ long; and inconspicuous thin (1.6–6.4 μ), branching hyphae, running very erratically, sometimes inflated locally (11.2 μ), bearing a fair number of blunt protuberances. Sometimes some spherocytes with few or very few diverticula and sometimes a few strikingly small (20–30 μ) \pm globose or slightly elongated (20 \times 30 μ) spherocytes, bearing only a few diverticula of greater length (2.7–3.6 μ). Veil on the stem consisting of a dense network of branching, disorderly arranged hyphae, bearing a small number of blunt protuberances and few spherocytes, identical with those of the veil on the cap but sometimes only sparsely or barely covered with diverticula or even practically bare. Most hyphae fairly thin, 3.2–8 (–12.8) μ , some inflated locally (up to 20.8 μ), few very thin hyphae (1.6–3.2 μ), thicker hyphae (12.8–22.4 μ) more numerous. Many hyphae slightly brownish. Crystals always and mucus as a rule absent.

HABITAT. — On dung, rubbish, compost, mixtures of compost and dung, decaying hay or plants, in grass, gardens and parks. Often more or less caespitose. Rare.

COLLECTIONS EXAMINED. — Delfgauw, 5 Nov. 1953, *J. H. Hueck* (L); Zeist, 'Wulperhorst', 9 Sept. 1953, *A. F. M. Reynders* (L); Kortenhoef, 14 Oct. 1957, *C. Bas 1310* (L); Ommen, Estate 'Ada's Hoeve', 29 Sept. 1965, *E. Kits van Waveren* (KvW).

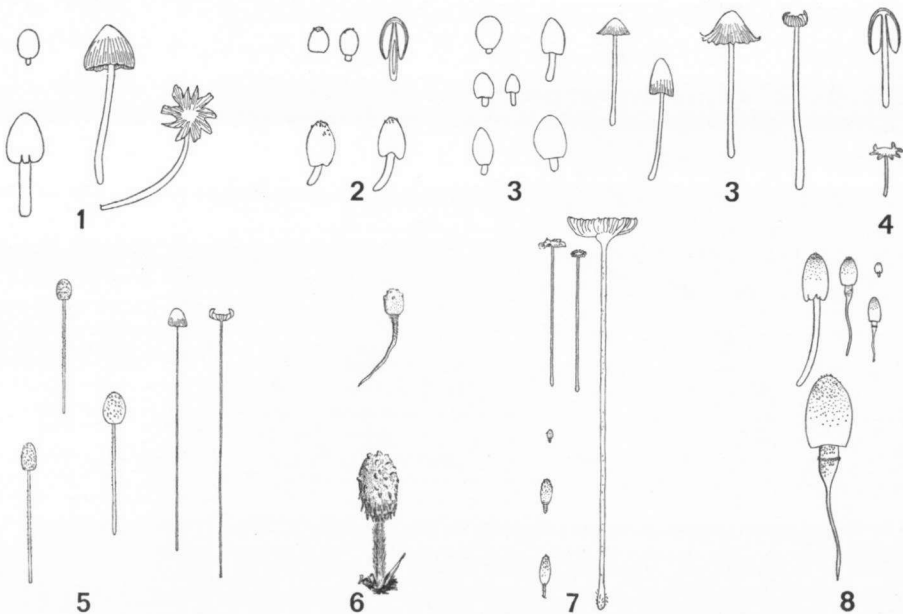
OBSERVATIONS. — A young specimen of the collection from Delfgauw shows a distinctly rooting stem, two others have a small root. In the description accompanying this collection the cap is said to be conical and up to 38 mm high and the stems 50–75 \times 4–6 mm. According to the finder himself some stems were even up to 100 mm long. The dried material, indeed, consists of exceptionally large carpophores. Also, almost all spherocytes and many hyphae from the universal veil on the cap were covered with a fair number of mucilaginous droplets. In the collection from Zeist facial cystidia were absent, but the specimens obviously were already old when they were collected. In the other three collections facial cystidia were always found

and they were nearly always strikingly broad-ellipsoid. Once, however, we found two very large ($135 \times 50 \mu$ and $160 \times 50 \mu$) more or less cylindrical facial cystidia (collection from Ommen).

The three basic characteristics by which *C. narcoticus* is distinguished from the other species of the 'stercorarius group' are its striking smell, its medium size, and the grey colour of its cap. Only *C. radicans* and *C. velox* possess the same smell, but the former has a distinct root and larger spores, while the latter is a very small and in its early stages white species with smaller spores.

Agaricus narcoticus as described and depicted by Batsch adequately corresponds with the species we have just described, and Fries's descriptions fully correspond with both Batsch's description and figures to which he referred.

Judging from Karsten's original description and his later picture (1885: 4, fig. 4) his *Coprinus inamoenus* must be conspecific with *C. narcoticus*. The name is only mentioned by Massee (1896: 167 and 1902: 236), it has never been used since. We have not examined the type material.



Figs. 1-8. Habit sketches. — 1. *C. narcoticus* (Ommen, 'Ada's Hoeve', 29 Sept. 1956). — 2-4. *C. laanii* (2: Leusden, 'De Treek', 26 Oct. 1963; 3: holotype, 1 Oct. 1965; 4: Denekamp, 'Singraven', 7 Oct. 1966). — 5-7. *C. velox* (5: Over-Asselt, 'Boonenhof', 17 Sept. 1965; 6: Leiden, 21 May 1958; 7: Llanwddyn-Cuddig, 21 Sept. 1967). — 8. *C. stercorarius* f. *stercorarius* (Nieuwersluis, 'Over-Holland', 30 Sept. 1967). (Fig. 1: $\times \frac{1}{2}$; figs. 2-4: $\times \frac{1}{2}$; fig. 5: $\times 2.5$; fig. 6: nearly $\times 2$; fig. 7: little more than $\times 1$; fig. 8: $\times 1.5$).

2. *COPRINUS RADICANS* Romagn.

Coprinus radicans Romagn. in *Revue Mycol.* 4: 122. 1951; *apud* Kühn. & Romagn., *Flore anal.* 385. 1953.

CHIEF CHARACTERISTICS. — Medium size; young, unexpanded cap 10–15 mm high; rooting stem; strong smell of gas; spores $12-15 \times 6-8 \mu$; base of spore narrowing and elongated, passing gradually and at a fairly distinct angle into a large excentric apiculus; perispore very conspicuous.

MACROSCOPICAL CHARACTERS (translation of Romagnesi's description). — Cap at the moment of expansion 10–15 mm high, glandiform, then campanulate, finally expanded, centre at first bumpy ("angulé") but without umbo, dirty colour (not pure white), then grey with apex brownish or only of a stronger colour, margin blackening due to deliquescence, at first covered with a coherent micaceous greyish meal on which in places one notices brown masses, then grey micaceous mealy, finally almost bare, margin delicately sulcate almost to the top.

Stem fragile, flaccid, about $30-50 \times 1.5-3$ mm, attenuated towards the apex, slightly thickened towards the base, continuing in a long frail tough root (we have not been able to pursue the root over a sufficient distance in the substrate in order to know whether it either did or did not grow from a sclerotium), white but distinctly coloured a fairly dark grey towards the base, in its upper part minutely pruinose, in its lower part silky-hairy.

Flesh rather thin. On cross section of a young specimen with its cap still closed, the cap shows a micaceous pulverulent greyish upper layer (veil) and a dark grey lower layer; interior of the stem pale pearly-grey, in the swollen lower part of the stem the cortical zone grey-blackish, as is the root. Striking and strong smell of gas, acetylene (very special).

Gills crowded with many small gills, lanceolate-ventricose, free, white at first, then blackish with the gill-edge micaceous and white, deliquescent.

Spore print black.

MICROSCOPICAL CHARACTERS (translation of Romagnesi's description). — Spores $12-15 \times 6-8 \mu$, ellipsoid, with apical germ-pore, almost always without perispore when black and opaque but when young and only little coloured with conspicuous perispore sac. According to Kühner one notices in a small number of ripe spores a broad perispore with conspicuous warts between perispore and episore.

Basidia 4-spored, spheropedunculate.

Facial cystidia present, ellipsoid or cylindrical.

Marginal cells vesiculose.

External layer of the cap a mass of echinulate-diverticulate spherocytes, diameter $40-65 \mu$, supported by a complicated system of branching hyphae with protuberances ("bourgeonnantes"), $5-13 \mu$ thick. Trama of cap with voluminous lactifers, loaded with crystals.

HABITAT. — On dung and on the ground (Romagnesi).

OBSERVATIONS. — According to Romagnesi (1951: 122) this species is remarkable because of its smell and its long root ("pseudorrhize") and it differs from *C. narcoticus* by its greyer colour and the perispore sac, vanishing from the ripe spores. In the 'Flore' (1953: 385), however, the difference from *C. narcoticus* is put in a slightly different way. *Coprinus radicans* is said to be rooting (*C. narcoticus* is not), its stem is distinctly grey in its lower part, the spore sizes are $12-15 \times 7-8 \mu$ (*C. narcoticus* $10-13 \times 5-6 \mu$ according to Romagnesi, $10.8-13.5 \times 5.4-6.8 \mu$ according to our

own measurements) and the perispore is very conspicuous only in immature spores, disappearing during the process of ripening. As stated earlier, some specimens of the *C. narcoticus* collection from Delfgauw had a distinctly rooting stem, so that the size of the spores, the early disappearance of the perispore, and the greyer flesh and stem seem to be the main differentiating characters of *C. radicans*.

Not quite understandable is Romagnesi's note in his original description that by loosing the perispore in the process of ripening, *C. radicans* approaches *C. stercorarius* Fr. sensu Kühn. & Romagn. (= *C. velox*) and *C. cineratus* (= *C. stercorarius*), "qui sont dépendant complètement inodores." Not only do the spores of these two species differ markedly from those of *C. radicans* (base of spore rounded, small apiculus), but according to Kühner & Romagnesi their *C. stercorarius* does have an "odeur désagréable de *C. narcoticus* Fr. au froissement."

Although we never examined specimens of this species, we have included Romagnesi's *C. radicans* in this revision because it does seem to differ in some respects from *C. narcoticus* and because it is included in the keys given by Kühner & Romagnesi (1953: 385) and by Orton (1960: 198).

We have not included *Coprinus neoradicans* Locq. (1955: 16). According to Locquin's description and figures the species must be very close to *C. narcoticus* and *C. cinereofloccosus*, having in common the type of spore. The stem of *C. neoradicans* has a large root, the species has only an "odeur faible désagréable," the spores are exceptionally large, $18-20 \times 9.5-10 \mu$, but Locquin did not state whether the basidia were 4- or 2-spored. The structure of the surface of the cap, however, is quite different from that of the species of the 'stercorarius group': "à sphérocytes incolores et lisses recouverts de sphérocytes hérissés d'aiguillons cylindriques les rendent verruqueux, le tout supporté par des hyphes vésiculeuses courtes elliptiques formant la cortine, le tout sur un derme cellulaire." We think this species needs confirmation. It is not included in the New British Check List (1960), neither in Orton's key.

3. *Coprinus laanii* Kits van Wav., *sp. nov.*

Pileus primo late ellipsoideus, ovoideus, cylindrico-ovoides, haud striatus, pallide griseus vel griseus (Munsell 10 YR 6/6), omnino farinaceo-granulosus, dein conico-campanulatus vel campanulatus, 5-17 mm altus, 3-10 mm latus, striato-sulcatus, murinus, ad discum farinoso-verrucosus verrucis crassioribus sordide diluteque ochraceis vel obscure griseo-ochraceis, postremo planus, plicato-sulcatus, radialiter fissuratus et plerumque margine revolutus.

Stipes primo 1-15 mm longus, 1-2(-3) mm latus, albus, albo-farinoso-fibrillosus, apice attenuatus, dein 30-55 mm longus, plus minusve 1 mm latus, subaequalis vel sursum attenuatus, albo-argillaceus vel pallide griseus, minute fibrillosus, cavus, ad basin vulgo incrassatus et griseus.

Lamellae liberae, 1-2 mm latae, primo albae, dein e fusco nigricantes (Munsell 2.5 YR 3/2; 7.5 YR 3/2) demum nigrae, confertae, ad aciem primo albo-flocculosae, deliquescentes.

Caro submembranacea, in pileo grisea, in stipite alba, odore nullo.

Sporae ellipsoideae sine facie adaxiali plano (!), $9-12.6 \times 5.4-6.3 \mu$, obscure fulvae (Munsell 5 YR 3/4, 4/4, 5/4), subpellucidae, apiculo recto, poro germinativo et perisporio fortiore ($0.5-2 \mu$) praeditae.

Basidia 4-sporigera, dimorphia, $20.8-33.6 \times 8-10 \mu$ et $16-20.8 \times 8-10 \mu$.

Pleurocystidia modice abundantia, elongato-fusiformia, saepius subutriformia, hyalina, $65-120 \times 22.5-40 \mu$.

Cheilocystidia abundantia, conferta (qua de causa lamellarum acies sterilis), spheropedunculata, vesiculosa, globosa vel elongato-ovoidea, hyalina, $30-75 \times 20-45 \mu$, nonnulla elongato-fusiformia, pleurocystidiis similia, $55-120 \times 20-45 \mu$.

Pilei velum universale e cellulis abundantibus globosis, vesiculososis, hyalinis et hyphis paucis constat. Cellulae globosae $32-96 \mu$, diverticulis minutis dense punctatae; hyphae $1.6-6.4(-11.2) \mu$ diam., protuberantiis praeditae.

Nascitur in uda lubrica muscosa superficiae arborum prope humum transverse sectarum; saepe ipsi musco inhaerens.

Aestate-autumno.

Holotypus: Denekamp, 'Singraven' ('Het Harseveld'), 1 Oct. 1965, *E. Kits van Waveren* (L).

CHIEF CHARACTERISTICS. — Medium size; young, unexpanded cap 5–17 mm high, 3–10 mm broad; smell none; on horizontal old cut surfaces of conifers and deciduous trees, cut close to the ground; spores $9-12 \times 5.4-6.3 \mu$, ellipsoid in all planes running through the longitudinal axis (adaxially not flattened!); base of spore narrowing and elongated, passing gradually and without clear delimitation into a large apiculus, located in the longitudinal axis; perispore strongly developed; facial cystidia often slightly but distinctly utriform.

