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THE 'STERCORARIUS GROUP' OF THE GENUS COPRINUS

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(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 perisporial 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-*

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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 Séguy," 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 × and for spores 2425 × 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. Josserand (1952: 305) already having introduced the terms "sporographe" and "sporologue," we have — while thinking of the terms cardiogram and encephalogram in medecine — 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 'stercorarius 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 'stercorarius 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 'stercorarius 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 'stercorarius 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. stercorarius*, *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 perisporial 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 germpore 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 "verrues intrapérisporiques") 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 epispore) 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 epispore 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 epispore in the lines formed by folds of the perisporial sac. This phenomenon is particularly distinct when the spores are mounted in H_2SO_4. The perisporial 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 perisporial 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 perisporial 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 perisporial sac, others had lost only part of it. Many isolated perisporial 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. stercorarius* 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. stercorarius* 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. stercorarius*. 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 ± 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 perisporial sac. 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 perisporial sac. 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.

F a c i a l c y s t i d i a. — The facial cystidia of the species of the 'stercorarius 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. stercorarius* 50–75 × 20–25 μ on white gills, 55–90 (120–130) × 20–40 μ on ripe gills; in *C. velox* 20–35 × 10–14 μ on white gills, and 30–50 × 15–25 μ on black gills. The facial cystidia are ellipsoid, ovoid, subcylindrical, 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.

M a r g i n a l c e l l s. — 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 spherocytes[1] 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. stercorarius* 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. stercorarius* 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.

U n i v e r s a l v e i l. — 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. Patouillardi* 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.

C l a m p s. — Clamps were sometimes seen (for instance in two of our collections

of *C. stercorarius*) 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. stercorarius*)) and absent on the hyphae of the mycelium of cultured specimens of their *C. stercorarius* (= *C. velox*).

Habitat, frequency. — Apart from *C. velox*, the species of this group often grow somewhat cespitose. *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 'stercorarius group'. *Coprinus velox*, we think, is quite common but because of its very small size probably very often overlooked. We found *C. stercorarius* 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 'stercorarius group'

Coprinus, groupe de *C. stercorarius* 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 perisporial 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 × 5.4–6.8 μ, stem usually non-rooting . . . . *C. narcoticus*
   3. Spores 12–15 × 6–8 μ, 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) × 4.1–4.5 μ; very small and in the early stages white species *C. velox*
   5. Spores 9–13.5 × 5.4–7.2 μ or even larger; medium-sized and grey species.
      6. On stems of *Carex*, *Juncus*, *Scirpus*; spores 13.5–14.9 × 7.7–8.6 μ . *C. martinii*
      6. On or around dung or in grass or in soil; spores 9–13.5 × 5.4–7.2 μ (2-spored forms: 13.5–16.2(–17.1) × 7.7–9 μ
         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 × 5.4–6.8 (–7.2) μ; 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 × 1–3 mm, white, densely covered with a woolly-hairy white coating; inside the cap tapering towards the apex. Later 15–60 (–75) × 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 (± 1 μ) and rather long (0.5–0.9 μ) excentric apiculus on the adaxial face, 10.8–13.5 × 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 (± 1.8 μ). 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 NH_4OH 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 × 8–11.2 μ and thickset basidia, 19.2–20.8 × 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 × 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 × 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) ± globose or slightly elongated (20 × 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 cespitose. 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).

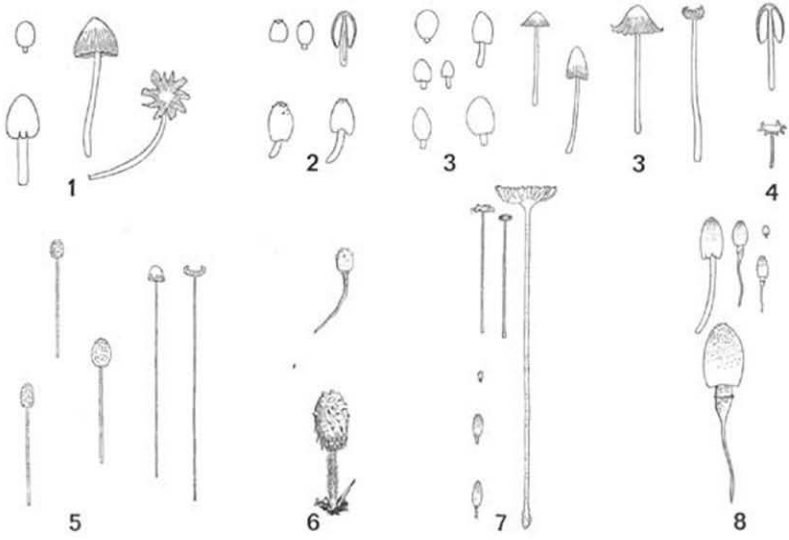
OBSERVATIONS. — A young specimen of the collection from Delfgauw shows a distinctly rooting stem, two others have a small root. In the description accompanying this collection the cap is said to be conical and up to 38 mm high and the stems 50–75 × 4–6 mm. According to the finder himself some stems were 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 × 50 μ and 160 × 50 μ) 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: × ½; figs. 2–4: × ½; fig. 5: × 2.5; fig. 6: nearly × 2; fig. 7: little more than × 1; fig. 8: × 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 × 6–8 μ; 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 × 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 × 6–8 μ, ellipsoid, with apical germ-pore, almost always without perispore when black and opaque but when young and only little coloured with conspicuous perisporial sac. According to Kühner one notices in a small number of ripe spores a broad perispore with conspicuous warts between perispore and epispore.

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 μ, supported by a complicated system of branching hyphae with protuberances ("bourgeonnantes"), 5–13 μ 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 perisporial 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 × 7–8 μ (*C. narcoticus* 10–13 × 5–6 μ according to Romagnesi, 10.8–13.5 × 5.4–6.8 μ 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 perisporial sac, 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 cependant 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. cinereo-floccosus*, 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 × 9.5–10 μ, 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 sphérocystes incolores et lisses recouverts de sphérocystes hérissés d'aiguillons cylindriques les rendent verruqueux, le tout supporté pas des hyphes vésiculeuses courtes elliptiques formant la cortine, le tout sur un derme celluleux." 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-ovoideus, 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 grisco-ochraceis, postremo planus, plicato-sulcatus, radialiter fissuratus et plerumque margine revoluto.

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 acien primo albo-flocculosae, deliquescentes.

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

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

Basidia 4-sporigera, dimorphia, 20.8–33.6 × 8–10 μ et 16–20.8 × 8–10 μ.

Pleurocystidia modice abundantia, elongato-fusiformia, saepius subutriformia, hyalinia, 65–120 × 22.5–40 μ.

Cheilocystidia abundantia, conferta (qua de causa lamellarum acies sterilis), spheropedunculata, vesiculosa, globosa vel elongato-ovoidea, hyalinia, 30–75 × 20–45 μ, nonnulla elongato-fusiformia, pleurocystidiis similia, 55–120 × 20–45 μ.

Pilei velum universale e cellulis abundantibus globosis, vesiculosis, hyalinis et hyphis paucis constat. Cellulae globosae 32–96 μ, diverticulis minutis dense punctatae; hyphae 1.6–6.4(–11 2) μ 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 × 5.4–6.3 μ, 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.

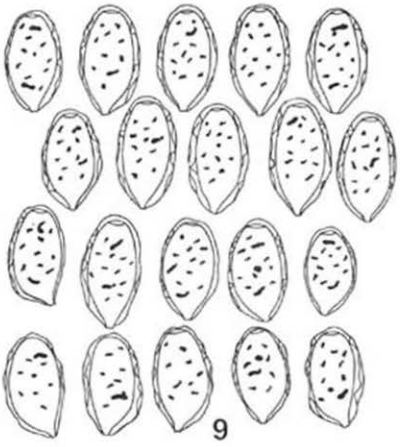
Stem in the early stages outside the closed cap thickset, 1–15 mm high, 1–2 (–3) mm thick, covered with a woolly-hairy, whitish coating particularly at the base; within the closed cap tapering conspicuously towards the apex. In the final stages 30–60 mm long, 1–2 mm thick, very gradually attenuated from 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.

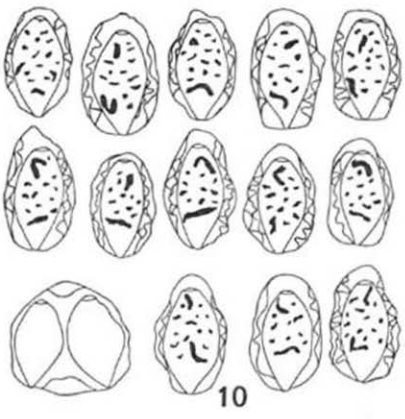
Gills lanceolate, ascending, free, 1–2 mm broad, at first white, later chocolate colour (M. 2,5 YR 3/2; 7,5 YR 3/2), finally purple-black to black with white, minutely granular-flocculose edge, deliquescent, in the final stages as fine purplish black lines along the undersurface of the by then dingy 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.

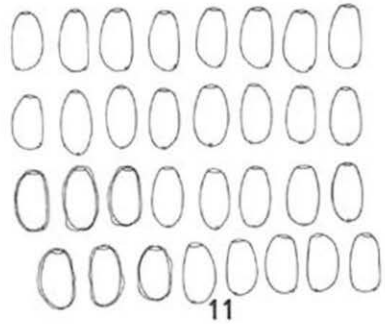
Flesh in cap very thin (± 0.5 mm) in centre, grey; in stem whitish (grey in base). At the apex of the cap granular veil and flesh about equally thick.

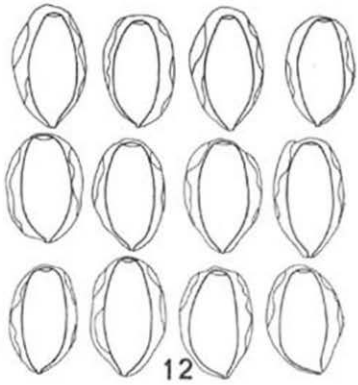
Smell none.

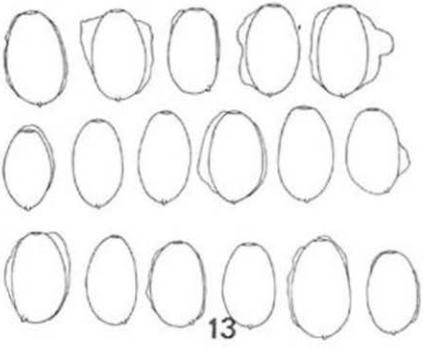
MICROSCOPICAL CHARACTERS. – Spores ellipsoid in all planes running through the longitudinal axis (adaxially not flattened!), apex rounded, base narrowing and elongated, passing gradually and without clear delimitation into a broad (± 1 μ) and rather long (0.5–0.9 μ) apiculus lying in the longitudinal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

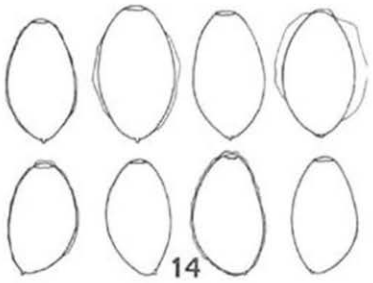












Figs. 9—14

(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 × 8–10 μ and thickset basidia, 16–20 × 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 × 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 × 20–45 μ; among them a small number of longer cells, 55–120 × 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 ± 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 perisporial sac it differs distinctly from *C. stercorarius*, *C. velox*, and *C. martinii*, and belongs to the group of *C. narcoticus*,

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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., × 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 12.2–13.5 × 5.4–6.3 μ; 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, ± 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, ± lanceolate, crowded, edge white flocculose at first.

Stem 25–50 × 2–4 mm before cap expands, then 50–100 (–150) × 2–6 mm, ± 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 (± 1μ) and long (0.5—0.9 μ) excentric apiculus on the adaxial face, 12.2–13.5 × 5.4–6.3 μ [Orton 11–13 (–15) × 5.5–7 μ], dark reddish-brown (M. 2,5 YR 3/4; 10 R 3/4) opaque, apical germ-pore very distinct (± 1.8 μ 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, 22.4–32 × 8–9.6 μ and thickset basidia, 16–22.4 × 8–9.6 μ.

Facial cystidia fairly numerous, 2 types: the one ellipsoid-ovoid (70–110 × 30–40 μ), the other short ovoid almost round (50–70 × 30–40 μ), 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 × 15–40 μ with fairly short stalk, no mucus or crystals. Here and there on the marginal cells a few thin (3.2–6.4 μ) hyphae with short blunt protuberances.

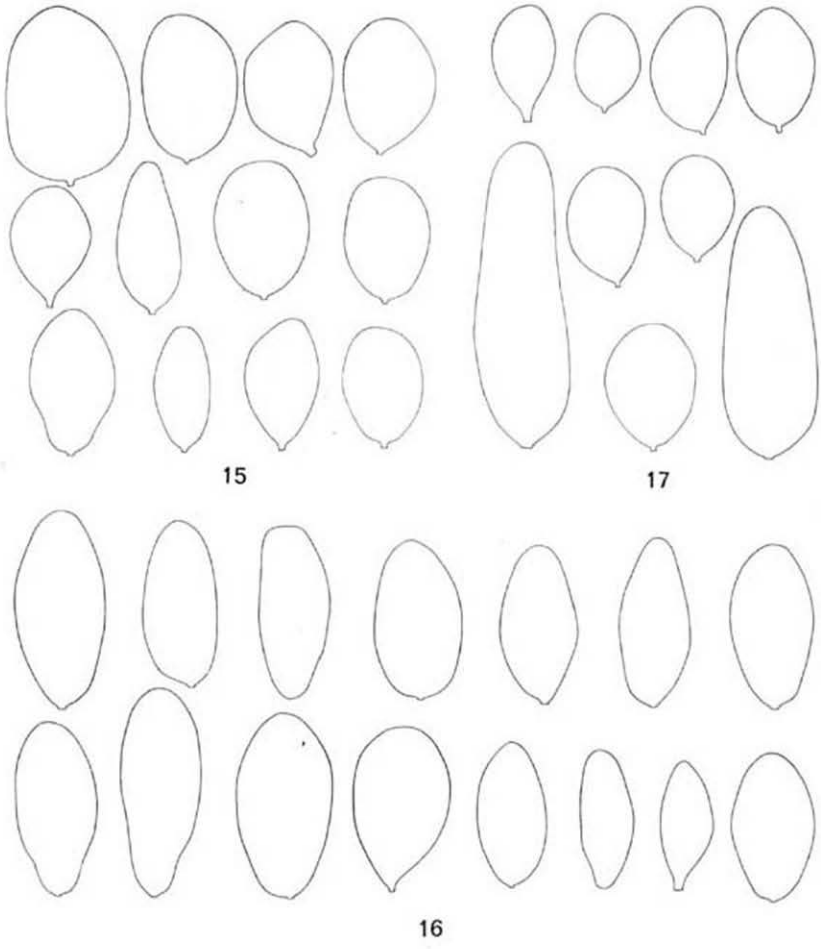
Universal veil on the cap consisting of numerous globose to slightly elongated, thin-walled and often light brown spherocytes, 30–80 μ, more or less densely covered with small diverticula, 0.5–0.9 (–1.4) μ long and inconspicuous branching, thin hyphae, 1.6–6.4 (–8) μ, bearing blunt protuberances. Veil 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).

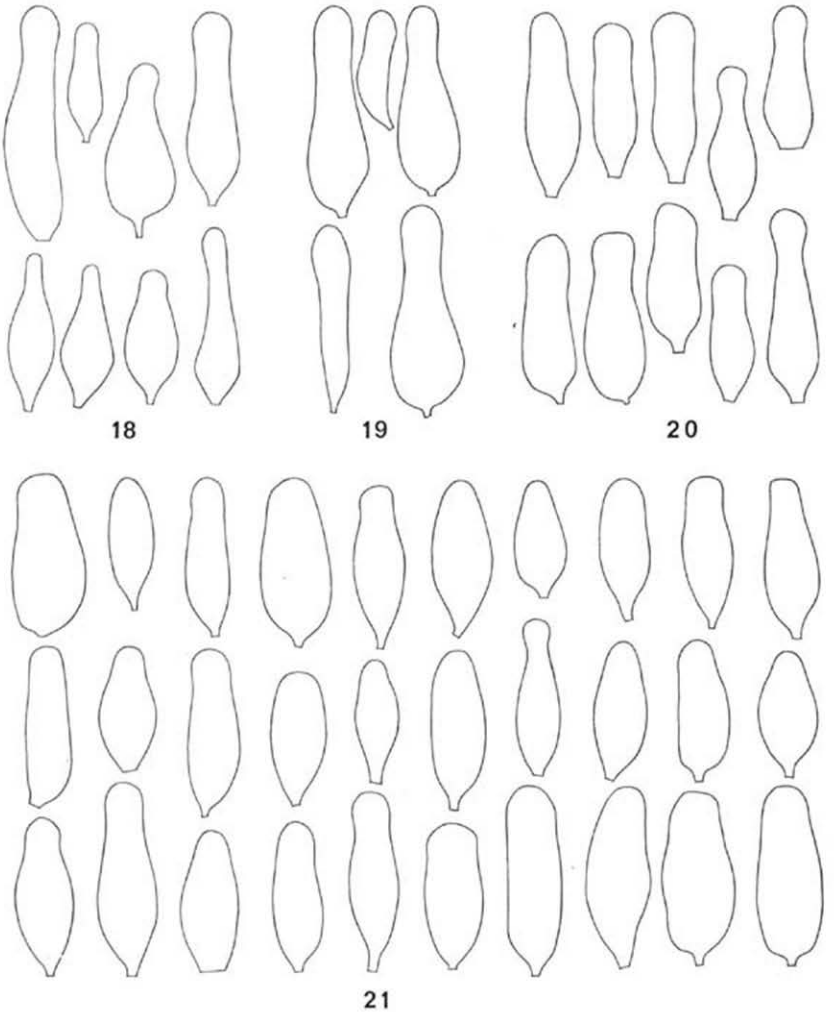
COLLECTIONS EXAMINED. — England, Rothamsted, Herts., The Manor, 8 Nov. 1958 (type, K).

