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SANCTIONED EPITHETS, SANCTIONED NAMES, AND CARDINAL PRINCIPLES IN ": PERS." AND ": FR." CITATIONS

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ABSTRACT

A historical perspective on the International Code of Botanical Nomenclature is given on (1) the establishment in 1910 of later starting-point works for fungal nomenclature (Persoon's **Synopsis Methodica Fungorum** of 1801 and Fries's **Systema Mycologicum** of 1821-1832), and (2) the dilemma of 1950-1981 in citing author citations for early species names once a 1 Jan. 1821 starting-point date had been established for 'fungi caeteri.' The concept of sanctioned names (and epithets), introduced into the Code at the Sydney congress in 1981, is explained. An urgent plea is made to mycologists to find holotypes or to designate lectotypes or neotypes of sanctioned names so that taxonomic mycology can proceed on a sound footing. Some principles in the practical application of the ": Pers." and ": Fr." system of notation for sanctioned names and epithets, also introduced at Sydney, are elucidated.

A BRIEF HISTORY OF LATER STARTING-POINT BOOKS AND DATES, AND OF THE ORIGIN OF "SANCTIONED" NAMES

At the 1910 (Brussels) International Botanical Congress (IBC) various later starting points for the nomenclature of plants were adopted where use of Linnaeus's **Species Plantarum** was felt ill-advised. For fungi four different starting-point works were named: Linnaeus's **Species Plantarum** (1753) was accepted for a starting- point book for myxomycetes and for lichens; Persoon's (1801) **Synopsis Methodica Fungorum** for rusts, smuts, and gasteromycetes; Sternberg's (1820) **Flora der Vorweldt** for all fossil plants (including fossil fungi); and Fries's 3-volume (1821-1832) **Systema Mycologicum** for all other fungi (termed the "fungi caeteri").

All fungal groups, except fungi caeteri, had a single volume as the starting-point book. Between 1910 and 1950 an often lively debate arose over how to interpret the 1821-1832 date-spread as a starting point for fungi caeteri. A few authors held that the starting point should be 1821, and that all names published after that date were validly published. Others held that names published prior to 1832 had no status and were not validly published except in the **Systema** itself. Still others assumed each group of fungi had its starting point on the date that Fries took up that group in the **Systema**. Thus agarics and aphyllophoralean fungi would mostly date from 1821, as would the Geoglossaceae of the Discomycetes; many other Discomycetes would date from vol. 2(1) of the **Systema** in 1822; the remaining Discomycetes in 2(2) in 1823; etc.

Because precision in dating nomenclatural matters is essential, a major change was enacted at the 1950 (Stockholm) IBC in which actual or arbitrary publication dates were set for starting-point works, and nomenclature for each of the groups was now defined as beginning on a particular **date** (rather than book). The dates which concern us were 1 May 1753 for Linnaeus's **Species Plantarum**, 31 Dec. 1801 for Persoon's **Synopsis**, 31 Dec. 1820 for Sternberg's **Flora**, and 1 Jan. 1821 for **volume 1** of Fries's **Systema**. (The other volumes of the **Systema** were not arbitrarily dated.)

The whole purpose of adopting later starting points had been to attain stability in nomenclature, recognizing that, in the case of fungi, there were two early authors, Persoon and Fries, who had brought some semblance of order out of the chaos of their pasts. The intent in 1910 was to build upon their taxonomy (and thus their interpretations of the taxonomy and nomenclature of earlier works). With the adoption of a starting-point **date** of 1 Jan. 1821, all those fungi caeteri in volumes 2 and 3 of the **Systema** were deprived of a starting-point **book** for reference. Since this was clearly at odds with the intent of having Fries's **Systema** serve as a later starting point, the 1950 IBC adopted a method of providing **priviledged status** to the names in those two volumes. They extended that priviledged status also to the names used by Fries in the 2-volume **Elenchus Fungorum** (1828), correctly seen as a true supplement to the **Systema**. The exact wording adopted for Art. 23f of the Stockholm Code was:

> f. FUNGI CAETERI, 1 Jan. 1821 (Fries, Systema Mycologicum Vol. 1). Vol. 1 of the Systema is treated as having appeared on 1 Jan. 1821, and the Elenchus Fungorum (1828) is treated as part of the Systema. Names of FUNGI CAETERI published in other works between the dates of the first (Vol. 1) and last (Vol. 3 part 2 and index) parts of the Systema which are synonyms or homonyms[1] of names of any of the FUNGI CAETERI included in the Systema do not affect the nomenclatural status of names used by Fries in this work.

The wording was not felicitous, since there is no definition of what the "nomenclatural status" of Fries's names is. The French text is perhaps clearer" "... n'ont point de répercussion sur la nomenclature des noms utilisés par Fries dans son ouvrage." The names in vols. 2 and 3 (and in the **Elenchus**) were thus accorded a special kind of priority as protected or priviledged names, and the

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[1] A reminder to the reader: a synonym is a different name for the same taxon based on the same or on a different type; a homonym is the same name based on a different type.

whole **Systema** was in some ways still a "starting-point book." For these priviledged names Donk (**1961**) coined the term "sanctioned" names. He also suggested adding an indication of such sanctioned status, ": Fr.," to those names which were **validly** published **prior** to the date that they were treated by Fries in the **Systema**. [Since valid publication of fungi caeteri did not begin until 1 Jan. 1821, the ": Fr." notation was only to be applied to names published in **other** works between 1821 and 1832 (index) that were adopted (in some form) by Fries in the **Systema/Elenchus**.] Though Donk's formal proposal for this system of notation was rejected at the next IBC, many workers, myself included, found it so useful that they often adopted this system in their publications.

THE 1950-1981 DILEMMA: AUTHOR CITATIONS

With the adoption in 1950 of 1 Jan. 1821 as the starting-point **date** for fungi caeteri, new problems in citing authorities arose. A single example is chosen here to illustrate how the many variations in permissible author citations came into being.

Peziza araneosa Bull. 1791, if it had been a plant with a 1753 starting point, would have complied with all the requirements for valid publication. Since it is a member of the fungi caeteri, it was "devalidated" (a term coined by Donk, **1957**) by provisions of later starting points. Fries accepted this species in Syst. Myc. **2**(1): 69, 1822. Prior to 1959 the International Code of Botanical Nomenclature (ICBN) permitted citation of this name in three ways:

(**1**) **Peziza araneosa** [Bull.] Fr.

(**2**) **Peziza araneosa** Bull. <u>ex</u> Fr.

(**3**) **Peziza araneosa** Fr.

The first two options clearly identified the source of the name, and thus of its type specimen; the third obscured the origin of the name. The foolishness of having two different ways of indicating a pre-starting-point author, square brackets and "<u>ex</u>," and the problem caused by thus introducing a different meaning for "<u>ex</u>" than used elsewhere in the ICBN, has been detailed elsewhere (Donk, **1957**). In the 1959 and 1964 Codes only citations (**1**) and (**3**) are approved. A reversal of this occurred in the 1969 and 1975 Codes, where only options (**2**) and (**3**) are approved. [The change was made (unwisely!) by the Editorial Committee, and not voted upon by the Congress. A proposal by Compère (**1973**) to restore square brackets instead of "<u>ex</u>" was not accepted at the Leningrad (1975) IBC.]

With the adoption in 1950 at Stockholm of a starting-point date of 1 Jan. 1821 a wholly new problem arose: whosoever **first** adopted the name after that date became the validating author (or, better, in Donk's terminology, the "revalidating" author of a devalidated name). The immense difficulty of ascertaining the name of this validating author was not given serious consideration by those who adopted the 1950 ICBN. The problem has been discussed at length elsewhere (Korf and Kohn, **1979**, **1980**; Demoulin *et al.* **1981**) and need not be restated here. Under the 1950 Code Bulliard's name (above) had special status since it was "sanctioned" by its use in Fries's **Systema**. **But the author citation was no longer that of the pre-1950 Codes,** for Fries only took up the name in late 1822, and at least four authors used it in 1821 (and at least one other author earlier in 1822 than Fries).

Extensive and painstaking bibliographic research over the years by such experts as Donald P. Rogers and Ronald H. Petersen (see Korf, **1982a**) has led to **partially complete** sequencing of the various books published in 1821 (and, to a much lesser extent, those published in 1822 and later). But for some 1821 books and articles an exact date of publication (and therefore their position in the sequence) will never be able to be established. (One could, of course, legislate arbitrary dates of publication for all of them!). Of the four known competing treatments in 1821 that adopted **Peziza araneosa** Bull., we know (Petersen, **1975**) that St.-Amans's **Flore Agenaise** was published between the 20th and 28th of April, Mérat's **Nouvelle Flore** between the 9th and 15th of June, and Purton's **Appendix** after August 1st. But Nocca and Balbis's **Flora Ticinensis** is, in Petersen's words, "unsequencable."

The 1950-1975 Codes left us with four[2] possibly correct citations:

(4) Peziza araneosa Bull. *ex* St.-Amans

(5) Peziza araneosa Bull. *ex* Nocca & Balb.

(6) Peziza araneosa St.-Amans

(7) Peziza araneosa Nocca & Balb.

For **none** of these was Fries's name to have any part in the citation, for his action in 1822 was **after** the starting-point date. Citations **(4)** and **(5)** had at least the merit of telling us where the type of the name is to be found (Bulliard's specimens if extant, publications, figures). Citations **(6)** and **(7)** make matters quite abstruse, since neither St.-Amans's nor Nocca and Balbis's works are available in many libraries, nor were they cited by Fries, Mérat, or Purton. On the contrary, even if Bulliard's work is not in many libraries, it **is** cited by Fries and by every one of the above authors, as it was the basis of all their treatments. (It is, moreover, now easily available on microfiche.)

And yet a further question haunted us: did Rogers and Petersen really exhaust the 1821 literature? Would someone unearth another obscure 1821 work using Bulliard's name?

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[2] I am intentionally ignoring two additional citations, **(4a) Peziza araneosa** [Bull.] St.-Amans and **(5a) Peziza araneosa** [Bull.] Nocca & Balb., permitted under the 1950 and 1954 Codes and demanded instead of **(4)** and **(5)** by the 1959 and 1964 Codes.

For example, a publication by Apocryphal, either in Jan.-Mar. 1821 or of undeterminable date within 1821, would yield two additional possibilities:

(8) **Peziza araneosa** Bull. ex Apocr.

(9) **Peziza araneosa** Apocr.

No "stability" in nomenclature arose from these changes in the Code in 1950: indeed, mycologists who wished to follow the Code were forced to leave their field work and their microscopes and to head for the dustiest library shelves to look at musty local floras, emerging finally with an author citation that - at best - "might" be the correct one!

THE 1981 CODE: SANCTIONED NAMES AND A UNIFORM STARTING POINT

In an effort to obviate the drudgery of sterile library searches that led to sometimes conflicting, sometimes unresolvable problems, a subcommittee of the Nomenclature Secretariat established in 1971 by the International Mycological Association made a series of proposals (after years of work and good-intentioned if not always good-natured in-fighting) that resulted in changes in the ICBN enacted at Sydney during the 1981 IBC. In brief, these restored Linnaeus's **Species Plantarum** (1 May 1753) as the starting point for all recent fungi (fossils still start in 1820), but at the same time gave protected status to the names adopted by Persoon in the **Synopsis** (1801) for rusts, smuts, and gasteromycetes, and to those adopted by Fries in the **Systema/Elenchus** (1821-1832) for fungi caeteri (excluding myxomycetes). Donk's term "sanctioned" was employed for any name "adopted" in those named works in the respective groups. Donk's proposed ": Fr." notation (for indication of a name "revalidated" by some other author than Fries that had, at a later date, been adopted in the **Systema**) was taken up in a modified form, since there are now two sanctioning works. (Persoon's names in the **Synopsis** were published under 1950-75 Codes on their own later starting point date, 31 Dec. 1801, and had automatic priority; to maintain that priority, sanctioning status was necessarily extended to that work.)

What did this do to our example fungus? It changed the status of Bulliard's 1791 name from "not validly published" to "validly published," since it appeared after 1 May 1753. By examination of the **Systema** we discover that Fries "sanctioned" the name. We need never look in the library for the works of St.-Amans, Mérat, Purton, or Nocca and Balbis in regard to this fungus, for they no longer have any nomenclatural impact; their sole claim to our current interest lies in distributional records or possible misidentifications. Likewise, we need never fear the discovery of "Apocryphal's" 1821 treatment. **The new Code now permits only two citations:**

(10) **Peziza araneosa** Bull.

(11) **Peziza araneosa** Bull. : Fr.

For many purposes the first will suffice. For certain situations the latter will be better, for it conveys an additional bit of information: "this name has been sanctioned by Fries." As we shall now see, sanctioning is a two-edged sword, having to do not only with priorability of names, but also with typification of names.

SANCTIONED NAMES:
PROTECTED AGAINST SYNONYMS AND HOMONYMS

Under the 1950-1975 Codes, names of fungi caeteri adopted by Fries in vols. 2 and 3 of the **Systema** and in the **Elenchus** were granted a priority over competing names (i.e., names at the same rank) published after 1 Jan. 1821 and before the index to vol. 3 (1832), whether these were synonyms or homonyms. Under the 1981 Code, all those names not only retain that priority status, but now similar status extending all the way back to 1753 has been extended to them and to all of the names of fungi caeteri adopted (sanctioned) by Fries in vol. 1 of the **Systema** and also to all of the names of rusts, smuts, and gasteromycetes sanctioned by Persoon in the **Synopsis** (1801). Sanctioned names are protected **only at the rank assigned them by Persoon or by Fries** in the sanctioning work, since priority is always rank-limited under ICBN (Art. 60.1. "... In no case does a name or epithet have priority outside its own rank").

TYPIFICATION OF SANCTIONED AND UNSANCTIONED NAMES

A very significant aspect of the changes adopted at Sydney was a further attempt to attain stability in application of sanctioned names. The ICBN is based on the type method, and though specific and infraspecific names have long been recognized as having **specimens** as their types, the Sydney Code makes amply clear that the names of all taxa, e.g., generic names, ultimately have **specimens** which fix the application of the name. For many early fungal names type specimens no longer exist, and for unequivocal application of a name, nomenclatural stability requires us to propose a **neotype** to fix the application of such names. Words and drawings cannot be sectioned, nor can reagents be applied to them to determine reactions. Under the Sydney Code the type of a sanctioned name may be selected not only from the original author's material, but also from the material of the sanctioning author or from material he cites by reference. Sometimes an early author's herbarium yields one or more specimens bearing the name in question, but their status as **holotype** or **syntype** material may be open to serious question. It should now be possible in most cases to choose a **lectotype**, or, far more frequently, a **neotype**, which corresponds to **current usage** of a name, as viewed through the eyes of the sanctioning and the original authors. When these two disagree, the choice should be based on whichever will cause the least discomfort and disruption of taxonomy. Neotype specimens will be able to be sectioned, examined, and characterized. A great advantage of these neotypes over the generally "lost" original materials is that they can be abundant collections, well-dried, and adequately characterized when in fresh condition. They would ideally serve the ends desired by Smith (**1977**: 123-125, 150-155) for "representative" specimens. I have discussed most of the processes of typification of sanctioned names elsewhere (Korf, **1982a**, **1982b**), and shall not belabor the matter further here.

Since the type method requires suitable types, mycologists must now devote themselves (1) to finding holotypes when they exist, (2) to designating lectotypes from undoubted "original material," and, far more frequently, (3) to providing adequate neotypes for old names that are now 'typified' by illustrations ('iconotypes') or by descriptions alone.

First in importance will be specimen typification of names used in the two sanctioning works. Scrupulous care must be used in designating neotypes, as the Code reminds us, but such care will result in neotypes (preferably topotypes from the type locality) that will fix the names as currently employed (at least in a great majority of cases). Only later will we need to consider names placed in synonymy by the sanctioning authors, or names overlooked or ignored by them. When such an early name, after specimen typification, competes with a sanctioned name, it will merely fall into synonymy with the sanctioned (protected) name. If such a name turns out not to be treated in the sanctioning work, it also will need to be specimen typified and will date from the date of its original publication. The principle of priority will in some cases then force us to adopt an old, forgotten name instead of a name in use but described later. This particular argument was advanced as a reason for not abandoning later starting points, but if priority is to be served (and it is a guiding principle of our Code) then it should be allowed to operate. If Quélet renamed a species in the 1880's that Bulliard had previously described in 1791, why should we continue to give credit to Quélet when Bulliard had come to the same conclusion nearly a century earlier? Where such later species names are of "major economic importance," we can resort to species conservation.[3]

SANCTIONED NAMES OR SANCTIONED EPITHETS?

It is unfortunate but true that legislators often make semantic errors. What zoologists call a "species name" botanists call a "species epithet." The various editions of

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[3] Though **nomina specifica conservanda** were (at long last) permitted under the Code adopted at Sydney in 1981, what botanists really intended to do, I remain convinced, was to conserve species epithets, not species names. The Vice-Rapporteur (Greuter and Voss, 1982: 54-55.) explained that under the new provisions of Art. 14 what will be conserved are **basionyms**. These are conserved against all homonyms and against all listed synonyms. When the epithet of that conserved basionym is transferred, it retains its priority (at the same rank) against any combination based on a rejected name. Horrendous circumlocutions were introduced into the new wording of Art. 14 merely to avoid admitting that we wanted to conserve species epithets rather than species names.

the ICBN have been plagued by use of 'name' in many places where 'epithet' had been intended. One of the most flagrant of these errors has been in regard to what is 'protected' in Fries's **Systema/Elenchus** (and now in Persoon's **Synopsis**) by the 1950-ff. Codes. Remember that the wording was (and still is) "Names of FUNGI CAETERI ...." What was intended was not only that **names** used by these authors were to be preserved, but also **epithets**, as can best be shown in an example:

Agaricus melleus Vahl was published in 1790, and is a sanctioned name in Fries's **Systema.** One of the synonyms cited by Fries is **Agaricus obscurus** Schaeff., published in 1762. With the new 1753 starting-point date, **both** names are validly published, and were it not for the sanctioned status accorded Vahl's name, we would be obliged to take up Schaeffer's name on the basis of priority.[4] This is the fungus known today as **Armillaria mellea** [or as **Armillariella mellea** by those who (I agree with Watling et al., **1982**) have selected an ineligible type for the name **Armillaria**]. If it is indeed Vahl's **name** that was sanctioned by Fries, what happens when we treat the epithet in another genus, **Armillaria** or **Armillariella**? Neither **Armillaria mellea** nor **Armillariella mellea** were names sanctioned by Fries, and neither would have priority status over the names "**Armillaria obscura** (Schaeff.) Author-X" or over "**Armillariella obscura** (Schaeff.) Author-Y." It was certainly never the intention of those who framed the wording in 1950 that gave privileged status to Fries's works nor those who adopted almost identical wording in 1981 for providing sanctioned status for Persoon's and Fries's works that old names synonymized in the protected works could ever rise again to haunt us nomenclaturally! When they wrote "Names of FUNGI CAETERI ..." they clearly meant "Names **and epithets** of FUNGI CAETERI ..." were to be accorded sanctioned status. Not only are the several generic and suprageneric names in the sanctioning works to have privileged status (at their rank), but likewise **epithets** (infrageneric epithets, specific epithets, and infraspecific epithets) have a priviledged status. When such epithets are transferred (and retain their same rank) it was clearly our intent that they should retain their special status.

Another very important point needs to be made here: sanctioned names and epithets are sanctioned against all "synonyms and homonyms," **whether these are mentioned in the sanctioning work or not.** In this regard **sanctioned** names differ markedly from **conserved** names. Both take priority over homonyms whether cited or not, but conserved names take priority **only** over those earlier synonyms that are specifically listed in the Appendices as **nomina rejicienda.**[5]

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[4] For our purposes here we shall assume that Fries was correct in synonymizing the two names, and that they are indeed taxonomic synonyms.

[5] Ever since first introduced, conserved family names have lacked listed nomina rejicienda despite the Codes' requirements that this be done! A new 'housekeeping' proposal was introduced on the floor at Sydney (Greuter and Voss, **1982**: 51-52) to exempt family names

In our example, **Agaricus melleus** Vahl. : Fr. is also protected against discovery of **any** pre-1790 name, even one not cited by Fries, which we conclude is a synonym. (And, as I have shown above, the intent is that the epithet "**mellea, -us,** -um Vahl. : Fr." is similarly protected in **Armillaria** and in any other genus to which it may be transferred at species rank.)

RANKS OF SANCTIONED NAMES

Anyone who has worked with the sanctioning books will be well aware that though genera and species are easily recognized ranks, many of the suprageneric taxa bear ranks unlike those in modern use, while many of the infrageneric categories are undesignated or are at times at ranks not permited under the Code.[6] Infraspecific categories are similarly of several levels, often not indicated; following tradition, "the rank of subspecies under species is marked by letters or figures; that of varieties by the series of Greek letters, α, β, γ, etc. Groups below varieties and half-breeds (mule of florists) are indicated by letters, figures or typographical signs, according to the will of the author" (de Candolle, **1868**). (Art. 35 of the ICBN deals in detail with cases where clear indication of rank is not provided.) What mycologists must now keep in mind, of course, is that even if the rank of the taxon in one of the sanctioning works is uncertain, the name is nonetheless sanctioned, and thus the sanctioning treatment should be weighed when typifying a name (at whatever rank!). Unlike priority, which is inoperative outside rank, typification remains constant, even though rank may change. Should **Agaricus melleus** be reduced to subspecific or varietal rank under another species name, it would retain the same type specimen it had when originally published at species rank (or when neotypified at any rank).