MACROSCOPICAL CHARACTERS. — Cap at first broadly ellipsoid, ovoid or grenade-shaped, 5–17 mm high, 3–10 mm broad, not striate, light grey to mouse-grey (M. 10 YR 6/2), surface covered with a mealy-pulverulent coating, increasing in thickness towards the apex of the cap, consisting chiefly of whitish and ultimately slightly brownish granules, clustering — as the carpophores ripen — increasingly and in some carpophores more so than in others towards the apex of the cap into warty, light brown (M. 10 YR 5/2) to dark greyish-brown protuberances. Cap later conico-campanulate or campanulate, 5–20 mm high, 10–15 mm broad, in the final stages plane, splitting radially and often with revolute margin, shrinking, surface strongly plicate-sulcate with purple-blackish grooves separated by grey to light brownish-grey ridges, browner towards the apex.

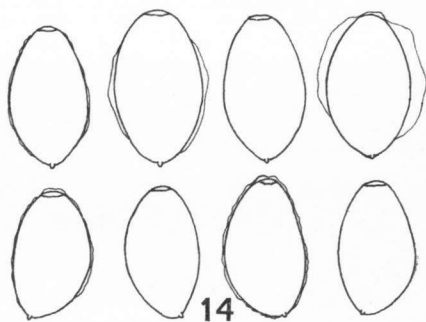
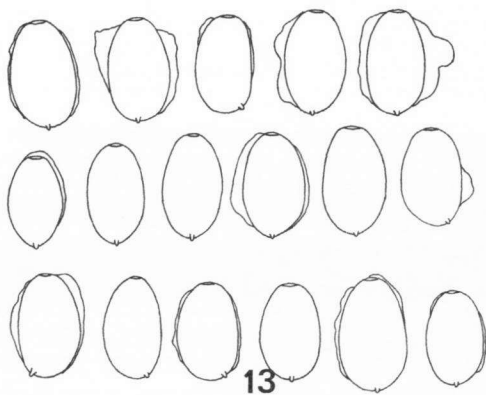
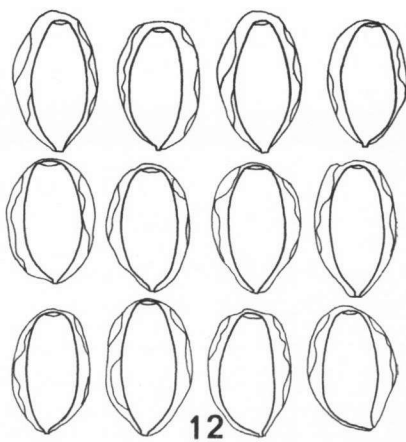
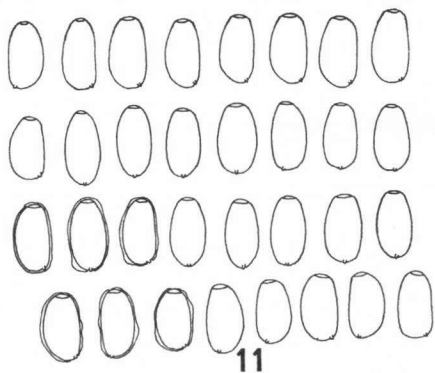
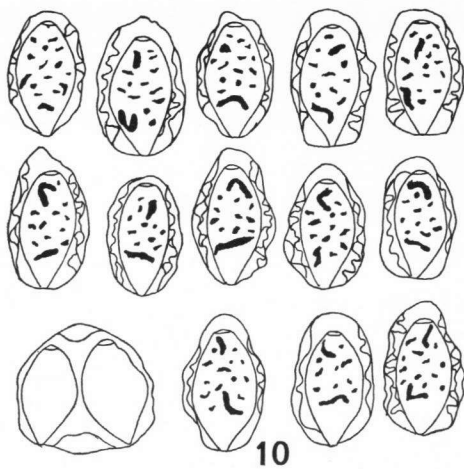
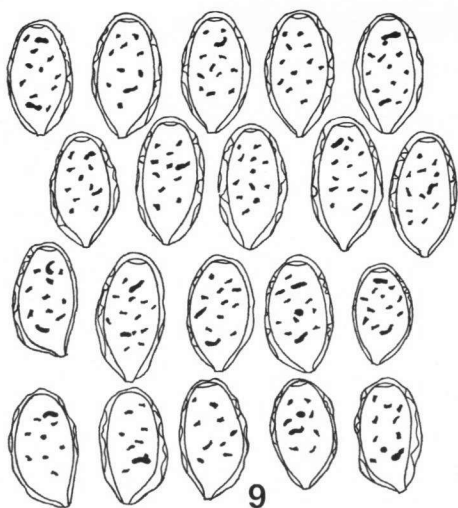
Stem in the early stages outside the closed cap thickset, 1–15 mm high, 1–2 (–3) mm thick, covered with a woolly-hairy, whitish coating particularly at the base; within the closed cap tapering conspicuously towards the apex. In the final stages 30–60 mm long, 1–2 mm thick, very gradually attenuated from base upwards, silvery-whitish to very light grey, hollow, non-rooting, sparsely but towards the base progressively covered with fine white fibres; base usually slightly swollen (1.5–2 mm) and darker grey or brownish-grey.

Gills lanceolate, ascending, free, 1–2 mm broad, at first white, later chocolate colour (M. 2.5 YR 3/2; 7.5 YR 3/2), finally purple-black to black with white, minutely granular-flocculose edge, deliquescent, in the final stages as fine purplish black lines along the undersurface of the by then dingy light brown-grey cap. Gill edge at first connected with the stem by abundant minute white fibres, forming a rather dense and beardy mass at the margin of the cap.

Flesh in cap very thin (± 0.5 mm) in centre, grey; in stem whitish (grey in base). At the apex of the cap granular veil and flesh about equally thick.

Smell none.

MICROSCOPICAL CHARACTERS. — Spores ellipsoid in all planes running through the longitudinal axis (adaxially not flattened!), apex rounded, base narrowing and elongated, passing gradually and without clear delimitation into a broad ($\pm 1 \mu$) and rather long ($0.5-0.9 \mu$) apiculus lying in the longitudinal axis of the spore, $9-12.6 \times 5.4-6.3 \mu$, apical germ-pore very distinct (diam. $\pm 1.8 \mu$), reddish-brown to brown



Figs. 9—14

(M. 5 YR 3/4, 4/4, 5/4), as a rule sub-opaque or translucent, sometimes opaque. Perispore strongly developed, light brown to light olive-brown in NH_4OH 10%, present in all spores, surrounding them entirely, 0.5–2 (–2.5) μ thick, outlines erratic and undulating, a number of blackish dots and short thick lines on the surface of the spore.

Basidia 4-spored; dimorphic, 20.8–33.6 \times 8–10 μ and thickset basidia, 16–20 \times 8–10.4 μ .

Facial cystidia fairly few to fairly numerous, of variable shape, many constricted or very slightly so below a distinctly to barely swollen apex, therefore more or less utriform, thin-walled, rarely slightly thick-walled (sometimes some cystidia with a flattened and thick-walled top), with a very short and narrow stalk, 65–120 \times 22.5–40 μ .

Marginal cells closely packed, vesiculose, globose to slightly elongate or ovoid, colourless, thin-walled, spheropedunculate with short, narrow stalks, 30–75 \times 20–45 μ ; among them a small number of longer cells, 55–120 \times 20–45 μ , resembling the facial cystidia. On top of the marginal cells isolated or in small groups or in irregularly interwoven networks a number of thin hyphae, 1.6–6.4 (–11.2) μ , increasing in number towards the margin of the cap and bearing small blunt protuberances.

Universal veil on the cap consisting of a great number of \pm globose, sometimes slightly elongate, vesiculose, thin-walled spherocytes, 32–96 μ , with very short and narrow stalks; and inconspicuous, branching, thin hyphae, 1.6–6.4 (–11.2) μ , bearing a number of fairly blunt protuberances. Spherocytes moderately densely covered with fairly thick diverticula, 0.9–1.8 (–2.7) μ long. Few or very few scattered spherocytes covered with only just a few diverticula. Wall of the spherocytes often slightly brown, especially towards the apex of the cap. Veil on the stem consisting of a dense network of hyphae like those of the veil on the cap, but also hyphae up to 20.8 μ thick. Hyphae sometimes slightly brown (membrane-pigment) and the network comprising only few spherocytes, identical with those on the cap. No clamp connections seen. No crystals or mucilaginous deposits on either hyphae or spherocytes.

HABITAT. — On greasy (greasy owing to thin film of mud and algae) and moss-covered horizontal cut surfaces of trunks of conifers and deciduous trees, cut close to the ground, often attached to the moss.

COLLECTIONS EXAMINED. — Denekamp, on the following areas of the Estate 'Singraven': 'Beugelskamp,' 5 Aug. 1961, 28 Oct. 1961, 26 Oct. 1962, *E. Kits van Waveren* (KvW); Park near Castle, 17 Oct. 1962, *E. Kits van Waveren* (KvW); 'Het Harseveld,' 1 Oct. 1965, *E. Kits van Waveren* (holotype, L, some 30 specimens); 'Het Nieuwe Werk,' 7 Oct. 1966, *E. Kits van Waveren* (KvW); Boekelo, Riding School near Landsteiner road, 26 July 1968, *E. Kits van Waveren* (KvW); Leusden, Estate 'De Treek,' 26 Oct. 1963, *E. Kits van Waveren* (KvW); 's-Graveland, Estate 'Boekesteyn', 3 Aug. 1968, *J. Daams* (KvW); Santpoort, Estate 'Duin en Kruidberg,' 13 Nov. 1962, *E. Kits van Waveren* (KvW).

OBSERVATIONS. — *Coprinus laanii* is a very characteristic species. By the shape of the base of the spore and the strongly developed perispore it differs distinctly from *C. stercorarius*, *C. velox*, and *C. martinii*, and belongs to the group of *C. narcoticus*,

EXPLANATION OF FIGURES 9–14

Figs. 9–14. Sporograms. — 9. *C. narcoticus* (Ommen, 'Ada's Hoeve', 29 Sept. 1965). — 10. *C. laanii* (Denekamp, 'Singraven', 5 Aug. 1961). — *C. velox* (Over-Asselt, 'Boonenhof', 17 Sept. 1965). — 12. *C. cinereofloccosus* (type). — 13. *C. stercorarius* f. *stercorarius* (Denekamp, 'Singraven', 18 May 1964). — 14. *C. martinii* (type). (All figs., \times 1212).

C. radicans, and *C. cinereofloccosus*. From these species it differs clearly in that its spores are ellipsoid in all planes running through the longitudinal axis, there being no flattened adaxial face. *Coprinus laanii* lacks the characteristic smell of *C. narcoticus* and *C. radicans*, and it has a very characteristic habitat (cut surfaces of trees). It is the only species in this group of which the majority of the facial cystidia are more or less utriform.

Through the courtesy of Dr. R. Watling we were able to examine a small piece of a cap of one of the specimens, found on 7 May 1966 in Buttercrambe Wood, Yorkshire, and recently described (1967: 47) and depicted. The spores are in every way typical of *C. laanii* and the specimens grew "on moss on old stump," so that there is not the slightest doubt about identifying this find as *C. laanii*. Watling's description is in full agreement with this diagnosis; he designated the specimens as *Coprinus* aff. *martinii*.

We have named this species after the late Mr. W. F. J. Laan, until his death on 17 July 1966 owner of the 'Singraven' Estate and himself a very keen dendrologist. We received his permission to do this at Easter 1966.

4. *COPRINUS CINEREOFLOCCOSUS* Orton

Coprinus cinereofloccosus P. D. Orton in Trans. Br. mycol. Soc. 43: 198. 1960.

CHIEF CHARACTERISTICS. — Comparatively large species; young, unexpanded cap 11–22 mm high, 8–20 mm broad; smell none; spores $12.2\text{--}13.5 \times 5.4\text{--}6.3 \mu$; base of spore narrowing and elongated, passing gradually and at a fairly distinct angle into a large excentric apiculus; perispore very conspicuous; basidia 2-spored.

MACROSCOPICAL CHARACTERS (Orton's description). — Cap at first ellipsoid or acorn-shaped, 11–22 mm high, 8–20 mm broad, then expanding, \pm plane 10–38 mm, pale greyish or grey-clay, sometimes darker grey in centre, entirely grey floccose-mealy at first often with denser mealy-floccose scales at centre which are sometimes tinged dirty ochraceous, later more scattered floccose-mealy and sometimes becoming radially plicate-sulcate, margin splitting radially and becoming revolute.

Gills free or very narrowly adnate, white, soon whitish, then black, \pm lanceolate, crowded, edge white flocculose at first.

Stem 25–50 \times 2–4 mm before cap expands, then 50–100 (–150) \times 2–6 mm, \pm equal or attenuated at apex, white or whitish to pale grey, entirely white or pale grey mealy-pruinose or silky, hollow, base with darker denser meal than on cap, sometimes also with thick mycelial strand.

Flesh thin except at cap centre, greyish, hyaline-grey in stem.

Smell none.

MICROSCOPICAL CHARACTERS (own examination of the type material). — Spores ellipsoid, adaxially flattened, apex rounded, base narrowing and elongated, passing gradually and at a fairly distinct angle into a broad ($\pm 1\mu$) and long (0.5–0.9 μ) excentric apiculus on the adaxial face, $12.2\text{--}13.5 \times 5.4\text{--}6.3 \mu$ [Orton 11–13 (–15) \times 5.5–7 μ], dark reddish-brown (M. 2,5 YR 3/4; 10 R 3/4) opaque, apical germ-pore very distinct ($\pm 1.8\mu$ diam.). Perispore very conspicuous, always present, surrounding the spores entirely, outlines moderately undulating, 0.5–2 (–2.5) μ thick, light brown in NH_4OH 10 %, no blackish dots and short lines on the surface of the spore.

Basidia 2-spored; dimorphic, $22.4\text{--}32 \times 8\text{--}9.6 \mu$ and thickset basidia, $16\text{--}22.4 \times 8\text{--}9.6 \mu$.

Facial cystidia fairly numerous, 2 types: the one ellipsoid-ovoid ($70-110 \times 30-40 \mu$), the other short ovoid almost round ($50-70 \times 30-40 \mu$), with rather long stalk, colourless, cell-wall not thin but of normal thickness (practically all cells were intact), no mucus or crystals.