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. cineratus* with Orton] in larger spores, more coarsely mealy cap and perhaps presence of bladdershaped 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 perisporial sac is very distinct. The spores of *C. stercorarius* on the contrary have a rounded base, a very small apiculus and a perisporial sac which is very much less in evidence. Although Orton in his description of *C. cinereofloccosus* calls the perisporial sac "rather thin," he gave the thickness of the spores without the perispore as 5.5–7 μ and with the perispore as 7–8.5 μ! His Figure 247, depicting the spores of *C. cinereofloccosus*, also shows a very distinct perisporial sac 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., × 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., × 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.

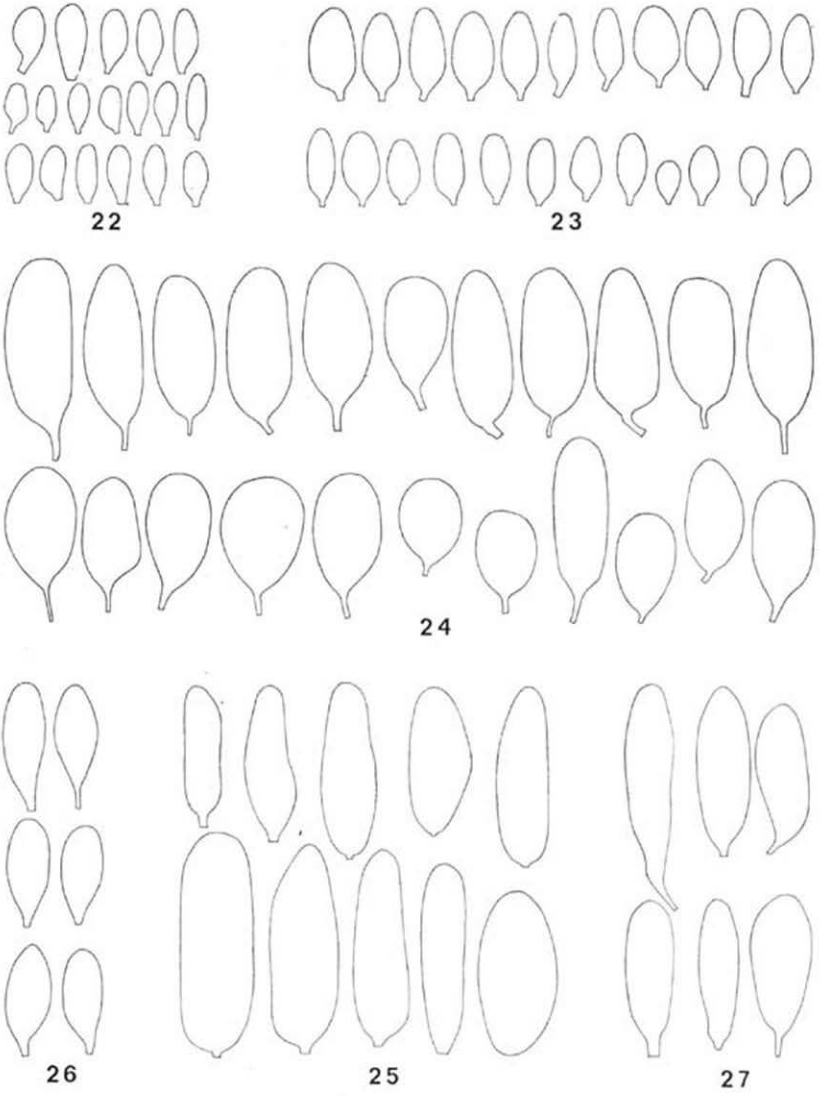
MICROSCOPICAL CHARACTERS. — Spores ellipsoid, ellipsoid-ovoid, often phaseoliform or subcylindric (!), adaxially flattened or even slightly concave, (5.4–) 6.3–7.7 (–8.1) × (3.2–) 3.6–4.1 (–4.5) μ, brown to reddish-brown (M. 5 YR 4/4, 3/4; 2,5 YR 3/6), opaque, wall relatively thick. Apical germ-pore 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 diverticule-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., × 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, cemetary, 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 × 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 Hoogezand, 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 tâche noire au sommet" (but "blanchâtre, disque avec une tâche brune" in the 'Tableaux'). No microscoscopical 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 × $4\frac{1}{2}$ 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. stercorarius*: "chapeau d'abord bien blanc, puis à peine cinérascent sous le voile, grossièrement hérissé de flocons saillants formés de sphérocystes avec un pinceau filamenteux à leur extremité (au moins pour les flocons non centraux)."

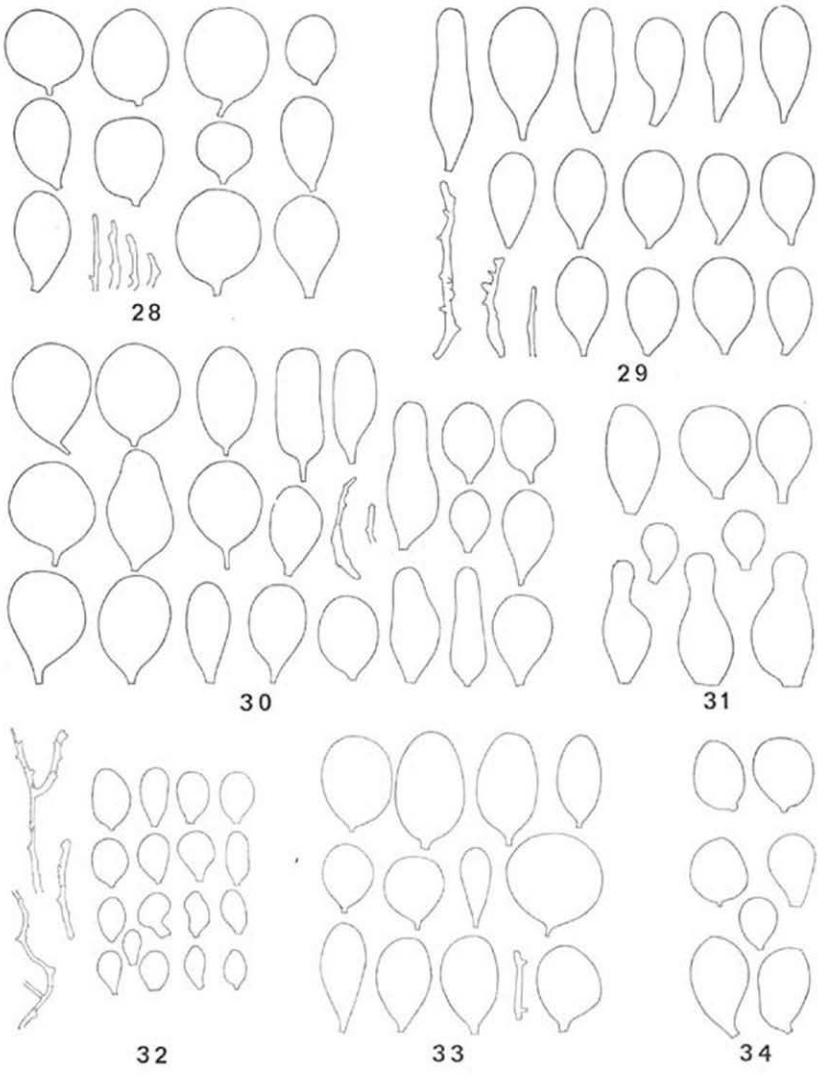
Our Elspeet material appeared to contain all transitional stages between very small specimens with fairly smooth, subfurfuraceous caps (= *C. velox* as described by Lange) and larger specimens with floccose, hairy-scaly veil on both cap and stem (= *C. stercorarius* as described by Kühner & Romagnesi). The spores of both forms are, as was expected, exactly the same: $7\frac{3}{4}$–$9 \times 4\frac{1}{2}\ \mu$ (Lange), 7–8 × 4–4.2 μ (Kühner & Romagnesi), 6.3–7.7 × 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 'stercorarius group'.

The discussion on the correct nomenclature of *C. velox* is thus very closely linked with the discussion on the nomenclature of *C. stercorarius*, to which we refer (see p. 170). As Fries (1838: 251) had already given the name *Coprinus stercorarius* (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. stercorarius*. 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. stercorarius* (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 Treek', 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., × 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 × 3.5–4 μ (usually 7 × 3.5–4 μ)" 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 bohemica. *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 × 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 × 7.7–8.6 μ; 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.

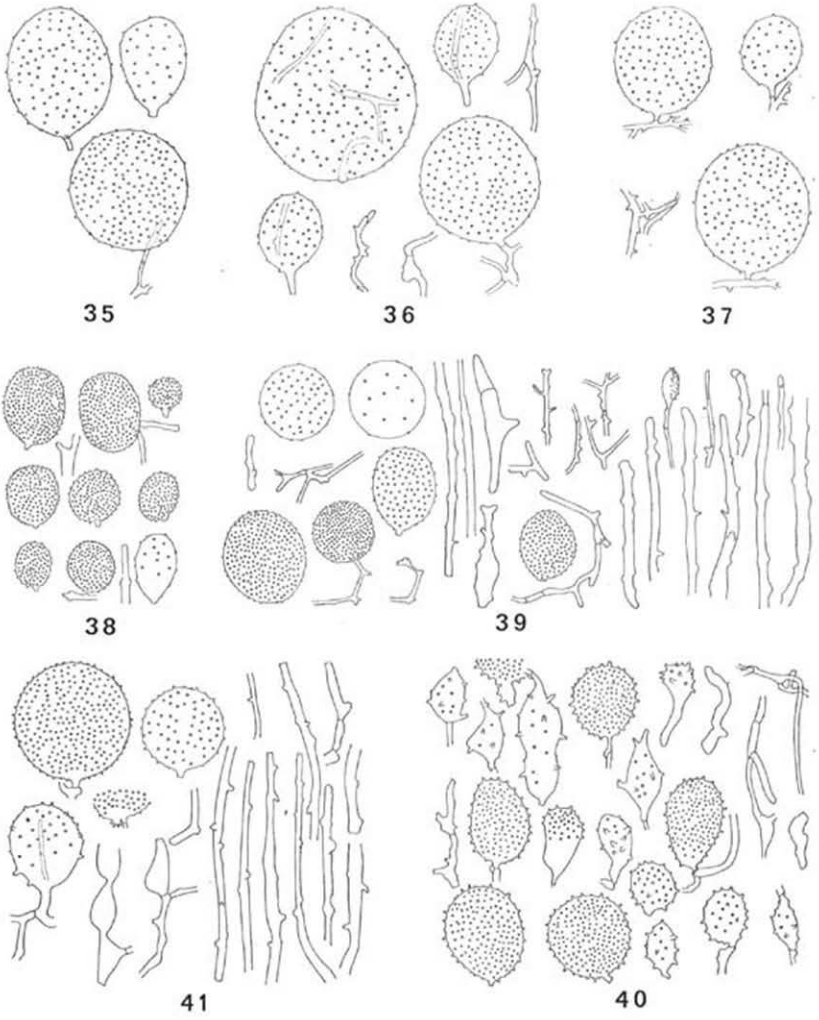
Gills free, grey then black, crowded, edge atomate-flocculose at first.

Stem 32–60 × 1.5–2 mm (less than 5 mm at base), ± 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 × 7.7–



Figs. 35–41. Elements of the veil of the cap. — 35. *C. narcoticus* (Kortenhoef, 14 Oct. 1957). — 36, 37. *C. laanii* (36: Denekamp, 'Singraven', 7 Oct. 1962; 37: Leusden, 'De Treek', 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., × 288.)

8.6 (–9) μ [Orton: 12–16 (–17) × 6.5–8.5 μ], reddish-brown (M. 5 YR 3/4, 4/4) translucent, with distinct apical germ-pore (diameter ± 2 μ, 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 × 8–9.6 μ, stout basidia 17.6–24 × 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 cespitose, 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 (devalidated name); not *Agaricus stercorarius* Bull., Herb. Fr. pl. 88. 1781 (devalidated name); not *Agaricus stercorarius* Schum., Enum. Pl. Saell. **2**: 286. 1803 (devalidated 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 (devalidated name); not *Agaricus stercorarius* Scop., Fl. carn., Ed. 2, **2**: 427. 1772 (devalidated name); not *Agaricus stercorarius* Schum., Enum. Pl. Saell. **2**: 286. 1803 (devalidated 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 Quél. *in* Bull. Soc. bot. Fr. **25**: 329, pl. 2 fig. 7. "1876" [1877].

Coprinus tuberosus Quél. *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) × 5.4–7.2 μ, from 2-spored basidia 13.5–16.2 (–17.1) × 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 × 1–2.5 mm, light grey to grey, covered with a dense woolly-hairy (particularly at the base) pulverulent coating; later 25–65 × 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 10–25mm long) or distinctly thickened at the base or both and sometimes the root springing from a ± 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, ± 0.5 mm, grey to dark grey or brownish-grey, of the stem lighter.

Smell none.

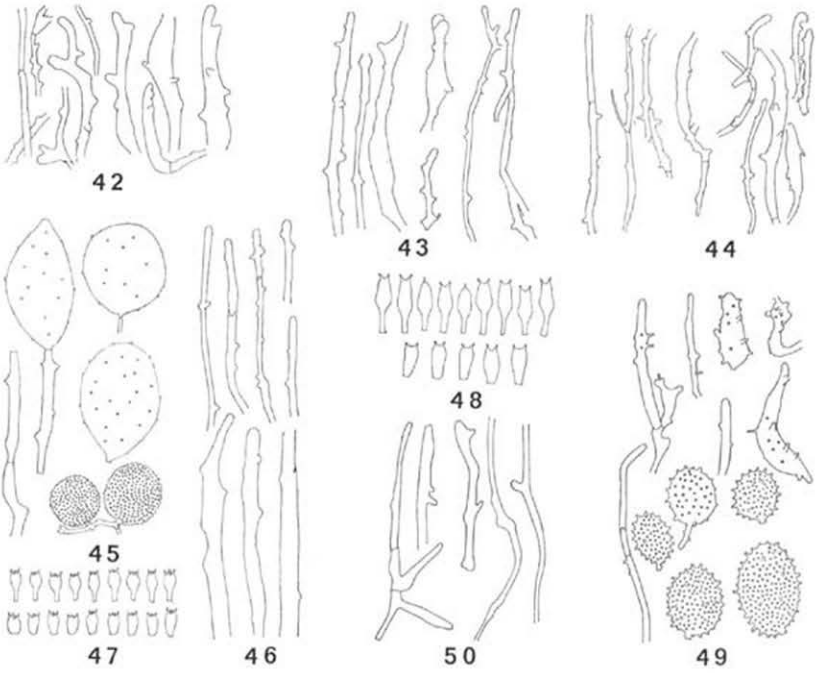
MICROSCOPICAL CHARACTERS. — Spores ellipsoid, ellipsoid-ovoid, adaxially flattened, of 4-spored basidia 9–11.7 (–12.6) × 5.4–7.2 μ, of 2-spored basidia 13.5–16.2 (–17.1) × 7.7–9 μ, dark to very dark reddish-brown, purple-brown (M. 10 R 3/3, 3/4; 2,5 YR 2/4, 3/4; 5 YR 3/3, 3/4), usually opaque, germ-pore very distinct (diam. in spores of 4-spored basidia ± 1.8 μ of 2-spored basidia ± 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 μ, 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 × 11.2 (–12) μ and stout basidia 17.6–22.4 × 8.8–11.2 μ; 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!) × 20–40 (–45) μ (one cell measuring 140 × 25 μ was found, in very young specimens smaller, 50–70 × 20–25 μ), thin-walled, colourless in NH_4OH 10%, no mucus or crystals.

Marginal cells densely packed, spheropedunculate, vesiculose, ± globose to ovoid, with short narrow stalk, 40–80 (–90) × (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* (Kortenhoef, 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., × 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 × 15–30 μ). 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 μ 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 5.4 μ. Hyphae branching, long, most of them thin, 1.6–6.4 μ, 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 mooth.

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', Almelosestraat, 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).

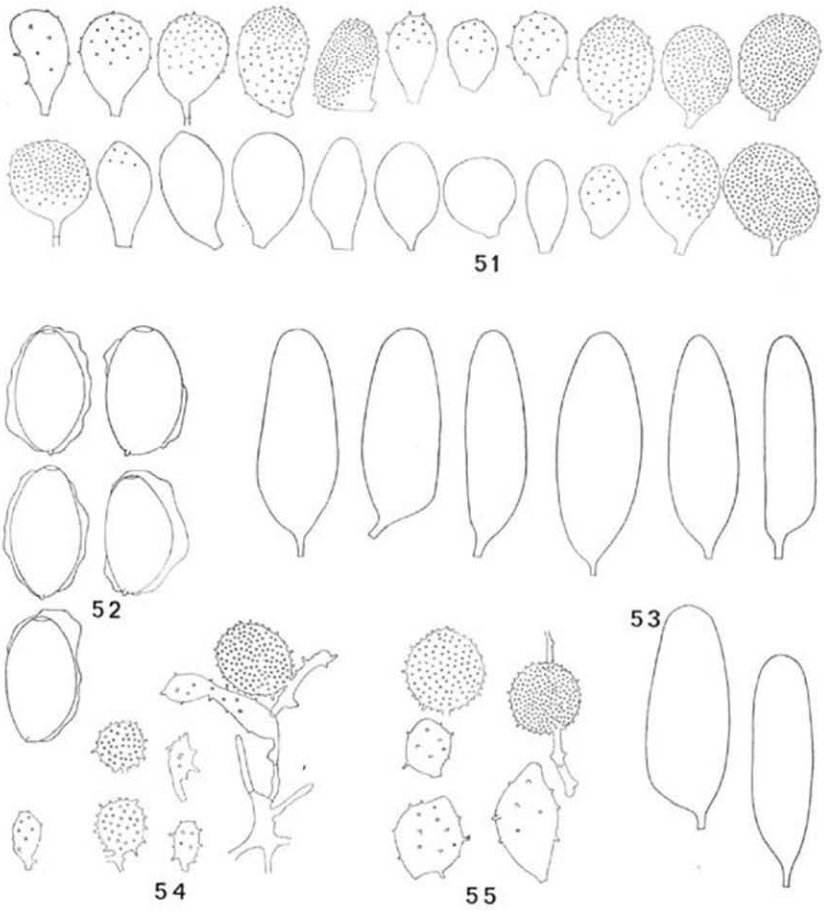
7b. COPRINUS STERCORARIUS f. **diverticulatus** Kits van Wav., *f. n.*

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. *diverticulatus*, 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, × 1212; all others, × 288.)

