PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 269–302 (1981)

NOTES ON BOLETE TAXONOMY—III

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Contributions involving bolete taxonomy during the last ten years have not only widened the knowledge and increased the number of species in the boletes and related lamellate and gastroid forms, but have also introduced a large number of new data on characters useful for the generic and subgeneric taxonomy of these fungi, resulting, in part, in new taxonomical arrangements. It is therefore timely to consider these new data with a view to integrating them into an amended classification which, if it pretends to be natural must take into account all observations of possible diagnostic value. It must also take into account all sufficiently described species from all phytogeographic regions.

1. CLAMP CONNECTIONS

Like any other character (including the spore print color), the presence or absence of clamp connections in the carpophores is neither here nor in other groups of Basidiomycetes necessarily a generic or family character. This situation became very clear when occasional clamps were discovered in *Phylloboletellus* and numerous clamps in *Boletellus fibuliger*. Kühner (*1978–1980*) rightly postulates that cytology and sexuality should be considered wherever at all possible. This, as he is well aware, is not feasible in most boletes, and we must be content to judge clamp-occurrence per se, giving it importance wherever associated with other characters and within a well circumscribed and obviously homogeneous group such as *Phlebopus*, *Paragyrodon*, and *Gyrodon*. (Heinemann (*1954*) and Pegler & Young (*1981*) treat this group on the family level.) *Gyroporus*, also clamp-bearing, is considered close, but somewhat more removed than the other genera. On the other hand, clamp connections observed by me in the stipe covering of *Leccinum*, a single species of *Boletellus* and the genus *Phylloboletellus* (mostly false or incomplete clamps) are no more than specific characters since the respective specimens do not differ by any other diagnostic character from their congenerics. The best and most easily applicable character of the genera *Psiloboletinus* and *Boletinus* is the constant presence of numerous clamp connections in the carpophore hyphae and the base of the basidia, here generally linked with a hollow stipe. The fact that in some *Suillus* species clamp connections occur in mycelial cultures is, with this definition and application, just as in *Chroogomphus*, taxonomically irrelevant. However,

Persoonia Vol. 11 Part 2 was issued 11 May 1981

the occurrence of rare clamp-less carpophores in common species of *Gyroporus* such as *G. castaneus* (Heinemann & Rammeloo, *1979*) or *G. subalbellus* (Singer, *1977*) should be explained cytologically. Until that has been accomplished, my strictly tentative explanation suggesting parthenogenesis is perfectly valid inasmuch as the fact that Heinemann had difficulties in finding clamp connections in some Gyrodontoideae is no proof of their absence or rarity. (In a specimen of *P. sudanicus* described by Heinemann as having non-clamped hyphae, we have found numerous clamp connections as in all other specimens of that species.) Species described as *Gyroporus* but constantly clampless are in my opinion misplaced. Heinemann & Ramelloo (*1979*) quote Watling & Largent (*1977*) for their opinion that 'it has now been established that the occurrence of clamp connections has no value at the generic level in the case of *Gyroporus*' whereas what these latter authors really say is: 'It is true members of the genus *Gyroporus* possess clamp connections.' They dedicate a few paragraphs only to bolete anatomy without making any new contributions, but surprisingly in a (phylogenetic?) scheme (p. 594) put clamp-bearing genera at the end of each series (cf. Chapter 8).

This is not to say that in any genus generally characterized by the presence of clamp connections, clampless forms will never be discovered. But we can classify only what has been discovered. If, on the other hand, we go so far as to neglect clamp connections we are close to the point where Smith & Thiers (*1977*) seem to have arrived who include the clamped boletes (excluding *Gyroporus*) in *Suillus*, even *Gyrodon*. As soon as anybody gives some emphasis to an important character like clamp connections or amyloidity of the spores, there will always be those who deduce from the fact that the character is not important in other groups the license for dropping the character as generally unimportant.

2. DEVELOPMENTAL STUDIES

Thanks to the important and interesting studies on carpophore development from the primordium to the adult stages by Reijnders (*1968*) and discussed by Arpin & Kühner (*1977*), we have now some data on bolete development, especially for the genus *Suillus*. Reijnders describes for the one genus *Suillus* the development as either gymnocarpic (*S. bovinus*) pilangiocarpic (*S. variegatus*, *S. placidus*, *S. granulatus*, *S. americanus*, *S. spectabilis*), probably pilangiocarpic (*S. pictus*), mixangiocarpic (*S. luteus*, *S. aeruginascens*), probably mixangiocarpic (*S. grevillei*). Since these distinctions do not coincide with generic separations nor even with sectional characters in any modern treatment, nor with pigment-chemical investigations (see below), we can hardly give them more than specific significance inasmuch as all other boletes show, in one or another species, the same development as either one of the *Suillus* species or one of the *Xerocomus* species. In *Xerocomus*, we find in one section (*Parasitici*) an additional type of development viz. hypovelangiocarpic in Reijnders's terminology, as had already been pointed out by me 1945 (Singer, *1977*), most or all of the others being gymnocarpous. Gomphidiaceae, in general, are metavelangiocarpic (in contrast to *Suillus* which many authors consider closely allied to *Gomphidius*), and *Strobilomyces* and *Gyroporus* are 'probably metavelangiocarpic' (Reijnders, *1968*).

Unfortunately, one knows the type of development in only one species of *Boletellus*, viz.

B. zelleri which is gymnocarpic. The supposed marginal veil of *Boletellus ananas* (often spelled *ananus* by European authors), present only in the type section of the genus, and not as Arpin & Kühner suppose, in all species, does not necessarily reveal another type of primordial development. This is best illustrated by Corner's description and illustration of the development of *B. longicollis* Ces. (*Boletellus singaporensis* (Pat. & Baker) Sing.) where the glutinous layer in his youngest carpophore seems to be continuous and the membranous layer merely an extension of the margin of the pileus apparently attached to but easily separable from the stipe and sheathing only the apex. The same situation, but without the glutinous layer, seems to represent the development of *B. ananas* (Corner, *1972*: 95) which, however, in the sense of Corner, is certainly related but not identical with the American type, provided it is described correctly. Although Corner may not have had the opportunity to study sufficiently young stages of *Boletellus*, it is rather probable that here we have development types ranging from gymnocarpous to partly pseudoangiocarpous or at least partially velangiocarpous ('angiocarpie primaire'). The development of *Strobilomyces* and *Gyroporus* seems to be not fully explored.[1] According to the drawing of *P. ravenelii* in Corner (*1972*: 201) one would add the latter to the species which are 'probably metavelangiocarpic.' Yet, this is not related to either *Strobilomyces*, or *Gyroporus*, or for that matter, to the Gomphidiaceae.

Neither is the development of the Paxillaceae (even if restricted to *Paxillus*) uniform or analogous with that of the Boletaceae inasmuch as the veiled species (sect. *Parapaxillus* and *Phyllobolites*) are still waiting for competent embryological research.

Ontogenetic data of Boletineae are therefore at present not automatically useful for generic and suprageneric taxonomy. On the other hand, I believe that a fuller investigation of this aspect of bolete studies will in the end be shown to have some significance in the taxonomy of the rough-spored genera of boletes, in the Gyrodontoideae including *Gyroporus*, in *Gastroboletus*, the sections of such genera as *Xerocomus* and *Pulveroboletus*, and *Paxillus* sect. *Parapaxillus*.

Supplementary to the developmental approach, a discussion of the situation in *Gyroporus* is necessary. Although we have no comparable data on *Paragyrodon*, *Gyroporus* would seem to stand out by its metavelangiocarpic development, which Kühner had previously assumed to be gymnocarpic (which would have approached *Gyroporus* to *Gyrodon*.) But there is another indication much exaggerated by some (Arpin & Kühner, *1977*; Corner, *1972*) that seemingly enhances the hiatus between *Gyrodon* and *Gyroporus*, viz. the structure of the stipe rind. This indication was originally an elaboration of Reijnders's finding that the stuffed interior of the stipe of *G. cyanescens* shows a surprising number of hyphae running horizontally. The rind itself is described as interwoven ('hyphes . . . emmêlees') in an early stage and remaining so for a long time. Reijnders (*1968*) explains this structure as a consequence of the hollowing by expansion observed in the stipe, accompanied by an outer veil layer strictly appressed to the cortex of the stipe and of similar structure. It is Corner (*1972*) who adds that he recognizes *Gyroporus* as a genus not (in contrast to Arpin & Kühner)

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[1] But Heim assured us that *Strobilomyces* is 'Réellement angiocarpe' (*In* Revue Mycol. **30**: 327. 1966), apparently judging from his observations on African material.

because of its spore color or the presence of clamp connections but because the stipe is not longitudinally fissile and not constructed by longitudinal hyphae but splitting transversely and being constructed by hyphae that have grown transversely round and across the longitudinal axis. This statement is apparently not based on Reijnders's careful observations but on observations on the Malaysian species *G. malesicus* (where the transversal fissibility of the stipe may have something to do with the series of vertically superimposed cavities in the specimen illustrated which is the smallest known in *Gyroporus*). The stipe sections (a and b, p. 55) do not prove transversal arrangement of the surface hyphae of the stipe. As for other species of *Gyroporus* Corner merely states that 'several species ascribed to *Gyroporus* may not belong because their stems appear to be longitudinally scissile e. gr. *G. atroviolaceus*', a species I have studied and find to belong to *Gyroporus* (Singer, *1977*). Arpin & Kühner (*1977*) merely translate Corner's statement and imply that it is valid also for *G. cyanescens* and *G. castaneus*, not commenting on the extra-European species *G. malesicus* and *G. atroviolaceus*.

Do then the anatomical features of the type of *Gyroporus* really agree with Corner's characterization? According to my own observations, I agree with Arpin & Kühner that the consistency of the stipe rind is undoubtedly due to a special structure, but this structure is not the one described by Corner. In *G. castaneus*, for example, longitudinal and transverse sections of the stipe show that the interior layer of the stipe trama is influenced by the horizontal pull exercized by the widening of the stipe which leads to horizontal stretching of some hyphal strands. This stretching causes air spaces to appear between hyphal strands and single hyphae, and finally these dissociate to such a degree that the cavity results whereby many of the remaining hyphae collapse. Further towards the stipe surface we find a rather thin layer of tissue which is composed of two elements (1) longitudinally arranged hyphae and strands of hyphae running vertically and parallel with each other or almost so, intermingled with (2) strongly interwoven, irregularly arranged hyphae. This structure is a result of the intermingling of the interwoven hyphae (growing at first almost horizontally outwards as in most boleti) of the external velar layer with the longitudinal-vertical hyphae of the subjacent rind layer. For reasons of a somewhat different development as compared with other hollow-stemmed boletes (*Boletinus*, *Pulveroboletus*), this structure of *G. castaneus* is not exactly the same as in the other genera where in the stipe context longitudinal hyphae predominate. A supplementary analysis of the stipe anatomy in *G. cyanescens* and *G. purpurinus*, showed me an analogous picture, only that in *G. cyanescens*, with a more extensive original velar layer, the prevalence of interwoven hyphae is stronger. These data complement those given by Reijnders and contradict those provided by Corner. Whether the stipe is longitudinally fissile or not seems to depend on the prevalent stretching direction of the stipe tissue, the thickness of the rind layer compared with the velar layer, and possibly the extension of the cavity or cavities at a certain stage of development. The position of the genus *Gyroporus* side by side with *Strobilomyces* is highly unsatisfactory, even if the type of development in both genera is supposed to be the same.

3. CHEMOTAXONOMY

The recent studies on the chemistry of the bluing boletes and the various pigments found in Boletineae and related families represent a definite progress in chemotaxonomy and may serve, in many cases, for a better definition of taxa, and also for the discussion of affinities between families and orders (suborders). With Kögl & *al.* (*1924–30*) and Gabriel (*1965*) as forerunners, Edwards and his collaborators (*1967*), especially Bresinsky and his collaborators (Besl, *1981*; Besl & *al. 1973, 1975, 1977, 1978;* Bresinsky, *1974*; Bresinsky & *al. 1970, 1971, 1974, 1979;* Steglich & *al, 1968, 1969, 1970, 1971, 1977*), and also Gaylord and collaborators (*1971*) have contributed a wealth of chemically and perhaps physiologically valuable data which are highly significant for the taxonomist, and provide new arguments for those interested in the phylogeny of the Boletineae and related groups.

On the other hand, a strict application of the principle that all Basidiomycetes — whether they are otherwise similar or not — which contain pulvinic acid derivatives are related, must be made with caution.

(1) The negative statement (i.e. absence of pulvinic acid derivatives) based until 1974 on 25 species examined (Boletineae excluded) might be considered insufficient evidence for the assumption of exclusivity of such substances in 'Boletales'.

(2) Other characteristic groups of pigments, such as carotenoid pigments, thelephoric acid and related benzochinones, and muscoflavin have been found to exist much beyond any systematically definable fungus groups, e.g. in Ascomycetes, Phallineae, Cantharellineae, Tricholomataceae (in the case of carotenoids). May not such sporadic occurrences of pulvinic acid derivatives and other pigments thus far known only in the Boletineae also be expected (even though at present not postulated) in other suborders or orders?

(3) The existence of pigments in mycelial cultures but their absence in the carpophores may be interpreted as a biochemically different set of transformations when compared with cases where these same pigments exist in the carpophore alone or in both the carpophore and the mycelium. For a better appreciation of pigment studies in cultures, one may hope for a future interpretation of the transformations of assimilates in the transition phase from the vegetative to the reproductive part of an organism.

With these reservations, one may say that the relations of lamellate and gastroid forms to the boletes have been confirmed by chemotaxonomical data, and the generic taxonomy of the boletes proper should not be judged on anatomical bases alone.

The findings of the Bresinsky group show clearly that *Phylloporus* does not belong in the Paxillaceae but in the Xerocomoideae; this coincides with the chemical and morphological reasons which cause Arpin & Kühner (*1977*) emphatically to agree with me that *Phylloporus* is very close to *Xerocomus*, in contrast to the statements by Watling (*1970*) and Smith & Thiers (*1971*).

It seemed at first that *Boletinus cavipes* is chemically different from *Suillus* in the fact that the first contains large amounts of xerocomic acid, whereas the second does not (Bresinsky & Orendi, *1970*). However later analyses showed that xerocomic acid occurs also in a few species of *Suillus*, *S. plorans*, *S. collinitus*, and *S. sibiricus* (Besl & Bresinsky, *1977*), *S. spectabilis*, *S. serotinus*, *S. grisellus*, *S. grevillei*, *S. hirtellus* ssp. *thermophilus*, and *S. tomentosus*.

Likewise, there is no chemotaxonomic objection to or confirmation of the difference between *Suillus* and *Fuscoboletinus* although Bresinsky & Besl (*1979*) obviously tend to consider sect. *Larigni* as homogeneous and hope for more enlightenment from an exact determination of the spore print color. I can provide some data for *S. nueschii*: Fresh spore print chestnut with a slight rusty tinge (material from Moravia, *Singer C 5743*, (*F*) but this may be a further variety of *S. aeruginascens* since it differs from typical *S. nueschii* in unchanging context). *S. aeruginascens* var. *aeruginascens* and var. *bresadolae* have the fresh spore print between 'Vandyke br' and 'English oak', dehydrated 'teakwood' (Maerz & Paul). *S. tridentinus* and *S. grevillei* have an olive tinge when the spore print is quite fresh, e.g. 'buckthorn br' to 'citrine', but on dehydration near 'bure' (Maerz & Paul). This, in combination with the pigment analyses at hand, would indicate that subsection *Megaporini* is well separated from subsect. *Leptoporini* if *S. tridentinus* is transferred to *Leptoporini*, or, because of its intermediate position and the presence of tridentine it may be considered as typical for a third subsection. *Fuscoboletinus weaverae* and *S. caerulescens* belong in my opinion to sect. *Suillus*, the first showing that fuscoboletinoid spore colors occur also in species with glandular dots on the stipe, the second showing that the lack of known pigments (Bresinsky & Besl, *1979*) also indicated for *S. borealis*, *S. cothurnatus*, and American *S. luteus* is apparently a characteristic of species of sect. *Suillus* (if indeed this finding is a final one). Since the pigment-spectrum of the species united in *Fuscoboletinus* (*F. paluster*, *spectabilis*) is more like that of sect. *Suillus* subsect. *Hirtellini* than that of *F. serotinus* (with gyroporin) or European *S. aeruginascens* we see no relation between dehydrated spore print color and pigments.

Bresinsky & Besl (*1979*: 260) owe no apology to taxonomists for not being able to show in all cases a clear support for one or the other of the different classifications proposed by Singer (*1975*) and Smith & Thiers (*1971*). No single approach will always be decisive. But there are numerous cases where the chemotaxonomical approach does give additional data. The absence of known pigments in *Xanthoconium affine* differentiates this genus from *Boletus* (except *B. griseus* and *B. ornatipes*, both obviously unrelated to *Xanthoconium*). Additional data on the type species of *Xanthoconium* (*X. stramineum*) are unlikely to give different results since the carpophores and mycelium are almost to quite white (pigmentless) in all parts but the spores.

With regard to gyroporin and gyrocyanin it may be said that it tends to support the relatively isolated position of *Gyroporus* at the same time as it shows the chemical affinity of *Chamonixia* since chamonixin differs from gyroporin only in the addition of an OH-group instead of an =O, and consequently confirms the affinity of some hymenogastraceous fungi with the Boletaceae. Gyroporin does however also occur in *S. serotinus*, in traces in *Tylopilus plumbeoviolaceus*, and in mycelial cultures of some species of *Leccinum*, including *L. eximium* recently transferred by me to *Leccinum*. *Leccinum* is undoubtedly another genus where the pigment approach does not lead to results fully parallel with the macromorphological and anatomical approach. Chemically, *Leccinum* appears to represent a transition between *Boletus* and *Tylopilus* (see below).

I said (Singer, *1975*: 744, 750) that 'I am certain that modern pigment analysis will confirm, however, that *Strobilomyces* and *Boletellus* are chemotaxonomically different' and that 'spore sections under E.M. and pigment analyses will eventually decide whether a subfamily or a family Strobilomycetoideae or Strobilomycetaceae is preferable.' The first of these statements has been clearly decided (Bresinky & Besl, *1979*) in the sense expected by me; the second will be discussed later (Chapters 4, 11). Chemotaxonomy would suggest that *Boletellus* is amply different from the other strobilomycetaceous genera except *Phylloboletellus* which seems to have a similar relationship to *Boletellus* as *Phylloporus* has to *Xerocomus*. The former pair has an olivaceous spore print, yellow colors in hymenophore and context, occurrence of clamp connections (one species with numerous clamps — *B. fibuliger*, few and often 'false' clamps in *Phylloboletellus*) as well as either gigantic or ornamented spores in common, aside from a predominantly tropical-subtropical distribution and a bilateral hymenophoral trama of the *Boletus*-type. This is in contrast to *Austroboletus* and *Porphyrellus*, as well as to *Strobilomyces* and *Xanthoconium*, *Tylopilus* and *Fistulinella*, one section or two of *Boletus*, and several species of *Leccinum*. In all these except the last two, the spore print is never olivaceous (fresh, not dehydrated), and all the data now available seem to indicate that there is a certain continuity here which cannot be expressed by separating the genera by spore ornamentation alone. Whether this reflects real affinity (a common ancestor) can now only be assumed, especially with the lack of positive identifications of pigments since the existing but unidentified pigments may in the end be found to be different in different genera.

In *Porphyrellus* sect. *Porphyrellus* tyrosine is converted to DOPA as in *Strobilomyces* and this puts *Porphyrellus* sensu stricto in an intermediate position between the Boletoideae (*Tylopilus*) and the Strobilomycetoideae (*Strobilomyces*), a situation foreseen by me because of the similar chemical color reactions of *Porphyrellus porphyrosporus* and *Strobilomyces floccopus*. 'This lends support to the placement, of *Porphyrellus* by Singer in the family Strobilomycetaceae' (Besl, *1981*) inasmuch as before the S.E.M.-studies on the spores of *Porphyrellus*, the transition from smooth-spored Porphyrelli to *Austroboletus* (with ornamentaed spores) was difficult to break. It is still difficult for Corner (*1980*) who seems to resent my putting his subgenus *Austroboletus* in synonymy with *Porphyrellus* in 1975 when it was still defined in the wider sense. Since I had no first hand knowledge of *B. dictyotus* (Boedijn) Corner (*Porphyrellus* (!) *dictyotus* Boedijn), I could not insert this species into any of my sections and since Corner's (*1972*) drawings of the development stages (figs. 25-6) do not compare with the descriptions and photomicrographs by Reijnders and may illustrate other than 'pseudoangiocarpic' development (with truly primordial stages possibly missing, and other species indicated probably being gymnocarpic; about *B. mucosus* Corner see later), the development of the carpophores (Singer, *1975*) was indicated as 'unknown'. While Corner indicates as type species of his subgenus *Austroboletus*: *B. dictyotus* (Boedijn) Corner (p. 77), he states on p. 8 'In the modern treatment of this genus [*Porphyrellus*] there are two sections, one with smooth spores (sect. *Porphyrellus*), and the other with ornamented spores (sect. *Graciles* Singer). The first I refer to *Tylopilus* ...For the second I have made subgen. *Austroboletus* ...' which would suggest that subgenus *Austroboletus* is based on sect. *Graciles*, and thus on *P. gracilis* (Peck) Sing. Since I now divide *Porphyrellus* sensu lato in *Porphyrellus* s.str. and *Austroboletus* and repress the family Strobilomycetaceae as such, it may seem an academic question to ask why Corner (*1980*) thinks that *B. dictyotus* does not fit my diagnoses (of *Porphyrellus*), and why *B. longipes* should not key out in Strobilomycetaceae (Singer, *1975*: 166) once it is established that it has ornamented spores.

Another field for further chemotaxonomical studies is represented by the genus *Gastroboletus*. Most authors were quick in deciding that that genus is merely an assembly of 'gasteromycetation' forms arising from different bolete genera, yet data on the pigments are available in only one single species, not the type species, nor in any other species. The same holds true for spore analysis. In both cases, we should keep in mind that possibly not all species described are really congeneric with the type and may be retarded forms or misformations of known or unknown Boletaceae. This, however, is certainly not the case in the ecologically best known species, *G. laricinus* (cf. Chapter 11).

Within the Boletaceae we find the genera *Xerocomus*, *Pulveroboletus*, *Chalciporus*, and *Boletus* rather similar in their pigments — a situation to be expected. On the other hand, the separation of *Chalciporus* with variegatorubin as characteristic pigment (Besl, Bresinsky & *al.*, *1975;* Bresinsky, *1974;* Bresinsky & Rennschmid, *1971;* Singer, *1975*) from *Suillus* appears justified. The identical pigments of *Pulveroboletus hemichrysus* and *P. auriporus* show that species with dry as well as viscid surfaces can be chemotaxonomically indistinguishable in this genus, justifying both Singer (*1975*) who put them in two sections of *Pulveroboletus* and Smith & Thiers (*1971*) who put them in the same section (*Subtomentosi*) of *Boletus*, the former as *B. sphaerocephalus*. This is not in support of Corner (*1972*) who puts Pulveroboleti in three different subgenera of *Boletus* and refers to *Pulveroboletus* (on the basis of frequently erroneous statements and misdeterminations) as a 'dump for species, mostly tropical, which do not fit the alliance of temperate species of subgenus *Boletus*.' May it just be stated here that of the 22 species referred to *Pulveroboletus* by me six are tropical. Chemotaxonomically, the split genera *Aureoboletus* Pouzar (based on *P. gentilis*, closely allied to *P. auriporus*) and *Buchwaldoboletus* Pilát (based on *P. lignicola* — twice misspelled by Corner — closely related to *P. hemichrysus*) should be abandoned unless microgenera are admitted for every section of *Pulveroboletus*. *Pulveroboletus* will be discussed further in Chapters 6 and 9.

There is still much room for chemical work on the species of *Pulveroboletus*. On the other hand, there is no sense in commenting on pigment-studies on rare, odd species which are insufficiently described, like *Phylloporus boletinoides* (spore print color? bluing?) which, if it had clamp connections and incrusted cystidia might well be a *Psiloboletinus*, or, if the anastomoses of the lamellae were less developed might approach *Phylloporus* sect. *Manaussenses*. Yet in either case would the chemotaxonomical support be moot. Further studies on *Leccinum* would also be welcome. *Leccinum* is rather easily separated from other boletes by macro- and microscopical as well as ecological-physiological characters, with uniform spore morphology as pointed out correctly by Pegler & Young (*1981*: 124) but not chemotaxonomically as discussed by Bresinsky & Besl (*1979*). Their data suggest that chemotaxonomy becomes important as a sectional character whereby for *L. subglabripes* (as the type species) a special section, closer to *Boletus*, should be separated from sect. *Luteoscabra*.

4. ELECTRON MICROSCOPY

Since the separation of the Strobilomycetaceae as a family from other boletes was strongly influenced by the ornamentation of the spores as seen in the light microscope (with only a few smooth-spored species left in these genera where no other differences could be discovered), it was considered highly interesting to obtain not only scanning electron microscope (S.E.M.) pictures of strobilomycetaceous and related species but also spore sections under electron microscopy (E.M.). This approach has indeed helped to revise some of our earlier assumptions. Since the pigment analyses have shown, as expected, that *Boletellus* (and presumably *Phylloboletellus*) are chemically different from other boletes with ornamented spores (Bresinsky & Besl, *1979*), the question comes up whether there are links between *Boletellus* and smooth-spored Boletaceae. Trying to answer this question, modern authors developed two hypotheses contradictory to each other, one attempting to link *Boletellus* with *Boletus*, the other with *Xerocomus*.

Pegler & Young (*1971*) were the first to show that under the scanning microscope certain Boletaceae have a weak striation on the spores. This refers to one collection of *Xerocomus subtomentosus* where in the basal region of the spore some ridges are visible, but this was not observed in other collections. In *X. truncatus* (=*X. porosporus*) the apex of the spore shows some truncation which reminded Perreau-Bertrand (*1961, 1964*) of the spore apex of *Boletellus betula*. The truncation of the spores is however visible in many specimens in only about half of the spores of a single carpophore (my own as well as Pouzar's observations) and this *Xerocomus* is so close to *X. chrysenteron* in all other regards that no affinity with *Boletellus* can be seen. Nevertheless, more recent S.E.M.-illustrations (Pegler & Young, *1981*: fig. 52) show the *X. truncatus* spore finely longitudinally striate whereas *X. chrysenteron* spores (fig. 53) are shown to be smooth. The striation of the *X. truncatus* spores appears however much finer and lower than that of *X. zelleri* (figs. 50–51). Even if in these cases a misidentification (confusion with the macroscopically similar *B. intermedius*, for example) is excluded, the ornamentations of the Xerocomi are certainly on a different level as compared with those in *Boletellus*. Since the ornamentations of *B. zelleri* and *B. intermedius* are not only quantitatively different from those claimed for *X. subtomentosus* and *X. truncatus* — they are even visible in light microscopy — but are accompanied by a *Boletus*-type hymenophoral trama as opposed to a *Phylloporus*-type in *Xerocomus*, the present evidence points much rather to a hiatus between *X. truncatus* and *X. subtomentosus* on one hand and *B. zelleri* and *B. intermedius* on the other.

In *Boletus* sensu str. Pegler & Young (*1971, 1981*) show only smooth-spored replicas. The spores are 'remarkably uniform in appearance' which is remarkable inasmuch as *Boletus* shares with *Boletellus zelleri* and *B. intermedius* the structure of the hymenophoral trama. In macroscopical characters *Boletellus* comes close only to section *Subpruinosi* of *Boletus*.

Since Pegler & Young's (*1981*) classification is derived basically from spore morphology it is not surprising that a different ornamentation such as we have in *Boletellus* sect. *Retispori* (*Heimiella*) as compared with that of the remaining species, or the different ornamentation of *Afroboletus* as compared with that of sect. *Strobilomyces* has led the authors to recognize the genera *Heimiella* and *Afroboletus*, and to transfer *B. betula* to *Austroboletus*, which is classified in another family in Pegler & Young's scheme. Fortunately this transfer is modified by the remark 'The olivaceous tint of the spores raises the possibility that this species may have a closer relationship with Boletaceae than with Strobilomycetaceae.' Here, again, a different genus concept (i.e. smaller than mine and infinitely smaller than Kühner's) may permit the introduction of smaller generic split groups, but in the case of

Afroboletus and *Heimiella* the argument based on phytogeography does not hold since representatives of both have also been found in the neotropics (Singer & *al.*, *1981*). With regard to *B. mirabilis* and *B. projectellus*, the spore measurements given by different authors (Pegler & Young, *1981*; Singer, *1977*; Smith & Thiers, *1971*) are in agreement and show spore sizes in these species that earned them the comment (Pegler & Young, *1981*) that 'sect. *Mirabiles* differs . . .only in larger spores' (the word 'only' is an exaggeration), and a special subsection in Smith & Thier's (*1971*) much emended section *Subtomentosi* of *Boletus* where it is combined with representatives of another subfamily (family for Pegler & Young). In reality sect. *Mirabiles* is intermediate between *Boletus* and *Boletellus* since it has spore size and wall thickness of many Boletelli, but the spores are smooth even under S.E.M. If one gives more emphasis to ornamentation, *Mirabiles* may be attached to *Boletus* as a section, but considering the projecting margin and lack of affinity to the species of *Boletus* sensu stricto, I prefer to maintain the section in *Boletellus*. Those who favor microgenera in Boletineae will probably come up with a third, new genus.

The other genera which I considered to belong to Strobilomycetaceae (*Porphyrellus*, *Fistulinella*, *Strobilomyces*) appear to have closer relations to *Tylopilus* than to *Boletus*. Thanks to the studies of Wolfe (*1979a*, *b*) it is now clear that the first three genera are sufficiently closely related to each other to be opposed to *Boletellus*, and that *Porphyrellus* can, in a restricted sense, be separated from *Austroboletus*. A large number of these decisions are now possible because of the S.M.-photos published by Wolfe (*1979a*) who showed that the genus *Austroboletus* can be defined by, among other characteristics, ornamented spores, including such species that under the light microscope seemed to be quite smooth. *Porphyrellus* is then restricted to *P. porphyrosporus* and related forms. Wolfe considered the spore differences between *Austroboletus* and *Porphyrellus* to be strictly accompanied by cystidial characters (cystidia, perhaps more precisely pseudocystidia, with optically discernible enclosures or pseudoamyloid contents in *Porphyrellus*, hyaline and inamyloid, optically 'empty' in *Austroboletus*).

These observations, in part confirmed by my own recent research (Singer & *al.*, *1981*), show that Strobilomycetaceae, in spite of a certain variability (just as in *Boletellus*) of ornamentation type even within a single otherwise homogeneous genus, consist of three groups (1) *Strobilomyces;* (2) *Porphyrellus*, *Austroboletus* and *Fistulinella* (=*Muciloporus* Wolfe, *1979b*); (3) *Boletellus*, *Phylloboletellus*. The affinities of the first are unknown, those of the second are with *Tylopilus*, and the third with *Boletus*. As we have seen before, these groupings are confirmed by chemotaxonomy.

In some minor points we do not agree with Wolfe (or for that matter with Smith & Thiers). I believe that *Porphyrellus* is a small genus, not a section or subgenus of *Tylopilus*, an opinion I share with Moser (*1978*) and Pegler & Young (*1981*). Furthermore, *B. mucosus*, macroscopically and anatomically a *Fistulinella*, differs from the latter genus in the fact that the glutinous veil of the stipe covers a rather strong reticulation and, more important, the strongly (S.E.M. as well as light microscope) ornamented spores. Again, we have a choice of either considering the spore ornamentation decisive (the choice preferred by Wolfe and Pegler & Young) or considering the rest of the characters whereby *B. mucosus* enters a rough-spored section (still unnamed) of *Fistulinella*. Those who insert *Boletus* sect. *Mirabiles* in *Boletellus* will, like the present author, prefer to insert *B. mucosus* in *Fistulinella*, a solution which imposes itself at the present time when the type species and some other species of *Fistulinella* have as yet not been studied with S.E.M. or E.M. techniques.

How different spore ornamentation types can be in *Austroboletus* becomes clear when available photomicrographs are compared (Moser, *1978*: pl. 45; Arpin & Kühner, *1977*: 29, figs. 131–139; Watling & Largent, *1977*: figs. 20, 22, 23, 25–28, 31, 36). Why, then, should *Heimiella* and *Afroboletus* be separated from *Boletellus* respectively *Strobilomyces?* We see that here we have *Boletellus* spores ranging from smooth (if we admit sect *Mirabiles*) to faintly longitudinally veined, winged or reticulate. In *B. betula* we find the 'coalescence of the alveoli often producing the individualization of a pillar' (Perreau & Heim) while the light microscope shows what appears like pillars forming an ornamentation type XI (Singer, *1975*). A similar ornamentation type is known in *B. alveolatus* (Heim & Perreau) Sing. Judging by the spore color and the yellow color of context and other parts of the carpophore, we may anticipate that all Boletelli are chemically similar to the species where pigment studies have already been made (cf. Bresinsky and collaborators).

Corner and some others seem to think that *Boletellus* if smooth-spored would be close to *Xerocomus*. This is correct as far as habitus is concerned, but incorrect with regard to the structure of the hymenophoral trama which is of the Phylloporus-type in *Xerocomus* and of the Boletus-type in *Boletellus* (see photomicrograph in 'Agaricales in Modern Taxonomy' (Singer, *1975*: pl. 26), verified in nearly all species referred to *Boletellus* by me. The misinterpretation of the tramal structure by Corner may have to do with his method of using alcohol-formalin or, as with Heim, with studying a non-suitable stage of development of the carpophore. Thus smooth-spored species would not be like *Xerocomus* inasmuch as they often have small pores depressed around the apex of the stipe. They would rather be like *Boletus*, and in habit much like sect. *Subpruinosi* where, however, the species with stipes showing coarse elevated ridges forming alveoli as found in sections *Dictyopodes* and *Allospori* would be out of place, as would be clamp-bearing species as *B. fibuliger*.

A similar range of ornamentation types exists in *Austroboletus*, as we have seen before, and this range includes even longitudinally veined spores if we accept — as we must — Corner's fig. 24 as illustrating the spore variations of *A. dictyotus*, or accept Corner's statement that *B. nanus* has an 'endospore' becoming finely longitudinally striate.

In *Strobilomyces*, again, we have spore ornamentation which ranges from finely punctulate in the light microscope and 'coarsely rugose to irregularly verrucose' (Pegler & Young) under S.E.M. to an angular mesh, strongly projecting. Traces of the intercostal ridging seen in those species with longitudinal wings or ridges (sect. *Pterospori*) can also be seen in Pegler & Young (*1981*: fig. 117, *S. polypyramis*); these are therefore not exclusive of section *Pterospori*.

It is possible that more detailed studies on spore sections under E. M. rather than S.E.M. might add something to bolete taxonomy but data are still not available for enough species to draw conclusions. At any rate, Pegler & Young's figures (p. 143–144) do not support the idea that Strobilomycetaceae can be maintained as a family on the basis of wall differentiation, especially if *Austroboletus* and *Boletellus* are removed from the type genus *Strobilomyces*.

The so-called plage (in reality different from that in *Galerina* and merely a smooth to lower ornamented area in the superhilar region) is absent in section *Pterospori*. Since according to my observations the fresh spore print in both sections of *Strobilomyces* is identical (fuscous-brown to chocolate brown or purple brown in thin, nearly or quite black in thick layers), the 'plage' in sect. *Strobilomyces* remains the only character supporting even a sectional subdivision of the genus, but it seems to be replaced, in sect. *Pterospori*, by a basal thickened rim. Arpin & Kühner (*1977*) rightly stress the frequent reddening and constant blackening (tyrosine – Dopa – melanines) as characteristic of *Strobilomyces*. This phenomenon holds secions *Strobilomyces* and *Pterospori* (*Afroboletus*) together.

Pegler & Young's well-documented observations which should be extended to other, particularly controversial species like *B. nanus*, are undoubtedly very valuable for the taxonomist as are those by Wolfe. Nevertheless, they cannot be a basis for a 'natural' classification, which, by definition, has to take all available characters into account.

There remain a few problems which spore morphology alone cannot solve. In the following I give a few examples.

PHYLOGENY.—Considering modern pigment chemistry, the relations demonstrated by many authors between hymenogastroid genera and Boletineae cannot any more be considered tenuous. The Corner hypothesis which can be read in the sense of Gomphaceae → Boletaceae → Gastroboletaceae or vice versa seems to me rather more tenuous, and cannot be discussed in the framework of Bolete spore characteristics alone (see also Chapter 8).

PAXILLACEAE.—This family is (p. 126) wrongly characterized. Even though spores are 'mostly' not elongated, some Paxilli not studied by Pegler & Young and even one studied by them have elongated 'boletoid' spores. Clamp connections are absent in an entire section (see below). As for spore ornamentation, a study of *Phyllobolites* (see Singer, *in* Mycologia **73**: 507. 1981) should throw some more light on the matter. Obligatory ectomycorrhiza has been shown to exist in *Paxillus boletinoides* and *P. defibulatus* and is probable in *Phyllobolites*. *Paxillus defibulatus* is transferred to *Phylloporus* as *P. statuum* (Speg.) Pegler & Young on the strength of non-clamped hyphae, and so is *P. veluticeps*. This is in error because we know enough about *A. statuum* not to identify it with *P. defibulatus*. It is only known from material from Staten Island which is the type or a topotype and authentic. It has been suspected to be the same as *P. boletinoides* Sing. because it has clamp connections and cystidia (neither seen with certainty in the hymenophore); the clamps, however, are scarce but definitely present; the cystidia may be occasional projections of the numerous oleiferous ducts with rusty granular contents; the stipe is evelate as was stressed by Spegazzini, who describes his species as having ferruginous-fuscous to badious color and as being grossly squamose (both in contrast to *P. defibulatus*). *P. defibulatus* is a common edible (but because of the bitterish taste not exactly delicious) mushroom in Patagonia and is taken for chanterelles by local mushroom hunters which gives an idea of how unlike its appearance is in comparison to *Phylloporus*. Its spore print color is between 'tortoise' and 'cookie' Maerz & Paul, a color not occurring in *Phylloporus* spores. *Phylloporus* is totally absent from the temperate *Nothofagus* region of South America whereas *Paxillus* is particularly well represented there, so much so that it is supposed that the Paxillaceae have South American origin (Singer, *1964*: 96).

BOLETINUS PICTUS.—This species has been transferred to *Suillus* by Smith & Thiers (*1964*). This transfer has been accepted by Singer (*1965–7; 1975*) because the species is neither clamp-bearing nor hollow-stemmed, nor is it associated with *Larix*, but its cystidia are often clustered (see Smith & Thiers, *1971*: fig. 25). The spore print of *S. pictus* when fresh, has an olive tinge but this is not a general character of *Suillus* or *Boletinus* since olive tinges are absent in spore prints of *Boletinus* subsection *Rubrini* and present in *Suillus*, subsection *Hirtellini*. I agree with Pegler and Young that *Boletinus* is a good, natural genus, but the above statements show clearly that it cannot be inserted in a different family from that of *Suillus*.

BOLETELLUS ANANAECEPS:—My findings (Singer, *1955*: 423) are closely similar to those by Pegler and Young (*1981*). However, the supposed synonyms (*S. pallescens* and *S. ligulatus*) have in light microscopy striate longitudinal wings on their spores and are thus more similar to those of *B. ananas*. It may be that my specimens were not identical with the holotype or that the light microscopy does not give identical results with S.E.M.-studies. But the matter seems to be in need of further revision.

PHYLLOBOLETELLUS CHLOEPHORUS.—This species is not only known from the type locality but from three different stations in the same general region (Selva Tucumano-Boliviana).

XEROCOMUS ZELLERI.—This as well as *B. intermedius* has striate spores; the striation has been clearly visible to Snell, Dick, Pouzar, and myself under light microscopy. This is therefore a pair of species belonging in *Boletellus* according to definition inasmuch as the hymenophoral trama in both is of the *Boletus*-type, not the *Phylloporus*-type. Putting *Heimiella* and *Boletellus* in two different families, even if the former genus were recognized because of different ornamentation, seems highly artificial.

LECCINUM CROCIPODIUM, L. VERSIPELLE, and L. CARPINI.—See Chapter 10.

FUSCOBOLETINUS AERUGINASCENS.—Neither pigment analyses nor spore color justify the transfer of this species to *Fuscoboletinus* which, at least in the circumscription of Smith & Thiers (*1971*) cannot be accepted even as a subgeneric or sectional unit, although some of the species described in it may be separated as subsections or series of three different sections of *Suillus*.