Marginal cells closely packed, more or less globose to slightly elongate, ovoid or clavate, spheropedunculate, vesiculose, thin-walled, colourless, $30-60 \times 15-40 \mu$ with fairly short stalk, no mucus or crystals. Here and there on the marginal cells a few thin ($3.2-6.4 \mu$) hyphae with short blunt protuberances.

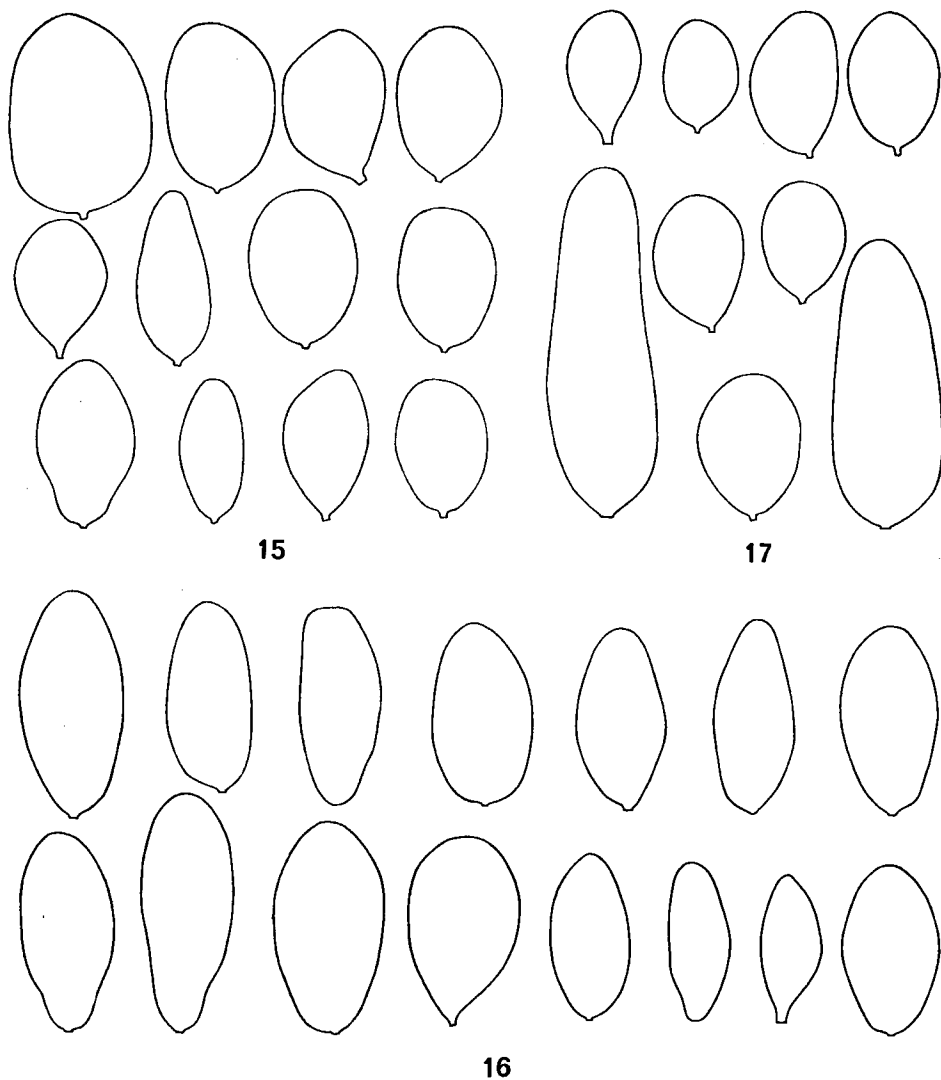
Universal veil on the cap consisting of numerous globose to slightly elongated, thin-walled and often light brown spherocytes, $30-80 \mu$, more or less densely covered with small diverticula, $0.5-0.9 (-1.4) \mu$ long and inconspicuous branching, thin hyphae, $1.6-6.4 (-8) \mu$, bearing blunt protuberances. Veil on the stem consisting of branching hyphae similar to those of the veil on the cap, forming a dense network, containing only few spherocytes, identical with those on the cap.

HABITAT. — In grass on lawn, on soil and on ashy soil (Orton).

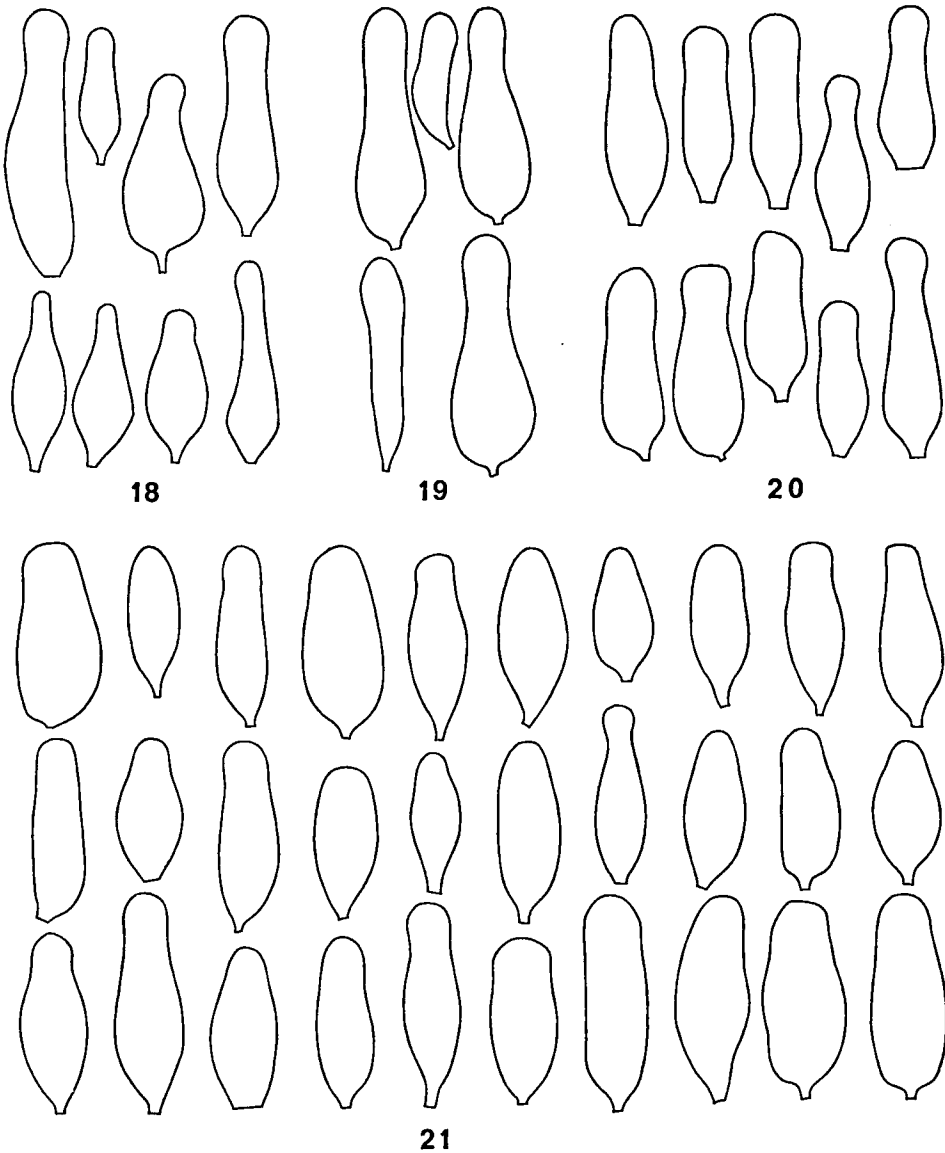
COLLECTIONS EXAMINED. — England, Rothamsted, Herts., The Manor, 8 Nov. 1958 (type, K).

OBSERVATIONS. — Orton (1960: 198) described the basidia as 4-spored, but we found the basidia of the type specimens distinctly 2-spored. If—as may well be the case—a 4-spored form exists, it is to be expected that its spores will be smaller.

According to Orton (l.c.) this species is easily distinguished from *C. narcoticus* and *C. radicans* by the absence of any smell and “it differs from *C. stercorarius* [= *C. cinereatus* with Orton] in larger spores, more coarsely mealy cap and perhaps presence of bladder-shaped cells at the base of the stem.” However, the larger size of the spores may be due to the basidia being 2-spored. Earlier (p. 140) we pointed out that in several species of the ‘stercorarius group’ and particularly in *C. martinii* we came across unusually large (“bladder-shaped”) cells in the veil (particularly on the stem), bearing only a few diverticula. Although we ourselves failed to find these cells in the type specimens of *C. cinereofloccosus*, Orton no doubt did see them. Orton already expressed doubts as to whether these cells are specific for *C. cinereofloccosus* and as stated earlier, we believe the taxonomic significance of these cells to be nil. The only difference between *C. cinereofloccosus* and *C. stercorarius* (particularly its 2-spored form!) would then be the “more coarsely mealy cap” of the former. In our opinion it is too hazardous to let this dubious character be the sole means of distinguishing between *C. cinereofloccosus* and the 2-spored form of *C. stercorarius*. Fortunately there is a far better way of distinguishing these two species. The spores of *C. cinereofloccosus* are of the same type as those of *C. narcoticus* and *C. laanii*, i.e. the base of the spore narrows into an elongation that passes gradually into a large apiculus and the perispore is very distinct. The spores of *C. stercorarius* on the contrary have a rounded base, a very small apiculus and a perispore which is very much less in evidence. Although Orton in his description of *C. cinereofloccosus* calls the perispore “rather thin,” he gave the thickness of the spores without the perispore as $5.5-7 \mu$ and with the perispore as $7-8.5 \mu$! His Figure 247, depicting the spores of *C. cinereofloccosus*, also shows a very distinct perispore indeed, comparable to the perispore of *C. narcoticus*! So that, even if a 4-spored form of *C. cinereofloccosus* should occur, the char-



Figs. 15-17. Pleurocystidiograms of *C. narcoticus*. — 15. Delfgauw, 5 Nov. 1953. — 16. Kortenhoef, 14 Oct. 1957. — 17. Ommen, 'Ada's Hoeve', 29 Sept. 1965. (All figs., $\times 288$).



Figs. 18–21. Pleurocystidiograms of *C. laanii*. — 18. Denekamp, 'Singraven', 28 Oct. 1961. — 19. Denekamp, 'Singraven', 7 Oct. 1962. — 20. holotype, 1 Oct. 1965. — 21. Leusden, 'De Treek', 26 Oct. 1963 (All figs., $\times 288$).

acters of the spores would still make it quite easy to distinguish it from *C. stercorarius*.

Neither Orton (l.c.) nor we saw on the surface of the spores of *C. cinereofloccosus* the blackish dots and short thick lines which are so characteristic in *C. narcoticus* and *C. laanii*.

C. cinereofloccosus is easily distinguished from the equally non-smelling *C. laanii* by its different habitat, the spores having a flattened adaxial face, the excentric apiculus and the absence of utriform facial cystidia.

This species has not yet been recorded for the Netherlands.

5. COPRINUS VELOX Godey

Coprinus velox Godey *apud* Gillet, Champ. Fr., Hym. 614, 1878.

Coprinus evanidus Godey *apud* Gillet, Champ. Fr., Hym. 614, 1878.

Coprinus velox var. *stenosporus* Svrček in Česká Mykol. 10: 176, 1956.

MISAPPLIED NAMES:

Coprinus stercorarius Fr. *sensu* Kühn. & Romagn., Fl. anal. 385, 1953.

Coprinus stercoreus Fr. *sensu* Watling in Notes R. bot. Gdn. Edinb. 28: 48, 1967.

EXCLUDED:

Coprinus velox Godey *sensu* Locquin in Bull. Soc. mycol. Fr. 63: 84, 1947.

Coprinus velox Godey *sensu* Horak in Z. Pilzk. 28: 19, 1962.

SELECTED DESCRIPTIONS AND ILLUSTRATIONS. — J. E. Lange, Fl. agar. dan. 4: 114, pl. 159 fig. C. 1939; Wichanský in Česká Mykol. 20: 32, 1966.

CHIEF CHARACTERISTICS. — Very small and in the early stages white species; young, unexpanded cap 0.3–6 mm high, 0.3–3 mm broad; veil on cap mealy-pulverulent but also—particularly in larger specimens—distinctly flocculose-woolly-hairy; distinct smell of gas (usually only perceptible if 2–4 caps are squeezed); spores (5.4–) 6.3–7.7 (–8.1) × (3.2–) 3.6–4.1 (–4.5) μ ; base of spore rounded, apiculus very small; perispore only very slightly developed, usually absent; exclusively on dung.

MACROSCOPICAL CHARACTERS. — Cap at first ellipsoid, globose-ellipsoid, cylindrical-ellipsoid or cylindrical, sometimes obovoid, 0.3–6 mm high, 0.3–3 mm broad, white. Surface of cap covered with a thick woolly coating (veil), consisting of a dense layer of hyaline, whitish granules, mixed with a woolly-hairy mass of fibres particularly prevailing at and near the margin of the cap, where—in very young specimens—they connect the margin of the cap with the stem, running down the latter. Often and particularly in the larger specimens, the fibres take a dominating share in the composition of the coating, making it woolly-hairy, also in the upper half of the cap which then becomes flocculose, scaly and even covered with perpendicular hairs and bundles of fibres sticking out like spines. Many specimens, however, remain very small (caps 0.3–2 mm high, stems 5–25 mm long) and in these the fibrous share in the veil on the cap usually develops to a much lesser extent, the coating being thin, predominantly granular-mealy-pulverulent and devoid of pointed hairy flocci, scales, and spines. As the carpophores ripen some fibres and an ever increasing number of spherocytes become brown, particularly towards the apex of the cap, the white colour of the cap accordingly changing gradually to brown (M. 10 YR 7/2). In all specimens the velar granules moreover cluster increasingly towards the apex (in some much more so than in others) forming warty, light to very dark brown lumps, from which fibres may stick out. As the carpophores and spores ripen the white colour changes to light grey (M. 10 YR 7/1), under the veil, however, the cap surface then being grey to very dark grey (M. 10 YR 6/1, 5/1, 4/1, 3/1) and strongly striate. On expanding the cap be-

comes campanulate to conico-campanulate, 1.5–4 mm high, 1–3 mm broad, finally plane, diameter 1–8 mm, and strongly striate with black grooves, the ridges between the grooves remaining mealy-pulverulent, light grey (M. 2.5 Y 7/0), towards the apex slightly brown (M. 2.5 Y 7/2; 10 YR 7/2, 5/2), bearing some remaining brownish lumps. In the old stages the woolly-hairy veil largely disappears, leaving a rather smooth surface, the cap splitting radially, the margin usually becomes revolute; both under and upper surface of the cap in the final stages dirty greyish to brownish-grey (M. 10 YR 8/1, 7/1).