OBSERVATIONS. — Under the microscope *C. stercorarius* 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. stercorarius*. The description of fresh material specifically states that there was no smell of gas and the spores are typical of *C. stercorarius* (opaqueness, size, apiculus, and perispore).

Our *C. stercorarius* 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. stercorarius*, 10.8–13.5 (–14.9) × 5.4–6.3 μ, 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. stercorarius*, 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 18.8 μ, mucilaginous deposits on their surface.

Fries, describing the stem of *C. stercorarius* 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 Léveillé 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. stercorarius* 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 stercorarius*, die aus Sclerotien keimt." Hansen (1897: 111–132) very clearly demonstrated that carpophores of *C. stercorarius* 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. stercorarius* 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. stercorarius* is distinguished from the other species following down the line in the key. Orton (1960: 198) in his key to the 'stercorarius group' mentioned neither a rooting stem nor the presence of a sclerotium.

While collecting our *C. stercorarius* 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 cespitose 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. stercorarius* 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 stercorarius* 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 stercorarius* Bulliard (1791) which indeed depict the present species very well. From Bulliard's later description (1809: 398) and the cited plate of *Agaricus stercorarius*, 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. stercorarius* 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 stercorarius* (without any reference to the homonymous name published by Scopoli) previous to the publication of his Plate 542. The 'original' *A. stercorarius* 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. stercorarius*.

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 stercorarius*.

Nomenclatively there are two taxa of *Coprinus* with the epithet "stercorarius," viz. *Agaricus stercorarius* Scop. 1772 = *Coprinus stercoreus* Fr. 1838 = *Coprinus stercorarius* (Scop.) ex Fries 1857, and *A. stercorarius* Bull. 1781 = *A. stercorarius* Bull. ex St-Amans 1821. The question arises whether or not Fries's form "stercoreus" has to be considered nomenclatively different from "stercorarius." In our opinion this is not so, as in his very first description Fries referred to the name "stercorarius" given by Scopoli and as in 1857 he himself used the name "stercorarius" 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 stercorarius*, 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 stercorarius* 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. stercorarius* 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. stercorarius* it is clear, that his species belongs to the 'stercorarius group.' Unless it is assumed that Brefeld's species has never been found since, it must have been either *C. stercorarius*, *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 × 5 μ) *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. stercorarius*. 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 *Ç. 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. stercorarius* by the presence of a sclerotium, the small size of the cap (3–5 mm), and the shape of the spores (in *C. tuberosus* "ellipsoide, noire" and in *C. stercorarius* "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. stercorarius* 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. stercorarius*. 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 stercorarius* forme *tuberosus* fully agrees with *C. stercorarius* except for the spore sizes (5–7 × 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. stercorarius* 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. stercorarius*, while J. E. Lange (1939: 114) regarded the species as probably identical with *C. stercorarius*. Judging by Quélet's descriptions of *C. stercorarius* and *C. cineratus* (1888: 49), the shape and size of the spores were the only means of distinguishing between them, those of *C. stercorarius* being "en amande ou lenticulaire, brun ou bistre violet, 12 μ," those of *C. cineratus* "ellipsoide noire, 10 μ." Orton (1960: 198) gives the same spore sizes for both species, *C. stercorarius* 9–11 × 5.5–7 μ and *C. cineratus* 9–11(–12) × 5.5–7(–8) μ. He concludes that "in view of the similarity of spore size it remains to be seen whether *cineratus* and *stercorarius* 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. stercorarius* 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. stercorarius* Fr. ex Bull., but not *C. cineratus* Quél. Later Kühner & Romagnesi (1953: 385) decided to substitute the name *C. stercorarius* 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 × 5.2–7 μ. 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) × 9–10 μ, while our own measurements read 14.4–16.2(–17.1) × 8.1–9.9 μ. 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.

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BEITRÄGE ZUR SYSTEMATIK UND BIOLOGIE VON PLECTOSPHAERELLA CUCUMERIS UND DER ZUGEHÖRIGEN KONIDIENFORM

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(Mit Tafeln 7, 8 und drei Abb.)

Die Konidienform von *Plectosphaerella cucumeris* Klebahn ist ein ausserordentlich häufiger *Cephalosporium*-ähnlicher Bodenpilz. Die Hauptfruchtform wurde in vier Reinkulturen aufgefunden. Sie entspricht den Beschreibungen von *Nectria septomyxa* Wollenweber und *Plectosphaerella cucumeris* Klebahn. Das für den ersten Namen verbindliche Basionym ist *Sphaerella solani* Ellis & Everh., wovon Typenmaterial erhalten ist. Auf Grund einer Nachuntersuchung wird dieser Pilz aus der Diskussion ausgeschlossen und als *Didymella solani* (Ellis & Everh.) W. Gams & Gerlagh, comb. nov. bezeichnet. Damit bleibt *Plectosphaerella cucumeris* als der einzige gültige Name für die perfekte Form übrig.

In den allermeisten Fällen liegt aber nur die Konidienform vor, deren eindeutige Bestimmung in Reinkulturen ebenfalls leicht durchführbar ist. Eine grosse Variationsbreite ist jedoch zu berücksichtigen. Nach kritischer Sichtung der verfügbaren Namen wird die neue Kombination *Fusarium tabacinum* (Beyma) W. Gams vorgeschlagen.

Im Anschluss an die morphologisch-systematischen Untersuchungen werden die bisher bekannten Tatsachen über die Biologie der Art zusammengefasst und ergänzt durch eigene Versuche zur Pathogenität.

Didymella solani (Ell. & Ev.) W. Gams & Gerlagh, *comb. nov.*

Sphaerella solani Ell. & Ev. *in* Proc. Acad. nat. Sci. Philad. **1893**: 134. 1893 (Basionym).
FEHLBESTIMMUNG: *Mycosphaerella solani* (Ell. & Ev.) Wollenw. *in* Phytopathology **3**: 229. 1913 (≡ *Nectria septomyxa* Wollenw. *in* Angew. Bot. **8**: 191. 1926).

Das Typenmaterial von Ellis & Everhart (in NY) zeigt Blattflecken auf *Solanum dulcamara* mit linsenförmigen schwarzen Ascomata, die im toten Blattgewebe eingesenkt sind. Sie messen ca. 100μ im Durchmesser. Die Wand ist an der Basis des Ascomas 8—10 μ dick. Die Asci sind bitunikat, stehen beinahe ohne basales Kissen in paralleler Anordnung am Grunde des Peritheciums und messen 34–40 × 12–15 μ. Die Ascosporen sind 2-zellig, am Septum eingeschnürt, an den Enden zugespitzt, manchmal schwach gekrümmt, hyalin, und messen 13–15 × 4.5–5.5 μ.

Dieser Pilz gehört somit eindeutig in die Gattung *Didymella*. Nach Corbaz (1957) lässt er sich am ehesten als *Didymella exigua* (Niessl) Sacc. bestimmen. Das Typenmaterial dieser Art (in M) erwies sich jedoch bei Nachprüfung als deutlich verschieden: Die Ascomata haben sich auf toten Stengeln von *Verbena officinalis* entwickelt; sie sind wesentlich grösser, ca. 250 μ im Durchmesser, und besitzen eine an der Basis etwa 25 μ dicke Wand. Die Asci messen 48–55 × 15–17 μ. Die Ascosporen sind ebenfalls etwas länger, 15–17 × 4.5–5 μ. Obwohl sich aus dem Herbarmaterial wenig Schlüsse über die Variationsbreite und den Wirtspflanzenkreis ziehen lassen, scheinen die Unterschiede doch auszureichen, um die beiden Arten gegeneinander abzugrenzen. Der Pilz von Ellis & Everhart wird deshalb als *Didymella solani* bezeichnet.

Wollenweber (1913) hatte offensichtlich mit der anschliessend zu beschreibenden *Plectosphaerella cucumeris* zu tun, die auf Kartoffelstengeln Perithecien bildete; seine Bezeichnung als *Mycosphaerella solani* (Ell. & Ev.) Wollenw. muss deshalb als Fehlbestimmung bezeichnet werden. Damit kann auch der neue Name *Nectria septomyxa* Wollenw. für denselben Pilz nicht übernommen werden.

PLECTOSPHAERELLA CUCUMERIS Kleb.—Abb. 1, 2; Taf. 7, 8

Plectosphaerella cucumeris Kleb. *in* Phytopath. Z. 1: 43. 1930.

Nur bei wenigen Isolaten wurden Perithecien erzielt. Bei den entsprechenden Stämmen kamen sie jedoch innerhalb von 14 Tagen auf Hafermehlagar zur Reife. Nach Abimpfung aus einer reich fruktifizierenden Kultur traten auch auf Kartoffel-Dextrose-, Malz-, Möhren- und Kirschenagar Perithecien auf; diese Nährböden erwiesen sich jedoch gegenüber Haferagar unterlegen, da die Perithecienzahl bei wiederholter Ueberimpfung mit der Zeit abnahm.

Die Perithecien sind flaschenförmig, im unteren Teil dunkelbraun, im Hals hyalin. Sie entstehen teils an der Agaroberfläche, teils völlig im Nährboden eingesenkt. Besonders im letzteren Fall besitzen sie oft 2, seltener 3 Hälse (Abb. 1; Taf. 8, Fig. 4). Die Höhe beträgt 200–330 μ, die Breite 90–110 (–140) μ im unteren bauchigen Teil und 30–45 μ im Hals. Die Peritheciumwand besteht im unteren pigmentierten Teil aus 3–4 Lagen plattenförmiger Zellen und besitzt eine Dicke von etwa 10 μ; in der Halsregion besteht die Wand aus schräg nach aussen gerichteten, stumpf endenden Hyphenzellen. Der Mündungskanal ist ausgefüllt mit zarten Periphysen (Taf. 7, Fig. 1).

Die zartwandigen Asci messen 50–65 × 6.5–7.5 μ; ein Apikalapparat fehlt; sie stehen in dichter regelmässiger Anordnung auf einem dünnen Basalkissen (Taf. 8, Fig. 3), das sich bei doppelhalsigen Perithecien als Trennwand zwischen die Ascuslager schiebt (Taf. 8, Fig. 4). Die Ascosporen sind undeutlich zweireihig angeordnet (Abb. 2). Sie sind regelmässig zweizellig, meist drehrund mit symmetrischen, allmählich verjüngten und abgerundeten Enden, am Septum manchmal schwach eingeschnürt und bleibend hyalin. Die Wand der reifen Ascosporen besitzt eine fein warzige Skulptur, die sich in Anilinblau leicht anfärben lässt; die Mittelwerte für die Länge liegen zwischen 10.8 und 12.0 μ, für die Breite zwischen 2.8 und 3.0 μ; der Längen/Breiten-Quotient schwankt zwischen 3.9 und 4.2.

Untersuchte Stämme:

Die folgenden 4 Stämme bildeten Perithecien:

CBS 292.66, isoliert aus Rapsfeld, Oostflevoland-Polder (Niederlande), 1966.
CBS 386.68, isoliert aus Weizenfeld, Oostflevoland-Polder, bei Biddinghuizen, Mai 1966.
1117, isoliert von rostbefallenen Blättern von *Tussilago farfara*, Kasseteich bei Schönkirchen, Kr. Plön (D.B.R.), Oktober 1965.
CBS 423.66, isoliert aus Boden, Katanga, durch Mlle. Lanneau.
Ausserdem wurden ca. 2000 konidienbildende Stämme aus Weizenböden in Kiel-Kitzeberg isoliert. Dazu kamen zahlreiche Kulturen von verschiedenen Seiten in Verband mit *Cephalosporium*-Zusendungen. Eine Reihe von Isolaten wurde auch im Herbarium des Commonwealth Mycological Institute, Kew (IMI- Nummern) bestimmt. Dazu vgl. den Abschnitt über Oekologie.

Klebahn (1930) beschrieb die Art offenbar in Unkenntnis der Arbeiten von Wollenweber, da er für seinen Pilz keine Verwandtschaft mit der Gattung *Nectria* vermutete. Klebahns Material ist nicht erhalten; aus der sorgfältigen Beschreibung geht jedoch ohne Zweifel hervor, dass er den hier diskutierten Pilz untersucht hat.

Es handelt sich offensichtlich um eine Hypocreacee (sensu Müller & von Arx, 1962) aus der Verwandtschaft von *Nectria*, jedoch mit besonders dunklen und schlanken Perithecien. Vor allem die Pigmentierung besitzt genügend taxonomischen Wert, um den Pilz von *Nectria* gesondert zu halten (entgegen der Auffassung von Müller & von Arx, 1962). Deshalb wird der Name *Plectosphaerella cucumeris* als der für die Perithecienform gültige angesehen.

Bisher ergaben alle Subkulturen aus einzelnen Ascosporen oder Konidien der fruktifizierenden Stämme wieder Perithecien. Stämme ohne Perithecienbildung konnten durch Kreuzung nicht zum Fruktifizieren gebracht werden. Deshalb muss die Art als homothallisch angesehen werden.

Von tausenden untersuchten Stämmen zeigten in unseren Versuchen nur 4 Perithecienbildung. Klebahn (1930) beobachtete reife Perithecien auf Gurken, in Agarkulturen erhielt er nur sterile Initialen. Wollenweber (1913) erzielte reife Perithecien in Reinkultur auf sterilisierten Kartoffelstengeln. In der Mehrzahl der Fälle ist bei Bodenisolaten offenbar die Fähigkeit zur Fruktifikation verloren gegangen.

Fusarium tabacinum (Beyma) W. Gams, *comb. nov.* — Abb. 3

Cephalosporium tabacinum Beyma *in* Zentbl. Bakt. ParasitKde (Abt. II) **89**: 239. 1933 (Basionym).
Cephalosporium ciferrii Verona, Studio sulle cause microbiche che danneggiano la carta ed i libri, Roma, 30. 1939.
Cephalosporiopsis imperfecta M. & F. Moreau *in* Revue Mycol. **6**: 67. 1941 (ohne lateinische Diagnose).
AUSZUSCHEIDEN:
Cephalosporium curtipes Saccardo *in* Michelia **2**: 286. 1881.
Fusarium affine Fautrey & Lambotte *in* Revue mycol. **18**: 68. 1896.

Die Konidienform von *P. cucumeris* lässt sich auf geeigneten Nährböden mit Sicherheit bestimmen. Alle Isolate bilden raschwüchsige, blass ockerfarbene oder

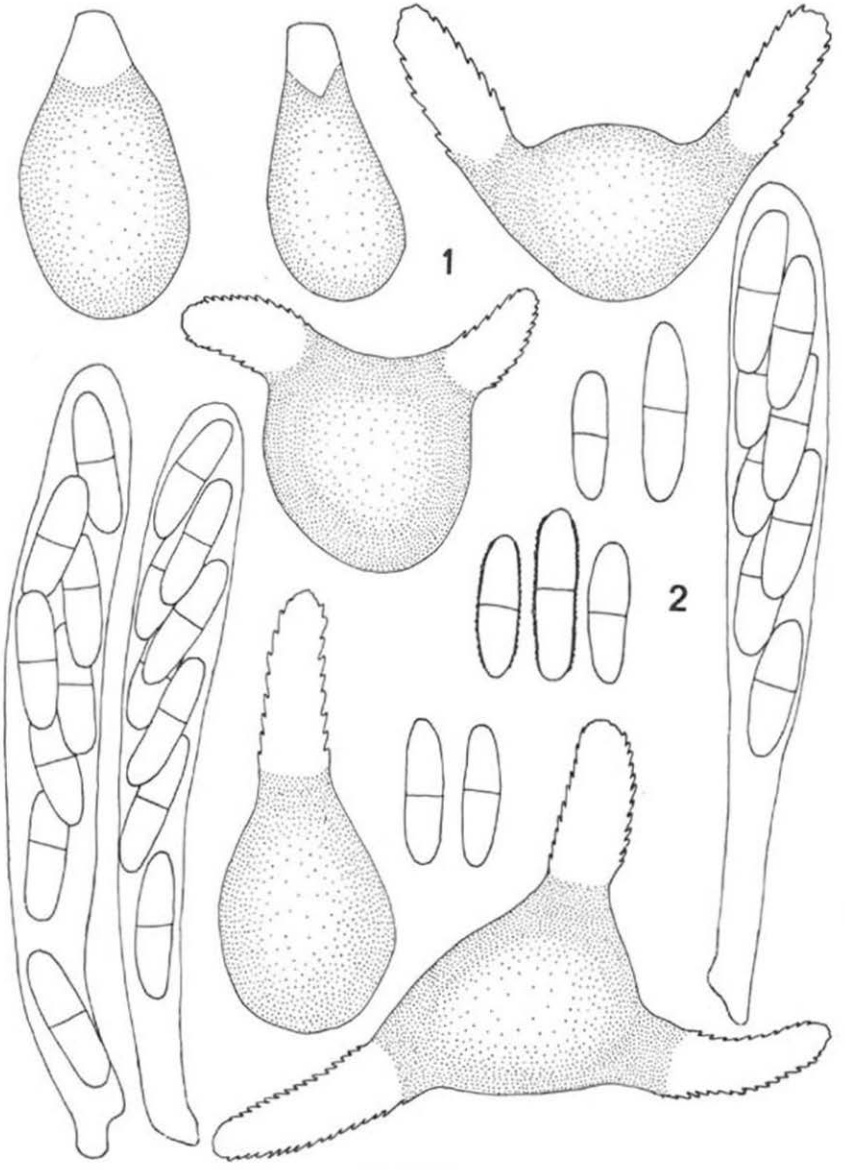

Abb. 1, 2

bei Lichtzutritt rosa getönte Kolonien; auf Malzagar erreichen sie in 10 Tagen bei 20° C einen Durchmesser von 40–50 mm. Durch Sporenbildung werden sie rasch schleimig; Luftmycel ist meist nicht ausgeprägt. Die Konidienträger (Abb. 3) sind wenig verzweigt und tragen solitäre oder wirtelig angeordnete Plagiophialiden (Gams, 1968) in dichten Ständen. Die Phialiden sind an der Basis manchmal leicht bauchig erweitert, 3–4.5 μ dick und gegen die Spitze auf 2 μ verschmälert; ihre Länge schwankt zwischen 12 und 30 μ. Die Phialiden sind oft unregelmässig verbogen, an der Spitze zeigen sie manchmal eine Reihe von Einschnürungen, die an Annellophoren erinnern, jedoch keine geschlossenen Ringe formen. Eine kurze, kaum erweiterte Collarette ist meist deutlich zu erkennen. In älteren Kulturen steht nur ein kleiner Teil der Phialiden aufrecht mit gesonderten Konidienköpfchen, der Grossteil gerät durch Schleimbildung mit der Agaroberfläche in Kontakt, wo sich grosse Sporenmassen ansammeln.