5. ASIATIC SPECIES AND THE CURRENT TAXONOMIES

The boletineous species of the tropics and other extra-European regions have certainly helped to modify the early 'natural' classifications which were basically European classifications. The classification proposed by me in the first, and gradually improved in the following editions of 'Agaricales in modern taxonomy' is the first classification based on fresh material of and anatomical data on extra-European material, including tropical species. The adjustments based on pigment studies and electron microscopy discussed in the present paper are certainly not unimportant but are relatively minor so that new species described from the tropics in South America and Asia have been absorbed relatively easily into these classifications which, because of this, have found wide acceptance. The one exception seemed to be that of the Malaysian species introduced or redescribed by Corner (*1972*). The question imposes itself whether there is really a difference between the African and neotropical, temperate holarctic and south-temperate bolete flora on one hand, and the tropical Asian Boletineae on the other, a difference that caused Corner to comment that the Malaysian bolete flora contains many species which 'bridge the generic differences which have been proposed' up to 1972. It seems to me that Corner (*1972*) has done an excellent piece of work which is indeed very useful to taxonomists by giving mostly detailed descriptions of numerous Malaysian boletes. A final reclassification has been postponed rather than newly proposed because this would have involved a new interpretation of extraterritorial material including types that were not at his disposal. His reviewers have taken a different position. Thiers (*1973*) thinks — as I do — that little has been accomplished by returning to a large all-encompassing generic concept and reproaches Corner for misunderstanding several already described species. Watling (*1973*) uses twice the word 'refreshing' for Corner's supposedly 'conservative approach' (which was merely a practical approach when editing his valuable data). Watling also says that the information we have at hand is rather sparse and is based almost exclusively on north temperate groups. I find both statements rather surprising and unsupported. Could it be that Watling (*1970*) saw in Corner's book an approval of his own 'conservative approach'?

To relegate genera one step down the taxonomic hierarchy — and this is the basic difference I can see between Kühner's and my classification — is no solution for the question of affinities between and delimitation of the various genera and subgenera of Boletineae or for that matter of any taxonomic group. The question to be answered is: Can we or can we not, on the basis of available data on the known world flora, discover a hiatus between these taxa? If there is no hiatus, neither genera nor subgenera are justified; if there is a hiatus the matter rests with the personal concept of what is a genus, a concept which is not at all uniform among authors. Arpin & Kühner (*1977*) seem to have a broad generic concept but possibly for reasons different from Corner's (cf. the latter's enormously extended concept of *Trogia*). Horak and Pilát & Dermek have a generic concept narrower than mine, recognizing aside from other European genera of boletes such genera as *Buchwaldoboletus*, *Rubinoboletus*, and *Aureoboletus*, so that in this regard, I find myself frequently on the more conservative side.

But do the Malaysian boletes really fill any gaps between existing genera? It is, I believe, useful to indicate a few examples which show the contrary. I cannot do this for all species described by Corner and depend on Corner's descriptions for many. Some cases have been discussed elsewhere in this paper. Others follow here:

BOLETUS AUREOMYCELINUS Pat. & Baker.—A study of the type and material preserved at Kew reconfirms my own and Corner's disposition of this species in *Boletus* where it was placed in the neighborhood of *B. patouillardii* Sing. Together with the latter species it forms apparently a subsection or section of small tropical Boleti with short, small spores, with *B. guadelupae* marking the connection with the species around *B. rubellus*.

BOLETUS BALLOUI Peck.—This is different from *B. balloui* Corner non Peck. See below in connection with *B. spinifer*.

BOLETUS BORNEENSIS Corner.—Although the color of fresh spore prints is unknown, it is obvious that this is indeed, as Corner believes, a representative of *Leccinum* (at least in my circumscription).

BOLETUS LONGIPES Mass. sensu Corner.—This apparently combines two species (*A. longipes* and *A. tristis*), at least according to Wolfe's (*1979a*) type studies contested by Corner (*1980*).

BOLETUS MIRANS Corner.—In Corner's description I find nothing to exclude it from *Tubosaeta* Horak (*1968*) who does not, as quoted by Corner, indicate the hymenophoral trama as boletoid, but describes it so that one must infer that it has a *Phylloporus*-type of trama, just as Corner indicates it for *B. mirans* and Heinemann (by implication) for *B. goosensii* and *B. calocystis*. Corner says that *B. mirans* 'has short spores as in *B. spinifer* (thus destroying the prime character of *Tubosaeta*)'. In reality, the spores of *B. mirans* are 'ellipsoid 6.5–8(9) × 4.5–5.3 µm', i.e. longer than in *B. spinifer* (spores 5.5–7 × 4–5 µm) and *B. bicolor* Mass. (5.5–7 × 3.5–4.5 µm) and slightly more elongated. Since there are short-spored forms in *Xerocomus*, there is no reason to assume that all *Tubosaeta* species must have strongly elongated spores. There are relatively short spores in some species of *Boletus*, *Chalciporus*, *Boletellus*, and *Tylopilus* which cannot be excluded from their respective genera if all other diagnostic characters are identical. It seems to me that Pegler & Young exaggerate the significance of the 'compressed' configuration of bolete spores whereas Corner (p. 23) states that 'sporographic analyses shows that subglobose spores are to be expected in any alliance of elongated spores.' However, *B. ascendens* Corner, also cited by Corner in his discussion of *Tubosaeta*, has extraordinarily large smooth spores (17–25 × 5.7–7 µm) and 'subboletoid' hymenophoral trama, which, as stated by Corner himself, should place it in *Boletellus* sect. *Mirabiles*, differing only by lack of any reticulation on the stipe and by a non-projecting margin. The slightly thickened wall of the cystidia has (Smith & Thiers, *1971*) been described in *B. projectellus*. A slightly thickened cystidial wall has also been observed in a variety of *Boletellus ananas* (Singer *& al.*, *1981*). It is therefore not considered to be worthy of generic significance in *Boletellus*. In some specimens of the species of sect. *Mirabiles* the sterile projection of the margin may be absent (Smith & Thiers, *1971*). *Boletus ascendens* should therefore be placed in sect. *Mirabiles*. The placing of *B. olivaceoluteus* is somewhat more difficult since it is not fully described (mycelium and spore print color when fresh, chemical data). It is useless to discuss affinities of not sufficiently known species. Other species discussed by Corner in connection with *Tubosaeta* have thin-walled hymenial cystidia.

BOLETUS NANUS Mass.—This is a real puzzle for me, not because the species is suspect as 'bridging generic limits' but because the data I have on the type of *B. pernanus* Pat. & Baker do not agree with those given by Corner for *B. nanus* which according to Corner is the same as *B. pernanus*. I cannot see therefore whether the indication of a dirty pink spore print refers only to *B. nanus* in which no veil was seen and the hymenophore is described as pale leather colored with relatively wide pores. I suspect that two species have been mixed up. I have not seen any trace of longitudinally striped spores in *B. pernanus* which, if present in *B. nanus* would be extraordinary for a *Tylopilus*. As for *B. nanus* as described by Corner, I am strongly tempted to consider it an *Austroboletus* related to *A. dictyotus*. The *B. nanus-pernanus* assemblage needs further study, especially E.M.-studies of the spores.

BOLETUS PHAEOCEPHALUS Pat. & Baker.—In the sense of Corner, this is a *Boletellus* (cf. Singer *& al.*, *1981*). But the type of *B. phaeocephalus* is a *Xerocomus* sect. *Moravici*, and has completely smooth spores, at least under the light microscope. The fine longitudinal striation of the spores of *B. phaeocephalus* sensu Corner, non Pat. & Baker, discovered by Corner, and confirmed by me on the type of *B. umbrinellus* Pat & Baker proves that Corner is right in synonymizing the latter with his interpretation of of *B. phaeocephalus* which is not a

Pulveroboletus, but *Boletellus*. A specimen cited by Corner for *B. phaeocephalus* (Borneo, K) is not a *Boletellus* and likewise not a *Xerocomus*, but probably a *Tylopilus* spec. In the case of *B. phaeocephalus*, while presumably one single species is discussed, three species of three different genera are involved. The citation of '*B. olivaceobrunneus* Zeller et Bailey' in the synonymy introduces a fourth species, unrelated and obviously misunderstood by Corner. It is quite clear that until this complex was unscrambled, no definite conclusion could be drawn.

BOLETUS PORTENTOSUS Berk. & Br.—We (Singer& *al., 1981*) have discussed this species. It is clearly a *Phlebopus* (=*Phaeogyroporus*).

BOLETUS RUBRIPORUS Corner.—This is obviously a good species of *Chalciporus*. Bluing species have been observed in *Chalciporus* (cf. *B. piperatoides* A. H. Sm. & Thiers). Although a slightly aberrant (more like the *Phylloporus*-type) hymenophoral trama is occasionally observed in certain stages of some species of *Chalciporus*, *C. rubinus* has, according to my own observations, a trama of the *Boletus*-type, which confirms an observation by Reid quoted by Corner. Corner's statement 'this complex proves the necessity of considering the world flora in mycological classification' can only be heartily applauded.

BOLETUS SPINIFER Pat. & Baker.—A revision of the thin- to thick-walled (in KOH) acute or subacute cystidia which reminded Patouillard and myself of setae (I called them later setiform cystidia) are in reality coscinocystidia. They are the only ones that occur both in *Linderomyces* (Gomphaceae) and *Boletochaete* (Boletaceae) and as such might have been an interesting item for those, like Corner (and perhaps Pegler) who look for links between the Gomphaceae and Boletaceae (*Clavaria*-hypothesis). Not knowing coscinocystidia when describing *Boletochaete*, I had no possibility to recognize these 'setiform cystidia' as coscinocystidia. Those of *B. spinifer* are ventricose below, with an outer thin to thickish wall (0.3–1.5 µm thick in KOH), unevenly thick and not well delimited from the spongy-chambered contents, appearing strongly metachromatic in toluidin-blue and cresyl blue (but it is not the outer wall which turns red; it turns blue!) with a subhyaline inner wall (both walls together in this medium appearing 0.5–3 µm thick). In KOH the color of these cystidia is dark ferruginous or olive to fulvous-brown. Aside from the coscinocystidia described, there are also thin-walled cystidia present which are mostly slightly narrower. Younger cystidial cells are less distinctly coscinoid and thinner walled. In *Linderomyces*, on the other hand, the coscinocystidia may be different insofar as they, according to Petersen (*1971*) are a stage of gloeocystidia (*Gloeocantharellus*). The cystidial characteristics, combined with the late gelatinizing lateral trama and the pale spore print (pale cinnamon pink according to Corner) and the short spores leave no doubt but that *B. spinifer* is generically different from other Tylopili. The genus seems to be restricted to tropical and subtropical Asia. *Boletus balloui* Peck sensu Corner (which is different from *T. balloui* (Peck sensu Peck) Sing.!) and which I assume is *B. bicolor* Mass. is apparently another species of *Boletochaete* where the coscinocystidia are much more scattered (and only melleous in NH_4OH) than in *B. spinifer*. The bitterish taste may be an additional characteristic of the genus, as well as the adnate hymenophores (see Chapter 6).

Corner considers *P. viscidulus* (Pat. & Baker) Sing. as conspecific with specimens he describes as *B. balloui* var. *fuscatus*. The type of *B. viscidulus* has a shining and viscidulous, perfectly smooth pileus, an appearance much like that of other *Pulveroboletus* species, unchanging context and spores 7.7–9.5 × 4–5.3 μm. Although I have not been able to study the cystidia, the above data suggest that it is not the same as *B. veluticeps* Pat. & Baker. The latter has somewhat more elongated spores (7.5–8.7 × 3.5–4.5 μm) than var. *fuscatus* and, most important, short cells in chain-arrangement and erect on the pileus, with only occasionally cylindric terminal cells, with the wall 1–1.3 μm thick (compare Corner's figure p. 194, fig. 66 with the above data). Corner has not seen the types of these species and 'can detect no difference in the original descriptions and in Singer's account of the microscopic details.' Yet here again we seem to be confronted with a group of species, all considered conspecific with each other by Corner, and therefore difficult to place without careful type studies.

BOLETUS VALENS Corner.—This species, unknown to me, does indeed not fit into any known genus, at least as described. However, this would be the only known species where both pinkish cinnamon and olivaceous-cinnamon (fresh?) spore prints occur in a single species. The comparison with *T. niveus* brings up the question of whether the spores are S.E.M.-smooth. The large spores exclude *Tylopilus*. If the spore print (fresh) is olivaceous and the spores really smooth, this may fit well into *Boletus* sect. *Grisei*.

BOLETUS VIRIDIS (Heinemann & Goos.) Corner.—This species seems to be a typical *Pulveroboletus* (section *Cartilaginei*) as originally stated by Heinemann (*1954*). The ferruginous spore print has also been observed for *P. curtisii*, the type of the section. The comparison with *Xanthoconium* (p. 17, 143) is unwarranted inasmuch as spore print color alone cannot be used as a single unifying character. But it may separate this section from the otherwise similar section *Glutinovelati* where the spore print as far as known has an olive tinge.

BOLETUS XYLOPHILUS Petch (identical with *P. viperinus* Sing.).—This species is not a *Phaeogyroporus* (*Phlebopus*), nor a *Gyrodon*, but quite obviously a *Pulveroboletus*, sect. *Sulphurei*, where the detersile fibrillosity is seemingly or really lacking, and in this case a continuity between sect. *Sulphurei* and sect. *Duckeani* Sing. (Singer & *al.*, *1981*) can be established. I have studied the respective types and additional material from Asia.

6. GROWTH PATTERNS OF THE CARPOPHORES

A new aspect has been introduced by Corner (1972) who without special emphasis on the hymenophore development in the primordium has studied the growth patterns of several species of boletes from early stages to maturity. The shortcomings of this approach were enumerated by Corner himself (p. 28) and include also the following: Too few species have been studied in this regard and the patterns, elaborated in the field, could not be checked under fully identical conditions of humidity and temperature. In spite of all this, this approach is interesting and worthy of a follow-up under more controlled conditions. If we analyze the data obtained thus far by Corner on boletes, and if we substitute for the generic position attributed to them by Corner those we consider correct (see previous chapter), we have:

Fig. 5 — *Boletochaete* (slow-growing long-lived type),
Fig. 6 — *Austroboletus* (rapidly growing, short-lived type),
Fig. 7 — *Pulveroboletus* (rather slow-growing but shorter-lived type),

Fig. 8 — *Boletochaete* (slow-growing, long-lived type),
Fig. 9 — *Pulveroboletus* (rather slow-growing but shorter-lived type),
Fig. 10 — *Boletellus* (rapidly growing and short-lived type),
Fig. 11 — *Boletellus* (rapidly growing and short-lived type).

The coincidence of generic identity and growth pattern is here quite obvious, and is in full agreement with my classification. It is perhaps too much to hope that, generalized for the genera of boletes of all subfamilies and of all floral districts, this coincidence would still hold, but the existence of such correlations in a few genera and in a tropical environment may well suggest some taxonomic significance for the different growth patterns.

7. MYCORRHIZAL RELATIONSHIPS

Several authors, aside from the present, for instance Benedix (*1963*) have drawn attention to the fact that ectomycorrhizal relationships may be a useful tool for specific and supraspecific taxonomy and even for an attempt to determine the direction of evolutionary lines. Recent experiences in the tropics (Singer, *1973–1978;* Singer & *al., 1981*) tend to modify some earlier conclusions sufficiently to warrant a new survey of the various taxa.—

Paxillaceae:
- *Hygrophoropsis* — Possibly some facultatively ectomycorrhizal.
- *Paxillus* — Sect. *Parapaxillus*: At least one species constantly ectomycorrhizal;
  - Sect. *Atrotomentosi* and *Panuoides*: Non-mycorrhizal, lignicolous;
  - Sect. *Paxillus*: Probably all (certainly *P. involutus*) facultatively ectomycorrhizal;
  - Sect. *Veluticiptes*: Perhaps; sect. *Defibulatie* certainly ectomycorrhizal.
- *Neopaxillus* — Facultatively ectomycorrhizal.
- *Ripartites* — No reliable studies available.
- *Phyllobolites* — At least facultatively ectomycorrhizal, possibly obligatorily, but host not established.

Gomphidiaceae:
- All genera ectomycorrhizal with conifers.

Boletaceae:
- *Gyroporus* — Ectomycorrhizal, but not specialized. Mycorrhizae possibly facultative.
- *Phlebopus* (*Phaeogyroporus*) — Facultatively mycorrhizal but not ectomycorrhizal in the species studied (a specialized form of peritrophic mycorrhiza in *P. tropicus*, with citrus).
- *Paragyrodon* — Ectotrophically mycorrhizal with Fagales.
- *Gyrodon* — Many species not mycorrhizal at all, others ecto- or ectendotrophically mycorrhizal with such genera as *Fraxinus*, *Alnus*, *Allophylus*.
- *Meiorganum* — Apparently non-mycorrhizal, lignicolous.
- *Psiloboletinus* — Ectomycorrhizal with *Larix*.
- *Boletinus* — Ectomycorrhizal with *Larix*.

Suillus — All ectomycorrhizal particularly with *Pinus* and other conifers, quite exceptionally with Salicaceae.

Phylloporus — Ectomycorrhizal with various trees (excepting perhaps sect. *Manaussenses*).

Xerocomus — Some non-mycorrhizal (some parasitizing Gasteromycetes), some ectomycorrhizal with conifers (but some of these only facultatively so, or with combined endomycorrhiza with *Monotropa*), some with Salicales, Fagales, Tiliaceae, Leptospermataceae, Leguminosae etc.

Tubosaeta — Possibly non-mycorrhizal, or with ectomycorrhizae on leguminous trees (?).

Chalciporus — All ectomycorrhizal with conifers, Fagales, Leguminosae, etc.

Pulveroboletus — Some non-mycorrhizal or even lignicolous, some ectomycorrhizal with Fagales, Leguminosae, more rarely conifers.

Boletus — All species ectotrophically mycorrhizal (obligatorily), the majority with angiosperms (one apparently with Nyctaginaceae), fewer with conifers (none with Leguminosae, *Alnus*, *Fraxinus*), usually very strictly specialized.

Xanthoconium — All ectomycorrhizal with Fagales.

Boletochaete — No data available.

Prophyrellus — Ectomycorrhizal with conifers and Fagales, mostly rather specialized.

Tylopilus — Ectomycorrhizal with conifers and Fagales, Leguminosae, (Rutaceae).

Leccinum — All species ectomycorrhizal, mostly specialized, with Fagales and Salicales, fewer with conifers.

Austroboletus — Some non-mycorrhizal (saprophytic or parasitic), but many ectomycorrhizal with a wide range of Cormophyta.

Fistulinella — Probably some ectomycorrhizal (facultative?), but some apparently non-mycorrhizal.

Boletellus — Probably some at least facultatively ectomycorrhizal, others probably non-mycorrhizal.

Phylloboletellus — Possibly non-mycorrhizal, but perhaps ectomycorrhizal with Sapindaceae or Leguminosae (if so, probably facultatively).

Strobilomyces — Possibly all ectomycorrhizal but with a wide range of hosts.

Evaluating this list we find, as expected, that among the subfamilies only Suilloideae are reasonably homogeneous in their tree association. Other subfamilies and some genera (*Paxillus*, *Xerocomus*, *Pulveroboletus*) show a gradually increasing dependency on obligatory extomycorrhiza and increasing specialization within the taxon. In the genera which one might characterize as mostly highly developed (*Boletus*, *Xanthoconium*, *Tylopilus*, *Leccinum*) all species are smooth-spored and associated predominantly with angiosperms, especially Fagales, and lacking clamp-connections. Here one finds the most constant association with the highest degree of specialization, except for the Suilloideae where the association is with conifers rather than angiosperms (which most authors derive from the Gymnospermae).

Ectomycorrhiza is (as compared with other symbioses with higher basidiomycetes and with endomycorrhiza in general) a relative newcomer in the history of fungus-cormophyte associations. We should not be surprised to find those Boletineae with short, 'non-compressed' spores, or with ornamented spores, with veils or with hemiangiocarpous development, with lamellate hymenophore, clamps, and particularly those groups where such indications of supposedly early steps in the evolution of boletes and allies are shown simultaneously, are frequently the same that also show no or only sporadic (facultative) mycorrhizal association, or those where this association does not seem to be fixed in a single host species, i.e. ubiquitous, non-specialized species.

While there is then a definite pattern, showing the probable trends in the evolution of the boletes, there are indeed some inconsistencies (recent species with partly primitive, partly evolved characters). More important, no particular living boletoid organism shows all these characters at the same time. Rather, a number of species or groupings have been considered relatively ancient (Gyroporoideae, Gyrodontoideae, *Boletinus*, some *Xerocomi*, *Boletellus*, especially *B. fibuliger*, Paxillaceae, especially *Hygrophoropsis*, *Paxillus* sect. 1–3, *Phyllobolites*, *Phylloboletellus* and the Gomphidiaceae), with emphasis on some of these by some authors whose phylogenetic hypotheses have been supported by such assumptions.

It must therefore be assumed that either some of the presumed 'primitive' characteristics are not indeed primitive in the boletoid fungi or that one organism, either recent or fossil, combines them but has not yet been discovered.

On the positive side, the absence of *Leccinum* in neotropical lowlands, but its demonstrated presence in *Betula* plantations almost all over the world, and in native fagaceous forests in tropical Asia can now be explained by the absence of Fagales in the tropical lowlands of the neotropics and their abundance in the Asiatic tropics. Also, all *Larix*-connected boletes belong in the subfamily Suilloideae, a subfamily with an area coinciding with that of the ectomycorrhizal conifers.

What is remarkable is the fact that Boletineae are extraordinarily rich in ecological adaptation and that their mycorrhiza formation includes association with a particularly wide spectrum of hosts viz. conifers (Pinaceae), Fagales and Salicales, Oleaceae, Tiliaceae, Leptospermaceae (*Leptospermum* and *Eucalyptus*), leguminous families, Sapotaceae, Nyctaginaceae, Sapindaceae, Rubiaceae (some *Psychotria* sp.), and probably Polygonaceae (*Coccoloba*).

8. PARADOXES

Those who have criticized or amended my classification by defining families, subfamilies or genera differently, have not come out with solutions comparable with each other, even less with a common counter proposal. Authors who have published new classifications for all or some Boletineae, or with an interpretation of their phylogeny, have arrived at extremely divergent points of view. While Smith & Thiers (*1971*; but not Thiers, *1971*) think of *Suillus* as the basic ('closest to the origin' of Boletaceae) genus, Pegler & Young (*1981*) strangely enough inserting *Suillus* in the Strobilomycetaceae, consider *Suillus* as a phylogenetically advanced genus (and we agree). Influenced by his 'Clavaria theory', Corner (*1972*) puts *Ixocomus* (=*Suillus*) near the end of his evolutionary line, considering *Heimiella*, *Boletellus*, and *Strobilomyces* most primitive (scheme, p. 27). While he is right, to a certain degree, in that the 'Gasteromycete-theory' suffers from the fact that it can be read in different directions, his own suffers from his supposition that fungi necessarily derive from algal ancestors (but cf. Broda, *1975*) and fruiting body similarities of Basidiomycetes with thallus shapes of algae indicate clavarioid fungi as the ancestral form of agarics, an argument we find unacceptable. As against the *Clavaria*-hypothesis we quote Donk's remarks (Thiers, *1971*: 437). Pegler & Young, although offering their classification as a phylogenetic one (which it is only in part), do not elaborate on detailed evolutionary lines, merely indicating some genera as 'less advanced' (*Paxillus*), citing Corner's hypothesis (which they find attractive) and giving *Heimiella* relict status. Watling (Watling & Largent, *1977*) says he is 'sympathetic' to the '*Clavaria*-theory' (p. 594).

All these modern hypotheses cannot be correct since they are mutually exclusive, unless, of course, we return to Heim's statements postulating polyphyletic origin of the boletes. We don't.

A few examples of contradictory statements in recent classifications.—
Species left in a single genus by Watling and Arpin & Kühner are classified in three different families by Pegler & Young. *Phylloporus*, relegated to the Paxillaceae by Smith & Thiers (*1971*) and Watling (*1970*) is congeneric with *Xerocomus* respectively *Boletus* (Boletaceae!) according to others (Arpin & Kühner, *1977;* Kühner, *1978–1980*). *Hygrophoropsis* whose position in the Paxillaceae has not been challenged by others, is placed in a family of its own together with *Omphalotus* by Kühner (*1978–1980*). This family, Hygrophoropsidaceae, is considered to be transient between Tricholomatales and Boletales. *Pulveroboletus* (sensu lato, in my definition) is recognized as such by Pegler & Young while it is totally incorporated in *Boletus* (in various subgenera) by Corner and restricted to *P. ravenelii* by Smith & Thiers. *Boletinus* is transferred from the Suilloideae to the family Gyrodontaceae by Pegler and Young, but considered congeneric with *Suillus* by Smith & Thiers and Arpin & Kühner. *Meiorganum*, originally considered (by Heim) to belong in a family of its own, was inserted in the Gyrodontoideae by me, transferred to the Coniophoraceae (Aphyllophorales) by Pegler & Young. It must be stated here, however, that the 'minute, deep ferruginous spores' are neither the smallest in the Boletineae, nor are they deep ferruginous but gray-brown-lilac purple (Heim), dull vinaceous pink to fawn brown (Corner, *1971*). Corner treats the genus in his 'Merulioid Fungi' but thinks that it is intermediate between Boletaceae or Paxillaceae and Meruliaceae, not Coniophoraceae. 'Its boletaceous affinity is clear' (Corner, l.c.: 357).

What seems to be more an error in identification than a taxonomic decision is Pegler & Young's insertion of *Boletinus pictus* with *B. cavipes*. The former, treated by Smith & Thiers and others as congeneric with *Suillus* (fam. Strobilomycetaceae according to Pegler & Young), differs from *Boletinus* and related species (family Gyrodontaceae according to Pegler & Young) by absence of clamp connections in the carpophore, ectomycorrhiza with *Pinus*, and solid stipe.

9. THE HIATUS BETWEEN GENERA

In most monophyletic, i.e. not artificial genera of Biota there are 'transitions' between genera. If we believe in evolution rather than creationism, this cannot be otherwise. But between genera and families (and all superspecific taxa) there must be a definable hiatus which is not always easy to describe or express in keys by a single character state alone (cf. Machol & Singer, *1971*). As we study more thoroughly more and more species and newly introduced characters, our assumption about the position of the hiatus may change. Finding the position of the hiatus is among the main difficulties in the delimitation of taxa, especially the superspecific taxa. Much depends on the idea each author has about the size of the hiatus which, for him, justifies generic separation, but the problems do not just go away if we relegate a genus to subgeneric status.

In the Boletineae many authors, including the present author, have in their lifetimes transferred one or several species to a genus or family other than the genus or family it was originally attached to, mostly because of new evidence that has become available to them, e.g. regarding *Phyllobolites* (Singer, *1964*; Singer *& al., 1981*). Some such cases have been discussed in the previous chapters. The remaining ones shall be discussed here.

Hygrophoropsis. After having redefined this genus and inserted it in the Paxillaceae, I at first admitted only species with pseudoamyloid spores, as have many Paxillaceae. These species were *H. aurantiaca* and *H. tapinia* (its identity with *Cantharellus flabelliformis* Berk. & Curt. cannot be accepted since the type has no spores and its description does not fit *H. tapinia*!). Only in 1975 I have added some species with inamyloid but cyanophilous spores. These species, with regard to their other characters, coincide with the type species. The spore wall of the latter was here described as simple (not 'thin-walled' and not 'mince et simple' as Kühner quotes me) and in my description of *H. aurantiaca* (Singer 1946, see Singer, *1977a*) was described as thin-walled to somewhat thick-walled. Kühner states that after 30 hours at 60°, numerous spores showed a wall of three coverings, the middle one swollen, the endosporium not very thick but well characterized. This, according to him, is not the case in *H. olida* although the spores, as indicated by me, are cyanophilous as in *H. aurantiaca*. I have also observed rather thickish wall in *H. kivuensis* Heinemann (Singer *& al., 1981*) and we have weakly to strongly pseudoamyloid spores together with inamyloid spores in *H. panamensis*. Consequently there is a continuity of spore characters if extra-European species are considered. On the other hand, *Gerronema albidum* which differs not only by acyanophilous spores but by absence of clamp connections (in contrast to all *Hygrophoropsis* species), cannot be placed at the end of this series inasmuch as chemotaxonomy cannot be of much help here since *G. albidum* carpophores are almost pigmentless; however a pigment analysis of the closely related *G. alutaceum* and E.M. sections of their spores may possibly add some further evidence in the case. For the time being, the hiatus appears to be between *H. olida* and *G. albidum*, not between *G. albidum* and the rest of the Gerronemas, and the circumscription of *Hygrophoropsis* must remain the same (Singer, *1975;* Pegler & Young, *1981*).

Gyrodon.—It has been separated from a genus *Boletinellus*, a monotypic genus erected for *G. merulioides* (Smith & Thiers, *1971*). There is no hiatus at all between the two genera, and I cannot go beyond my comment (Singer, *1975*: 705) since Smith & Thiers (*1971*) who maintain

Boletinellus as a valid genus, have neither explained their reasons nor keyed out the genus in their book. This is a rather puzzling situation inasmuch as a genus much more different from *Gyrodon* than *G. merulioides*, viz. *Paragyrodon sphaerosporus* has been placed in *Suillus* by the same authors.

Pulveroboletus.—The continuity between the type species with a fibrillose veil and the other sections is difficult to understand for those who are not familiar with representatives of all sections. At first glance, the pulverulent-arachnoid veil of *Pulveroboletus ravenelii* sets this species apart but the veil hyphae may be present and forming a pulverulence, more or less detersile, in other sections, and the gelatinization, present in the epicutis of *P. ravenelii* and related species, may become very strong in the ex-velar layer or even an indistinct velar layer leading to sections *Glutinovelati* and *Cartilaginei*. This gelatinized layer may be reduced to simply viscid pileus and stipe as in sect. *Auripori*, or else the gelatinization may be practically absent, as in sect. *Sulphurei*. I have added a new section (Singer *& al., 1981*), *Duckeani*, where both pulverulence and stipe viscosity are absent. The continuity between sect. *Sulphurei* and *Duckeani* has been discussed under *B. xylophilus* (Chapter 5). The genus as a whole consists of species unrelated to species of *Xerocomus*, *Chalciporus*, and *Boletus* but the pulverulent-arachnoid surfaces, which may be replaced by glutinous surfaces, or the habit, the tendency of the stipe to become hollow and/or cartilaginous, the absence of blue reactions of the fresh surfaces with ammonia are characters common to the species of *Pulveroboletus* even where one of these characteristics should be missing in a given specimen. The transition from dry to glutinous species is neatly illustrated by the fact that Corner (*1972*: 134) describes *P. umbilicatus* as having a cover on the surfaces which is originally a dry, piloso-fasciculate tomentum then becoming mucilaginous. This statement is turned by Corner (p. 10) into a fact supporting his contention that *Pulveroboletus* is not a natural genus in my circumscription, while, on the contrary, *P. umbilicatus* underscores the continuity of sections in this genus. As in other genera of mostly elongated-spored ('boletinoid') boletes, there is a tendency in *Pulveroboletus* towards short spores and, as in *Chalciporus*, there is a tendency of the hymenophoral trama to maintain a seemingly *Phylloporus* type of structure over longer periods, especially in species with reduced gelatinization or collected in dry periods.

It is understandable that it was European authors, unfamiliar with some sections of *Pulveroboletus*, who separated the split genera *Buchwaldoboletus* and *Aureoboletus* for the only two sections occurring in Europe. It goes by itself that Corner (*1972*) accepting an excessively wide circumscription of the genus *Boletus*, incorporated all Pulveroboleti in *Boletus*, but, following Smith & Thiers (*1971*) restricted the subgenus *Pulveroboletus* to *P. ravenelii* which, according to him is, in contrast to other sections, 'angiocarpic'. But this is neither proved nor necessarily diagnostic on a generic level (*Xerocomus* contains paravel-angiocarpic species), even if Corner's assumptions should turn out to be correct. Corner's further comments (p. 9–11) are partly based on misquotations. Neither do I say that the pores of the *Glutinovelati* are always golden yellow but they are described as 'golden yellow, cream color' (1962 as well as 1975) nor is *P. corrugatus* claimed to be angiocarpic, nor was the diagnosis of sect. *Glutinovelati* (1947!) taken from *P. lithocarpisequoiae* (1959!) nor is the latter a 'coniferous species' since no mycorrhiza with conifers was present. Another part of his comments is based on misinformation since species were referred to in the discussion without knowledge of the types (*S. lithocarpisequoiae*, cf. Singer, *1975*: 727) or were misdetermined (*B. olivaceobrunneus*, *B. balloui*, *B. phaeocephalus* and others). Since we know that some species of *Pulveroboletus* as well as the closely related *Chalciporus* either have or do not have resinous-incrusted cystidia, there is nothing strange or confusing about two species of section *Glutinovelati* being different in this regard. Considering all this, Corner's criticisms are not supported by convincing facts, and expressions like 'confusion of Malayan mycology' and 'dump for species' are uncalled for and misleading or at least a sample of Corner's frequently acid style (I prefer the second alternative because I believe that his opinions are sincere and open to new facts).

I admit that I may have contributed to misunderstandings about *Pulveroboletus* by referring there *B. ornatipes* and *B. phaeocephalus* although these mistakes have been corrected by me. Unless new evidence is presented, or a much smaller generic concept is admitted, there is no reason to change my circumscription of *Pulveroboletus* (Singer, 1975) as accepted by Snell & Dick (*1970*), Moser (*1978*), Pegler & Young (*1981*), and Bertault (*in* Bull. Soc. mycol. Fr. **95**: 308–309, 1979).

10. NOMENCLATURE AND OTHER FORMALITIES

Kühner (*1977*; *1978–1980*) removes the nomenclature of Kühner & Romagnesi (1953) from their own basic set of rules to internationally accepted nomenclature. This development will be met with applause by all those mycologists who at times have found it difficult to coordinate the names used in Kühner & Romagnesi and those that conform to the Code. It is unfortunate that those botanists most concerned with the continuity of botanical names and thus with the general acceptance and application of the Code of Nomenclature are often the same who discourage taxonomists by a continuing flood of new proposals and introduction of new examples and modifications of the rules. Kühner's historical merits in basidiomycete systematics make his exposé of the 'grandes lignes' of classification even if 'centred on European genera' and 'essentially critical and historical' an extraordinarily interesting and valuable source of information not only on characters introduced by him but for an exploration of the reasons behind his taxonomic thinking (but hardly as an alternative to Singer's or other systematists' classification as suggested by some reviewers). Thus, it is not without regret that I have to insist on some minor points of nomenclature and other formalities since they were brought up in recent papers (Arpin & Kühner, *1977*; Kühner, *1977*) critical of my own work (which Kühner at the same time called 'monumental'). By relegating several of the (nowadays mostly recognized as generic) taxa of Boletaceae to subgeneric status, Arpin & Kühner (*1977*) overlooked the fact that Fries and others had already subdivided *Boletus* into several infrageneric taxa which, applying the type principle, should be considered as having priority over the ones now proposed (Arpin & Kühner, l.c.) It is hard to imagine that Fries (1836) did not introduce, with Roman numerals, what he considered tribus and which are now to be treated as subgenera. If so, subgenus *Tylopilus* whould have to be called *Boletus* subgen. *Hyporrhodius*. What is now the genus *Suillus* was apparantly first treated as a subgenus by Kuhner & Romagnesi (1953) under the name *Ixocomus* Quel.; by Schröter as II. *Leucocricos*, IV. *Cricunopus*, (V. *Boletinus*); *Leccinum*=*Krombholzia* (P. Karst.) Schröt. (subgenus).

Kühner (*1977*) finds it 'shocking' that the bibliography of my 'Agaricales in modern taxonomy' omits the works of E. M. Fries, and the '(Fr.)' in the citation of the genera proposed by Kummer is, for him, 'deeply regrettable' and 'a profound injustice'. It is hardly to be expected that a book called 'Agaricales in modern taxonomy' which does not even analyze most of the characters on which Fries's classification was based, would again (after an explicit account of the history of Agaricales-systematics provided in 1936, referred to in 1951, 1962 and 1977) enumerate and list all the classical works of Fries (or for that matter Persoon). Who, indeed, would at present feel that Fries himself whose name is attached to perhaps a majority of fungus taxa presently accepted in Europe, were injured in any way by the fact that his name is now omitted in some of the author citations — and that for good reasons. In the case of Kummer, this is a strictly formal question (in which, it is true, not all mycologists agree with me). This is based on Kummer's own words who, as I have explained before (Singer, *1951*), says that he merely used the same name as Fries for what he introduced as 'new genera'. Few authors realize that this means more than a minor formality, and that it has rather far-reaching consequences in nomenclature. A new genus is not nomenclatorially based on the homonymous tribus name and therefore the type species does not have to be selected from the latter. If we consider Kummer's genera as merely elevations in rank, the designation of a lectotype would have to go back to the earliest use of the name at any rank, and the resulting choice would often be difficult or even embarrassing. Nomenclature rules have been made for the stated purpose of unification and continuity of nomenclature and not for historical justice. It is undoubtedly a historical 'injustice' that according to the new Code the family names Rhodogoniosporaceae Heim and Rhodophyllaceae Sing. had to be replaced by the nomenclatorially correct family name Entolomataceae or that *Calocybe carnea* (Bull. ex Fr.) Kühner was replaced by *Calocybe carnea* (Bull. ex Fr.) Donk. The case of *Armillariella* vs. *Armillaria* — where Donk (*1962*) says that under some conditions Singer's selection has to be respected — is another example for what has been said above. In a discussion of bolete taxonomy, however, I cannot enter into detailed discussions on other groups. But with all possible respect for the feelings of historical justice and taxonomical preferences, such feelings cannot be used as an argument against a nomenclatorial solution dictated by the rules, even if we tend to oppose it.

On Staude's so-called 'genera' the reader is again referred to my comments of 1951. Kühner's opinion that the so-called residue rule is an automatic rule like the 'first-species rule' is not well founded since the former is recommended in the present Code whereas the second is specifically rejected in the Code. What Kühner calls historical or scientific lectotypification is unfortunately something that doet not exist in the rules. While it should in certain cases be a guide for new lectotypifications, it has no standing in 'correct' namegiving. Kühner's speculations with regard to the motive of taxonomists for a certain taxonomical or nomenclatorial solution are often incorrect and mostly irrelevant as they are in the case of my supposed motive for the lectotypification of *Armillaria*.

These minor points do not affect the taxonomy of boletes beyond the introductory remarks by Kühner cited above, nor is Kühner the only one who arrives at conclusions which are nomenclatorially unacceptable. The rejection of *Gyrodon* in favor of *Uloporus* by Watling (*1970*) is hardly convincing inasmuch as in the Fries Herbarium at Upsala, material determined by Fries himself is conserved. This material is the only authentic material existing and is identified as *Boletus sistotremoides*. My own analysis of this specimen proves that it is *Gyrodon lividus*. *Boletus sistotremoides* is the type species of *Gyrodon* (cf. also Singer *in* Taxon **5**: 30–33, 1956).

Furthermore, *Leccinum crocipodium* has an epithet not validly described and not very well (certainly without analysis) illustrated by Letellier. The correct name is *L. nigrescens* (Richon & Roze) Sing. *Leccinum versipelle* (Fr. ex Hök) Snell is neither demonstrably identical with *L. testaceoscabrum* nor is *B. testaceoscabrum* illegitimate since the example of the Leningrad Code (outlawing Secretan's names) is in contradiction with the main text of Art. 23 I.C.B.N. A proposal has been made to remove the respective example from the text of the Code. *Leccinum carpini* (R. Schulz) Moser ex Watling (1965) as cited by Watling (*1970*) is clearly a synonym of the earlier *Gyroporus griseus* Quél.=*Leccinum griseum* (Quél.) Sing.

11. CONCLUSIONS

The often divergent and to a certain degree contradictory results obtained by various authors and the few erroneous statements made by some cannot be an excuse for neglecting all but those that corroborate one's own earlier conclusions.

Far from minimizing Kühner's attempt to re-introduce the historical aspect which so often cannot be expressed satisfactorily in names or taxonomic schemes, I suggest that it would be useful and interesting to devote more time to the history of mycology (not only mycological taxonomy) than is now devoted to it. The rapid progress of science has not suppressed but rather spurred a renewed interest in the history of physics. A painstakingly detailed and unbiassed reconstruction of the history of certain taxa and the role of mycologists involved in it would certainly put into perspective the progress thus far made in bolete taxonomy. It would also reintroduce the contributions by Snell & Dick whose works are too often forgotten where the history of bolete taxonomy is or should have been told.