Stem 5–65 × 0.1–0.75 mm, within the young and still closed cap tapering towards the apex, outside this cap cylindrical, white with only the extreme base grey and slightly swollen, hollow, as a rule non-rooting, very minutely striate under a thick woolly-hairy white coating—particularly at the base—of white and ultimately isabelline fibres and groups of fibres, comprising comparatively few hyaline granules, in ripe specimens filiform, tapering very gradually from base upwards, along its entire length sparsely covered with white hairy fibres.

Gills lanceolate, 0.5–1 mm broad, strongly ascending, free, white at first, then via brown quickly becoming black, finally deliquescent. Gill edge white, connected with the stem by a very thin film of minute white hairs forming a denser hairy mass at the margin of the cap.

Flesh in cap very thin, visible only in the centre of sections of young specimens, grey (M. 10 YR 6/1, 5/1) both in cap and uppermost part of the stem, whitish in the remainder of the stem but grey in the base.

Smell of gas, but in single specimens only noticeable when these are large, in small specimens only when some 2–4 caps are squeezed.

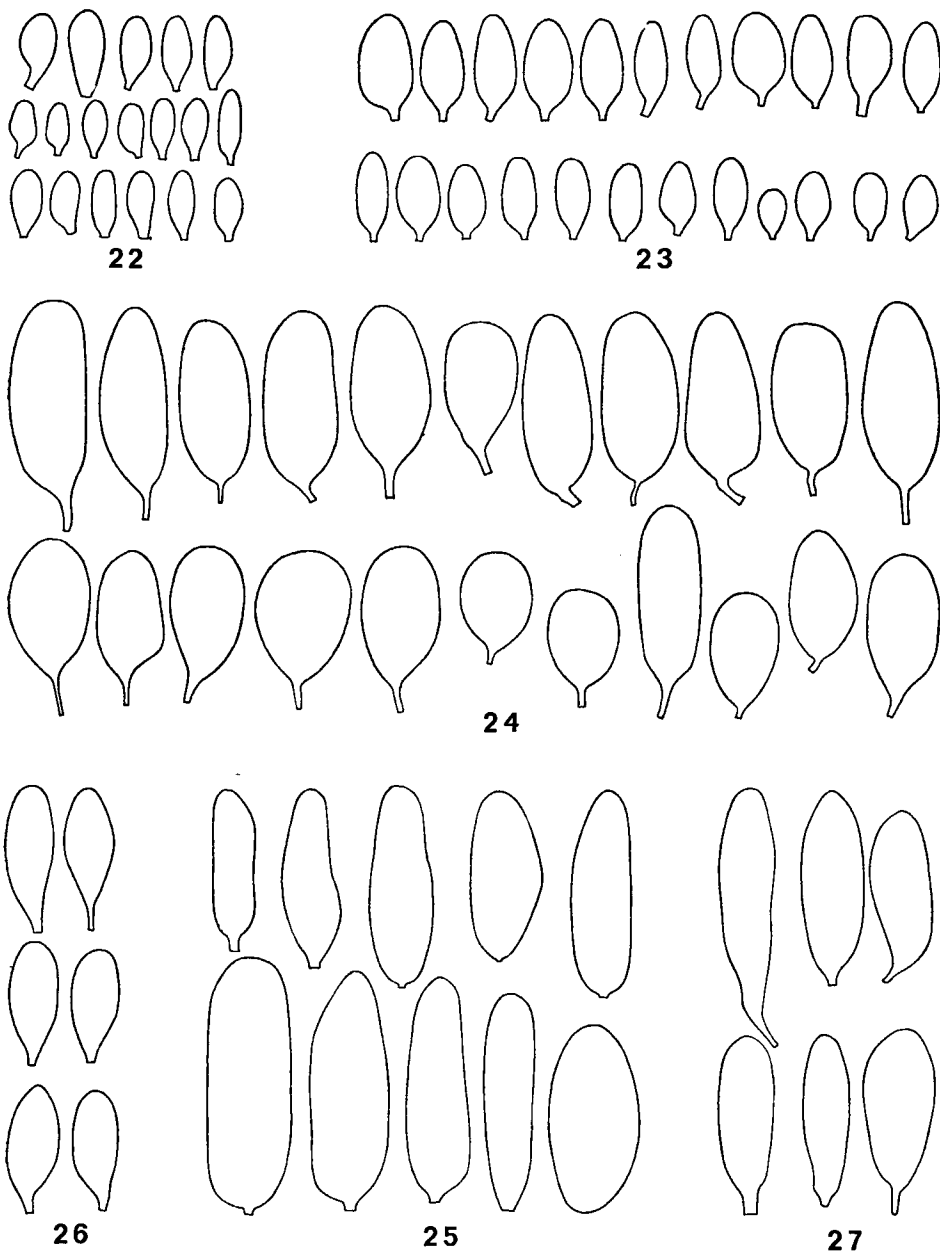
MICROSCOPICAL CHARACTERS. — Spores ellipsoid, ellipsoid-ovoid, often phaseoliform or subcylindric (!), adaxially flattened or even slightly concave, (5.4–) 6.3–7.7 (–8.1) × (3.2–) 3.6–4.1 (–4.5) μ , brown to reddish-brown (M. 5 YR 4/4, 3/4; 2.5 YR 3/6), opaque, wall relatively thick. Apical germ-pore distinct, very slightly to distinctly excentric towards the adaxial face, 0.9–1.4 μ diameter. Apiculus very small, excentric on the adaxial face. Perispore usually absent, but some (and sometimes quite a few) ripe spores gathered from the gills show a perispore either as droplets or frills or as thin colourless deposits on small or larger parts of the surface of the spore, rarely along the entire wall, 0.3–0.5 μ thick, in places up to 1 μ .

Basidia 4-spored; dimorphic, 12.8–19.2 × 5.6–7.2 μ , and stout basidia, 9.6–12.8 × 5.6–7.2 μ .

Facial cystidia fairly numerous, ovoid or ellipsoid-ovoid, 30–50 × 15–25 μ , colourless, cell-wall rather firm, consequently cells rarely bruised or collapsed, stalks quite distinct, no mucus or crystals. Facial cystidia always present on white gills of young specimens but then smaller, 20–35 × 10–14 μ , and of more variable shape, ellipsoid, ellipsoid-ovoid, ovoid, cylindrical, clavate.

Marginal cells densely packed, thin-walled, globose to slightly elongate, often irregularly shaped, vesiculose, spheropedunculate, colourless, 20–35 × 10–25 μ , with short and broad stalk. Among them a few clavate cells or cells resembling the facial cystidia. No mucus or crystals. On the surface of these cells, either isolated or in small groups or even networks, a number of branching, irregularly-shaped, thin hyphae, 1.6–4.8 (–6.4) μ , with fairly numerous, short, blunt, and a few narrow diverticula-like protuberances. No clamps seen.

Universal veil on the cap consisting of great numbers of spherocytes, but also of a rather large number of hyphae. Spherocytes globose to slightly elongate, 32–72 (–88) μ (the majority 32–48 μ , in young or small specimens practically all spherocytes 20–40 μ), thin-walled, colourless or slightly brown, densely covered with small diverticula, 0.5–0.9 (–1.4) μ long, rarely up to 1.8 μ , stalks very short and narrow. Some spherocytes covered with only few or very few diverticula or none at all or with



Figs. 22–27. Pleurocystidiograms. — 22–23. *C. velox* (22: from young specimen, Vorden, 12 Sept. 1958; 23: Elspeet, 26 March 1966). — 24. *C. cinereofloccosus* (type). — 25–27. *C. stercorarius* f. *stercorarius* (25: Leiden, 30 July 1954; 26: Hilversum, 'Gooilust', 20 July 1963; 27: Denekamp, 'Singraven', 18 May 1964). (All figs., $\times 288$.)

diverticula only on part of their wall. Among the spherocytes many thin, branching hyphae $1.6-4.8$ (-11) μ , with blunt and a few diverticule-like protuberances but also a fair number of thicker ($11.2-32$ μ) hyphae without protuberances, particularly near the margin of the cap and especially in the larger specimens with strongly developed veil. Veil on the stem consisting of a network of rather broad and fewer thin ($1.6-4.8$ μ) hyphae, the latter with blunt protuberances. The network comprises few spherocytes, identical with those of the veil on the cap. Rarely large numbers of small mucilaginous droplets on spherocytes and hyphae of the veil on the cap (collection of 5 July 1963). No clamps seen.

HABITAT. — On dung of cow, horse, sheep, rabbit, deer, also found on excrements of large birds, fairly common.

COLLECTIONS EXAMINED. — Vorden, 12 Sept. 1958, *E. Kits van Waveren* (KvW); Denekamp, Estate 'Singraven', area 'Het Harseveld', 5 July 1963, *E. Kits van Waveren* (KvW); Elspeet, 26 March 1966, *J. van Brummelen* (for many weeks fresh specimens were collected, KvW); Aerdenhout, 'Oranjekom', dunes of Amsterdam municipal waterworks, 24 Sept. 1957, *E. Kits van Waveren*, (L); Overveen, cemetery, 27 Jan. 1958, *J. van Brummelen* 633 (L); Leiden, 21 May 1958, *C. Bas* 1433 (L); Over-Asselt near Mook, meadow of farm 'Boonenhof', 5 July 1963, 17 Sept. 1965, *E. Kits van Waveren* (KvW); GREAT BRITAIN (Wales): meadow alongside Bala road at north east end of Lake Vyrnwy, 10 Sept. 1967, *E. Kits van Waveren* (KvW); meadow on grounds of Lake Vyrnwy Hotel, at southern end of Lake Vyrnwy, 17 Sept. 1967, *E. Kits van Waveren* (KvW); meadow alongside road from Llanwddyn to Cuddig, 21 Sept. 1967, *E. Kits van Waveren* (KvW).

OBSERVATIONS. — From our macroscopical description it is clear that in *C. velox* a great variability may and indeed does arise in the features of the texture of the young and ripening caps and their colour (far more so than in the other species of the 'stercorarius group'). Depending both on their ultimate size and ripeness the caps can be very white or whitish to definitely brown (apex!) or grey and either merely mealy-pulverulent (small specimens) or conspicuously woolly-hairy (large specimens), but they can also be chiefly light grey to grey (older specimens) and then either mealy-pulverulent or predominantly woolly-hairy and in all these cases the caps are dotted to a greatly varying extent with brownish flocculose warts towards the apex. Sometimes a find consists exclusively of very small white to grey specimens with merely a thin mealy-pulverulent coating with hardly any brownish warts.

In the descriptions of *C. velox* by Godey (apud Gillet, 1878: 614), Lange (1939: 114), Wichanský (1966: 32), and Watling (1967: 48, "*Coprinus stercoreus*") no smell is mentioned, but Watling on the other hand did state that his "material agreed in all respects with *C. stercorarius* as outlined by Kühner & Romagnesi, 1953," who do mention the smell. Our own notes only record a "strange smell" for the find of 5 July 1963, but up till 1966, when we started studying the species of the 'stercorarius group', we never practiced squeezing a number of caps in order to test the smell. While studying our Elspeet material, it appeared that no smell could be detected by trying just one specimen, not even after it had been squeezed, unless it was large. At least 2-4 small caps must be squeezed in order to smell the very characteristic odour of gas. It is therefore not in the least surprising that this smell escaped Godey, Lange, Wichanský, and possibly Watling, like it previously had escaped us.

Kühner & Romagnesi (1953: 385) who evidently examined the larger specimens (strongly developed veil!) did notice the smell "au froissement."

Our finds of 12 Sept. 1958, 5 July 1963, and 17 Sept. 1965 consisted exclusively of very small specimens of *C. velox*. All caps were rather smooth and certainly not "grossièrement hérissé de flocons saillants" (Kühner & Romagnesi, 1953: 385), so that at the time these specimens were not identified as *C. stercorarius* sensu Kühn. & Romagn. even though the spores corresponded exactly with Kühner & Romagnesi's description. It was not until we were able to study the very abundant material from Elspeet (26 March 1966) that it became quite clear that there is every possible stage of transition between *C. velox* as described by Lange (1939: 114) and *C. stercorarius* sensu Kühn. & Romagn.

Only one specimen from the Elspeet collection had a rooting stem and some of the specimens of the find of 21 May 1958 also had a conspicuous root (see Fig. 6, a drawing made at the time by Mr. C. Bas). In the literature a rooting stem had never been mentioned until Wichanský (1966: 32) depicted two specimens having a very distinct root.

Elongated inflated spherocyte-like cells, very sparsely covered with diverticula (Fig. 45) were found within the dense woolly veil at the base of the stem only in the collection of 12 Sept. 1958. Watling (1967: 48) also mentions the presence "at the edge of the pileus and base of the stipe of a few bladder shaped cells 50–100 \times 15–20 μ ."

On 22 August 1964 Wildervanck (1965: 18) found this species on excrements of large birds in reed in the nature reserve 'Westerbroek' near Hoogezaand, as is clear from his description.

Coprinus velox was described by Godey together with another tiny species, *Coprinus evanidus* Godey, both found on dung in Normandy, which he believed to be very closely related. Both species are depicted on Pl. 175 of Gillet's 'Tableaux analytiques' (1898), and in Gillet's key to the species of the genus *Coprinus* they adjoin. The colour of the cap seems to have been the main, if not only, real difference between the two species: the cap of *C. velox* was "entièrement gris," that of *C. evanidus* "blanchâtre avec une tache noire au sommet" (but "blanchâtre, disque avec une tache brune" in the 'Tableaux'). No microscopical characters were given.