Die Sporenform ist stark abhängig vom verwendeten Nährboden. Die folgenden Merkmale sind für die Bestimmung von besonderer Wichtigkeit und nur im Stadium der *Hochkultur* gut zu erkennen. Sie sind besonders deutlich in Kulturen auf Hafermehlagar oder zelluloschaltigen, zuckerarmen Nährböden zu beobachten. Die Mehrzahl der Sporen ist median septiert. Daneben kommen jedoch auch immer unseptierte Sporen vor. Die untere Zelle ist zylindrisch, kaum gekrümmt, gegen die Basis konisch verschmälert und am Ende abgestutzt. Die distale Zelle ist einseitig gekrümmt und am Ende deutlich zugespitzt. Die Krümmung ist so schwach, dass die Sporeninnenseite meist nicht konkav ist. Die Mittelwerte der Konidienmaße für mehrere Kulturen liegen zwischen 8.2 und 13.5 μ für die Länge und zwischen 2.2 und 3.0 μ für die Breite. Extreme Sporen können bei manchen Kulturen zwischen 5 und 15 μ in der Länge, und zwischen 2.0 und 4.0 μ in der Breite messen. Der Längen/Breiten-Quotient liegt im allgemeinen zwischen 3.4 und 4.4. Bei Beobachtung in Milchsäure liegen die Messwerte allgemein etwas niedriger als in Wasser.

Auf stark zuckerhaltigen Nährböden treten leicht Mastformen auf, die charakterisiert sind durch kürzere, selten septierte, kaum gekrümmte Sporen mit abgerundeten Enden; septierte Sporen besitzen geschwollene Zellen, wodurch sie am Septum eingeschnürt erscheinen (vgl. Abb. bei Moreau, 1941).

Die untersuchten Stämme zeigen in der Konidienform beträchtliche Variabilität, insbesondere bezüglich der Konidienseptierung. Diese Variabilität ist bei den perithecienbildenden Stämmen nicht kleiner als bei den Konidienstämmen, weshalb kein Grund besteht, an der Einheitlichkeit der Art zu zweifeln.

Nomenklatur

Cephalosporium curtipes Sacc. (1881) wurde manchmal als Name für den besprochenen Pilz gebraucht. Nach der Abbildung in Saccardos „Fungi italici delineati" (1881: No. 707) ist diese Art wahrscheinlich nicht mit *P. cucumeris* identisch. Typenmaterial ist nicht erhalten.

ERKLÄRUNG DER ABB. 1, 2

Abb. 1–2. *Plectosphaerella cucumeris*. — 1. Perithecien auf Hafermehlagar (200 : 1). — 2. Asci und Ascosporen (2000 : 1).

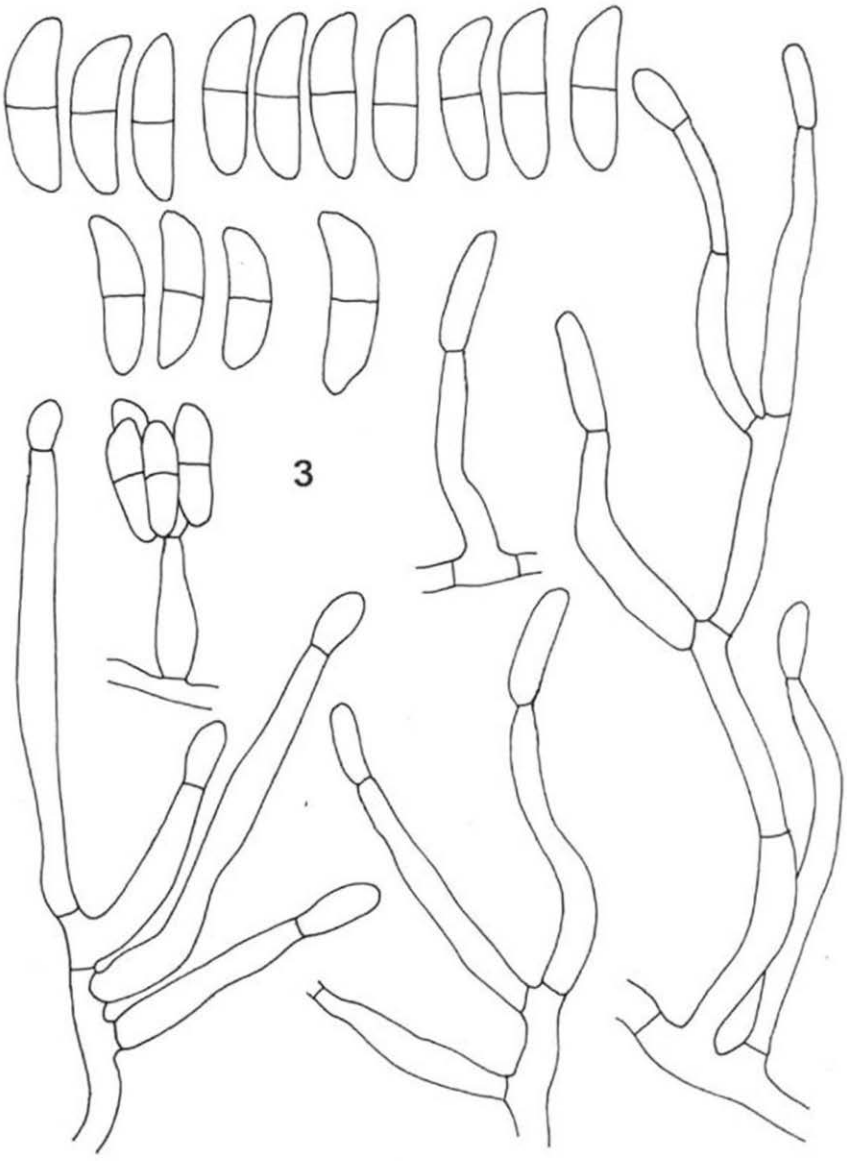

Abb. 3

Fusarium affine Fautrey & Lamb. (1896) wurde von Sherbakoff (1915: 126) im Sinne der Konidienform von *P. cucumeris* aufgefasst. Wollenweber erkannte diese Beschreibung an und schuf die Neukombination *Septomyxa affinis* (Sherb.) Wollenweber (1930: No. 643). Eine Kultur von Wollenweber ist erhalten als CBS 291.38. *Fusarium affine* Fautrey & Lamb. gehört nach Wollenweber (1917 und 1932) jedoch zu *Hymenula* und kann damit nicht als Basionym für die Konidienform von *P. cucumeris* dienen.

Klebahn (1930) verzichtete darauf, der Konidienform von *P. cucumeris* einen eigenen Namen zu geben, da die Hauptfruchtform bekannt ist: „Nötigenfalls kann er den Speziesnamen des zugehörigen Ascomyceten führen". Die übrigen von ihm (l.c., 43–44) diskutierten *Cephalosporium*-Arten sind mit Ausnahme der überhaupt nicht mehr rekonstruierbaren Arten *C. fructigenum* McAlp. und *Hyalopus populi* Nypels deutlich von *P. cucumeris* verschieden.

Die Typenkulturen von *Cephalosporium tabacinum* Beyma (CBS 137.33), *Cephalosporium ciferrii* Verona (CBS 137.37) und *Cephalosporiopsis imperfecta* M. & F. Moreau (CBS 121.42) entsprechen der Konidienform von *P. cucumeris*.

Daraus ergibt sich als ältestes gültiges Epitheton *tabacinum* Beyma.

Verschiedene Ansichten über die Gattungszugehörigkeit wurden von Wollenweber (1932) diskutiert. Nach der Definition von Gams (1969) kann die Art nicht zu *Acremonium* (= *Cephalosporium* ss. auct. plur.) gehören, da sie keine typischen Orthophialiden besitzt. Die Gattung *Cephalosporiopsis* beruht mit *C. alpina* Peyronel auf einem ungenügend bekannten Pilz und wird am besten fallen gelassen. Die Gattung *Septomyxa* kann nach von Arx (1963) ebenfalls nicht verwendet werden, da die Lectotypenart *S. aesculi* Sacc. in *Discella* aufgeht. Es bleibt die Alternative, den Pilz in *Fusarium* zu belassen oder eine neue Gattung zu beschreiben. Aufgrund des allgemeinen Habitus (derbe Hyphen, rasches Wachstum, reichliche schleimige Sporulation) lässt er sich in die Sektion *Eupionnotes* der Gattung *Fusarium* neben *F. merismoides* Corda einreihen, wenngleich die Konidien schwächer gekrümmt sind als bei anderen *Fusarium*-Arten. Die für *Fusarium* charakteristische Zuspitzung und Septierung ist jedoch bei Hochkulturen auch vorhanden. Die Phialidenmorphologie passt ebenfalls auf *Fusarium*. Ebenso wie *F. merismoides* besitzt *P. cucumeris* keine ausgeprägten Tuberculariaceen-Merkmale, noch weniger kann von Melanconialen-Merkmalen gesprochen werden. Die mikroskopisch ähnlichste Art ist *F. dimerum* Penzig, die sich durch meist grössere, stärker gekrümmte (einseitig konkave), oft mehrfach septierte Sporen und den Besitz von Chlamydosporen leicht unterscheiden lässt. Als gültiger Name für die Konidienform von *P. cucumeris* wird deshalb hier *Fusarium tabacinum* vorgeschlagen.

ERKLÄRUNG DER ABB. 3

Abb. 3. *Fusarium tabacinum*, Konidienträger und Konidien (2000 :1).

Oekologie

Nach allen verfügbaren Beobachtungen ist *P. cucumeris* ein sehr häufiger Bodenpilz in Wiesen- und Ackerböden. Die allermeisten Beobachtungen liegen aus Mittel-, West- und Nordeuropa vor, eine geringere Anzahl aus Nordamerika. In Afrika wurde die Art mehrfach als Tabakschädling erkannt (s. unten). Ueber reichliches Vorkommen in Ackerböden berichten Guillemat & Montégut (1956), Machacek (1957), Domsch & al. (1968) und J. Rintelen, Stuttgart-Hohenheim (1967, persönl. Mittlg.). Das stärkste Auftreten wurde in Weizenfeldern bei Kiel festgestellt mit beinahe 2000 von insgesamt über 23,500 Isolaten; in einem der untersuchten Böden stand die Art an 2. Stelle, in dem anderen an 4. Stelle der Gesamtpilzhäufigkeiten. In einer besonders tonreichen Ackerparzelle im Wieringermeer-Polder stand sie mit 24 % der Gesamtisolate überhaupt an der Spitze (Gams & al., 1969). Aus Waldboden wurde bisher erst eine Kultur erhalten: von einem Eichenbestand auf kalkreichem Mull, Hackfort, isoliert durch Frl. Dr. J. C. Went, Arnheim. Die Art wurde auch aus Sanddünen in Meeresnähe isoliert (Moreau, 1941, und eigene Isolate bei Kiel).

Im allgemeinen werden die oberen Bodenschichten bevorzugt, bei 40 cm Tiefe ist *P. cucumeris* kaum mehr anzutreffen (Guillemat & Montégut, 1956). Eine leichte Vermehrung nach Mineraldüngung ($N > P > K$) wurde festgestellt (ibid.). Eine geringe Anreicherung in Weizenfeldern nach vorausgehender wiederholter Rapskultur gegenüber der Dauerweizen-Vergleichsparzelle konnte statistisch abgesichert werden (Domsch & al., 1968).

Beobachtungen an oberirdischen Pflanzenteilen sind nicht sehr zahlreich: An Kartoffelstielen (Wollenweber, 1913; Sherbakoff, 1915), an Tomatenstielen (IMI 57,860), Tabak (s. unten), Gurken (Klebahn, 1930), an Melonenstielen (Kultur von F. Roll-Hansen aus Norwegen, Prov. Vestfold), auf *Phlox drummondii* (IMI 126,437), Salat (IMI 110,303), *Canna indica* (eigene Beob.). Häufiger wurde die Art von Pflanzenwurzeln isoliert, wenngleich keine nennenswerten Anreicherungen in der Rhizosphäre bekannt sind: *Ammophila arenaria* (eigene Isolate, Bottsand bei Kiel), *Allium sativum* (Guillemat & Bigot, 1960), *Linum usitatissimum* (Timonin, 1941), *Sinapis arvensis*-Sämlinge (Kulturen erhalten von J. Rintelen, Stuttgart-Hohenheim), *Veronica hederaefolia*-Sämlinge (dto.), *Vicia faba* (IMI 53,258), *Viola tricolor* max. hort. (van Eek, 1937, Kultur CBS 355.36), *Nicotiana tabacum* (CBS 286.64). Eine Isolierung von Cysten von *Heterodera rostochiensis* wurde bekannt (IMI 111,017).

Krankheitssymptome wurden beschrieben an 4 Pflanzenarten:

An grünen Kartoffelstengeln treten schwarzbraune Streifen auf (Wollenweber, 1913). Infektionsversuche waren nicht signifikant. An Tabaksämlingen (Slagg, 1921; Tisdale, 1929) treten im Feld und im Gewächshaus unregelmässige olivfarbene Blattflecken und Stengelbräune auf; bei besonders hoher Feuchtigkeit können die Pflanzen absterben. Die Symptome sind durch Infektionsversuche reproduzierbar. In den letzten 20 Jahren wurden in verschiedenen afrika-

nischen Staaten starke, teilweise totale, Schäden an Tabaksaatbeeten durch *Septomyxa affinis* gemeldet („blotch" oder „scab"): In Rhodesien durch Hopkins (1949), in Nyasaland durch Bates (1957), Hopkins (1958) und Anon. (1959), in Tanganyika durch Riley (1958) und auf Mauritius durch Orieux (1958).

Bei Treibhausgurken (Klebahn, 1930) vergilben die jungen Früchte bald nach dem Abblühen von der Spitze her und sterben ab. Aehnliche Symptome traten auch ohne Pilzbefall auf, sie liessen sich jedoch durch künstliche Infektionen induzieren. An Stiefmütterchen (*Viola tricolor* max. hort.) konnte van Eek (1937) in Infektionsversuchen sowohl unter sterilen Bedingungen *in vitro* wie in Topfversuchen starke Schädigungen induzieren. Bei Verwendung sterilisierter Erde waren die Ausfälle am stärksten. Die überlebenden Pflanzen waren in der Grösse signifikant reduziert. Bei kombinierter Infektion reduzierte jedoch *Septomyxa affinis* den durch *Brevilegnia gracilis* verursachten Schaden.

Im Anschluss an diese Beobachtungen führten wir selbst mit den ersten drei perithecienbildenden Kulturen Infektionsversuche im Gewächshaus durch an Kartoffeln, Gurken, Weizen und Raps. Bei den ersten beiden Arten wurde eine Sporensuspension in die Stengel bzw. in die jungen Früchte injiziert. Bei Gurken wurde die Sporensuspension auch nach Klebahns Angaben auf die Narben aufgetropft. Bei Weizen und Raps wurden Sporensuspensionen auf die Blätter von jungen Pflanzen gespritzt oder vor der Aussaat mit dem sterilisierten Boden (Sand oder Ton) vermischt. Ausserdem wurden die Wurzeln von Sämlingen gewaschen, in eine Sporensuspension getaucht und danach in Erde gepflanzt. Alle diese Versuche blieben ohne Ergebnis.

Auch Domsch & Gams (1968a) stellten mit 5 anderen Isolaten keinerlei schädliche Einflüsse einer Reinkultur auf sterile Wurzeln von Weizen und Raps fest; das Trockengewicht von Erbsenwurzeln war jedoch gegenüber der Kontrolle um $\frac{1}{4}$ reduziert. Zugleich wurde eine schwache Förderung von *Chlorella pyrenoidosa* in Agarkulturen festgestellt.