One general tendency, especially justifiable on chemotaxonomical grounds, has manifested itself rather strongly in recent times: The boletes and bolete-like families should be united into a taxon above family level. There are however — as pointed out by me (Singer, *1975*) — some difficulties involved in such a procedure. Added difficulties arise when we deal with families where gastromycetous affinities have been demonstrated. If Aphyllophorales or Gasteromycetes are involved, just how far back or how far ahead in evolutionary lines should this superfamily or order reach? While we now seem to agree that mammals are not necessarily monophyletic, we do not introduce additional taxa on the same level. If the gastromycetoid and hymenogastrineous groups related to the boletes, Gomphidii, and Paxillaceae are for the time being excluded, as I would prefer to do, the remaining groups do not pass order limits, and do not, therefore, require a taxon on the level of order unless Aphyllophorales, Agaricales, and Gasteromycetes are all split into orders (as proposed by Kühner, *1978–1980* for the Agaricales sensu lato). It is therefore proposed to accept, for the bolete-like families, the rank of suborder, Boletineae, such as it has been used before (Singer, *1977*) and discussed by me as a possible solution (Singer, *1975*: 152–153), leaving the Agaricales as such intact (non-aphyllophoraceous Higher Basidiomycetes with autobasidia). Nearly all proposals of orders within the Agaricales sensu lato have neglected the suborder as an intermediate position in the taxonomic hierarchy as given in the Code. Its acceptance may also lead to the recognition of Kühner's new orders (Tricholomatales, Agaricales sensu stricto, Pluteales, Russulales, and Boletales) on the suborder level although the distribution of the families in these groups will hardly find immediate and wide acceptance among agaricologists. However this may be, Boletineae as a common denominator above family rank is now acceptable as well as Russulineae for Russulaceae (*Russula, Lactarius*).

What families should enter the suborder Boletineae? The following Table I will provide ample choice.

TABLE I. Families of Boletineae Gilbert

Snell, 1941	Moser, 1978	Pegler & Young	Kühner, 1977-80	Singer, 1936-75 Snell & Dick	Proposed readjustment
	Paxillaceae (incl. *Hygrophoropsis, Omphalotus*)	Paxillaceae (incl. *Hygrophoropsis*)	Paxillaceae Hygrophoropsidaceae	Paxillaceae (incl. *Hygrophoropsis*)	Paxillaceae (incl. *Hygrophoropsis*)
	Gomphidiaceae	Gomphidiaceae		Gomphidiaceae	Gomphidiaceae
Boletaceae	Boletaceae	Boletaceae	Boletaceae (incl. Gomphidiaceae)	Boletaceae	Boletaceae
	Strobilomycetaceae	Strobilomyceaceae (sensu lato)		Strobilomycetaceae	
		Gyrodontaceae			
		Xerocomaceae			
				(Gastroboletaceae)	(Gastroboletaceae)

As for the Paxillaceae, their recognition appears to be unanimous, and only Kühner (*1978–1980*) seems to favor a separate family for *Hygrophoropsis*. His decision is perhaps influenced by the uncertain position of *Omphalotus*. The latter is probably but not certainly related to the Paxillaceae (cf. Chapter 3), yet a Chinese species of what is obviously an *Omphalotus* has recently been published as *Paxillus* (Zang & Zeng, *1978*).

The affinity of Gomphidiaceae to the Suilloideae is not evident since spore print color, hymenophoral configuration, carpophore development, and pigment occurrence (Besl *& al., 1975;* Bresinski & Besl, *1979*) are not alike in any *Gomphidius* or *Chroogomphus* and any species of *Suillus*, even though some identical pigments or related substances may occur in both, as pointed out by Arpin & Kühner (*1977*) yet this is also true if we compare the Paxillaceae with certain other bolete genera. The one remarkable similarity between Gomphidiaceae and *Suillus* is their conifer specialization when forming ectomycorrhiza. It is however incorrect to say that oleocystidia in the sense of Corner and Kühner exist only in the Gomphidiaceae and *Suillus* (they occur in some *Chalciporus, Phylloporus, Pulveroboletus,* etc.) and the *Boletus*-type of bilaterality of the hymenophoral trama is even more widely

TABLE II. Arrangement of the genera in Boletineae

PAXILLACEAE	BOLETACEAE	
Omphalotus (tentatively)	Subfamily Gyroporoideae:	Subfamily Boletoideae:
Hygrophoropsis	*Gyroporus*	*Chalciporus*
Paxillus		*Pulveroboletus*
Phyllobolites	Subfamily Gyrodontoideae:	*Boletus*
Neopaxillus	*Meiorganum*	*Boletellus*
Ripartites	*Paragyrodon*	*Phylloboletellus*
	Gyrodon	*Leccinum*
	Phlebopus	*Xanthoconium*
GOMPHIDIACEAE	Subfamily Suilloideae:	*Tylopilus*
	Boletinus	*Boletochaete*
Chroogomphus	*Psiloboletinus*	*Fistulinella*
Gomphidius	*Suillus*	*Austroboletus*
Cystogomphus		*Porphyrellus*
	Subfamily Xerocomoideae:	Subfamily Strobilomycetoideae:
	Phylloporus	*Strobilomyces*
	Xerocomus	
	Tubosaeta	

distributed. These are the reasons why I cannot agree to place *Gomphidius* or other Gomphidiaceae next to *Suillus* in the Boletaceae.

There is obviously a necessity to revise the limits and status of the Strobilomycetaceae Gilbert, accepted by Singer, Moser, Snell & Dick (*1977*), and also (but in a strong, in my opinion exaggerated, emendation) by Pegler & Young (*1981*). There are however too few characteristics to hold the four genera together. I propose, therefore, to restrict this group to the genus *Strobilomyces* (including *Afroboletus*), with a characteristic spore print color, development type, and some minor spore characteristics, pigments, etc. and subordinate it as a subfamily to the Boletaceae. On similar grounds, and in spite of the obvious similarities, we may also separate the genus *Gyroporus* as a separate subfamily which must be placed in the immediate neighborhood of Gyrodontoideae.

Porphyrellus, Fistulinella, and *Austroboletus* should then be separated from the Strobilomycetaceae or Strobilomycetoideae and be placed along with the genera *Tylopilus* and *Boletochaete* in the Boletaceae. This leaves the ex-strobilomycetaceous genera *Boletellus* (incl. *Heimiella*) and *Phylloboletellus* which must be inserted close to *Boletus* and perhaps *Pulveroboletus*.

As for the two families Gyrodontaceae and Xerocomaceae it seems to me that the hiatus between them is not comparable with that admitted in other families of Agaricales. On the other hand, if a recognition of the orders Boletales, Tricholomatales, etc. comes close to a general uplifting of taxa by one step, it would not be entirely unreasonable to raise the bolete subfamilies to families. Most mycologists will however agree that such an attitude does not contribute to any visible progress of taxonomy.

With regard to position, recognition and circumscription of the genera, I refer to the respective discussions in previous chapters.

The proposed readjusted arrangement of the genera of Boletineae is shown on Table II, above. It does not take into account any gastroid forms which are at present better accommodated in the Hymenogastrineae, fam. Gastroboletaceae. The one exception can be seen in the boletes supposed to have arisen by 'gastromycetation' — the 'gastroid form (?) of ' *Suillus decipiens* and perhaps some species now inserted in the genus *Gastroboletus*. Where there is enough evidence to consider them as descendants of boletaceous genera, they should, of course, be attached to the respective genus in Boletaceae. But, as we have seen in Chapter 3, the final decision is by no means as easy as it may seem to some authors, inasmuch as little attention has been paid to the type, *G. boedijnii*. It was perhaps unfortunate that the family Gastroboletaceae Sing. (*1962*) was based on *Gastroboletus* and thus on *G. boedijnii*, but this type species has been revised (Singer, *1973–1978*) anatomically if not ecologically. The presence of apobasidia (as in *G. laricinus*) indicates that it is probably congeneric with *G. laricinus* even though the spores are generally asymmetric-heterotropic. No generalized statement should be made without a careful study of our observations on *G. laricinus* (Singer & Both, *1977*). It is here suggested that a possible approach to solving the *Gastroboletus* problem would be an attempt to see whether the primordial hymenophore is formed earlier in *Gastroboletus* than in supposedly related species of spore print producing boletes.

At any rate chamonixin and boviquinone have now been established as the links between Paxillaceae and Boletaceae on one hand, Gastroboletaceae and Rhizopogonaceae (secotioid and hymenogastrineous fungi) on the other, proving chemotaxonomically the affinity of the Boletineae with the Hymenogastrineae, an affinity which has been postulated for many years by Heim, Singer, Singer & Smith, Moser, Horak, and others. The evolutionary pattern, i.e. the direction of the evolutionary lines can be deducted in either way — from the gastroid to the agaricoid-boletoid side, or vice versa. Judging the entirety of the data and arguments involved, we still prefer the former without excluding the possibility of the opposite direction having prevailed, perhaps in more recent times and in certain instances (cf. Singer, *1975*, especially pp. 19–20, 128–151). 'Proof ' will only be provided by palaeontological data (but cf. Singer, *1977b*).

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INDEX TO GENERA, INFRAGENERIC TAXA, AND SPECIES

PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 303–310 (1981)

ON HIMALAYAN SPECIES OF ASTROSPORINA AND INOCYBE (AGARICALES)

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Two species of *Astrosporina* and two species of *Inocybe* from the southern slopes of the Himalayas are described and illustrated. *Astrosporina shoreae* and *I. claviger* are described as new. The new combination *A. calospora* is proposed.

Recently monographs on Indomalayan species of *Astrosporina* Schroet, and *Inocybe* Fr. have been published (Horak, *1979; 1980*). After the edition of the pertinent manuscripts, however, several Indian collections belonging to these agaricoid genera came to my attention. The well annotated material was gathered 1964 by Dr. C. Bas (Leiden) in deciduous and coniferous forests at different localities on the southern slopes of the Himalayas (Uttar Pradesh, Punjab).

Further taxonomic information and references on Himalayan representatives of *Astrosporina* and *Inocybe* are found in Ahmad (*1980*) and Watling & Gregory (*1980*).

Type material of the new species is kept in the Rijksherbarium Leiden (L; isotypes in ZT). If not otherwise stated the magnifications of the figures are: carpophores (nat. size), spores (×2000), basidia (×1000), cystidia (×1000).

1. **Astrosporina shoreae** Horak & Bas, *spec. nov.*—Fig. 1

Pileus –30 mm, conicus dein umbonato-convexus, argillaceus. Lamellae densissima, concolores. Stipes –50 × –2.5 mm, teres, ad basim bulbosomarginatus, argillaceus reflectu carnoso, omnino pruinosus. Sporae 5.5–7 × 4–5 µm, angulatae, subnodosae. Cystidia metuloidea, incrustata, numerosa. Ad terram in silva Shoreae et Malloti. India. Typus: *Bas 4308* (L).

Pileus –30 mm, conical to convex with papillate umbo, becoming plano-convex with umbonate centre; dingy buff to pale argillaceous, often darker around disc; in young carpophores entirely covered with concolorous, appressed to felty hyphae of veil, centre becoming subsquamulose with age, margin fibrillose, not striate or splitting, dry. Lamellae very crowded, narrow (up to 1.5 mm wide), subfree to adnexed; pale argillaceous with reddish tinge, edge entire, concolorous or paler. Stipe –50 × –2.5 mm, cylindrical, equal above, with small but distinct marginate bulb (–5 mm diam.); pale brown with pink or reddish tinge, bulb often white; entirely pruinose, margin of bulb occasionally with whitish, submembranous veil remnants (cp. veil remnants on pileus); dry, solid, single. Context pale brown. Odour and taste aromatic turning to subfetid.

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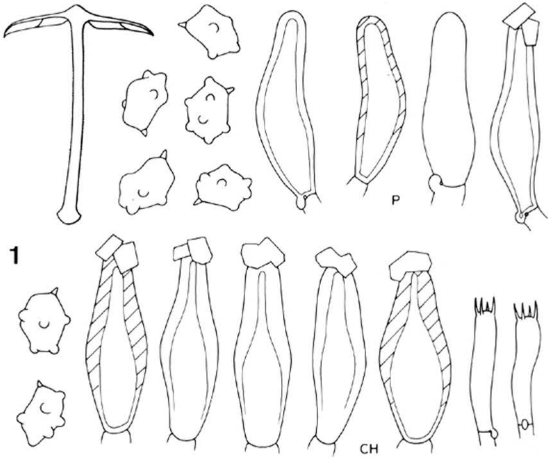

Fig. 1. *Astrosporina shoreae* (type): carpophore, spores, basidia, cheilocystidia (CH), pleurocystidia (P).

Spores 5.6–7×4–5 μm, angular with rather few, small, hemispheric knobs, brown, membrane thin-walled. Basidia 20–25×5 μm, 4-spored. Cheilo-, pleuro-, and caulocystidia 30–45×10–19 μm subfusoid, metuloid (membrane up to 4 μm diam. near apex), yellow-brown (KOH), encrusted with crystals. Clamp connections present on septa.

HABITAT.—On soil (clay, loam) in forest (dominated by *Shorea* sp. and *Mallotus* sp.), 400–600 m a.s.l. India.

MATERIAL.—INDIA: Uttar Pradesh, Dehra Dun, Gachiwala (about 15 km SE. of Dehra Dun), 7.IX.1964, *Bas 4308* (L, holotype; ZT 495, isotype); Rajspur (about 8 km N. of Dehra Dun), 8.IX.1964, *Bas 4313*.

The colour of the carpophores, the rather slender stipe with a bulbous-marginate base and especially the very narrow-crowded lamellae make *Astrosporina shoreae* taxonomically a close relative of *A. angustifolia* Corner & Horak (*1979*) which is a very wide spread species in Indomalayan and Australasian oak forests. Microscopically, however, the two species are well separated by the smaller and much less gibbose spores in the new Himalayan taxon. In addition *A. shoreae* is distinctive by cystidia of yellow-brown colour whereas those of *A. angustifolia* are hyaline.

Both examined collections of *A. shoreae* have been observed in association with *Shorea* (Dipterocarpaceae) and it is likely that this agaric enters ectotrophic mycorrhiza with teak.

2. **Astrosporina calospora** (Quél.) Horak, *comb. nov.*—Fig. 2

Inocybe calospora Quél. apud Bres., Fungi Trid. **1**: 19. 1882 (basionym).

Description of the Indian collection:

Pileus –30 mm, broadly conical to convex, mostly with slight papillate umbo, expanded with age; dark brown; covered with reddish brown fibrillose small scales, tips occasionally turned upwards (especially at disc), radially fibrillose towards fibrillose, splitting margin; dry, veil remnants absent. Lamellae crowded to subdistant, free to adnexed, broadly ventricose (up to 5 mm wide); dark umber brown, edge concolorous or paler, subfimbriate.

2

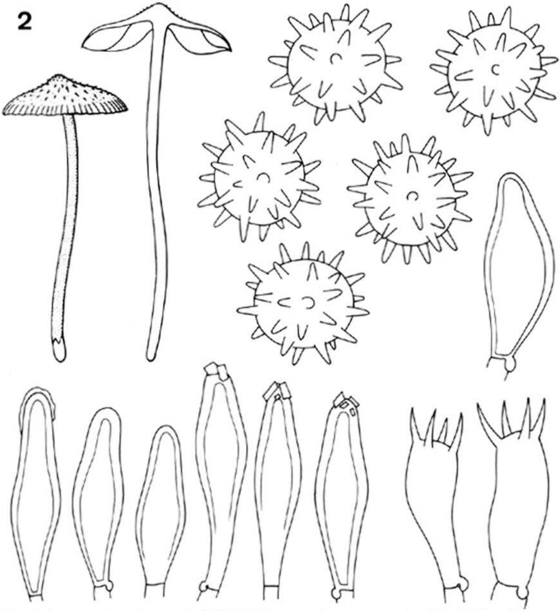

Fig. 2. *Astrosporina calospora* (L 964298.393): carpophores, spores, basidia, cheilo-, pleuro-, and caulocystidia.

Stipe –65 × –2.5 mm, cylindrical, equal, slender; dark vinaceous brown (reminding of *A. asterospora* Quél.); pruinose all over, dry, solid, single. Context whitish in pileus, vinaceous brown in stipe. Odour and taste sourish, herbaceous.

Spores globose (to broadly ovate), 9.5–11 µm (without projections), dendely covered with conical, up to 3.5 µm long projections, brown. Basidia 30–40 × 10–12 µm, 4-spored, sterigmata up to 10 µm long. Cheilo-, pleuro-, and caulocystidia 30–60 × 10–16 µm, fusoid, metuloid, membrane hyaline to pale yellow (KOH), apex beset with small crystals or resinous incrustation or being naked, numerous on stipe. Cuticle a cutis or trichoderm of cylindrical hyphae (4–10 µm diam.), encrusted with yellowish (KOH) pigment. Clamp connections present on septa.

HABITAT.—On soil in forest (*Quercus incana, Rhododendron arboreum*), 1800 m. India, Europe, Japan, U.S.A.

MATERIAL.—INDIA: Uttar Pradesh, Mussooree, Balansar, 14.IX.1964, *Bas 4386* (L 964298.393).

All macroscopic and microscopic characters on the Indian material studied indicate that *Astrosporina calospora* (Quél.) Horak is also present in the temperate *Quercus-Rhododendron* forests covering the Mussooree Hills in Uttar Pradesh. In Eurasia *A. calospora* (Quél.) Horak is not only extending from Europe into the Himalayas but is also reported from U.S.S.R. (Vassilieva, *1973*) and Japan (Kobayasi, *1952*).

Finally this agaric belongs also to the North American mycoflora where – under the synonyms: *Inocybe subfulva* Peck and *I. echinocarpa* Ell. & Ev. – it has been described both from the East and West of the U.S.A. (Heim, *1931*; Horak, unpublished data on type studies).

Among the European representatives *A. calospora* is unique due to its subglobose spores bearing conspicuous spiny or cylindrical projections. In the Indomalayan region, however, there are several taxa which are obviously close to *A. calospora* viz. *A. echinosimilis* Horak (*1979*), *A. gemina* Horak (*1979*) and *A. petchii* (Boedijn) Horak (*1979*). It appears therefore that the centre of evolution for this section of *Astrosporina* has to be sought for in Indomalaya and S.E.-Asia.

3. INOCYBE CALAMISTRATA Fries—Fig. 3

Inocybe calamistrata Fries, Syst. Myc. 1: 256. 1821.

Description of the Indian material:

Pileus –18 mm diam., –13 mm high, conical to broadly conical or parabolical, rarely becoming umbonate-expanded; dark grey-brown with olive tinge in centre, reddish towards not striate margin; especially disc covered with small, erect, concolorous or reddish brown scales, fibrillose near margin; dry, veil remnants absent. Lamellae rather crowded, adnexed, ventricose (up to 3 mm wide); argillaceous, turning dark reddish brown with age, edge albofimbriate. Stipe –95 × –1.8 mm, cylindric, slender equal or slightly tapering towards apex, bulb at base absent; dark olive-grey or dark grey-brown with reddish tinge (especially in young carpophores); apex with white to pale brown-ochraceous floccose pruina, towards base with loose, scattered, concolorous fibrils, tomentum (if present) whitish with pale grey-olive tinge; dry, fistulose, veil remnants none, single. Context pale grey, turning pale brown in cap, concolorous in stipe. Odour and taste not distinctive, or faintly like *Pelargonium*.

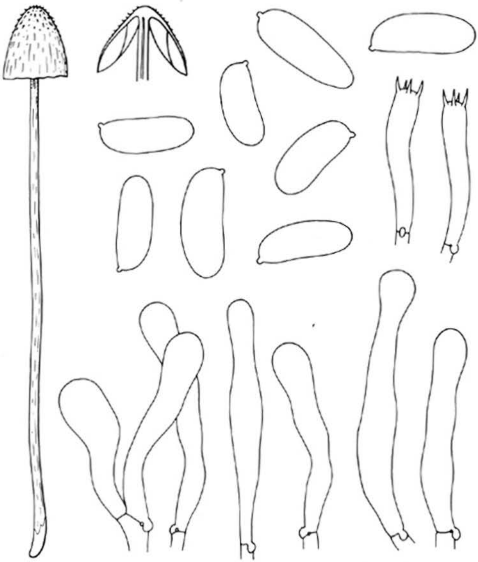

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Fig. 3. *Inocybe calamistrata* (L 964298.372): carpophores, spores, basidia, cheilocystidia.

Spore print dark argillaceous brown. Spores 9–12 × 4–5 µm, cylindric-allantoid, slender bean-shaped, brown, smooth, germ pore absent. Basidia 25–35 × 5–7 µm, 4-spored. Cheilocystidia 20–60 × 6–10 µm, clavate to subfusoid-capitate, membrane thin-walled, hyaline, crystals absent. Pleurocystidia none. Caulocystidia scattered, like cheilocystidia. Cuticle a cutis or trichoderm of cylindric hyphae (4–8 µm diam.), strongly encrusted with yellow-brown (KOH) pigment. Clamp connections numerous on septa.

HABITAT.—On soil in forest (*Quercus incana,* intermixed with *Cedrus deodara*), 2300 m a.s.l., India. Widely distributed in the temperate regions of the northern hemisphere.

MATERIAL.—INDIA: Uttar Pradesh, Mussooree, Oak-villa, 16.VIII.1964, *Bas 4393* (L 964298.372).

Except for the rather slender carpophores the Himalayan material agrees in all essential morphological details with *Inocybe calamistrata* Fr. as described from Central Europe (Kühner, *1955*).

This collection taken from mixed *Quercus-Cedrus* forests in the Mussooree Hills represents the first record of *I. calamistrata* Fr. in India (cp. *I. calamistratoides* Horak (*1977*) from New Zealand).

4. **Inocybe claviger** Horak & Bas, *spec. nov.*—Fig. 4

Pileus –35 mm, ex hemisphaerico umbonato-convexus, pallide ochraceus, albidus (e velo) marginem versus, fibrillosus. Lamellae albidae dein griseo-argillaceae. Stipes –65 × –4.5 mm, cylindricus, bulbosus, albidus dein ochraceus, omnino pruinosus. Sporae 7–8.5 × 3.5–4.5 µm, amygdaliformes. Cystidia ovoideo-clavata, metuloidea, hyalina. Ad terram in silva Cedri et Abietis. India. Typus: *Bas 4187* (L).

Pileus –35 mm, hemispherical becoming conical or convex with broadly umbonate apex, margin remaining strongly incurved also in aged carpophores; ochraceous cream to ochraceous buff, whitish near margin from veil; felty to fibrillose becoming subsquamulose, margin dentate to appendiculate from whitish veil remnants (obvious in young material), dry, margin smooth, not splitting. Lamellae crowded, narrow (up to 2.5 mm wide), subfree to adnexed; whitish at first turning argillaceous-grey, whitish edge subcrenulate. Stipe –65 × –4.5 mm, cylindrical, equal above, base slightly swollen to bulbous (not marginate), –7 mm diam.; white when young turning to pale ochraceous-yellow; pruinose all over, becoming fibrillose towards base (in aged specimens), dry, solid, single. Context white, unchanging. Odour and taste strongly herbaceous, reminding of *Pelargonium*.

Spores 7–8.5 × 3.5–4.5 µm, amygdaliform, brown, smooth, membrane thin-walled, germ pore none. Basidia 20–28 × 5–6 µm, 4-spored. Cheilo-, pleuro-, and caulocystidia 30–55 × 10–22 µm, ovoid-vesiculose to broadly clavate, metuloid (membrane –1.5 µm diam.), hyaline (KOH), incrustation absent but occasionally with resinous cap or crystals at apex. Cuticle a cutis (or trichoderm) of cylindrical hyphae (3–8 µm diam.), membrane subgelatinized, with yellowish, plasmatic pigment. Clamp connections present on septa.

HABITAT.—On soil (loam) in forest (dominated by *Cedrus deodara* and *Abies pindro*), 2000 m a.s.l. India.

MATERIAL.—INDIA: Punjab, Kulu Valley, Manali, Beas River, 20.VIII.1964, *Bas 4187* (L, holotype; ZT 497, isotype).

Inocybe claviger is characterised by the following most distinctive features: entirely pruinose stipe with bulbous base, ovoid to clavate, thick-walled cheilo-, pleuro-, and caulocystidia (encrusting crystals scattered or absent), and small amygdaliform spores (7–8.5 × 3.5–4.5 µm). Owing to these characters *I. claviger* is reminiscent of several rare European species of *Inocybe*. The (for the genus rather unusual) short cystidia are shared with *I. amygdalispora* Métrod (*1955*), *I. brevicystis* Métrod (*1955*), *I. citrinofolia* Métrod (*1955*), *I. ochroalba* Bruylants (*1969*), *I. ovoideicystis* Métrod (*1955*) and/or *I. piricystis* Favre (*1955*). But the small-sized amygdaliform spores in combination with the presence or absence of metuloid caulocystidia distinguish the new Himalayan taxon from all beforementioned species.

Macroscopically *I. claviger* could also be taken for *I. pelargonium* Kühner (*1955b*), however, the cystidia of the latter species distinctly separate the two agarics.

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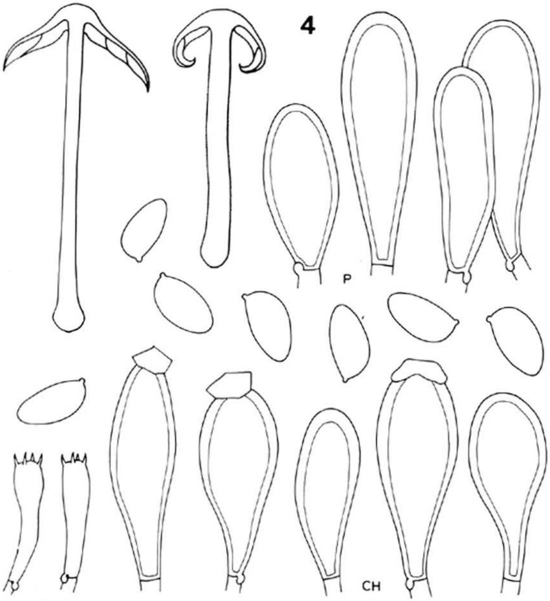

Fig. 4. *Inocybe claviger* (type): carpophores, spores, basidia, cheilocystidia (CH), pleurocystidia (P).

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 311–315 (1981)

PHOMA PISKORZII (PETRAK) COMB. NOV., THE ANAMORPH OF LEPTOSPHAERIA ACUTA (FUCKEL) P. KARST.

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The pycnidial state of *Leptosphaeria acuta* appeared to be identical with the lectotype of *Diploplenodomus piskorzii*, and belongs to *Phoma* sect. *Plenodomus*. The binomials *Phoma acuta*, *Leptophoma acuta* and *Plenodomus acuta* are misapplied ambiguous names often referring to the anamorph of *Leptosphaeria doliolum* sensu stricto.

The conical perithecia (pseudothecia) of *Leptosphaeria acuta* (Fuckel) P. Karst. can be found in Europe nearly everywhere in winter and spring at the base of dead nettle stems, particularly *Urtica dioica*. Nettles are apparently the only hosts of this fungus; old records on other plants have not been confirmed by recent workers (Müller, *1950*; Holm, *1957*).

Superficially the perithecia of *L. acuta* may be confused with those of *Leptosphaeria doliolum* (Pers. ex Hook.) Ces. & de Not. sensu stricto (=subsp. *doliolum* var. *doliolum* cf. Boerema, *1976*), which occur in late summer and autumn on dead last year's nettle stems. *L. acuta*, however, is easy to distinguish by the relatively long and multiseptated ascospores: mostly 45–54 × 4.5–7 μm with 8–13 septa (in *L. doliolum* sensu stricto mostly 25–30 × 4–5 μm with 3 septa).

The perithecia of *L. acuta* are just like those of *L. doliolum*, characterized by the development of more or less thick-walled hyaline cells in the peridium: scleroplectenchyma (Holm, l.c.) Typical scleroplectenchyma can be differentiated by addition of Lugol's iodine: their cell walls then stain red by adsorption of the iodine (blotting-paper effect).

Most species of *Leptosphaeria* with a typical scleroplectenchymatous wall structure (Holm l.c.: 'group doliolum') also produce *Phoma*-like pycnidia which have a similar wall structure. This has been demonstrated experimentally for the various infraspecific taxa of *L. doliolum*, see Boerema l.c. These scleroplectenchymatous *Phoma*-like anamorphs are at present arranged under *Phoma* sect. *Plenodomus* (Boerema *& al.*, *1981*) originally founded as a separate form-genus *Plenodomus* Preuss (*1851*); synonyms *Leptophoma* Höhnel (*1915*) and *Diploplenodomus* Diedicke (*1912*). According to this classification the correct name of the anamorph of the collective species *L. doliolum* is *Phoma hoehnelii* Kest. (van Kesteren, *1972*). The anamorph of *L. doliolum* sensu stricto, which commonly occurs on dead nettle stems can be classified as *Phoma hoehnelii* subsp. *hoehnelii* var. *urticae* Boerema & Kest. (Boerema, *1976*; conidial dimensions usually (3–)3.5–5(–5.5) × 1–1.5(–2) μm).

In older literature it has been repeatedly suggested that the anamorph of *Leptosphaeria acuta* is represented by *Phoma acuta* (Cooke, *1871*; Karsten, *1873*; Grove, *1935*), also known as *Leptophoma acuta* (von Höhnel, *1915*) and *Plenodomus acutus* (Bubák, *1915;* Petrak, *1921*). The epithet of these names can be traced back to *Sphaeria acuta* Hoffmann (*1787*) ex S. F. Gray (*1821*), a *Sphaeronaema*-like pycnidial state described from branches and bare wood, which is certainly not related to *Leptosphaeria acuta.* The descriptions under the misapplied binomials *Phoma acuta, Leptophoma acuta,* and *Plenodomus acutus* refer partly to the above mentioned *Phoma hoehnelii* var. *urticae,* the anamorph of *Leptosphaeria doliolum* sensu stricto on *Urtica dioica,* and partly to two other species of *Phoma* sect. *Plenodomus,* viz. *Phoma leonuri* Letendre, the anamorph of *Leptosphaeria slovacica* Picb. on *Ballota nigra,* and *Phoma sydowii* Boerema *& al.* on *Senecio fuchsii* (Boerema & *al., 1981*). For more details of the concatenation of misapplications of *Sphaeria acuta* Hoffm. ex Gray reference may be made to Boerema (*1976*), who concluded that this name (epithet) should be rejected according to Art. 69 of the Code (ambiguous name).

Using the normal laboratory procedure of culturing fungi on standardized agar media at room temperature with alternating periods of light and darkness, ascospore isolates of *Leptosphaeria acuta* produce only sterile mycelium. The first record of cultural experiments which demonstrated the metagenetic relation between a *Phoma*-like anamorph and *Leptosphaeria acuta* can be found in Müller & Tomašević (*1957*). These authors, however, did not give any details of their experiments and also adopted the misapplied name *Phoma* (*Leptophoma*) *acuta.* Exact information on the anamorph of *Leptosphaeria acuta* was first given in the cultural study of this fungus by Lacoste (*1965*). He found that the fungus requires relatively low temperature of about 10 °C, for fructification. At this temperature Lacoste obtained pycnidia in vitro on sterilized stems of *Urtica dioica* and leaves of *Typha latifolia* inoculated with single ascospore cultures. On nettle the pycnidia developed simultaneously with perithecia; on *Typha latifolia* the pycnidia were produced before the development of perithecia. In culture on synthetic media the fungus produced perithecia at 10 °C. He concluded: 'La formation des fructifications asexuelles semble donc exiger, outre les mêmes conditions physiques que celles, nécessaires à la fructification sexuelle, des conditions nutritives, mal définies mais assez strictes.'

Lacoste further notes that the *Plenodomus*-like anamorph of *L. acuta* also frequently occurs in nature, but 'en raison de la multiplicité des formes de même type sur la tige sèche d'ortie, elle peut souvent être confondue avec celle des espèces voisines, de *L. doliolum* notamment.' Lacoste's drawing of a vertical section of a pycnidium of *L. acuta* on a nettle stem has been reproduced in Fig. 1a (with permission of the author). He added the following description.—

> 'La coupe ci-jointe permet de se rendre compte de la structure puissante de ces curieuses pycnides souvent imperforées, qui s'ouvrent par rupture et jamais par un pore bien organisé. La paroi est constituée à l'extérieur de plusieurs couches de cellules fortement pigmentées. Vers l'intérieur les

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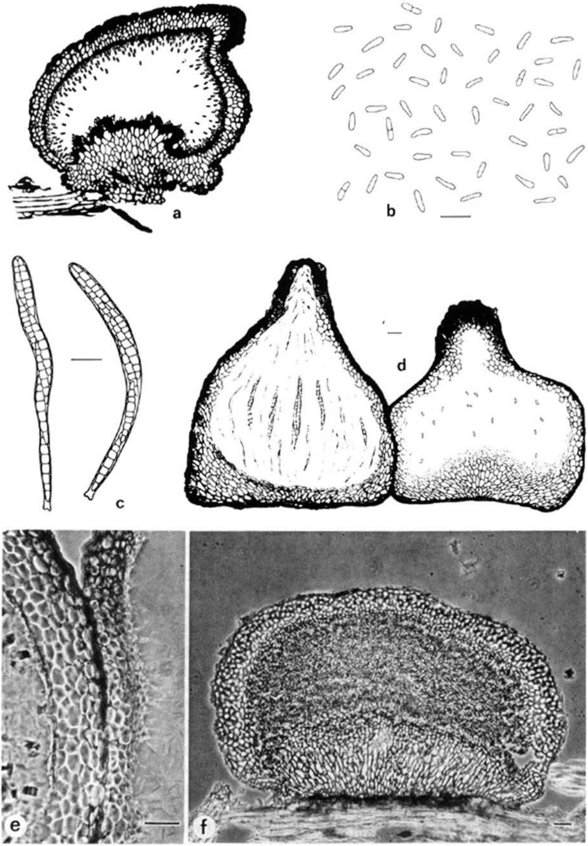
Fig. 1. *Leptosphaeria acuta,* stat. anamorph *Phoma piskorzii.* on dead nettle stems. — a. Pycnidium after Lacoste (*1965*), France. — b. Conidia from pycnidium coalesced with perithecium (see d.), Netherlands, 1977. — c. Asci after Lacoste (*1965*), France. — d. Coalesced perithecium and pycnidium, Netherlands, 1977. — e. Micrograph of detail of d: coalesced perithecial and pycnidial wall. — f. Micrograph of pycnidium from lectotype of anamorph (W), Czechoslovakia, 1922. Scale bars = 20 µm.


a
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couches de cellules deviennent de plus en plus hyalines. La cavité interne est tapissée de très nombreux conidiophores, serrés, les uns contre les autres et très courts. Leur ensemble constitue une couche plus pigmentée. A la partie inférieure, un épaississement de la paroi forme une sorte de base d'appui sur la tige d'ortie et une saillie dans la cavité interne. Les conidies hyalines, cylindriques, longues de 8–9 μ sur 2 à 3 μ sont produites en très grande quantité.'

In the springtime we repeatedly find this anamorph of *L. acuta*, which can be distinguished at once from the anamorph of *L. doliolum* by the relatively large conidia. At first the pycnidia develop usually inside the hollow nettle stems, which may explain why they often have been overlooked. Later, the pycnidia also develop on the outside of the stems, between the perithecia. Sometimes the fruitbodies of the anamorph and teleomorph of *L. acuta* are even coalesced, see Fig. 1d, e. Specimens collected in winter often showed only the teleomorph, so that in nature the development of perithecia apparently precedes the development of pycnidia. The previous year's dead nettle stems may bear in autumn only the anamorph.

The pycnidia are variable in shape, up to 500 μm diam., flattened-subglobose, usually papillate but also with a prolonged neck. They may be opened by rupture or by the development of a narrow ostiole (pore; compare Boerema & van Kesteren, *1964*). The conidia we measured (compare Fig. 1b) varied usually between (6–)8–10(–12) × 2–2.5(–3) μm, but incidentally also extreme long conidia (up to 16 μm) have been observed. They are mostly continuous but occasionally two-celled by an indistinct septum, which phenomenon had been apparently overlooked by Lacoste.

Comparative study with old herbarium material revealed that Petrak had already examined and described this anamorph of *L. acuta* in 1923 from dead stems of *Urtica dioica* collected September 1922 by J. Piskoř in the 'Ritscher'-forests near 'Sternberg in Mähren' (Sternberk, Moravia), Czechoslovakia (preserved in Petrak's herbarium, W). Petrak classified it as a species of *Diploplenodomus* on account of the occasionally occurring two-celled conidia: 'Konidien . . .einzellig oder ungefähr in der Mitte mit einer undeutlichen Querwand, 6–12 × 2–2,75 μm'. He notes that Piskoř found similar scleroplectenchymatous pycnidia on dead stems of various other herbaceous plants in the 'Ritscher'-forests, e.g. on *Atropa belladonna*. Petrak therefore concluded that it concerns a plurivorous species, although he observed substantial differences in the conidial dimensions of the specimens on *Urtica* and *Atropa*. He named the species after the collector *Diploplenodomus piskorzii* Petrak.

The scleroplectenchymatous pycnidia on the dead stems of *Atropa belladonna* collected by J. Piskoř (also preserved in Petrak's herbarium, W) appeared to belong to the large spored *Phoma hoehnelii* subsp. *amplior* (Sacc. & Roum.) Boerema & Kest., the anamorph of the plurivorous *Leptosphaeria doliolum* subsp. *pinguicula* Sacc. (Boerema, *1976*). The conidia of *P. hoehnelii* subsp. *amplior* are extremely variable in vivo; they may be still longer than those of the anamorph of *L. acuta*, and moreover they are also occasionally two-celled. The synonymy of *P. hoehnelii* subsp. *amplior* includes e.g. *Diploplenodomus malvae* Diedicke (*1912;* holotype in Herb. von Höhnel, FH) and *Diploplenodomus microsporus* (Berl.) Höhnel (*1918;* = *Plenodomus microsporus* Berlese, *1889*; representative specimen in Herb. Diedicke, JE), of which Petrak had already noted that their descriptions agreed with the characteristics of the specimens collected by Piskoř. Petrak, however, had not seen herbarium specimens of *D. malvae* and *D.* (*P.*) *microsporus* (which he also considered to be indentical), and finally concluded on account of the description of *D. microsporus* by von

Höhnel (*1918*) that *D. piskorzii* represents a different species. This now appears to be correct but only so far as it concerns the specimens on nettle. Therefore we hereby designate Piskoř's collection on *Urtica dioica* as lectotype of *Diploplenodomus piskorzii* Petrak. In accordance with the present classification of this kind of pycnidial states it needs to be transferred to *Phoma* sect. *Plenodomus*.—

Phoma piskorzii (Petrak) Boerema & Loerakk., *comb. nov.;* anamorph of *Leptosphaeria acuta* (Fuckel) P. Karst.

Basionym: *Diploplenodomus piskorzii* Petrak *in* Annls mycol. **21**: 123–124(–125). 1923. — Lectotype: on dead stems of *Urtica dioica*, collected by J. Piskoř, September 1922 in the 'Ritscher'-forests, near Sternberk, Moravia, Czechoslovakia (Herb. Petrak, W as Herb. Mus. Nat. Vind. No. 1225).

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 317–331 (1981)

NOMENCLATURAL NOTES ON SOME SPECIES OF PHOMA SECT. PLENODOMUS

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This paper deals with the synonymy of five species of *Phoma* formerly referred to *Plenodomus: Phoma astragalina* (Gonz.-Frag.) comb. nov., *Phoma petrakii* nom. nov., *Phoma pezizoides* (Ell. & Ev.) comb. nov., *Phoma ruttneri* (Petr.) comb. nov. and *Phoma sclerotioides* (Preuss) ex Sacc. (in phytopath. literature well known as *Plenodomus meliloti* Dearness & Sanford). Further a review is given of the synonymy of previously treated species of *Phoma* sect. *Plenodomus*.

The pycnidial states belonging to *Phoma* sect. *Plenodomus* (Preuss) Boerema *& al.* (*1981*) form a natural group, originally founded as a separate genus *Plenodomus* Preuss (*1851*), synonyms *Diploplenodomus* Diedicke (*1912*) and *Leptophoma* Höhnel (*1915*). They are characterized by their ability to produce more or less thick-walled hyaline cells in the peridium of the pycnidia: scleroplectenchyma. By addition of Lugol's iodine (JKJ) the thickened hyaline walls of this scleroplectenchyma stain red by adsorption of the iodine (blotting-paper effect).