J. E. Lange (1915: 44), believing Godey's description of *C. velox* to fit adequately—as indeed it does—with the species he described in 1915 and which is clearly the same species we have just described, applied the name *C. velox* to this species and added the chief microscopical characters: "cells on surface of cap globular, warty, 24–40 μ diameter" and spores "ellipsoid, $7\frac{3}{4}$ –9 \times 4 $\frac{1}{2}$ μ , dark brown." Later Lange (1939: 114) again described this species and also depicted it (Pl. 159 fig. C) and both his description and his pictures fully correspond with our collections of this species, particularly with the numerous very small specimens with little developed and barely fibrous veil of the material from Elspeet (26 March 1966): "cap pallid-greyish, mealy and somewhat furfuraceous on the disc." One young and larger specimen of his pictures, however, distinctly shows a dense coating with a hairy veil

and this specimen thus corresponds exactly with the far less numerous larger specimens of our Elspeet collection, having a strongly developed floccose-woolly-hairy veil. It also corresponds exactly with Kühner & Romagnesi's (1953: 385) description of their *C. stercorearius*: "chapeau d'abord bien blanc, puis à peine cinérascent sous le voile, grossièrement hérissé de flocons saillants formés de sphérocytes avec un pinceau filamenteux à leur extrémité (au moins pour les flocons non centraux)."

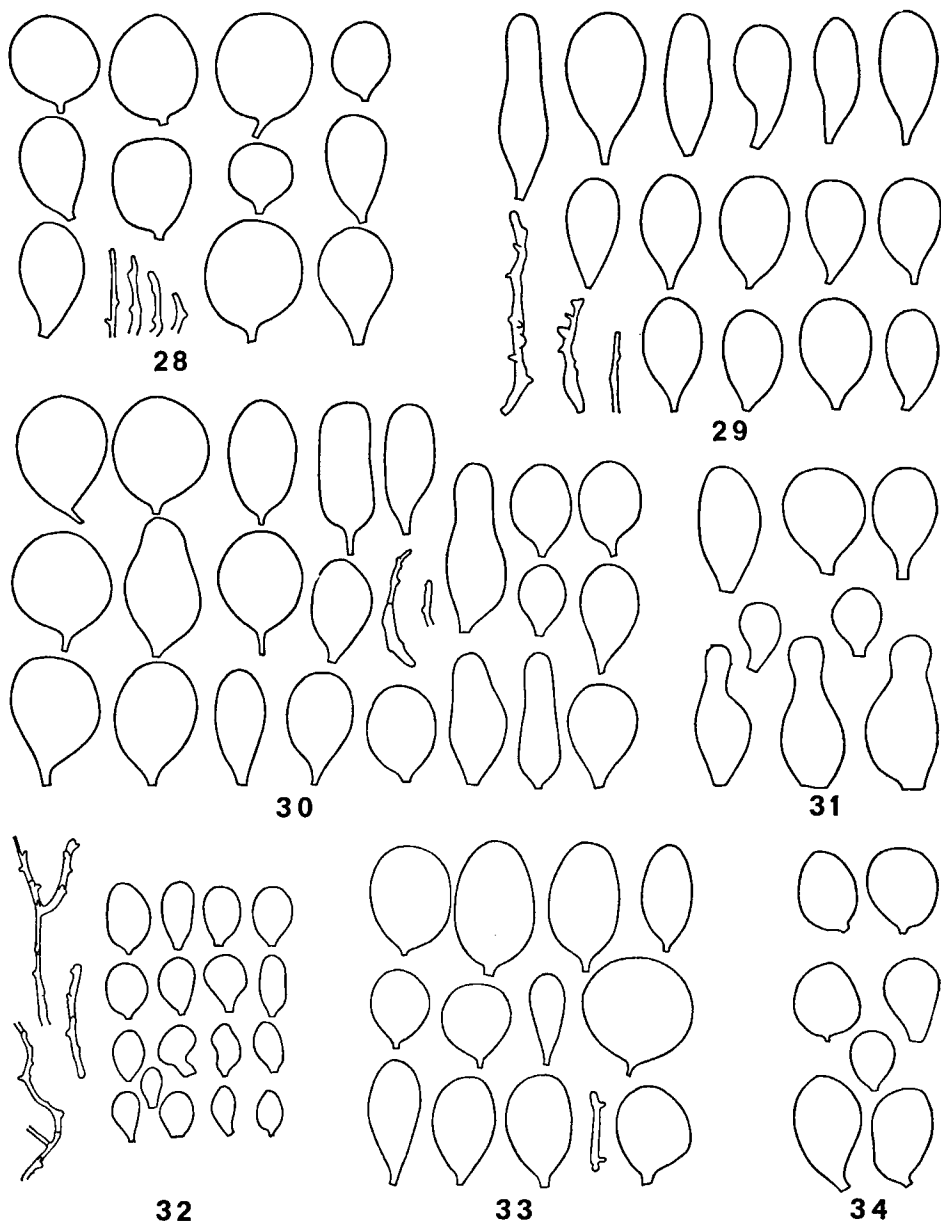
Our Elspeet material appeared to contain all transitional stages between very small specimens with fairly smooth, subfurfuraceous caps (= *C. velox* as described by Lange) and larger specimens with floccose, hairy-scaly veil on both cap and stem (= *C. stercorearius* as described by Kühner & Romagnesi). The spores of both forms are, as was expected, exactly the same: $7\frac{3}{4}$ –9 \times $4\frac{1}{2}$ μ (Lange), 7–8 \times 4–4.2 μ (Kühner & Romagnesi), 6.3–7.7 \times 3.6–4.1 μ in our own material. Lange found the spherocytes to be small (24–40 μ) and in our own material also most spherocytes were strikingly small in comparison with the spherocytes of the other species of the 'stercorearius group'.

The discussion on the correct nomenclature of *C. velox* is thus very closely linked with the discussion on the nomenclature of *C. stercorearius*, to which we refer (see p. 170). As Fries (1838: 251) had already given the name *Coprinus stercorearius* (or rather 'stercoreus') to another and quite different species, the name *Coprinus velox* should, in accordance with Lange be used for the species we have just described. Romagnesi (1941: 20–36) included this species as *C. velox* sensu Lange in his key (no descriptions!) to the species of the genus *Coprinus*. But in their 'Flore' Kühner & Romagnesi (1953: 385) no longer mention the name *C. velox*, not even in the Index, and the species is called *C. stercorearius*. They were the first authors to mention the 'narcoticus'-smell. Moser (1955: 247) took up *C. velox* in his key, referring to Lange's Plate 159 C, but in the new edition (1967: 209) in accordance with the 'Flore' *C. velox* is no longer mentioned, the species being named *C. stercorearius* (Bull.) Fr. sensu Kühn. & Romagn. In the New British Check List (1960: 41) *C. velox* Godey apud Gillet 1874 sensu Lange is listed with reference to Lange's Plate 159 C. Curiously enough this species was not included in Orton's (1960: 198) key to the species of the 'narcoticus group', to which it obviously belongs. Watling (1967: 48) calls the species *C. stercoreus* Fr.

Coprinus velox Godey sensu Locquin (1947: 84) is a totally different species. The structure of the surface of the cap is hymeniform, there are setulae on the cap, which is covered with a veil, composed of a network of very thin hyphae, bearing masses of smooth spherocytes, without crystals or diverticula. Accordingly Kühner & Romagnesi (1953: 391, note 2) mention Locquin's species in relation to the 'Setulosi group' of *Coprinus* (*C. heptemerus* M. Lange & Smith).

Coprinus velox Godey sensu Horak (1962: 19) is yet another interpretation of Godey's *C. velox*. It has caulocystidia and pilocystidia (the latter up to 80 μ long), so that this species also belongs to the 'Setulosi group'.

C. velox var. *stenosporus* Svrček (1956: 176). Wichanský very kindly sent us German translations of his own article (1966: 32) on *C. velox* and of Svrček's article (1956:



Figs. 28–34. Cheilocystidiograms (and a few irregularly-shaped hyphae) — 28. *C. narcoticus* (Ommen, 'Ada's Hoeve', 29 Sept. 1965). — 29–31. *C. laanii* (29: Denekamp, 'Singraven', 7 Oct. 1962; 30: Leusden, 'De Treck', 26 Oct. 1963; 31: holotype, 1 Oct. 1965). — 32. *C. velox* (Elspeet, 26 March 1966). — 33. *C. cinereofloccosus* (type). — 34. *C. stercorarius* f. *stercorarius* (Denekamp, 'Singraven', 18 May 1964). (All figs., $\times 288$.)

178) on *C. velox* var. *stenosporus*. He ends his own article by saying that Svrček's var. *stenosporus* differs from *C. velox* by its spores being narrower and its velar spherocytes having smooth walls. His translation of Svrček's article, however, states that the velar spherocytes are "evident und ziemlich feinwarzig." This is in full agreement with Svrček's Latin description of the spherocytes: "conferte minute verrucosis." The spore sizes, as given by Svrček, are " $6-8 \times 3.5-4 \mu$ (usually $7 \times 3.5-4 \mu$)" and these figures do not really differ from those given by Kühner & Romagnesi, Lange, Wichanský, Moser, Watling, and our own figures. At our request Svrček very kindly then sent us the type specimens for examination. We received an envelope on which was written: "Typus! No. 618407. Flora bohémica. *Coprinus stercorarius* Fr. sensu Kauffman = *C. stenosporus* Svr. = *C. velox* var. *stenosporus* Svr. Čes. Mykol. 10: 178, 1956." The envelope contained one small envelope with three pellets, one of which bearing a beautifully preserved specimen, the other two only remnants of specimens, and a second envelope with two very ripe and a few semi-ripe specimens. On microscopical examination these specimens turned out to be typical specimens of *C. velox*. We very carefully measured the spores and found their size to be $7.2-8.1 \times 3.6-4.1$ (-4.5) μ , this being in full agreement with the sizes given by Svrček himself and with those given by the various authors and our own figures for *C. velox*. We therefore regard Svrček's variety as identical with *C. velox*. Svrček curiously enough states in his article that the spores have no visible germ-pore, but we found the germ-pores of his type specimens very distinct, like they always are in *C. velox*.

6. COPRINUS MARTINII P. D. Orton

Coprinus martinii Favre in Bull. Soc. mycol. Fr. 53: 286. 1937 (nomen nudum, lacking Latin descr.).

Coprinus martinii P. D. Orton in Trans. Br. mycol. Soc. 43: 201. 1960.

SELECTED DESCRIPTIONS AND ILLUSTRATIONS. — Kühn. & Romagn., Flore anal. 386. 1953; Reid in Trans. Br. mycol. Soc. 38: 395. 1955.

CHIEF CHARACTERISTICS. — Medium size; young, unexpanded cap 5–22 mm high, 3–8 mm broad; smell none; growing on stems and debris of *Carex*, *Scirpus*, and *Juncus*; spores $13.5-15.3 \times 7.7-8.6 \mu$; base of spore rounded, small apiculus; perispore distinct but only slightly developed.

MACROSCOPICAL CHARACTERS (Orton's description). — Cap at first ovoid-cylindrical often elongated, 5–22 mm high, 3–8 mm broad, then expanded umbonate with revolute margin 8–15 mm, ashgrey, mealy-pulverulent becoming smooth and sulcate in outer part as cap expands.

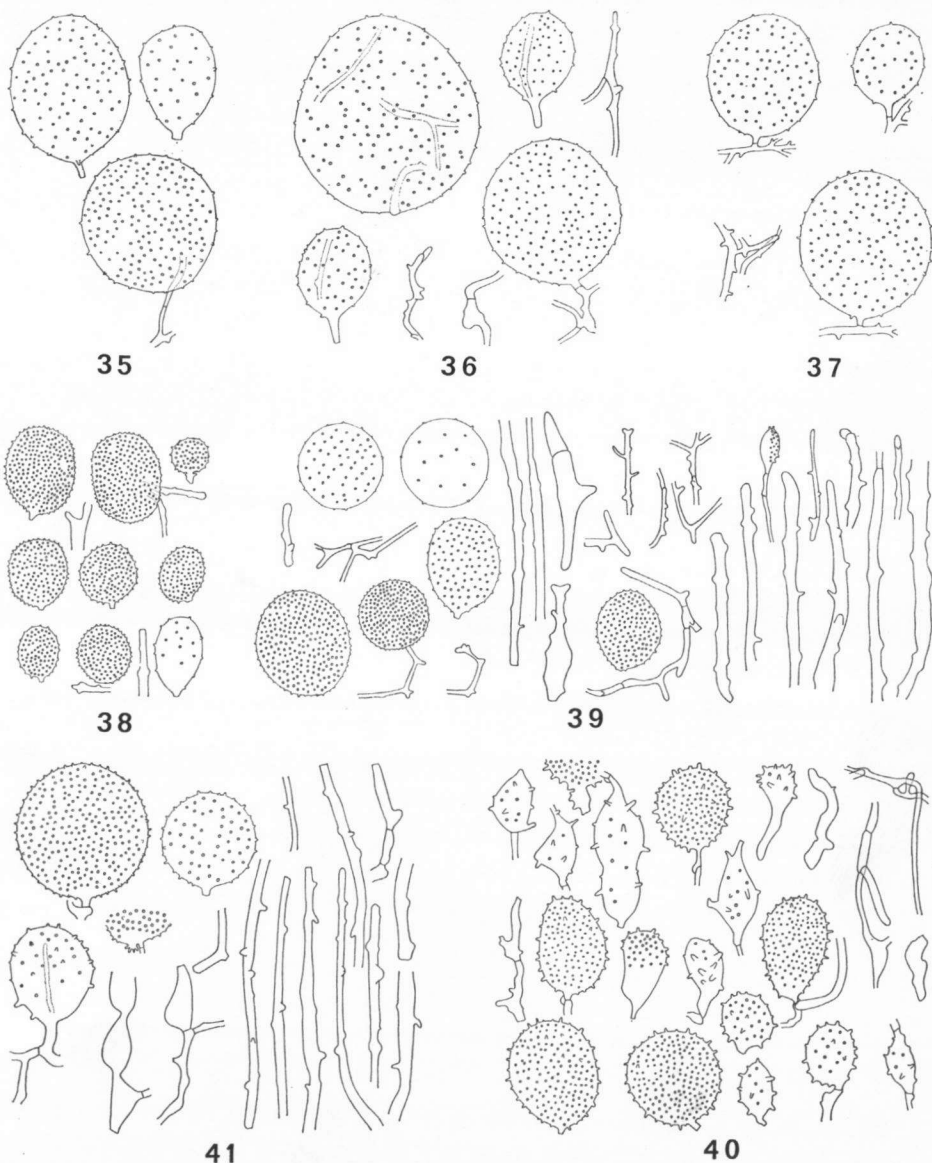
Gills free, grey then black, crowded, edge atomate-flocculose at first.