SOME CARDINAL PRINCIPLES FOR ": PERS." AND ": FR." CITATIONS

Having spent something over two years now working with how to cite names under the new provisions adopted at Sydney, I have come to see several possible pitfalls. Perhaps I can prevent others from repeating my mistakes. The main difficulty has been in attempting to make these notations do more than one job, in a mistaken sense that economy of citation is an ideal. Once it is firmly entrenched in one's mind that such notation **only** indicates sanctioning of the particular generic or suprageneric name or infra-

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from the requirement to list nomina rejicienda. The Rapporteur-Général saw no problems arising over the proposal. Yet a clear distinction was thereby made between the treatment of conserved generic and specific names and those of families. The treatment now afforded conserved family names comes closer to the priority aspects of sanctioned fungal names than it does the priority aspects of conserved generic or specific names.

[6] The pertinent rule of the Code (Art. 33.4, 33.5) makes an exception for Fries's taxa termed "tribes" (tribus) in the **Systema**, "which are treated as validly published." No other misplaced ranks are permitted.

generic, specific, or infraspecific epithet, then use of the notation system becomes unambiguous and easy to apply.

Principle 1

": Pers." and ": Fr." are notations which may be left out of author citations in non-taxonomic work, but should normally be used in any taxonomic treatment, since they convey information about priorability, typification, or both.

Principle 2

Sanctioning is independent of rank, and the notations ": Pers." and ": Fr." in no way indicate the rank at which a name or epithet was sanctioned. The purpose of the notation is to say: "**Beware**: this name (epithet) was adopted in a sanctioning work, and has special priority and typification status."

Principle 3

Priority of sanctioned names and epithets extends only within the rank assigned by the sanctioning author. (E.g., an epithet, sanctioned at varietal level, when raised to species rank does not retain priority over an earlier, validly published but non-sanctioned species epithet.)

Principle 4

Typification is independent of rank, even when ranks differ between original and sanctioning treatments. Typification of sanctioned names and epithets must be viewed not only on the basis of the protologue of the original author, but also of all other elements referred to (directly or indirectly) in the sanctioning work.

Principle 5

When the notation ": Pers." or ": Fr." is used it must always **immediately** follow the name of the original author. Even though a sanctioning author may have sanctioned a previous combination, it is critical that the notation be inseparable from the name of the original author, for the two must be transferred together when the epithet itself changes generic placement or rank. [E.g., **Octospora applanata** Hedw. 1801 was transferred to **Peziza** in 1805 by Albertini and Schweinitz. It might seem logical to cite the name, sanctioned by Fries in 1822, as "**Peziza applanata** (Hedw.) A. & S. : Fr.," but this is illusory! When we transfer this species to yet another genus or give it another rank, it is "**applanata** (Hedw. : Fr.)" that we will want to transfer so that workers will still know of its special priority and typification status. The correct citation in **Peziza** is "**P. applanata** (Hedw. : Fr.) A. & S." If treated as a species of **Octospora**, it should be cited as "**O. applanata** Hedw. : Fr." even though Fries did not sanction it under that generic name.[7]]

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[7] Again I find here convincing evidence that it is epithets of species and infraspecific

Principle 6

When a new combination is made in one of the sanctioning works, the sanctioning author thereby simultaneously sanctions the basionym and makes the transfer. His name should appear twice. [E.g., citations such as "**Daedalea striata** (Swartz) : Fr." or "**D. striata** (Swartz : Fr.) Fr. : Fr." should be avoided for a first transfer of Boletus striatus Swartz (now **B. striatus** Swartz : Fr.). The correct format for this is "**Daedalea striata** (Swartz : Fr.) Fr." This clearly differentiates the two actions by Fries, transferral and sanctioning. To ask ": Fr." to do two jobs will lead to complications when the name is transferred again. Everything within the parentheses will transfer, and nothing outside the parentheses will do so.[8]]

Principle 7

When a new taxon is published in a sanctioning work, it is necessary in taxonomic works to cite the sanctioning author's name twice, separated by a colon. (E.g., "**Thelephora avellana** Fr. : Fr." would be the preferred citation for a new species published by Fries in 1821 in the **Systema**. Not only is the name Fries's, but when transferred it is imperative that its special priority status be recognized. So long as it is treated at the rank of species, the epithet has priority over any epithet published earlier.)

Principle 8

When two competing names of the same date have both been sanctioned, the first author to choose one over the other should be followed, in accordance with the general practice of ICBN (Art. 57.2). When they are of different date, priority of original publication will take effect (Art. 57.1).

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taxa that are sanctioned. One could argue that in this instance **both** the name (combination) "**P. applanata**" and the epithet "**applanata** Hedw." were sanctioned, but it is only critical that the sanctioning author's name be connected to the epithet when it is transferred, and of no importance that it be attached to the name (combination).

[8] A citation such as **Peziza bolaris** Batsch : Fr. var. **explanata** (Holmsk. : Fr.) Fr. conveys the information that (1) Holmskjold erected this taxon in some other genus or at some other rank, or at the rank of varietas under some other species name, (2) that the epithets **bolaris** and **explanata** are both sanctioned, and (3) that Fries (at some time) transferred Holmskjold's epithet to varietal status under **P. bolaris**. Though the transfer was actually made in the sanctioning work, the desire therefore to cite this as "**P. bolaris** Batsch : Fr. var. **explanata** (Holmsk.) : Fr." must be resisted. While that would convey the additional information that the transfer was made in the sanctioning work and not in an earlier or later publication by Fries, such is **not** the purpose of ": Pers." and ": Fr." notations. Better we know what to transfer, "**explanata** (Holmsk. : Fr.)," when the epithet is moved than particulars about when or where a combination was made, not a normal function of author citations.

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ON THE GENERA *COCHLIOBOLUS* AND *PSEUDOCOCHLIOBOLUS*

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Abstract

Intraspecific variation in the two characteristics used to distinguish *Pseudocochliobolus* from *Cochliobolus* highlight the difficulties involved in keeping these genera separate, and it is proposed that the former name be put into synonymy. The anamorphs of *Cochliobolus* species are species of *Bipolaris* and *Curvularia*, and these genera are compared. Observations on conidium septation are reported, and application of the terms 'euseptate' and 'distoseptate' is discussed. The new combinations *Cochliobolus australiensis* (Tsuda & Ueyama) comb. nov., *C. nisikadoi* (Tsuda, Ueyama & Nishihara) comb. nov., and *Bipolaris chloridis* (Alcorn) comb. nov. are proposed. In addition the combination *B. homomorphus* (Luttrell & Rogerson) Subram. is validated, and a lectotype designated for *C. heterostrophus* (Drechsler) Drechsler.

INTRODUCTION

When fungi in *Eu-Helminthosporium* (*Bipolaris*) were first shown to have ascal state connections, those teleomorphs were described as species of *Ophiobolus*. In describing *O. heterostrophus* Drechsler, Drechsler (1925) indicated that 'the leaf spot fungus is tentatively assigned to *Ophiobolus*', and that this was 'not intended to imply close relationship to certain species referred to this genus' such as *O. cariceti* (Berk. & Br.) Sacc. and

O. herpotrichus (Fr.) Sacc. Four more correlations between *Helminthosporium* species and *Ophiobolus* were soon identified. Ito and Kuribayashi (1927) described *O. miyabeanus* Ito & Kurib. as the perfect state of *H. oryzae* B. de Haan. The other species described in this period were *O. kusanoi* Nisik. (Nisikado 1928), *O. sativus* Ito & Kurib. (Ito & Kuribayashi in Kuribayashi 1929), and *O. setariae* Ito & Kurib. (Ito & Kuribayashi in Ito 1930). The anamorphs recorded for these fungi were respectively *H. kusanoi* Nisik., *H. sativum* Pamm., King & Bakke, and *H. setariae* Saw.

Cochliobolus was erected by Drechsler (1934) for the fungus he had described previously as *O. heterostrophus*. The main features distinguishing the new genus from *Ophiobolus* were greater ascus and ascospore width, the strongly helicoid arrangement of spores in the ascus, and the associated conidial state. Two species of *Ophiobolus* from *Ambrosia trifida* L. were found to produce *Phoma*-like conidial states in culture, while other species produced no anamorphs at all. In contrast the anamorph associated with the type species of *Cochliobolus* was a species of *Helminthosporium* exhibiting bipolar germination (*H. maydis* Nisik. & Miyake). Drechsler realized that several other species described in *Ophiobolus* belonged in the new genus. He included *O. kusanoi*, *O. miyabeanus*, *O. sativus*, and *O. setariae* in his concept of *Cochliobolus*, but did not formally transfer the names of these species. In addition to the four species just listed, Drechsler regarded the unnamed *Ophiobolus* states of *H. micropus* Drechsler and *H. stenospilum* Drechsler as belonging in *Cochliobolus*. Transfer to *Cochliobolus* of the names of the four *Ophiobolus* species accepted by Drechsler was made by Dastur (1942) who also added *C. tritici* Dastur. Subsequently the genus has been expanded to include 32 species, many of which have *Bipolaris* anamorphs (Table 1).

The correlation of some *Bipolaris* species with the teleomorph genus *Pseudocochliobolus* (Tsuda, Ueyama, & Nishihara 1977; Tsuda & Ueyama 1981) introduced heterogeneity into the anamorph-teleomorph connection previously thought to be predictive, namely that all *Bipolaris* species will prove to have *Cochliobolus* ascogenous states (Luttrell 1977, 1978). The differences between the two teleomorph genera are examined below.

Table 1. *Cochliobolus* species and their anamorphs

Species	Author(s)	Anamorph *
bicolor	Paul & Parbery 1966	B. bicolor
boutelouae	Sprague 1951	unknown
carbonum	Nelson 1959	B. zeicola
chloridis	Alcorn 1978	D. chloridis
cymbopogonis	Hall & Sivanesan 1972	C. cymbopogonis
cynodontis	Nelson 1964a	B. cynodontis
dactyloctenii	Alcorn 1982	B. dactyloctenii
geniculatus	Nelson 1964c	C. geniculata
hawaiiensis	Alcorn 1978	B. hawaiiensis
heterostrophus	(Drechsler) Drechsler 1934	B. maydis
homomorphus	Luttrell & Rogerson 1959	B. homomorphus
intermedius	Nelson 1960b	C. intermedia
kusanoi	(Nisikado) Drechsler ex Dastur 1942	B. kusanoi
lunatus	Nelson & Haasis 1964	C. lunata
melinidis	Alcorn 1982	B. melinidis
miakei	Hino & Katumoto 1966	unknown
miyabeanus	(Ito & Kuribayashi) Drechsler ex Dastur 1942	B. oryzae
nodulosus	Luttrell 1957	B. nodulosa
palmivora	Rao & Chaudhury 1964	unknown
peregianensis	Alcorn 1982	B. peregianensis
perotidis	Alcorn 1982	B. perotidis
ravenelii	Alcorn 1981a	B. ravenelii
sasae	Hino & Katumoto 1960	unknown
sativus	(Ito & Kuribayashi) Drechsler ex Dastur 1942	B. sorokiniana
setariae	(Ito & Kuribayashi) Drechsler ex Dastur 1942	B. setariae
sitharamii	Reddy 1976	unknown
spicifer	Nelson 1964b	B. spicifera
sporoboli	Castellani 1951	H. sp.
stenospilus	Matsumoto & Yamamoto 1936	B. stenospila
tripogonis	Alcorn 1981a	B. tripogonis
tritici	Dastur 1942	H. sp.
victoriae	Nelson 1960a	B. victoriae

* B = *Bipolaris*, C = *Curvularia*, D = *Drechslera*, H = *Helminthosporium* (sensu lato)

OBSERVATIONS ON *COCHLIOBOLUS* AND *PSEUDOCOCHLIOBOLUS*

Tsuda et al. (1977) distinguished their genus *Pseudocochliobolus* from *Cochliobolus* on two characteristics. One was the presence of stromatic tissue below the ascocarp body in *Pseudocochliobolus*. The other was the degree of ascospore coiling in the ascus, pronounced in *Cochliobolus* and slight or absent in *Pseudocochliobolus*.

Stromatic tissue

In the type species of *Cochliobolus*, *C. heterostrophus* (Drechsler) Drechsler, there was no stroma developed in association with ascocarps formed on leaves of *Zea mays* L. incubated in a moist chamber (Drechsler 1925, 1934). Numerous ascomata were produced during a study of Australian races and mating types of this fungus, but in no case was a conspicuous supporting stroma developed (Alcorn 1975). In the current study, ascomata were produced by paired cultures on Sachs' agar + maize leaf, and examined carefully for any supporting stromatic tissue. None was seen. Stromata were not induced by growing paired cultures on filter paper, maize grain, wheat straw, or *Chloris gayana* Kunth leaf (each on Sachs' agar), although ascocarps formed on these substrates. In contrast, ascomata of *Pseudocochliobolus nisikadoi* Tsuda, Ueyama & Nishihara are borne on a stroma, consisting of a short cylindrical base or a flattened crust in the substrate (Tsuda et al. 1977; pers. obs.).

In other species assigned to *Cochliobolus*, a sterile stromatic base is sometimes present below the ascogenous locule. These species include *C. ravenelii* Alcorn, *C. tripogonis* Alcorn (Alcorn 1981a), *C. perotidis* Alcorn (Alcorn 1982), *C. lunatus* Nelson & Haasis (Nelson & Haasis 1964), *C. geniculatus* Nelson (Nelson 1964c), and *C. spicifer* Nelson (Nelson 1964b). I have shown that in *C. cymbopogonis* J.A. Hall & Sivan., this characteristic is strongly influenced by the culture medium. A distinct stroma is commonly produced on Sachs' agar + *Z. mays* leaf, but only rarely formed on water agar + wheat straw (Alcorn 1981b). The ascomata of *Cochliobolus* species are ascostromatic ascocarps (Luttrell 1973), and in some species additional basal stromatic tissue occurs. It seems undesirable to use such a variable attribute as a generic criterion, and such use in the context of the taxa under discussion is rejected.

Ascospore coiling

Tsuda et al. (1977) claimed that the degree of ascospore coiling was pronounced in *Cochliobolus*, and slight or absent in *Pseudocochliobolus*. This characteristic was examined in fresh material of *C. heterostrophus* produced by pairing compatible isolates on Sachs' agar + *Z. mays* leaf. Ascocarps were crushed individually in lactofuchsin, and each mature ascus categorized with respect to degree of ascospore coiling. The following categories were used:-

(a) spores tightly coiled in a helical path over the whole length, except sometimes very near the tip where the spores tended to be parallel to the long axis of the ascus.

(b) spores tightly coiled in the lower two thirds, loosely coiled to straight in the upper third.

(c) spores loosely coiled for the whole length of the ascus.

(d) spores looped in the lower half, coiled helically in the upper half.

The number of asci in each category was counted in 18 ascocarps (Table 2). In addition to these, there were low numbers of asci in which the spores were tightly coiled in the upper and lower parts, and loosely coiled to straight in the median section; or looped irregularly for the whole length. This characteristic is thus more variable than suggested by Drechsler's account of the species (Drechsler 1925), or by the report of Tsuda et al. (1977).

Table 2. Ascospore coiling in asci of *Cochliobolus heterostrophus*

	Coiling category (see text)			
	(a)	(b)	(c)	(d)
No. asci	103	183	62	27
%	27.5	48.8	16.5	7.2

Ascospore arrangement in asci of *P. nisikadoi*, the type species of *Pseudocochliobolus*, was described as parallel to loosely coiled or very rarely coiled in a close helix (Tsuda et al. 1977). Maximum lengths of asci and ascospores were reported as 258 µm and 288 µm respectively. In an isotype specimen (IMI 214643), 75 asci from a single ascocarp were examined. Sixty asci had spores which were straight to loosely coiled over much of the ascus length. In most of these asci, spores were coiled more tightly for 20-30 µm in the apical section. Some were coiled apically and basally but were more or less straight in the median section. In the other asci examined, ascospores were classified as moderately to closely coiled over their whole length. These categories are broad, but there is a continuum between spores straight and parallel, and spores coiled in a close helix. An attempt was made to produce ascocarps of *P. nisikadoi* under the same cultural conditions as *C. heterostrophus*. Unfortunately two isolates supplied by Dr. Tsuda (1021-3, 7-3-2) failed to form the teleomorph when paired and a direct comparison was not possible.

Ascospores are loosely coiled in other species, for example *C. hawaiiensis* Alcorn, *C. peregianensis* Alcorn, *C. perotidis*, *C. tripogonis*, *C. dactyloctenii* Alcorn and *C. cymbopogonis*. In the last-named species ascospores commonly are straight and parallel for much of the ascus length, although Hall and Sivanesan (1972) did not report this fact. They described ascospores as 'closely spirally coiled in the ascus', but gave maximum lengths of asci and ascospores as 275 µm and 300 µm (rarely 420 µm) respectively. My observations on an isolate of *C. cymbopogonis* studied by Hall and Sivanesan (IMI 130402) indicate that many asci have spores only loosely coiled, or straight for much of the ascus length. Species which have some ascospores closely coiled for most of the ascus length also have maximum ascospore length greater than maximum ascus length. In contrast, where coiling is not pronounced the maximum ascospore length may be equal to or less than that of asci. Examples of the latter type are *C. geniculatus* (ascospore maximum 270 µm, ascus maximum 290 µm), *C. hawaiiensis* (190 µm, 205 µm), *C. kusanoi* (Nisik.) Drechsler ex Dastur (170 µm, 170 µm), *C. lunatus* (270 µm, 300 µm), *C. nodulosus* Luttrell (193 µm, 193 µm), *C. peregianensis* (200 µm, 255 µm), *C. spicifer* (240 µm, 260 µm), *C. sporoboli* E. Castell.

(140 µm, 140 µm), and *C. tripogonis* (275 µm, 310 µm). For *C. cymbopogonis*, the corresponding values are 370 µm and 340 µm (pers. obs.).

Discussion

Intraspecific variation in the characteristics used by Tsuda et al. (1977) to separate *Pseudocochliobolus* and *Cochliobolus* throws doubt on their use as generic differentials. I believe the evidence does not support the retention of *Pseudocochliobolus* on the grounds offered, and suggest that the name be put into synonymy with *Cochliobolus*.

ANAMORPHS OF *COCHLIOBOLUS*

The description of *Cochliobolus* included details of the anamorph, and Drechsler (1934) indicated that the new genus was 'defined in both its sexual and asexual stages'. By definition therefore, other *Cochliobolus* species should have anamorphs congeneric with *Bipolaris maydis* (Nisik. & Miyake) Shoem. Drechsler recognized that species such as *Helminthosporium geniculatum* Tracy & Earle differed from others then referred to *Helminthosporium* sensu lato, but he did not exclude them from the genus. Subsequently *H. geniculatum* and similar species have been segregated in *Curvularia* (Boedijn 1933). This genus has been considered quite distinct from *Bipolaris* (Ellis 1966, 1971; Groves & Skolko 1945; Putterill 1954), but the teleomorphs discovered for members of both genera have been assigned to *Cochliobolus* (Table 1). This would seem contrary to Drechsler's circumscription of the genus, unless *Curvularia* and *Bipolaris* are not distinct. Von Arx and Luttrell (1979) have in fact suggested that *Bipolaris* should be made a synonym of *Curvularia*. I have examined this proposal and present results of my observations below.

The genera *Curvularia* and *Bipolaris*

The genus *Curvularia* was erected in 1933, with *C. lunata* (Wakker) Boedijn as the type species (Boedijn 1933). Conidia of *C. lunata* are obovoid, curved, 3-septate, with the penultimate cell swollen, thicker walled, and darker than the other cells. *Bipolaris* was established in

1959, with *B. maydis* as the type species (Shoemaker 1959). Conidia of *B. maydis* are fusoid, curved, multiseptate, with cells concolorous and lacking any disproportionate swelling.

Ellis (1971) has provided standarized descriptions for many dematiaceous hyphomycetes. His descriptions of *Curvularia* and *Drechslera* sensu lato (which includes *Bipolaris*) reveal no differences in characteristics of the colonies, mycelium, stromata, conidiogenous cells or conidiophores. The genera are distinguished on the basis of conidium morphology, summarized for each genus in the following table. These data are drawn from the accounts by Ellis (1966, 1971, 1976).

Conidium characteristics in the genera *Curvularia* and *Drechslera* sensu lato

Curvularia	*Drechslera*
solitary or catenate	solitary or catenate
acropleurogenous	acropleurogenous
simple, often curved	simple, straight or curved
clavate, ellipsoidal, broadly fusiform, obovoid or pyriform	clavate, cylindrical, ellipsoidal, fusiform or obclavate
pale or dark brown, often with some cells paler	straw-coloured, pale to dark brown or olivaceous brown, sometimes with end cells paler
smooth or verrucose	mostly smooth, rarely verruculose
hilum flush or protruding	hilum flush or protruding
septate	pseudoseptate
swollen median cell or cells present	swollen median cell or cells absent

This comparison highlights the similarities between these genera. Curved conidia occur in both, but in *Curvularia* the curvature is often associated with a disproportionately swollen median cell or cells, a characteristic previously stressed by Ellis (1966). The conidia of many species of *Drechslera* and *Bipolaris* have numerous septa, although some have only a few. Examples of species with the latter condition are *B. australiensis* (M.B. Ellis) Tsuda & Ueyama, *D. papendorfii* (van der Aa) M.B. Ellis, *B. spicifera* (Bain.) Subram., *D. biseptata* (Sacc. & Roum.) Richardson & Fraser, and *B. ravenelii* (Curt.) Shoem. Most *Curvularia* species have only three or four septa in mature conidia.