Phoma sect. *Plenodomus* is related to the 'doliolum-group' of the ascomycetous genus *Leptosphaeria* Ces. & de Not. (Holm, *1957*), i.e. species in which the perithecia (pseudothecia) also have a scleroplectenchymatous wall structure.

The natural variability in pycnidial shape of species *Phoma* sect. *Plenodomus* and their variation in conidial dimensions has lead to much nomenclatural confusion, especially in the case of plurivorous species. A review of the synonymy of the species of section *Plenodomus* treated in the previous studies by Boerema & van Kesteren (*1964*), Boerema (*1976*), Boerema *& al.* (*1981*), Boerema (*1981*), Boerema & Loerakker (*1981*), and Janse (*1981*) is given in Table I.

This paper covers the nomenclature of five other species of *Phoma* sect. *Plenodomus*.

Phoma astragalina (Gonz.-Frag.) Boerema & Kest., *comb. nov.*

Basionym: *Ceuthospora astragalina* Gonz.-Frag. *in* Boln. R. Soc. esp. Hist. nat. **18**: 84. 1918. — *Plenodomus astragalinus* (Gonz.-Frag.) Petr. apud Rechinger *& al. in* Annln naturh. Mus. Wien **50** (1939): 498–499. 1940.

Plenodomus dianthi Bub. *in* Annln k.k. naturh. Hofmus. Wien (Annln naturh. Mus. Wien) **28**: 204. 1914. — *Phoma dianthi* (Bub.) Bub. *in* Annls mycol. **13**: 30. 1915; not *Phoma dianthi* Sacc. & Malbr. *in* Atti R. Ist. veneto Sci. Vi, **1**: 1276. 1883; not *Phoma dianthi* Lagière *in* Annls Éc. natn. Agric. Grignon III, **5**: 160. 1946.

Plenodomus khorasanicus Petr. apud Rechinger *& al. in* Annln naturh. Mus. Wien **50** (1939): 499–500. 1940.

TABLE I. Previously treated species of Phoma sect. Plenodomus with their teleomorphs and the Plenodomus-, Diploplenodomus-, and Leptophoma-names under which they have been described in literature

Anamorph	Teleomorph	References
Phoma hoehnelii Kest. (1972)	Leptosphaeria doliolum (Pers. & Hook.) Ces. & de Not.	van Kesteren (1972)
subsp. hoehnelii	subsp. doliolum	
var. hoehnelii ≡ Leptophoma doliolum Höhn. (1915) (not Phoma doliolum P. Karst.) ≡ Plenodomus doliolum (Höhn.) Höhn. (1918) ≡ Plenodomus doliolum (Höhn.) Petr. (1923 a, b)	var. conoidea (de Not.) Sacc.	Boerema (1976)
var. urticae Boerema & Kest. (in Boerema, 1976) = 'Leptophoma acuta' sensu Höhn. (1915) pro parte = 'Plenodomus acutus' sensu Bub. (1915) pro parte = 'Plenodomus acutus' sensu Petr. (1921) pro parte (all three rejected ambiguous names)	var. doliolum	Boerema (1976)
subsp. amplior (Sacc. & Roum.) Boerema & Kest. (in Boerema, 1976)	subsp. pinguicula Sacc.	Boerema (1976)
= Plenodomus microsporus Berl. (1889) = Diploplenodomus malvae Died. (1912) = Diploplenodomus microsporus (Berl.) Höhn. (1918) = Plenodomus labiatarum Petr. (1923)		Boerema & al. (1981)
Phoma leonuri Letendre (in Roum., 1884) ≡ Plenodomus leonuri (Letendre) Moesz & Smarods (in Moesz, 1932) = 'Plenodomus acutus' sensu Bub. (1915) pro parte = 'Plenodomus acutus' sensu Petr. (1921) pro parte (both rejected ambiguous names)	Leptosphaeria slovacica Picb. = L. doliolum var. leonuri Sandu-Ville	Boerema & al. (1981)
Phoma lingam (Tode ex Schw.) Desm. (1849) ≡ Plenodomus lingam (Tode ex Schw.) Höhn. (1911) = Plenodomus rabenhorstii Preuss (1851)	Leptosphaeria maculans (Desm.) Ces. & de Not.	Boerema & van Kesteren (1964)
Phoma macdonaldii Boerema (1970)	Leptosphaeria lindquistii Frezzi	Boerema & al. (1981)

Phoma pedicularis Fuckel (in Heuglin, 1874) = Plenodomus gentianae (Moesz) Petr. (1925) = Plenodomus prominens (Bres.) Petr. ex von Arx (1950) = Plenodomus sphaerosporus Petr. (1942) = Plenodomus helveticus Petr. (1948)		Boerema & al. (1981)
Phoma piskorzii (Petr.) Boerema & Loerakker (1981) ≡ Diploplenodomus piskorzii Petr. (1923) = 'Leptophoma acuta' sensu Müller & Tomašević (1957) (rejected ambiguous name)	Leptosphaeria acuta (Fuckel) P. Karst.	Boerema & Loerakker (1981)
Phoma riggenbachii Boerema & Janse (in Janse, 1981) ≡ Plenodomus corni Batista & Vital (1957) = 'Plenodomus rabenhorstii' sensu Riggenbach (1956)		Janse (1981)
Phoma rubefaciens Togl. (1953)		Boerema & al. (1981)
Phoma sublingam Boerema (1981) ≡ Plenodomus lunariae Syd. (1924) (not Phoma lunariae Moesz)	Leptosphaeria submaculans Holm	Boerema (1981)
Phoma sydowii Boerema & al. ≡ Plenodomus senecionis (Syd.) Bub. (1915) ≡ Plenodomus senecionis (Syd.) Petr. (1921) (not Phoma senecionis Syd.) = Plenodomus rostratus Petr. (1923) (not Phoma rostrata O'Gara) = 'Leptophoma acuta' sensu Höhn. (1915) pro parte (rejected ambiguous name)	possibly Leptosphaeria senecionis (Fuckel) Winter	Boerema & al. (1981)

HERBARIUM MATERIAL EXAMINED.—

Ceuthospora astragalina Gonz.-Frag.; on dead stems of *Astragalus erinifolius*, Küh-e Sefid (Elburz Mts., near Dāmghān), N. Iran, June 1899, *F. M. de la Escalera* (holotype, MA).

Plenodomus astragalinus (Gonz.-Frag.) Petrak; on dead stems of *Astragalus totschalensis*, Küh-e Dāsht, near Karaj, N. Iran, 25 May 1937, *K. H. Rechinger* (ZT); on dead petioles of *Astragalus mitchellianus*, Sabounjou-Kaive, between Izmar and Manisa, W. Turkey, 19 June 1854, B. Balansa (ZT); on dead stems of *Astragalus* sp., Unai mountain-pass, alt. *c.* 3150 m (Paghman Mts., west of Kabul), E. Afghanistan, 27 July 1951, *A Isllt* (Herb. Petrak, M).

Plenodomus dianthi (*Phoma dianthi*) Bub.; on dead stems of *Dianthus orientalis*, Nemrut Dağ (Taurus Range), alt. *c.* 2000–2500 m, near Kâhta, Mamuret-ül-Asis district, western Kurdistan, E. Turkey, 12 July 1910, *F. Bubák* (holotype, BPI).

Plenodomus khorasanicus Petrak; on dead stems of an unidentified Rubiaceae, Alamli mountain ridge (Kopet Dağ Range), alt. *c.* 2000 m, between Quchan and Lotfābād in Khorāsān Prov., N. Iran, 14 July 1937, *K. H. Rechinger* (holotype Herb. Rechinger No. 2467, S).

This fungus has been found on dead stems and occasionally on petioles of various herbaceous plants in the mountainous regions of Southwest Asia (Iran, Turkey, Afghanistan), see Table II. Most host records refer to *Astragalus* spp.

The fungus can be differentiated from other species of *Phoma* sect. *Plenodomus* on herbaceous plants at once by the extremely small conidia, 2–3 × 0.5–0.8(–1) µm. The scleroplectenchyma of the papillated globose to ellipsoid pycnidia, 150–300 × 200–500(–600)

TABLE II. Records of Phoma astragalina

Matrix	Location*	References
Astragalus sp. dead stems	Unai Gardaneh, west of Kabul, E. Afghanistan	Herb. Petrak (M)
A. erinifolius dead stems	Kūh-e Sefid, near Dāmghān, N. Iran	Gonzáles-Fragoso (1918)
A. johannis dead petioles	Kūh-e Barf, near Shiraz, S.W. Iran	Petrak (1942)
A. mitchellianus dead petioles	Sabounjou-Kaive, between Izmir and Manisa, W. Turkey	Petrak (1942)
A. totschalensis dead stems	Kūh-e Dasht, near Karaj, N. Iran	Rechinger & al. (1940)
Dianthus orientalis dead stems	Nemrut Dağ, near Kâhta, W. Turkistan, E. Turkey	Bubák (1914, 1915)
Picris sp. dead stems	Olsus, on Van Gölū, near Reşadiye, E. Turkey	Petrak (1942)
Zozinia tragioides dead stems	Kūh-e Būl, near Eqlīd, S.W. Iran	Petrak (1942)
unidentified plant (Rubiaceae)	Afamli Kūh, between Quchan and Lotfābat, N. Iran	Rechinger & al. (1940)

*Dağ (Turk.) = mount, Gardaneh (Afghan.) = pass, Gölū (Turk.) = lake, Kūh. (Iran.) = mount.

µm, is not so conspicious as in most other species of the section. For this reason Bubák (*1914, 1915*), who was the first to study this fungus, changed his opinion about its classification. In 1914 he called the pycnidia sclerotioid and named the species *Plenodomus dianthi* Bub. In 1915 he deleted the word 'sclerotioidea' in the diagnosis and classified the fungus as a common species of *Phoma*. The name *Phoma dianthi* (Bub.) Bub. (*1915*), although in accordance with the present classification of the fungus, has to be rejected as it is a later homonym of *Phoma dianthi* Sacc. & Malbr. (*1883;* holotype PAD); *P. dianthi* Sacc. & Malbr. just as *P. dianthi* Lagière (*1946*) refers to a species of *Phomopsis*. The proposed new combination *Phoma astragalina* is based on the next oldest name of the fungus, *Ceutospora astragalina*, described by Gonzáles-Fragoso (*1918*) from material already collected in 1899. This species was transferred to *Plenodomus* by Petrak (in Rechinger *& al., 1940*). Gonzáles-Fragoso's classification of the fungus in the form-genus *Ceuthospora* Grev. was apparently based on the often irregular or plurilocular appearance of the pycnidial cavity. This is a common phenomenon in pycnidia of species of *Phoma* sect. *Plenodomus*, due to thin-walled seriate cellular protusions of the proliferous layer (Boerema & *al., 1981*). *Plenodomus khorasanicus* has been described by Petrak (in Rechinger *& al., 1940*) as closely allied to *Plen. astragalinus*, but different by its regular, non-divided pycnidial cavities and more pronounced ostioles. However, all specimens examined bear unilocular as well as plurilocular pycnidia, provided with more or less papillated ostioles. Our conclusion that one plurivorous species is involved, was in fact already reached by Petrak (*1942*). In the latter study, of oriental fungi, Petrak wrote about 'pleophage Arten', resembling *Plenodomus dianthi, Plen. astragalinus* and *Plen. khorasanicus*, which are very difficult to differentiate because of their similarity on quite different hosts.

Phoma petrakii Boerema & Kest., *nom. nov.*

Plenodomus nieslii Petr. *in* Annls mycol. **20**: 322–323. 1922; not *Phoma nieslii* Sacc. *in* Michelia **2** (3): 618. 1882.

HERBARIUM MATERIAL EXAMINED.—

Plenodomus nieslii Petr.; Fl. Boh. Morav. exs. II, **1**, No. 1874, on dead stems of *Melampyrum nemorosum*, Hrabuvka, near Mähr.-Weisskirchen, Czechoslovakya, Sept. 1923, *F. Petrak* (U, S, ZT; often with *Phoma sylvatica* Sacc., see note).

Characteristic specimens of this fungus are also preserved under the misapplied name *Phoma sylvatica* Sacc. ('*silvatica*'), e.g. Krieger. Fungi sax. No. 2432 on dead stems of *Melampyrum sylvaticum*, near Königstein, Saxony, East Germany, June–July 1913–1917 (U).

This species is known from dead stems of various *Melampyrum* spp. (*M. nemorosum, M. pratense, M. sylvaticum*, and *M. commutatum*), and has been recorded in Austria, Czechoslovakia, East and West Germany, and Russia (cf. Petrak, *1922, 1931*, Rupprecht, *1959*, and herbarium material examined). Probably it occurs in Europe wherever the host plants are able to grow.

The typical scleroplectenchymatous, papillated, conoid pycnidia of the conidial state, 200–350 µm diam., are described in detail by Petrak (*1922*) from specimens on *M. nemoro-*

sum collected in May and June 1918 near Rybno, Stanislav = Ivano-Frankovsk, S.E. Galicia, U.S.R.R. (these specimens have not yet been recovered). Petrak (*1922*) named the species after G. Niessl von Mayendorf because a similar specimen had been collected by Niessl in lower Austria and labelled '*Lept. suffulta*, fungus spermogonicus' (not recovered). Petrak endorsed Niessl's opinion that it belongs to *Leptosphaeria suffulta* (Nees ex Fr.) Niessl, which according to Holm (*1957*) also only occurs on *Melampyrum* spp. Some of the specimens examined certainly showed scleroplectenchymatous perithecia of *L. suffulta* in close association with the pycnidia, but a metagenetic relation must still be proved by cultural experiments.

We have renamed the conidial state after F. Petrak, because the transfer of *Plenodomus niesslii* to the genus *Phoma* should result in a later homonym of *Phoma niesslii* Sacc. (*1882*), a different species described from *Gentiana lutea*.

The conidial dimensions of *Phoma petrakii* vary between (3.5–)4–5 × (1–)1.5–1.8(–2) µm. Conidia with approximately the same dimensions are produced by *Phoma sylvatica* Sacc. (1881; holotype in PAD), a different pycnidial state which also occurs commonly on dead stems of *Melampyrum* spp., and according to Petrak (*1922*) belongs to *Didymella winteriana* (Sacc.) Petrak.[1] The pycnidia of *P. sylvatica* are smaller than those of *P. petrakii* and not scleroplectenchymatous, but because of the similar conidial dimensions both species often have been confounded and confused. Even specimens of Petrak's Fl. Boh. Morav. exsiccatae No. 1874, labelled *Plenodomus niesslii* (see specimens examined), often contain only *Phoma sylvatica*, sometimes associated with *Didymella winteriana*. The combination *Plenodomus sylvaticus* (Sacc.) Rupprecht (*1959*; as '*silvatica*') was also based on misidentified material. Rupprecht refers e.g. to specimens distributed by Krieger as Fungi sax. No. 2432, which are labelled *Phoma sylvatica* (see specimens examined), but contain *P. petrakii*, often accompanied with perithecia of *Leptosphaeria suffulta*.

Phoma pezizoides (Ell. & Ev.) Boerema & Kest., *comb. nov.*

Basionym: Aposphaeria pezizoides Ell. & Ev. *in* Proc. Acad. nat. Sci. Philad. 1894: 358. 1894. — *Coniothyrium pezizoides* (El. & Ev.) O. Kuntze, Revis. Gen. Pl. **3** (3): 459. 1898.

Aposphaeria salicum Sacc. apud Syd. *in* Annls mycol. **1**: 537–538. 1903; *in* Sylloge Fung. **18**: 276. 1906. — *Plenodomus salicum* (Sacc.) Died. *in* Annls mycol. **9**: 140. 1911.

Phoma wallneriana Allesch. *in* Rabenh. Krypt.-Fl. ed. 2, Pilze **6** (Lief. 61): 175. 1898 (vol. dated '1901'). — *Plenodomus wallneriana* (Allesch.) Bub. *in* Annls mycol. **13**: 30. 1915.

Plenodomus helicis Curzi & Barbaini *in* Atti. Ist. bot. Univ. (Lab. crittogam.) Pavia III, **3**: 173. 1927.

HERBARIUM MATERIAL EXAMINED.—

Aposphaeria pezizoides Ell. & Ev.; N. Am. Fungi **2**, No. 3158, on decorticated wood of *Salix nigra* var. *falcata*, Nuttallburg, West Virginia, U.S.A., April 1894, *L. W. Nuttall*

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[1] The conidial dimensions listed by Müller & von Arx (*1962*) for the 'phomaartigen Nebenfruchtform' of *Didymella winteriana* are much larger than those of *Phoma sylvatica*. Their data are not based on cultural studies but on observations of herbarium material including *Plenodomus ruttneri* Petr. on *Rhinanthus* spp., which in our opinion certainly does not belong to *Didymella winteriana*. See the discussion under *Phoma ruttneri* (p. 325).

(lectotype FH; isotypes e.g. in FH, L, PAD); Ell. & Ev., Fungi Columb. No. 570 on decorticated wood of *Platanus occidentalis*, Nuttallburg, West Virginia, U.S.A., April 1894, *L. W. Nuttall* (FH).

Aposphaeria salicum Sacc.; on dead twigs of *Salix viminalis*, Schmilka on the river Elbe, Saxony ('Sax. Switzerland', Ober Lausitz), East Germany, 15 Aug. 1903, *P. Sydow* (holotype Herb. Sacc., PAD; duplicate Herb. Syd., B; other specimens of this collection distributed as Syd., Mycoth. germ. No. 87, e.g. in B).

Phoma wallneriana Allesch.; on dead petioles of *Aesculus hippocastanum*, Vienna, Austria, Nov. 1872, *J. Wallner* (holotype Herb. Winter ex Herb. von Thümen, with Bubák's annotation: *Plenodomus wallneriana* (Allesch.) Bub., B).

Characteristic specimens of this fungus have further been preserved under the misapplied name '*Plenodomus rabenhorstii* Preuss' (see discussion): Herb. Preuss No. 838 (B) and Rabenh., Klotzschii Herb. mycol. No. 1282, on old soft decorticated wood ('ad ligna vetusta') of *Ailanthus altissima*, near Hoyerswerda, Ober Lausitz, East Germany (formerly prov. Silesia), no date, *G. T. Preuss* (e.g. B, M).

This saprophytic species has been found on decorticated stems, branches or twigs, and occasionally petioles of various broadleaved trees or shrubs in the northeast of the United States (West Virginia) and in central and southern Europé (East Germany, Austria, Italy), see Table III. As shown in this table most observations are made in the vicinity of rivers, especially near river banks. The records in the United States refer exclusively to stems of trees damaged by driftwood carried by fast-moving flood water. It is quite possible that man has played a role in the occurrence and distribution of this wood-inhabiting fungus in two different continents.

Ellis & Everhart (*1894*) and Sydow & Sydow (*1903*) have classified this pycnidial state in the genus *Aposphaeria* Berk. emend. Saccardo (*1880;* = *Coniothyrium* Corda sensu O. Kuntze, *1898*), formerly commonly used for *Phoma* species on wood. At present *Aposphaeria* Sacc. and *Coniothyrium* Corda are nomina conservanda with different types, see Sutton (*1977*).

The typical *Plenodomus*-like pycnidia of the fungus (compare Diedicke, *1911*; Bubák, *1915*; and Curzi & Barbaini, *1927*) are relatively large, (150–)250–500(–750) μm diam., and at maturity are provided with broad papillated ostioles (pori). At length the pycnidia often collapse and become discoid or pezizoid as indicated by the selected epithet pezizoides. This phenomenon is also known from species of *Phoma* sect. *Plenodomus* occurring on herbaceous plants, e.g. the crucifer-parasite *Phoma lingam* (Table I; Boerema & van Kesteren, *1964*), having large scleroplectenchymatous pycnidia on dead cabbage stems which superficially very much resemble those of *Phoma pezizoides*. This explains why Preuss (*1862*) misidentified specimens of the latter on wet old wood as *Plenodomus rabenhorstii* = *Phoma lingam*. The wood fragments of this oldest known collection of the fungus (distributed as Rabenh., Klotzschii Herb. mycol. No. 1282) were identified at the Department of Silviculture, Agricultural University in Wageningen, as *Ailanthus altissima*.

Phoma pezizoides may produce two types of one-celled conidia: relatively short conidia, 4.5–6(–7.5) × 2–3 μm, and/or significant longer conidia, 6–10 × 2–3 μm. In both cases occasionally two-celled conidia may also occur, 8–10 × 2–3 μm. Similar variability in conidial dimensions is known from other species of *Phoma* sect. *Plenodomus* (cf. Boerema & *al.*, *1981*). The specimens of *Phoma pezizoides* on *Ailanthus altissima* (B, M), which were

TABLE III. Records of Phoma pezizoides

Matrix	Location	References
Acer sp. decorticated wood of small tree on river bank below high-water level	Nuttallburg, West Virginia, U.S.A.	Ellis & Everhart (1894)
Aesculus hippocastanum fallen petioles, with peeled-off epidermis	Vienna, Australia	Allescher (1898), Bubák (1915)
Ailanthus altissima wet (soft) decorticated old wood	near Hoyerswerda, Ober Lausitz, East Germany	Rabenh., Klotzschii Herb. mycol. No. 1282 (1849), Preuss (1862)
Fraxinus sp. decorticated wood of small tree on river bank below high-water level	Nuttallburg, West Virginia, U.S.A.	Ellis & Everhart (1894), Barneth & Hunter (1972)
Hedera helix fallen decorticated twigs	Catignano, on the river Nora, Italy	Curzi & Barbaini (1927)
Liquidambar styraciflua decorticated wood of small tree on river bank below high-water level	Nuttallburg, West Virginia, U.S.A.	Ellis & Everhart (1894), Seymour (1929)
Platanus occidentalis decorticated wood of small tree on river bank below high-water level	Nuttallburg, West Virginia, U.S.A.	Ellis & Everhart (1894), Ell. & Ev. Fungi Columb. No. 570. (1894)
Salix *nigra* var. *nigra* *nigra* var. *falcata* decorticated wood of small tree on river bank below high-water level	Nuttallburg, West Virginia, U.S.A.	Ellis & Everhart (1894) Ell. & Ev. N. Am. Fungi II, No. 3158 (1894)
S. viminalis decorticated twigs of tree on river bank	Schmilka, on the river Elbe, 'Sax. Switzerland', Ober Lausitz, East Germany	Sydow (1903), Syd., Mycoth. germ. No. 87 (1903)

distributed as '*Plenodomus rabenhorstii*', bear pycnidia with short conidia as well as pycnidia with long conidia. The specimen on *Hedera helix*, described by Curzi & Barbaini (1927) as *Plenodomus helicis*, the specimens of *Aposphaeria pezizoides* on *Salix nigra* var. *falcata* and *Platanus occidentalis* (FH, L, PAD), and the holotype of *Aposphaeria salicis* on *Salix viminalis* (PAD) refer to pycnidia with short conidia. The pycnidia of the duplicate of the type of *Aposphaeria salicis* on *Salix viminalis* (B), and those of the holotype specimen of *Phoma wallneriana* on *Aesculus hippocastanum* contain the longer type of conidia.

Phoma ruttneri (Petr.) Boerema & Kest., *comb. nov.*

Basionym: *Plenodomus ruttneri* Petr. *in* Sydowia **8**: 582–583. 1955.

HERBARIUM MATERIAL EXAMINED.—
Plenodomus ruttneri Petr.; on dead stems of a *Rhinanthus* (*Alectorolophus*) sp., pass foot Scheillingsstein, near Lunz, Austria, June 1943 (holotype and isotype Herb. Petrak, M).

There are so far only two records of this conidial state: the type material on dead stems of an unidentified *Rhinanthus* (=*Alectorolophus*) species collected near Lunz, Austria (see specimens examined), and a specimen on dead stems of *Rhinanthus serotinus* (=*Alectorolophus major*) collected near Siegen, West Germany (Rupprecht, *1959*, as '*Plenodomus sylvaticus* (*silvatica*)', see below).

The papillated conoid to subglobose pycnidia of *Phoma* (*Plenodomus*) *ruttneri*, 250–350 µm, have a typical scleroplectenchymatous wall structure and contain, at maturity, cylindrical conidia 5–7 × 1.5–2 µm. On the type substratum (dead stems of *Rhinanthus* sp.) the pycnidia occur together with perithecia of different Ascomycetes: e.g. *Didymella ruttneri* Petrak and *Leptosphaeria affinis* P. Karst.

Petrak (*1955*) considered *Didymella ruttneri* as the perfect state of *Phoma* (*Plenodomus*) *ruttneri*. This statement, however, is not reliable in our opinion. *Didymella ruttneri* according to Müller & von Arx (*1962*) is a later synonym of *D. winteriana* (Sacc.) Petr. described from *Melampyrum* spp. On these hosts the perithecia often occur in close association with the non-scleroplectenchymatous pycnidia of *Phoma sylvatica* Sacc., see the discussion under *Phoma petrakii* (p. 321).

A metagenetic relation between *Leptosphaeria affinis* and *Phoma* (*Plenodomus*) *ruttneri* is plausible, but not yet proved by cultural experiments. *L. affinis* produces typical scleroplectenchymatous perithecia and is widespread in Europe on *Rhinanthus minor* (Holm, *1957*).

Rupprecht (*1959*) has treated the species of *Phoma* sect. *Plenodomus* occuring on *Rhinanthus* and *Melampyrum* spp. as conspecific. He overlooked that the conidia of *Phoma* (*Plenodomus*) *ruttneri* on *Rhinanthus* are significant longer (5–7 µm) than those of *P. petrakii* (=*Plenodomus niessli*) on *Melampyrum* (max. 5 µm; see p. 322). At present there are no indications that one species with variable conidial dimensions is involved. The fact that both conidial states occur in association with two different species of *Leptosphaeria* is also an argument to maintain them as separate species.

Rupprecht (l.c.) introduced for his 'Scrophulariaceae-*Plenodomus*' the combination *Plenodomus sylvaticus* (Sacc.) Rupprecht (as '*silvatica*'). However, this combination was based on misidentified material: *Phoma sylvatica* Sacc. refers to a non-scleroplectenchymatous pycnidial state, probably related to *Didymella winteriana*, see above and the discussion under *Phoma petrakii* (p. 321).

PHOMA SCLEROTIOIDES (Preuss) ex Sacc.—Figs 1, 2

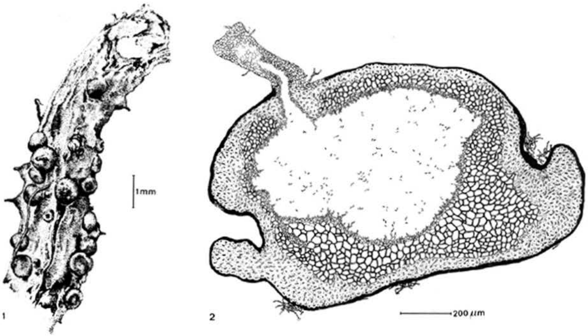
Plenodomus sclerotioides Preuss *in* Rabenh., Klotzschii Herb. mycol. No. 1281. 1849 (nomen nudum). — *Phoma sclerotioides* (Preuss) ex Sacc., Fung. Herb. Brux. 21. 1892; *in* Sylloge Fung. **11**: 492. 1895.

Plenodomus meliloti Mark.-Let. *in* Bolez. Rast. **16**: 195. 1928.

Plenodomus meliloti Dearn. & Sanford *in* Annls mycol. **28**: 324–325. 1930.

Plenodomus sorghi Morochkovskii *in* Trudý bot. Inst. Akad. Nauk S.S.S.R. **1**: 277–278. 1933.

Plenodomus karii Petr. *in* Annls mycol. **34**: 453–455. 1936.



Figs. 1, 2. *Phoma sclerotioides*, scleroplectenchymatous pycnidia as seen in vivo and in vitro. — 1. Surface view on dead root of red clover. — 2. Vertical section of pycnidium in culture on oatmeal agar (somewhat simplified).

MATERIAL EXAMINED

HERBARIUM MATERIAL.—*Plenodomus sclerotioides* Preuss; on decorticated roots and basal stems of an unidentified herbaceous plant, near Hoyerswerda, Ober Lausitz, East Germany (formerly Silesia Prov.), no date, *G. T. Preuss* [holotype on roots: Herb. Preuss No. 839, B; specimen on stem: Herb. Preuss No. 840 (labelled with only the genus name *Plenodomus*), B; other small specimens of Preuss collection 'ad caules herbarum elatiorum' distributed as Rabenh., Klotzschii Herb. mycol. No. 1281, e.g. in B, BR].

Plenodomus meliloti Dearn. & Sandford; on roots of *Melilotus albus*: Lacombe, Alberta, Canada, 10 May 1968, *W. B. Berkenkamp* (LAC, L); on roots of *Trifolium hybridum*: Lacombe, Alberta, Canada, 6 June 1967, *W. B. Berkenkamp* (LAC, L); on roots of *Trifolium pratense*: Inari, Mudusniemi, Finnish Lapland, 10 June 1961, *A. Salonen* (HPP, L), Lacombe, Alberta, Canada, 13 May 1971, *W. B. Berkenkamp* (LAC, L).

LIVING CULTURES.—CBS 353. 34, isolated from roots of *Melilotus albus*, western Canada, 1933 by *G. B. Sanford*; three isolates from roots of *Medicago sativa*: Manitoba, Canada, 1951 by *W. C. McDonald*, Mile 1019, Yukon, Canada, May 1963 by *N. Colotelo*, Duck Lake, Saskatchewan, Canada, July 1979 by *J. Drew Smith;* two isolates from roots of *Trifolium pratense*: Inari, Muddusniemi, Finnish Lapland, 10 June 1961 by *A. Salonen*, Zenon Park, Saskatchewan, Canada, July 1979 by *J. Drew Smith*; four isolates from roots of *Triticum aestivum*: Lacombe, Alberta, Canada, May 1964 by *A. W. Henry;* Lacombe, Alberta, Canada, Nov. 1979, by *J. Drew Smith;* Three Hills, Alberta, Canada, Nov. 1979, by *J. Drew Smith;* Melfort, Saskatchewan, Canada, Nov. 1979, by *J. Drew Smith;* one isolate from roots of an unidentified grass, Saskatoon, Saskatchewan, Canada, June 1979, by *J. Drew Smith;* two isolates from soil: Saskatoon, Saskatchewan, Canada, 1968, by *R. A. A. Morrall;* Mt. Allen, Kanaskis Range, Alberta, Canada, 1972, by *J. Bissett.*

This plurivorous fungus is known from areas with severe winters (continental climate) in Europe (Finland, Russia, East Germany) as well as in North America (Alaska, Canada), see

Table IV. In western Canada, Finland, and Russia it is recorded as a destructive pathogen of herbage legumes ('Brown Root Rot'), especially following the winter dormancy period (Sanford, *1933*; Cormack, *1934*; Rodigin, *1935*; McDonald, *1955*; Mead, *1962*; Salonen, *1962*). It may also be pathogenic to other plants which have been exposed to low temperature (Robertson, *1931*; Lebeau & Logsdon, *1958*; Henry & Berkenkamp, *1965*).

A typical character of the fungus is that the pycnidia (Fig. 1) are produced on the roots of the host (4–20 cm below soil surface), and only occasionally on the stems of dead host plants, and then mainly at or near ground level, comp. Table IV.[2] The relatively large subglobose to conoid pycnidia, (200–)350–650(–800) µm diam. may occur singly, but are usually closely clustered. At maturity the ostioles (pori) develop directly on the surface of the pycnidia as short papillae, but usually long tubular outgrowths (beaks) of various lengths develop. The conidia, (4–)4.5–6.5(–8) × 2–3(–3.5) µm, are produced on cone-shaped conidiogenous cells (Netolitzky & Colotelo, *1965*). If environmental conditions become unfavourable for the development of the fungus, sterile 'pycnosclerotia' (cf. Boerema & van Kesteren, *1964*) are produced (Salonen, *1962*). These pycnosclerotia have also been found in soil (Sanford, *1933*: possibly surviving and spreading in dry soils).

White sweet clover (*Melilotus albus*) is apparently the most susceptible host of the fungus. It has been described from this plant independently in Russia and Canada as *Plenodomus meliloti* (Markova-Letova, *1928*; Dearness & Sanford, *1930*). However, a comparative study of herbarium material has shown that the fungus had already been described in 1892 by Saccardo as *Phoma sclerotioides*, based on material of '*Plenodomus sclerotioides* Preuss' (nomen nudum) in 1849 (!) distributed as Rabenh. Klotzschii Herb. mycol. No. 1281. The host is indicated as a large herbaceous plant ('herbarum elatiorum'). The bulk of this material is preserved in Preuss's herbarium (B): e.g. the selected lectotype specimen, labelled *Plenodomus sclerotioides* in Preuss's hand-writting, which consists of some branched roots of the unidentified host covered with pycnidia and pycnosclerotia of the fungus. Preuss generally collected his fungi in the locality of Hoyerswerda (Ober Lausitz, E. Germany; formerly Silesia), which includes mountainous regions with low winter temperature (continental climate).

In the thirties the fungus was twice described as new, viz. *Plenodomus sorghi* Morochkovskii (*1933*), the name of which refers to a specimen on dead roots of a species of *Sorghum*, collected in the garden of the Polytechnic Institute in Kiev, U.S.S.R., and *Plenodomus karii* Petr. (*1936*), based on typical specimens on the basal stem parts of *Achillea millefolium*, collected near Inari, Finnish Lapland, where the fungus also has been recorded by Salonen (*1962*).

ACKNOWLEDGEMENTS

This investigation was made possible thanks to the help of the Directors or Scientific Officers of Institutes and Herbaria at Baarn, Beltsville, Berlin, Brussels, Cambridge

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[2] The phenomenon of underground pycnidial production in darkness has been studied by Zafar & Colotelo (*1978, 1979*).

TABLE IV. Records of Phoma sclerotioides

Matrix	Location*	References
Achillea millefolium stems at ground level	reg. Inari (Laanila Kaunispää), Lapland, Finland	Petrak (1936)
Althaea rosea roots	prov. Alta (Calgary), Canada	Robertson (1931)
Amaranthus retroflexus roots	prov. Alta/Sask, Canada	Dearness & Sanford (1930), Sanford (1933)
Avena sativa roots	prov. Alta/Sask, Canada	Sanford (1933)
Axaris amaranthoides roots	prov. Alta/Sask, Canada	Dearness & Sanford (1930), Sanford (1933)
Chenopodium sp. roots	prov. Alta/Sask, Canada	Dearness & Sanford (1930)
Festuca rubra roots	state Alaska (Fairbanks), U.S.A.	Lebeau & Logsdon (1958)
Hedysarum mackenzii roots	terr. Yukon, Canada	Lebeau & Logsdon (1958)
Lotus ceniculatus roots	prov. Alta, Canada	Berkenkamp & Baenziger (1969)
Medicago sativa subsp. *sativa* roots stems	prov. Alta, prov. Man, prov. Sask and terr. Yukon (Mile 1019), Canada	Dearness & Sanford (1930), Sanford (1933), McDonald (1955), Lebeau & Logsdon (1958), Colotelo & Netolitzky (1964)
subspp. *falcata* and *varia* roots	prov. Ulyanovskaya (Ulyansk), U.S.S.R. Terr. Yukon (Mile 1019), Canada	Rodigin (1935), Tsukamoto (1965)
Melilotus *albus* roots	prov. Alta (Athabasca, Beaverlodge, Edmonton, Lacombe), prov. Sask (Prince Albert, Waldheim, Wakau, and terr. Yukon (Mile 1019), Canada	Dearness & Sanford (1930), Sanford (1933), Cormack (1934), Lebeau & Logsdon (1958) Netolitzky & Colotelo (1965), Mead (1962), Berkenkamp & Baenziger (1969)
stems at ground level	prov. Leningradskaya (Luga) prov. Ulyanovskaya (Ulyansk) U.S.S.R.	Markova-Letova (1928) Rodigin (1935)
M. officinalis roots	prov. Alta (Lacombe), Canada	Berkenkamp & Baenziger (1969)
Poa pratensis roots	state Alaska (Palmer), U.S.A.	Lebeau & Logsdon (1958),
Sorghum sp. roots	prov. Oekraîne (Kiev), U.S.S.R.	Morochkovskii (1933)
Trifolium hybridum	prov. Alta, prov. Sask, Canada state Alaska (College), U.S.A.	Dearness & Sanford (1930), Lebeau & Logsdon (1958)
T. pratense roots	prov. Alta, prov. Sask and terr. Yukon (Mile 970), Canada reg. Inari (Muddusniemi), Lapland, Finland	Sanford (1933), Lebeau & Logsdon (1958), Salonen (1962)
Triticum aestivum roots	prov. Alta (Lacombe), Canada	Henry & Berkenkamp (1965)
Unidentified plant roots stems at ground level	reg. Ober Lausitz (area Hoyerswerda), East Germany	Herb. Preuss (B), Rabenh., Klotzschii Herb. mycol. No. 1281 (1849), Saccardo (1892)

*The Canadian provinces Alberta, Manitoba and Saskatchewan are abbreviated as Alta, Man and Sask.

(U.S.A.), Edmonton, Helsinki, Lacombe, Leyden, Madrid, Munich, Ottawa, Padova, Saskatoon, Stockholm, Utrecht, Vienna, Winnipeg and Zürich.

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 333–358 (1981)

THE GENUS ASCODESMIS (PEZIZALES, ASCOMYCETES)

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In this taxonomic revision of the genus *Ascodesmis* the monotypic family Ascodesmidaceae and the genus *Ascodesmis* are delimited and defined. Six species are recognized, described, and illustrated from living material and specimens preserved in herbaria. The typifications of the genus *Ascodesmis* and of the species *A. nigricans*, and *A. sphaerospora* are discussed without far-reaching consequences. *Ascodesmis nana* is described as new and the new name *Ascobolus perforatus* is proposed for *Ascodesmis canina* Jeng & Cain. A list of doubtful and excluded names is appended.

The genus *Ascodesmis* was established by van Tieghem in 1876 for *Ascodesmis nigricans* and *A. aurea*, two dung inhabiting fungi he considered to represent the elementary type of the Discomycetes. The generic name *Ascodesmis* was given by van Tieghem because the fruit bodies consist of an unprotected bundle of asci only. The growth and development of one of the species (*A. nigricans*) was studied in culture and described in detail.

Before *Ascodesmis* was established, species later regarded as members of this genus were classified under *Ascobolus* Pers. per Hook.

The Crouan borthers (*1857*) were the first to describe a species of *Ascodesmis*, naming it *Ascobolus microscopicus*. Their concept of the genus *Ascobolus* included all species of Ascomycetes with asci opening at their apex by an operculum.

Cooke (*1877*) included *Ascobolus microscopicus* in his new genus *Boudiera*.

Massee & Salmon (*1902*) described *Ascodesmis volutelloides* as a new species from England.

Hennings (*1903*) described the fungus of Claussen's (*1905*) developmental studies as *Boudiera claussenii*. Both Cavara (*1905*) and Dangeard (*1907*) recognized this as a species of *Ascodesmis*.

Bainier (*1908*) added two new species, *A. reticulata* and *A. echinulata*, from cultures in France.

Seaver (*1916*) recognized two species from North America, a species he identified as *A. microscopica* and a new species, which he named *A. porcina*. He (Seaver, *1928*) also placed *Sphaeridiobolus* Boud. in the synonymy of *Ascodesmis*.

Le Gal (*1949*) contributed much to the knowledge of the genus *Ascodesmis* by giving good descriptions and illustrations of two species. By presenting an acceptable interpretation of *A. nigricans* and a description after the type of *A. microscopica*, she ended the numerous misapplications of these names and gave a solid base for later studies of the genus.

Obrist (*1961*) presented a study of *Ascodesmis* in which he published full descriptions of four species, based on American material. *Ascodesmis macrospora* was newly described and *A. sphaerospora* was proposed as a new name for Seaver's misapplication of *A. microscopica*.

Jeng & Cain (*1976*) contributed, with *A. canina*, a new species from Venezuela.

In recent times, developmental studies of the fruit body by O'Donnell *& al.* (*1976*) and Delattre-Durand & Janex-Favre (*1979*) and electron microscopical studies of the spore ornamentation by Merkus (*1973, 1976*), also of the ascus wall by Samuelson (*1978*) and van Brummelen (*1978, 1981*) have strongly augmented our knowledge of *Ascodesmis*.