Somit scheint sehr selten der Fall einzutreten, dass einzelne Stämme von *P. cucumeris* pathogen werden können. Bei Gurken kann dieser Fall nach Klebahn (1930) nur in Gewächshäusern eintreten, da hohe Temperaturen und Feuchtigkeit erforderlich sind.

Physiologie

Bisher wurden nur konidienbildende Stämme von *Plectosphaerella cucumeris* physiologisch untersucht.

Geringe Cellulasebildung (White & al., 1948) sowie Pectinasebildung (Wieringa, 1956) sind bekannt. Untersuchungen von Domsch & Gams (1969) zeigten relativ geringe und sehr variable Pectinase-Aktivität, hohe Xylanaseaktivität und mässige, aber konstante Cellulaseaktivität (gemessen an Carboxymethylcellulose für das Enzym C_x). Pisano & al. (1963) beobachteten guten Casein-Abbau, geringe Gelatineverflüssigung, mässige Milchausflockung, geringe fibrinolytische Aktivität, geringe

Hydrolyse von Hämoglobin, fehlende α-Amylase und β-Glucosaminidase bei dem Kulturfiltrat von *Cephalosporium ciferrii*. Pisano & Machinist (1961) sowie Sardinas & Pisano (1967) wiesen intensive Steroidumsetzungen nach. Mehrere Kulturen oxydierten Mangan (Schweisfurth, 1966, persönl. Mittlg.).

In einem Antibiosetest konnten keine Hemmwirkungen gegen pathogene Bodenpilze festgestellt werden (Domsch & Gams, 1968 b).

Herrn Dr. J. A. von Arx danken wir für zahlreiche wertvolle Hinweise im Laufe dieser Arbeiten und für Beratung über die Systematik der Gattung *Didymella*. Den zahlreichen Einsendern von Kulturen, die nur zum Teil im Text genannt werden konnten, sei auch hier herzlich gedankt. Unser Dank gilt auch den Kuratoren der Herbarien von Commonwealth Mycological Institute (Kew), New York Botanical Garden und dem Botanischen Institut München für die Ermöglichung der Herbaruntersuchungen.

Summary

The ascigerous and conidial states of *Plectosphaerella cucumeris* Klebahn are redescribed. Perithecia were readily obtained only in four out of several thousand cultures. The species is homothallic. The correct name of the ascigerous state is considered to be *Plectosphaerella cucumeris* Klebahn; *Nectria septomyxa* Wollenweber is rejected, because it is based on a bitunicate ascomycete *Sphaerella solani* Ellis & Everh., for which the new combination *Didymella solani* (Ellis & Everh.) W. Gams & Gerlagh is proposed. For the identification of the conidial state the need for a 'Hochkultur' is emphasized. It is renamed *Fusarium tabacinum* (Beyma) W. Gams.

A compilation of data has been made for the frequency of occurrence of the fungus in arable soils. The most significant observations on pathogenicity reported in the literature refer to tobacco and pansies. Own pathogenicity tests with potatoes, cucumbers, wheat, and rape were not successful. The most significant biological activities reported were xylan decomposition and steroid transformations.

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ERKLÄRUNGEN DER TAFELN 7 UND 8

TAFEL 7

Fig. 1. *Plectosphaerella cucumeris*, Längsschnitte durch Perithecien aus einer 14 Tage alten Kultur auf Hafermehlagar (500:1).

TAFEL 8

Fig. 2–4. *Plectosphaerella cucumeris*. — 2. Querschnitt durch ein Perithecium (500 : 1). — 3. Längsschnitt durch Perithecium-Basis, ungefärbt (1000 : 1). — 4. Paramedianer Längsschnitt durch ein doppelhalsiges Perithecium (500 : 1).

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NEW SPECIES OF THYSANOPHORA AND CUSTINGOPHORA GEN. NOV.

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(With Plate 9 and four Text-figures)

Two monoverticillate species of *Thysanophora* are described and figured, *T. canadensis* spec. nov. and *T. taxi* (Schneider) comb. nov. A new hyphomycetous genus, *Custingophora*, related to *Thysanophora* and *Phialocephala*, is proposed with *C. olivacea* spec. nov. as type species.

The genus *Thysanophora* was erected by Kendrick (1961a), who included two species, *T. penicillioides* (Roum.) Kendrick, the type species, and *T. longispora* Kendrick. Both species are characterized by brown-coloured sympodially branched conidiophores, bearing biverticillate penicilli resembling those of *Penicillium*. In this paper two species with monoverticillate penicilli are added to the genus.

The third fungus dealt with in this paper resembles superficially an *Aspergillus* but shows some significant differences from this genus. Ontogenetically it rather resembles a monoverticillate *Penicillium* but has slimy spores, just like *Phialocephala* Kendrick (1961b) resembles a polyverticillate *Penicillium*. Since the fungus cannot be satisfactorily placed in any existing genus of the Moniliales either, a new genus is proposed for it, *Custingophora*.

Thysanophora canadensis Stolk & Hennebert,

spec. nov.—Text-fig. 1, Pl. 9, figs. 1–4

Fungus imperfectus. Coloniae in natura inconspicuae, e conidiophoris atro-brunneis, conidiis griseo-viridibus, hyphis repentibus et sclerotiis constistentes, in vitro variabiliter crescentes, centro zonatae, velutinae, griseo-virides vel olivaceae, fertiles, margine sparsae et pallidiores, sclerotia formantes, facie reversa atro-brunnea. Mycelium e hyphis immersis hyalinis vel subhyalinis 1.5–3 μ latis, hyphisque aeriis in natura atro-brunneis prostratis reticulatis in vitro subhyalinis lanosis formatum. Conidiophora mononemata, solitaria vel adjuncta, in hyphis immersis vel aeriis enata, erecta, simplicia et successive proliferantia. Stipites cylindracei, 150–1000 μ longi, 4.5–6.5 μ lati, septati, atro-brunnei, basi parce vel haud inflati, cellulis duabus distalibus hyalinis vel subhyalinis usque ad 2–2.5 μ attenuatis, apice abrupte usque ad 4.5–6 μ incrassatis, pariete laevi. Proliferationes singulae laterales e cellula subdistali formatae, sympodiales, parce vel haud septatae, 15–30 μ longae, 2.5–3 μ latae, fertiles. Penicilli verticillo unico phialidum 3–8 instructi. Phialides hyalinae, parallelae

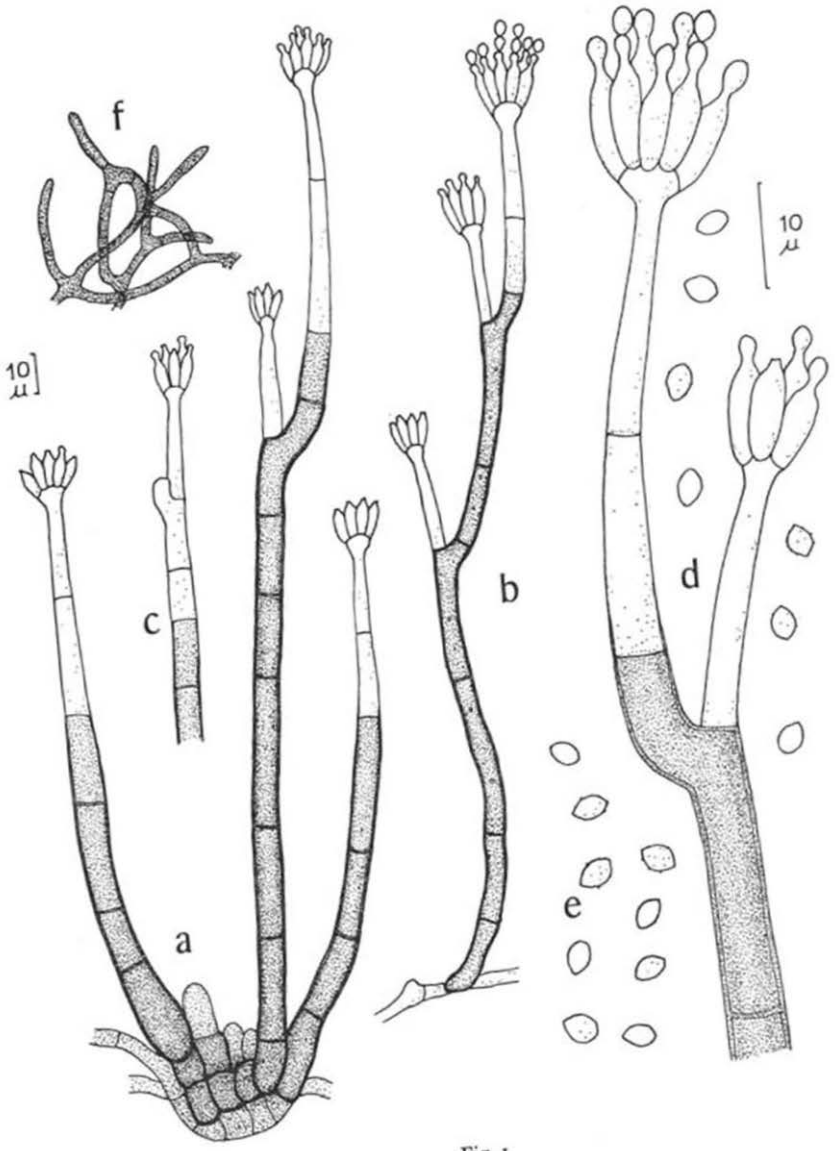

Fig. 1

parum divaricatae, cylindraceae, tubulares, apice in collum curtum 1 μ diam. attenuatae, collario nullo, 7.5–12 × 2.5–4 μ. Phialosporae continuae, siccae, catenas basipetales formantes, postea ovoideae, apiculatae, verruculosae, 2–3.5 × 1.7–2.5 μ. Sclerotia 250–400 μ diam.; medulla e cellulis hyalinis crasso-tunicatis formata; cortex cellulis brunneis instructus, hyphisque brunneis anastomosantibus intertextis 2–4 μ latis setisque radiantibus sterilibus tectus.

Typus in aciebus *Tsugae canadensis* repertus, Bell's Corners, Ontario, Canada, Sept. 1961, *G. L. Hennebert*, et in culturis desiccatis et vivis conservatus (G.L.H. 2497-B, CBS 334.68).

The first subcultures made from the fresh material, preserved as dried cultures (Plate 9, fig. 1), grew rapidly on both malt agar and potato dextrose agar. They were zonate, producing abundant conidial structures in the centre of the colonies, but more scarcely in the external zone, while this zone was drying out. Sclerotia were produced in a more or less radiate arrangement, at first appearing whitish, but later becoming surrounded by brown shining hyphae and then appearing dark brown.

After 7 years of preservation under mineral oil the cultural appearance has changed considerably (Pl. 9, fig. 2). Colonies on malt agar grow slowly, attaining a diameter of 4 cm within two weeks at 25° C. They consist of a well-developed, largely submerged mycelium, upon which abundant conidial structures are produced, forming a thin, velutinous, slightly zonate layer, pale greyish green coloured near Tea Green (Ridgway, Pl. 47) when young, but soon turning more greyish approximating Deep Olive-Gray (Ridgway, Pl. 51). Colony margins consisting of submerged hyphae often show dark green colours. Sclerotia are not produced any more. Reverses of colonies are zonate, showing greenish black shades near Ivy Green and Olivaceous Black (Ridgway, Pls. 31, 46).

Colonies on oatmeal agar grow more slowly, about 2 cm within two weeks at 25° C. They are very thin, greyish brown, approximating Grayish Olive (Ridgway, Pl. 46). Sclerotia are not produced. Reverses show grey to brownish shades.

Colonies on Czapek agar grow very restrictedly, about 1 cm within 14 days at 25° C, and are sterile.

In culture the mycelium is hyaline to subhyaline, septate, 1.5–3 μ in diameter. Production of conidial structures is most pronounced on malt agar. Conidiophores occur singly, erect or ascending, arising mostly as branches from submerged hyphae but occasionally, especially in the centre of the colonies, also from aerial hyphae. Stipes are septate, olivaceous when young, brown-coloured in age, but paler toward the apex, with the upper two cells hyaline or subhyaline; they are somewhat sinuous, unbranched or sometimes sympodially branched by successive single subapical proliferations of the penultimate cell of the stipe, and consequently geniculate. They are variable in length, ranging from 150–1000 μ, with a diameter of 4.5–6.5 μ, uniform over almost their entire length, but tapering very gradually in the upper two cells to a diameter of 2–2.5 μ, enlarging again abruptly to about 4.5–6 μ diameter at the apex. Their walls are smooth, about 0.5 μ thick, becoming thinner toward the apex. Distal cells may become lateral, following the proliferation of the penultimate cell of the stipe, and then appear like branches (metulae), 15–30 ×

EXPLANATION OF FIGURE 1

Text-fig. 1. *Thysanophora canadensis*, CBS 334.68 — a. Group of conidiophores emerging from the host. — b. Conidiophore in culture. — c. Development of a proliferation of the penultimate cell of the stipe (culture). — d. Upper part of the conidiophore with monoverticillate penicilli (culture). — e. Phialospores (culture). — f Reticulum of hyphae surrounding the sclerotium (host).

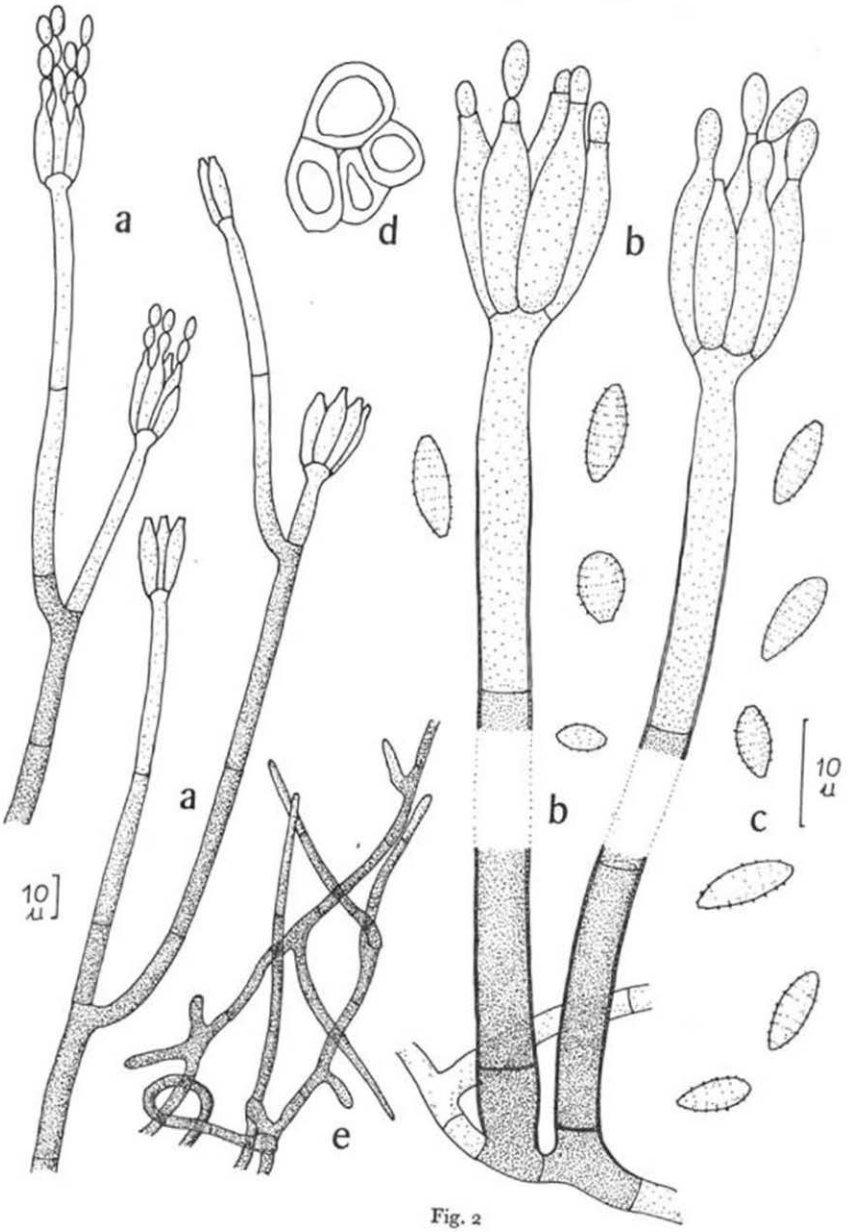

Fig. 2

2.5–3 μ. Proliferations are very variable in length, reaching 100 μ, 1–4-septate, concolorous with the stipe; up to 3 or 4 proliferations may develop successively on one stipe. Penicilli consist of a verticil of 3–8 phialides, borne in a parallel or slightly divergent cluster at the apex of the stipe. Phialides, measuring 7.5–12 × 2.5–4 μ, are concolorous with the distal cell of the stipe, flask-shaped, cylindrical at the base, tapering abruptly to a small narrow neck of about 1 μ diameter; a collarette is lacking. Phialospores are borne in basipetal chains, they are dry, continuous, subhyaline, globose to subglobose at first, soon becoming ovoid to broadly ellipsoid, slightly apiculate at both ends, with walls smooth or very finely roughened, 2–3.5 × 1.7–2.5 μ. Sclerotia are white when young, becoming dark brown in age, occurring singly or in small clusters, about 250–400 μ in diameter, consisting of a medulla of thick-walled hyaline cells and a cortex of one layer of similar brownish cells; they are surrounded by a dense reticulum of brown, septate, abundantly branching and anastomosing hyphae 2–4 μ in diameter emerging from the cortex. Toward the outside these hyphae become more loosely woven, producing sterile seta-like projections at the periphery.