Stem 32–60 \times 1.5–2 mm (less than 5 mm at base), \pm thickened at base or attenuated upwards, pale grey, darker grey below when old, hyaline, minutely silky-fibrillose at first then smooth, base tomentose.

Flesh hyaline, white above, hyaline grey below.

Smell none.

MICROSCOPICAL CHARACTERS (own examination of the type material). — Spores ellipsoid-ovoid, adaxially flattened, apex and base both rounded, $13.5-15.3 \times 7.7-$



Figs. 35-41. Elements of the veil of the cap. — 35. *C. narcoticus* (Kortenhoeft, 14 Oct. 1957). — 36, 37. *C. laanii* (36: Denekamp, 'Singraven', 7 Oct. 1962; 37: Leusden, 'De Treck', 26 Oct. 1963). — 38, 39. *C. velox* (38: Over-Asselt, 'Boonenhof', 17 Sept. 1965; 39: Elspeet, 26 March 1966). — 40. *C. martinii* (type). — 41. *C. stercorarius* f. *stercorarius* (Hilversum, 'Gooilust', 31 July 1962). (All figs., $\times 288$.)

8.6 (–9) μ [Orton: 12–16 (–17) \times 6.5–8.5 μ], reddish-brown (M. 5 YR 3/4, 4/4) translucent, with distinct apical germ-pore (diameter $\pm 2 \mu$, according to Favre 1.5–2 μ). Perispore distinct but only slightly developed, on many spores seemingly absent, forming roundish or flattened droplets or frills with irregular outlines on top of the germ-pore and thin deposits with irregular outlines along parts of the surface of the spore, sometimes along the entire spore-wall.

Basidia 4-spored; dimorphic, 30.4–38.4 \times 8–9.6 μ , stout basidia 17.6–24 \times 8–9.6 μ .

Facial cystidia absent in the material examined, Orton (1960: 201) also having been unable to find them; according to Favre (1937: 286) numerous, elongated-ovoid or somewhat fusiform, up to 115 μ long.

Marginal cells absent in the material examined, Orton also having been unable to find them in spite of the fact that he described the gill-edge as “atomate-flocculose,” which indicates that the edge must have been lined with spherocytes like in all other species of this group. He merely quoted Favre (1937: 286) who recorded the presence on the gill edge of cells, similar to the facial cystidia and depicted “poils cystidiformes ovales-allongées ou subfusiformes” (in the text called cystidia) found both on the face and the edge of the gills.

Universal veil on the cap consisting of large numbers of thin-walled vesiculose, subglobose to slightly elongated, colourless or slightly brown spherocytes, 24–48 (–56) μ , with very short stalk, densely covered with rather long and rather thick diverticula, 1.8–2.7 (–3.6) μ ; and a fair number of branching, thin hyphae, 1.6–8 μ , with normal or slightly thickened cell walls, bearing a number of usually blunt protuberances. A few spherocytes are small and equipped with a few long, finger-like diverticula, up to 5.4 μ , and some of the hyphae show local inflations, 12.5–22.5 μ broad, with a few, up to 8 μ long and often also broad diverticula. Clamps present but very few in number. Veil on the stem consisting of a great many hyphae, identical with those on the cap, 1.6–8 μ wide, sometimes forming dense networks. In places many of these hyphae are irregularly inflated, 7.5–15 μ diam., bearing large, blunt protuberances and a few up to 8 μ long diverticula. At the base of the stem the veil contains many spherocytes identical with those of the veil on the cap, also a strikingly large number of spherocytes covered with large and blunt diverticula. Transitions between the latter spherocytes and the inflated hyphae occur.

HABITAT. — Cespitose on dead erect stems of *Carex* near the edge of ditches in peat, just above the surface of the water (Favre, 1937: 286); on *Carex*, *Scirpus*, and *Juncus* debris (Orton, 1960: 201); on stems of *Carex* or rotting debris of *Carex* in *Sphagnum* (Kühner & Romagnesi, 1953: 386). M. Lange (1955: 59) found specimens along the border of a lake in Greenland, deeply rooting in moss and, as he believed, probably on the leaves and stems of *Carex*.

COLLECTION EXAMINED. — GREAT BRITAIN: Sheffield, 9 Oct. 1954 (type, K).

OBSERVATIONS. — The spherocytes appear to be rather densely covered with diverticula and the diverticula seem to be slightly longer and usually also somewhat thicker than those of the spherocytes of the other species of this group. Neither Favre (1937: 286), nor Reid (1955: 395) nor Orton (1960: 201) mentioned this feature. One would have to study more material to ascertain whether these features are indeed characteristic of *C. martinii*.

Both in the veil on the cap and in the veil on the base of the stem we found a number of strikingly small spherocytes and furthermore greatly and often irregularly, locally inflated hyphae, bearing in these inflated areas a few strikingly long diver-

ticula (see Figs. 40, 49). Neither Favre, nor Reid or Orton mentioned these structures (compare p. 140).

Favre (1937: 286) distinguished "une forme terricole," growing on rotting debris of *Carex* in *Sphagnum*. This form grows less caespitose, it is larger (cap up to 25 mm high, stem up to 85 mm long) and apart from the facial cystidia described above, the gills have also slender and very long cystidia, up to 240 μ !

The apex of the cap of *C. martinii* is apparently more umbonate than in the other species of this group. Favre (1937: 395) mentioned and depicted the presence of a "mamelon" and Reid (1955: 395) spoke of a "central umbo."

Orton (1960: 201) believed this species to be closely related to *C. stercorarius* (= *C. cineratus* with Orton) and *C. narcoticus*. To our opinion the relationship obtains only for *C. stercorarius* as *C. martinii* has neither the 'narcoticus' type of spores, nor the characteristic smell. The characters of the spores mark the close relationship with *C. stercorarius*, from which species it is distinguished by the spore size and habitat.

Favre found this species for the first time and described it very accurately (1937: 286), but omitted a Latin description. Orton's description (1960: 201) included a Latin one and was based on material found and previously described by Reid (1955: 395); it corresponds in every way with that of Favre from which he took some of the details. However, he based the description on a different type from that of Favre's species, which automatically makes his species nomenclatively different from Favre's. The consequence of this is that the authors' citation should be P. D. Orton, not Favre ex P. D. Orton.

M. Lange (1960: 201) described this species from Greenland; like us he also noticed the presence of clamps (1955: 59).

Coprinus martinii has not yet been recorded for the Netherlands.

7. *COPRINUS STERCORARIUS* (Scop.) ex Fr.

Agaricus stercorarius Scop., Fl. carn., Ed. 2, 2: 427. 1772 (devaluated name); not *Agaricus stercorarius* Bull., Herb. Fr. pl. 88. 1781 (devaluated name); not *Agaricus stercorarius* Schum., Enum. Pl. Saell. 2: 286. 1803 (devaluated name). — *Coprinus stercorarius* (Scop.) ex Fr., Epicr. 251. 1838 ("stercoreus"); Summa Veg. Scand. 2: 298. 1849 ("stercoreus"); Monogr. Hym. Suec. 1: 467. 1857; Hym. europ. 330. 1874.

Agaricus stercorarius Bull., Herb. Fr. pl. 88. 1781 (devaluated name); not *Agaricus stercorarius* Scop., Fl. carn., Ed. 2, 2: 427. 1772 (devaluated name); not *Agaricus stercorarius* Schum., Enum. Pl. Saell. 2: 286. 1803 (devaluated name). — *Agaricus stercorarius* Bull. ex St-Amans, Fl. agen. 567. 1821; not *Agaricus stercorarius* Schum. ex Fr., Syst. mycol. 1: 291. 1821. — *Coprinus stercorarius* (Bull. ex St-Amans) J. E. Lange in Dansk bot. Ark. 2 (3): 44. 1915; not *Coprinus stercorarius* (Scop.) ex Fr., Epicr. 251. 1838.

Coprinus cineratus Qué. in Bull. Soc. bot. Fr. 25: 329, pl. 2 fig. 7. "1876" [1877].

Coprinus tuberosus Qué. in Bull. Soc. bot. Fr. 25: 289, pl. 3 fig. 2. "1878" [1879].

Coprinus cineratus var. *nudisporus* Kühner in Bull. Soc. Nat. Oyonnax (Mém. hors Sér.) 2: 3. 1957.

Coprinus saccharomyces P. D. Orton in Trans. Br. mycol. Soc. 43: 202. 1960.

MISAPPLIED NAME:

Agaricus (*Coprinus*) *ephemerus* Bull. sensu Swartz in K. VetAcad. nya Handl. 30: 202. 1808.

EXCLUDED:

Agaricus stercorarius Bull. *sensu* Sowerby, Col. Fig. Engl. Fungi 3: 9. pl. 262. 1803.

Coprinus stercorarius Fr. *sensu* Rea, Brit. Basid. 513. 1922.

Coprinus stercorarius Fr. *sensu* Kühn. & Romagn., Fl. anal. 385, 1953.

SELECTED DESCRIPTIONS AND ILLUSTRATIONS. — Cooke, Ill. Brit. Fungi pl. 673 (685). 1886-1888 (*C. stercorarius*); Ricken, Blätterp. 58, pl. 2 fig. 7. 1915 (*C. stercorarius*); Konr. & Maubl., Icon. sel. Fung. 1: pl. 36 fig. 3. 1930 (*C. stercorarius*); J. E. Lange, Fl. agar. dan. 4: 114, pl. 159 fig. A. 1939 (*C. stercorarius*); Kühn. & Romagn. Fl. anal. 385. 1953 (*C. cineratus*).

CHIEF CHARACTERISTICS. — Medium size; young, unexpanded cap 5-10 (-15) mm high, 2-7 mm broad, diameter of expanded cap 10-20 mm; smell none; spores from 4-spored basidia $9-11.7$ (-12.6) \times $5.4-7.2$ μ , from 2-spored basidia $13.5-16.2$ (-17.1) \times $7.7-9$ μ , very dark reddish-purple-brown, opaque; base of spore rounded, apiculus very small; perispore distinct but only slightly developed.

MACROSCOPICAL CHARACTERS. — Cap in the earliest stages subglobose, broad ovoid to elongated, ellipsoid, cylindrical or grenade-shaped, 3-10 (-15) mm high, 2-10 mm broad, not striate, dirty whitish to very light grey (M. 10 YR 7/1) or mouse-grey, at apex very slightly brownish (M. 10 YR 7/2, 5/2), later darker grey (M. 10 YR 6/1, 5/1; 7.5 YR 5/0), in the upper half more brownish-grey (M. 10 YR 7/2, 6/2) even light brown (M. 10 YR 6/3), finally dark grey (M. 10 YR 4/1; 7.5 YR 4/0) or dark grey-brown (M. 10 YR 4/2), under the veil dark grey to almost black and strongly striate. Surface of cap mealy-pulverulent, coated with minute whitish granules, which in the centre and sometimes down to halfway the margin of the cap cluster to irregularly shaped brownish protuberances; in later and final stages striate with black grooves, ridges between the grooves near the margin of the cap grey to dark grey, towards the centre increasingly greyish-brown, cap conical (12 mm high, 5-20 mm broad), finally plane and usually with revolute margin, splitting radially.

Stem at first short and stout, 5-10 \times 1-2.5 mm, light grey to grey, covered with a dense woolly-hairy (particularly at the base) pulverulent coating; later 25-65 \times 0.8-2 mm, attenuated from the base upwards, hollow, very minutely striate, sometimes whitish but as a rule rather greyish to dark brown-grey, coating gradually disappearing, leaving the stem sparsely covered with whitish fibres. Stem, particularly when the specimens grow in mixtures of dung and straw, often rooting (root 10-25 mm long) or distinctly thickened at the base or both and sometimes the root springing from a \pm globose sclerotium, which is very easily overlooked, up to 5 mm diameter, brownish-black, inside white.

Gills lanceolate, strongly ascending, free, up to 3 mm broad, at first white, then greyish with white gill edge, finally via reddish-brown (M. 5 YR 3/4) and dark purple (M. 2.5 YR 2/4, 2/2) becoming black and deliquescent, the edge in the earliest stages along its entire length connected with the stem by a film of minute, white fibres, strongly developed at the margin of the cap.

Flesh of the cap very thin, \pm 0.5 mm, grey to dark grey or brownish-grey, of the stem lighter.

Smell none.