The small size of the fruit bodies, rarely surpassing two tenth of a millimeter, make the species of *Ascodesmis* difficult objects to find in natural habitats and thus unlikely to be collected frequently in nature. When brought into the laboratory, in cultures on dung or on artificial media, fruit bodies of *Ascodesmis* can be found more easily, especially when they aggregate and form crusts covering large parts of the substrate. So most records of species of *Ascodesmis* are from investigators who cultured them. In addition these fungi are ideal objects for studies on development, cytology, and ultrastructure because of their easy growth on artificial media and the absence of the protective parts of the receptacle, like excipulum and flesh.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to the directors and curators of the institutes mentioned in the chapter 'Materials and methods', for the loan of specimens.

Grateful acknowledgement is made to Dr. J. A. von Arx, Centraalbureau voor Schimmelcultures, Baarn, and Madame Dr. J. Nicot, Mycothèque, Laboratoire de Cryptogamie, Muséum d'Histoire Naturelle, Paris, for cultures of *Ascodesmis*. Dried or living material has also been gratefully received from Dr. G. Arnold, Mrs. P. N. Bartlett, Dr. W. Gams, Dr. J. C. Krug, and Dr. M. J. Richardson.

Thanks are also due to Dr. H. O. Sleumer, for sending collections of dung from Libya and New Guinea. The author wishes to thank Mr. J. T. Palmer for linguistic advice.

MATERIALS AND METHODS

METHODS.—Observations were made, whenever possible, on living material, but the major part of the material studied consisted of dried specimens.

The procedures and methods for cultivation, isolation, and microscopic examination were, in essence, the same as described earlier (van Brummelen, *1967*).

For a more accurate indication of herbarium specimens, especially where the labelling is not wholly adequate, the customary abbreviations are followed by the author's revision numbers.

HERBARIUM MATERIAL.—Collections of dried specimens were received on loan from the following herbaria. The abbreviations are borrowed from Lanjouw & Stafleu (*1964*).

BPI,	National Fungus Collections, Beltsville, Maryland, U.S.A.
C,	Institut for Sporeplanter, Botansk Laboratorium, Copenhagen, Denmark.
DOAM,	Mycological Herbarium, Division of Plant Pathology, Ottawa, Canada.
E,	Royal Botanic Gardens, Edinburgh, Scotland, Great Britain.
FH,	Farlow Libary and Herbarium of Cryptogamic Botany, Harvard University, Cambridge, Massachusetts, U.S.A.
H,	Botanical Museum, Helsinki, Finland.
HBG,	Staatsinstitut für allgemeine Botanik, Hamburg, Federal Republic of Germany.
K,	Herbarium, Royal Botanic Gardens, Kew, Great Britain.
L,	Rijksherbarium, Leiden, Netherlands.
M,	Botanische Staatssamlung, München, Federal Republic of Germany.
MPU,	Institut de Botanique, Université de Montpellier, Montpellier, France.
NY,	Herbarium of the New York Botanical Garden, New York, U.S.A.
PAD,	Instituto e Orto Botanico dell'Universita, Padova, Italy.
PC,	Muséum d'Histoire Naturelle, Laboratoire de Cryptogamie, Paris, France
S,	Naturhistoriska Riksmuseet, Botaniska Avdelningen, Stockholm, Sweden.
TRTC,	Cryptogamic Herbarium, University of Toronto, Toronto, Canada.
U,	Institute for Systematic Botany, Utrecht, Netherlands.
URM,	Instituto de Micologia, Universidade do Recife, Recife, Pernambuco, Brazil.
W,	Naturhistorisches Museum, Wien, Austria.
ZT,	Institut für specielle Botanik der Eidgenössischen Technischen Hochschule, Zürich, Switzerland.

DEVELOPMENT AND CYTOLOGY

Since their first discovery, species of *Ascodesmis* have been very attractive organisms for investigations on ontogeny, morphology, and cytology. Usually their ascospores germinate readily after inoculation on a wide scale of agar-media without special treatment. The whole life cycle may be finished within four days. No covering tissues of the receptacle, like excipulum or flesh will hide the initial stages from the eyes of the investigators.

In many cases the names given by investigators were wrongly applied. Therefore, the published developmental research on *Ascodesmis* listed below is, as far as possible, arranged according to the species concerned.

Ascodesmis nigricans	van Tieghem (*1876*)
	O'Donnel *& al.* (*1976*)
Ascodesmis microscopica	Zukal (*1886;* as *A. nigricans*)
	Claussen (*1905; as Boudiera claussenii*)
	Dangeard (*1903a, b; 1907;* as *A. nigricans*)
Ascodesmis sphaerospora	Swingle (*1934;* as *A. nigricans*)
	O'Donnell & *al.* (*1976*)
	Delattre-Durand & Janex-Favre (*1979;* as *A. microscopia*)

All species studied thus far are homothollic.

Dangeard (*1903b*) observed four chromosomes in the mitoses of *A. microscopica*.

The development of the different species does not show essential differences. After germination of the ascospores, a septate mycelium with multinucleate cells is formed in which the growth is circular radiating. No conidia or spermatia have been found on the mycelia. Under favourable conditions, ascogonia and antheridia are differentiated after forty to fifty hours. Ascogonia and antheridia may be situated on the same or on more remote branches. They proliferate as short branches perpendicular to the mycelial hyphae and branch dichotomously twice or thrice. The terminal branches of different origin grow together as an ascogonial and an antheridial branch, which coil around each other. There are usually four to eight coils in a cluster formed by a main ascogonial and antheridial branch.

All these elements are multinucleate. A unicellular trichogyne is separated at the top of the ascogonia.

Much difference of opinion exists among cytologists concerning the conduct of the nuclei and the occurrence of a nuclear fusion in the ascogonium (cf. Zukal, *1886;* Claussen, *1905;* Dangeard, *1903a, b; 1907;* Swingle, *1934*).

Cells at the base of the gametangia or of adjacent hyphae proliferate and branch repeatedly to form the short-celled hyphae at the base of the fruit body. Several of the hyphae elongate and form the paraphyses. Investing hyphae are not differentiated.

Near their base, the ascogonia proliferate to from ascogenous hyphae. Crozier initials are formed on the ascogenous hyphae which develop into young asci. Meiosis takes place in the ascus and eight ascospores are formed. The asci swell strongly and protrude on ripening. The spores are forcibly discharged.

In *Ascodesmis,* the hymenium and even the ascogonium are exposed from the first until the maturation of the asci. Such fruit bodies are termed eugymnohymenial ascomata (without excipulum) and represent here the most reduced type of development in the Discomycetes.

STRUCTURE

A great uniformity consists in the structure of the species of *Ascodesmis*.

The general ultrastructure has been described by Moore (*1963, 1965*), Carroll (*1967*), and Brenner & Carroll (*1968*).

MYCELIUM.—The mycelium consists of hyaline, septate, cylindrical hyphae that branch monopodially. No formation of conidia or spermatia has been observed.

APOTHECIA.—The apothecia are very simple in structure, consisting only of a bundle of asci surrounded by paraphyses on a small base.

The number of asci in each fruit body is rather variable from two to five in the smallest and up to over thirty in the largest. Often individual apothecia may contain more than a single bundle of ascogonia and antheridia. Most species, under favourable conditions, show a tendency to aggregate on the surface of the substrate and form complexes or crusts. In such complexes it is often difficult to distinguish the individual apothecia.

ASCI.—The asci are obovoid to broadly clavate with a broad base and a rounded top. The thin wall and the periascus do not stain blue with iodine.

At maturity, the asci are swelling strongly and proliferating above the hymenial surface when the maximum length of asci is rather variable.

In a very late stage a large operculum is differentiated at the top of the ascus. The position of the operculum is determined by the direction of the maximum light intensity (O'Donnel & *al.*, *1976*).

As seen with the electron microscope (van Brummelen, *1978*; *1981*; O'Donnell & *al.*, *1976;* Samuelson, *1978*), the operculum is sharply delimited by a weak indentation on the inside where the wall disintegrates circumscissilely within a narrow zone from both sides. The ascostome is smooth. A funnel and a funiculus (respectively 'entonnoir' and 'tractus apical' of Chadefaud) are not differentiated in the top of the ascus, which is in contrast with the asci in most of the other genera of the Pezizales.

ASCOSPORES.—The ascospores have the most important characters for the identification of the species.

The shape of the ascospores varies from ellipsoid to perfectly spherical. The mean length/breadth ratio has proved to be a more reliable measure than circumscriptions in words.

Only mature ascospores are measured exclusive of their ornamentation for identification.

Young spores are hyaline and smooth before the formation of an ornamentation. At first, the ornamentation on the surface of the spores is visible as hyaline spines, warts, crests, or reticulations which stain with cotton blue or methyl blue. Brown pigment is gradually formed in these ornamentations. In fully mature ascospores, the ornamentation is pale to dark brown and does not stain any longer with cotton- or methyl blue. Such staining at an intermediate stage of ripening will show spores only partly turning blue. This may explain the blue staining 'perispore', observed in some species of *Ascodesmis* (Obrist, *1961*). Sometimes the ascospores were found to be discharged without reaching the full intensity of the brown pigment.

Le Gal (*1949*) described two different types of origin of the spore ornamentation in *A. microscopica* and *A. nigricans*. However, electron microscopical studies on the same species by Merkus (*1973*) revealed that the development of the ornamentation is according to the same process for both. A process which proved to be unique among the Pezizales so far studied (Merkus, *1976*).

PARAPHYSES.—The paraphyses are rather frequent, septate, hyaline, cylindrical, often rather stout, simple or branched at the base. Their ends are scarcely enlarged. Often rather large; colourless vacuoles are seen with rather diffuse lipoid contents.

HABITAT AND DISTRIBUTION

HABITAT.—All known species of *Ascodesmis* are coprophilous. Dung of carnivores is the most common substratum but they also occur on dung of herbivores and omnivores. They have sometimes been isolated from materials such as soil, seeds, and sewage, which are likely to have been contaminated by dung.

DISTRIBUTION.—Since the small size of the apothecia make them unlikely to be collected frequently, it is difficult to draw conclusions about their distribution.

Most collections originate from localities in Europe, Canada, and the United States. Only incidental records are available from Asia, Africa, Australia, and South America. Despite this lack of information, it is possible to conclude that *Ascodesmis nigricans*, *A. microscopica*, and *A. sphaerospora* are cosmopolitan. The latter species is probably more common on the American continent than in Europe.

Ascodesmis porcina has a wide distribution but is probably more or less confined to the tropical region.

ASCODESMIDACEAE Schroet.

Ascodesmidaceae Schroet. *in* Krypt.-Fl. Schles. **3** (2). 31. 1893 ('Ascodesmidacei'; fam.). – Type: *Ascodesmis* Tiegh.

Ascodesmidoideae Brumm. *in* Persoonia (Suppl.) **1**: 59. 1967. – Type: *Ascodesmis* Tiegh.

Ascodesmidoideae Brumm., emend Korf *in* Mycologia **64**: 949. 1972; Korf *in* The fungi (ed. Ainsworth & *al.*) **4A**: 270. 1973 (in part).

Ascomata eugymnohymenial, very small. Receptacle restricted to a small group of basal hyphae. Excipulum absent. Asci broad, thin-walled, not staining blue with iodine, without funiculus and funnel. Operculum very large, sharply delimited by a weak indentation at the inside of the ascus where the wall disintgrates circumscissilely within a narrow zone from both sides. Ascospores without oil globules, nonseptate. Secondary wall material at first hyaline, finally brown, forming directly a permanent and rigid ornamentation on the outer surface of the primary wall. Paraphyses present, septate.

Fimicolous.

GENUS.—*Ascodesmis* Tiegh.

EXCLUDED GENERA.—*Pyronema* Carus, *Zukalina* O.K., *Boudiera* Cooke, *Lamprospora* De-Not., *Svrcekia* Kub., *Ascocalathium* Eidam apud Schroet., *Pulparia* P. Karst., *Sphaerozone* Zobel *in* Corda, *Jafneadelphus* Rifai.

The present concept of the Ascodesmidaceae is mainly based on microscopic and submicroscopic characters of asci and ascospores. It is therefore remarkable that Schroeter's (*1893*) diagnosis of the family still holds. However, his inclusion of the poorly known genus *Ascocalathium* Eidam apud Schroet. is not tenable. The position of this genus with cylindrical asci, smooth, hyaline ascospores and conspicuous, very long, acuminate, setiform paraphyses is very questionable.

The ascospores of the Ascodesmidaceae—as this family is understood here—are unique among the Pezizales because their ornamentation is immediately constituted by the secondary wall material in a definitive form (Merkus, *1973; 1976*). The secondary wall is internally differentiated. The formation of the operculum in the ascus wall is also distinguished as a special type within the Pezizales (van Brummelen, *1978*).

The family Ascodesmidaceae remains restricted to the type genus.

Many authors (e.g. van Tiegh, *1876;* Saccardo, *1884;* Massee, *1895*; Massee & Salmon, *1902*; Dangeard, *1907*; Fennell, *1973*; Benny & Kimbrough, *1980*) see in *Ascodesmis* a very primitive type of discomycete related to the Gymnoascaceae. Von Arx (*1967, 1971*) considers it as the most primitive of all Ascomycetes, while others (Le Gal, *1949*; Durand, *1969*; Nicot & Durand, *1970*; Delattre-Durand & Janex-Favre, *1979*) support the view of a specialized discomycete which has undergone a strong reduction.

The idea of a relationship with the Gymnoascaceae is based on the simplicity of the ascomata and similarities in gametangiogamy but the asci in *Ascodesmis* are typically operculate.

In view of the complex structure of asci and ascospores, *Ascodesmis* is here considered as a rather specialized organism with a strongly reduced receptacle.

Seaver (*1928*) placed *Ascodesmis* in his highly artificial tribe Sphaerosporeae of the Pezizales in which he united all genera of operculate Discomycetes with hyaline or brown spherical ascospores. All species of *Ascobolus* sect. *Sphaeridiobolus* (Boud.) Brumm. were placed in the synonomy of *Ascodesmis*.

Korf (*1972*, *1973*) recognized a very extensive family Pyronemataceae with five subfamilies, one of which is the Ascodesmidoidea, characterized by asci that do not stain blue with iodine and ascospores or cell walls with brown pigments. Besides *Ascodesmis*, he includes *Pulparia* P. Karst., *Sphaerozone* Zobel *in* Corda, and *Jafneadelphus* Rifai.

Ascodesmis was considered to be related to *Boudiera* by e.g. Cooke (*1877*), Le Gal (*1949*), Obrist (*1961*), Eckblad (*1968*), and Kimbrough (*1970*). The latter genus, however, is characterized by asci clearly staining blue with iodine, an opercular type related to *Ascobolus* and *Saccobolus* (van Brummelen, *1978*) and a wholly different development of the spore ornamentation (Merkus, *1974*; *1976*).

In our (van Brummelen, *1967*) monograph of *Ascobolus* and *Saccobolus*, we created a new subfamily Ascodesmidoideae within the Ascobolaceae to accommodate the genus *Ascodesmis* but later research, especially on the fine structure of asci (van Brummelen, *1968*) and ascospores (Merkus, *1973*; *1976*), has convinced us that those fungi are not closely related to *Ascobolus*, *Saccobolus*, or any other genus of Pezizales sufficiently investigated. Their isolated position within the Pezizales is best expressed by the reinstallation of the family Ascodesmidaceae.

ASCODESMIS Tiegh.

Ascodesmis Tiegh. *in* Bull. Soc. bot. Fr. **23**: 275. 1876. — Lectotype: *Ascodesmis nigricans* Tiegh.

Apothecia superficial or immersed, sessile, very small, 50–300 μm diam., consisting of a bundle of asci surrounded by paraphyses on a small subhymenial group of strongly intermingled short-celled hyphae. Excipulum absent. Asci ellipsoid, obovoid, oblong-obovoid or broadly clavate, rounded above, with a broad base or a short broad stalk, thin-walled, protruding at maturity, 8-spored or rarely with only part of the spores developed. Ascospores multiseriate or irregularly disposed in the upper part of the ascus, free, globular, subglobular, or broadly ellipsoid, without oil globules, at first hyaline, becoming brown or brownish at maturity, ornamented with a pattern of spines, warts, ridges, or reticulations. Paraphyses usually frequent, septate, rarely branched, hyaline. Mycelium hyaline, septate, consisting of coenocytic elements, branching monopodially, with ascogonia and antheridia developing as short dichotomously ramifying side branches.

HABITAT.—Fimicolous, also isolated from soil samples.

ETYMOLOGY.—From Greek ασκοσ, leather sack and δεσπιζ, bundle: a bundle of asci.

When van Tieghem (*1876*) introduced the genus *Ascodesmis* he included two species: *A. nigricans* and *A. aurea*. The former was described in detail and is the object of the author's extensive studies on the development of the fruit body, while *A. aurea* has only a very fragmentary description.

Van Tieghem remarks: 'C'est surtout l'*A. nigricans* que je me suis appliqué à cultiver tant en grand sur crottin de cheval bouilli, qu'en cellule dans divers liquides nutritifs. Aussi est-ce de cette espèce et surtout des résultats obtenus sur elle par les cultures cellulaires qu'il sera exclusivement question dans ce que va suivre!'

Considering these statements of van Tieghem Saccardo's (*1884*) typification of the genus *Ascodesmis* by *A. aurea* cannot be correct and should not be followed as was done by Eckblad (*1968*).

It is clear that van Tieghem's knowledge of *Ascodesmis* was almost exlusively based on *A. nigricans* and that only this species can be the lectotype. *Ascodesmis nigricans* was selected as type by Clements & Shear (*1931*) on other grounds.

KEY TO THE SPECIES OF ASCODESMIS

1a. Ascospores spherical, subglobose, or broadly ellipsoid; length/breadth ratio under 1.2: 2
 b. Ascospores broadly ellipsoid to ellipsoid; length/breadth ratio over 1.2: 3
2a. Ascospores ornamented with round warts, only rarely with a few connectives or short crests 2. *A. nana*
 b. Ascospores ornamented with a more or less regular net-work of ridges ... 6. *A. sphaerospora*
3a. Ascospores more than 16 μm long .... 4. *A. macrospora*
 b. Ascospores less than 16 μm long: 4
4a. Ascospores ornamented with an irregular net-work of prominent ridges ... 5. *A. microscopica*
 b. Ascospores without such a network: 5
5a. Ascospores ornamented with isolated or anastomosing spines with only a few connectives; the spines often broadened at their tips .... 1. *A. nigricans*
 b. Ascospores ornamented with one very conspicuous simple or branched ridge (up to 3 μm high) extending over the major part of the spore surface, together with isolated or occasionally connected warts and spines .... 3. *A. porcina*

1. ASCODESMIS NIGRICANS Tiegh.—Fig. 1

Ascodesmis nigricans Tiegh. *in* Bull. Soc. bot. Fr. **23**: 275. 1877. — Holotype: not known to be in existence; type locality near Paris, France. Neotype: on dung of goat and sheep (with conserved part of culture), Adiopodumé, near Abidjan, Ivory Coast, VII. 1949, *M. Moreau* (PC-A2365).

Ascodesmis echinulata Bainier *in* Bull. Soc. mycol. Fr. **23**: 139, pl. 19 fs. 4–7. 1908. — Type: represented by Bainier l.c. pl. 19 fs. 4–7; type locality France.

EXCLUDED.—*Ascodesmis nigricans* Tiegh. sensu Schroeter *in* Kryptog.-Fl. Schles. (ed. Cohn) **3**(2): 32. 1883 = *Ascodesmis microscopica*.

Ascodesmis nigricans Tiegh. sensu Massee, Brit. Fungus-Fl. **4**: 19. 1895 = *Ascodesmis microscopica*.

Ascodesmis nigricans Tiegh. sensu Saccardo, Syll. Fung. **8**: 825. 1889 = *Ascodesmis microscopica*.

Ascodesmis nigricans Tiegh. sensu Swingle *in* Am. J. Bot. **21**: 519–545. 1934 = *Ascodesmis sphaerospora*.

Apothecia solitary or gregarious, rarely confluent, superficial or immersed, sessile on a narrow base, 70–200(–250) μm diam., up to 100 μm high, at first subcylindrical, obconical, or

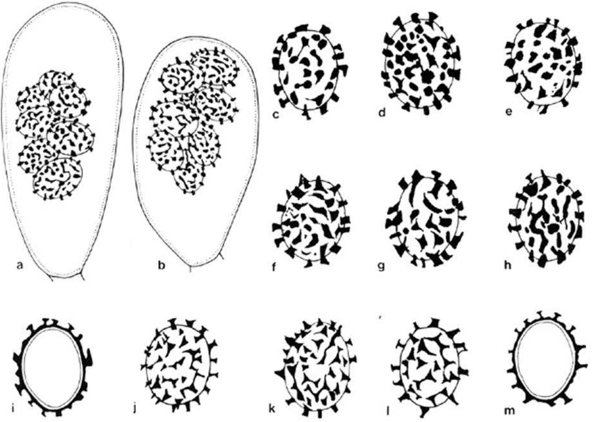

Fig. 1. *Ascodesmis nigricans*. — a, b. Asci × 1000. — c–h, j–l. Ascospores × 1600. — i, m. Ascospores in optical section × 1600. (a–i from *Bartlett*, 4.XII.1979, L; j–m from neotype of *A. nigricans*, PC–A2365.)

barrel-shaped, becoming flattened with age, hyaline than brown, consisting of 3–10(–20) asci surrounded by paraphyses. Hymenium convex, dotted with the brown protruding tips of ripe asci. Hypothecium scarcely differentiated, of strongly intermingled thin-walled hyphae 4–8 µm wide. Excipulum absent. Asci broadly clavate to obovate with a broad base or a short broad stalk, rounded above, with a very large operculum, 45–55(–65) × 25–30 µm, 8-spored. Ascospores irregularly arranged in the upper part of the ascus, broadly ellipsoid to ellipsoid (length/breadth ratio 1.2–1.5, average 1.25–1.35), at first hyaline, soon becoming chocolate brown, (9.5–)10.5–12.0(–12.5) × (7.5–)8.5–9.5(–10) µm (without ornamentation), without oil globules or granules, ornamented with isolated or rarely anastomosing spines, with a few fine connectives; the spines usually flat and broadened at their tips. Paraphyses rather frequent, septate irregularly cylindrical, simple or branched at the base, hyaline, 3–5.5 µm thick, not or scarcely enlarged at the tip, not embedded in mucus, containing vacuoles and granules. Mycelium hyaline, cylindrical, sometimes in part aerial, without conidia or spermatia. Antheridia and ascogonia with broad symmetrically dichotomous branches.

HABITAT.—On dung of dog, fox, rat, pig, sheep, goat, donkey, and ostrich, also isolated from soil and beans.

ETOMOLOGY.—From Latin nigricans, becoming black.

ILLUSTRATIONS.—Van Brummelen *in* Persoonia **10**: 118 f. 9. 1978 (E.M.); van Brummelen *in* Ascomycete Systematics (ed. Reynolds). Chapt. 3: 34 f. 3.9. 1981 (E.M.); Le Gal *in* Revue Mycol. **14**: 87–90 fs. 1–3. 1949; Merkus *in* Persoonia **7**: pls. 28 A, B, 31, 33, 37, 38. 1973 (E.M.); Obrist *in* Can. J. Bot. **54**: 573–575 fs. 3, 4, 9, 10. 1975 (development, S.E.M.).

MATERIAL EXAMINED.—FINLAND: on dog dung, Åbo (Turku), 6.X.1861. *Karsten* (H-A2745).

GREAT BRITAIN: culture, Edinburgh, Scotland, *s. dat.*, *Richardson* (L); culture isolated from goat dung, Univ. Cardiff, 4.XII.1979, *Bartlett* (L); on dung of ostrich, Zoological Garden, Kew, VI.1901 [Massee & Salmon] (K).

THE NETHERLANDS: culture isolated from sandy soil, Wageningen, V.1968, *Tigelaar* (CBS 389.68).

DENMARK: on album graecum, *s. loc.*, 18.VII.1874, *E. C. Hansen* (C–A59); on dog dung, Hellebäck, VII.1874, *E. C. Hansen* (K–A2515).

FRANCE: culture, *s. loc.*, *s. dat.* (Mycothèque PC No. 315, L).

LIBYA: on dung of goat (comm. Dr. H. O. Sleumer), near Tripoli, 9.VIII.1971, *van Brummelen 3296* (L, also culture).

IVORY COAST: on dung of goat and sheep, with conserved part of culture, Adiopodoumé near Abidjan, VII.1949, *M. Moreau* (PC–A2365, as *A. nigricans* det. Le Gal, neotype of *A. nigricans* Tiegh.); culture, idem, VIII.1949, *M. Moreau* (Mycothèque PC No. 100; CBS 114.53).

PAKISTAN: on donkey dung (comm. T. Wassif), Karachi, XII.1962, *Cain* (TRTC 38847).

INDIA: culture isolated from dung, Sargar, *s. dat.*, *S. C. Agrawal A17* (CBS 163.74; IMI 179.865).

INDONESIA: on rat dung, Bogor, III.1956, *Boedijn* (drawing, L).

CANADA: on dog dung (?), Bear Island, Lake Timagami, Ontario, 15.VIII.1931, *Cain* (TRTC 34711); on fox dung, Nashville, York Co., Ontario, 4.II.1957, *Cain* (TRTC 32679); on dog dung, Nashville, York Co., Ontario, 5.XII.1959, *Cain* (TRTC 35292); isolated from soil, Nashville, York Co., Ontario, XI.1963, *Cain* (TRTC 40454); isolated from beans, Guelph, Ontario, 24.XI.1948, *J. W. Groves 20239* (DOAM).

U. S. A.: on dog dung, Cambridge, Massachusetts, II.1887, *Thaxter* (FH–A3156 in part); grown on agar, *s. loc.*, New York, *s. dat.*, *B. O. Dodge 31-1* (NY–A1065; TRTC–B2001); on pig dung, New Jersey, 11.XII.1915, *Seaver* (NY–A1085 in part); on dung of carnivorous animal, Colfax, Louisiana, 25.VIII.1960, *Cain* (TRTC 36466).

When van Tieghem (*1876*) founded the genus *Ascodesmis*, he gave a rather diffuse description of *A. nigricans*, which was the subject of his detailed developmental studies.

The following parts of his description are relevant: '... le fruit mûr de ces plantes se compose simplement d'un bouquet ou d'une rosette d'asques divergents, entremêlés de paraphyses, le tout inséré à la surface supérieure d'une petite masse cellulaire arrondie, qui à son tour s'attache au milieu de sa face inférieure et par un court rameau à un filament mycélien. Complètement dépourvus d'enveloppe ou de périasque, ces fruits sont très-petits, le plus gros atteignant à peine 2 à 3 dixièmes de millimètre; ... Les asques, ovales allongés ou claviformes, contiennent huit spores bisériées qu'ils mettent tardivement en liberté par résorption ou déchisure de leur membrane mince et incolore. Les spores, sphériques ou subsphériques, dont le protoplasme est homogène et incolore, sont revètues d'une exospore colorée et cuticularisée, munie de remarquables épaississements. ... Dans l'*A. nigricans*, où la spore légèrement ovale mesure 0_{mm}, 012 sur 0_{mm}, 010, ce ne sont aussi d'abord que des pointes brunes, plus foncées que le reste de la membrane, et parfois même la chose paraît en rester là; mais le plus souvent l'exospore se développe bientôt au-dessous des pointes en les soulevant et forme un réseau brun à mailles hexagonales ou pentagonales qui porte une pointe à chacum de ses sommets, ...'

Since no illustrations are given, nor have any specimens of van Tieghem been preserved, *A. nigricans* should be interpreted from the original description.

Madame Le Gal (*1949*) succeeded very well in identifying van Tieghem's fungus with living material sent by M. Moreau from Abidjan (Ivory Coast). The development of the ascospore ornamentation agrees especially well.

We agree with Obrist (*1961*: 948) that Le Gal's specimen should be designated as the neotype of the species. This, however, is the preserved part of the culture studied by Le Gal (*M. Moreau*, VII. 1949, PC–A2365). The indication of Culture No. 100 of the 'Mycothèque' of the Laboratoire de Cryptogamie in Paris as neotype (Obrist, l.c.: 947) is not allowed according to Article 9.5 of the present International Code of Botanical Nomenclature.

Ascodesmis echinulata Bainier with ascospores about 11 × 8.4 µm and isolated spines, without connectives, fits well within the variability of *A. nigricans* and is considered to be a synonym.

The present species can be distinguished from *A. microscopica* by the smaller ascospores and the usually isolated spines of the spore ornamentation. It differs from *A. nana* in the longer ascospores and spines that are often flattened and broadened at the ends.

Ascodesmis nigricans is also recorded from Kenya (Minoura, *1969*) and Taiwan (Liou & Chen, *1977*). It is a cosmopolitan species.

2. **Ascodesmis nana** Brumm., *sp. nov.*—Fig. 2

Apothecia solitaria aut gregaria, 60–100 µm diam., 60–70 µm alta, initio subcylindracea vel doliiformia, deinde semiglobularia, constans ex 4–9 ascis et paucis paraphysibus. Excipulum deest. Asci obovoidei ad ellipsoidei, 50–63(–80) × 25–28 µm, 8-spori. Ascosporae globulosae, globosae ad late ellipsoideae, initio hyalinae, deinde pallide brunneae, 8.5–10.0(–11.0) × 8.3–9.5(–10.0) µm, verucis rotundatis satis magnis aut parvis ornatae, aliquando connectivis tennibus aut cristis brevibus. Paraphyses rarae, septatae, irregulariter cylindraceae. In fimo Pecary tajaou invenitur. Typus: *van Brummelen 717* (L).

Apothecia solitary or gregarious, superficial or partly immersed, sessile on a rather broad base, 60–100 µm diam., 60–70 µm high, at first subcylindrical or barrel-shaped, then semiglobular and spreading, hyaline then pale brownish, consisting of a bundle of 4–9 asci surrounded by a few paraphyses. Hymenium convex, dotted with the brownish ends of protruding ripe asci. Hypothecium scarcely developed and of only a few thin-walled strongly intermingled short-celled hyphae, 4.5–7.5 µm wide. Excipulum absent. Asci obovoid to ellipsoid, with a short broad stalk, rounded at the apex, with a very large operculum, 50–63(–80) × 25–28 µm, 8-spored. Ascospores irregularly arranged in the upper half of the ascus, globular, globose, or broadly ellipsoid (length/breadth ratio 1.00–1.20, average 1.13), at first hyaline then pale brown, 8.5–10.0(–11.0) × 8.3–9.5(–10.0) µm (excluding ornamentation), without oil globules or granules, ornamented with rather large and small isolated round warts and occasional fine connectives or short crests. Paraphyses rather scarce, septate, irregularly cylindrical, simple, hyaline, 3.5–5 µm thick, not enlarged at the ends, embedded at their base in hyaline or pale brown mucus, containing one or only a few large vacuoles with a lipoid substance. Mycelium hyaline, cylindrical, branching monopodially, without conidia or pycnidia.

HABITAT.—Only known from dung of collared pecary.

ETYMOLOGY.—From Latin nanus, a dwarf, staying low.

SPECIMEN EXAMINED.—THE NETHERLANDS: on dung of collared peccary (*Pecary tajacu*), Zoological Garden, Amsterdam, 11.VIII. 1959, *van Brummelen 717* (type of *Ascodesmis nana*, L; also isolated in culture).

This new species is closely related to *A. nigricans* with which it has in common the presence of small asci and ascospores, also a spore ornamentation consisting mainly of isolated elements.

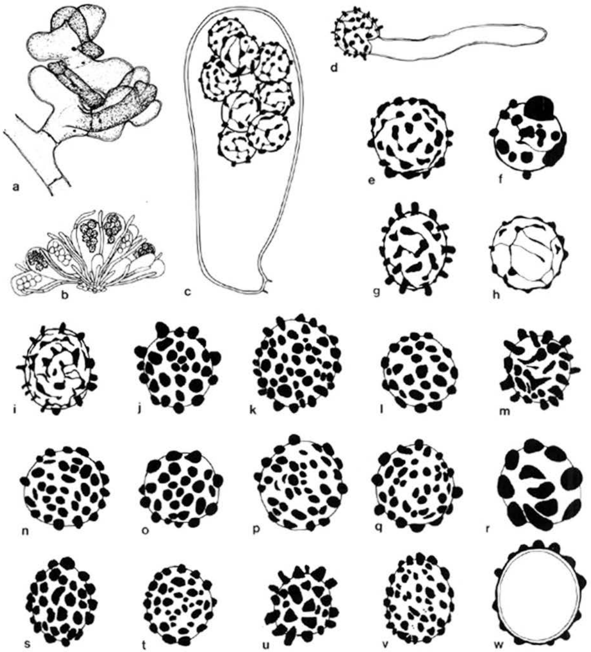

Fig. 2. *Ascodesmis nana*. — a. Gametangia × 1000. — b. Apothecium × 125. — c. Ascus × 900. — d. Germinating ascospore × 900. — e–v. Ascospores × 1600. — w. Ascospore in optical section × 1600. (From type of *A. nana*.)

The ascospores in *A. nana* are subglobular or spherical with a mean length/breadth ratio under 1.15 and isolated round warts. In *A. nigricans* the shape of the ascospores is clearly ellipsoid with a mean length/breadth ratio over 1.2 and isolated or somewhat anastomosing spines, often flattened and broadened at their ends.

3. ASCODESMIS PORCINA Seaver—Fig. 3

Ascodesmis porcina Seaver *in* Mycologia **8**: 3, pl. 172 fs. 6–9. 1916; North Am. Cup-fungi (Operc.) 80, pl. 5 fs. 6–9. 1928. – Holotype: on pig dung [comm. G. L. Fawcett], Porto Rico, I. 1915, *Seaver* (slides, NY–A1084).

Apotheca solitary or gregarious, superficial, sessile 60–150 μm diam., 80–100 μm high, at first subglobular, then hemispherical, becoming more flattened, finally more or less discoid to pulvinate, hyaline then brown. Hymenium convex, roughened by the protruding brown tips of ripe asci. Hypothecium scarcely differentiated consisting of a few strongly intermingled thin-walled hyphae 4–7 μm wide. Excipulum absent. Asci broadly clavate, oblong, or obovoid, with a broad base or a short broad stalk, rounded above, with a large operculum, 65–80(–90) × 20–30(–35) μm, 8-spored. Ascospores irregularly disposed in the upper part of the ascus, broadly ellipsoid to ellipsoid (length/breadth ratio 1.2–1.7, average 1.3–1.55), at first hyaline, then brown, (11.0–)11.5–13.5(–14.5) × (7.0–)7.5–10.0(–11.5) μm (without ornamentation), without oil globules or granules, ornamented with a very variable pattern of isolated warts and spines with occasional fine connectives and with one very conspicuous simple or branched ridge up to 3 μm high extending over the major part of the spore surface. Paraphyses rather scarce, septate, irregularly cylindrical, simple, hyaline, 4–6 μm thick, scarcely enlarged upwards, not embedded in mucus, containing several vacuoles and granules. A conidial state is unknown.

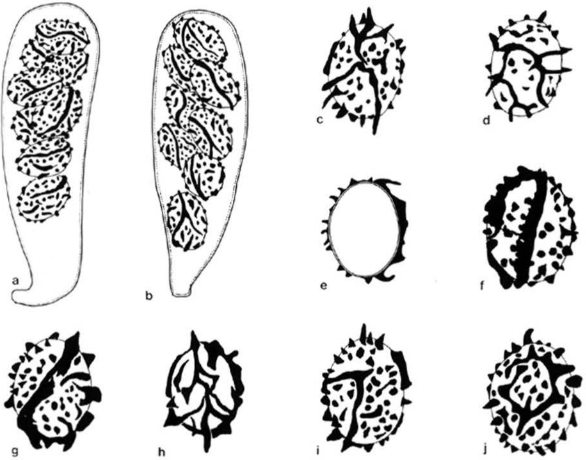

Fig. 3. *Ascodesmis porcina*. — a, b. Asci × 1000. — c, d, f–j. Ascospores × 1600. — e. Ascospore in optical section × 1600. (a, b redrawn after *Boedijn*, III. 1956, L–B2035; c–j from holotype of *A. porcina*.)

HABITAT.—On dung of rat, peccary, pig, goat, and donkey.

ETYMOLOGY.—From Latin porcinus, a pig; from the habitat of type specimen on pig dung.

ILLUSTRATIONS.—Obrist *in* Can. J. Bot. **39**: 952 f. 11. 1961; Seaver *in* Mycologia **8**: pl. 172 fs. 6–9. 1916. Seaver, North Am. Cup-fungi (Operc.) pl. 5 fs. 6–9. 1928.

MATERIAL EXAMINED.—INDONESIA: on rat dung, Bogor, III. 1956, *Boedijn* (drawing, L).

NEW GUINEA (West): on goat dung (Comm. Dr. H. O. Seumer), Tablasoefoe, 21. VIII. 1061, *van Brummelen 1487* (L).

U. S. A.: on pig dung, New Jersey, 11.XII.1915 [*Seaver*] (TRTC–B2003, in part); *s. loc., s. dat., Seaver 'No. 4'* (slide, NY–A1073).

PORTO RICO: on pig dung [comm. G. L. Fawcett], *s. loc.*, I. 1915, *Seaver* (slides, NY–A1084, holotype of *A. porcina*).

VENEZUELA: on pig dung, Margarita, 1903, *Blakeslee* (as *Saccobolus*, FH–A3064); on goat dung, between Manacal and Los Pacitos, NW. of Irapa, Edo. Sucre, 13.VII.1972, *Dumont VE 4892a* (TRTC), on dung of burro (donkey), 19 km SW. of Caripe, Edo. Monagras, 19.VII.1972, *Dumont VE 5521r* (TRTC).

BRAZIL: on peccary dung (comm. Dr. A. C. Batista), Recife, VIII.1960, *Obrist* (TRTC 36308).

This species shows some similarity to *Ascodesmis nigricans* but differs in having ascospores with a conspicuous simple or branched ridge extending over the greater part of the spore surface.

The species is also recorded from Panama (Meyer & Meyer, *1949*) and Taiwan (Liou & Chen, *1977*). Gunnell's (*1960*) record for Britain probably relates to another species because of the ascospore characters given.

With the exception of Seaver's specimens grown on pig dung from New Jersey, U.S.A., *A. porcina* shows a circum-tropical distribution,

4. ASCODESMIS MACROSPORA Obrist—Fig. 4

Ascodesmis macrospora Obrist *in* Can. J. Bot. **39**. 951 f. 12. 1961. — Type on dung of puma (*Felis concolor*) comm. Dr. A. C. Batista, Recife, Brazil, isolated [by *Obrist*] I. 1960 (TRTC 35512).

Apothecia solitary or gregarious, often confluent, superficial or semi-immersed, sessile, (100–)140–300 µm diam., (100–)120–180 µm high, at first hemispherical to subglobular, then often aggregating into a crest, hyaline, finally brown, consisting of a bundle of 8–25 aci surrounded by paraphyses. Hymenial surface convex, roughened by the far protruding ends of ripe asci. Hypothecium scarcely differentiated, consisting of a small group of rounded thin-walled cells 4.5–11 µm wide. Excipulum absent. Asci very broadly clavate, oblong, ellipsoid, or obovoid, with a broad base, rounded above 84–115(–150) × (29–)35–42 µm, 8-spored but sometimes with only a part of the spores developed. Ascospores irregularly disposed in the upper part of the ascus, broadly ellipsoid (length/breadth ratio 1.17–1.30, rarely 1.4), at first hyaline, then brown, (18.0–)19.0–20.5(–21.5) × (13.5–)15.0–16.5(–17.6) µm (excluding ornamentation), without oil globules or granules, ornamented with a more or less incomplete irregular network of major ridges and crests 1.5–3.0 µm high with smaller and

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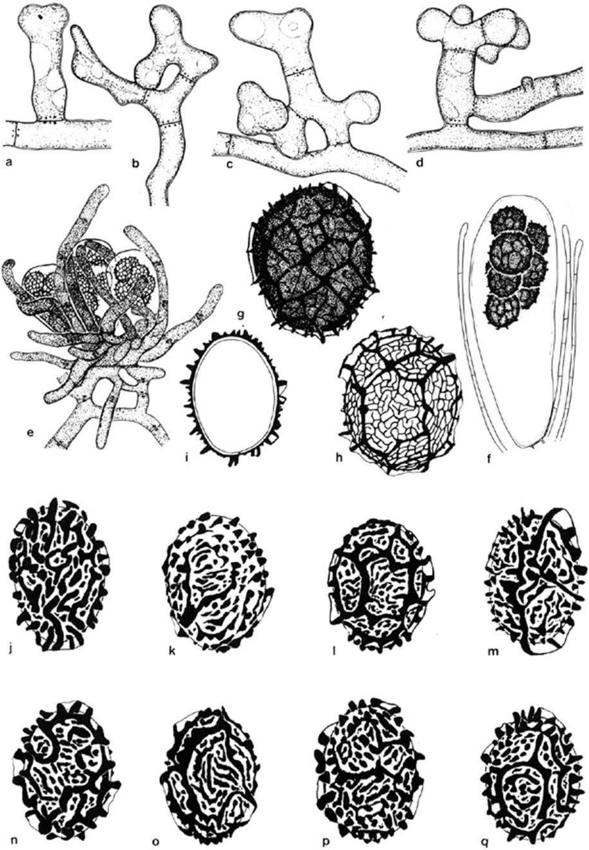
Fig. 4. *Ascodesmis macrospora*. — a–d. Gametangia × 1000. — e. Apothecium × 320. — f. Ascus and paraphyses × 500. — g, h, j–q. Ascospores × 1600. — i. Ascospore in optical section × 1600. (a–h from *van Brummelen 716*; i–q from holotype of *A. macrospora*.)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more delicate ridges and spines up to 1.5 μm high in the space between the meshes. Paraphyses present, septate cylindrical, rarely branched, hyaline, 3–6 μm thick, scarcely enlarged at the tip, not embedded in mucus, contents rather homogeneous. Mycelium hyaline, branching monopodially, without conidia or spermatia.