There is an important difference in the nature of conidial septa, used by Ellis as a differentiating character in his key to genera (Ellis 1971, p. 21, couplet 193). Conidia of *Drechslera* are distoseptate (= pseudoseptate sensu Ellis), while those of *Curvularia* are septate. Luttrell (1963) has pointed out that the term 'pseudoseptate' has been used in two senses by Ellis. In the context of comparing *Drechslera* and *Curvularia*, it is clear that Ellis has used the term in the sense of 'distoseptate', and that 'septate' means 'euseptate' when applied to *Curvularia* conidia.

Euseptate and distoseptate conidia

The terms euseptate and distoseptate were introduced by Luttrell (1963). Euseptate conidia have a single wall from which true septa form as inward extensions. *Sporidesmium* and *Vakrabeeja* (= *Nakataea*) were used as examples of genera with such conidia by Luttrell. Distoseptate conidia have at least two distinct walls. There is a thin, rigid outer wall to which septa are not joined. This outer wall encloses a thick, hyaline inner wall. The distosepta delimiting cells of the conidium are formed by the inner wall alone, and the outer wall does not participate. In some fungi, for example *Bipolaris sorokiniana* (Sacc.) Shoem., the outer wall of the conidium is brittle and easily fractured by pressure. In such conidia the internal structures often can be expelled intact, revealing cells enclosed by the thick hyaline wall (Luttrell 1963).

Other species Luttrell used as examples of fungi with distoseptate conidia were *D. avenacea* (Curt. ex Cooke) Shoem., *Deightoniella torulosa* (Syd.) M.B. Ellis, and *Corynespora cassiicola* (Berk. & Curt.) Wei. In another paper, Luttrell (1964) reported that conidia of *B. maydis* and *Exserohilum turcicum* (Pass.) Leonard & Suggs were distoseptate, but that this characteristic was difficult to demonstrate in the former species because of the tough outer wall.

Observations on conidium septation in various genera

Conidia were mounted in 3% KOH and fractured by tapping or pressing on the coverslip, then stained by irrigation with 0.5% aqueous phloxine. This stained protoplasm a deep pink colour, and after some time hyaline walls became pale pink. The term 'wall' is used in the following section in a broad sense, to describe ' a morphological entity of apparent structural uniformity' (Sutton & Sandhu 1969).

Septation in *Bipolaris, Drechslera* and *Exserohilum*

Conidia of *B. maydis*, the generic type, have two distinct walls which can be demonstrated by the treatment described above. Under pressure the thin pigmented outer wall splits to release the hyaline contents. The latter sometimes emerge intact, and consist of a hyaline wall enclosing the cells of the conidium (Fig. 2). As reported by Luttrell (1964), the outer wall in this species is stronger than that in *B. sorokiniana*, and more pressure must be applied to achieve the same degree of fragmentation. The inner wall often ruptured under these conditions.

Only slight pressure is necessary to break the outer wall in conidia of *B. sorokiniana*, and the contents often can be expelled intact. A thick hyaline wall encloses more or less globose cells with deeply-staining protoplasm (Fig. 3). A fine dark transverse line is often visible between the cells. There is no evidence of torn attachment points for septa when all structures internal to the brown outer wall have been expelled.

Conidia of other *Bipolaris* species, and of *Drechslera* and *Exserohilum* species, were examined by the same method. Species in which conidia were found to be distoseptate are listed in Table 3. The brittle nature of the outer conidial wall in *B. sorokiniana* was not matched in all other species, and some resembled *B. maydis* in having a wall much more resistant to fracturing under pressure.

Luttrell (1963) raised the possibility that a third wall existed in conidia of *B. sorokiniana*, enclosing the spherical protoplasts. Evidence was obtained to support this suggestion. An inner hyaline wall was seen enclosing protoplasts in some extruded conidial contents. This third wall layer was also seen in conidia of *B. indica* Rai, Wadhwani & Tewari (Fig. 4), but in that species the inner wall was thinner than in *B. sorokiniana*. Electron microscopy has led to differing opinions on wall structure in conidia of the latter species. Cole (1973) reported that the wall in developing conidia is two-layered, while Old and Robertson (1969) and Mills (1970) recognized three distinct layers. Subsequently a fourth layer was discovered by Old and Robertson (1970).

Septation in *Curvularia* species

When conidia of *C. lunata* (the generic type) are ruptured under pressure, the wall breaks at one or both ends to release part or all of the contents. The extruded portion consists of a thick, hyaline wall ensheathing the protoplasm which often is still divided into cells by hyaline cross walls (Fig. 5). In other instances the protoplasm was continuous in the extruded portion. Often all protoplasm was expelled, leaving the extruded wall material as a more or less cylindrical tube equal to or greater in length than the conidium (Fig. 7). Expelled protoplasts sometimes retained their shape, but burst with the application of greater pressure. The dark bands which accentuate the septa in conidia of this species usually remain within the conidium, torn centrally but still attached to the outer wall. The torn segments of the septa are directed towards the point of egress of the cell contents (Fig. 5). Sometimes septa did not rupture, but bulged towards the apex or base of the conidium without releasing the cell contents. Occasionally one or more dark septa were carried out of the conidium, and remained as

Table 3. *Bipolaris, Drechslera* and *Exserohilum* species in which conidia are distoseptate

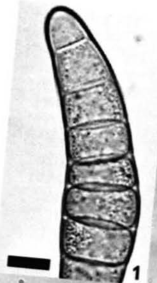
Species	Isolate *	Species	Isolate
australiensis	7750a	monoceras	7792a
australis	77126	multiformis	1215
avenae	14880	neergaardii	DAOM 154282
bicolor	77106	nicotiae	PC 2230
biseptata	PDDCC 6205	nobleae	5063
brizae	7855	nodulosa	20927
bromi	DAOM 169239	oryzae	5401
campanulata	WU.60/78	ovariicola	7813
catenaria	116-8	panici-miliacei	CBS 199.29
chloridis	7670	papendorfii	77151
clavata	77144c	pedicellatum	4951
coicis	CBS 192.29	peregianensis	7848
	7-3-2	perotidis	7905a
	1021-3	phlei	146
crustacea	1353	poae	2879
cylindrica	7835	prolatum	Ep 1
cynodontis	7842a	ravenelii	7976
dactylidis	DAOM 126766	rostratum	77162
dactyloctenii	7909	sacchari	20721
dematioidea	478	setariae	8562
dictyoides	7838a	siccans	5066
ellisii	DAOM 155097	sorghicola	7791
erythrospila	148	sorokiniana	7723
fugax	655	spicifera	77144b
gedarefensis	8021	stenospila	DAOM 147411
graminea	DAOM 159452	subpapendorfii	PC 2227
hawaiiensis	7770	teres	1535
holmii	7795b	tetrarrhenae	7725a
homomorphus	ATCC 13409	tripogonis	77158
incurvata	7783	triseptata	PDDCC 6120
indica	20114	tritici-repentis	21615
iridis	DAR 29777	tuberosa	WU.51/78
kusanoi	CBS 137.29	turcicum	77159
leersii	7704	urochloae	77127
maydis	22228	victoriae	IMI 89977 (ii)
melinidis	7837	yamadae	CBS 202.29
micropus	8452	zeicola	77107a

* Voucher specimens for all isolates used in this study are deposited in BRIP

distinctive dark bands across the expelled portion (Fig. 6). These septa appeared to have been torn from the outer periclinal wall intact. In face view these expelled accentuated septa were circular, and had a small central pore.

Twenty-five other *Curvularia* species were examined, and all were found to have conidium septum structure similar to that of *C. lunata* (Table 4). The variations in morphology of the septa and extruded contents of conidia noted for that species also occurred in some of the other species examined (Figs. 8-11). Conidia of some species were very difficult to crush, for example in *C. verruciformis* Agarwal & Sahni, *C. uncinata* Bugnicourt, and *C. geniculata* (Tracy & Earle) Boedijn. In these species each cell tends to release its contents separately from a rupture in the lateral wall, leaving the septa intact, but a hyaline inner wall can still be demonstrated. *C. catenulata* Reddy & Bilgrami and *C. tritici* Kumar & Nema are included in Table 4 on the basis of observations on intact conidia. The inner wall visible in some conidia, especially those with a swollen median cell, could not be shown by crushing, to which conidia of these two species are very resistant.

Septa in conidia of *Curvularia* species are therefore double-walled. There is a thin central pigmented plate which commonly remains attached to the periclinal wall after the conidia are ruptured, and a thicker hyaline wall which sometimes can be expelled intact. Published illustrations of *Curvularia* conidia generally indicate only a single outer wall to which septa are joined. Exceptions are provided by some of the drawings of conidia of *C. deightonii* M.B. Ellis, *C. borreriae* (Viégas) M.B. Ellis, *C. andropogonis* (Zimm.) Boedijn, *C. tuberculata* Jain, and *C. robusta* Kilpatrick & Luttrell, where an inner wall to some or all of the cells is shown (Ellis 1966, 1971). Similarly the conidia of *C. ischaemi* McKenzie are shown as either single- or double-walled (McKenzie 1981).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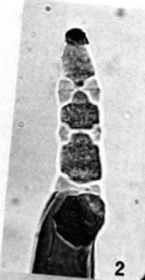
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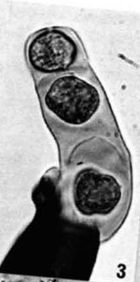
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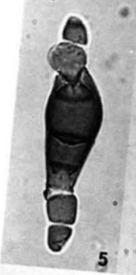
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Septation in *Bipolaris coicis*

Septa in conidia of *B. coicis* (Nisik.) Shoem. are commonly accentuated by a dark band in a manner similar to that of *Curvularia* conidia. Three isolates of *B. coicis* have been examined, namely CBS 192.29 authentic for the name *Helminthosporium coicis* Nisik., and isolates 7-3-2 and 1021-3 cited by Tsuda et al. (1977). Septum structure in conidia of these isolates is similar to that in conidia of *Curvularia* species (Figs. 12, 13), and a proposal to accept this fungus as a species of *Curvularia* could be advanced using this evidence. The binomial *C. coicis* E. Castell. (Castellani 1955) would be available; I have examined the type specimen (IMI 53422) and agree with Luttrell (1969) that the name refers to the same fungus as described by Nisikado. Characteristics other than those of septum structure, however, point to *Bipolaris* as a more appropriate genus than *Curvularia* for this taxon. Thus, curvature of conidia is not associated with a disproportionate swelling of one or more cells, nor is there any marked darkening of median cells.

Septation in *Sporidesmium* and *Nakataea*

It was found that conidia of *Curvularia* species differ in septum structure from species of *Bipolaris*. In the former genus conidia are not euseptate as narrowly defined by Luttrell (1963), who used *Sporidesmium tropicale* M.B. Ellis and *Nakataea sigmoidea* (Cav.) Hara as examples of fungi where this condition applies. The form of septation in these species has been examined for comparison with that in *Bipolaris* and *Curvularia*.

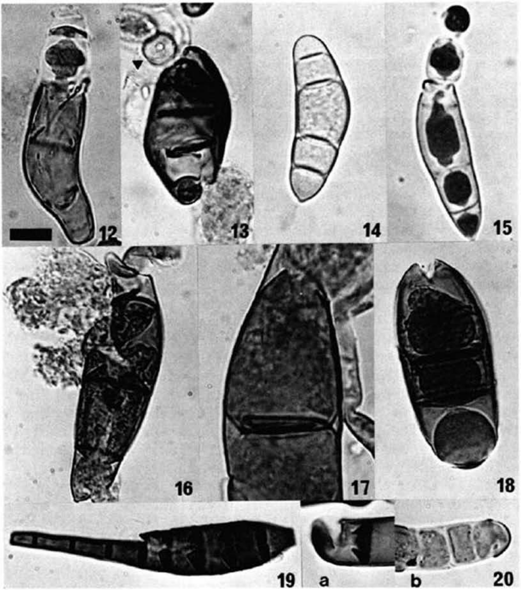
Figs. 1-11. Septum structure in conidia of *Bipolaris* and *Curvularia* spp. (1, water mount; 2-11, fractured in 3% KOH and stained with phloxine). 1 & 2. *B. maydis*. 3. *B. sorokiniana*. 4. *B. indica*. Note thin inner wall around protoplast of second cell from base. 5. *C. lunata*, with ruptured dark septa retained internally. 6. *C. lunata*, one dark septum expelled at apex; intact protoplast free of inner hyaline wall at base. 7. *C. lunata*, inner wall ruptured at apex and releasing protoplasm. 8. *C. cymbopogonis*, lower septum bulged but not ruptured. 9. *C. robusta*, lower two cells intact, upper three cells partly freed and with dark septa intact. 10. *C. richardiae*, inner wall intact. 11. *C. richardiae*, inner wall ruptured to release protoplasts. Scale = ca. 10 µm, all figures.

Table 4. *Curvularia* species in which conidia are 'euseptate'

Species	Isolate	Species	Isolate
affinis	MRL.1085	lunata	81151
andropogonis	19862b	oryzae	IMI 103899
brachyspora	8130	ovoidea	MRL.1222
catenulata	MRL.1175	pallescens	MRL.1086
clavata	8123c	prasadii	MRL.1087
cymbopogonis	IMI 130402	protuberata	7788c, ATCC 16397
eragrostidis	81114b		
fallax	IMI 102690	richardiae	7708
geniculata	IMI 103902	robusta	ATCC 16788
harveyi	WA.227	senegalensis	8025
inaequalis	MRL.1091	trifolii	77169
intermedia	8013b	tritici	MRL.1193
ischaemi	PDDCC 6142	uncinata	77153a
		verruciformis	IMI 115252

An authentic specimen of *Sporidesmium tropicale* (IMI 41526, dupl. in BRIP) was examined. Conidia of this species commonly rupture laterally. The cell contents are not enclosed in a second wall as occurs in *Curvularia* conidia, and when released often assume a diffuse amorphous shape. The conidial septa rupture in a manner similar to that described for *Curvularia*, however, with the torn fragments directed towards the cell where pressure was released by partial or complete expulsion of the protoplasm (Fig. 19).

Splitting laterally under pressure is also common in conidia of *Nakataea sigmoidea*. Again there is no suggestion of a thick hyaline inner wall similar to that seen in *Curvularia* conidia. Under moderate pressure the larger median cells usually rupture, with much more pressure necessary to break the polar cells. Septa break in the same way as do those of *Sporidesmium tropicale* (Fig. 16). Unlike the conidia of *S. tropicale*, those of *N. sigmoidea* appear to be double-walled, at least in the median two cells. There is often a small triangular space where the middle septum meets the periclinal wall. In some conidia this space is much larger, and it appears that the cells on either side of the median septum have walls which are structurally distinct from the outer conidial wall (Fig. 17).



Figs. 12-20. Septum structure in conidia of *Bipolaris*, *Curvularia*, *Drechslera*, *Nakataea*, and *Sporidesmium* spp. (14, water mount; others as for Figs. 2-11). 12. *B. coicis*, ruptured dark septa internally, distal septum carried out intact. 13. *B. coicis*, face view of expelled dark septum (arrow). 14. *C. protuberata*, conidium from hyaline mutant (7788c). Compare with Fig. 1. 15. *C. protuberata*, hyaline mutant. 16. *N. sigmoidea*. 17. *N. sigmoidea*, detail of median septum, showing triangular space where septum meets periclinal wall. 18. *D. triseptata*, inner wall constricted at accentuated septum. 19. *S. tropicale*. 20. *D. erythrospila*, ruptured dark basal septum (a), and distoseptate inner portion expelled from apex (b). The cap on this structure is the apical part of the dark outer wall, freed during rupturing. Scale = ca. 6.5 µm Fig. 17; 10 µm all other figures.

The septa delimiting the end cells appear to be formed by a single wall, namely the inner wall surrounding each median cell. The limitations imposed by light microscopy prohibit an unequivocal statement about septation in this species, but it may be similar to that described for *Seiridium* (Roberts & Swart 1980), which has thinner-walled, paler end cells.

Discussion

Cochliobolus as defined by the type species *C. heterostrophus* has anamorphs in *Bipolaris*. The discovery that some *Curvularia* species have teleomorphs which apparently could be referred to *Cochliobolus* has introduced a divergence from that principle. It has also raised the question of whether *Bipolaris* and *Curvularia* are distinct. Conidia of the former genus are distoseptate, while those of *Curvularia* can be termed euseptate in a broad sense, but not in the way used by Luttrell (1963) when referring to *Sporidesmium tropicale*. He defined euseptate conidia as being 'surrounded by a single wall and have true septa formed as inward extensions of the lateral walls'. In a glossary of new terms at the end of the paper cited, a less restrictive definition than that given above was included, that is - 'Euseptate: conidium with true septa consisting of diaphragms merging peripherally with the lateral walls'. The latter terminology presumably would allow for the existence of a wall or walls other than the lateral wall from which the septa originated. In this study, such a wall was demonstrated in conidia of *Curvularia* species.

Mangenot and Reisinger (1976) recognized three distinct categories of septal walls in conidia. In their classification the septa are defined as outgrowths of a single wall (euseptation), or from a second inner wall (distoseptation). A third type, called a double process by Mangenot and Reisinger, involved both walls in the formation of septa. Conidium septation in the *Curvularia* species examined during the present study is referable to this last type, rather than to euseptation as narrowly defined, and perhaps could be referred to as 'secondarily euseptate'.

Considerable intergeneric variation in conidium septum structure can be demonstrated by simple manipulation and observation by light microscopy. The results reported above show that uniformity in septum structure occurs within genera such as *Bipolaris* and *Curvularia*. They also support the observations of Sutton (1969) that classification of septa into two categories might prove to be an oversimplification. Roberts and Swart (1980) concluded that the terms euseptate and distoseptate had not been clarified by studies of conidium fine structure in *Pestalotiopsis*, *Seiridium*, and similar genera, and that further elucidation was necessary before they could be used to indicate distinctions of taxonomic importance.

HOLOMORPH TAXONOMY FOR *COCHLIOBOLUS*

The genus *Cochliobolus* has been used to accommodate fungi with anamorphs in *Bipolaris*, and also fungi with anamorphs in *Curvularia*. This apparent heterogeneity depends on the recognition of these anamorph genera as distinct. Von Arx and Luttrell (1979) have suggested that *Bipolaris* should be made a synonym of *Curvularia*. If this were done, all anamorphs of *Cochliobolus* would be in *Curvularia*. I think it is preferable to maintain these genera as distinct, especially in view of the evidence on septum structure presented in this paper. If other conidium characteristies are intermediate between those of *Bipolaris* and *Curvularia*, then a consideration of septum structure should allow taxa of otherwise uncertain affinities to be placed in one or other of these genera.

If *Curvularia* is accepted, then the suitability of *Cochliobolus* as a name for fungi with *Curvularia* anamorphs must be considered. Drechsler (1934) defined the genus *Cochliobolus* in terms of teleomorphic and anamorphic forms, and used the concept that the conidial state was an important criterion in helping distinguish it from *Ophiobolus*. He showed that *Ophiobolus* species were connected with *Phoma*-like anamorphs, and that *C. heterostrophus* and congeneric species were connected with conidial forms in *Helminthosporium* sensu lato (*Bipolaris*). By the same reasoning, it might be argued that *Cochliobolus* species with *Curvularia* anamorphs cannot be maintained in the same genus as those with *Bipolaris* conidial states, and that a separate ascomycete genus should be established for them.

I once held such a view but now retreat from that position, which emphasized differences in septum structure, to one in which similarities in conidium morphology are given more weight. Thus the wall and septum structure in conidia of *Bipolaris* and *Curvularia* are regarded as fundamentally alike. There is a thin pigmented outer wall, and a thicker hyaline inner wall which takes part in septum formation. In *Curvularia* species the septa are accentuated by a dark band which is attached to the outer periclinal wall. When conidia are fractured under pressure, this 'secondary septum' commonly ruptures centrally but sometimes is carried out of the conidium. If the latter occurs, the similarity of the extruded portion to that produced when *Bipolaris* conidia are treated in the same way is obvious.

Other features highlight the resemblances described above. When *Bipolaris* conidia are mounted in water, the inner wall is much less obvious than in lactophenol, and the cells appear as overlapping circles (Fig. 1). They have often been illustrated in this form by various authors. *Curvularia* conidia mounted in water do not assume this aspect, and the dark septa still appear to be united with the lateral wall. An isolate of *C. protuberata* Nelson & Hodges used in these studies (7788c) gave rise to a hyaline mutant in culture, which produced numerous conidia lacking pigment. When such conidia are viewed in water mounts, there is a striking similarity to distoseptate conidia of *Bipolaris* (Fig. 14). Crushing these hyaline conidia in KOH also reveals their congruity with this coniditon (Fig. 15). It may be noted that conidia of *C. robusta* were described as distoseptate by Kilpatrick and Luttrell (1967).

Accentuated conidial septa are also found in species which undoubtedly belong in *Drechslera*, for example *D. dematioidea* (Bubák & Wrób.) Subram. & Jain, *D. biseptata*, *D. triseptata* (Drechsler) Subram. & Jain, and *D. erythrospila* (Drechsler) Shoem. In conidia of the last-named fungus, the accentuated basal septum often ruptures as described for *Curvularia*, while a normal distoseptate endospore is expelled from an apical split (Fig. 20). Similar variation in a single conidium was noted in *C. inaequalis* (Shear) Boedijn. In *D. triseptata*, the internal wall of some conidia had become constricted at the septa, clearly showing the darkened septum free from the outer wall (Fig. 18).