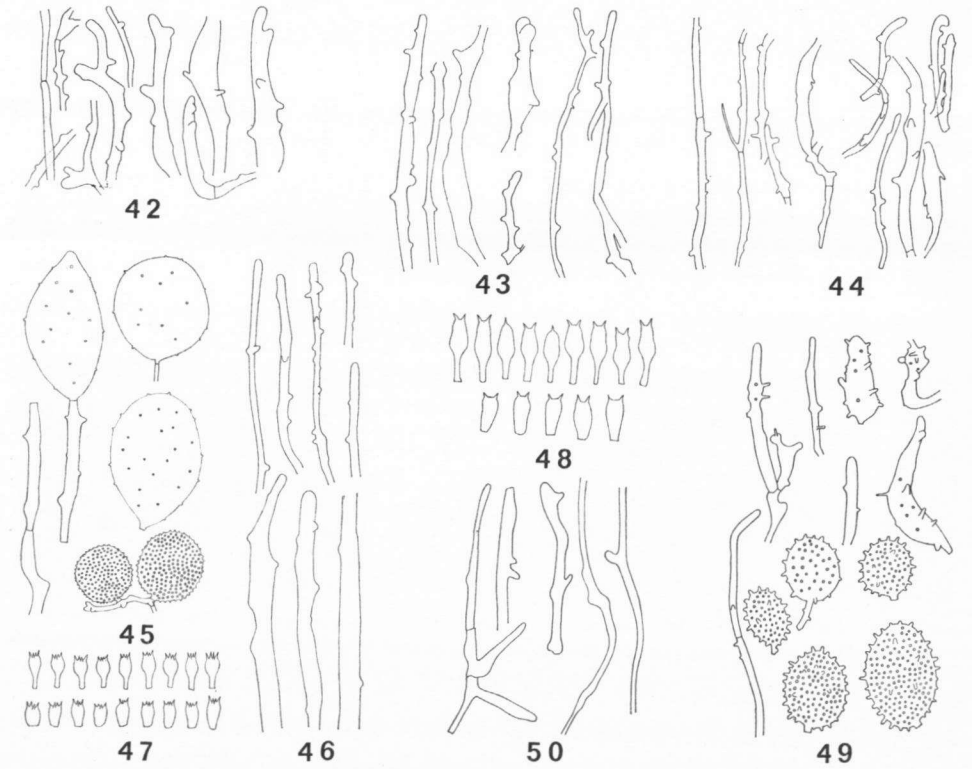
MICROSCOPICAL CHARACTERS. — Spores ellipsoid, ellipsoid-ovoid, adaxially flattened, of 4-spored basidia $9-11.7$ (-12.6) \times $5.4-7.2$ μ , of 2-spored basidia $13.5-16.2$ (-17.1) \times $7.7-9$ μ , dark to very dark reddish-brown, purple-brown (M. 10 R 3/3, 3/4; 2.5 YR 2/4, 3/4; 5 YR 3/3, 3/4), usually opaque, germ-pore very distinct (diam. in spores of 4-spored basidia \pm 1.8 μ of 2-spored basidia \pm 2.5 μ), apiculus outside longitudinal axis on the adaxial face. Perispore present in most ripe spores,

either as a narrow tight smooth layer, $0.3-1\ \mu$, or as a somewhat thicker wrinkled layer, $0.5-1.5$ (-2) μ , along the entire wall of the spore or only as local wrinkled frills or droplets, sometimes only on the germ-pore, colourless or almost so in NH_4OH 10%, sometimes absent in a number of or even in most spores, depending on the stage of ripeness of the carpophore.

Basidia 4- or 2-spored; dimorphic, $19.2-33.6 \times 11.2$ (-12) μ and stout basidia $17.6-22.4 \times 8.8-11.2\ \mu$; 2-spored basidia slightly larger.

Facial cystidia fairly few to fairly numerous, of variable form, as a rule ovoid-ellipsoid or cylindrical-ellipsoid, rarely slightly clavate, with fairly to very short stalk, $55-90$ ($120-130!$) $\times 20-40$ (-45) μ (one cell measuring $140 \times 25\ \mu$ was found, in very young specimens smaller, $50-70 \times 20-25\ \mu$), thin-walled, colourless in NH_4OH 10%, no mucus or crystals.

Marginal cells densely packed, spheropedunculate, vesiculose, \pm globose to ovoid, with short narrow stalk, $40-80$ (-90) $\times (15-)$ $25-45$ (-50) μ , colourless in NH_4OH



Figs. 42-50. Elements of the veil of the stem (and basidia of two of the species). — 42. *C. narcoticus* (Kortenhoeft, 14 Oct. 1957). — 43, 44. *C. laanii* (43: Denekamp, 'Singraven', 17 Oct. 1962; 44: Leusden, 'De Treek', 26 Oct. 1963). — 45-47. *C. velox* (45: Vorden, 12 Sept. 1958; 46, 47: Elspeet, 26 March 1966). — 48. *C. cinereofloccosus* (type). — 49. *C. martinii* (type). — 50. *C. stercorarius* f. *stercorarius* (Denekamp, 'Singraven', 18 May 1964). (All figs., $\times 288$.)

10%, cell wall as a rule very thin, rarely slightly thicker, the cells then being firmer. Among them a small number of more ovoid cells, transitions to the facial cystidia. Sometimes all marginal cells small ($25-35 \times 15-30 \mu$). On the surface of these cells either isolated or united in small groups or even fairly dense networks a number of branching, irregularly shaped, thin hyphae, $1.6-6.4$ (-11.2) μ , bearing small and rather blunt protuberances and being identical with the thin hyphae of the veil on the cap, sometimes almost absent, sometimes (specimens of 17 September 1965) occurring in great numbers. Clamps were sometimes seen on the septa of these hyphae.

Universal veil on the cap consisting of vesiculose spherocytes and inconspicuous hyphae. Veil on the stem consisting of a dense network of hyphae with only few spherocytes. Spherocytes globose to slightly elongate, vesiculose, $24-72$ (-96) μ , densely covered with diverticula, $0.9-3.6 \mu$ long; many spherocytes, particularly towards the centre of the cap and usually also those of the veil on the stem, slightly brown. Repeatedly in the veil on the cap smaller or even very small spherocytes, $15-20$ (-40) μ , or small distinctly elongate vesiculose cells, bearing strikingly few or only just a few diverticula, which often are long, up to 5.4μ . Hyphae branching, long, most of them thin, $1.6-6.4 \mu$, the veil on the cap containing very few, the veil on the stem somewhat more thicker hyphae, $6.4-11.2$ (-12.8) μ . The thinner hyphae possess a fair number of irregularly distributed and usually rather blunt protuberances. Clamps sometimes present. A few thicker hyphae of the veil on the stem slightly brown. No mucus or crystals on either hyphae or spherocytes.

HABITAT. — On and around dung heaps, on cow dung, in manured grass or mixtures of grass and moss, often cespitose in groups of 3–8 specimens. Fairly common.

7a. *COPRINUS STERCORARIUS* f. *STERCORARIUS*

For synonymy, see p. 164.

MICROSCOPICAL CHARACTERS. — Marginal cells smooth.

COLLECTIONS EXAMINED. — Denekamp, Estate 'Singraven', 21 May 1961, 18 May 1964, *E. Kits van Waveren* (KvW); Denekamp road to Tilgte, 15 Oct. 1966, *E. Kits van Waveren* (KvW); Delden, garden of Hotel 'Carelshaven', Almlosestraat, 27 July 1968, *J. E. Kluvers* (KvW); de Bilt, 29 July 1961, *E. Kits van Waveren* (KvW); Nieuwersluis, Estate 'Over-Holland', 30 Sept. 1967, *E. Kits van Waveren* (KvW); Hilversum, Estate 'Gooilust', 20 July 1963, *E. Kits van Waveren* (KvW); Leiden, Nachtegaallaan, 30 July 1954 *C. Bas* (L); Leiden, 19 May 1958, *C. Bas* 1432 (L); Over-Asselt near Mook, farm 'Boonenhof', 17 Sept. and 14 Oct. 1965, *E. Kits van Waveren* (KvW).

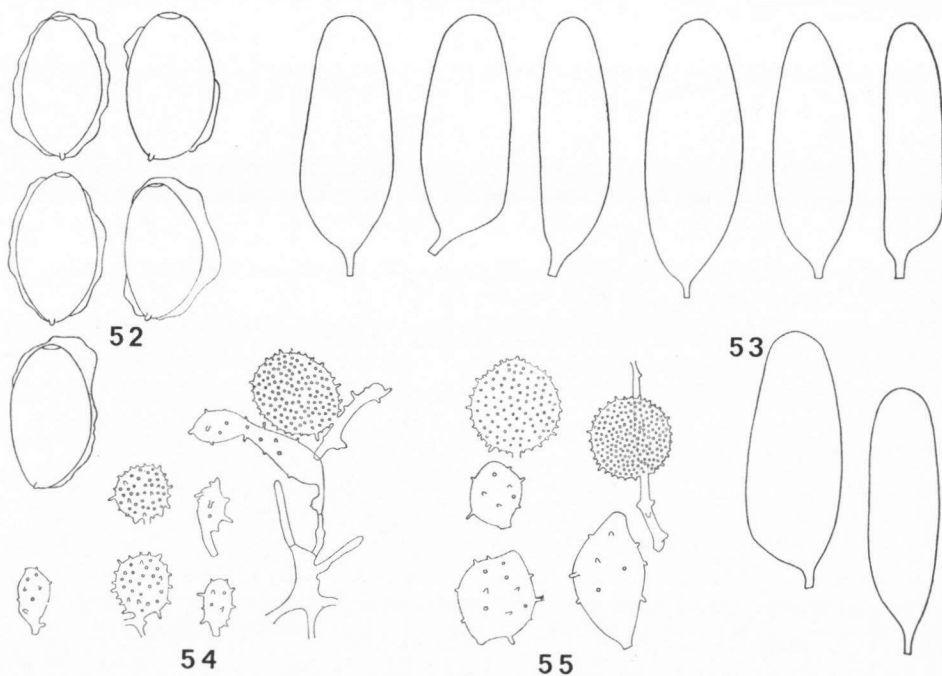
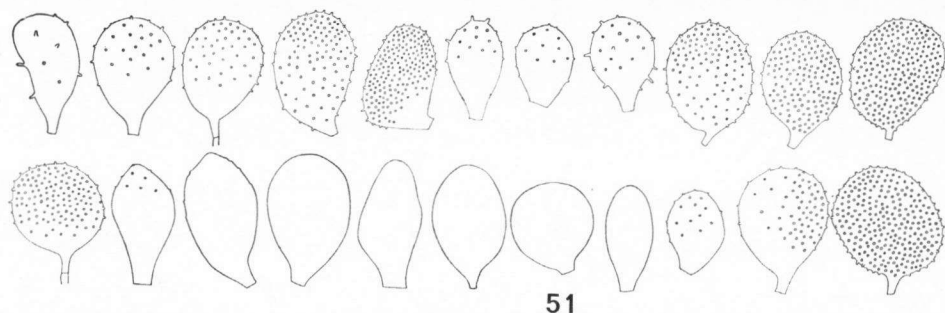
7b. *COPRINUS STERCORARIUS* f. *diverticulatus* Kits van Wav., f. n.

A Coprini stercorarii forma typica differt cheilocystidiis diverticulatis.

Holotypus: Denekamp, 14 Oct. 1967, *E. Kits van Waveren*, in fimo (L).

This form of *C. stercorarius* differs from the typical form only by the presence along the entire edge of the gills of a great many cheilocystidia ($2/3-3/4$ of all marginal cells in one find, $1/4-1/3$ in the other), having—like the typical cheilocystidia of the species of the 'stercorarius group'—distinct stalks, but bearing numerous diverticula like those of the spherocytes of the veil on the cap, either all over the cell surface or only on part thereof (compare p. 139).

COLLECTIONS EXAMINED: Hilversum, Estate 'Gooilust', 31 July 1962, *E. Kits van Waveren* (KvW); Denekamp, farm near Borg Bosch, 14 Oct. 1967, *E. Kits van Waveren* (holotype, L).



Figs. 51–55. *C. stercorarius*. — 51. *f. divarticulatus*, cheilocystidiogram (holotype, 14 Oct. 1967). — 52–55. two-spored form (52: sporogram; 53: pleurocystidiogram; 54: veil of the cap; 55: veil of the stem, all from Over-Asselt, 'Boonenhof', 14 Oct. 1965). (Fig. 52, $\times 1212$; all others, $\times 288$.)

OBSERVATIONS. — Under the microscope *C. stercorearius* can be recognised immediately by its very dark reddish-brown to purple-brown opaque spores and very small apiculus.

The specimens in the Rijksherbarium at Leiden, labelled *Coprinus radicans* were re-labelled *C. stercorearius*. The description of fresh material specifically states that there was no smell of gas and the spores are typical of *C. stercorearius* (opaqueness, size, apiculus, and perispore).

Our *C. stercorearius* find of 17 Sept. 1965 consists of specimens with 2-spored and specimens with 4-spored basidia and also of specimens with both 2- and 4-spored basidia on one gill. The spores of the specimens with 4-spored basidia are slightly longer than those of any other find of 4-spored *C. stercorearius*, $10.8-13.5 (-14.9) \times 5.4-6.3 \mu$, their shape also being slightly different, both ends of the spore being more pointed. But, all other macroscopical and microscopical characters being identical with those typical of *C. stercorearius*, we have ignored this feature. The size of the spores also shows a greater variation than it normally does, which may have been due to the presence of 2-spored basidia, although these were not found.

The spherocytes and the hyphae on the cap and to a lesser extent also of the veil on the stem of our collection of 17 Sept. 1965 has numerous small and larger and sometimes very large, up to 18.8μ , mucilaginous deposits on their surface.

Fries, describing the stem of *C. stercorearius* as non-rooting, "primo bulbillosus" (1838: 251) and "primo ovatobulboso" (1857: 467, 1874: 330), did not mention a sclerotium. He (1874: 251) referred to three authors, Kickx, Scopoli, and Bulliard, none of whom mentioned a sclerotium. Kickx (1867: 187) called the stem "ovale bulbeux à la base dans la jeunesse," but did say that according to Lévillé the stem sometimes springs from a "mycélium sclérotique." Scopoli (1760: 24) called the stem "basi rostrato definente." Bulliard (1791: 398) mentioned neither root nor sclerotium. The fact that Fries never noticed sclerotia in his *C. stercorearius* became once again clear through Brefeld (1877: 13), who said that Fries regarded the carpophores Fries was able to culture from sclerotia which Brefeld had sent him, as a "besondere Form von *Coprinus stercorearius*, die aus Sclerotien keimt." Hansen (1897: 111-132) very clearly demonstrated that carpophores of *C. stercorearius* when cultured may either spring directly from sclerotia or develop straight from mycelium grown from spores. Neither Brefeld nor Hansen mentioned a root at the base of the stem.

Since these early publications opinions whether the stems of *C. stercorearius* may be rooting and whether the carpophores sometimes or always spring from a sclerotium have varied. Gillet (1878: 613), Quélet (1888: 49), Massee (1892: 326), and Konrad & Maublanc (1930: pl. 36 III) mentioned neither root nor sclerotium, Gillet called the stem "bulbeux à la base," Massee described the base of the stem as "ovately bulbous," Konrad & Maublanc as "un peu épaissi à la base," their picture showing neither root nor sclerotium.