HABITAT.—On dung of crocodile, puma, and *Cerdocyon thous*.

ETYMOLOGY.—From Greek μακροζ, long (improperly used for μεγαζ, large) and σπορα, a seed: with long spores.

ILLUSTRATION.—Obrist *in* Can. J. Bot. **39**: 952 f. 12. 1961.

MATERIAL EXAMINED.—THE NETHERLANDS: on dung of crocodile, Zoological Garden, Amsterdam, 8.VIII.1959, *van Brummelen 716* (L, also as culture 59.19); idem, 13.III.1970, *van Brummelen 2749* (L, also as culture 72); idem, 20.IV.1970 (L); idem, 12.V.1970, *van Brummelen 2775* (L); idem, 14.XII.1970, *van Brummelen 3254* (L).

BRAZIL: on dung of puma (*Felis concolor*) (comm. Dr. A. C. Batista), Recife, isolated [by *Obrist*] I.1960 (holotype of *A. macrospora*, TRTC 35512); on dung of *Cerdocyon thous* (comm. Dr. A. C. Batista), Recife, isolated [by *Obrist*], III.1960 (TRTC 35596).

The present species would appear rather close to *A. microscopica*, differing mainly in the much larger ascospores.

A rather abberant collection (TRTC 35537), cultivated on Jaguar dung from Brazil, was specially mentioned by Obrist (*1961*: fig. 1) and included in *A. macrospora*. This fungus has smaller, more broadly ellipsoid ascospores, measuring 14.3–15.5 × 11.5 × 12.7 μm, ornamented with an irregular network. It should not be included in *A. macrospora*, until more is known about the variability of this species.

Ascodesmis macrospora seems to be restricted to dung of carnivores. In culture it grows fast and produces mature ascospores within four days after inoculation. Ascospores that have been preserved dry for more than ten years germinated with only a minor delay.

5. ASCODESMIS MICROSCOPICA (Crouan) Seaver—Fig. 5

Ascobolus microscopicus Crouan *in* Annls Sci. nat. (Bot.) IV **7**: 175 pl. 4E fs. 20–23. 1857; not *Ascobolus microscopicus* (Wallr.) Sacc., Syll. Fung. **8**: 524. 1889. —*Boudiera microscopica* (Crouan) Cooke *in* Grevillea **6**: 76. 1877. — *Ascodesmis microscopica* (Crouan) Seaver *in* Mycologia **8**: 3. 1916 (misapplied). — Type: on album graecum, near Brest, Finistère, France, *s. dat.*, Crouan (PC-A2351).

Boudiera claussenii P. Henn. *in* Hedwigia **42** (Beibl.) 182. 1903. — Type distribution: Rehm, Ascom. 1526.

Ascodesmis reticulata Bainier *in* Bull. Soc. mycol. Fr. **23**: 137 pl. 19 fs. 1–3. 1908. — Type: not known to be in existence, represented by Bainier l.c.; type locality, near Paris, France.

EXCLUDED.—*Ascodesmis microscopica* (Crouan) Seaver sensu Seaver *in* Mycologia **8**: 3, pl. 72 fs. 1–5. 1916; North Am. Cup-fungi (Operc.) 79. 1928 = *Ascodesmis sphaerospora* Obrist.

Apothecia solitary, gregarious, or confluent, superficial, sessile (50–)80–200(–250) μm diam., 70–150 μm high, at first irregularly cylindrical, then obconical and or flattened, hyaline, finally brown, consisting of a bundle of only a very few to many asci surrounded by paraphyses. Hymenial surface convex, dotted with the brown protruding tips of ripe asci. Hypothecium scarcely differentiated, of only a few thin-walled, short-celled hyphae 5.5–9.5 μm wide. Excipulum absent. Asci broadly clavate to obovoid, with a broad base, rounded above, with a very large operculum, (63–)70–80(–88) × (26–)29–31(–33) μm, 8-spored. Asco-

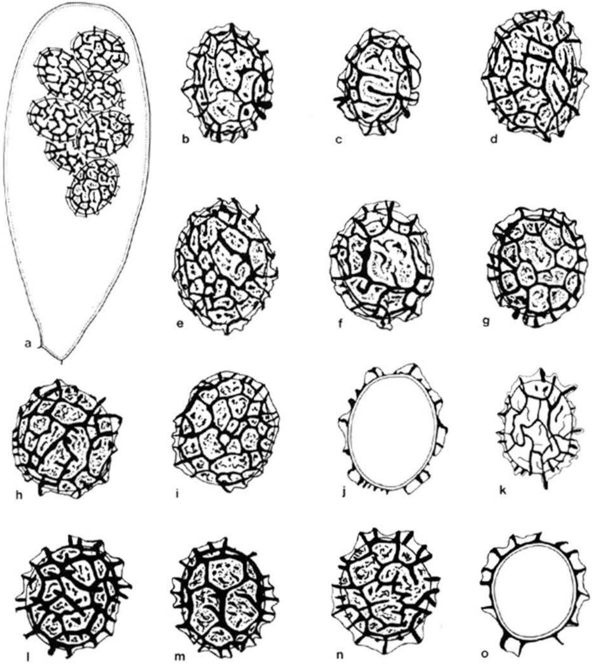

Fig. 5. *Ascodesmis microscopica*. — a. Ascus × 1000. — b–i, k–n. Ascospores × 1600. — j, o. Ascospores in optical section × 1600. (a from *G. Arnold m 424*, CBS; b–j from type of *A. microscopica;* k–o from Rehm, Ascomyceten 1526, k from M, l–o from S.)

spores irregularly disposed in the upper part of the ascus, broadly ellipsoid, rounded at each end (length/breadth ratio (1.14–)1.20–1.35(–1.50), at first hyaline becoming brown at maturity (11.0–)11.5–14.0(–15.5) × (8.0–)9.0–12.0(–13.5) µm (excluding ornamentation), without oil globules or granules, ornamented with an irregular wide-meshed network of brown ridges up to 2 µm high with enforced points of interception and the spaces within filled with isolated spines, warts or short ridges. Paraphyses frequent, septate, subcylindrical, simple or branched near the base, hyaline, 4–6 μm thick, not or scarcely enlarged at the tip, not embedded in mucus, containing a few large vacuoles with lipoids. Mycelium hyaline, cylindrical, branching monopodially, without conidia or spermatia.

HABITAT.—On dung of dog, wolf, rabbit, goat, rat, and *Cerdocyon thous*.

ETYMOLOGY.—From Greek μικρος, small and σκοπειν, to observe, to examine: so minute as to be invisible without the use of a microscope.

ILLUSTRATIONS.—van Brummelen *in* Persoonia **10**: 118 f. 10. 1978 (E.M.); van Brummelen *in* Ascomycete Systematics (ed. Reynolds). Chapt. 3: 34 f. 3.10.1981 (E.M.); Claussen *in* Bot. Ztg. **63**: pls. 1–3. 1905 (very good, as *Boudiera*); Crouan *in* Annls Sci. nat. (Bot.) IV **7**: pl. 4E fs. 20–23. 1857 (not very characteristic, as *Ascobolus microscopicus*); Hennings *in* Hedwigia **42** (Beibl.): (182) fs. I–III. 1903 (as *Boudiera claussenii*); Le Gal *in* Revue Mycol. **14**: 95 f. 4. 1949; Merkus *in* Persoonia **7**: pls. 28c, 29, 30, 32, 34–36. 1973 (E.M.).

MATERIAL EXAMINED.—GREAT BRITAIN: culture, Edinburgh, Scotland, *s. dat.*, *Richardson s.n.* (L).

FRANCE: on dog dung, Bois de Boulogne [near Paris], VII.1901, *Rolland* (FH–A3079); idem, VIII.1901 (PC–A2247).

GERMAN FEDERAL REPUBLIC: on dung of rabbit and cultured, Freiburg, Baden, *s. dat.*, *Claussen* (comm. P. Hennings), in Rehm, Ascom. 1526 (type distribution of *Boudiera claussenii*; BPI, HBG; K, M, MPU, PAD, S, W, ZT); idem, VIII.1903, *Claussen*, in Sydow, Mycoth. germ. 132 (*Boudiera claussenii*); BPI, E, K, M, MPU, S, U, W, ZT).

GERMAN DEMOCRATIC REPUBLIC: culture isolated from dung, 'Wilder Graben', Weimar, 20.V.1975, *G. Arnold m 424* (CBS).

LIBYA: on goat dung (Comm. Dr. H. O. Sleumer), near Tripoli, 3.VIII.1971, *van Brummelen 3292* (L); idem, 9.VIII.1971, *van Brummelen 3297* (L).

CANADA: on dog dung, Nashville, York Co., Ontario, 12.XII. 1959, *Cain* (TRTC 35293); on wolf dung, Shabotic River, Algoma District, Ontario, 20.VI.1961, *Cain* (TRTC 38512).

U. S. A.: culture isolated from rat dung, Los Angeles Co., California, IV.1961, *Orr 0–523* (CBS 124.61); on dog dung, Cambridge, Massachusetts, *s. dat.*, Thaxter (FH–A3152); idem (FH–A3154); on dog dung, New Haven, Connecticut, *s. dat.*, *Thaxter* (FH–A3155).

VENEZUELA: on dog dung, N. of Maraval, along Rio Aguas Calientes, Edo. Sucre, 8.VII.1972, *Dumont VE 4338b* (ascospores only; as *Ascodesmis caninus*, TRTC).

BRAZIL, on dung of *Cerdocyon thous* (comm. Dr. A. C. Batista), Recife, isolated [by *Obrist*] III.1960. (TRTC 35597).

The name of this species has been variously misapplied until Le Gal (*1949*) gave a description of the type specimen. In general *A. microscopica* was confused with *A. nigricans* by European authors (Saccardo, *1889;* Schroeter, *1893;* Massee, *1895*) and with *A. sphaerospora* by American authors (Seaver, *1916, 1928;* Meyer & Meyer, *1949*).

Cavara (*1905*) already presumed that *Boudiera claussenii* Henn. belongs to the genus *Ascodesmis*. This is confirmed by a study of the type material. Henning's name is a synonym of *A. microscopica*.

Ascodesmis reticulata Bainier (*1908*) with ascospores measuring 15 × 11 μm and a brown or blackish net-work is certainly a synonym of *A. microscopica*.

The present species was apparently not known to Obrist (*1961*), who did not report any collection and refered to Le Gal's (*1949*) description. Some of the collections which he included in *A. sphaerospora* proved to be typical representatives of *A. microscopica*. Both are certainly closely related but can be maintained as separate taxa at the specific level.

The ascospores in *A. microscopica* are more ellipsoid with a mean length/breadth ratio over 1.2 while the net-work of the ornamentation is rather irregular and often incomplete. In *A. sphaerospora* the shape of the ascospores is subglobular, rarely perfectly spherical, with a mean length/breadth ratio under 1.15, while the net-work of the ornamentation is more regular and complete.

Ascodesmis microscopica, which is also recorded from Taiwan (Liou & Chen, *1977*), is a cosmopolitan species.

6. ASCODESMIS SPHAEROSPORA Obrist—Fig. 6

Ascodesmis microscopica (Crouan) Seaver sensu Seaver *in* Mycologia **8**: 3, pl. 72 fs. 1–5. 1916 (non sensu Crouan). — *Ascodesmis sphaerospora* Obrist *in* Can. J. Bot. **39**: 948. 1961 (nomen novum). — Type: on dung of raccoon dog, Bronx Zoological Garden, New York, U.S.A., XI.1915, *Seaver* (NY–A1066).

Apothecia solitary or gregarious, often confluent, superficial or partly immersed, sessile, (80–)110–230 µm diam., 90–120 µm high, at first hyaline becoming brownish with maturity, obconical, then semiglobular and more flattened, consisting of a bundle of 5–20(–50) asci surrounded by paraphyses. Hymenium convex dotted by the brown ends of protruding ripe asci. Hypothecium scarcely differentiated, consisting of a few strongly intermingled thin-walled, short-celled hyphae, (5–)7–9 µm wide. Excipulum absent. Asci cylindric-clavate or oblong, with a broad often curved stalk, rounded above, with a very large operculum 15–20 µm wide, (60–)70–95(–100) × (26–)29–33(–34) µm, 8-spored. Ascospores irregularly arranged, globular, subglobose to broadly ellipsoid (lenght/breadth ratio (1.05–)1.10–1.20(–1.26), average (1.05–1.15) at first hyaline, brown at maturity, (10.5–)11.5–13.0(–14.0) × (9.0–) 10.0–11.5(–12.0) µm (without ornamentation), without oil globules or granules; ornamented with a more or less regular net-work of ridges and more prominent spines (up to 1.8 µm high) at the points of interception and the spaces within filled with isolated spines and short ridges. Paraphyses rather frequent, septate, cylindrical, simple or branched at the base, hyaline, 2.7–4.8 µm thick, enlarged up to 6.0 µm at the tip, not embedded in mucus, vacuoles with lipoid substance and granules. Mycelium hyaline, cylindrical, branching monopodially, without conidia or spermatia.

HABITAT.—On dung of lion, tiger, jaguar, American ocelot, *Cerdocyon thous*, dog, racoon-dog, rabbit, elk, and giraffe, also isolated from soil and from a trickling-filter.

ETYMOLOGY.—From Greek σφαιρα, a ball, a globe and σπορα, a seed: with spherical spores.

ILLUSTRATIONS.—Brenner & Carroll *in* J. Bact. **95**: 660–669 fs. 1–44. 1968 (E.M.); Delattre-Durand & Janex-Favre *in* Bull. Soc. mycol. Fr. **95**: 53–59 pls. 1–4. 1979 (development, as *A. microscopica*); Moore *in* Nova Hedwigia **5**: pls. 38–43. 1963 (E.M.); Obrist *in* Can. J. Bot. **39**: 949 fs. 2–9. 1961; O'Donnell *& al.* *in* Can. J. Bot. **54**: 573–576 fs. 1, 2, 5–8, 11–14. 1975 (development, S.E.M.); Samuelson *in* Am. J. Bot. **65**: 752 fs. 9–16. 1978 (E.M.); Seaver *in* Mycologia **8**: pl. 172 fs. 1–5. 1916 (as *A. microscopica*); Seaver, North Am. Cup-fungi (Operc.) pl. 5 fs. 1–5. 1928 (as *A. microscopica*); Swingle *in* Am. J. Bot. **21**: pls. 1, 2. 1934 (cytology, as *A. nigricans*).

MATERIAL EXAMINED.—THE NETHERLANDS: on giraffe dung, Zoological Garden, Amsterdam, 1.VII.1959, *van Brummelen 693* (L); on lion dung, Zoological Garden, Amsterdam, 16.IV.1970, *van Brummelen 2762* (L, also as culture).

GERMAN DEMOCRATIC REPUBLIC: on dung of wild bear (?; Comm. H. Sydow), Tamsel, Brandenburg, 6.XII.1935, *Cain* (TRTC 34710).

CANADA: on dung of carnivore, W. of Manitouwadge, Thunder Bay Dist., Ontario, 18.VI.1963, *Cain* (TRTC 44832); culture isolated from soil, Winnipeg, III. 1973, *J. Reid* (CBS 394.73).

U. S. A.: on elk dung, near Elwha River, Olympic National Park, Clallam Co., Washington,

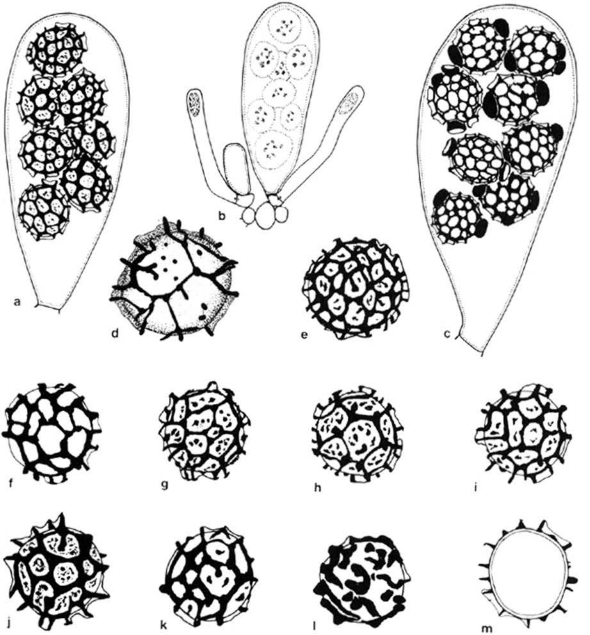

Fig. 6. *Ascodesmis sphaerospora*. — a, c. Asci with mature ascospores × 1000. — b. Young ascus and paraphyses × 1000. — d–l. Ascospores × 1600 (in l a rather aberrant type of ornamentation). — m. Ascospore in optical section × 1600. (a from *van Brummelen 2762*, L; b, c from culture 548, Mycothèque PC; d from *van Brummelen 693*, L; e–m from *W. B. Cooke*, 27.VI.1955, TRTC 35288.)

21.VIII.1962, *Cain C.1849* (TRTC 48381); isolated from trickling filter, Dayton, Montgomery Co., Ohio, 27.VI.1955, *W. B. Cooke* (TRTC 35288); idem, VI.1955, *W. B. Cooke 131E* (TRTC 32093; PC–A2250, sent to Madame Le Gal by R. F. Cain; culture 548 in Mycothèque, PC); on dog dung, Cambridge, Massachusetts, II.1887, *Thaxter* (FH–A3153); on dog dung, Cambridge, Massachusetts, I.1891, *Sturgis* (NY–A1067, NY–A1068, NY–A1069, TRTC); idem, III.1891 (NY–A1070, TRTC); culture, Cornell Univ., Ithaca, New York, III.1961, *R. T. Moore* (CBS 125.61, CUP 45103, ATCC 13978, BPI); on Jaguar dung, New York City, VII.1909, *Seaver* (NY–A1071, TRTC); on tiger dung, VII.1909, *Seaver* (NY–A1072); on Racoon-dog dung, Zoo (Bronx, N.Y.), XI.1915, *Seaver* (NY–A1066, TRTC; type of *Ascodesmis sphaerospora*); culture isolated from rabbit dung, Waco, Texas, 1962, *W. G. Fields* (CBS 440.74).

BRAZIL: on dog dung, Dois Irmãos, Recife, Pernambuco, 15.XII.1947, *Pontual* (URM–A284); on jaguar dung (Comm. Dr. A. C. Batista), Recife, *s. dat* [*Obrist*] (TRTC 35535); on dung of *Cerdocyon thous* (Comm. A. C. Batista), Recife, III.1960 [Obrist] (TRTC 35593); on dung of American ocelot (*Felios pardalis*) (Comm. A. C. Batista), Recife, *s. dat.* [*Obrist*] (TRTC 35598).

When Seaver (*1916*) published his study on North American species of *Ascodesmis*, he thought that he had recognized *Ascobolus microscopicus* Crouan and placed it in the genus *Ascodesmis* with *Ascodesmis nigricans* as one of the synonyms. Later studies of the type specimen of *Ascobolus microscopicus* by Le Gal (*1949*) revealed that Seaver had misapplied Crouan's name. Unfortunately, Le Gal did not handle the problem in accordance with the 'International Code of Botanical Nomenclature'.

Obrist (*1961*: 948) introduced a new name ('nom. nov.') for *Ascodesmis microscopica* (Crouan) Seaver sensu Seaver. In fact, he considered *Ascodesmis microscopica* (Crouan) Seaver to be an inacceptable homonym of '*Ascodesmis microscopica* (Crouan) Le Gal' [=*Ascodesmis microscopica* (Crouan) Seaver sensu Crouan, sensu Le Gal]. In consequence of this, *A. sphaerospora* is typified by the original specimen studied by Seaver. This is one of the two specimens Obrist indicated as type.

Ascodesmis sphaerospora has been the object of many investigations on development, cytology, genetics, and ultrastructure, e.g. by Swingle (*1934*; as *A. nigricans*), Carroll (*1967*), Brenner & Carroll (*1968*), O'Donnell *& al.* (*1976*), Samuelson (*1978*), Delattre-Durand & Janex-Favre (*1979*; as *A. microscopica*).

The present species would appear to be very close to *A. microscopica*, differing only in the subglobular or spherical shape of the ascospores and the more regular net-work of the spore ornamentation.

In this species, the variability in shape and ornamentation of the ascospores is sometimes rather conspicuous. Especially in cultures which have been growing for many generations on artificial media, aberrations may have accumulated. Such a case is found in culture No. 548 of the 'Mycothèque' of the Laboratoire de Cryptogamie in Paris, which was originally isolated, cultured and distributed by W. B. Cooke. The ornamentation of the ascospores is very strongly developed here. Therefore the reticulum may be changed, in the most extreme case, into a single more or less complete layer of vesicles. Such ascospores often show subapical thickenings up to 5 μm high (see Fig. 6c and Delattre-Durand & Janex-Favre, *1979*: 59 pl. 4C, E).

Ascodesmis sphaerospora is also recorded from Taiwan (Liou & Chen, *1977*). It seems to be a cosmopolitan species.

For its delimatation against *A. microscopica*, see under that species.

INSUFFICIENTLY KNOWN AND EXCLUDED SPECIES

The following species have been referred to *Ascodesmis* or were, at some time or other, considered to be related to this genus. These species are either excluded because they do not answer to the present concept of *Ascodemis* or they are doubtful on account of the lack of sufficient descriptions and adequate material.

aurea. — *Ascodesmis aurea* Tiegh. *in* Bull. Soc. bot. Fr. **23**: 275. 1876. — Type: not known to be in existence. — Type locality: France.

Van Tieghem (l.c.) gives only a short and very fragmentary description of this species. He merely compares some characters of it with *A. nigricans*, which is more fully described. The fruit bodies are very small, golden yellow and the ascospores are spherical, only 6 µm across with an ornamentation of more strongly coloured golden yellow dots.

According to Dangeard (*1910*: 247) *A. aurea* is only a young *A. nigricans* in which the fruit bodies have not yet attained their definitive brown colour. This supposition, however, is very unlikely since young ascospores in *Ascodesmis* are not considerably smaller than mature ones while the pigment of the spore ornamentation is brown and manifests only very shortly before maturity.

The original description could even include some members of the Gymnoascaceae.

Because of the very insufficient description and the lack of material *A. aurea* should be regarded as a nomen dubium.

brachyascus. — *Lasiobolus brachyascus* March. *in* Bull. Soc. R. bot. Belg. **24**: 73. 1884. — *Cubonia brachyasca* (March.) Sacc., Syll. Fung. **8**: 527. 1889. — Type: not known to be in existence. — Type locality: Werbomont (Liège), Belgium.

The type specimen of this species is neither preserved in the Marchall herbarium at Meise (BR), Gembloux nor in the Saccardo herbarium at Padua (PAD).

Lasiobolus brachyascus was selected as type of the genus *Cubonia* Sacc. by Clements & Shear (*1931*). Other species of *Cubonia*, like *Cubonia dentata* Boud. and *C. hyracis* Faurel (cf. Durand, *1973*), with a strongly developed receptaculum, an excipulum and flesh, and cleistohymenial ascomata opening in the mid-meso-hymenial phase, do certainly not belong to the same genus, and should probably be placed among the 'Ascophani' with spherical ascospores.

Cubonia boudieri (Renny apud Phill.) Sacc. proved to be a synonym of *Ascobolus brassicae* Crouan (van Brummelen, *1967*: 91).

Seaver (1928) inserted *Cubonia* in his 'North American Cup-fungi' but had not seen any typical material.

Bezerra & Kimbrough (*1975*) in their monograph of the genus *Lasiobolus* Sacc. did not accept *C. brachyasca* in this genus.

The following characters might suggest an eventual relationship of *C. brachyasca* with *Ascodesmis* (van Brummelen, *1967*): (1) the small fruit bodies (120–200 µm diam.), (2) the obovoid-pyriform, protruding asci (40–45 × 19.5–21.5 µm) not staining blue with iodine, (3) the spherical ascospores (8.8–9.2 µm diam.), roughened with small dots, and (4) the growth on dog dung. However, the presence of an excipulum clothed with long hyaline hairs, strongly curved paraphyses and hyaline ascospores are contrary to such a relationship.

Until material of this species is found again, *Cubonia brachyasca* and *Cubonia* will remain doubtful names.

canina. — *Ascodesmis canina* Jeng & Cain *in* Mycotaxon **3**: 392, fs. 1–14. 1976. — Holotype: *Dumont & al. VE-4338b* (TRTC).

This fungus shows a relatively well-developed receptaculum with an excipulum of textura prismatica or porrecta (cf. Jeng & Cain, l.c.: f. 2). Young ascospores are hyaline and surrounded by a gelatinous layer.

The pigment is present in an almost continuous, rather uniform, 0.7–1.3 μm thick layer of

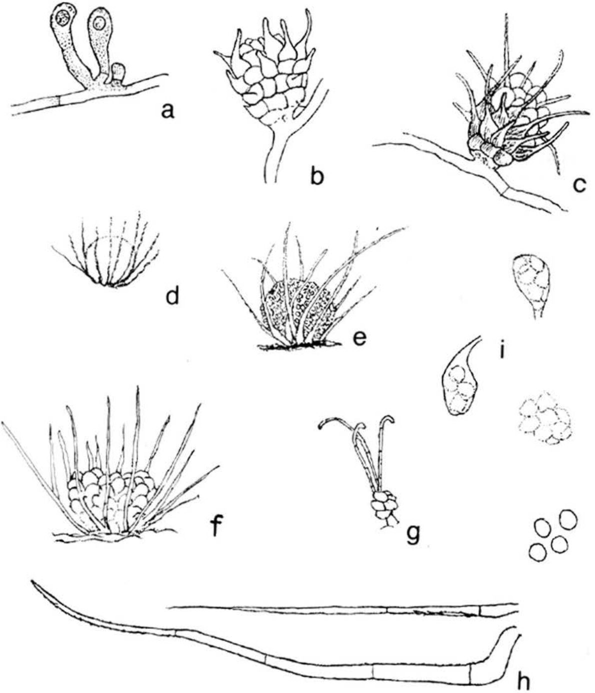

Fig. 7. *Ascodesmis volutelloides*. — a. Initials. — b–c. Young fruit bodies. — d–f. Fruit bodies. — g. Paraphyses. — h. Hairs. — i. Asci and ascospores. (Redrawn after original drawings in Massee herbarium, NY.)

brown granules. Only incidental holes, pores, and small fissures occur in this layer, giving the secondary wall of mature ascospores a more or less perforated aspect.

This type of ornamentation and pigmentation are characteristic of *Ascobolus* Hooker per Pers. The paragymnohymenial ascomata, the texture of the excipulum and the shape of the asci show its relationship with *Ascobolus* sect. *Pseudascodesmis* Brumm.

The new name **Ascobolus perforatus** Brumm., *nom. nov.*[1] is proposed for this species.

volutelloides. — *Ascodesmis volutelloides* Mass. & Salmon *in* Annls Bot. **16**: 61, pl. 4 fs. 13–17. 1902. — Type: not known to be in existence. — Type locality: Kew, England.

Besides the published illustrations of this species, a series of drawings are preserved in the Massee herbarium (NY). These drawings give a more complete picture of the development of the fruit bodies but are insufficient in the details of asci and ascospores (Fig. 7).

In certain characters, this fungus resembles *Ascodesmis*, e.g. in: the small fruit bodies (*c.* 150 μm diam.), (2) the pyriform to oblong asci (28–35 × 14–16 μm), and (3) the spherical ascospores (10 μm diam.). Other characters, however, like the presence of (1) long seta-like, septate hairs on the outside, (2) hyaline or pale straw-coloured ascospores, (3) curved, evanescent paraphyses, and (4) the development of fruit bodies only after some months, are contrary to a position in that genus.

The asci are probably not operculate. A certain similarity is observed with *Cubonia brachyasca* (see above) and both might very well be congeneric.

A position of *A. volutelloides* in the Gymnoascaceae, as proposed by Massee & Salmon (l.c.), is not unlikely.

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[1] Basionym: *Ascodesmis caninus* Jeng & Cain *in* Mycotaxon **3**: 392. 1976; not *Ascobolus caninus* Fuckel *in* Hedwigia **5**: 3. 1866 not *Ascobolus caninus* Auersw. *in* Hedwigia **7**: 52. 1868.

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 359–368 (1981)

NOTES ON THE GENUS PSATHYRELLA—VII

Psathyrella longicauda versus Psathyrella atrolaminata (= P. melanophylla pr. p. maj., excl. type)

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The name *Psathyrella melanophylla* proposed in our previous paper (*1976*: 370) to replace the misapplied name *P. caudata*, is in its turn replaced by the name *atrolaminata* as a result of the discovery that in our previous paper a collection belonging to *P. longicauda* had erroneously been selected as the type of *P. melanophyllum*, which renders the latter name a synonym of *P. longicauda*. It is argued that Ricken's plate 68 fig. 1 (*1913*) does not represent *P. atrolaminata* as erroneously stated by Kühner & Romagnesi (*1953*: 359) and us (*1976*: 370) but *P. longicauda*. A redescription of both species is given.

In our previous paper (*1976*: 370) we argued that *Psathyrella caudata* sensu Lange, Kühner & Romagnesi, Moser was a misapplied name for a well known, be it rare species, reason why we proposed the name *P. melanophylla* for that species. Unfortunately there was among the material on which we based our description of *P. melanophylla* one collection of which we now realise that it represents *P. longicauda*. We even designated that collection the type specimens of *P. melanophylla*. The explanation of our mistake is that we were misled by the fact that of that collection (16 Oct. 1963) the gills were very black — as they occasionally can be in *P. longicauda* — and had a white edge (both characters constant in *P. atrolaminata*) while overlooking the conspicuously long pseudorrhizae of the carpophores (see Kits v. Waveren, *1976*: 349, fig. 3). The error necessitates proposing a new name for this species, which we have now come to call *P. atrolaminata*. We designate the specimens of our collection from 'Het Naaldenveld', 28 Oct. 1980 as type specimens of *P. atrolaminata*. We discovered that both Kühn. and Romagn. (*1953*: 359) and we (Kits v. Waveren, *1976*: 370) wrongly quoted Ricken's plate 68 fig. 1 (*1913*) as representing *P. atrolaminata*, whereas obviously it depicts *P. longicauda*.

For our methods of examining the basidiocarps both macro- and microscopically the reader is referred to our previous papers (Kits van Waveren, *1971*: 249, *1972*: 24, *1976*: 346). Spore sizes are given as a range with mean values (of each collection always 20 spores were measured) added between brackets together with the number of collections examined. For the description of the colours of the macro- and microscopic structures 'Munsell Soil Color Charts', editions 1954 and 1971, and their code designating the colours, were used (abbreviation: Mu.). In the lists of collections examined the author's, name is abbreviated to E. K. v. W.

In the present study an attempt is made to unravel the confusing interpretations of *P. longicauda* and *P. atrolaminata*. The latter name we now give to the species known in the literature as *P. caudata* (Fr.) Quél. A brief recapitulation of the reasons for this renaming needs to be given. Kühner & Romagnesi rightly stated in a note (*1953*: 371, note 4) that Fries' *Agaricus caudatus* differs from their *Drosophila caudata* in that the cap of Fries' plant turns pink on drying, is very fragile, splits in rainy weather and is deliquescent, to which might have been added that according to Fries the growth is not caespitose and — most important of all — the gill edge is red. Fries (*1821*: 299) regarded his *A. caudatus* as a large variety of *A. gracilis* (described by him as having a red gill edge) and for a full description he referred to his description of *A. caudatus* in his Observationes (*1818*: 187), in which the gills are said to have a 'margine roseae'. Also, in Fries' Epicrisis (*1838*: 239) *A. prona* is said to have a red gill edge as the preceding species, which is *A. caudatus*. The colour of the gill edge is not mentioned in his later publications in all of which, however, Fries referred to his 1818 description.

We have three reasons for coming back to our earlier (*1976*: 366–370) descriptions of *P. longicauda* and *P. atrolaminata* (= *P. melanophylla* pr. p. maj., excl. type).

(i) A. H. Smith (*1972*: 334), claiming having seen only two collections of what he called *P. caudata*, believes that *P. longicauda* is possibly the same as *P. caudata*, whereas Kühner & Romagnesi (*1953*: 359) distinguish these two species; this controversy needs a solution.

(ii) Misled by the rather dark greyish black colour of the gills (this colour printed bold face by Kühner & Romagnesi as the essential character of their *Drosophila caudata)* of the ten specimens of our 1963 (Oldenzaal) collection, we wrongly (as we now realise) named them *Psathyrella caudata* in 1963 and *P. melanophylla* instead of *P. longicauda* in our 1976 paper. We overlooked the trace of brown in the colour of the gills and above all ignored the excessive length of the pseudorrhizae. This grave error urgently required rectification.

(iii) In 1980 we had the good fortune of finding excellent collections of both species, casting new light on both.

Karsten (*1891*: 298) gave an excellent description of his longicauda in which the main points are: cap 15 mm broad, veil present, stem 30 mm long and strongly rooting ('eximie radicatus'), the pseudorrhiza twice as long as the stem (which comes to 60 mm!), gills at first whitish grey, then 'purpurascente atrae', gill edge white, spores bay ('badius'), opaque or semi-opaque, 13–16 × 7–9 µm, pleurocystidia fusoid, 55–60 × 15 µm. According to Karsten the species differed from *P. gracilis* by its white gill edge, pseudorrhiza and darker and slightly larger spores. No mention is made of any brown colour in the gills and of a germ pore, neither of two characters which are typical of *P. atrolaminata*, viz. caespitose growth and revolute marginal area of the cap.

Karsten's species has received very little acknowledgement in the literature. It is only mentioned by Massee (*1902*: 218) who copied the main points from Karsten, calling the stem 'remarkably rooting'; by Konrad & Maublanc (*1928*: 77), whose verdict was that the species is little known, doubtful and to be excluded; by von Schulmann (*1960*: 70), who gave a very brief description; by Moser (*1978*: 268), whose brief description, adopted from Kühner & Romagnesi, is in small print, meaning that the species is rare or only known from a limited area; finally by Kühner & Romagnesi (*1953*: 359) and by Malençon & Bertault (*1970*: 186). With the latter authors the pseudorrhiza is very short, only 10–20 mm, the marginal area of the cap distintly revolute, the gill edge neither white nor red but yellowish cinnamon, the germ pore very distinct and even truncate and the cheilocystidia utriform (their figure shows three lageniform cells with a fairly thick short neck without a subcapital constriction), so that their description reminds more of *P. caudata* sensu auct: *P. atrolaminata*.

Ricken and Lange never mentioned the species and Ricken's (*1913*: 265) description of what he called *P. caudata* and above all his plate 67 fig. 1 beautifully agrees with *P. longicauda*. Kühner & Romagnesi (*1953*: 359) and we (*1976*: 370) wrongly quoted this plate for *P. atrolaminata* instead of for *P. longicauda*.

Kühner & Romagnesi (*1953*: 359) and we (*1976*: 370) unfortunately contributed to the confusion around *P. longicauda* and *P. atrolaminata*. Thanks to a recent (1980) collection, typical of *P. longicauda*, and two recent (also 1980) collections typical of *P. atrolaminata* in addition to our previous collections of both species, we now have a clear insight in these two closely related and rare species. As a result our Oldenzaal collection (16 Oct. 1963) at that time named *P. caudata* and in our previous paper (*1976*: 370) *P. melanophylla* had to be reidentified as *P. longicauda*. From all our material we learned that there are no real microscopical differences between the two species. *Psathyrella longicauda* is characterised by its excessively long pseudorrhiza (30–70 mm and in the young specimens from our 11 Nov. 1969 collection just as long as the stems), its non-revolute margin of the cap and (slightly) pigmented gill trama (to be studied on the 'washed' gill and under the microscope). *Psathyrella atrolaminata* is characterised by its black gills, very short pseudorrhiza (*c.* 10 mm) practically coulourless hymenophoral trama and above all by its revolute marginal area of the cap. It should be realised, however, that only at maturity the cap reaches its characteristic shape. The spores for both species are exactly the same, very dark and thus masking the slight pigmentation of the gill trama in *P. longicauda* so that the colour of the gills in both species is black with only a trace of brown or purple in *P. longicauda*, easily escaping attention (as it did in our 16 Oct. 1963 collection).

Kühner & Romagnesi (*1953*: 359) to a certain extent gave a misrepresentation of the two species. Their description suggests too much that *P. atrolaminata* (= *Drosophila caudata* with them) has grey-black gills as opposed to *P. longicauda*, which in their key is ranked under the heading 'gills tinged brown (tobacco) or purple'. Karsten himself did not mention brown in his description of the colour of the gills in *P. longicauda*, which he called 'purpurascente atrae'. Kühner & Romagnesi mentioned the occurrence of concentric zones of slightly different colour in the drying cap only for *P. atrolaminata*, whereas we clearly saw these zones also in our 1963 collection of *P. longicauda*. Next Kühner & Romagnesi only mentioned for *P. atrolaminata* that the spores are very dark and have a 'tout petit pore'. Romagnesi (in litt.) explained, that this description did not refer to the width of the pore but to the pore being 'bas et peu tronquant', in other words low and indistinct (because the spore wall is very thin and very dark). We found both the spores and their pore to be exactly the same for both species. Romagnesi (in litt.) expressed his doubts about the importance of the indistinctness of the wide germ pore. Although it is a striking character in the two species we are inclined to share his view, as in one of our collections of *P. longicauda* (21 Oct. 1980) and in two of *P. atrolaminata* (21 and 28 Oct. 1980) the pore was distinct. But in all three collections almost all spores were not dark reddish brown but merely brown and thus very likely immature. For the size of the pleurocystidia Kühner & Romagnesi gave practically the same figures for both species, so that it is confusing that only for *P. atrolaminata* these cells were called 'sveltes'. We found both size and shape of these cells to vary considerably in both species; they usually are provided with a more or less long and narrow (4–5 µm) neck and usually indeed are slender.

Before giving below renewed descriptions of both species, we must draw attention of the reader to the fact that in our 1976 description fig. 6 (p. 353) and the coloured plate 62 indeed depict *P. longicauda*, but that regrettably the basidiocarps depicted in fig. 3 (p. 349) and the marginal cells and pleurocystidia depicted in figs. 29 and 30 (p. 371) also pertain to *P. longicauda* and not to *P. melanophylla* (= *P. atrolaminata*) as stated on these pages.

Psathyrella atrolaminata Kits van Wav., *spec. nov.*—Figs. 1–11

Pileus primo 10–20 mm latus, ellipsoideus vel conico-paraboloideus, castaneus, mox fuscescens; deinde 20–40 mm latus, obtuso-conicus sive conico-campanulatus, ambitu revoluto, brunneus, at centro badio-brunneus, 2/3 striatus, hygrophanus, pallide brunneus, centro ochraveo-fulvus, haud vel raro paululum roseus, micaceus, rugulosus. Velum album, primo pilei marginem obtegens sed fugax. Lamellae 2–5 mm latae, ventricosae, late adnatae, cinereae, demum atrae; acie alba. Stipes 50–60(–75) × 1–1.59–2) mm, rectus, albus, deorsum isabellinus, radicans (pseudorrhiza brevis, *c.* 10 mm). Caro fusca in pileo, albida in stipite. Sporae in cumulo atrae.