Although *Bipolaris* and *Curvularia* are obviously similar, I do not believe they should be united as has been suggested (von Arx & Luttrell 1979). Nor do I believe, however, that the differences between them are sufficient to warrant the erection of a separate genus to accommodate the teleomorphs of *Curvularia*. This leaves as the only option a maintenance of the status quo, accepting a certain degree of heterogeneity within the anamorphs of *Cochliobolus* species. This is not without precedent. For example in *Nectria* the anamorphs might be considered variations on the theme of cylindrical phialide, in which increasing complexity of arrangement of conidiogenous cells can be recognized (Samuels & Rossman 1979).

New combinations

Earlier in this paper I proposed that the name *Pseudocochliobolus* be put into synonymy with *Cochliobolus*. The following changes then become necessary.

Cochliobolus nisikadoi (Tsuda, Ueyama & Nishihara) comb. nov.
  Pseudocochliobolus nisikadoi Tsuda, Ueyama & Nishihara, Mycologia 69: 1117, 1977.
Cochliobolus australiensis (Tsuda & Ueyama) comb. nov.
  Pseudocochliobolus australiensis Tsuda & Ueyama, Mycologia 73: 92, 1981.

I shall show in a subsequent paper that *Bipolaris* and *Drechslera* should be maintained as separate taxa. *Drechslera chloridis* Alcorn is the only *Cochliobolus* anamorph to which a binomial has been applied (Table 1), and which is now considered misplaced. The necessary new combination is:

Bipolaris chloridis (Alcorn) comb. nov.
  Drechslera chloridis Alcorn, Trans. Br. mycol. Soc. 67: 148, 1976.

In addition, the combination *B. homomorphus* (Luttrell & Rogerson) Subram. (Subramanian 1971) was not validly published (Art. 33, basionym not indicated). This ommission is corrected here.

Bipolaris homomorphus (Luttrell & Rogerson) Subram. ex Alcorn

Helminthosporium homomorphus Luttrell & Rogerson, Mycologia 51: 195, 1959.

A LECTOTYPE FOR *COCHLIOBOLUS HETEROSTROPHUS*

A specimen labelled as the type was obtained from BPI. The label details agreed with those cited by Drechsler (1925):

> *Cochliobolus heterostrophus* (Drechs.) Drechs. on *Zea mays*
>
> Sanford, Fla. Sept. 22, 1923
> Coll. A.C. Foster
> Det. Charles Drechsler

An inner packet contains approximately 24 leaves or leaf segments. They are quite narrow, and very thin, suggesting that they originated from seedlings. Numerous lesions typical of infection by *C. heterostrophus* are present on the leaves, but a thorough search of all the material revealed no ascocarps, and only very scanty conidial sporulation. Twenty-seven other collections from BPI labelled *C. heterostrophus* were examined, but no ascigerous state was detected. No slides from the type showing the ascal state are preserved in BPI (M. Stransky, pers. comm. 1977), and it therefore appeared that a neotype would have to be selected to typify *C. heterostrophus*. Fortunately, ascal material identified by Drechsler is available. In a paper in which the new genus *Pseudocochliobolus* was established, Tsuda et al. (1977) referred to a specimen of *C. heterostrophus* from BPI in a manner suggesting that ascal material had been seen. This was confirmed in correspondence (Tsuda, pers. comm. 1978), and subsequently the specimen was obtained from BPI. The typed outer label bears the data:

> *Cochliobolus heterostrophus* Drechsler on *Zea mays*
>
> Washington D.C. Oct. 7, 1924
> Coll. & Det. Charles Drechsler

A handwritten inner label shows that the original name given was *Ophiobolus heterostrophus*, that the host is 'Philippine corn leaf', and that it was incubated in a damp chamber for 30 days beginning Oct. 7, 1924. This is some of the material collected in the Philippines in November 1921 and referred to by Drechsler in his account of *O. heterostrophus* (Drechsler 1925, p. 707). The specimen consists of the contents of three moist chambers, made up on 9 cm diam. filter papers. There are seven leaf segments in all, each 6-7 cm long, darkened by fungal colonies and bearing ascocarps visible without magnification. The ascocarps are black, scattered, amphigenous, erumpent, mostly with a prominent cylindrical to conical beak and often with brown setae or hyphae over the upper half of the body but not on the neck. Three ascocarps were examined. They were 460-520 µm high x 360-400 µm diam., with the beak 140-160 µm high, 90-110 µm diam. at the base and 60-100 µm at the apex. Asci were obclavate to cylindrical, with a short pedicel, and measured 132-165 x 22.5-30 µm. Ascospores were not released from the asci when the ascocarps were dissected in a drop of water, so measurements of length were not possible. They were closely coiled in the ascus, hyaline to faint yellowish brown, multiseptate, and 5-10 µm diam. As reported by Tsuda et al. (1977), there was no evidence of stromatic tissue at the base of the ascocarps. Conidia on the specimen were similar to those on 28 other collections of *C. heterostrophus* in BPI examined previously.

The specimen described above is designated as the lectotype for *Cochliobolus heterostrophus*, the generic type, in order that this important species may be properly typified.

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TREMELLALES OF ISRAEL

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ABSTRACT

Nine taxa of tremellaceous fungi growing mainly with oak and pine trees, are described. They were found in the Galilee and the central parts of the country and eight of them are new records for Israel.

INTRODUCTION

The Agaricales of Israel have already received attention (Binyamini, 1977, 1980 and Moser, Binyamini & Avizohar-Hershenzon, 1977), but information about the Tremellales of Israel has, until now, been neglected. There is neither a flora, nor are there monographic studies of the tremellaceous fungi covering the study area around Israel. The nearest area is Greece, as exemplified in the Fungus Host Index of Pantidou (1973).

Owing to its geographical dry climate, Israel has a relatively few tremellaceous resupinate fungi. This report is concerned with 9 taxa, of which 8 are newly recorded for Israel. Most of the collections upon which this report is based were made during the period 1974-1981/2. Some of the examined specimens show slight differences compared with European material, possibly because of the dry climatic conditions, and consequently, it was deemed worthwhile to provide at least a short description of the species in our collections.

One species listed has already been recorded by Rayss & Reichert (1952). The systematics of the families and genera follow Martin (1952) and Lowy (1971). The source of each record is indicated at the end of the description and the herbarium numbers are given in parentheses. The colours specified in parentheses are taken from Kornerup & Wanscher (1967). Microscopic structures were observed on fresh material. All collections cited have been deposited in the herbarium of the Department of Botany, Mycology Division, Tel Aviv University.

TREMELLACEAE

Exidia glandulosa Fr., Syst. Mycol. 2 : 224.1882 Fig. 1

Fruit body firm gelatinous, dark brownish, becoming black, glistening when dry; hymenium smooth to tuberculate. Flesh blackish. Hyphae with clamp connections; probasidia ovate or elliptical, 10-16 x 8-14 µm, becoming cruciate-septate, spores hyaline, allantoid, 10-15 x 4-5 µm.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Ha'arbaim Wood, 9.2.81 (81p137), Upper Galilee, Bar'am Wood, 3.2.81 (81p460), Hiram Wood, 3.2.81 (81p451, 81p452).

Our specimens conform well with the descriptions of Martin (1952) and Lowy (1971).

Exidia nucleata (Schw.) Burt, Ann. Missouri Bot. Gard. 8 : 371.1921. Fig. 2

Fruit body cerebriform, gelatinous, whitish becoming brown with pinkish tinge to brown vinaceous with whitish granules; hymenium smooth. Hyphae with clamp connections; probasidia ovate, 10-12 x 6-8 µm, cruciate-septate, epibasidia subcylindrical up to 60 x 3.5-4.5 µm, spores hyaline, 8-11.5 x 4-4.5 µm, cylindrical curved, germinating by repetition.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Bet Oren S. 29.12.80 (80p117, 80p151), Ha'arbaim Wood, 9.2.81 (81p138). Upper Galilee, Bar'am Wood, 3.2.81 (81p130), on dry branch of *Calycotome villosa*, Hiram Wood, 3.2.81 (81p139).

The white colour which changes through brown pinkish to brown vinaceous is characteristic of our specimens, and conform well with the descriptions of Martin (1952) and Lowy (1971).

Exidiopsis effusa (Bref. ex Sacc.) A. Möller, Fig. 3
Bot. Mitth. Tropen 8 : 82.1895

Fruit body soft gelatinous, greyish hyaline to nearly chalk white; hymenium finely granulose, smooth < 100 µm, thick. Hyphae with clamp connections; dikarioparaphyses subcylindrical branched, forming a thin layer above the basidia; probasidia ovoid to subglobose, 10-15 x 8-10µm, clamps at the base, epibasidia four, up to 40 x 4 µm, spores cylindrical curved to allantoid, 12-15 x 4-5 µm, germinating by repetition.

Habitat. On dry branch of *Quercus*, Mt. Carmel,,Ha' arbaim Wood, 9.2.81 (81p280, 81p281, 81p284, 81p389). On dry branch of *Rhamnus*, Upper Galilee, Bar'am Wood, 3.2.81 (81p431).

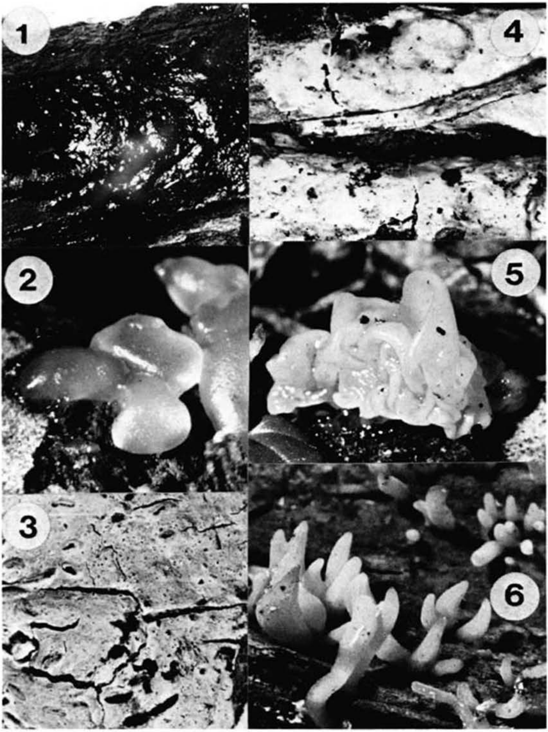
The effused gelatinous greyish-white basidiome, with branched dikaryoparaphyses and larged curved spores is characteristic of our specimens. Spores are slightly snaller than those described by Lowy (1971) and Wells & Raitviir (1977), but close to those of Christiansen (1959) and Reid (1970). According to Wells (1961), *E. effusa* is a synonym of *E. grisea* (Pers.) Bourd. & Maire, but Wells & Raitviir (1977) agree that *E. effusa* is very closely related to *E. grisea* and that the differences in substrate, colour of dry specimens and spore size differentiate the two taxa.

Sebacina incrustans (Fr.) Tul., Jour. Linn. Fig. 4
Soc. Bot. 13 : 36. 1871.

Fruit body fleshy coriaceous, up to 1 mm thick, cream-yellow (4C3, 4C2, 4B2), margin slightly fibrillose. Hyphae without clamp connections; probasidia subglobose, becoming cruciate-septate, 15-20 x 11-13 µm, epibasidia 30-75 x 2.5-3 µm, spores ovate to oblong, with lateral apiculus, 10.5-15 x 5.5-7 µm, germinating by repetition.

Habitat. On dry branch of *Pinus*. Ramot Menashe, Goara, 3.3.81 (81p221).

The resupinate, cream-yellow fruit body, and large, ovate spores characterise our specimens; in these respects the collection conforms well to the descriptions of Martin (1952), Christiansen (1959) and Lowy (1971).



Figs.1-6. 1. *Exidia glandulosa* x5. 2. *E. nucleata* x4. 3. *Exidiopsis effusa* x5. 4. *Sebacina incrustans* x4. 5. *Tremella mesenterica* x2. 6. *Calocera cornea* x4.

Tremella fimbriata Fr., Syst. Mycol. 2 : 212, 1822.
= *T. foliacea* Fr., Syst. Mycol. 2 : 212. 1822.

Fruit body leaf-like folds, gelatinous, cinnamon-brown, becoming vinaceous black on drying. Hyphae with clamp connections; probasidia subglobose, becoming cruciate-septate, 12-18 x 10-15 µm, epibasidia up to 70 µm, spores subglobose-ovate, 8-9 x 5-7 µm, germinating by repetition.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Bet Oren S. 20.1.81 (81p122).

Our specimens were slightly dry when found, but the microscopic characters, such as clamped hyphae and spores, all conform well to the descriptions of Martin (1952) and Lowy (1971).

Tremella mesenterica Fr., Syst. Mycol. 2 : 214 1822. Fig. 5
= *T. lutescens* Fr., Syst. Mycol. 2 : 213. 1822.

Fruit body cerebriform to lobate, usually large, < 10 cm in length, gelatinous, orange, or golden yellow. Hyphae with clamp connections; probasidia subglobose, becoming cruciate-septate, 10-17 x 8-14 µm, epibasidia up to 75 µm, spores subglobose to ovoid, 10-14 x 8-12 µm, germinating by repetition.

Habitat. On dry branch of *Quercus*. Upper Galilee, Bar'am Wood, 23.1.72 (72p152), 9.3.81 (81p209), Mt. Carmel, Bet Oren S., 29.12.80 (80p118), 17.1.82 (82p103).

This, our commonest large *Tremella*, is frequently found on dry branches and trunks of oak. Lowy (1971) supports the interpretation of considering *T. mesenterica* Fr. and *T. lutescens* Fr. to be a single variable species.

DACRYMYCETACEAE

Dacrymyces deliquescens (Mérat) Duby, Bot. Gall. 729. 1829.

Fruit body lenticular, up to 5 mm, gelatinous, orange-yellow or pallid (4B6), becoming reddish brown on drying, smooth. Hyphae with clamp connections, smooth or rarely roughened; probasidia subclavate, 30-50 x 4-6 µm, epibasidia bifurcate, up to 15 x 3 µm, spores allantoid, becoming 3 septate, 14-16 x 5-6.5 µm.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Ha'arbaim Wood, 9.2.81 (81pl35, 81p286). On dry branch of *Pinus*, Bet Oren, 9.2.81 (81pl41, 81pl69).

The lenticular or sometimes flattened orange-yellow fruit body, with bifurcate epibasidia and large allantoid septate spores are characteristic for our specimens and conform well to the description of Martin (1952).

Calocera cornea (Batsch ex Fr.) Fr., strip. Agri. Tems. 67. 1826. Fig. 6

Fruit body gelatinous to tough, narrowly club-shaped, unbranched or very sparsely branched above, round in cross-section, up to 15 mm high and 1 mm thick, pale yellow or orange-yellow; hymenium smooth. Probasidia subclavate, 35-40 x 2.5-5 µm, spores cylindrical, curved, 8-10 x 3-4.5 µm.

Habitat. Scattered to gregarious, usually two to three clustered together. Upper Galilee, Pa'ar Cave, on dry branch and trunk of *Quercus*, 25.1.72 (72p505), 3.2.81 (81pl29).

This small and beautiful species is variable in its colour, size and degree of branching. The reddish tinge on drying, which is described by Martin (1952) and Lowy (1971), is not clear in our specimens.

AURICULARIACEAE

Auricularia auricula (Hooker) Underwood in Barrett,
Mycologia 2 : 12. 1910.
= *Hirneola auricula-judae* Berk., Outl. Brit. Fung.
298. 1860.

Habitat. On cut trunk of *Ficus*, Mique Izra'el 28.11.74 (74pl06), 26.2.74 (74pl04), 12.1.77 (77pl13), Hulda, 8.2.75 (75pl05), Ramat Hasharon, 1.9.78 (78pl26).

This species has already been encountered in Israel and described by Rayss and Reichert (1952). It has been found several times; it is common each year.

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A NEW JAPANESE SPECIES OF *NEOCOSMOSPORA* FROM MARINE SLUDGES

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Since 1899 when E. F. Smith established the genus *Neocosmospora* with *N. vasinfecta* as the type, a total of 5 species and 3 varieties has been described (Mahoney, 1976; Domsch et al., 1980). Only one of these, *N. striata* Udagawa et Horie (1975), has ascospores covered with 8-10 transverse crests. A second member of *Neocosmospora* with striate ascospores was isolated during a continuing survey of the polluted fungi of Nagasaki Prefecture, Japan (Ueda, 1981). In this paper a new species based on the isolate is described and the major differences distinguishing the species from *N. striata* are presented. The specimen studied is preserved at the Mycological Herbarium, National Institute of Hygienic Sciences, Tokyo (NHL).

Neocosmospora tenuicristata Ueda et Udagawa, sp. nov. (Figs. 1-12)

Stat. Anam. *Acremonium tenuicristatum* Ueda et Udagawa, anam. sp. nov.

Coloniae in agaro cum decocto tuberorum et dextroso celeriter crescentes, funiculosae, tenues, vinaceo-bubalinae; perithecia abunde producentia, persicina vel badia, cum hyphis aeriis et conidiis albis obtecta; reversum brunneum vel brunneo-aurantiacum vel hinnuleum.

Perithecia superficialia, dispersa vel aggregata, rubro-brunnea, ovoidea vel pyriformia, 335-415 × 265-320 µm, glabra vel parce pilosa; pili hyalini vel dilute flavi, non ramosi, septati, leves, breves, hyphoidei, 6-8 µm diam; perithecii collum breve, conicum plus minusve valde rubrobrunneum, 65-80 × 80-115 µm, glabrum; peridium membrana-

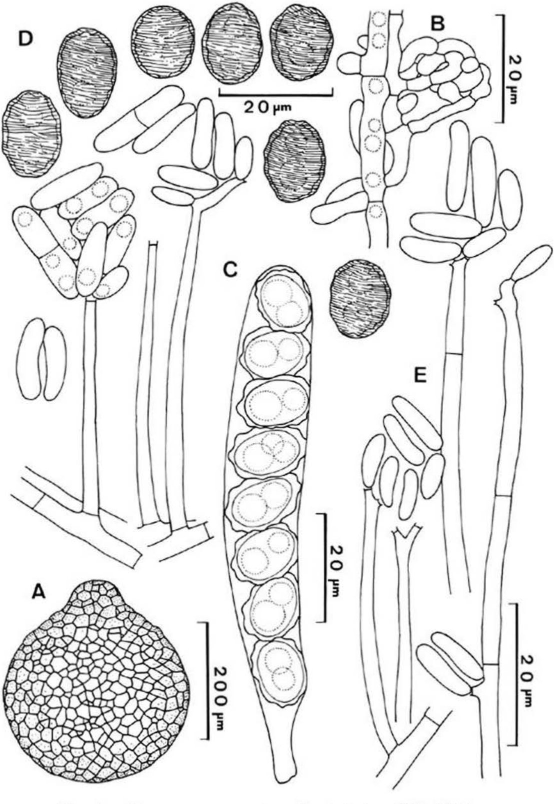


Fig 1. *Neocosmospora tenuicristata*, NHL 2911. A. Perithecium. B. Perithecial initial. C. Ascus. D. Ascospores. E. Conidia-bearing structures and conidia.

ceum, pseudoparenchymaticum, dilute flavo-aurantiacum, saepe semitranslucens, 'textura angularis'; stratum exterius e cellulis dilute salmoneis, incrassatis, angularibus, 10-32 × 10-22 µm compositum; stratum interius e cellulis hyalinis, tenuibus, complanatis, angularibus compositum; periphyses hyalinae, filiformes, septatae, non ramosae, ad basim 3-4 µm diam, ad apicem rotundatae. Asci octospori, hyalini, cylindracei, 90-110 × 13-15 µm, superne rotundati vel aliquantum truncati, sine poro apicali instructi, breviter stipitati, in fasciculo basali dispositi. Ascosporae uniseriatae, unicellulares, flavo-brunneae, late ellipsoideae vel ellipsoideae, 13.5-17 × 10-11.5 µm, guttulatae, incrassatae, sine poro germinali instructi, subtiliter et transverse striatae.

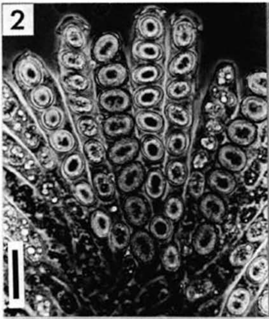
Mycelium e hyphis hyalinis vel dilute flavo-brunneis, ramosis, septatis, levibus, 1.5-10 µm diam, saepe in funiculo aggregatis compositum. Conidiophora brevia, plerumque 15-35 × 3-5 µm, hyalina, non ramosa vel pauci-ramosa, levia, septata, erecta, e mycelio vegetativo vel funiculis hypharum et hyphis aeriis orientia, mononemata. Cellulae conidiogenae monophialidicae vel polyphialidicae, plerumque simplices sed interdum sympodice proliferae vel percurrentes, terminales, saepe in conidiophoris incorporatae, rectae, hyalinae, 30-50(-125) × 2.5-4 µm, superne gradatim attenuatae, collari parvo praedita. Conidia hyalina, guttulata, 0-1-septata, ellipsoideo-cylindracea vel fusiformia, parum incurvata, 6.5-15(-19) × 2.5-4.5 µm, levia, utrinque rotundata, in massa mucida aggregata. Chlamydosporae absunt.