On the host the mycelium is partly immersed in the tissues and hyaline, partly creeping on the surface, thick-walled, dark brown, sinuous, branched, and often anastomosed, forming a reticulum. Conidiophores are erect, either emerging in groups of 6–16 from small thick-walled, dark brown, roundish cells filling the stomata, or ascending solitarily from creeping hyphae. Conidiophores are 120–350 μ in length by 6–9 μ in diameter, being longer and slightly thinner in culture. The conidial heads and conidia in culture look like those developing on the host.

The holotype is represented by natural specimen, dried and living cultures from needles of *Tsuga canadensis*, Bell's Corners, Ontario, Canada, 10 Sept. 1961, *G. L. Hennebert*, (G. L. H. 2497-B, CBS 334.68).

Conidial structures of this new species were detected on the host amongst the much larger structures of *T. penicillioides*. The two species are closely related, *T. canadensis* differing from *T. penicillioides* in producing monoverticillate conidial heads, whereas those of *T. penicillioides* are biverticillate. Moreover there is a slight difference in size and shape of the phialospores, those of *T. canadensis* being less ellipsoid than those of *T. penicillioides* (1.8–6.7 × 1.4–4 μ). *Thysanophora canadensis* differs from the monoverticillate species *T. taxi* by the much smaller phialides and phialospores.

Thysanophora taxi (Schneider) Stolk & Hennebert,

comb. nov.—Text-fig. 2, Pl. 9, figs. 5, 6

Penicillium taxi Schneider *in* Zentbl. Bakt. ParasitKde, II Abt., **110**: 47. 1956 (basionym).

Colonies on malt agar grow restrictedly, attaining a diameter of about 2.5 cm within two weeks at 25° C. They consist of a well-developed mycelium, but largely submerged, upon which abundant conidial structures are borne. Colonies are

EXPLANATION OF FIGURE 2

Text-fig. 2. *Thysanophora taxi*, CBS 206.57. — a. Branched conidiophores. — b. Conidiophores showing monoverticillate penicilli and foot cells. — c. Phialospores. — d. Thick-walled cells of the sclerotium. — e. Reticulum of hyphae surrounding the sclerotium.

velutinous, plane, showing dark olivaceous green colours near Lincoln Green (Ridgway, Pl. 41), becoming more grey-green near Grayish Olive (Ridgway, Pl. 46) in age. Sclerotia, produced in limited number, are white when young. Reverses of colonies show dark green to almost black shades, approximating Olivaceous Black (Ridgway, Pl. 51).

Colonies on oatmeal agar grow about 1.2 cm within two weeks at 25° C, they are thinner than those on malt agar, producing somewhat more vegetative mycelium and sporulating less abundantly, and show olivaceous green shades near Grayish Olive, becoming brownish grey near Drab and Hair Brown in age (Ridgway, Pl. 46). Sclerotia are produced in limited numbers, and become black soon. Reverses of colonies show brown colours.

Colonies on Czapek agar grow very restrictedly, about 1 cm within 14 days at 25° C, producing only limited conidial structures.

The mycelium is hyaline to subhyaline or brownish, with the hyphae 2–4 μ in diameter. Conidiophores arise singly as branches from submerged or aerial hyphae. Stipes are erect or ascending, septate, olivaceous when young, brown-coloured in age, mostly paler toward the apex. They are somewhat sinuous, unbranched or sometimes branched by successive, single, subapical proliferations of the penultimate cells of the stipes, occasionally of one of the lower cells, and consequently becoming geniculate. They are variable in length, ranging from 100–1000 μ in length, and 4–6 μ in diameter, tapering in the upper cell to a constriction beneath the apex of 3–4 μ diameter, abruptly enlarging again at the apex to a diameter of 6–7 μ. Their walls are smooth, up to 0.5 μ thick, becoming thinner toward the apex. Distal cells may become lateral following proliferation of cells of the stipe, then appearing like branches. These branch-like structures are subhyaline or brownish, of variable length, the aseptate ones mostly about 40 μ long, but up to 100 μ when 1- or 2-septate. Proliferations are usually concolorous with the stipe or slightly paler, 1–4-septate, very variable in length, up to 200 μ. Penicilli consist of one verticil of phialides, which are mostly parallel-ranged. Phialides are subhyaline to pale olivaceous when young, mostly darkening in age, usually concolorous with the distal cell of the stipe. They are smooth-walled, 17–24 × 5–7 μ, cylindrical at the base, tapering abruptly to a small narrowed neck of about 1.5 μ diameter; a collarette is lacking. Phialospores are continuous, dry, subhyaline to slightly olivaceous, ovoid to ellipsoid, showing scars at each end, slightly roughened, with the roughenings often arranged in parallel bands, 6.5–10 × 2–3.5 μ, forming very long, parallel to slightly divergent chains, appearing silky when viewed under low magnifications. Sclerotia are white when young, becoming dark brown to almost black in age, occurring singly or in clusters, 300–600 μ in diameter, very hard, consisting of a medulla of thick-walled hyaline cells and a cortex of similar brownish cells. They are surrounded by a reticulum of brown, septate, abundantly branching and anastomosing hyphae 2–2.5 μ in diameter, producing sterile seta-like projections at the periphery of up to 40 μ long.

CBS 206.57, representing the holotype, was isolated by Dr. R. Schneider from needles of *Taxus baccata* in March 1953 and sent to the CBS as strain 74.80 in 1957.

Dr. Schneider reported the production of abundant sclerotia on malt agar, developing in concentric zones. After having been cultivated for 15 years, the production of sclerotia is very much reduced.

The penicillate structures producing long conidial chains as well as the colour of the colonies of *T. taxi* suggest a *Penicillium*. However, this fungus clearly belongs in *Thysanophora* because of its brown-coloured sympodially branched conidiophores. In

addition the structure of the sclerotia is identical with that occurring in *Thysanophora*. The species is closely related to *T. longispora*, since both produce large phialides and large spores, but differs from it in producing monoverticillate penicilli. The shape and size of the phialospores (*T. longispora*: 8–16.2 × 1.8–3 μ) and the cultural appearance of the two species are also different. The branching of the conidiophores is more irregular in *T. taxi* than in other species of the genus in that proliferations develop from lower cells of the stipe.

Custingophora Stolk, Hennebert & Klopotek, *gen. nov.*[1]

Deuteromycetes, Moniliales.

Hyphae hyalinae vel fuliginosae, ramosae, septatae. Conidiophora mononemata, simplicia vel sympodialiter proliferantia, erecta, fuliginea, septata, basi saepe radicibus munita, apice in vesiculam inflata. Phialides uniseriatae, conidiophori apice successive enatae, brunneae. Phialosporae mucosae, continuae.

Species typica: *C. olivacea* Stolk, Hennebert & Klopotek.

Hyphae hyaline or coloured, branched, septate. Conidiophores mononematous, simple or sympodially branched by subapical proliferation, erect or ascending, brown, septate, arising from foot cells which may produce rhizoids, enlarging apically to form a more or less distinct vesicle. Phialides produced successively on the apex of the conidiophore or vesicle, brown. Phialospores continuous, collecting at the apex of the conidial head in drops of slime.

Type species: *C. olivacea* Stolk, Hennebert & Klopotek.

The new genus shows similarities with the genera *Aspergillus* Micheli ex Fr., *Thysanophora* Kendrick, and *Phialocephala* Kendrick (1961b).

The conidial heads of *Custingophora* resemble superficially those of *Aspergillus*, yet the two genera differ in some important characteristics. In *Aspergillus* the development of the conidial head starts with the production of an apical swelling of the conidiophore to form the vesicle, then phialides develop simultaneously on this vesicle. In *Custingophora*, on the other hand, phialides develop successively on the apex of the conidiophores, which enlarges gradually to accommodate the increasing number of phialides until finally a vesicle is formed (Text-fig. 4). In *Aspergillus* conidiophores are always simple, in *Custingophora* sympodially branched conidiophores occur. Moreover, the conidia in the new genus do not adhere in dry conidial chains, as is usual for most *Aspergillus* species, but they collect in conspicuous slime balls.

Before the apex of the stipe swells to produce the characteristic vesicle, the developing conidial heads of *Custingophora* resemble those of the genus *Thysanophora*. Moreover in both genera sympodially branched brown conidiophores occur, which develop by subapical proliferation of the stipe. However, the genera *Custingophora* and *Thysanophora* can easily be separated on the characters of the phialospores. In *Thysanophora* phialospores are dry amerospores forming conspicuous long chains, whereas in

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[1] Etymology: κύστις, small vesicle, φόρειν, to bear.

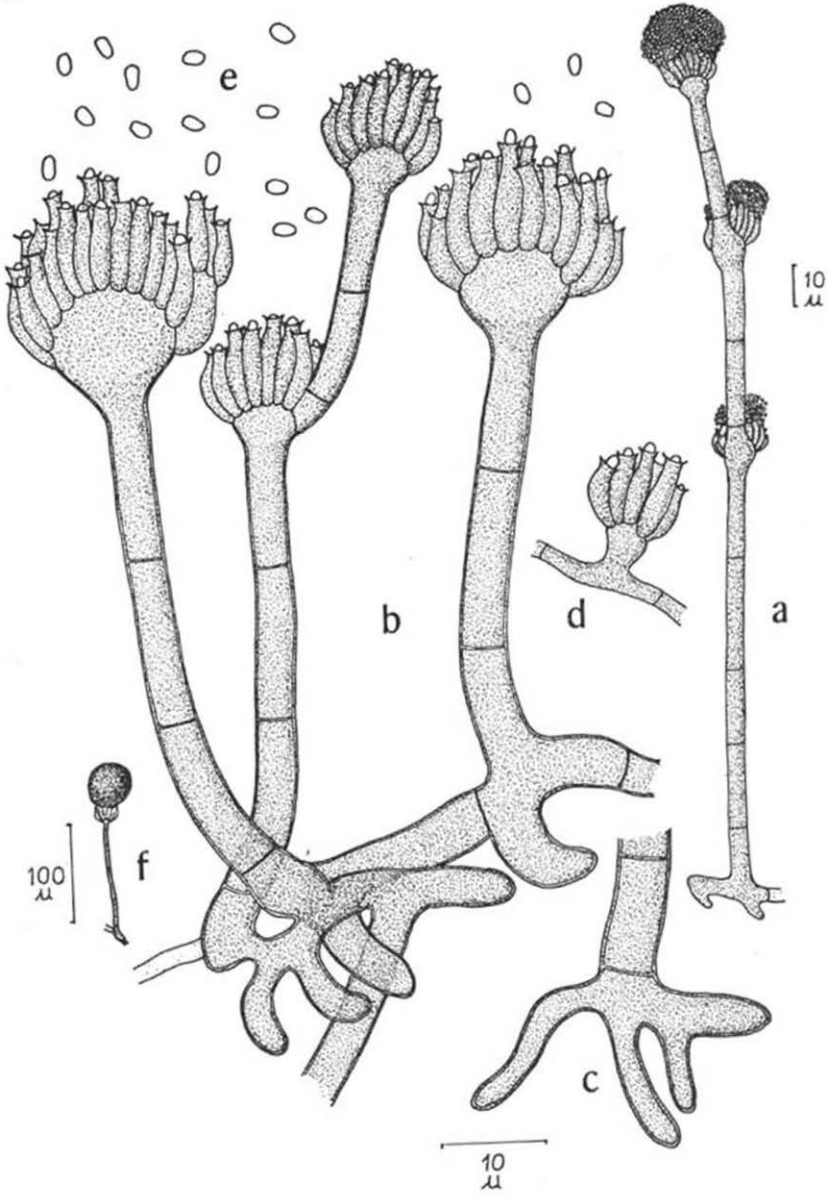

Fig. 3

Custingophora phialospores collect in slime balls. In addition the shape and the colour of the phialides are different in the two genera, those of *Thysanophora* resembling the phialides of *Penicillium*, whereas in *Custingophora* the phialides are similar to those of *Phialophora*.

The new genus has in common with *Phialocephala* the brown colour of the stipe, the phialides with well-marked collarettes and the phialospores collecting in drops of slime. However, they differ in the structure of the sporogenous head and in the branching of the conidiophore. In *Custingophora* the conidial head consists of one series of phialides covering the conspicuous swollen vesicle-like apex of the stipe, in *Phialocephala*, on the other hand, the sporogenous heads are complex structures, consisting of one to several series of metulae with the ultimate series bearing the phialides. Neither the apex of the stipe nor the apices of the phialide-bearing metulae form vesicle-like swellings. The stipe of *Custingophora* may become geniculate by successive proliferation, in *Phialocephala* no geniculate stipes occur.

Custingophora olivacea Stolk, Hennebert & Klopotek,

spec. nov.—Text-figs. 3, 4, Pl. 9, figs. 7, 8

Fungus imperfectus. In vitro coloniae satis rapide crescentes, velutinae, olivaceo-brunneae, azonatae, margine alba, facie reversa olivacea vel atro-brunnea, saepe sectores pallidiores formantes. Mycelium e hyphis hyalinis vel subhyalinis 1.5–2.5 μ latis formatum. Conidiophora numerosa, erecta vel ascendentia, plerumque e hyphis submersis rarius aeriis formata, plerumque singula interdum pauca aggregata, in omnibus partibus uniformiter brunnea. Stipites septati, simplices vel sympodialiter proliferationibus succesivis simplicibus et subapicalibus ramosi, ideoque geniculati, e cellulis basalibus rhizoidibus conspicuis aseptatis digitaliformibus notatis enascentes, 20–200 μ longi, 2.5–5.5 μ diam., basi usque ad 7 μ diam., apicem versus attenuati, interdum constricti, vesicula distali, brunnea, subglobosa, 6–12 μ diam. Phialides successive enatae, uniseriatae, parallelae, externae incurvatae, internae rectae, laeves, cylindraceae vel botuliformes, brunneae, insuper constrictae collarioque conspicuo praeditae 6.5–10 × 2–2.5 μ. Phialosporae continuae, mucosae, ellipsoideae vel ovoideae, subhyalinae, laeves, 1.8–3 × 1–1.5 μ.

Typus in cultura desiccata et viva, e materiis vegetalibus putrescentibus, Germania, *A. Klopotek*, 1965 (CBS 335.68, G.L.H. 9398).

Colonies on malt agar grow fairly rapidly, attaining a diameter of about 9 cm within two weeks at 30° C. They are composed of a largely submerged vegetative mycelium bearing a very thin layer of conidial structures, which lend the colonies an olivaceous to brownish colour near Dark Grayish Olive (Ridgway, Pl. 46); they are azonate, showing a tendency to produce almost colourless sectors. The margin is broad and colourless. Reverses of colonies are olivaceous or dark brown.

Colonies on oatmeal agar in general agree with those on malt agar. Sporulation

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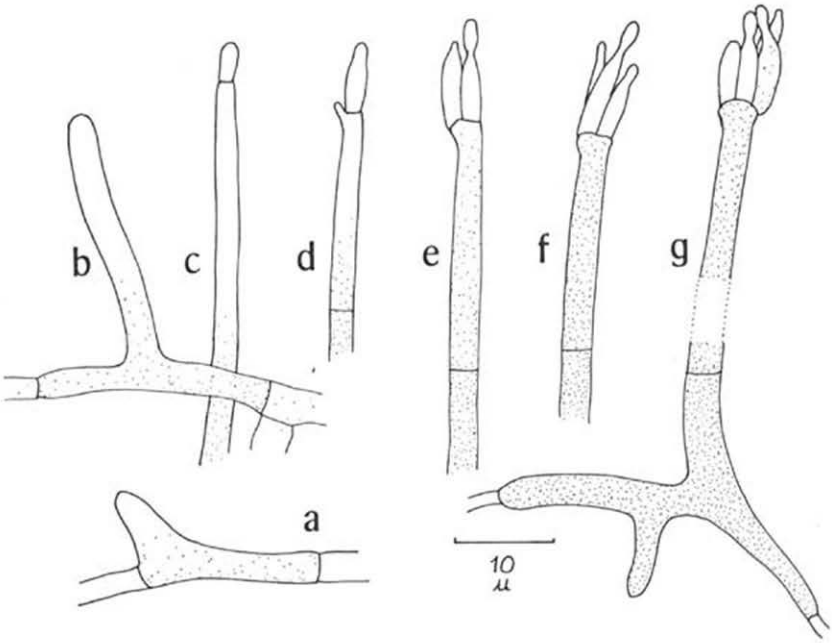
EXPLANATION OF FIGURE 3

Text-fig. 3. *Custingophora olivacea*, CBS 335.68. — a. Sympodially branched conidiophores. — b. Different types of conidiophores. — c. Foot cell showing finger-shaped rhizoids. — d. Reduced conidial head. — e. Phialospores. — f. Habit sketch of a conidiophore with a slime ball consisting of phialospores.

is more pronounced. Colonies range from Dark Grayish Olive to Olivaceous Black (Ridgway, Pl. 46).

Colonies on Czapek agar develop only poorly, they are almost sterile.