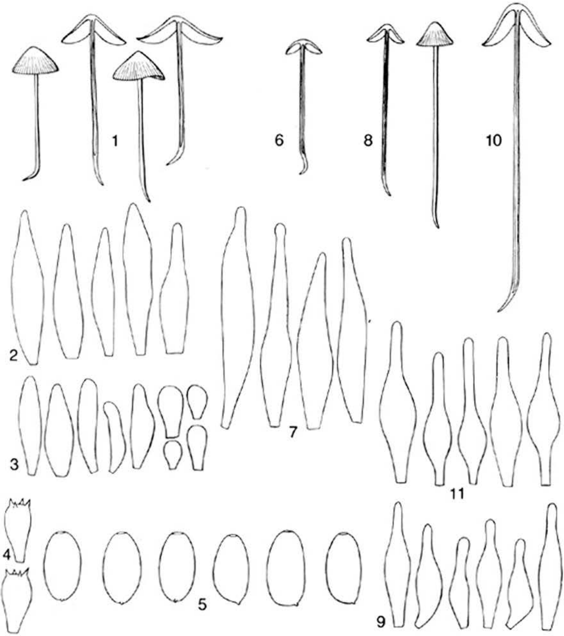
Sporae 10.8–14.4 × 6.3–7.7 µm, ellipsoido-amygdaliformes, in aqua observata castaneae, opacae, poro germinativo tenui sed lato (1.8–2 µm). Basidia 22.5–32.2 × 10–12.8 µm, 4-sporigera. Pleurocystidia 35–82.5 × 9–15(–17.5) µm, pauca, lageniformia-pedicellata, collo cylindraceo vel subcylindraceo vel subfusoideo, interdum gracili, apice acute vel subacuto, tenui-tunicata. Cellulae marginata: cheilocystidia pleurocystidioidea haud numerose, 22.5–55 × 6–15 µm, cellulae spheropedunculatae et clavatae 10–27.5 × 7.5–12.5 µm. Trama lamellarum incolor vel fere incolor. Cuticula pilei cellularis. Cespitosa vel subcespitosa vel interdum isolata, terrestris ad lignum. Typus: 'The Netherlands, prov. North Holland, Aerdenhout, estate 'Het Naaldenveld', 28 Oct. 1980, *E. K. v. W.*' (L).

MISAPPLICATIONS.—*Psathyra caudata* (Fr. ex Fr.) J. E. Lange sensu Lange, Fl. agar. dan. **4**: 99, pl. 155A. 1939. — *Drosophila caudata* (Fr. ex Fr.) Kühn. & Romagn. sensu Kühn. & Romagnesi, Fl. anal. 359. 1953. — *Psathyrella caudata* (Fr. ex Fr.) Quél. sensu Hennig in Michael/Hennig, Handb. 268 Pilzfr. **4**: 280, fig. 278. 1967; sensu Moser in Gams, Kl. KryptogFl. **2**(b2): 268. 1978 (spore size excluded); non *Agaricus caudatus* (Fr. ex Fr., Epicr. 239. 1838 (= form of *P. gracilis*). — *Psathyrella melanophylla* Kits van wav. *in* Persoonia **8**: 370. 1976 (pr. p., excl. type).

SELECTED DESCRIPTIONS AND ILLUSTRATIONS.—J. E. Lange, Fl. agar. dan. **4**: 99, pl. 155 A, 1939 (as *Psathyra caudata*); Kühn. & Romagn. Fl. anal. 359. 1953 (as *Drosophila caudata*); Cooke, Ill. Brit. Fungi **4**: pl. 622/596, 1884–1886 (as *Agaricus microrrhizus*) and **5**: pl. 639/637. 1886–1888 (as *Agaricus caudatus*).

CHIEF CHARACTERISTICS.—Caespitose, subcaespitose or sometimes solitary; cap 10–40 mm, conico-campaulate, margin at maturity revolute; veil rudimentary; gills broadly adnate conspicuously dark grey to black, with white edge; stem rooting (pseudorrhiza short, *c.* 10 mm); spores 10.8–14.4 × 6.3–7.7 µm (mean values 11.6–13.5 × 6.1–7.3 µm), with indistinct but wide (1.8–2 µm) germ pore, very dark reddish brown; pleurocystidia 35–82.5 × 9–15(–17.5) µm, lageniform-pedicellate with subcylindric to cylindric narrow neck or subfusoid to subcylindric; pleurocystoid cheilocystidia scattered among abundant spheropedunculate cells; hymenophoral trama practically colourless.

MACROSCOPICAL CHARACTERS.—Cap at first ellipsoid conical or conical-paraboloid, 10–20 mm broad, dark reddish brown (Mu. 5YR 3/3, 3/4) later 20–40 mm broad and obtusely



Figs. 1–11. *Psathyrella atrolaminata*. — 1–5. 28 Oct. 1980. — 1. Habit sketch (× 1). — 2. Pleurocystidiogram (×575). — 3. Cheilocystidiogram (×575). — 4. Basidia (×575). — 5. Spores (×1212). — 6–7. 21 Oct. 1980. — 6. Habit sketch (×1). — 7. Pleurocystidiogram (×575). — 8–9. 19 Sept. 1964. — 8. Habit sketch (×1). — 9. Pleurocystidiogram (×575). — 10–11. 18 Oct. 1974. — 10. Habit sketch (×1). — 11. Pleurocystidiogram (×575).

conical, spreading to conical-campanulate, finally with distinctly revolute margin; in central half reddish brown (Mu. 5 YR 4/3, 4/4), the periphery brown or greyish brown (Mu. 10 YR 5/3), extreme margin sordid white; striate up to 2/3 from margin, hygrophanous, drying to pale ochreous brown (Mu. 7.5 YR 7/6) at centre, pale brown (Mu. 10 YR 7/3) in the middle, very pale brown (Mu. 10 YR 8/2) near margin, sometimes pale greyish brown all over, rarely a trace of pink and occasionally with two or three concentric zones of slightly different shades of pale greyish brown (Mu. 10 YR 4/3, 4/2) or slightly purplish brown (Mu. 7.5 YR 5/2) appearing during the process of drying.

Veil leaving a few fugacious small white fibrils or wickerworks of fibrils on surface of cap near margin and on stem.

Gills 2–5 mm broad, at first only slightly ventricose, later — when margin of cap turns up — to strongly ventricose, broadly adnate with or without tooth, at first conspicuously grey (Mu. 10 YR 5/1), later via dark grey to finally black (Mu. 5 YR 4/1, 3/1) sometimes with a trace of purple; edge white and minutely fimbriate.

Stem 50–60(–75) × 1–1.5(–2) mm, straight, cylindric, white in upper part, isabelline lower down, hollow, rooting (pseudorrhiza short, up to 10 mm); apex pruinose; base strigose.

Flesh of cap at centre 1–1.5(–2) mm thick, dark brown (Mu. 10 YR 4/3), of stem in upper part white, lower down very pale brown but superficial layer whitish. Smell none.

Trama of 'washed' gill in NH_4OH 10% under binocular lens practically colourless (Mu. 10 YR 7/1, 7/2) from base to edge, rarely very pale brown all over (Mu. 10 YR 7/3, 7/4) or only in a narrow strip at the base.

Spore print black.

MICROSCOPICAL CHARACTERS.—Spores 10.8–14.4 × 6.3–7.7 μm (mean values of 4 collections 11.6–13.5 × 6.1–7.3 μm), in face view elliptic, in profile amygdaliform, in water very dark red-brown (Mu. 2.5 YR 3/2–3/4), opaque to subopaque, thin-walled; germ pore as a result usually inconspicuous but wide (1.8–2 μm); small hilar appendix.

Basidia 22.5–35.2 × 10–12.8 μm, 4-spored.

Pleurocystidia 35–82.5 × 9–15(–17.5) μm, few to very few in number, sometimes fairly numerous; shape variable, lageniform-pedicellate with cylindric to subcylindric narrow (4–5 μm) neck, or subfusoid to subcylindric, sometimes slender, with acute to subacute apex, thin-walled, colourless, without mucus or crystals.

Marginal cells: pleurocystoid cheilocystidia 22.5–55 × 6–15 μm, few in number to fairly numerous; spheropedunculate and clavate cells 10–27.5 × 7.5–12.5 μm, numerous; all cells thin-walled, colourless, without mucus or crystals.

Gill trama in NH_4OH 10% sub micr. practically colourless.

Pileipellis cellular; cells globose to subglobose, 20–40 μm in diam., colourless.

HABITAT & DISTRIBUTION.—Terrestrial and often caespitose in small groups or subcaespitose, but also isolated, against pieces of wood in deciduous woods, in ruderal places, humus, also in grass (parks). September–October. Rare. Known from The Netherlands, France, and British Isles.

COLLECTIONS EXAMINED.—THE NETHERLANDS: Overijssel, Delden, estate 'Twickel', 19 Sept. 1964, *E. K. v. W.* (L); Denekamp, estate 'Singraven', 18 Oct. 1974, *E. K. v. W.* (L); Noord-Holland, Aerdenhout, estate 'Naaldenveld', 28 Oct. 1980, *E. K. v. W.* (type L); Bloemendaal, estate 'Leyduin', 21 Oct. 1980, *E. K. v. W.* (L).

Psathyrella atrolaminata can easily be confused with *P. gracilis*. But for those who are familiar with the species of the genus *Psathyrella* and particularly *P. gracilis*, *P. atrolaminata* is conspicuous in the field by its very black gills and white gill edge, microscopically by its very dark spores and indistinct, though wide, germ pore. Ancillary characteristics are the habit (revolute margin of the cap, but this phenomenon is only present in matrue stages), absence of pink in the drying cap (rarely a trace of pink mixes with the other colours), presence of velar remnants (very fugacious), presence (but only sometimes) of concentric colour zones in the drying cap, a usually caespitose or subcaespitose growth. *Psathyrella longicauda* differs from *P. atrolaminata* above all by its very long pseudorrhiza and non-revolute cap, furthermore by its – particularly towards the base – slightly browner gills (which, however, in the field at first sight look back), the accordingly slightly pigmented gill trama. This species also may show concentric colour zones in the drying cap.

Of the species, described by Smith (*1972*: 334) under the name *P. caudata*, the colour of the gills is called 'pallid cinnamon-buff, soon dark greyish to purplish brown', the germ pore is said to be broad and even somewhat truncate and the species is not called caespitose and a veil is said to be lacking. Therefore *P. caudata* sensu Smith is not identical with *P. caudata* sensu Lange, Kühn. & Romagn., and Moser and consequently not with *P. atrolaminata*.

PSATHYRELLA LONGICAUDA P. Karst.—Figs. 12–20

Psathyrella longicauda P. Karst. *in* Hedwigia **30**: 298. 1891.—*Drosophila longicauda* (P. Karst.) Kühn. & Romagn., Fl. anal.: 359. 1953 (incomplete reference to basionym).

Psathyrella melanophyllum Kits van Wav. *in* Persoonia **8**: 370. 1976 (Pr. P., incl. type).

MISAPPLIED NAME.—*Psathyrella caudata* (Fr. ex Fr.) Quél. sensu Ricken, Blätterp.: 265, pl. 68 fig. 1. 1913.

SELECTED DESCRIPTIONS AND ILLUSTRATIONS.—Ricken, Blätterp. 265, pl. 68 fig. 1. 1913; Kühn. & Romagn., Fl. anal. 359. 1953; Kits van Wav. *in* Persoonia **8**: pl. 62. 1976 (description excluded).

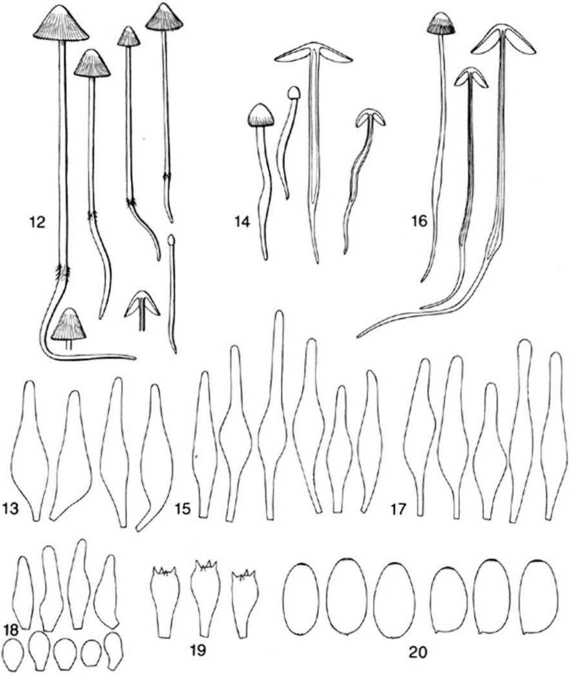
CHIEF CHARACTERISTICS.—Cap 15–30 mm broad, at first paraboloid, soon conical-paraboloid to conical, without revolute margin, dark reddish brown, later brown; veil distinct in primordia and very early stages, fugacious; gills broadly adnate, greyish black with a trace of brown, with white edge; stem strongly rooting (pseudorrhiza 30–70 mm long); spores 10.8–14.4 × 6.3–8.1 μm (mean values 12.1–13.5 × 6.3–7.6 μm), with indistinct but wide (1.8–2 μm) germ pore, very dark reddish brown; pleurocystidia 42.5–80 × 7.5–15(–17.5) μm, fusoid-pedicellate with fairly long subcylindrical neck; pleurocystoid cheilocystidia scattered among numerous spheropedunculate cells; hymenophoral trama moderately pigmented.

MACROSCOPIC CHARACTERS.—Cap in early stages (7–11 mm broad, 5–9 mm high) paraboloid, dark reddish brown (Mu. 5 YR 3/2, 3/3; 7.5 YR 3/2; colour of *Agrocybe erebia*), paler towards margin and at margin still paler (Mu. 10 YR 6/4), scarcely striate, smooth, later 15–30 mm broad, spreading to conspicuously conical or conical-paraboloid, the reddish brown colour making way for dark brown (Mu. 10 YR 3/2, 3/3) at centre, brown (Mu. 10 YR 4/3) towards the margin and near margin greyish brown (Mu. 10 YR 5/2) or both at centre and in marginal area brown (Mu. 10 YR 3/3, 3/4) with between these areas still reddish brown (Mu. 5 YR 3/3), with margin itself whitish, striate up to 1/2–2/3 from margin, hygrophanous, when drying remaining for a long time ochreous brown (Mu. 7.5 YR 5/6, 5/8), finally pale brown (Mu. 10 YR 7/2, 7/3, 7/4) with ochreous brown (Mu. 7.5 YR 6/6) centre, without pink, sometimes with vague concentric zones of different colourshades, sometimes micaceous, usually rugulose or even rugose.

Veil in primordia and early stages distinct, forming a conspicuous uninterrupted white collar connecting stem with cap with on surface of cap a zone of radially arranged fibrils reaching 1 mm from margin, very fugacious, absent at maturity.

Gills 2–3 mm broad, slightly ventricose or only ventricose near margin of cap and then straight, ascending, broadly adnate, usually protruding below margin of cap, at first near edge grey (Mu. 5 YR 5/1; 10 YR 5/1) with a trace of purple, the rest brownish grey (Mu. 10 YR 6/2, 5/2) with a trace of purple and at base slightly browner (Mu. 10 YR 6/3), finally dark purplish grey to black with a trace of brown; edge white and minutely fimbriate.

Stem in early stages 20–35 × 3 mm, strongly rooting (pseudorrhiza 15–30 mm), at matu-



Figs. 12–20. *Psathyrella longicauda*. 12–13. 16 Oct. 1963. — 12. Habit sketch (× 1). — 13. Pleurocystidiogram (×575). — 14–15. 11 Nov. 1969. — 14. Habit sketch (× 1). — 15. Pleurocystidiogram (×575). — 16–20. 21 Oct. 1980. — 16. Habit sketch (× 1). — 17. Pleurocystidiogram (×575). — 18. Cheilocystidiogram (×575). — 19. Basidia (×575). — 20. Spores (×1212).

rity 70–90 × 2–3 mm (pseudorrhizae 30–70 mm), tapering towards their ends; straight or slightly flexuous, remarkably firm, cylindric but base thickened (up to 4 mm), glossy, white, lower down sometimes isabelline, pruinose at apex.

Flesh of cap in centre 1–2 mm thick, dark brown (Mu. 10 YR 3/3, 4/3, 4/4), in stem also brown (Mu. 7.5 YR 5/4; 10 YR 5/3), but with white superficial layer.

Trama of 'washed' gill in NH_4OH 10% under binocular lens distinctly brown (Mu. 10 YR 6/6, 6/4, 6/3) in a narrow zone along base, for the rest pale brown (Mu. 10 YR 7/2).

Spore print purplish black to black.

MICROSCOPICAL CHARACTERS.—Spores 10.8–14.4 × 6.3–8.1 µm (mean values of 5 collections 12.1–13.5 × 6.3–7.6 µm), in face view elliptic, in profile amygdaliform, in water very dark reddish brown (Mu. 2.5 YR 3/2, 3/4), opaque to subopaque, thin-walled; germ pore wide (1.8–2 µm) but indistinct; hilar appendix small.

Basidia 25–30 × 9–15(–17.5) µm, 4-spored.

Pleurocystidia 42.5–80 × 7.5–15(–17.5) µm, few in number, pedicellate-fusoid with fairly long cylindrical to subcylindrical neck (4–5 µm broad) and acute to subacute apex, sometimes very slender, without mucus or crystals.

Marginal cells: pleurocystoid cheilocystidia 22.5–40 × 7.5–10(–12.5) µm, scattered to fairly numerous; spheropedunculate and clavate cells 10–30 × 5–15(–17.5) µm, numerous to densely packed; all cells thin-walled, colourless, without mucus or crystals.

Gill trama in NH_4OH 10% sub micr. distinctly yellowish brown to brown from membranal pigment at and near base, with yellowish hyphal septa and a few encrustations, for the rest very pale brown.

Pileipellis cellular; globose to subglobose cells 10–40 µm in diam., colourless.

HABITAT AND DISTRIBUTION.—Terrestrial; isolated or subcaespitose; in humus, decaying leaves, rotting hay, manured grass. Rare. October–November. Known from Finland, The Netherlands, France, and British Isles.

COLLECTIONS EXAMINED.—THE NETHERLANDS: Overijssel, Oldenzaal, estate 'Egheria', 16 Oct. 1963, *E. K. v. W.* (L); Noord-Holland, Bloemendaal, estate 'Leyduin', 21 Oct. 1980, *E. K. v. W.* (L); Zuid-Holland, Goedereede, 'Middelduinen', 11 Nov. 1969, *E. K. v. W.* (L).

FINLAND: Tammela, Mustiala, Oct. 1891, *P. A. Karsten* (Type, H); Tammisaario, 17 June 1960, *O. v. Schulmann* (H).

The above description is based on our rich collections from Oldenzaal [in our previous paper (1976: 374) selected as type of *P. melanophylla*], Bloemendaal, and Goedereede. We also examined Karsten's type material, which turned out fully to agree with our finds. For the difference between *P. longicauda* and *P. atrolaminata* see the discussion under the latter species.

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 369–372 (1981)

TYPE STUDIES IN THE POLYPORACEAE—12

Species described by F. W. Junghuhn

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F. W. Junghuhn described 30 polypores out of which 4 types could not be located. Of the rest, 15 species are accepted, 11 are regarded as synonyms. *Ganoderma tropicum* (Jungh.) Bres. is described.

F. W. Junghun (*1838, 1840*) described a restricted number of polypores based on his own collections from Java. The lectotypes of these polypores are today in the Leiden herbarium, while a few isotypes are in the Stockholm herbarium. Almost all species were described in *Polyporus* and in the following they are treated alphabetically according to the specific epithet. After the name there is a reference to the paper in which they were published. As the label only indicated 'Java, Junghuhn', this text is not repeated for each species. However, later a number of species was given an accession number in the Leiden herbarium. If indicated, this number is cited.

When the type was found to be a taxonomic synonym, this is marked with =, followed by the proper name. When the species has been accepted, it is cited in its proper genus with a reference to a modern description. Some of Junghuhns types have been examined earlier by Lloyd (*1912*) and Bresaldola (*1910*) and the synonym indicated by the two mycologists are referred to in a few cases.

POLYPORUS ANNULATUS (Junghuhn, *1838*: 53).
Type not found, already noted as missing by Lloyd (*1910*: 2).

POLYPORUS ASPER (Junghuhn, *1838*: 60). L 910.232.1662.
This is an accepted species and should be cited *Coriolopsis asper* (Jungh.) Teng. For a description see Ryvarden & Johansen (*1980*: 283).

POLYPORUS BICOLOR (Junghuhn, *1838*: 54). L 910.222.3718.
= *Coriolopsis sanguinaria* (Jungh.) Ryv.

POLYPORUS BYSSOGENUS (Junghuhn, *1838*: 43). L 910.277.133.
The species is accepted in *Trichaptum* as *T. byssogenum* (Jungh.) Ryv. For a description, see Ryvarden & Johansen (*1980*: 594).

POLYPORUS CERVINO-GILVUS (Junghuhn, *1838*: 45). L 910.252.1687.
This is an accepted species and should be cited as *Oxyporus cervino-gilvus* (Jungh.) Ryv. For a description see Ryvarden & Johansen (*1980*: 451).

POLYPORUS CERVINO-PLUMBEUS (Junghuhn, *1838*: 61). L 910.111.3526.
= *Hexagonia tenuis* (Hook.) Fr.

LASCHIA CRUSTACEA (Junghuhn, *1838*: 75). L 910.252.1753.
This is an accepted species and the type *Junghuhnia* Corda. For a description see Ryvarden & Johansen (*1980*: 387).

POLYPORUS DURUS (Junghuhn, *1838*: 62). L 910.252.1699.
The species is accepted in *Nigroporus* as *N. durus* (Jungh.) Ryv. For a description see Ryvarden & Johansen (*1980*: 447).

POLYPORUS FLAVUS (Junghuhn, *1838*: 46).
Irpex flavus Kl. 1833.

POLYPORUS FLOCCOSUS (Junghuhn, *1838*: 49).
This is an accepted and widely distributed species and should be cited as *Coriolopsis floccosus* (Jungh.) Ryv. For a description see Ryvarden & Johansen (*1980*: 289).

POLYPORUS FURCATUS (Junghuhn, *1838*: 69).
The type is missing and was also missing in 1912 (Lloyd, *1912*).

POLYPORUS FUSCO-ALBUS (Junghun, *1838*: 52).
The type has not been found. Fries (*1851*: 56) indicated that Junghuhn's name was a homonym and changed it to *P. junghuhnii* Fr. I have not been able to trace *Polyporus fusco-albus* Fr. and it is not mentioned in Donk's checklist (Donk 1973) nor in Saccardo's Syllogue Fungorum.

POLYPORUS INDECORUS (Junghuhn, *1838*: 51). L 910.252.1692. (isotype in S).
= *Trametes scabrosa* (Pers.) G. Cunn. This has been noted already by Bresadola (*1910*: 585).

DAEDALEA INDICA (Junghuhn, *1838*: 74). (isotype in S).
= *Lenzites elegans* (Fr.) Pat. The synonym has already been indicated by Lloyd (*1912*: 3).

POLYPORUS LACERUS (Junghuhn, *1838*: 65). (isotype in S).
= *Microporellus obovatus* (Jungh.) Ryv. as already noted by Bresadola (*1910*: 585).

POLYPORUS MICROSCOPICUS (Junghuhn, *1838*: 52).
The type has not been found. It was missing in 1910 as already noted by Lloyd (*1910*: 4).

POLYPORUS MINIATUS (Junghuhn, *1838*: 68). L 910.252.1316.
= *Laetiporus sulphureus* (Fr.) Murr. The synonym was also noted by Lloyd (*1912*: 4).

POLYPORUS MINIMUS (Junghuhn, *1838*: 64).
I have not seen the type, but from the description it seems to be a poroid agaric and should be cited *Favolaschia minima* (Jungh.) Sing. For a description see Singer (*1945*: 200).

POLYPORUS MONS-VENERIS (Junghuhn, *1838*: 61). L 910.222.3757.
= *Funalia leonina* (Kl.) Pat. Synonym already noted by Bresadola (*1910*: 585).

POLYPORUS NIVEUS (Junghuhn, *1838*: 48). L 910.252.1674.
This is an accepted species and should be cited *Incrustoporia nivea* (Jungh.) Ryv. For a description see Ryvarden & Johansen (*1980*: 381).

POLYPORUS OBOVATUS (Junghuhn, *1838*: 65). L 912.252.1664.
The species is accepted in *Microporellus* and should be cited *M. obovatus* (Jungh.) Ryv. For a description see Ryvarden & Johansen (*1980*: 427).

POLYPORUS PELLICULA (Junghuhn, *1838*: 44). L 910.277.128.
The species is accepted in *Oxyporus* as *O. pellicula* (Jungh.) Ryv. For a description see Ryvarden & Johansen (*1980*: 455).

POLYPORUS PUNCTATUS (Junghuhn, *1838*: 64). L 910.270.917.
= *Rigidoporus lineatus* (Pers.) Ryv. The specimen cited above may not be the type, but was collected and named by Junghuhn. Until a more authentic specimen is found, the specimen cited above is selected as a neotype.

FAVOLUS PUSTULOSUS (Junghuhn, *1838*: 73).
The type was already noted as missing by Lloyd (*1910*: 4), but he pointed out that the description clearly pointed towards a poroid agaric. His interpretation has been accepted by Singer, and the species is today cited as *Favolaschia pustulosa* (Jungh.) Sing. For a description see Singer (*1945*: 198).

POLYPORUS ROSEO-ALBUS (Junghuhn, *1838*: 43). L 910.277.135. (isotype in S).
The species is accepted in *Loweporus* as *L. roseo-albus* (Jungh.) Ryv. For a description see Ryvarden & Johansen (*1980*: 415).

POLYPORUS SPADICEUS (Junghuhn, *1838*: 54). L 910.270.888.
= *Cyclomyces tabacinus* (Mont.) Pat.

LASCHIA SPATULATA (Junghuhn, *1838*: 75). L 910.222.3512.
The species is accepted in *Favolus* as *F. spatulatus* (Jungh.) Lév. The species has repeatedly been described as new, because of its variable pores. For a description see Ryvarden & Johansen (*1980*: 331).

POLYPORUS TROPICUS (Junghuhn, *1838*: 63). Lectotype in BPI noted 'Orig!' by Bresadola.
As already noted by Lloyd (*1910*: 5) and Bresadola (*1912*: 586) this is a *Ganoderma* species. The genus is badly in need of a revision and in the Species-Index in the National Fungus Collection (BPI) there are approximately 240 names under *Ganoderma*. Whether Junghuhn's name ultimately will be accepted or reduced to synonymy has to be decided when the genus is revised. Junghuhn's species belongs in the *Ganoderma lucidum* complex (as do most of the 240 names mentioned above). There is seemingly no modern description of the species and the following is based on the lectotype.

GANODERMA TROPICUM (Jungh.) Bres. *in* Annls Mycol. **8**: 586.1910

Fruitbody annual (?) pileate, applanate, sessile, semicircular, 6 × 8 cm, approximately 1 cm thick at the base, woody hard. Pileus smooth, to slightly rugulose, glabrous and with a thin laccate crust, reddish brown at the margin, deep bay to almost black at the base. Pore surface umber brown, pores 6–8 per mm, tubes dark umber brown, up to 4 mm deep at the base. Context dark brown, homogenous, fibrous in radial direction, rather dense.

Hyphal system probably trimitic, generative hyphae only seen in a few fragments, 2–4(–5) µm wide and with clamps, fruitbody dominated by arboriform skeletal hyphae, solid to very thickwalled, pale brown, up to 8 µm wide in the stem, slightly to moderately branched, sidebranches up to 80 µm long. The crust on the pileus consists of a palisade of clublike swollen hyphal endings with a few (apparently) simple septa at the base, probably arising from generative hyphae as in other *Ganoderma* species, hyphal endings very thickwalled in the apex and dark brown, some clubshaped and evenly widened towards the apex, others with short protuberances and partly lobed, especially in the top, up to 60 µm long, 8–22 µm wide. Spores truncate, verruculose, pale brown, 11–14×7.5–10 µm.

The species is characterized rather by its laccate surface, large spores (distinctly larger than for most species in the *G. lucidum*-complex) and the slightly lobed hyphal endings in the crust. It is difficult to decide how taxonomically siginificant these hyphal endings are. We do not know how they vary (eventually) with age, climate, etc., or if their form really is genetically fixed.

POLYPORUS UDUS (Junghuhn, *1840*: 189). L 910.222.3756.

This is an accepted species in *Polyporus* s.str. For a description see Ryvarden & Johansen (*1980*: 507).

POLYPORUS UMBILICATUS (Junghuhn, *1838*: 72). L. 910.270.899. (isotype in S).

= *P. arcularius* Fr. as already stated by Lloyd (*1912*: 5).

POLYPORUS VENULOSUS (Junghuhn, *1838*: 57). L 910.270.884.

The type is badly destroyed today and Lloyd has in the herbarium noted specimen L 910.270.901 as type. They are both of the same taxon and their identity is unknown to me, but my best guess is that the type is a small immature specimen of *Trametes scabrosa* (Pers.) G. Cunn. Its hyphal system is in accordance with that of this species.

Lloyd (*1912*: 4) indicated *P. macrotrema* as validly published by Junghuhn. However, Léveillé (*1884*: 200) changed the name proposed by Junghuhn, which he probably found on the envelope in Leiden, to *Hexagona molkenboeri*. Later Fries (*1851*: 101) published Junghuhn's name, which then according to the Botanical Code is a superfluous name since it is based on the type of the prior name of Léveillé.

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 373–376 (1981)

NOTES ON MARASMIUS—I

Marasmius pseudocaricis spec. nov. and the status of Gloiocephala Mass.

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A new caricicolous species of *Marasmius*, viz. *M. pseudocaricis*, is described and its taxonomic position within the genus *Marasmius* is discussed. As a consequence the genus *Gloiocephala* Mass. is reduced to a section of *Marasmius*, close to sect. *Epiphylli*. A key is given to all species known from the temperate northern hemisphere.

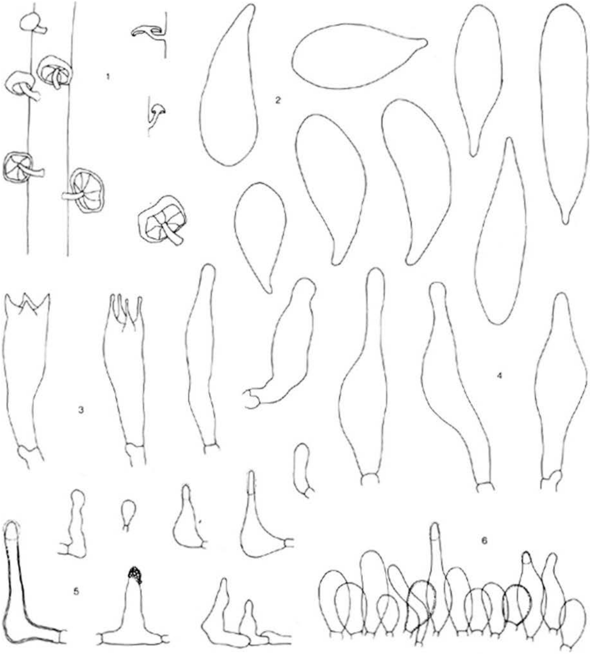
While collecting agarics in Scotland during the rather dry season of 1981, I came accross a very small marasmioid fungus growing on dead leafs of a species of *Carex* at the edge of a half-dried pond. It appeared to be a new species closely related to *Marasmius caricis* P. Karst. and is described below.

Marasmius pseudocaricis Noordeloos, *spec. nov.*—Figs. 1–6

A Marasmio caricis P. Karst. differt in pileo ochraceo-roseo et basidiis tetrasporigeris. — Typus: *M. E. Noordeloos 1421*, 4 IX 1981, 'at edge of pond, 200 m NW. of Kindrogan Field Station, Enochdhu, Perthshire, Scotland' (holotypus, L; isotypus, E).

Fruitbodies very small, gregarious on putrescent leafs of a *Carex* species. Pileus 1–3 mm broad, hemispherical to convex, sometimes slightly radially wrinkled, with involute margin, not hygrophanous, not translucent, pinkisch-ochraceous (Muns. 7.5 YR 7/6–6/4), slightly paler creamy to whitish at margin, dull. Lamellae 3–7; short lamellulae absent, usually ± well-developed, not interveining or anastomosing, rarely ± reduced, broadly adnate, thickish, pallid. Stipe 0.5–2.5×0.5–1 mm, always distinct, central, rarely excentrical, never lateral, pale pinkish-ochraceous, darker et base, entirely minutely white pruinose, base almost insititious, but slightly disc-shaped and woolly-tomentose, Flesh relatively thick in pileus, not distinctly gelatinised, white or creamy. Smell absent.

Spores 11.5–20(–22)×5.5–7 μm, very variable in size and shape, from more or less obovoid to fusoid, more rarely subcylindrical (many ranging from 12–16×5.5–6.5 μm), usually inequilateral, with broadly rounded apex and tapering towards apiculus, rather thin-walled, usually with one large and several small oil-drops, inamyloid, not cyanophilous. Basidia 24–36×8–16.7 μm, 4-spored, with clamp. Cheilocystidia scattered among the basidia 27–56×5.5–12 μm, slenderly fusiform to lageniform, thin-walled, sometimes with hyalinous, granular mucous cap covering the tip. Hymenophoral trama irregular, non-gelatinised, made up of cylindrical hyphae. Pileipellis hymeniform, made up of more or less globose cells, 19–35×9–19 μm, often with slightly thickened, hyalinous or yellowish walls, interspersed with thin- or thickwalled, clavate-flexuose to lageniform pileocystidia, 28–62×7.5–19 μm,



Figs. 1–6. *Marasmius pseudocaricis* — 1. Fruitbodies (× 5). — 2. Spores (× 2000). — 3. Basidia (× 1000). — 4. Cheilocystidia (× 1000). — 5. Caulocystidia (× 500). — 6. Pileipellis (× 500). (All figs. from holotype.)

sometimes encrusted with yellowish pigment, rarely subcapitate, sometimes with granular mucous cap covering the tip. Pileitrama regular, made up of 2.5–7 μm wide, more or less cylindrical hyphae with hardly gelatinised, hyaline and colourless walls. Stipitepellis a compact cutis with numerous rather irregularly shaped caulocystidia, 12–90×7–19 μm with acute or rounded, rarely subcapitate tip, thin- or thick-walled, colourless or yellowish, frequently with a hyaline mucous cap covering the tip. No part of the carpophore amyloid or dextrinoid.

HABITAT.—At the edge of half dried pond, gregarious on putrescent leafs of *Carex* sp.

COLLECTION STUDIED.—Scotland, Perthshire, Enochdhu, pond along road about 200 m NW. of Kindrogan Field Station, 4 Sept. 1981, *M. E. Noordeloos 1421* (holotype, L; isotype, E).

Marasmius pseudocaricis differs from *M. caricis*, which grows in similar habitats, by the distinctly coloured pileus and the constantly 4-spored basidia; the last character probably causing the smaller spore-size in *M. pseudocaricis*. When fresh the colour and surface of *M. pseudocaricis* strongly reminds those of *Marasmiellus ramealis* (Bolt. ex Fr.) Sing.

Marasmius caricis and *M. pseudocaricis* belong to a small group of species that were placed by Bas (1961) and Singer (*1975, 1976*) in the genus *Gloiocephala* Mass. Singer (l.c.) placed in this genus all marasmioid species that differed from *Marasmius* sect. *Epiphylli* in one or more of the following characters: (1) The presence of metuloid and/or capitate and/or pigmented pileocystidia ('oleocystidia'). (2) A pigmented pileus. (3) The presence of hymenial cystidia which are not fusiform and not thin-walled. (4) A reduced carpophore. (5) The presence of a gelatinous matrix in the pileitrama.

Bas (l.c.) already expressed his doubts as to the value of these criteria. Dr. A. E. Jansen and myself, while studying marasmioid genera in the Netherlands during the years 1972–1975, found new arguments, supplemented by data in the publications of Gilliam (*1975, 1976*) on Northamerican Marasmii, to reduce *Gloiocephala* to the synonymy of *Marasmius*.—

(1) Pileocystidia are a normal character in sect. *Epiphylli* and in other sections of *Marasmius*, such as in sect. *Hygrometrici*, and their variation with thin, thick, and even encrusted walls (for example in *M. epiphylloides* and *M. recubans*) does not seem to be different from that found in *M. caricis* and *M. menieri*. Very interesting in that respect is also *M. epifagus*, described by Gilliam (*1975*: 821) from the U.S.A. This species, which undoubtedly belongs to sect. *Epiphylli*, has pileocystidia which have coloured projections and in addition a dextrinoid cell-content, similar to that found in *M. menieri*.

(2) A pigmented pileus occurs in *Marasmius epifagus*, a recently described member of sect. *Epiphylli* mentioned above. In connection with this it is interesting that Redhead (*1981*: 574–476) described a form of *M. menieri* from Manitoba, Canada, with an almost white pileus, due to the relative scarcity of pigmented cells.

(3) Thick-walled, almost setiform hymenial cystidia are not restricted to *Gloiocephala*. They are also found in sect. *Epiphylli*, e.g. in *M. epiphylloides* and *M. epifagus*.

(4) Reduced carpophores with fold-like and often anastomosing lamellae and a short, almost absent, excentric or lateral stipe can be observed in many genera of tribe *Marasmieae* Fayod (See Singer, *1975*: 341). This can be observed in *Marasmius* sect. *Epiphylli* (*M. tremulae* and *M. epiphyllus*) and in sect. *Neosessiles* Sing. and cannot be considered a major argument in separating genera.

(5) Although a gelatinized trama seems to be a diagnostic character of great value for the distinction of some genera, it does not seem to be very constant in other genera. It may be present or absent e.g. in *Micromphale* and *Marasmiellus*. Also in *Gloiocephala* this character is very variable; in *M. pseudocaricis* and *M. caricis* it is almost absent. This was the main reason Redhead (1981: 580) placed *M. caricis* in the genus *Marasmius* and retained *M. menieri* in *Gloiocephala*.

(6) *Marasmius epiphylloides* shows a metachromatic reaction in the hymenium which resembles very much that described from *M. menieri* by Bas (l.c.).

Considering the arguments listed above there seem to be insufficient reasons for maintaining *Gloiocephala* as an independant genus.

Therefore we propose the following new combination: **Marasmius** Fr. sect. **Gloiocephala** (Mass.) A. E. Jansen & Noordeloos, *comb. & stat. nov.* — Basionym: *Gloiocephala* Mass. *in* Grevillea **21**: 34. 1892.

We prefer to treat the species concerned as a section within *Marasmius*, close to section *Epiphylli*, from which it differs mainly in the relatively more reduced carpophores, the development of a basal mycelium and the occurrence of very long (up to 450 μm) strigose hairs on the pileus in some species.

KEY TO THE SPECIES OF MARASMIUS SECT. GLOIOCEPHALA KNOWN FROM THE TEMPERATE NORTHERN HEMISPHERE

1a. Pileus white to pale ochraceous 2
b. Pileus distinctly pigmented yellow to ochraceous, pale brown or reddish brown 4
2a. Stipe well-developed; pileipellis consisting of only one kind of cells and in addition non-capitate pileocystidia 3
b. Stipe curved and often excentric; pileipellis with thin- and thick-walled cells and in addition capitate pileocystidia; on *Carex* .... *M. menieri* forma (see Redhead *1981*: 574)
3a. Pileocystidia 32–53 × 7–15 μm, cylindrical to slender conical with narrow but rounded apex; fold-like gills with cheilocystidia present; on *Carex* .... *M. caricis*
b. Pileocystidia 50–120 × 6–18 μm; with filiform apical appendage; hymenium smooth or at best with some folds or wrinkles; cheilocystidia absent; on *Carex*
M. menieri sensu Corner (*Gloiocephala* sp. with Bas)
4a. Lamellae merulioid; pileus yellow then ochraceous; on *Carex* in Canada *M. flavomerulius* Redhead
b. Lamelllae distinctly developed or fold-like, sometimes anastomosing but never merulioid; pileus without yellow tinges 5
5a. Pileus pale brown to reddish-ochraceous brown; stipe strongly reduced, almost always excentric or lateral; pileipellis of two types of cells with in addition, at least at margin, capitate pileocystidia; on *Typha* .... *M. menieri*
b. Pileus pinkish-ochraceous; stipe almost always central, sometimes slightly excentric but never lateral, pileipellis with one type of cells and in addition fusiform to lageniform, never capitate pileocystidia; on *Carex* .... *M. pseudocaricis*

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, pp. 377–394 (1981)

NOTES AND BRIEF ARTICLES

ASCOBOLUS XYLOPHILUS REDESCRIBED FROM FRANCE WITH REMARKS ON ITS TAXONOMIC POSITION

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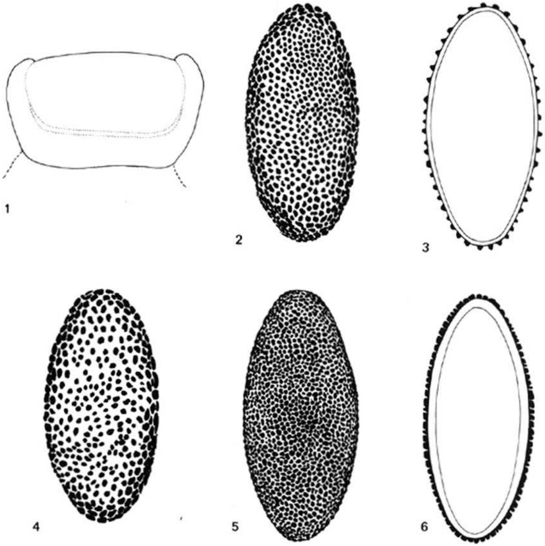
During a collecting trip in the High Pyrenees (France) the second author has collected several fruit bodies of *Ascobolus xylophilus* Seaver on a log of rotten coniferous wood in a mountain stream. Till then this fungus was only known from the original specimens, collected by Prof. E. Bethel & Dr. F. J. Seaver, September 1910 in the Geneva Creek Canyon, Colorado, U.S.A. (van Brummelen, *1967*: 153). As the material of the type specimen is rather scarce and consists of a few very old fruit bodies, from which it was difficult to make a complete description, the species has been redescribed and pictured from the newly collected European material.