Holotypus: cultura NHL 2911 ex limo (marine sludge), Nagasaki in Japonia, in 26.i.1981, a S. Ueda, isolata. In collectione fungorum 'National Institute of Hygienic Sciences (NHL), Tokyo, Japan'.

Etymology: lat. *tenui-* = thin and *cristatus* = crested, referring to the nature of the ascospore ornamentation.

Colonies on potato-dextrose agar spreading broadly, attaining a diameter of 8.0 cm in 2 weeks at 23 C, funiculose, consisting of a thin mycelial felt, Vinaceous Buff (Rayner, 1970) in color; perithecia abundantly produced on the felt, Peach or Bay (Rayner, 1970), covered loosely with white aerial hyphae and conidia; reverse brown to brownish orange or Fawn (Rayner, 1970).

Perithecia superficial, scattered or aggregated, at first flesh-colored, then becoming pale pink or orange-red, finally reddish brown, ovoid to pyriform, 335-415 × 265-320 µm, glabrous or sparingly covered with hyaline to pale yellow, unbranched, septate, smooth-walled, short, hyphal-like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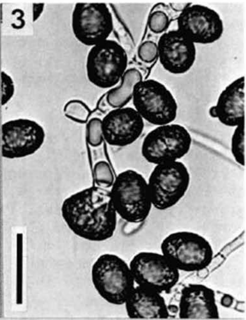
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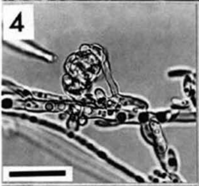
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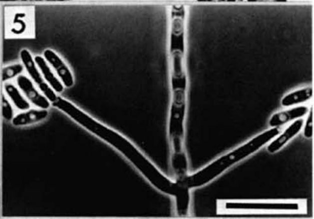
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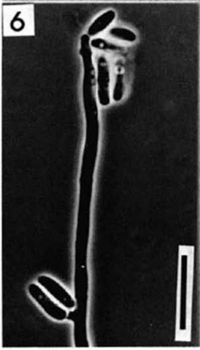
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hairs measuring 6-8 μm in diam; neck short, conical, more or less dark reddish brown, 65-80 × 80-115 μm, glabrous, at the ostiole region composed of short, cylindric cells; peridium membraneous, pseudoparenchymatous, pale yellowish orange, often semitransparent, textura angularis; outer layer composed of pale salmon-colored, thick-walled, angular cells measuring 10-32 × 10-22 μm; inner layer of hyaline, thin-walled, flatten, angular cells; periphyses hyaline, filiform, septate, unbranched, 3-4 μm in diam at the base, tapering to a rounded tip. Asci 8-spored, hyaline, cylindric, 90-110 ×13-15 μm, rounded or somewhat truncate above, without distinct apical structure, short-stalked (stipe: up to 20 μm long), borne in a basal fascicle. Ascospores uniseriate, one-celled, yellowish brown, broadly ellipsoid to ellipsoid, 13.5-17 × 10-11.5 μm, guttulate, thick-walled, without germ pore, with surface ornamented by very fine ridges which are roughly transverse and wavy in appearance, extruded at maturity in the form of a gelatinous mass; epispore ca. 1.5 μm thick.

Mycelium composed of hyaline to pale yellowish brown, branched, septate, smooth-walled hyphae 1.5-10 μm wide, often aggregated in funicles. Perithecial initials arising as coiled or contorted side branches of hypha, then becoming surrounded by hyphae arising from the neighboring cells. Conidiophores short, usually 15-35 × 3-5 μm, hyaline, unbranched or a few branched, smooth-walled, septate, arising directly from the vegetative mycelium or hyphal ropes and aerial hyphae, mononematous. Conidiogenous cells monophialidic or polyphialidic, usually simple but sometimes proliferating sympodially or percurrent, terminal, integrated, straight, hyaline, 30-50(-125) × 2.5-4 μm, tapering gradually to the minute apical collarette measuring 2-2.5 × 1.5-2 μm; phialides sometimes reduced to a collarette on the hypha. Conidia hyaline, guttulate, 0-1-septate, ellipsoid-cylindric or fusiform, slightly incurved, 6.5-15(-19) × 2.5-4.5 μm, smooth-walled, rounded at both ends, aggregated in a slimy mass measuring 7.5-18 μm in diam. Chlamydospores absent.

At 37 C, growth is slightly slower that at 23 C and perithecial production is reduced.

Specimen examined: an isolate from marine sludge, at Oomura Bay, Higashisonogi-gun, Nagasaki-pref., Japan, Jan.

Figs. 2-8. *N. tenuicristata*, NHL 2911.
2. Asci. 3. Ascospores, showing germination. 4. Perithecial initial. 5-8. Conidia-bearing structures and conidia. The line in all figures equals 20 μm.

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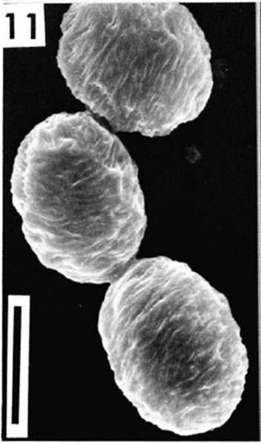

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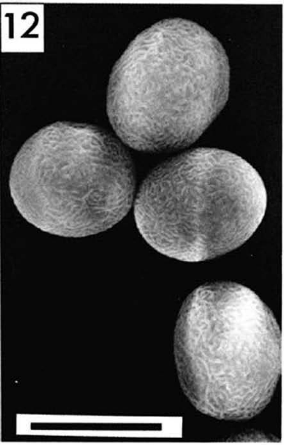

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26th, 1981, S. Ueda, NHL 2911, holotype. Subculture of NHL 2911 has been deposited with the American Type Culture Collection (ATCC).

Neocosmospora tenuicristata, with its striate ascospores and polyphialidic anamorph, is unique in its genus. In the ascospore ornamentation, it has a strong resemblance to *N. striata* Udagawa et Horie (1975), which differs by having smaller perithecia with a cylindric neck, irregular-elongate cells of the peridium in place of angular-shaped cells, smaller asci and ascospores which are ornamented with more rugged 8-10 transverse crests, and the absence of anamorph. According to van Warmelo's SEM study (1976), the patterns of surface ridges of ascospores in *N. vasinfecta* and *N. africana* von Arx appeared to be quite similar. The ascospore ornamentation in both species consists of a network of anastomosing ridges over the surface, while the ridges in *N. tenuicristata* are clearly separate as revealed by SEM observation (Figs. 10-12) as well as examination with the light microscope.

Another interesting point in *N. tenuicristata* is its anamorphic characters. There are a few species such as *A. hyalinulum* (Sacc.) W. Gams and *A. brunnescens* W. Gams in the form-genus *Acremonium* (Gams, 1971, 1975) having proliferation of phialides (polyphialides). Both *Acremonium* are distinguished from the anamorph of *N. tenuicristata* by their small (not exceeding 7 µm in length and 2.5 µm in width) and catenated conidia, as well as by very slow-growing fine mycelia. For the anamorph of *N. vasinfecta*, Domsch et al. (1980) stated that "*Cephalosporium*-like, but as the colonies grow fast and the hyphae are wide, it recalls the micro-conidial states of *Fusarium* rather than *Acremonium*." In fact, the growth-rate on usual media, and the features of vegetative mycelium and conidiogenous structures in *N. tenuicristata* are similar to those of *Fusarium proliferatum* (Matsushima) Nirenberg in the sect. *Liseola*. Matsushima (1971) firstly described *Cephalosporium proliferatum* as follows: Phialophora ex hyphis repentibus vel aeriis ascendentia, simplicia vel ramosa, usque ad 100 µm alta, 2-4 µm crassa, rami terminales fertilia, sym-

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Figs. 9-11. *N. tenuicristata*, NHL 2911, and Fig. 12. *N. africana* von Arx, No. 78-S-35-10.
9. Ascospores with light microscopy. 10-12. Ascospores with scanning electron microscopy, showing their difference in surface ornamentation. The line in Fig. 9 represents 20 µm; in Figs. 10-12 equals 10 µm.

podialiter sub apice proliferascentia et polyphialidibus geniculatis formata. Conidia of *C. proliferatum* are more or less clavate, one-celled, 5-11 × 2-4 μm, and with a truncate base. Matsushima failed to observe the macroconidia on his material of *C. proliferatum*, but after comparing with 46 isolates of *Fusarium moniliforme* Sheld. sensu Wollenw. et Reinking pr. p., Nirenberg (1976) concluded that pyriform conidia of both are conspecific and transferred *C. proliferatum* to the genus *Fusarium*. The anamorph of *N. tenuicristata* differs from *F. proliferatum* in having broader mycelium, larger ellipsoid-fusiform conidia with rounded ends and in the absence of macroconidia.

Since the conidia of the previous *Neocosmospora* species have usually been placed in *Acremonium* or *Acremonium*-like genera, the anamorph of *N. tenuicristata* seems to be better treated as *Acremonium* until the discovery of its associated macroconidia. However, the occurrence of polyphialidic structures further emphasizes the affinity of anamorphs of this and other *Neocosmospora* to *Fusarium*.

ACKNOWLEDGMENT

Appreciation is expressed to Dr. S-C. Jong, American Type Culture Collection, for reviewing the manuscript.

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NEW RECORDS OF HYPOGEOUS ASCOMYCETES IN ARIZONA

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SUMMARY

The following hypogeous ascomycetes are reported as new records for Arizona, USA: *Balsamia magnata*, *Elaphomyces verrucosus*, *E. granulatus*, *Geopora cooperi* f. *cooperi*, *G. cooperi* f. *gilkeyae*, *Tuber dryophilum*, and *T. levissimum*. All species are putative mycorrhizal symbionts with *Pinus ponderosa* Laws. They were major food items in the diet of the tassel-eared squirrel, *Sciurus aberti*.

A nearly pure stand of *Pinus ponderosa* Laws. covers 7.5 million acres in northern Arizona and western New Mexico. The tassel-eared squirrel, *Sciurus aberti* Woodhouse, and its various subspecies (Hofmeister and Diersing, 1978), are closely associated with this conifer. Citing a close dependence on ponderosa pine for food and shelter, Keith (1965) and Hall (1981) point out a restricted distribution of tassel-eared squirrels to the southwestern United States and northern Mexico, with particular abundance in Arizona and New Mexico.

Stephenson (1975) in a study of the food habits of tassel-eared squirrels in northern Arizona, noted that fungi are a major component in their diet throughout most of the year, but he did not attempt to identify the species involved. Upon examination of the spores in the stomach contents provided by Stephenson, I determined that the majority of the fungi consumed were hypogeous species, both ascomycetes (truffles) and basidiomycetes (false truffles). The ascomycete spores were particularly interesting since they represented the genera *Geopora*, *Elaphomyces*, and *Tuber*, all previously unreported from Arizona. Although the squirrels proved to be much more efficient truffle collectors, I have discovered, through my own forays over the past three years, the fruitbodies of the major ascomycete species whose spores are most frequently represented in the squirrel diet.

The hypogeous fungi are little known in the southwestern United States and only occasional collections have been reported, especially in Smith et al. (1981). Fogel and Trappe (1976) have reported the occurrence of hypogeous ascomycetes in the Rocky Mountain region. Some of these are quite similar to those reported here. Nonetheless, I am able to add three additional species in two genera as well as additional host tree associations as presumptive ectomycorrhizae. All species described are new records for Arizona. Collections are deposited in the Deaver Herbarium, Northern Arizona University, and in the herbarium of Oregon State University (OSC).

1. *BALSAMIA MAGNATA* Harkn. *Sensu* Trappe, Mycotaxon 2:119. 1975.

A single collection of three ascocarps match in most respects the description by Gilkey (1916) as *Pseudobalsamia magnata* (Hark.) Gilkey. The very distinctive brownish pink to reddish brown ascocarps measuring 0.5-1.5 cm in diameter made them difficult to detect among the reddish jasper and chert debris of the mineral soil. The verrucae and the occasional small surface depressions of the peridium strongly resembled the surface texture of a russett potato.

ASCOCARPS hypogeous in shallow mineral soil or only slightly imbedded beneath a thin needle layer of *Pinus ponderosa*. Basal tuft and surface opening canals (venae externae) were not clearly evident.

COLLECTION EXAMINED: Coconino County--Jacob Lake, June, elev. 2250 m., States AHF71.

2. *ELAPHOMYCES VERRUCOSUS* Dodge, Ann. Mycol. 27:171-172. 1929.

Species of *Elaphomyces* are difficult to identify. Spore ornamentation as a prime character has been shown to be variable according to conditions of desiccation and developmental stage (Hawker, 1968). The separation of *E. verrucosus* from related species is based primarily on coloration of a marbled peridium when cut in cross section. I have found peridial marbling and the development of surface warts to be inconsistent when comparing different collections. Trappe considers *E. verrucosus* as a synonym of *E. decipiens* (pers. comm.). Until better resolution of this problem is achieved I am satisfied with the present disposition of the collections. The description also fits my collections made in ponderosa pine forests in the Wyoming Black Hills, States WHF14 and WHF32.

ASCOCARPS sphaerical to ovoid, variously depressed when formed near rocky debris; the surface covered by a dense, earthy crust easily separable and composed of *Pinus ponderosa* mycorrhizae and brownish yellow mycelium; peridium yellow or ochraceous, drying yellow brown, verrucose with pointed to rounded yellow warts 90-200 μm high and 100-175 μm wide, hyphal layers strongly to inconspicuously marbled in cross section, when dry 2.0-3.0 μm thick, vinaceous brown with dull rose or rose gray veins interspersed, the layer above the gleba light rose tan; gleba powdery, dark brown to fuliginous; spores globose, 22-28 (31) μm in diameter, ornamentation evenly distributed and densely echinulate, friable after desiccation and easily splitting away from the spore surface when pressed; odor slight or not detectable.

COLLECTIONS EXAMINED: Coconino County--Jacob Lake, June through August, elev. 2250 m., States AHF88, AHF89, AHF117, AHF146, AHF209; Paradise Rd. Flagstaff, States AHF149; Woody Mountain, States AHF103.

3. *ELAPHOMYCES GRANULATUS* Fr., Syst. Myc. 3:58. 1829.

Fogel and Trappe (1976) described *E. granulatus* collected in Colorado among ectomycorrhizae of *Pinus contorta*. The characteristics of our specimen generally follow theirs but some of the special features are listed below.

ASCOCARPS beneath *Pinus ponderosa* litter, deep in mineral soil, associated with a removable soil crust containing pine ectomycorrhizae; peridium smooth, pallid to tawny yellow with faint rusty brown on drying with warts closely appressed as superficial black spots, 3-4 mm thick when fresh and 2-3 mm when dry, tough but cartilaginous and flexible, somewhat viscid when wet, the outer layer in cross section grayish yellow with alternate zones or lenses of brown hyphae in different shades below, the light gray to tan layers above the gleba turn black when cut or bruised; gleba gray brown to dark brown or black at maturity, separating from peridial hyphae as a central powdery mass of spores and hyphae; spores held in globose clusters of eight by an evanescent ascus, globose, 12-22 µm in diameter including ornamentation, the smaller spores dark brown, the larger spores brownish gray to gray, ornamented with crowded spines joined to form small groups of parallel ridges traversing the spores in an undulating pattern, the fragile epispore splitting to reveal a large sphaerical oil droplet imbedded in a gelatinous matrix.

COLLECTIONS EXAMINED: Coconino County--Jacob Lake, June, elev. 2250 m., Lanphear AHF82; Woody Mountain, August, elev. 2190 m., STATES AHF250.

4. *GEOPORA COOPERI* Harkn. f. *COOPERI*, Bull. Calif. Acad. Sci. 1:168. 1885.

This species is likely to be widely distributed in Arizona coniferous forests as indicated by its frequent occurrence in fecal wastes of tassel-eared squirrels. Fogel and Trappe (1976) recorded it from Colorado and I have found it in the Medicine Bow Mountains of Wyoming, States WHF31.

ASCOCARPS hypogeous among ectomycorrhizae of *Pinus ponderosa, Picea angelmanii,* and mixed stands of pine and *Quercus gambelli*. Mostly in exposed sites in rocky mineral soil, May to November, elev. 2100-3300 m.

COLLECTIONS EXAMINED: Coconino County--White Horse Hills, States AHF4; San Francisco Peaks, Snow Bowl ski area, States AHF131; Casner Park, States AHF174; Transition Zone Horticultural Institute near Flagstaff, States AHF175; Hoffderker Hills, States AHF105.

5. *GEOPORA COOPERI* Harkn. f.*GILKEYAE* Burdsall, Mycologia 60:518-519. 1968.

ASCOCARPS were found to be gregarious in deep mineral soil beneath *Pinus ponderosa* and *Pseudotsuga menziesii* litter and surrounded by ectomycorrhizae. The collections fit Burdsall's description who reported it from Colorado and Idaho. I have made collections of both forms of *Geopora* in adjacent locations. Spore size is a constant difference and only in f. *GILKEYAE* was the sporocarp odor pronounced, much like fermented cider. In addition, f. *GILKEYAE* possessed a cream to yellowish tan hymenium whereas the hymenium of f. *COOPERI* was more typically white to light cream in mature specimens.

COLLECTIONS EXAMINED: Coconino County--Woody Mountain, October to November, elev. 2280 m., Lanphear AHF175; Paradise Rd., Flagstaff, States AHF178; Pinal County--Santa Catalina Mountains, September, elev. 2440 m., States AHF242.

6. *TUBER DRYOPHILUM* Tul. Fungi Hypog. 147. 1851.

The discovery of *Tuber* in Arizona is noteworthy because it represents a significant range extension for *T. dryophilum* as well as *T. levissimum* recorded below. A comparison of their striking spore ornamentation is illustrated in Figure 1.

ASCOCARPS hypogeous in mineral soil, 2-6 cm deep with a moderate covering of leaf litter, primordia were noted in mid-August and mature fruitbodies were noted in early December, widely scattered among ectomycorrhizae of *Pinus ponderosa* and *Quercus gambellii*, most abundant on steep south-facing slopes in dense forest stands, rare occurrences were noted beneath alligator juniper (*Juniperus depeanna*), small, 0.5-1.5 cm in diameter, white becoming yellow brown, irregularly subglobose, lightly lobed with white furrows beneath the lobes; peridium variable in thickness, 150-300 (400) µm thick; asci short stipitate when immature, subglobose and persistent as the spores develop, 1-4 rarely 5 spores per ascus; spores globose-ellipsoid to nearly globose, 20-40 x 22-40 (45) µm, bearing prominent alveoli, the ornamentations extending well beyond the spore surface, 3-5 (6) alveoli spanning the greatest diameter, walls and ornamentations becoming rich brown in age.

COLLECTIONS EXAMINED: Yavapai County--Five-mile lake, August, elev. 2150 m., States AHF121; Coconino County--Oak Creek Canyon, August to October, elev. 2080 m. States AHF148, AHF167; Paradise Rd., Flagstaff, August to

December, elev. 2150 m, States AHF162, AHF180.

7. *TUBER LEVISSIMUM* Gilkey, Univ. Calif. Publ. Bot 6:313. 1916.

ASCOCARPS 0.5-1.5 (2.0) cm in diameter, glabrous, smooth texture, bruising tan to light brown, white becoming light yellow brown at maturity, lined with white furrows which extend to the interior as venae externae, contours lobed especially in larger specimens; peridium thin, brown pigmented, 100-250 µm thick, distinctly pseudoparenchymatous becoming hyphal near the glebal cavities; gleba in cross section marbled with tan to gray brown fertile regions contrasting with the white venae; asci subglobose becoming evanescent at maturity with 1-4 dark brown spores; spores subglobose to broadly ellipsoid, alveolate with 5-6 (7) alveoli spanning the diameter of the largest spores, small spores mostly subglobose, 44-53 (62) x 35-45 µm, 3-4 alveoli across the diameter, taste mild and richly mushroom-like.

COLLECTIONS EXAMINED: Coconino County--Paradise Rd., Flagstaff, June to December, elev. 2150 m, States AHF170, AHF181; Casner Park, October, elev. 2200 m., States AHF228.

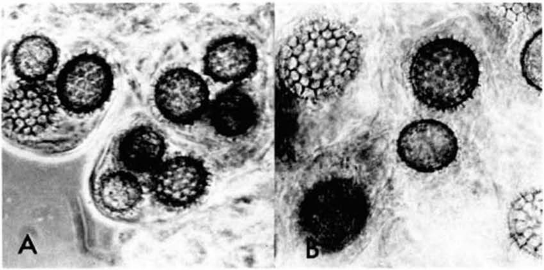

Figure 1. Photomicrographs of *Tuber* ascospores: (A) *Tuber dryophilum* and (B) *Tuber levissimum*, X520.

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STUDIES IN THE GENUS *PHOMA*. I.
PHOMA AMERICANA SP. NOV.

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ABSTRACT

Phoma americana Morgan-Jones and White is described and illustrated from isolates from wheat leaves in Alabama, corn roots in Georgia and cysts of the nematode *Heterodera glycines* Ichinohe in Arkansas, Mississippi and Missouri soils.

PROLOGUS

This being the inaugural number of a series of studies in which taxonomic parameters and species concepts in the genus *Phoma* Saccardo are re-examined.