Schroeter (1889: 520), however, stated that this fungus often produces sclerotia

of which he gave a detailed description. According to J. E. Lange (1915: 44) "this fungus springs (always?) from a black sclerotium" and later (1939: 114) he speaks of "a shorter or longer 'root' which (always?) springs from a roundish, 2-5 mm broad black sclerotium." Ricken (1915: 58, pl. 21 fig. 7) described the stem as having a "knolliger, bisweilen langbewurzelter (3-4 cm) Basis. Er entsprosst häufig aus schwärzlichem flachknolligem 3-5 mm starkem Sklerotium." His picture shows a distinctly swollen base of the stem from which a pointed and rather long root emerges. According to Möller (1945: 165) the stems have a "thickened base which often has a long tap-root (sclerotium not seen)" and M. Lange (1955: 59) found "deeply rooting specimens attached to sclerotia." Moser (1955: 247) in his key to the genus *Coprinus* even uses the presence of a rooting stem "meist mit schwarzem Sclerotium" as the essential character by which *C. stercorearius* is distinguished from the other species following down the line in the key. Orton (1960: 198) in his key to the 'stercorearius group' mentioned neither a rooting stem nor the presence of a sclerotium.

While collecting our *C. stercorearius* finds in the past (up till 1966) we failed to pay special attention to these structures, but while studying our dried material, we repeatedly found the stem to be distinctly rooting. In some specimens (collection of 17 Sept. 1965) the root sprang from a conspicuously swollen, woolly-hairy base of the stem. Ricken (1915: pl. 21 fig. 7), J. E. Lange (1939: pl. 159 A) and Möller (1945: 165) beautifully depicted this swollen base and its root. We found a small brownish-black sclerotium in the dried material of a small caespitose group of very young specimens, found on 31 July 1962 on a dungheap and two beautiful, subglobose, black sclerotia, soft and white inside, measuring 3 resp. 5 mm, in a collection of some 10 fresh specimens from a dungheap on 30 Sept. 1967.

Summarising it is clear, both from the literature and our own observations that specimens of *C. stercorearius* repeatedly possess a rooting stem and sometimes may spring from a sclerotium and that both root and sclerotium are very easily overlooked! External circumstances (nutritional conditions, humidity) are believed (Hansen, 1897: 111-132) to determine whether a sclerotium is formed or not and whether the carpophores spring from mycelium or a sclerotium.

In 1838 Fries (1838: 251) described the present species, naming it *Coprinus stercoreus* and referring to *Agaricus stercorearius* Scopoli (1772: 427) and to *Agaricus (Coprinus) ephemerus* Bull. ex Pers., as described by Swartz (1808: 202). Both descriptions correspond adequately with the one given by Fries and with the current conception of this species. Fries also referred to Plate 542 figures 2 M-D of *Agaricus stercorearius* Bulliard (1791) which indeed depict the present species very well. From Bulliard's later description (1809: 398) and the cited plate of *Agaricus stercorearius*, of which he wrote that the species "varie extraordinairement dans sa forme, sa couleur et surtout dans ses dimensions," it is clear that his *A. stercorearius* comprised more than one species. As stated above, Fries (1838: 251) was already of this opinion, for in his reference he did not include Bulliard's Plate 542 fig. 2 L—which depicts very small

specimens—and later (1874: 330) he referred only to Plate 542 fig. 2 M. Neither Fries nor Bulliard mentioned the presence of a smell, a rooting stem or a sclerotium, but according to Scopoli (1760: 24) the stem is “basi rostrato definente.”

It may be pointed out that Bulliard had published his own *Agaricus stercorearius* (without any reference to the homonymous name published by Scopoli) previous to the publication of his Plate 542. The ‘original’ *A. stercorearius* Bull. was published on his Plate 68 (1781) and this is obviously a different species from Fries’s *Coprinus stercoreus*. In his final description (1809) Bulliard made the species very inclusive, not only by incorporating his Plate 542 but also *Agaricus cinereus* Schaeff., as he had described and depicted it on his Plate 88 in 1781, which he then regarded as a mere variety of his *A. stercorearius*.

In 1849 Fries (1849: 298) still called his species *Coprinus stercoreus* “(Scop.)” but subsequently (1857: 467 and 1874: 330) he modified the epithet into *Coprinus stercorearius*.

Nomenclatively there are two taxa of *Coprinus* with the epithet “stercorearius,” viz. *Agaricus stercorearius* Scop. 1772 = *Coprinus stercoreus* Fr. 1838 = *Coprinus stercorearius* (Scop.) ex Fries 1857, and *A. stercorearius* Bull. 1781 = *A. stercorearius* Bull. ex St-Amans 1821. The question arises whether or not Fries’s form “stercoreus” has to be considered nomenclatively different from “stercorearius.” In our opinion this is not so, as in his very first description Fries referred to the name “stercorearius” given by Scopoli and as in 1857 he himself used the name “stercorearius” instead of “stercoreus”: the latter may well have been a misprint.

Later Fries (1874: 330) once again described this species, referring to Kickx (1867: 187), Scopoli (1772: 427), and Bulliard’s Plate 542 fig. 2 M–P. St-Amans (1821: 567) gave a very short and rather inadequate description of *Agaricus stercorearius*, referring to Bulliard’s Plates 68 (1781), 88 (1781), and the whole of Plate 542 fig. 2 and so to a miscellany of quite different species. The species that both Schumacher (1803: 286) and Fries (1821: 291)—who referred to Schumacher—described as *Agaricus stercorearius* is again a different species and conspecific with *Stropharia semiglobata* (Batsch ex Fr.) Quél. (= *Agaricus semiglobatus* Batsch ex Fr., 1831: 284).

Conclusive evidence, that Fries indeed applied the name *C. stercorearius* to the species we have just described and not to the species named *C. velox* in this paper, is furnished by Brefeld (1877: 13). From Brefeld’s pictures of the microscopical features of his *C. stercorearius* it is clear, that his species belongs to the ‘stercorearius group.’ Unless it is assumed that Brefeld’s species has never been found since, it must have been either *C. stercorearius*, *C. velox*, or *C. cinereofloccosus*, the absence of a special smell and the habitat ruling out the other four species. Because of its dark grey colour, the medium sized carpophores, the presence of a sclerotium, and the rather large spores ($15 \times 5 \mu$) *C. velox* is ruled out. So is *C. cinereofloccosus*, which has 2-spored basidia, a perispore that could not have escaped Brefeld, and no sclerotia. Brefeld’s Figs. 8 and 9 of Plate 2 and the figures of Plate 3, all natural size, depict carpophores, cultured in full daylight, typical of *C. stercorearius*. The shape of most of his specimens, however, was atypical because for technical reasons Brefeld had to keep his cultures

in the dark and he noticed that this caused the stems to become abnormally long and slender and the caps to remain abnormally small. In our opinion, therefore, Brefeld's species must have been what in this paper in accordance with almost universal opinion is called *C. stercorarius* (Scop.) ex Fr. Brefeld himself, however, expressed doubt about this identification. He believed that his species did not fit in with Fries's description of *C. stercorarius* (1874: 330). His specimens were very short-lived and as he believed that they shed their spores only during the night, he called his species *Coprinus noctiflorus*. But he sent sclerotia to Fries, whereupon Fries informed him that he had been able to culture from these sclerotia carpophores, which he had identified as his *C. stercorarius*, be it a "besondere Form, die aus Sklerotien keimt." This then means, that the specimens, described and above all beautifully depicted by Brefeld were identified by Fries himself as his *C. stercorarius*.

Hansen (1897: 111-113) found and cultured on dung (of cow, horse, pig, dog, and man) sclerotia, producing carpophores which, according to him, fully answered Fries's description of *C. stercorarius*. Judging from Hansen's description, these must indeed have been *C. stercorarius*. His carpophores grew either from sclerotia or directly from mycelium, their size varied considerably, the species belonging to the "Coprinen von mittlerer Grösse, Stiel oft 8 cm lang, Hut 1 cm in Durchmesser." Hansen gave a clear description as well as pictures of the perispore of both ripe and unripe spores. For a few reasons, difficult to judge, he believed his *C. stercorarius* to be different from Brefeld's *C. noctiflorus*.

Coprinus stercorarius sensu Kühner & Romagnesi. — As already pointed out while discussing the nomenclature of *C. velox* Godey (compare p. 158) the description by Kühner & Romagnesi (1953: 385) of their *C. stercorarius* is in full agreement with the larger specimens of *C. velox* Godey. The specimens depicted on Bulliard's Plate 542 fig. 2 L might well represent this species, but these specimens were distinctly ruled out by Fries in his description of his *C. stercorarius*. Orton (1960: 198) took up two species *C. stercorarius* in his key, one sensu Ricken and Lange, and one sensu Kühner & Romagnesi, the latter, according to Orton, not yet having been recorded for Great Britain. Although *C. velox* figures in the 'New British Check List' this species is not mentioned in Orton's key to the species of the 'stercorarius group'. Orton entered *C. stercorarius* sensu Kühner & Romagnesi in his key as having no smell, whereas Kühner & Romagnesi specifically stated that their species had an "odeur désagréable de *C. narcoticus*."

Coprinus tuberosus Quélet. — Cooke & Quélet (1878: 109) described *C. tuberosus*, using only ten words ("Parvus, pulverulentus, niveus, lamellis sporisque nigroviolaceis; stipite filiformi; sclerotio fusco-nigro"), but later (1879: 289, 1886: 126, and 1888: 49) Quélet gave more elaborate descriptions. Since then this species has been mentioned and described as a separate species only by Rea (1922: 513) although he added "= *C. stercorarius* Fr.," by Gillet (1884: 138), and Massee (1902: 235), the unanimous opinion in the literature being that this species is synonymous with those forms of *C. stercorarius* that possess a sclerotium (Ricken, 1915: 58; J. E. Lange, 1915:

44 and 1939: 114; Konrad & Maublanc, 1930: pl. 36 III; the New British Check List). Quélet's descriptions (1888: 49) reveal that *C. tuberosus* is distinguished from *C. stercorearius* by the presence of a sclerotium, the small size of the cap (3–5 mm), and the shape of the spores (in *C. tuberosus* "ellipsoïde, noire" and in *C. stercorearius* "en amande ou lenticulaire, brun ou bistre violet"), the size of the spores for both species being the same, 12 μ . But it is generally agreed that *C. stercorearius* may also have a sclerotium and differences in shape of the spores being somewhat difficult to assess and describe, the strikingly small size of the cap of Quélet's *C. tuberosus* seems to be the only significant difference from *C. stercorearius*. The small size of the cap might suggest *C. velox*, but that species is not known to have a sclerotium, it smells, grows exclusively on dung, and has particularly small spores. Kraft's description (1964: 6) of specimens he cultured from sclerotia and called *Coprinus stercorearius* forme *tuberosus* fully agrees with *C. stercorearius* except for the spore sizes (5–7 \times 4.5 μ). He stresses the point that on the one hand the sizes of the caps of his specimens were much larger than those given by Quélet, while on the other hand the spores were much smaller.

We feel that we should adhere to the current opinion in the literature that *C. tuberosus* and *C. stercorearius* are synonymous.

Coprinus cineratus Quélet. — Quélet (1877: 329) described *C. cineratus* as a cespitose, medium-sized, non-smelling and non-rooting species growing in gardens and woods. Cooke & Quélet (1878: 107) gave a very short and inadequate description of only ten words, which was followed by Quélet's full descriptions (1886: 126 and 1888: 49). Since Quélet the species has been described only by Patouillard (1886: 198), Gillet (1884: 138), and Massee (1896: 64). Konrad & Maublanc (1930: pl. 36 III) regarded *C. cineratus* as merely a variety of *C. stercorearius*, while J. E. Lange (1939: 114) regarded the species as probably identical with *C. stercorearius*. Judging by Quélet's descriptions of *C. stercorearius* and *C. cineratus* (1888: 49), the shape and size of the spores were the only means of distinguishing between them, those of *C. stercorearius* being "en amande ou lenticulaire, brun ou bistre violet, 12 μ ," those of *C. cineratus* "ellipsoïde noire, 10 μ ." Orton (1960: 198) gives the same spore sizes for both species, *C. stercorearius* 9–11 \times 5.5–7 μ and *C. cineratus* 9–11(–12) \times 5.5–7(–8) μ . He concludes that "in view of the similarity of spore size it remains to be seen whether *cineratus* and *stercorearius* s. Ricken, J. Lange are really distinct." We agree that they are not. Nevertheless *C. cineratus* Quél. figures in Orton's key as a separate species, the difference in habitat being believed to be the only difference between the two species, *C. cineratus* on soil, *C. stercorearius* on dung. Both Saccardo (1887: 1099) and Massee (1902: 164), however, had already reported that in France *C. cineratus* had also been found on dung!

Romagnesi (1941: 20–35) included—like we do in this paper—*C. velox* sensu Lange and *C. stercorearius* Fr. ex Bull., but not *C. cineratus* Quél. Later Kühner & Romagnesi (1953: 385) decided to substitute the name *C. stercorearius* Fr. for *C. velox* and they then had to find another name for what in 1941 Romagnesi had called *C.*

stercorarius Fr. ex Bull. The name *C. cineratus* was readily found and subsequently used. They gave the same spore sizes as Orton, $9-11 \times 5.2-7 \mu$. It seems sufficiently clear that *C. cineratus* is conspecific with *C. stercorarius* and so is *C. cineratus* var. *nudisporus* Kühn. (1956-1957: 10-11 Suppl. 3), compare p. 138.

Coprinus saccharomyces as described by Orton (1960: 202) and of which we examined the type material, corresponds in every way with *C. stercorarius*, the only difference being that its basidia are 2-spored and its spores larger. Orton found $(14-15-19(-20) \times 9-10 \mu$, while our own measurements read $14.4-16.2(-17.1) \times 8.1-9.9 \mu$. The spores are dark reddish-brown and opaque and they have a very small apiculus and a distinct but poorly developed perispore; in other words they are identical with the spores of the 2-spored forms of *C. stercorarius* which we found on 17 Sept. and 14 Oct. 1965. We therefore regard *C. saccharomyces* Orton as merely a 2-spored form of *C. stercorarius*. The "smell of wet yeast, stronger after being cut or enclosed in a tin" (not of gas) noticed by Orton is in our opinion too dubious (like all smells that are not very characteristic and distinct) and in any case inadequate to serve as the sole character by which *C. saccharomyces* might be distinguished from the 2-spored form of *C. stercorarius*.

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EXPLANATION OF PLATE 6

Figs. 1-2. Spores of *Coprinus laanii*. — 1. Showing the surface of the perisporial sac; note the dots and short lines. — 2. View at the equatorial plane of the same; note the wrinkling of the sac.