ASCOBOLUS XYLOPHILUS Seaver—Figs. 1–7

Ascobolus xylophilus Seaver *in* Mycologia **3**: 61. 1911; Seaver, North Am. Cup-fungi (Operculates) 90. 1928.

Apothecia scattered, superficial, sessile, 0.5–2.0 mm diameter, about 0.5 mm high. Receptacle at first subglobular, then expanding and becoming lenticular to discoid, finally scutellate, purplish brown; surface smooth; margin scarcely differentiated, slightly elevated on drying. Disc at first concave, then flat, roughened by the protruding tips of ripe asci, becoming purplish with maturity. Hymenium about 250 μm thick. Hypothecium not very compact (30–)40–75 μm thick, consisting of groups of isodiametric to oblong thin-walled cells 7–15 × 5–8 μm, the contents of which intensively stain with methyl blue. Flesh not clearly differentiated from the excipulum, of subparallel or somewhat intertwined colourless thin-walled hyphae 2–5 μm wide. Excipulum at the margin 35–50 μm wide, pale purplish violet, consisting of thin-walled septate subparallel hyphae 2.5–5 μm thick (textura porrecta) and of rather strongly intricated hyphae (textura intricata) in the outer layers especially near the base. Asci cylindric-clavate to clavate with a stem-like base, rounded above, 210–240 × 25–28 μm, 8-spored; the wall deep blue in Melzer's reagent. Ascospores at first uniseriate, finally irregularly biseriate, ellipsoid or more rarely slightly asymmetrical (length/breadth ratio 1.8–2.2, average 1.98), at first hyaline, then purplish violet, purplish brown at maturity, 28.0–33.5 × 13.0–16.3 μm (without ornamentation), with homogeneous contents, ornamented with rather densely placed warts or punctate. Paraphyses abundant, septate, slender filiform, simple, hyaline, about 2 μm thick, not or scarcely enlarged (up to 3.5 μm) at the tip.

HABITAT.—On a fallen trunk of *Abies* in the water of a small mountain stream, accompanied by fruit bodies of *Pachyella babingtonii* (Berk.) Boud.



Figs. 1–6. *Ascobolus xylophilus*. — 1. Diagrammatic section of fruit body × 50. — 2, 4, 5. Ascospores × 1600. — 3, 6. Ascospores in optical section × 1600. (1–4, from *Candoussau*, 2.X.1972; 5, 6, from 'cotype' of *A. xylophilus*, BPI.)

SPECIMEN EXAMINED.—France. Payolle near Bagnères de Bigorre, Hautes Pyrénées, 2.X.1972, *F. Candoussau* (L).

The gross and microscopic characters of the French material agree well with the descriptions of the American type specimen (Seaver, *1911*, *1928;* van Brummelen, *1967*).

Both specimens were found growing on rotten coniferous wood at high altitudes.

The large ascospores with finely warted sculpturing are especially a characteristic feature of this species, and provide a valuable aid to its identification.

Macroscopically the fruit bodies in this species resemble somewhat eroded fruit bodies of *Ascobolus carbonarius* P. Karst., while the ascospores in both species show a similar warted ornamentation. Consequently, in absence of knowledge about the development of the fruit

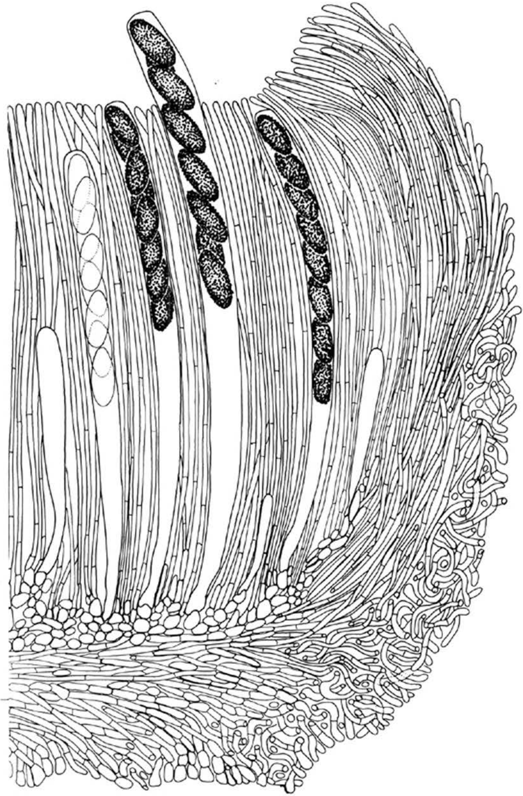


Fig. 7. *Ascobolus xylophilus* (from *Candoussau*, 2.X.1972), median section of margin of fruit body ×400.

bodies, *Ascobolus xylophilus* was placed 'with doubt' *in Ascobolus* sect. *Ascobolus* (van Brummelen, l.c.).

From the better French material, the developmental type of the ascomata could be established. *Ascobolus xylophilus* showed eugymnohymenial ascomata with a well-developed excipulum, in which the hymenium is exposed from the first until the maturity of the asci (cf. van Brummelen, *1967*, *1972*). Such a type of development is characteristic of *Ascobolus* sect. *Gymnascobolus* Brumm. of which *Ascobolus scatigenus* (Berk.) Brumm. is the type and the best-known representative.

Both *A. xylophilus* and *A. scatigenus* show a structure of the excipular layer which is rare in the genus *Ascobolus*, viz. a tissue of fine intertwined or subparallel thin-walled hyphae with textura intricata or porrecta.

From our observations it is not yet clear if there is an active submarginal growing zone as found in other representatives of *Ascobolus* sect. *Gymnascabolus* (*A. scatigenus* and *A. castaneus* Teng.). Such a zone gives rise at the adaxial side to branches forming the paraphyses and at the abaxial side to branches which differentiate into the elements of flesh and excipulum. Structurally, such a zone is also present in *A. xylophilus* (see Fig. 7), but its activity could not be proven. The maximum size of the ascomata in *A. xylophilus* is considerably smaller than in the two other species mentioned. So its development could also be explained by activities of the more common interstitial and intercalary growth.

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HYDNANGIUM NIGRICANS VAR. LONGISPINOSUM, A NEW HYPOGEOUS FUNGUS FROM MADAGASCAR

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On July 7, 1980, the author collected a semi-hypogeous gasteromycete at Andasibe, Malagasy (=Madagascar). Drying of the specimen was improvised on filter paper. Three days later a second specimen was collected at the same locality. Unfortunately the latter was totally destroyed by insects during the process of drying. The remaining specimen was studied in the laboratory of the Centraalbureau voor Schimmelcultures at Baarn, Netherlands. It appeared to be the first hypogeous macromycete recorded from Madagascar. As it showed a close resemblance to the South African *Hydnangium nigricans*, which according to Singer & Smith (*1960*) is closely related to *Octavianina nigrescens* (Zeller) Sing. & A. H. Sm., a comparison of the author's specimen was made with the type material of these species.

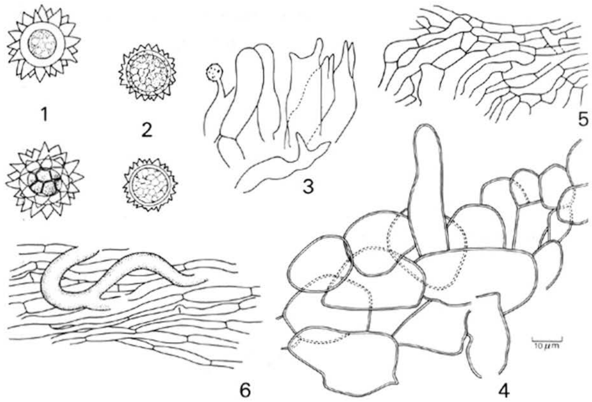
The fungus from Madagascar appeared to be conspecific with *H. nigricans*, only differing by its coarser spore ornamentation. A new variety is therefore proposed.

Hydnangium nigricans Kalchbr. var. **longispinosum** Vries, *var. nov.*—Figs. 1–7

Basidioma sessile, gasteroideum, depresso-globosum, opaco-pallide-brunneum, parte subterranea cremea, in statu sicco umbrina, 20 × 20 × 25 mm, columellam et basim sterilem carens, contexto homoiomero, loculis sinuosis, minutis praeditum. Peridium brunneum, in solutione $FeSO_4$ nigrescens, pseudoparenchymaticum, cellulis inflatis, tenuitunicatis, brunneis, 16–40 µm latis, paulatim in hyphas, 2.5–12 µm latas, transientibus compositum. Gleba straminea ad ochracea, in statu sicco spadicea, in solutione $FeSO_4$ olivaceo-cinerascens. Contextus centralis dissepimentorum pallide griseus. Dissepimenta 85–120 µm lata. Mediostratum hyphis parallelibus, hyalinis, 2.5–5.0 µm latis compositum. Cellulae magnae, inflatae, in dissepimentibus dispositae, sphaerocytas simulantes. Fibulae adsunt. Basidia 2-sporifera, subcylindracea, 33–42 × 8–15 µm. Sterigmata subuliformia, 6–10 × 2–3.5 µm. Cystidia nulla. Hyphae oleiferae in peridio et dissepimentibus sinuosae, non septatae, 2.5–10 µm latae, in solutione cresylici caerulei caerulescentes, in solutione sulfovanillini non colorantes. Basidiosporae statismosporicae, orthotropicae, globosae, forte dextrinoideae, pariete ad 6.3 µm crassa, spinis conicis, 6–8.5 µm altis, 3.4–4.8 µm latis dense obtectae, 21.5–30.5 µm (orn. incl.), interdum appendicem sterigmatis gerentes, aream glabram carentes. Paries et spinae sporarum in solutione sulfobenzaldehydi forte viridescentes, in solutione sulfovanillini forte purpurascentes, in 30% KOH pallide lutescentes. Latex absens. Odor nulla.

Hab.: Basidioma vertice emergente in terra argillacea, viatica, in silva frondosa tropicale, prope Andasibe (=Perinet), Rep. Dem. Malagasy (=Madagascar), 7.VII.1980.

Typus: Partes speciminis holotypici (*de Vries 762*) in Herbario Lugduno Batavorum (L), Hollandiae, in herbario J. M. Trappei, Corvallis, Oregon, Americae Septentrionalis, in herbario The New York Botanical Garden (NY), New York, Americae Septentrionalis et in herbario autoris conservantur.



Figs. 1–6. *Hydnangium nigricans* var. *longispinosum*, microscopical characters. — 1, 2. Basidiospores of var. *longispinosum* (in 1) compared with basidiospores of var. *nigricans* (in 2). — 3. Basidia. — 4. Outer peridial layers. — 5. Inner peridial layers. — 6. Oleiferous hyphae in gleba.

Basidioma sessile, depressed-globose, pale dull brown with cream-white hypogeous part, 'Burnt Umber' (Kornerup & Wanscher, 1978, 6F6) when dry, 20 × 20 × 25 mm, lacking columella and sterile base, with homoiomerous texture and small, sinuous locules. Peridium brown, turning black in $FeSO_4$ solution, pseudoparenchymatous, consisting of several layers of closely appressed, thin-walled, more or less isodiametrical, 16–40 µm wide, brown cells. Inner layers plectenchymatous, composed of 2.5–12 µm thick, hyaline hyphae. Gleba straw-yellow to ochre-yellow, 'Sunburn' (Kornerup & Wanscher, 1978, 6D5) when dry, turning dark olivaceous grey in $FeSO_4$. Tramal plates 85–120 µm thick, with pale grey mediostratum composed of a bundle of parallel, 2.5–5.0 µm thick, hyaline, septate hyphae. Large, swollen cells in tramal plates resemble sphaerocytes. Clamp connections present. Basidia 2-spored, subcylindrical, 33–42 × 8–15 µm. Sterigmata awl-shaped, 6–10 × 2–3.5 µm. Cystidia not observed. Oleiferous hyphae in septal and deep peridial trama sinuous, aseptate, 2.5–10 µm thick, turning blue in cresyl blue and very pale yellow in sulfobenzaldehyde, not stained with sulfovanilline. Basidiospores statismosporic, orthotropic, globose, strongly dextrinoid, 21.5–30.5 µm (incl. ornamentation) with an up to 6.3 µm thick spore wall, covered with 6–8.5 µm high, 3.4–4.8 µm broad conical spines. Sterigmal appendage occasionally present. 'Plage' area absent. Spore wall and spines turning dark purple in sulfovanilline, dark blue green in sulfobenzaldehyde and pale yellow in 30% KOH. Latex absent. Odour none.

HABITAT.—Partly erumpent in a steep, loamy side of a jungle track in a primeval, tropical rainforest at Andasibe (=Perinet), Rep. Dem. Malagasy (=Madagascar), 7.VII.1980.

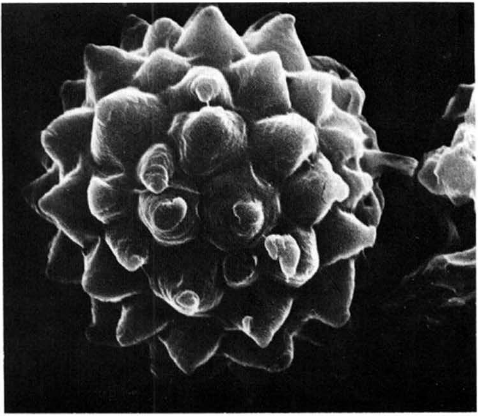


Fig. 7. *Hydnangium nigricans* var. *longispinosum*, scanning electron micrograph of basidiospore (×4600).

TYPE.—Parts of the type specimen (*de Vries 762*) are conserved in the Rijksherbarium (L) at Leiden, Netherlands, J. M. Trappe's Herbarium at Corvallis, Oregon, U.S.A., the Herbarium of the New York Botanical Garden (NY) and the author's private herbarium.

Hydnangium nigricans var. *longispinosum* has generative hyphae with clamp connections and a regular pattern of eusporial ornamentation. The presence of these two characters led Pegler & Young (*1979*) to distinguish the Hydnangiaceae Gaüm. & B. O. Dodge sensu Pegl. & Young from the Octavianinaceae Locq. ex Pegl. & Young. Because of the nonamyloid myxosporium and the homoiomerous trama they excluded these families from the Russulales Kreisel emend. Pegl. & Young and retained them in a residual order Hymenogastrales G. H. Cunn. *Hydnangium nigricans* var. *longispinosum* differs from *H. nigricans* var. *nigricans* by the much higher spines of the spore wall ornamentation and the greater total spore measurements, the spore body in both varieties being almost equal in size.

Oleiferous hyphae were observed which did not stain in sulfovanilline (sv) and which turned only very pale yellow in sulfobenzaldehyde (sb). The spore wall and its ornamentation, however, stained dark blue green in sb and deep purple in sv. This colour reaction was macroscopically and microscopically very distinct. Only with spores in mass of *H. nigricans* var. *nigricans* could a pale reddish staining of the spore wall and spore ornamentation in sv and an olivaceous grey staining in sb be observed. As Singer (*1975*) stated that sb and sv must be used on fresh material, the very poor colour reaction in *H. nigricans* var. *nigricans* was taken to be a result of preservation since 1876.

In order to investigate whether or not the colour reaction seen in var. *longispinosum* could be demonstrated in related fungi, herbarium specimens of *Hydnangium carneum* Wallr. (*de Vries 724*), *Octavianina tasmanica* (Kalchbr.) Pegl. & Young (*de Vries 740* and *757*) and *Laccaria tortilis* (Bolt.) S. F. Gray (coll. van der Aa) and fresh material of *Laccaria laccata* (Scop. ex Fr.) Berk. & Br. were tested. The colour reaction described above was not shown in any of these species. The only change observed was a purple colouring in sv of the trama of the gills of the two species of *Laccaria* and the trama of the septa of *H. carneum*. The colour reaction in sb and sv of the spores of *H. nigricans* var. *longispinosum* did not appear to have been described in connection with hypogeous fungi. Application to fresh material of Hydnangiaceae, Octavianinaceae, and related genera might be of great interest and taxonomic value.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. P. Holmgren of the New York Botanical Garden for placing type material of *Hydnangium nigricans* and *Octavianina nigrescens* at his disposal and to Dr. J. A. Stalpers for the scanning electron micrograph. He is further indebted to Dr. G. S. de Hoog for critical reading of the manuscript and to Dr. C. A. N. van Oorschot for correction of the English text.

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NOTES ON CLITOCYBE—I

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Since 1976 I have studied the taxonomy of the genus *Clitocybe*, with special emphasis on the hygrophanous species. Results of this study have been published in a report in the Dutch language (Kuyper, *1981*). The most interesting parts of it will be published separately as short notes in this journal. In the present note some new combinations used in the report mentioned above are validated.

Kühner (*1934*, Atlas pl. LXIV) depicted—sub nomine *Clitocybe gallinaceae* (Scop. ex Fr.) Gill.—a hygrophanous species of *Clitocybe* microscopically characterized by the presence of dermatocystidia in the pileipellis and stipitepellis. Malençon (*1942*: 34–36) demonstrated however that Kühner misapplied this name, as *Agaricus gallinaceus* was, according to Fries (*1838*: 63–64), a small white opaque species with a convex cap, closely related to *A. dealbatus* Sow. ex Fr. Referring to Fries (*1867*: 71) he proposed the name *Clitocybe hydrogramma* (Bull. & Vent. ex Fr.) Kumm. His choice has been generally accepted, e.g. by Kühner & Romagnesi (*1953*: 132–133), Harmaja (*1969*: 82–83; *1974*: 113–115), and Moser (*1978*: 99–100). Kühner & Romagnesi (*1953*: 141) stated explicitly: 'Nous ne voyons pas ce que pourrait être *Omphalia hydrogramma* Fries, si ce n'est cette expèce'.

It is, however, highly improbable that *Clitocybe hydrogramma* is the correct name for this species. *Agaricus hydrogrammus* as described by Bulliard & Ventenat (*1809*: 515) and illustrated by Bulliard in the same work (pl. 564) is a mixture of different species, which have only a striate cap in common. Fries (*1821*: 169) restricted this wide concept of *A. hydrogrammus* by referring only to fig. A. of Bulliard's plate 564 which shows an almost white species.

It is remarkable that Fries, when (re)describing *A. hydrogrammus*, never mentioned the striking odour (reminding of smelt) and the astringent-bitter taste, for he was plainly aware of the importance of smell within *Clitocybe*. In the descriptions of almost all species (19 out of 22) within the taxa *Cyathiformes* and *Orbiformes* the odour is mentioned, whereas in *A. hydrogrammus* — which was, moreover, classified as an *Omphalia* (!) — no mention of it is made. Besides, Lasch (apud Fries, *1838*: 74–75) described *Agaricus fritilliformis*, which was amongst others characterized by 'sapore amaro et odore forti ingrato'.

Fries (*1825*) indicated that he had found *A. hydrogrammus* in the vicinity of Femsjö. It is, however, highly improbable both for ecological and phytogeographical reasons that *C. hydrogramma* sensu Malenç. occurs there. Its northernmost distribution seems to coincide with that of calcareous *Fagus* woods (cf. the distribution map in Harmaja (*1969*: fig. 149). Professor Moser (pers. comm.) who has been collecting fungi in Femsjö for many years, expressed as his view that *C. hydrogramma* sensu Malenç. will probably never be found around Femsjö.

It has to be admitted, however, that Malençon was right in concluding that the illustration of Fries (*1867*: pl. 71) represented the same species as Kühner's. It is not unlikely that the specimens depicted were found in the southernmost part of Sweden.

The oldest name for *C. hydrogramma* sensu Malenç. is *Agaricus phaeophthalmus* (Persoon, *1828*: 72). The type (in Leiden) has been investigated by Singer (*1961*: 38) and by me, and was found to possess the typical dermatocystidia. And although Fries (*1830*: 706) thought of *A. phaeophthalmus* as '*Agaricus hydrogrammus* semiexpallens', I propose the following new combination:

Clitocybe phaeophthalma (Pers.) Kuyper, *comb. nov.* — Basionym: *Agaricus phaeophthalmus* Pers., Mycol. eur. **3**: 72. 1828.

In addition the following new combinations in *Clitocybe* are considered necessary:

Clitocybe albofragrans (Harmaja) Kuyper, *comb. nov.* — Basionym: *Lepista albofragrans* Harmaja *in* Karstenia **18**: 53. 1978.

Clitocybe pseudo-obbata (J. E. Lange) Kuyper, *comb. & stat. nov.* — Basionym: *Clitocybe vibecina* var. *pseudo-obbata* J. E. Lange. *in* Dansk bot. Ark. **6** (5): 55. 1930.

I am much indebted to Prof. M. Moser (Innsbruck) for information about the occurrence of species of *Clitocybe* around Femsjö. Thanks are also due to Dr. C. Bas for critically reading the manuscript of this paper.

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PITHOSIRA AND XENOPLACA, TWO DEMATIACEOUS HYPHOMYCETE GENERA FROM SOUTH AMERICA

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The genera *Pithosira* and *Xenoplaca* were described but not illustrated by Petrak (*1949*). The following notes and figures are based on a study of the type specimens, which were collected by H. Sydow in 1937 during a field trip in Ecuador and which are maintained in the 'Naturhistorisches Museum' in Vienna.

1. Pithosira sydowii Petrak—Fig. 1

The fungus is the causal agent of scab on leaves of *Passiflora alnifolia*. A membranaceous, thin, pellicle-like stroma is formed between the epidermis and the cuticle of the leaves. It is 3–10 μm thick and composed of light brown, thin-walled, 3–6 μm sized cells or of filaments. The stroma is connected with the superficial hyphae by narrow pegs perforating the cuticle. The superficial hyphae are branched, septate, brown-walled, 2.5–3.5 μm broad and expand

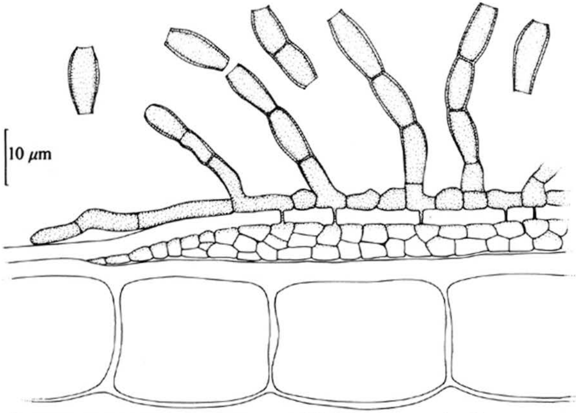

Fig. 1. *Pithosira sydowii*, subcuticular stroma, conidiogenous hyphae, and conidia.

radially over the leaf surface. Erect or suberect branches become rather densely septate and desintegrate into arthroconidia, which are cylindrical or swollen, rather thick-walled, usually 1-celled, and measure 10–17 × 5–8 µm.

Pithosira sydowii is an anamorph of a Stigmateaceae (Venturiaceae) and is related to the genera *Spilocaea* Fr., *Fusicladium* Bon., and *Karakulinia* Golovina, all anamorphs of *Venturia* species. In *Karakulinia* the conidia are also catenate, but are formed in acropetal chains and show distinct scars on release. No other Stigmateaceae are known on Passifloraceae.

2. XENOPLACA AEQUATORIENSIS Petrak—Fig. 2

The fungus was collected on fallen leaves of *Clusia,* but may be parasitic, because an intraepidermal stroma is present. This is composed of subhyaline or light brown, 4–8 µm broad hyphal cells and is connected with the superficial structures by stomatal bodies of thick-walled, brown cells. The superficial structures are flat, scutate, appressed to the cuticle, roundish or irregular in outline, dark brown, 500–1100 µm diam. and 26–40 µm high.

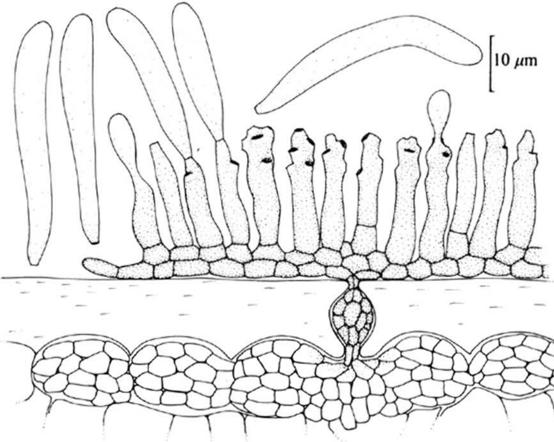

Fig. 2. *Xenoplaca aequatoriensis,* intraepidermal, stomatal and superficial stroma, conidiogenous cells and conidia.

They are composed of a basal layer of dark brown, 5–8 µm broad hyphal cells, from which densely packed conidiogenous cells or short, micronematous conidiophores arise. The conidiogenous cells are irregularly cylindrical or geniculate, either attenuated or slightly swollen at the tip, brown, measuring 20–26 × 4–6 µm. The conidia develop successively and sympodially, are cylindrical clavate, often slightly curved, rounded at the tip, truncate at the attenuated base, 1-celled, subhyaline, thin-walled, 40–70 × 5–7 µm. Old conidiogenous cells show several rather distinct scars in the upper region.

The fungus is rather distinct in the dematiaceous Hyphomycetes, no relatives being known. *Hadrotrichum phragmitis* Fuckel and *Asperisporium caricae* (Speg.) Maublanc show a similar kind of conidiogenesis, but the conidiogenous cells develop on erumpent stromata (Ellis, *1971*; Carmichael *& al.*, *1980*) and the conidia are much smaller.

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ACROCLADIUM, A SYNONYM OF PERICONIELLA

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Petrak (*1949*) described the genus *Acrocladium* (type species: *A. andinum* Petrak) from unidentified leaves of a liane, collected by H. Sydow in 1937 in Ecuador. He compared the genus with *Stachybotrys* Corda and *Sterigmatobotrys* Oudem. The type specimen (W) was available for study.

The leaves bear several fungi with hemispherical-discoid fructifications, including *Asterinella puiggarii* (Speg.) Theiss., *Chaetothyrina musarum* (Speg.) Theiss., and *Asterina* cf. *guaranitica* Speg. The fungus described as *Acrocladium andinum* is hardly visible with the naked eye, but can easily be recognized under a stereo microscope. Petrak (*1949*) considered this fungus to be a leaf parasite, but it may be also a mycoparasite.

The conidiophores arise from light brown, apparently superficial, delicate hyphae and are erect, 160–220 µm long, 4–8 µm broad at the base, slightly tapering towards the branched tip, rather thick-walled, septate and dark brown. The conidiogenous cells which form an apical penicillus, are formed in lateral and terminal position on the upper cells of the conidiophore, elongate sympodially, are cylindrical, light brown, 15–30 µm long, 2–3.5 µm broad and become covered with numerous, small, slightly protuberant scars with age. The conidia are ellipsoidal, 1-celled, subhyaline, smooth, 5–8 × 2.5–3.5 µm and show a rather distinct scar at the base.

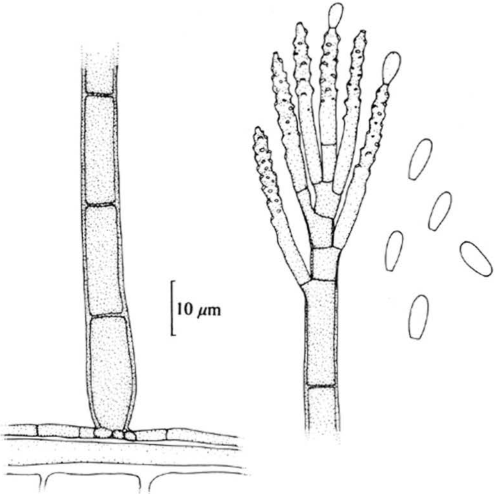

Fig. 1. *Periconiella andina*, base and apical part of a conidiophore and conidia.

This fungus fits the genus *Periconiella* Sacc. sensu Ellis (*1967*) in all respects and is reclassified as **Periconiella andina** (Petrak) v. Arx, *comb. nov.* (basionym: *Acrocladium andinum* Petrak *in* Sydowia **3**: 263. 1949)—Fig. 1. The conidiogenous cells and conidia correspond to those of *P. musae* M. B. Ellis and *P. anisophylleae* M. B. Ellis in size, shape, and structure. In the former species the conidiogenous cells are usually integrated in lateral branches, in the latter they are mostly discrete and form an apical penicillus.

Most of the other species have much larger, often catenate, septate and/or ornamented conidia, which retain more distinct scars on release. All species of the genus *Periconiella* have been collected on leaves of mainly tropical plants.

Ellis (*1967, 1971*) placed the genera *Acrodesmis* H. Sydow and *Ramichloridium* Stahel (*nom. nud.*) in synonymy with *Periconiella; Acrocladium* is here added to this list of synonyms. De Hoog (*1977*) reintroduced *Ramichloridium* with *Chloridium apiculatum* Miller *& al.* as type. He treated 12 species, among which *Periconiella musae* M. B. Ellis and some species, classified by Ellis (*1976*) in *Veronaea*. *Veronaea musae* M. B. Ellis was placed in synonymy with *Periconiella musae* (syn. *Ramichloridium musae*) being a mononematous, mainly cultural state of the latter. The genus *Veronaea* sensu Ellis is heterogeneous, though classification of the leaf-inhabiting species with mononematous conidiophores in either *Periconiella* or *Ramichloridium* is a matter of taste. *Ramichloridium* Hoog contains mononematous taxa with an integrated conidiogenous cell and taxa with branched conidiophores; the condiogenous cells may have scars or denticles, and the conidia may secede rhexolytically or schizolytically or may be even catenate, Some species of *Periconiella* also are characterized by catenate conidia and in this respect are similar to *Cladosporium*.

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XENOSTILBUM, A SYNONYM OF CALOSTILBELLA

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The generic name *Xenostilbum* was introduced by Petrak (*1959*) for a coremial fungus, collected by H. Sydow in 1937 in Ecuador on a branch of an unidentified tree. The type specimen of *X. sydowii* Petrak (in Herb. W) was studied. The voluminous description given by Petrak (*1959*) proved to be correct and complete.

The bright synnemata develop in brushes on a basal stroma and are 5–10 mm long and 0.3–0.6 mm broad. The conidiogenous head is slightly darker and broader. The conidia develop singly and apically on filiform, 60–120 µm long and 2–3 µm broad, subapically swollen and attenuated hyphae. Mature conidia are ellipsoidal, 4-celled, composed of two large, golden-yellow central cells and two small, nearly hyaline apical cells, rather thick-walled and measure 36–55 × 13–18 µm. The conidiogenous cells are surrounded by numerous, often branched, 1.5–2 µm broad and up to 250 µm long filaments.

The fungus is identical to *Calostilbella calostilbe* Höhnel, the anamorph of *Nectria striispora* Ellis & Ev. It has been redescribed and depicted by Samuels (*1973*).

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A NEW SPECIES OF SPOROTHRIX FROM KUWAIT

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During an ecological study of fungi of the tidal mudflats in Kuwait, a *Sporothrix* species has been recorded twice, in 1977 and 1980. It differs from other species of the genus (de Hoog, *1974, 1978*) in several characters and is here described as a new species. A comparison with similar species of the genus is added.

Sporothrix ranii Moustafa, *spec. nov.*—Fig. 1

Coloniae in agaro maltoso 25 °C post 7 dies ad 25 mm diam., lanosae ad funiculosae, albae; reversum dilute flavum; exsudatum et odor absunt. Hyphae submersae hyalinae, leves, irregulariter ramosae, 1.5–3.0 µm latae, nonnumquam 3–9 µm latae et in singulas cellulas secedentes; hyphae aeriae fragiles, singulae vel fasciculatae, leves, 2.0–3.5 µm latae. Cellulae conidiogenae in mycelio aerio sparsae, terminales vel laterales ex hyphis indistinctis singulis vel fasciculatis plus minusve erectis orthotropice oriundae, rectae vel modice curvatae, cylindricae, sursum paulo angustatae, vulgo 30–60 µm longae;

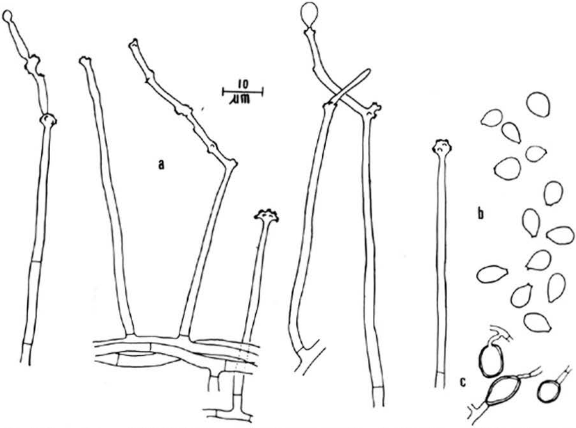

Fig. 1. *Sporothrix ranii*, CBS 119.81. —a. Conidiogenous cells. —b. Conidia. —c. Chlamydospores.

apices plerumque inflati, ad 8 cicatricibus paulo prominentibus praediti, sed saepe latitudine indistincti, geniculati-denticulati, saepe sympodialiter multo elongati et novos capitulos conidiorum formantes, aspectu irregulariter nodoso, saepe huc et illuc flexi, longitudine variabiles. Conidia in successione sympodiali formata, hyalina, levia, obovata ad ellipsoidea, (4.5–)5.5–7.5(–8.5) × (3.5–)4.5–5.5(–6.5) µm, cicatrice basilari prominente 1 µm lata. Chlamydosporae intercalares subglobosae ad ellipsoideae, hyalinae, crassitunicatae, 11–15 × 8–13 µm. Teleomorphosis ignota.

Typus: CBS 119.81 isolatus e sedimento lutoso supra marinorum aestuum recessum in Kuwait.

Colonies on malt agar at 25 °C attaining a diameter of 25 mm in 7 days, appearing lanose to funiculose, white. Reverse pale yellow; exudate and odour absent. Submerged hyphae hyaline, smooth, irregularly branched, 1.5–3.0 µm wide, intermingled with straight hyphae 3–9 µm wide which occasionally disarticulate into separate cells; aerial hyphae mostly fertile, fragile, loose or in tufts, smooth, 2.0–3.5 µm wide. *Conidiogenous cells* scattered in the aerial mycelium, arising terminally and laterally from suberect hyphae or hyphal fascicles, with usually orthotropic branching; conidiogenous cells straight or slightly curved, cylindrical, tapering gradually towards the tip, 30–60 µm long, in a later stage often with 1(–2) thin septa; apex usually inflated, with up to 8 slightly prominent scars about 1 µm wide. The head often proliferates to form new clusters of conidia, leading to an irregularly nodose, often sharply bent conidiiferous rachis of variable length. *Conidia* arising by sympodial growth, rarely poduced from intercalary clusters of denticles, hyaline, smooth, obovate to ellipsoidal, (4.5–)5.5–7.5(–8.5) × (3.5–)4.5–5.5(–6.5) µm; basal scar prominent, about 1 µm wide. *Chlamydospores* intercalary, thick-walled, hyaline, subglobose to ellipsoidal, 11–15 × 8–13 µm sometimes present in the submerged mycelium. *Teleomorph* unknown.

TYPE.—CBS 119.81 (living and dried), isolated from tidal salt marsh, Kuwait.

ETYMOLOGY.—The name is dedicated to my daughter Rani.

TABLE I. Characteristics of some species of Sporothrix related to S. ranii

	S. ranii	S. ramosissima	S. foliorum	S. schenckii
colony appearance	funiculose	funiculose	compact, farinose	lanose or moist
ramification	orthotropic	dichotomous	plagiotropic	irregular
secondary conidia	absent	absent	absent	often present
conidial shape	obovoidal to ellipsoidal	obovoidal to ellipsoidal	subglobose to obovoidal	guttuliform to fusiform
conidial size	5.5–7.5 x 4.5–5.5 µm	5.5–6.5 x 2.8–4.3 µm	2.8–3.5 x 2.0–2.6 µm	2.5–5.5(–8.0) x 1.3–2.5(–3.0) µm
conidial scars	prominent, c. 1 µm wide	prominent, c. 1 µm wide	flat, c. 0.5 µm wide	inconspicuous

Growth and sporulation were found to be optimal on oatmeal and Czapek's +0.5% yeast extract agars. On the latter medium the colony attained 40 mm diam. in 7 days. The yellow pigmentation of the colony reverse was most intense on malt extract agar.

Sporothrix ranii is similar to *S. ramosissima* Arn. ex Hoog in the shape and size of the conidia and conidium-bearing denticles. The conidiogenous cells of *S. ramosissima*, however, show a peculiar dichotomous branching (de Hoog, *1974*). In addition, the fertile hyphae of *S. ranii* may occur in suberect fascicles, and the conidiiferous apices often proliferate to form irregularly nodose or geniculate rachids. The species also resembles *S. vizei* (Berk. & Br.) Hoog, which however differs by septate conidia. The salient characteristics of some related *Sporothrix* species are summarized in Table 1.

I am indebted to Dr. G. S. de Hoog who critically read and corrected the manuscript, and to Dr. W. Gams who prepared the Latin diagnosis.

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PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 11, Part 3, p. 395 (1981)

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M. C. CLARK (editor), *A fungus flora of Warwickshire* (British Mycological Society, London, 1980). Pp. 272. Price £ 8.–.

This book is an annotated list of the fungi of the English county of Warwickshire. This unique survey of the fungus flora of a British county was undertaken jointly by members of the Birmingham Natural History Society and members of the staff of the Department of Plant Biology of the University of Birmingham. It supplements the earlier-published survey of the vascular plants and bryophytes of the county (Cadbury, Hawkes & Readett. 'A computer-mapped flora: a study of the county of Warwickshire.' London, 1971). There is information on habitats, distribution, and other details relating to 2,600 species of slime molds, fungi, and lichens. This book is very useful to mycologists interested in field work and those engaged in mycological surveys of other areas. The methods employed and their specific difficulties are discussed.

F. KOTLABA, *Unsere Pilze* (Albatros, Praha, 1980). Pp. 360.

This pocket-book is a field-guide for mycological beginners or the mushroom hunter. Its main part consists of 126 coloured plates representing many species of common fungi accompanied by short macroscopic descriptions and indications on edibility or toxicity. It is a German translation of Kotlaba's 'Naše Houby' (1965).

H. P. UPADHYAY, *A monograph of Ceratocystis and Ceratocystiopsis* (Univ. of Georgia Press, Athens, U.S.A., 1981). Pp. XIV + 176, 513 Figs. Price: $ 27,50.

This book deals with the study of both the sexual and asexual states of *Ceratocystis* and *Ceratocystiopsis*. Seventy-five species of *Ceratocystis* and fifteen species of *Ceratocystiopsis* are described. The ascomycetous genus *Ceratocystis* has *Sporothrix* and *Acremonium* as conidial states. Keys for identification are included. Thirty-nine names are reduced to synonymy and fifteen species are excluded for taxonomic reasons or inadequate knowledge.

This well-illustrated monograph is a basis for future taxonomic work in the group. It provides a useful reference book for mycologists and plant pathologists who have to deal with these fungi.