The generic name *Phoma* has long suffered the ignominious fate of many other commonly encountered genera of the Deuteromycotina by having added to it, largely indiscriminately, a plethora of specific epithets based on such sometimes spurious distinctions as host substrate relationships and miniscule morphological discontinuities. Add to this the fact that many of the contributions to our knowledge of the genus have included descriptions ranging from the mediocre to the moderately competent and we have a recipe for chaos. So much so that a situation has been reached where the application of specific epithets within the genus with confidence can, at best, be a hazardous undertaking.

Over the years the main weakness in the documentation of species peculiarities in the *Phoma*-complex has been a lack of cultural studies under standardized conditions and of adequate accounts of phenotypic plasticity. In *Phoma*, as in such other genera as *Cladosporium* Link and *Fusarium* Link, it has not been merely a matter of interplay between "lumpers" and "splitters". There has long been a dearth of sufficiently adequate information on which to make valid judgements. With the singular exception of the work of Dennis (1946), critical comparative studies *in vitro* of *Phoma* isolates remained unattempted

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until the 1960's when Dr. G. H. Boerema and his co-workers in the Netherlands initiated their far-reaching reassessment of a chaotic taxonomy. Dennis, recognizing the impossibility of defining taxa without linkage with extant type specimens, wisely left in abeyance the matter of speciation choosing instead to classify his isolates into groups of strains. During the last two decades Dr. Boerema has succeeded in doing for *Phoma* what Dr. W. H. Wollenweber did for *Fusarium* some thirty years earlier and we are now in the position to proceed with evolving a satisfactory classification on a sound foundation.

Much remains to be done to fully document the variable expressions of taxa given species rank. As more fresh isolates become available from diverse substrates and ecological niches, in different geographic locations, opportunity arises to increase the data base by which a stable, not to say practical, taxonomy can come into being.

The investigation by Johnston (1981) on fifteen species of *Phoma* occurring on grasses and legumes in New Zealand pastures is exemplary of the type of study which should now be undertaken.

In this series we propose describing in detail strains of *Phoma* originating mainly in the United States.

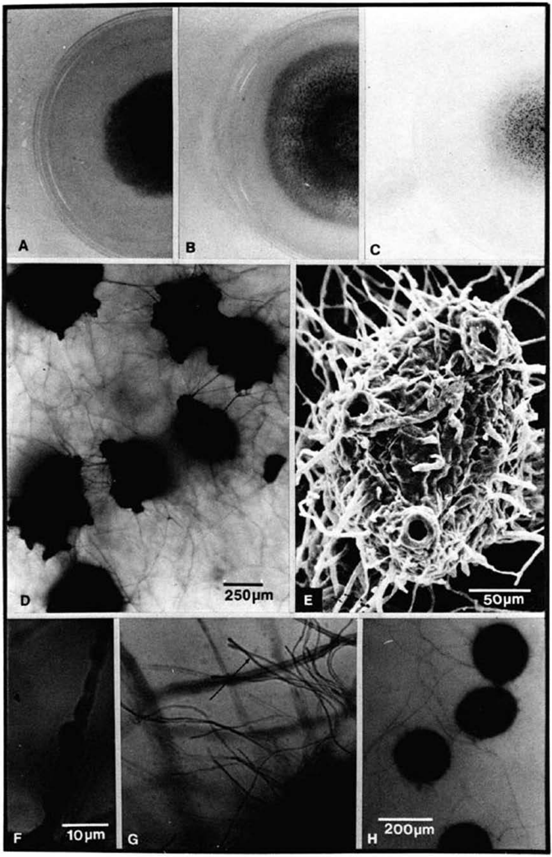
PHOMA AMERICANA - INTRODUCTION

In the course of studying many isolates from various sources we have determined seven strains of *Phoma*, from three diverse substrate origins, to represent a taxon for which no name is currently available in the literature.

The first of these strains examined by us was isolated in the spring of 1981 from leaves of wheat growing in Alabama. The fungus resembled in some respects the plurivorous *Phoma pomorum* Thum. [*Phoma prunicola* (Opiz) Wollenw. and Hochapf.] which is cosmopolitan in its distribution (Morgan-Jones, 1967; Boerema, Dorenbosch and van Kesteren, 1968, 1971, 1977).

Through consultation with Dr. G. H. Boerema we were given to understand that isolates of the same organism had been obtained by Dr. D. R. Sumner from roots of corn grown in Georgia. Subsequently, during a survey of fungi associated with populations of the cyst nematode *Heterodera glycines* Ichinohe in Arkansas, Mississippi and Missouri soybean field soils (Morgan-Jones, Gintis and Rodriguez-Kabana, 1981), the fungus was again encountered [it is referred to in that publication as "black yeast (I)" since, in its cultural characteristics, it somewhat resembles species of the black yeast complex (sensu de Hoog and Hermanides-Nijhof, 1977) and pycnidia were not

PLATE 1. A, 10-day old colony on MEA; B, 10-day old colony on PDA; C, 7-day old colony on cellulose agar; D, clustered pycnidia on cellulose agar; E, SEM view of pycnidial cluster; F, droplet-like deposits on hypha (stained with aniline blue); G, appendage-like pycnidial hyphae; H, uni-ostiolate pycnidia on cellulose agar.


A
B
C
D
250µm
E
50µm
F
10µm
G
H
200µm

initially formed].

This *Phoma*, which is not known to occur in Europe (Boerema, personal communication), where *P. pomorum* is quite common, is described here as a new species.

MATERIALS AND METHODS

All isolates, including three obtained from Dr. D. R. Sumner, were single-spored prior to use for cultural studies under standardized conditions. Colony characteristics and radial growth rates of cultures were determined on potato dextrose agar (Difco) and malt extract agar (Difco) plates incubated at various temperatures (20, 25, and 30 C respectively) in the dark. Four replicates per treatment were used. Cultures were initiated in Petri dishes from agar discs bearing mycelium, 5mm in diameter (obtained with a No. 2 cork borer), derived from actively growing margins of 7-day old colonies growing on PDA. Two cellulose agar [Eggins and Pugh, 1962, but substituting cellulose (Sigmacell®) Type 20 for ball-milled Whatman's cotton cellulose powder] culture plates were prepared for each isolate, incubated at 25 C, and exposed to a cycle of alternating 12 hours near ultra-violet illumination (Westinghouse 20 watt F20T12/BLB) and 12 hours white light (Westinghouse 20 watt F20T12/CW). Determinations of radial growth were made after 4 days. Measurements of pycnidial and conidial size were made from cellulose agar plates after 10 days. For each isolate 10 pycnidia and 20 conidia were measured. Representative cultures (one from each substrate source) have been deposited at the American Type Culture Collection.

Pycnidia were embeded in plastic methacrylate. Sections 3 microns thick were obtained using a Sorvall® JB-4 microtome and stained in Delafield's hematoxylin followed by congo red. Specimens for scanning electron micrography were dried using a Denton Vacuum DCP-1 critical point drying apparatus and coated with gold and palladium using a Denton DV-502 vacuum evaporator. Micrographs were obtained using a Phillips AMR model 1000 scanning electron microscope.

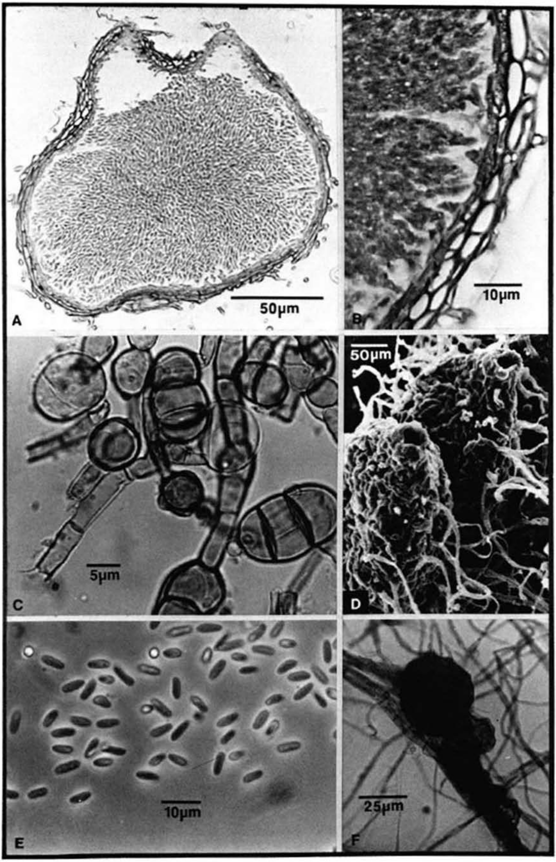
TAXONOMIC PART

Phoma americana sp. nov.

Maculae amphigenae, ellipticae, brunneae, marginibus rubellis, 2 - 4mm longae. Pycnidia partim immersae in maculis.

Coloniae in agaro maltoso olivaceae, mycelio sparso aereo, post 4 dies 25 C and 19mm diametro, reverso olivaceo; in agaro decocto

PLATE 2. Type isolate. A, V.S. bi-ostiolate pycnidium; B, section of pycnidial wall; C, chlamydospores; D, SEM view of uniostiolate pycnidia; E, conidia; F, pycnidial primodium.


50µm
A
10µm
B
5µm
C
50µm
D
10µm
E
25µm
F

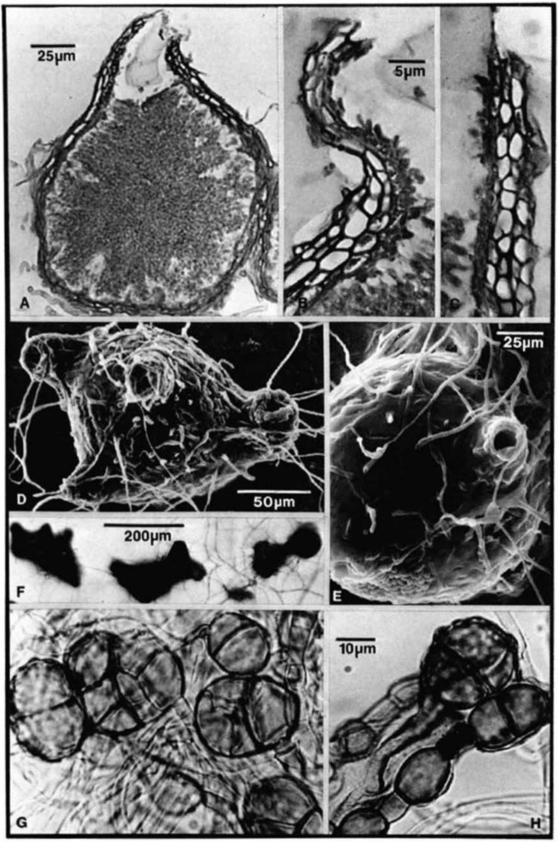
tuberorum olivaceae, lanosae vel floccosae, margine sparsae, post 4 dies 25 C ad 53mm diametro, celeriter crescentes, reverso brunneo. Mycelium ex hyphis septatis, ramosis, subhyalinis vel pallide brunneis, levibus, 1.5 - 3µm crassis compositum; hyphis interdum irregulariter inspissatis, interdum fasciculatis. Pycnidia solitaria vel gregaria vel confluentia, subglobosa vel ampullacea, brunnea vel fusca, partim immersa vel superficialia, pseudoparenchymatica, ostiolata, saepissime collo brevi praedita, 100 - 220µm diam.; paries plerumque cellularum isodiametricarum compositum. Cellulae conidiogenae (phialides) hyalinae, simplices, ex cellulis interioribus parietis pycnidii, ampulliformes, 3 - 5 X 3 - 4µm. Conidia enteroblastica, hyalina, simplicia, plerumque biguttulata, cylindrica vel ellipsoidea, utrinque rotundata, levia, plerumque continua, interdum uniseptata, 5 - 7 X 2 - 2.5µm. Chlamydosporae intercalares vel terminales, solitariae vel catenulatae, subglobosae, globosae, ellipsoideae vel irregulares, uni-, bi- vel multicellulares, crassitunicatae, leves vel asperatae, pallide brunneae vel brunneae, 15 - 40µm diam.

In foliis vivis Tritici, Montgomery County, Alabama, April 1981, A. K. Hagan, AUA, holotypus.

Figures 1 and 2; plates 1,2 and 3.

Lesions amphigenous, elliptical, brown, margin reddish in color. Pycnidia partly immersed in the leaves. Colonies on malt extract agar (Plate 1, A) olivaceous, with sparse aerial mycelium, particularly in a wide marginal zone, attaining a diameter of 9mm at 20C after 4 days, 19mm at 25 C and 20mm at 30 C, center darker and thinly floccose or in part slightly ropy in appearance, reverse olivaceous; on potato dextrose agar (Plate 1, B) pale to dark olivaceous, zonated, lanose or somewhat floccose, margin thin, generally darker towards the center, attaining a diameter of 39mm at 20 C after 4 days, 53mm at 25 C and 57mm at 30 C, reverse brownish. On both MEA and PDA mature pycnidia are produced sparsely after 10 days, partly immersed in the agar. Colonies on cellulose agar (Plate 1, C) with very little aerial mycelium, producing abundant pycnidia superficially after 7 days. Mycelium composed of septate, branched, subhyaline to pale brown, smooth, 1.5 - 3µm wide hyphae; hyphae sometimes irregularly thickened, occasionally bearing more or less hemispherical or flattened, droplet-like deposits (Plate 1, F), sometimes aggregated into closely appressed strands. Pycnidia solitary or gregarious or frequently, especially on cellulose agar, confluent, subglobose to flask-shaped, brown to blackish brown, partly immersed or superficial, pseudoparenchymatous, covered to varying degrees by hyphae (Plates 1, E; 2, D; 3, D, E), frequently bearing long, unbranched, flexuous, appendage-like, 1 - 1.5µm wide hyphae which are sometimes slightly swollen at their tips (Plate 1, G), with one or more ostioles (up to four), usually bearing one or more short necks, 100 - 220µm in

PLATE 3. Corn isolate. A, V. S. pycnidium; B, C, sections of pycnidial wall; D, E, SEM views of multi - and uniostiolate pycnidia; F, pycnidial clusters; G, H, chlamydospores.


25μm
A
5μm
B
C
D
50μm
25μm
E
200μm
F
G
10μm
H

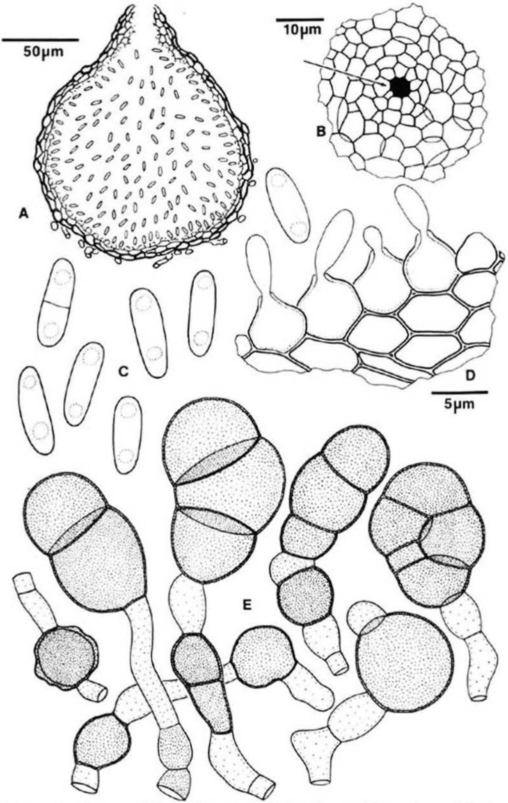


FIGURE 1. A, V.S. pycnidium of type isolate; B, portion of pycnidial wall around ostiole (indicated by arrow); C, conidia; D, conidiogenous cells; E, chlamydospores of type isolate.

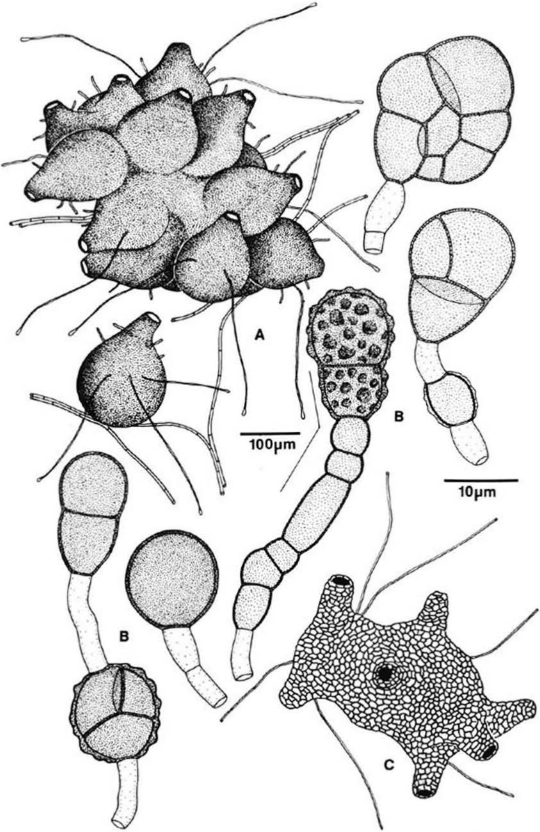


FIGURE 2. A, pycnidial cluster on cellulose agar; B, chlamydospores of corn isolate; C, heavily confluent pycnidial cluster.

diameter where solitary; where confluent the pycnidial mass (Plates 1, D; 3, F; Fig. 2, A) can reach up to 850µm in diameter and contain as many as 10 to 14 separate units as evidenced by the number of necks; wall composed of isodiametric or somewhat elongate cells (Plates 2, B; 3, B, C), up to four layers (7 - 11µm thick), frequently slightly thicker in the zone of transition between the neck and the main pycnidial body with individual cells 3.5 - 5µm in diameter, wall cells becoming progressively elongate towards the pycnidial base where frequently only one layer is present and cells measure 8 - 9 X 1.5 - 2.5µm. Conidiogenous cells phialidic, hyaline, simple, smooth-walled, borne on the innermost cells of the pycnidial wall up to the base of the neck region (Plate 3, B), subglobose to broadly flask-shaped, 3 - 5 X 3 - 4µm. Conidia enteroblastic, hyaline, simple, frequently biguttulate, cylindrical or narrowly ellipsoidal, obtuse at each end, smooth, continuous or occasionally one-septate, 5 - 7 X 2 - 2.5µm. Exuded conidial mass salmony in color. Chlamydospores very variable, intercalary or terminal, solitary or in chains, subglobose, ellipsodial or irregular, uni-, bi - or multicellular, when septate phragmosporous or dictyosporous, thick-walled, smooth or roughened, pale brown to brown, 15 - 40µm in diameter, non-septate chlamydospores 15 - 18µm; chlamydospores produced abundantly on PDA, sparsely on MEA and cellulose agar.

On leaves of wheat, roots of corn and in cysts of *Heterodera glycines*; North America.

Collections examined: on *Triticum aestivum* L., Montgomery County, Alabama, April 1981, A. K. Hagan, AUA, holotype; on *Zea mays* L., Baker County, Georgia, May 5, 1980, Miller County, Georgia, May 22, 1980, Tift County, Georgia, May 28, 1980, D. R. Sumner, AUA; from cysts of *Heterodera glycines* from soybean field soils, Lee County, Arkansas, Pontotoc County, Mississippi, Pemiscot County, Missouri, July 1981, G. Morgan-Jones and B. O. Gintis, AUA.

ADDITIONAL NOTES

Although the seven strains of *Phoma americana* represent a distinct taxon, considerable variation is exhibited among them in some regards particularly in pycnidial and chlamydospore characteristics.

On cellulose agar the strains derived from nematode cysts failed to show pycnidial clustering and confluence to the same degree as in the others but multiostiolate pycnidia were abundant. It should be noted, however, that there is sometimes difficulty in distinguishing between clustered pycnidia derived from the confluence of a few primodia and bone fide single, but multiostiolate, entities. One strain from corn differed by failing to produce any pycnidia on this medium.

The type isolate produced no chlamydospores on cellulose agar, whereas such structures were produced sparsely on this medium by the other strains and moderately in the case of the corn isolate that produced no conidia. The degree of chlamydospore production on

MEA and PDA respectively also varies among strains. Furthermore the type of chlamydospore predominating varies. The corn isolate that failed to produce pycnidia produced single-celled, heavily melanized, roughened chlamydospores almost exclusively.

One-septate conidia were encountered, though infrequently, mainly in the corn isolates.

Phoma americana is easily distinguished from other species, including *P. pomorum*, by its chlamydospores, relatively thick-walled pycnidia, and its slow growth on malt extract agar [*P. pomorum* attains a diameter of 5 - 7.5cm on MEA after 7 days (Dorenbosch, 1970)].

ACKNOWLEDGMENTS

We have had the benefit of consultation with Dr. Gerhard H. Boerema, Wageningen, The Netherlands, and are grateful to him for his comments on some of our isolates. Dr. D. R. Sumner, Tifton, Georgia, kindly provided us with cultures of his isolates from corn. Dr. Richard T. Hanlin, University of Georgia, kindly reviewed the manuscript.

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A NEW SPECIES OF *AMANITA*

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ABSTRACT

Amanita media (fig. 1) is described as new from Alabama. It appears to be intermediate between sections *Lepidella* and *Validae*.

Amanita media Jenkins, sp. nov.
Holotype: Alabama - rest area, Hiway 231, between Florala and Opp, Al, 11. vi. 1981, Jeannie and David Jenkins 1629(DTJ).