The mycelium is hyaline to subhyaline, with the hyphae 1.5–2.5 μ in diameter. Conidiophores arise abundantly as erect or ascending branches mostly from submerged but also from aerial hyphae, usually singly, occasionally in small groups, all parts of them being evenly brown-coloured. Stipes are septate, simple or sympodially branched by successive, single, subapical proliferation, and consequently geniculate; they develop from foot cells which are characterized by conspicuous, aseptate, finger-shaped rhizoids, and range from 20–200 μ in length, 2.5–5.5 μ in diameter, the base being somewhat thicker, about 3.5–7 μ; at the apex they develop into a vesicle beneath which they are sometimes slightly constricted; they have smooth walls, up to 0.2 μ thick. Proliferations arise from the vesicle, developing successively up to 4 per conidiophore, and measuring usually 20 to 40 μ in length. Vesicles are mostly subglobose or slightly ellipsoid, 6–12 μ in diameter, with a dense mass of phialides covering one half to two thirds of its surface. Phialides develop successively on the apex of the conidiophore, which gradually enlarges to form the vesicle (Text-fig. 4); they are parallel and the outer ones definitely incurved, cylindrical to flask-shaped, showing an inconspicuous slightly narrowed neck,



Text-fig. 4. *Custingophora olivacea*, CBS 335.68. — a–g. Development of the conidial head and the foot cell.

provided with a marked collarette, and measure 6.5–10 × 2–2.5 μ. Phialospores are hyaline to subhyaline, continuous, smooth-walled, almost cylindrical when young but soon becoming ovoid or ellipsoid, 1.8–3 × 1–1.5 μ, collecting in slime balls, which are colourless or creamish when young but brownish in age, about 40 μ in diameter.

Reduced conidial heads are often found to develop on aerial hyphae with very short stipes of about 5 μ in length and with very small vesicles.

Sclerotia are not known to occur, a perfect state has not been observed.

The holotype, CBS 335.68, G.L.H. 9398, was isolated from compost by Dr. A. von Klopotek, Giessen, Germany, in 1965.

The species is thermotolerant, having its optimal development at 30° C. At 40° C the colonies reach a diameter of 5 cm within two weeks, but do not sporulate. At 10° C and 45° C growth ceases.

The authors wish to thank Miss J. B. Pannebakker for making the photographs reproduced in Pl. 9.

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EXPLANATION OF PLATE 9

Figs. 1–4. *Thysanophora canadensis*, CBS 334.68. — 1. Dried culture made soon after isolation. — 2. Living subculture on malt agar, made 7 years later, originating from same isolate. — 3. Conidiophore, 480 ×. — 4. Section through a sclerotium, 400 ×.

Figs. 5, 6. *Thysanophora taxi*, CBS 206.57. — 5. Phialospores, 1200 ×. — 6. Conidiophore, 1200 ×.

Figs. 7, 8. *Custingophora olivacea*, CBS 335.68. — 7. Conidiophore, 1200 ×. — 8. Conidiophore, 480 ×.

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REMARKS ON SPECIES OF PHOMA REFERRED TO PEYRONELLAEA—II

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(With Plates 10, 11 and one Text-figure)

Additional data are given on *Phoma glomerata* (Cda.) Wr. & Hochapf., *Phoma prunicola* (Opiz) Wr. & Hochapf., and *Phoma jolyana* Pirozynski & Morgan-Jones. The new combination *Phoma indianensis* (Deshpande & Mantri) is proposed and its characteristics and habitat are discussed.

In an earlier paper on this subject (Boerema & al., 1965) we concluded that there is no reason for separating *Peyronellaea* Goid. ex Togliani from *Phoma* Sacc. It was recognized that the material ascribed to the former genus represents the species *Phoma glomerata* (Cda.) Wr. & Hochapf., *P. prunicola* (Opiz) Wr. & Hochapf., and *P. musae* (Joly) Boerema & al.

In the present paper some further data on these three species are given, while a fourth species, recently described as *Peyronellaea indianensis*, is discussed more extensively.

Phoma glomerata (Cda.) Wr. & Hochapf.

Phoma herbarum var. *euphorbiae-guyonianae* Pat., Cat. rais. Pl. cell. Tun. 116. 1897.

To the numerous synonyms listed in our previous paper (Boerema & al., 1965: 52) the one mentioned above can be added.

The holotype material (PC; as '*Phoma Euphorbiae Guyonianae* Pat.', Tozeur 1893) consists of one stem piece with a few pycnidia associated with multicellular chlamydosporal structures similar to those produced by *P. glomerata* in vivo. Moreover, the shape and dimensions of the spores (averaging 6.6 × 3.1 μ, but varying from 5.1–11 × 2.5–4 μ) agree with those of *P. glomerata*. The identity of *P. herbarum* var. *euphorbiae-guyonianae* with *P. glomerata* is also in accordance with Patouillard's original opinion that it represented only a variant of a ubiquitous species.

Additional data. —

A convenient description and summary of diagnostic data of *P. glomerata* was recently given by Morgan-Jones (1967a).

Concerning the effect of the composition of the agar media on the production of dictyochlamydospores (Boerema & al., 1965: 56) we must in addition refer to the experimental study of Bosmans (1961) on five strains of *P. glomerata* (some indicated

with different names, now all known to be synonyms of *P. glomerata*). His conclusion that in certain growth-conditions "the chlamydospores of *Peyronellaea* are not formed, so that it is difficult to distinguish *Peyronellaea* from *Phoma*" accords completely with our statement that it is undesirable to separate the two genera (Boerema & al. 1965: 48, 49).

PHOMA PRUNICOLA (Opiz) Wr. & Hochapf.

Coniothyrium prunicola (Opiz) Husz *in* Magy. kertész. szölész. Föisk. Közl. **5**: 23. 1939 [as '*C. prunicolum* (Sacc.) Husz'].
Phoma herbarum f. *capparidis* Sacc. *in* Michelia **2** (1): 93. 1880.
Phoma herbarum var. *tulostomatis* Pat., Cat. rais. Pl. cell. Tun. 116. 1897.

To the synonyms listed in our previous paper (Boerema & al. 1965: 59) the three cited above can be added.

Husz made the combination *C. prunicola* because of the sometimes olive-green to brownish colour of the mature spores (compare Boerema & al., 1965: 60).

The infraspecific taxon *P. herbarum* f. *capparidis* was described by Saccardo from an exsiccatum of Roum., Fungi gall. exs. No. 280, current name '*Pleospora capparidis* Speg.' The specimen concerned was not found in Saccardo's herbarium, but a copy preserved in the Farlow Herbarium (FH, stems of *Capparis spinosa*, Toulouse 1878) apparently contains a pycnidial fungus identical with that described by Saccardo (compare Wehmeyer, 1961: 294). The characteristics of this fungus agree completely with those of the ubiquitous *P. prunicola*, including the occurrence of chlamydospores and the often pale-brown colour of the mature spores.

The holotype of *P. herbarum* var. *tulostomatis* (FH; as '*Phoma Tulostomatis* Pat.', Fedjej 1893) consists of one fruit body of *Tulostoma volvulatum* (Sclerodermatales-Homobasidiomycetidae), on whose fibrous stalk many pycnidia occur associated with chains of single chlamydospores and multichlamydosporal structures similar to those of *P. prunicola*. Furthermore the shape and dimensions of the spores agree with those of *P. prunicola*. As the latter has been shown to be one of the most common soil-borne fungi (Dorenbosch, 1969) its occurrence on a mushroom is not surprising.

ADDITIONAL DATA. —

A convenient description and summary of diagnostic data of this species was recently given by Morgan-Jones (1967b).

Concerning the confusing misinterpretation of the synonym *Phyllosticta pirina* Sacc. by Sheldon (1907), who had in mind a true *Coniothyrium* species (Boerema & al., 1965: 60), it may be helpful to refer to a study of Mutto & Pollacci (1915). These authors were the first to make clear that *Phyllosticta pirina* (= *Phoma prunicola*) is entirely different from the *Coniothyrium* species studied by Sheldon, which is *Coniothyrium tirolense* Bubák.

With respect to the variability of *P. prunicola* in culture and the influence of the culture media on the production of dictyochlamydospores (Boerema & al., 1965: 62) we also refer to an experimental study published by Mutto & Pollaci (1917; as

Phyllosticta pirina). It is of interest to note that they found that 2 % of the spores are septate on a certain medium, while dictyochlamydospores are absent when grown on various other substrata.

PHOMA JOLYANA Pirozynski & Morgan-Jones

Phoma musae (Joly) Boerema, Dorenb. & Kest. *in* Persoonia **4**: 63. 1965; not *Phoma musae* (Cke.) Sacc. *in* Sylloge Fung. **3**: 163. 1884; not *Phoma musae* Carp. *in* Rep. Hawaii agric. Exp. Stn **1918**: 39. 1919.

Phoma jolyana Pirozynski & Morgan-Jones *in* Trans. Br. mycol. Soc. **51**: 200. 1968.

When we proposed the combination *P. musae* we failed to observe that it was preoccupied. Dr. Patrick Joly, who made an extensive study of this funges, is rightly honoured in the new name given by Pirozynski & Morgan-Jones.

Phoma indianensis (Deshpande & Mantri) Boerema, Dorenb. & Kest., *comb. nov.* — Fig. 1, Pls. 10, 11.

Peyronellaea indianensis Deshpande & Mantri *in* Mycopath. Mycol. appl. **30**: 341–344. 1966 (basionym).

DESCRIPTION. — Pycnidia (Fig. 1, Pl. 11) superficial on or partly immersed in agar, dark brown to pitch black, irregularly obpyriform to ampulliform, usually with a characteristic neck; ostiole irregularly lined by dark-walled cells (pore-like); size variable, as a rule 80–200 × 75–200 μ. Occasionally pycnidia coalesce to form irregular fructifications with several cylindrical necks. In aerial mycelium occasionally aberrant small globose pycnidia, light brown in colour, 5–15 μ diam.

Pycnidiospores (Fig. 1) hyaline to brown coloured, with or without guttules, mostly ovoid to ellipsoid or globose, usually continuous, very occasionally 1-septate, 2.5–8 × 1.5–4 μ, mostly 4–7 × 2–3.5 (average 5.4 × 2.5) μ

Single chlamydospores (Fig. 1, Pl. 11) brown to dark brown, separate or in short chains, 7–15 μ diam.

Dictyochlamydospores and intermediate stages between chlamydospores and dictyochlamydospores (Fig. 1, Pl. 11) brown to dark brown, as a rule intercalary, usually fusiform-ellipsoid, sometimes ovoid-globose or irregular, size variable, 15–50 × 7–25 μ.

Habitat. — Apparently soil-borne in tropical and subtropical regions. Isolated from different parts (leaves, stems, roots and fruits) of various plants, e.g. *Ananas*, *Citrus*, *Coffea*, *Mangifera*, and *Pinus* spp. Probably a secondary invader.

The growth habit of this fungus in vitro varies widely (Pl. 12). It is easily distinguishable from the other *Phoma*-species producing dictyochlamydospores, especially by the black, beaked pycnidia and the intercalary occurrence of the dictyochlamydospores. Furthermore, it is characterized by the production of a conspicuous reddish (orange to red-purple) pigment.

This species was originally described from soil in India and was isolated from a filter paper buried in the soil. Examination of a culture of the type, obtained from Prof. Deshpande (Marathwada University, Aurangabad, India) revealed that it is apparently identical with an unnamed *Phoma*-species in our collection isolated from

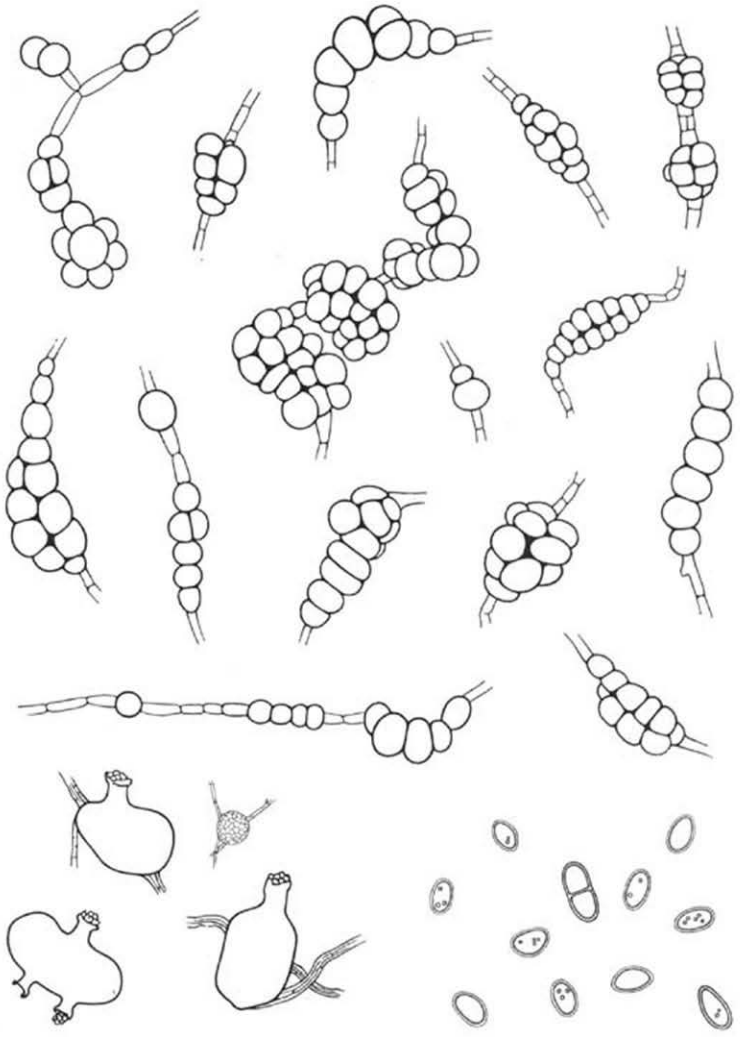

Fig. 1. *Phoma indianensis;* pycnidia, pycnidiospores, chlamydospores and dictyochlamydospores. Note the intercalary position of the dictyochlamydospores.

a *Pinus*-stem and roots of a conifer in Madagascar, the stem of *Citrus* in South France, leaves of *Ananas* and roots of *Mangifera* in Mali (Africa), and *Coffea*-fruits in India respectively (all received via CBS, Baarn). Recently the fungus has also been isolated from *Chrysanthemum*-cutlings in a greenhouse in the Netherlands.

ACKNOWLEDGEMENTS

The authors wish to express their thanks to Prof. K. B. Deshpande, Marathwada University, Aurangabad, India, for supplying a living culture of *P. indianensis*, to Dr. R. A. Maas Geesteranus, Leiden, for kindly going through the manuscript, and to Mrs. E. van Maanen-Helmer, Amsterdam, for revising the English text.

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EXPLANATION OF PLATES 10, 11

PLATE 10

Figs. 1–10. *Phoma indianensis;* various types of pycnidia, chlamydospores and dictyochlamydospores in culture. — Figs. 1–6, c. × 65. — Figs. 7–10, c. × 130.

PLATE 11

Figs. 11–14. *Phoma indianensis;* cultures of different strains. — Fig. 11, on cherry agar. — Figs. 12 and 13, on oat agar. — Fig. 14, on malt agar.

REVIEWS

R. W. G. Dennis, *British Ascomycetes*. Revised and enlarged edition of "British cup fungi." (Verlag J. Cramer, Lehre, 1968). Pp. xxxii + 455, 31 figures, 40 coloured plates. Price DM 100,—; £ 8 10s.

The first edition of the present book, entitled "British cup fungi and their allies," was welcomed among others with the words ". . . the only reasonably complete synthesis of modern thought on Ascomycete classification known to this reviewer." (Korf *in* Mycopath. Mycol. appl. **16**: 111. 1962). These words have lost nothing of their truth and could have been written with equal justification to greet the second edition; for it continues to be the best general book we have on Ascomycete taxonomy. But is it the kind of book that leaves nothing to be desired? Certainly not. The following may seem, and probably will be considered by some, to be mere details, but I have yet to meet the author who would maintain that details do not matter.

Date of publication. — Through no fault of the author the date of publication has been printed as 22.IV.1968. However, the publisher personally intimated that the first copies were delivered on the 10th of May, 1968.

Authors' citation. — In the enumeration shown below some examples are given of authors' citations as used by Dennis, followed by the corrected citation: p. 6, *Gyromitra esculenta* (Persoon) Fries—(Pers. ex Krombh.) Fr.; p. 17, *Peziza repanda* Persoon—Pers. ex Pers.; p. 32, *Leucoscypha leucotricha* (Albertini & Schweinitz ex Fries) Boudier—(A. & S. ex Pers.) Boud.; p. 42, *Cheilymenia theleboloides* (Albertini & Schweinitz ex Fries) Boudier—(A. & S. ex Pers.) Boud.; p. 48, *Geopyxis carbonaria* (Albertini & Schweinitz ex Fries) Saccardo—(A. & S. ex Pers.) Sacc.; p. 67, *Sarcoscypha coccinea* (Fries) Lambotte—(Scop. ex St-Amans) Lamb.; p. 143, *Pseudographis elatina* (Acharius) Nylander apud Karsten—(Ach. ex Fr.) Nyl. ap. Karst.; p. 152, *Dasyscyphus niveus* (Hedwig ex Fries) Saccardo—(Hedw. fil. ex Fr.) Sacc.; p. 153, *Dasyscyphus nidulus* (Schmidt & Kunze) Massee—(Schmidt & Kunze ex Schleich.) Massee.

Spelling of authors' names, — St. Amans (p. 7)—Saint-Amans (p. 259); Schröter (p. 98)—Schroeter (p. 363). The names of Sadebeck and Johansson (pp. 77–80) and of van Brummelen (p. 52, 58) have frequently been misspelled, the names of Starbäck (p. 334) and Blumer (p. 346) twice.

Citation of literature. — There are many instances of inconsistent citation. Here are a few. Ann. mycol. (p. 405)—Annales mycologici (p. 405); Beiträge zur Kryptogamenflora der Schweiz (p. 259)—Beitr. Krypt.-Fl. Schweiz (p. 382)—Beitr. Krypt. Flora Schweiz (p. 407); Giornale botanico italiano (p. 74)—Giorn. bot. ital. (p. 200)—Giornale Botanico Italiano (p. 426); Icones Fungorum (p. 403)—Icones fungorum (p. 422); Jahrb. Nass. Ver. Naturk. 23/24 (p. 406)—Jahrb. Nass. Vereins f. Naturkunde 23–24 (p. 409); S.B. Akad. Wiss. Wien (p. 161)

—Sitzber. K. Akad. Wiss. Wien (p. 161); Systema Mycologicum (p. 424)—Systema mycologicum (p. 426).