Corpus fructus medius. Pileus: quanto 78 mm latus, planus convexusque cum in orbe loco depresso tenuique, margo non striatus, pileipellis mediocriter ac facile separabilis, fulgens, levis, argenter ac alba, verum cum colore destincto vero, praecipue in orbe, caro albue, quanto 7 mm crassus ad centrum, fastigata adversus marginem. Lamellae: densae, annexae, gilvae; lamellulae truncae convertentes in superficie, tenuissime attenuata. Stipes: quanto 50 x 14-15 mm, solidus, gilvus, levis, tegumen partim et in forma apicis, albus, delicatissimus, iam evanescens bulbus ad basem obovatus, quanto 30 x 25 mm; reliquae universi teguminis ita panni fortuiti floccosique in bulbo supero, albae, facile remotae. Odoratio no distinctus. Spores 4.69-5.47 x (9.37) 10.15-12.50 µm.

Fruit body medium, solitary. PILEUS: up to 78 mm diam, plano-convex with slight depression in center, margin non-striate, pileipellis fairly easily separable, shiny, smooth, silvery white, but with distinct tannish tint primarily on disc, flesh white, up to 7 mm thick at center, tapering toward margin; universal veil as few small, floccose patches. LAMELLAE: crowded, adnexed, creamy-white; lamellulae truncate to slightly attenuate. STIPE: up to 50 x 14-15 mm, solid, creamy-white, smooth; partial veil apical, white, very delicate, soon disappearing; basal bulb obovate, up to 30 x 25 mm; universal veil remnants as random, floccose patches on upper bulb, white, easily removed. Smell not distinct.

PILEIPELLIS: filamentous hyphae densely interwoven, considerable gelatinization, 2-6 µm diam, moderately abundant, oleiferous hyphae present. PILEUS TRAMA: filamentous hyphae undifferentiated, moderately branched, no clamps, 2-7 µm diam; inflated cells abundant, mostly terminal, mostly elongate, up to 191 x 38 µm. LAMELLA TRAMA: bilateral; filamentous hyphae undifferentiated, no clamps, 2-8 µm diam; inflated cells elongate, terminal. SUBHYMENIUM: inflated ramose to subcellular, no clamps. BASIDIA: up to 43 x 4-11 µm, mostly 4-sterigmate, but with a consipcuous number of 2-sterigmate, thin walled, no clamps. UNIVERSAL VEIL: filamentous hyphae at base of stipe abundant, sparsely to moderately branched, no clamps, 3-7 µm diam, some gelatinization, irregularly

Fig. 1. *Amanita media* Jenkins (DTJ 1629)

disposed; inflated cells abundant, globose, subglobose, broadly elliptic, up to 78 x 78 µm, very few small elliptical cells, mostly short, terminal chains: tissue on pileus the same. STIPE TRAMA: filamentous hyphae undifferentiated, sparsely branched, no clamps, 3-6 µm diam; inflated cells terminal, clavate, longitudinally oriented, up to 154 x 41 µm, most smaller. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, no clamps, 2-8 µm diam, interwoven; inflated cells sparse, small, terminal.

SPORES: 4.69-5.47 x (9.37)10.15-12.50 µm, ($\underline{E}$ = 1.99-2.29; $\underline{E}^m$ = 2.12), elongate to cylindric, adaxially flattened, thin walled, hyaline, amyloid, spore print white; contents guttulate; apiculus sublateral, cylindrical.

Habitat and distribution: terrestrial, loblolly pine and mixed hardwoods, Alabama.

Collections examined: rest area, U.S. Hiway 231, between Florala and Opp, Alabama, 11. vi. 1981, Jeannie and David Jenkins 1629(DTJ): roadside, U.S. Hiway 231, near Florala, Alabama, 11. vi. 1981, Jeannie and David Jenkins 1657(DTJ).

Discussion: *Amanita media* appears to be intermediate between sections *Lepidella* and *Validae*. The characters of elongate to cylindrical spores, whitish pileus, and a delicate partial veil appear to indicate a relationship with section *Lepidella*. However, features such as the easy removal of volval patches from pileus, non-appendiculate pileus margin, and the pileus margin not exceeding the gills indicates a relationship with section *Validae*.

Although the above characters are used to delineate sections *Lepidella* and *Validae* respectively, exceptions to the definitiveness of each character can occur. For example, the whitish pileus is most characteristic of members of section *Lepidella*. However, *Amanita demissa* Corner & Bas, section *Validae*, has a whitish pileus with a grayish disc. Singer (1975) mentions that there are a few members of section *Validae* with cylindrical spores, a feature more commonly associated with section *Lepidella*.

The features which characterize section *Validae*, i.e., easy removal of volval material from the pileus and the non-appendiculate pileus margin, can occasionally be found in members of section *Lepidella*. For example, the volval remnants of *Amanita polypyramis* can easily be washed off by rain or removed by scraping. The appendiculate margin is quite definitive when present. The character is the result of the adherence of the partial veil fragments to the pileus margin as the fruit body expands. Frequently, however, this material can easily be washed off or fall off with age, resulting in a non-appendiculate margin.

It is obvious from the above examples that the variability of characters within individual specimens is frequent enough that no single feature can unquestionably indicate a sectional relationship. As can be seen from the description of *Amanita media*, it possesses combinations of characters which indicate a possible relationship with two different sections. Therefore, *Amanita media* will not be assigned to a particular section at this time. Future collections may allow for better discernment.

ACKNOWLEDGEMENTS

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MYCOTAXON

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DESCRIPTIONS OF NEW SPECIES AND COMBINATIONS IN MICROSPHAERA AND ERYSIPHE (III)

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The present paper continues the taxonomic studies in the genera *Microsphaera* and *Erysiphe*. It comprises some descriptions of new species and a new combination.

1. *Microsphaera neglecta* U. Braun spec. nov.

Syn.: *M. alni* emend. Salmon p.p.; *M. penicillata* f. *ulmi* Jacz. (1927, p.364), nom. nud.; *M. ulmi* (Jacz.) Bunkina, in Vodorosli, griby i mhi Dal´nego Vostoka, p. 42, Vladivostok 1978 (not validly published, combination not indicated, basionym not cited, basionym = nom. nud.).

Mycelium amphigenum, evanescens vel subpersistens. Cleistothecia 65-100 µm diam., cellulae peridii ca. 10-15 µm diam., appendices 5-12, diametro cleistothecii 1-1.5plo longiores, hyalinae, superne tenui- et inferne crassitunicatae, basi 5-8 µm latae, ad apicem dichotome ramosae (4-5x), apice recurvatae, asci 3-6, 40-50 x 30-40 µm, ascosporae 6-7, 15-19 x 10-12 µm.

Holotypus: hospes - *Ulmus americana*, U.S.A., Galeria and Council Hill, Ill., 19-9-1882, Seymour (BPI).[1]

Mycelium effused, amphigenous, usually epiphyllous, evanescent to subpersistent. Cleistothecia 65-100 µm in diam., cells obscure, polygonal to rounded, ca. 10-15 µm diam., 5-12 ± equatorially inserted appendages, curved and flexuous, 1-1.5 times as long as the cleistothecial diameter, stalk hyaline, coloured at the very base, 0-1-septate, moderately thick-walled throughout or thin above and thick below, 5-8 µm wide near the base, apex 4-5 x regularly branched, the branchings form a small, compact complex, tips recurved, primary branches sometimes somewhat elongated and slightly recured, 3-6 asci, mostly without stalk, 40-50 x 30-40 µm, 6-7 spores, 15-19 x 10-12 µm (fig. 1).

I studied an additional sample of the species (on

Ulmus fulva, U.S.A., Columbia, Mo., 9-10-1910, leg. ?, BPI). The new species resembles *M. juglandis-nigrae* U. Braun (distinguished by 4-5-spored asci). The name *M. penicillata f. ulmi* Jacz. has been introduced for the fungus on *Ulmus americana* in N. America. Therefore, this name is a synonym of *M. neglecta*. The identity of Bunkina's collection from the Far East of the Soviet Union is uncertain.

2. *Microsphaera magnifica* U. Braun spec. nov.

Syn.: *M. alni* emend. Salmon p.p.

Mycelium amphigenum, subpersistens. Cleistothecia (75-) 85-125 µm diam., cellulae peridii 10-25 µm diam., appendices 5-18, diametro cleistothecii 1-1.5plo longiores, hyalinae, superne tenui- et inferne crassitunicatae, basi 6-10 µm latae, 0-1-septatae, ad apicem dichotome ramosae (4-6x), apice recurvatae, asci 4-6, 45-65 x 40-55 µm, ascosporae 3-5, (16-) 20-26 x 10-15 µm.

Holotypus: hospes - *Magnolia acuminata*, U.S.A., Bureau of Plant Industry, Harrisburg, Pa., Northeast Erie Co., 18-10-1920, Cubbin (BPI).

Amphigenous, mycelium effused or in spots, subpersistent. Cleistothecia scattered, (75-) 85-125 µm in diam., cells conspicuous, 10-25 µm diam., 5-18 equatorially inserted appendages, stiff to flexuous, 1-1.5 times as long as the cleistothecial diameter, stalk hyaline, coloured near the base, smooth, aseptate or with a single septum at the base, thin-walled above, thick towards the base, 6-10 µm wide below, sometimes enlarged at the very base (-15 µm), apex 4-6 x branched, ornate, somewhat loose, ultimate tips distinctly recurved, often somewhat circinate to subhelicoid, 4-6 asci, mostly without stalk, 45-65 x 40-55 µm, 3-5 spores, (16-) 20-26 x 10-15 µm (fig. 2).

The new species is near to *M. nemopanthis* Peck, *M. ornata* U. Braun and related taxa. It is distinguished by the features of the asci and ascospores. I investigated two additional samples (on *Magnolia acuminata*, U.S.A., Washington, Agric. Grounds, 22-11-1910, Norton, BPI; on *Magnolia liliflora*, U.S.A., Semmes, Alab., 4-11-1946, Gill, BPI).

3. *Microsphaera neomexicana* U. Braun spec. nov.

Mycelium amphigenum, subpersistens. Cleistothecia 90-140 µm diam., cellulae peridii 10-20 µm diam., appendices 10-30, diametro cleistothecii 0.75-1.5 (-2)plo longiores, hyalinae, tenuitunicatae, eseptatae, basi 5-10 µm latae, ad apicem irregulariter dichotome ramosae (3-6 x), apice non recurvatae, asci 6-16, 45-65 x 25-40 µm, ascosporae 3-6, 18-24 x 10-14 µm.

Holotypus: hospes - *Forestiera neomexicana*, U.S.A., Flaggstaff, Ariz., 24-9-1919, Godding (BPI).

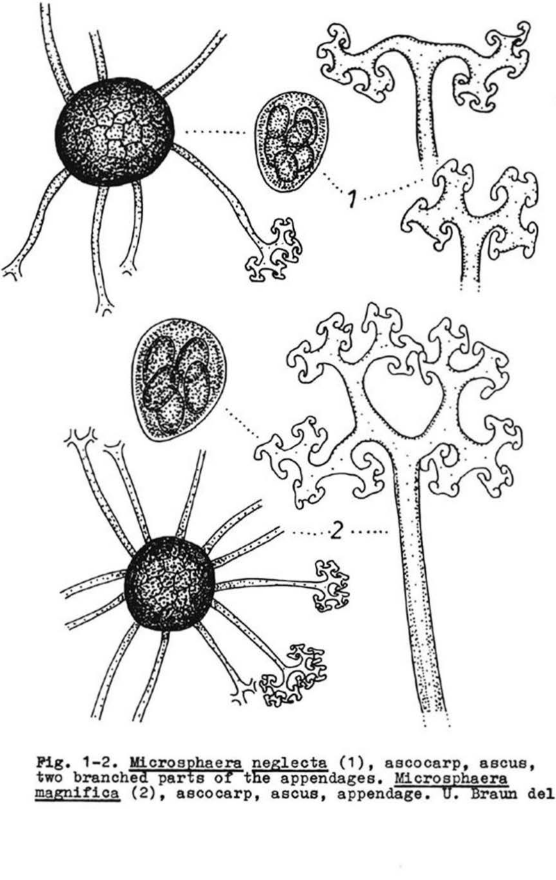

Fig. 1-2. *Microsphaera neglecta* (1), ascocarp, ascus, two branched parts of the appendages. *Microsphaera magnifica* (2), ascocarp, ascus, appendage. U. Braun del.

Amphigenous, mycelium effused, subpersistent. Cleistothecia 90-140 µm in diam., cells of the wall polygonal, ca. 10-20 µm diam., appendages numerous, about 10-30 per ascocarp, equatorially inserted or somewhat in the upper half, radially spread, rather stiff, 0.75-1.25 (-2) x as long as the cleistothecial diameter, stalk hyaline, aseptate, rough, thin-walled, slightly thicker towards the base, about 5-10 µm wide below, apex 3-6 times branched, branchings very irregular, loose, diffuse, deeply cleft, tips mostly straight, obtuse, few recurved, asci 6-16, stalked, 45-65 x 25-40 µm, 3-6-spored, 18-24 x 10-14 µm (fig. 3).

The species resembles *M. diffusa* C. & P. It differs by relatively short appendages and very numerous asci. *M. neomexicana* is also close to *M. prasadii* Bhatnagar & Kothari, a species on *Hamiltonia* in India (distinct by very numerous appendages).

4. *Microsphaera friesii* Lév. var. *dahurica* U. Braun var. nov.

Syn.: *M. alni* p.p., ss. Homma (1937); *M. friesii* ss. Bunkina (1979).

Cleistothecia 80-105 µm diam., asci 4-5, ascosporae 6-7, 16-24 x 9-12 µm.

Holotypus: hospes - *Rhamnus dahurica*, Japan, Morioka, Prov. Rikuchu, 23-9-1903, Yamada (TNS-F-217398).[1]

Amphigenous, mostly epiphyllous, subpersistent. Cleistothecia 80-105 µm in diam., cells obscure, polygonal to rounded, ca. 8-25 µm diam., appendages ± equatorially inserted, 7-15, about as long as the cleistothecial diam. (0.75-1.25x), stalk hyaline, sometimes coloured near the base, smooth, thick-walled towards the base, thin above, 7-11 µm wide below, apex 4-6 x closely branched, regular, tips recurved when mature, 4-5 asci, 40-50 x 25-45 µm, 6-7-spored, 16-24 x 9-12 µm (fig. 4).

The number of ascospores distinguishes var. *dahurica* from var. *friesii* (3-5). The spores of var. *friesii* are smaller.

5. *Microsphaera miurae* U. Braun spec. nov.

Syn.: *M. alni* p.p., ss. Homma (1937).

Mycelium amphigenum, subpersistens. Cleistothecia 70-115 µm diam., cellulae peridii 10-20 µm diam., appendices 5-10, diametro cleistothecii 1-2plo longiores, hyalinae, 0-1-septatae, tenuitunicatae, basi 6-10 µm latae, ad apicem dichotome ramosae (3-5x), apice recurvatae, asci 3-5, 40-65 x 30-45 µm, ascosporae 4-5, 18-25 x 12-15 µm.

Holotypus: hospes - *Lonicera morowii*, Japan, Omagari, Prov. Uzen, 3-11-1908, Miura (TNS-F-214110).

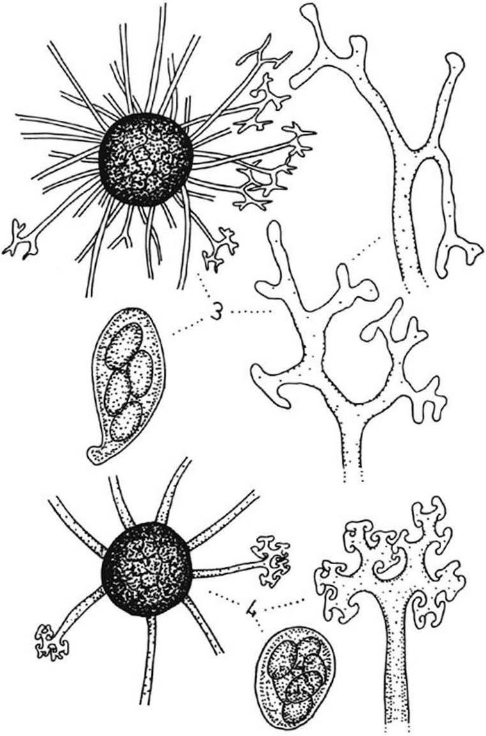

Fig. 3-4. *Microsphaera neomexicana* (3), ascocarp, ascus, two branched parts of the appendages. *Microsphaera friesii* var. *dahurica* (4), ascocarp, ascus, appendage. U. Braun del.

Mycelium amphigenous, subpersistent. Cleistothecia 70-115 µm in diam., cells obscure, ca. 10-20 µm diam., 5-10 equatorial appendages, rather stiff, often deeply cleft, stalk hyaline, sometimes yellowish, brown near the base, 0-1-septate, thin-walled, slightly thicker below, 1-2 x diam. of the cleistothecium in length, 6-10 µm wide below, apex 3-5 x loosely branched, primary branches usually elongated, often somewhat twisted in different planes, asci 3-5, without stalk, 40-65 x 30-45 µm, 4-5 spores, 18-25 x 12-15 µm (fig.5).

I examined some additional samples on Lonicera from Japan (ex TNS): Lonicera morowii, L. orientalis, L. chamissoi, and L. ciliata. All collections agree with M. miurae. The species is morphologically related to M. miyabeana U. Braun on Styrax in Japan and allied taxa. It is not related to M. lonicerae (cleistothecial appendages with straight ultimate tips) and M. caprifoliacearum U. Braun (an American species, apex of the appendages richly branched, compact).

6. Microsphaera ornata U. Braun var. europaea U. Braun var. nov.

Syn.: (Pseudonym), M. betulae (DC.) Magn., Ber. deutsch. bot. Ges. 16, p.67 (1898).

Cleistothecia 75-105 µm diam., appendices 4-13, diametro cleistothecii 0.5-1 (-1.5)plo longiores.

Holotypus: hospes - Betula pubescens, Bavaria, Bayreuth, Oct. 1874, de Thümen, Myc. univ. 56 (K).[1]

Because of the changed "Art. 13" of the ICBN, adopted at the Sydney Botanical Congress (1981), the name Microsphaera betulae (DC.) Magn., published as a combination with the basionym Erysiphe betulae DC. (1815, = Phyllactinia guttata), becomes a synonym of the latter species. Hence it is necessary to introduce a new name for the European Betula-Microsphaera. After seeing a large amount of material on different American Betula species, I prefer to consider the European fungus as a mere variety of M. ornata. The collections on Betula lenta and lutea are well distinguished from European specimens. Samples on Betula sandbergii and pumila (studied mat. ex herb. AZ), however, are intermediate. The cleistothecial appendages on B. sandbergii are only 0.5-1 times as long as the cleistothecial diam. (1-1.5 x on B. lenta and lutea). The only constant difference between European and American collections is in the number of appendages. American specimens possess always numerous appendages (average > 10). "M. betulae" on B. dahurica in Asia (Bunkina 1979) belongs undoubtedly to M. ornata var. ornata.

7. Erysiphe cichoracearum DC. var. poonaensis (Chiddarwar) U. Braun stat. nov.

Bas.: Erysiphe poonaensis Chiddarwar, Current Sci.

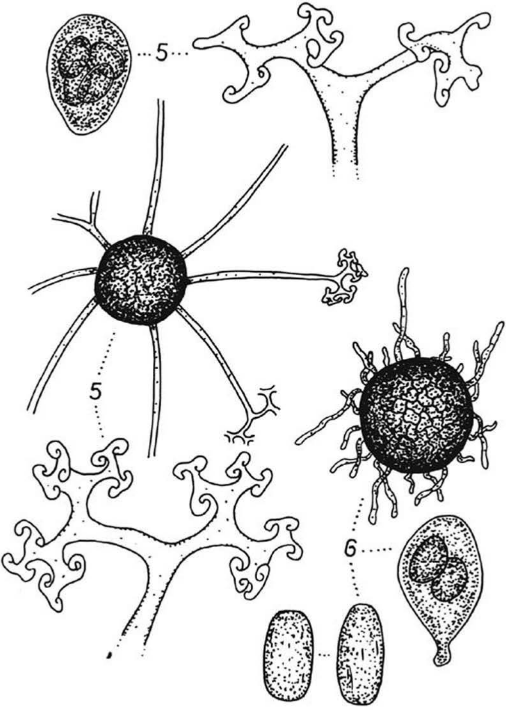

Fig. 5-6. *Microsphaera miurae* (5), ascocarp, ascus, two branched parts of the appendages. *Erysiphe cichoracearum* var. *poonaensis*, ascocarp, ascus, two conidia. U. Braun del.

24(12), p.421 (1955).

Studied mat.: on *Goniocaulon glabrum*, Poona, India, IX. 54, P. P. Chiddarwar (IMI 61831, type).[1]

Amphigenous, mycelium persistent, conidia in chains, ellipsoid to barrel-shaped, 24-29 x 12.5-15 µm (dried!). Cleistothecia 90-145 µm in diam., cells obscure, appendages numerous, basally attached, mycelioid, strongly interlaced with the mycelium, brown when mature, thin-walled, septate, simple, ca. 5-10 um wide, shorter than the cleistothecial diam., numerous asci per fruit body (ca. 8-12), stalked, 50-70 x 25-35 µm, 2-spored, spores subglobose, ca. 14-19 x 10-13 µm (fig. 6).

Var. *poonaensis* differs from var. *cichoracearum* by small conidia and small, subglobose ascospores. The differences are only slight; the fungus is hardly more than a variety of *E. cichoracearum*.

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[1] I am deeply indebted to the staffs of the mentioned herbaria (BPI, TNS, K, IMI) that have sent valuable material for the present investigations.