Comments with some taxa. — British mycologists seeking information on two species of British origin, *Peziza domiciliana* Cooke and *P. gerardii* Cooke, will draw a blank. On the other hand, mention is made of a Czechoslovakian species, *Fimaria porcina* Svrček & Kubička, of which it is not clear whether it has been found in Great Britain. Moreover, is it really a true *Fimaria?*

Saccobolus glaber (Persoon) Lambotte lacks a reference to the relevant literature.

Sphaerosporella hinnulea (Berkeley & Broome) Rifai is said to differ from *S. brunnea* "in growing on wet ground." Would that be all the difference?

The basionym author in *Trichophaea hemisphaerioides* is Mouton, not Montagne.

On reading the generic name *Cordyceps*, the writings of E. B. Mains come to mind, and *Hypoxylon* immediately evokes the name of its monographer, J. H. Miller. No reference is made to the work of either author.

The lack in the first edition of keys to the species has been felt; in the present edition amateurs with scanty access to scientific literature will find the tracking down of a species in large genera like *Nectria* and *Leptosphaeria* particularly difficult.

R. A. MAAS GEESTERANUS

ARX, J. A. VON, *Pilzkunde.* Ein kurzer Abriss der Mykologie unter besonderer Berücksichtigung der Pilze in Reinkultur (Verlag J. Cramer, Lehre, 1967). Pp. viii + 356, 123 illustrations. Price DM 29.50; $ 7.50.

The present book is an introduction to mycology and the two outstanding features are its conciseness and the clarity of its drawings.

As stated in his Foreword, the author endeavoured to provide a book that would be a guide both to students and to all those who are professionally concerned with mycology. Strictly confining himself to very few examples chosen to illustrate the the taxa treated, the author has succeeded in producing a guide, not a text-book. He also introduced some changes in the taxonomic arrangement to fit his personal views. Some of the figures presented in the book have been derived from sources which are not acknowledged.

The book proves to fill a need, for information was received about a new edition being in preparation.

R. A. MAAS GEESTERANUS

Mushroom Science VI. Proceedings of the First Scientific Symposium on the Cultivated Mushroom, Wageningen, 1965, and the Sixth International Congress on Mushroom Science, Amsterdam, 1965 (Centre for Agricultural Publications and Documentation, Wageningen, 1967). Pp. 585, 130 text-figures, 115 tables, 14×21.6 cm, sewn. Price Dfl 45.—; 90 s; $ 12.50.

This compact volume comprises fifty-two papers, dealing among others with the genetics, physiology, and cytology of *Agaricus bisporus*, with diseases, control of parasites, cultivation methods, and many other topics. Although most of the papers are obviously meant for circles engaged in a different occupation, some are of the greatest interest also for the mycologist-taxonomist. Examples are the papers by B. Betty Ivanovich (*Cytological behaviour in mushroom mycelium grown in submerged liquid culture*) and by Kisaku Mori & Kosuke Yamashita (*Differentiation and distribution of Lentinus edodes in Japan*).

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Fidalgo, O. & Fidalgo, M. E. P. K., *Dicionário micológico* (*in* Rickia, Supl. 2, 1967). Pp. viii + 232, 217 figures.

This dictionary has primarily been compiled to be used by Brazilian students of mycology and related disciplines.

The authors have freely borrowed from, and acknowledged the use of, the various glossaries already in existence. The resulting dictionary boasts of about 7000 terms which, combined with the numerous figures, will go far to compensate for the apparent lack of specialized educational matter in Brazil.

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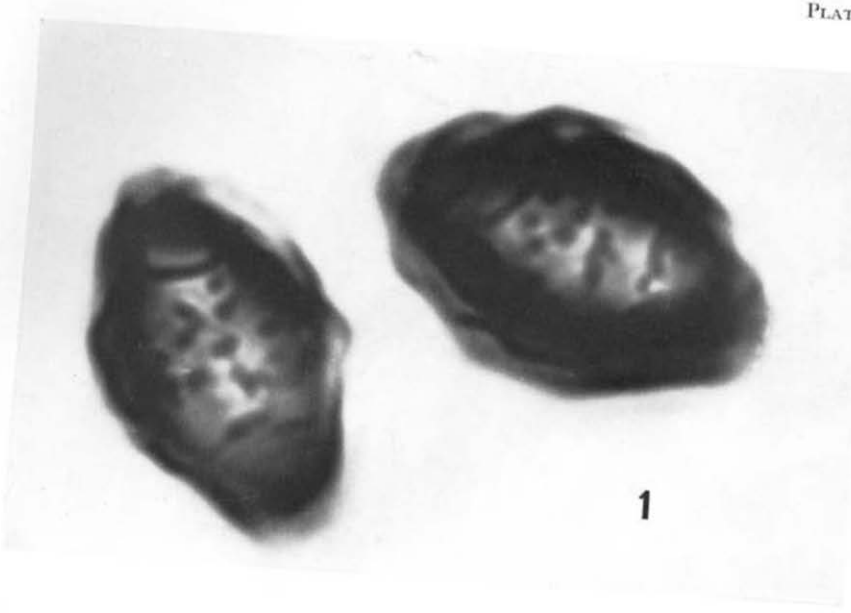
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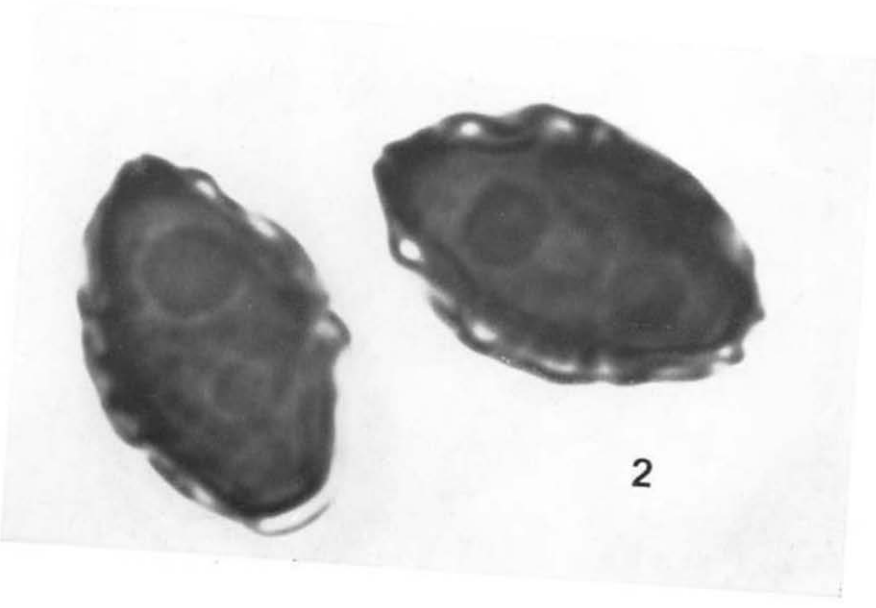
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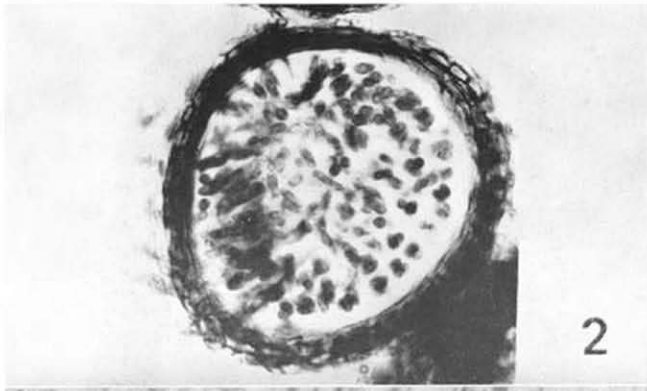
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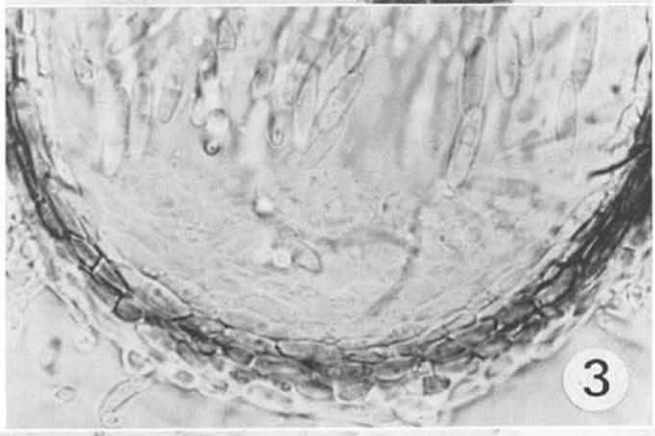
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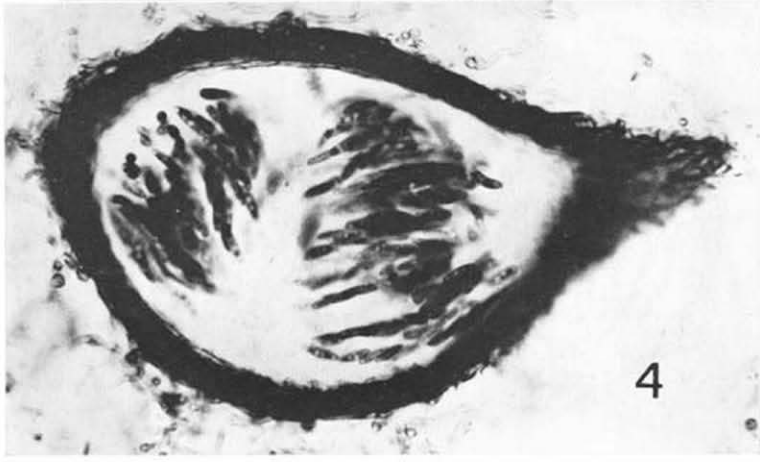
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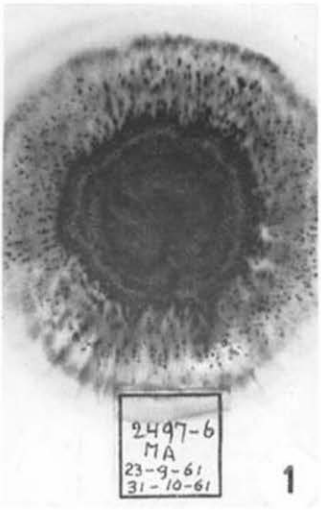
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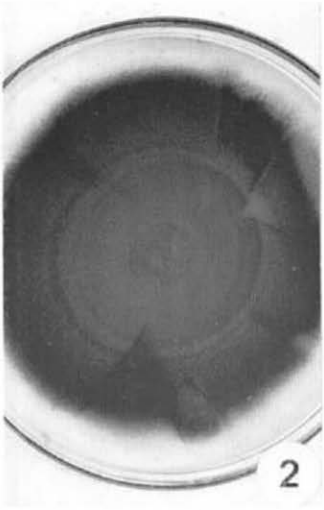
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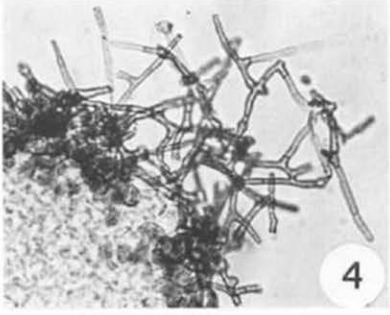
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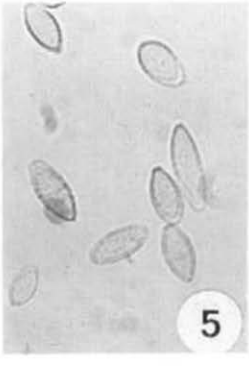
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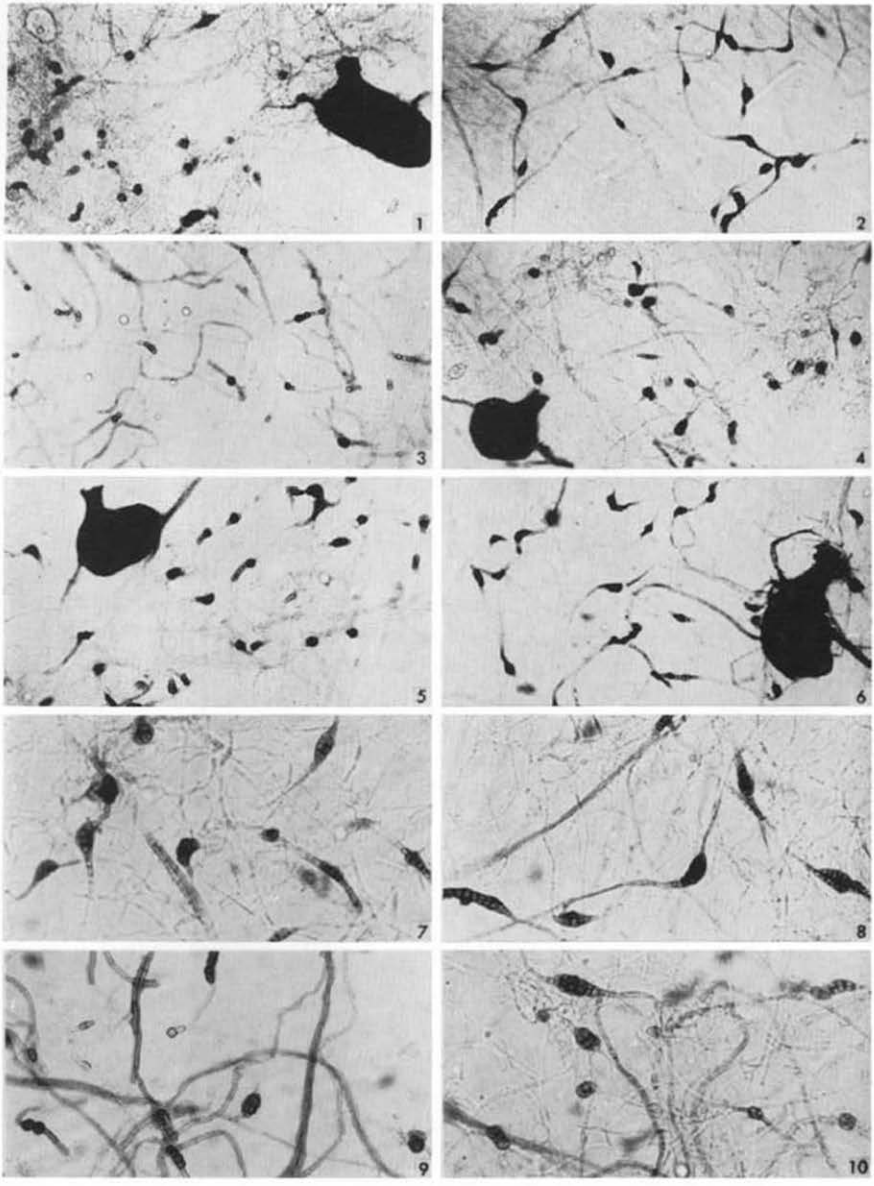
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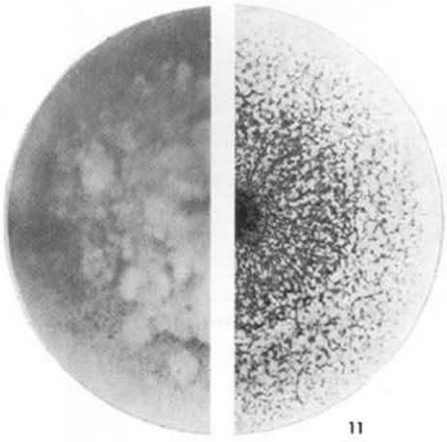

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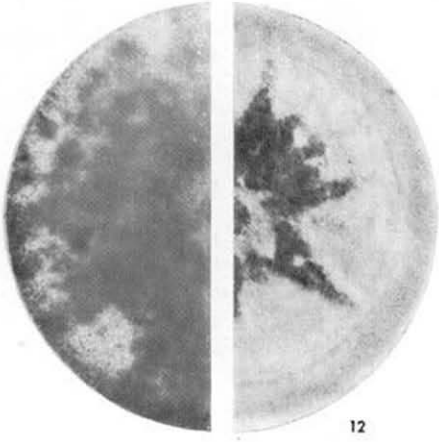

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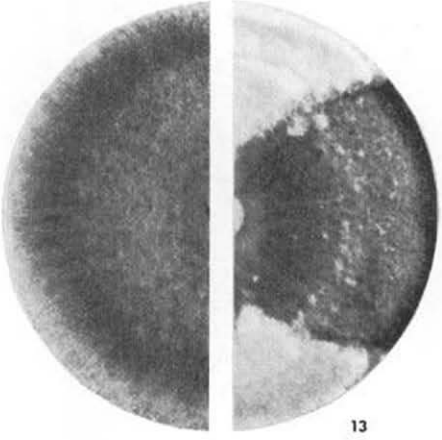

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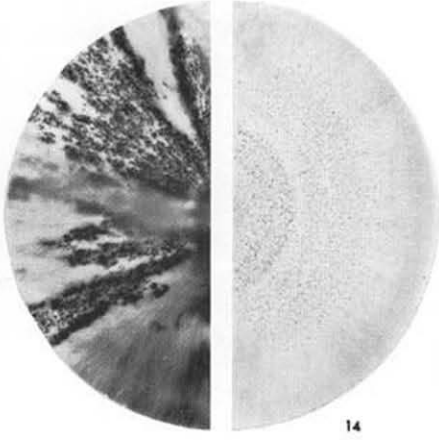

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