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TAXONOMIC NOTES ON SOME POWDERY MILDEWS (II)

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The present paper contains the description of *Uncinula oleosa* Zheng & Chen var. *zhengii* var. nov. and the new combination *Uncinula necator* (Schw.) Burr. var. *ampelopsidis* (Peck) stat. nov. Furthermore, a discussion about the impact of the changed "Art. 13" (ICBN) on the Erysiphaceae is included.

1. *Uncinula* in Asia on *Tilia*

Zheng & Chen (1977) described *Uncinula oleosa* on *Tilia tuan* from China. The species is clearly different from *U. clintonii* Peck, an American fungus on *Tilia americana*, by the features of the appendages. *U. oleosa* has few appendages (about 8-23 per ascocarp), whereas *U. clintonii* possesses a higher number (average > 20). The appendages of *U. clintonii* are enlarged from base to top, including the coiled part. The apical part of the appendages in *U. oleosa* is not enlarged, its width is sometimes even decreasing. Homma (1937) and subsequent authors determined Japanese collections on *Tilia* either as *U. clintonii* or *U. miyabei*. I reinvestigated some specimens on *Tilia japonica* (TNS-F-216134, 216135, 216137). The material agrees entirely with *U. oleosa* and is characterized as follows:

Uncinula oleosa Zheng & Chen, Acta Microbiol. Sinica 17 (4), p.290 (1977)

Mycelium amphigenous, evanescent to subpersistent. Cleistothecia 85-125 µm in diam., cells polygonal to rounded, ca. 10-20 µm diam., 8-25 equatorially inserted appendages, flexuous, sometimes abruptly bent, 1-2.5 x as long as the cleistothecial diam., mostly 1.5-2 x, hyaline, coloured at the base, usually 1-septate, thin-walled, somewhat thicker towards the base, 5-8 µm wide below, width uniform throughout or slightly enlarged upwards (-10 µm), coiled part not enlarged, sometimes even decreasing, apex closely circinate to subhelicoid, oil drops present, especially in the upper half of the appendages,

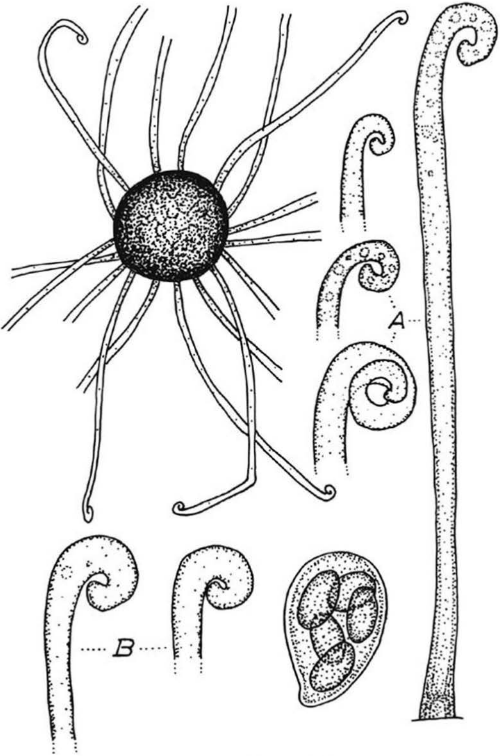

Fig. 1. Uncinula oleosa Zheng & Chen var. oleosa on Tilia japonica, ascocarp, ascus, appendages (A); var. zhengii on Tilia maximowicziana, two upper parts of the appendages (B). U. Braun del.

3-7 asci, without or shortly stalked, 45-60 x 35-50 µm, 5-7 spores, (15-) 18-25 x 10-15 µm (fig. 1).

I studied some collections on *Tilia maximowicziana*. The appendages are 5-7.5 µm wide near the base and increasing upwards (- 7-10, rarely - 14 µm). They are rather regularly increasing from base to top (circinate part). The apex is frequently slightly enlarged, oil drops are rare. Otherwise this form of the fungus coincides with typical *U. oleosa*. It should be regarded as a variety of the latter species. *U. clintonii* and *U. oleosa* are undoubtedly related, but they are morphologically and geographically differentiated.

Uncinula oleosa Zheng & Chen var. *zhengii* U. Braun var. nov. (Etym.: Prof. Zheng, Beijing, Chinese mycologist)

A typo differt appendices ad apicem incrassatae et clavulatae in forma.

Holotypus: hospes - *Tilia maximowicziana*, Japan, Muruyama near Sapporo, 14-10-1925, Homma (TNS-F-216179).

2. *Uncinula necator* (Schw.) Burr. var. *ampelopsidis* (Peck) U. Braun stat. nov.

Bas.: *Uncinula ampelopsidis* Peck, Trans. Albany Inst. 7, p.215 (1872).

Syn.: *Uncinula subfusca* Berk. & Curt., Grevillea 4, p.160 (1876).

U. ampelopsidis is usually included in *U. necator*. The differences between *U. necator* on *Vitis* and the fungus on *Parthenocissus* have been pointed out by Salmon (1900) and Blumer (1933). The appendages of *U. necator* s. str. are long and flexuous (about 1-6 x as long as the cleistothecial diam.). *U. ampelopsidis*, confined to N. America, possesses shorter, rather stiff appendages (length ca. 1-2.5 x diam. cleist.). The average diameter of the ascocarps is larger. The conidial states are agreeing. There is a close overlapping of the cleistothecial features in both species, but the differences are constant. Therefore, I consider *U. ampelopsidis* as a variety. In Europe (Braun 1982) and Japan (Nomura 1981) *U. necator* infects occasionally *Ampelopsis* or *Parthenocissus*. Fruit bodies are not formed and the conidial states correspond with *U. necator* on *Vitis*.

3. Nomenclatural notes

The impact of the changed "Art. 13" (ICBN), adopted at the Sydney Botanical Congress (1981), on the Erysiphaceae is only moderate. Two new combinations have been inevitable. They are already published:

Erysiphe cynoglossi (Wallr.) U. Braun replaces *E. asperifoliorum* Grev.

Sphaerotheca aphanis (Wallr.) U. Braun replaces *Sph. al-*

chemillae (Grev.) Junell

Besides, the citations of some additional species are influenced. The protected status of names adopted by Fries is indicated with the sign " : ". It has to be placed between the original author and Fries. The following list comprises the correct citations of the species in question.

Erysiphe aquilegiae DC.
E. cichoracearum DC.
E. convolvuli DC.
E. depressa (Wallr.) Schlecht.
E. galeopsidis DC.
E. graminis DC. (= *Blumeria graminis* (DC.) Speer)
E. heraclei DC.
E. hyperici (Wallr.) Blumer (= *Microsphaera hypericacearum* U. Braun)
E. pisi DC.
E. polygoni DC.
E. urticae (Wallr.) Blumer
Microsphaera astragali (DC.) Trev.
M. *berberidis* (DC.) Lév.
M. divaricata (Wallr.) Lév.
M. euonymi (DC.) Sacc.
M. grossulariae (Wallr.) Lév.
M. lonicerae (DC.) Wint.
M. penicillata (Wallr. : Fr.) Lév.
Phyllactinia guttata (Wallr. : Fr.) Lév.
Podosphaera clandestina (Wallr. : Fr.) Lév.
Sphaerotheca epilobii (Wallr.) Sacc.
Sph. ferruginea (Schlecht. : Fr.) Junell
Sph. fuliginea (Schlecht. : Fr.) Poll.
Sph. macularis (Wallr. : Fr.) Lind
Sph. pannosa (Wallr. : Fr.) Lév.
Uncinula adunca (Wallr. : Fr.) Lév.
U. bicornis (Wallr. : Fr.) Lév. (= *Sawadaea bicornis* (Wallr. : Fr.) Homma)
U. prunastri (DC.) Sacc.

I wish to express my gratitude to the staff of the herbarium TNS for the valuable material that has been used for the present study.

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MYCOTAXON

Vol. XVI, No. 2, pp. 429-435 January-March 1983

GIGASPORA RETICULATA: A NEWLY DESCRIBED ENDOMYCORRHIZAL FUNGUS FROM NEW ENGLAND*

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Collections of endogonaceous spores from sand dunes in Rhode Island and an orchard in Massachusetts yielded a previously unknown species of Gigaspora with unusually ornate spores. The species, here named Gigaspora reticulata sp. nov. forms arbuscular endomycorrhizae.

GIGASPORA RETICULATA Koske, Miller et Walker sp. nov. (Figs. 1-10)

Sporae cinnamomeae vel obscure castaneae, globosae vel subglobosae, 188 - 340 x 208 - 470 um, in solo singillatim genitae, lateraliter ad cellulam instar suspensoris efformatae. Sporarum tunica turmis duobus separatis strata reticulo alveolato inductis. Turma externa stratis tribus. Stratum exterius 0.5-1 um crassum, cinnamomeum vel castaneum, reticulo 0.5-1 um alto, pagina sporae inter cristas reticuli spinis gradatim decrescentibus vel cristis angustis 0.5-2 um altis. Stratum medium 5-11 um crassum,

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* Journal Paper No. J-10794 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 2266.

hyalinum vel luteolum, strato interiore 0.3-0.7 um crasso adhaerens. Turma interna stratis tribus. Stratum exterius et interius utrumque 1 um crassum, stratum medium 2 um crassum, amorphum. Cellula instar suspensoris 45-87 x 85-140 um, cinnamomea vel castanea. Vesiculae in solo 25-30 x 30-40 um, in fasciculis 10-40 numero, atrobrunneae vel castaneae, projecturis obtusis nodosis. Endomycorrhizae arbusculis formans.

Spores (azygospores?) orange-brown to dark red-brown, globose to subglobose, 208-470 x 188-340 um, borne singly in the soil, laterally on bulbous suspensor-like cells formed at the tips of thick-walled, sparsely septate or coenocytic pale-brown hyphae. Wall structure complex, consisting of two separate groups of wall layers overlain by an alveolate reticulum. *Outer wall group* three-layered. Outer layer 0.5-1 um thick, orange-brown to red-brown, supporting raised, straight to sinuous interconnecting ridges that form a reticulum 0.5-1 um high, with 4- to 8-sided meshes 2-24 x 2-30 um across. Spore surface between ridges covered with polyhedral, conical or subcylindrical spines, or narrow straight, curved, or angular ridges 0.5-2 um high and 0.25-0.5(-1) um apart; the spines 0.3-1.5 um diam at base, tapering to a point or a rounded tip less

FIGURES 1-9. *Gigaspora reticulata* spores by brightfield (B), differential interference contrast (DIC), or scanning electron (SEM) microscopy.

1. An intact spore showing the reticulate outer covering and the laterally attached bulbous suspensor-like cell (B).

2. The vesicles formed in the soil by *G. reticulata*.

3. A crushed spore that has lost or failed to develop fully the reticulate outer covering, the vestiges of which (ret) can be seen near the spore base. The flexible inner wall-group (iw) and the germination shield (gs) can clearly be seen (DIC).

4. A crushed spore showing the reticulate covering and the flexible inner wall group (iw) (B).

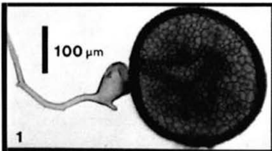
5. Detail of the outer wall-group. The alveolate reticulum, spiny layer, and thick, colored middle layer are evident. The thin, hyaline basal layer is not evident (SEM).

6. Base of a spore showing the bulbous suspensor-like cell with a peg-like hyphal protrusion (SEM).

7. Spore surface detail by brightfield microscopy.

8. Same part of spore surface as in Figure 7, but by differential interference microscopy.

9. Detail of reticulum showing alveoli filled with spines.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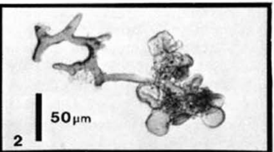
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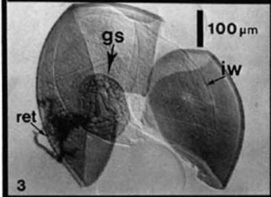
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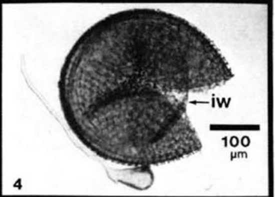
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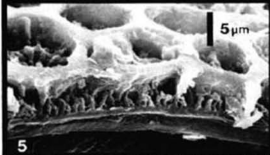
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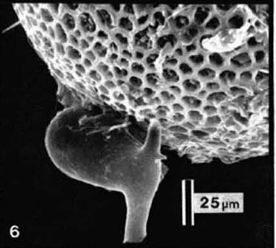
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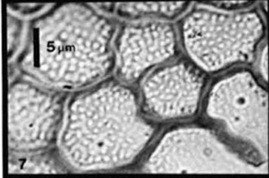
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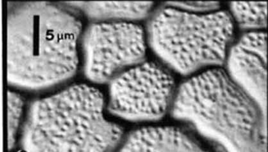
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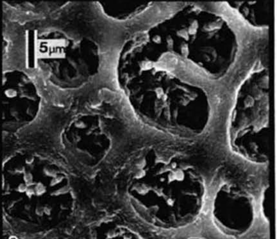
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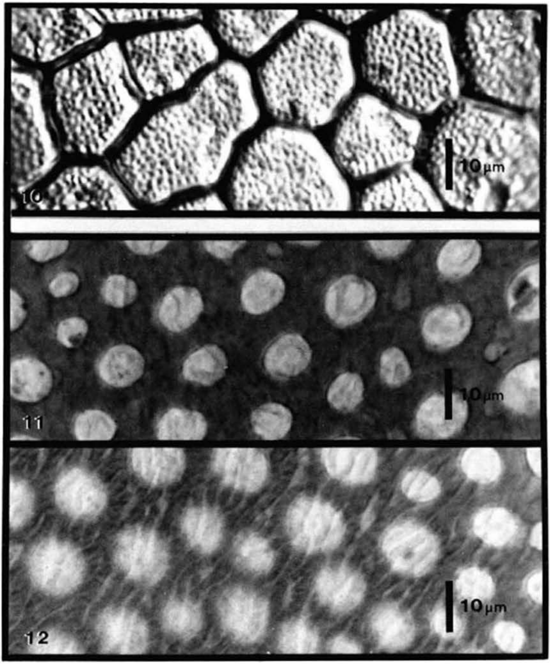

FIGURES 10-12. Light microscopy of outer wall-layers of *Gigaspora reticulata* (Figure 10) and *G. nigra* (Figures 11 and 12). Figures 11 and 12 show the even, rounded holes in the outer wall of the latter. Figure 10 shows the difference between the reticulate outer covering of the former and the apparently sinuous nature of the wall of *G. nigra* beneath the outer wall. This can be compared with the spines and ridges evident on *G. reticulata* in Figure 10.

than 0.5 um diam; the ridges 0.5-1 x 1-7 um at the base, tapering to a rounded edge less than 0.5 um wide. Middle layer hyaline to pale yellow, 5-11 um thick, tightly adherent to the thin, hyaline inner layer that is 0.3-0.7 um thick. Reticulate ridges on outer wall supporting a detachable alveolate reticulum 0.5-2 um wide and 2-6 um high. Inner wall group three-layered, consisting of membranous inner and outer hyaline layers each 1 um thick, connected by a hyaline amorphous middle layer 2 um thick. Outer and inner layers separating before germination to form a complex, circular to reniform germination shield, 94-156 x 156-208 um, from which germ tubes arise near the spore base.

Suspensor-like cell 45-87 x 84-140 um, with a peg-like protrusion extending 10-20 um towards the spore wall. Wall of suspensor-like cell laminated, orange-brown to red-brown, 3-5 um thick except near the spore-base where it thickens to 7-10 um; in some specimens, consisting of two distinct laminated layers, the inner layer 1.5-3 um thick, orange-brown to red-brown, the outer layer 2-7 um thick, hyaline to pale yellow.

Vesicles in the soil forming in clusters of 10-40 on somatic hyphae or around the suspensor-like cell, dark brown to red-brown, 25-30 x 30-40 um, with blunt, knobby projections 4-8 x 2-6 um.

Forming endomycorrhizae with arbuscules.

DISTRIBUTION AND HABITAT: Known from coastal sand dunes at the boundary with a saltmarsh, Sand Hill Cove, Rhode Island, and from a barrier sand dune at Moonstone Beach, Rhode Island. Also found in a Montauk soil (coarse-loamy, mixed mesic Typic Fragiochrepts (Soil Survey Staff, 1975)) in an orchard at Belchertown, Massachusetts. Associated, but not proved mycorrhizal, with roots of Phragmites communis Trinx, Ammophila breviligulata Fern., Myrica pensylvanic Loisel., Malus domestica Borkh., Prunus persica (L.) Batsch., Dactylis glomerata L., and Agropyron repens (L.) Beauv.

MYCORRHIZAL ASSOCIATIONS: Forming arbuscular mycorrhizae in greenhouse pot cultures with Sorghum sudanese (Piper) Staph. and Coleus x hybridus. Attempts to induce mycorrhizal formation with Allium sativa L. cv Agway sweet spanish, Zea mays L. cv seneca chief, and Malus domestica were not successful.

ETYMOLOGY: Latin, reticulata, referring to the prominent reticulate outer wallcovering of the spores.

COLLECTIONS EXAMINED: HOLOTYPE: RHODE ISLAND - Washington County, Sand Hill Cove, in rhizosphere of Phragmites communis on a sand dune. Collected 23 iii 1981 (Koske Collection # 286, Walker Accession # 379) (OSC; isotypes FH, K). PARATYPE: MASSACHUSETTS - Hampshire County, Belchertown, University of Massachusetts Horticulture Research Farm. Collected 13 viii 1980 (Miller accession # 56, Walker # 321) (OSC, ISC). OTHER COLLECTIONS: RHODE ISLAND, Washington County, Sand Hill Cove sand dunes, 4 iv 1979 collected by E. Ovsenik (Koske # 239): RHODE ISLAND - Washington County, Moonstone Beach sand dune, 9 ix 1978 (Koske # 201). In addition, specimens from pot cultures established with sorghum and coleus have been examined. Besides the specimens lodged in herbaria, samples have been retained in the collections of each suthor.

Gigaspora reticulata is readily distinguishable from other species in the genus by the prominent dark reticulum covering the spore surface. Only G. nigra J. F. Redhead in Nicolson & Schenck could be confused with G. reticulata, but these two differ distinctly. G. reticulata has globose to subglobose spores 188-340 x 208-470 (mean 264 x 281) um, considerably smaller than spores of G. nigra, which are globose and 297-1050 (mean 402) um in diameter. In addition, spores are much darker than those of G. reticulata , being dark brown to black compared with orange-brown to dark red-brown. The main difference between the species, however, is in the wall structure. G. reticulata has an outer wall covered by rounded spines and ridges that are contained, but not overlain, by a polygonal reticulum with ridges 0.5-2 um wide and meshes varying from 2 x 2 to 24 x 30 um across (Figure 10). The inner wall-group of G. reticulata consists of two membranous walls apparently fastened together by an amorphous middle layer. G. nigra, in contrast, has a distinct outer wall pitted by rounded pores 7-10 um diam, overlaying a second wall made up of coiled elements (Nicolson & Schenck, 1979; Old et al., 1973) that appear as densely packed, sinuous rods by light microscopy (Figures 11 and 12). The inner wall-group in this species consists of a continuous, laminated wall surrounding two thin, membranous walls.

G. reticulata spores tend to lose their suspensor-like cells during sieving from the soil and can then be confused with spores of fungi in the genus Acaulospora. The resemblance of this species to A. bireticulata Rothwell & Trappe is particularly striking, and the plates in Rothwell and Trappe (1979) and Walker and Trappe (1981) (Figure 2 amd Figure 12, respectively) are almost indistinguishable from Figures 7, 8, and 10 in this paper. Care should therefore be taken when identifying spores in this group to verify the nature of the attached hyphae.

ACKNOWLEDGMENTS: We thank Dr. William J. Lord, Extension Pomologist, University of Massachusetts, who kindly allowed the collection of samples at the Massachusetts Horticultural Research Farm; E. Ovsenik for collecting one of the sand samples from Rhode Island; and Don Scales for the scanning electron microscopy. We also thank Dr. N. C. Schenck and Dr. J. M. Trappe for their helpful comments. Dr. Trappe prepared the Latin diagnosis. Dr. Francis Sanders suggested the term "germination shield" and kindly permitted its use in this description.

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MYCOTAXON

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A NEW THERMOPHILIC SPECIES OF *MYCELIOPHTHORA*

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SUMMARY

A new hyphomycete, *Myceliophthora hinnulea* Awao & Udagawa isolated from cultivated soil in Japan, is described. The species is typically thermophilic, with a minimum growth temperature somewhat below 20 C, an optimum between 40 and 45 C, and a maximum somewhat above 50 C.

In the course of a study of thermophilic fungi in Japan (Awao and Mitsugi, 1973; Awao and Otsuka, 1973, 1974), a hyphomycete belonging to the genus *Myceliophthora* was isolated from cultivated soil. It differs from previously described species by having dull red to grayish brown colonies and brownish conidia with a conspicuously verrucose to spinulose surface.

Myceliophthora hinnulea Awao & Udagawa, sp. nov. (Fig. 1)

Coloniae in agaro cum decocto tuberorum ad 40 C effusae, paene planae, constantes ex mycelio basali tenui et conidio abundanti, velutinae vel plus minusve floccosae, primo albae vel roseo-vinaceae, dein griseo-brunneae vel hinnuleae, ad marginem tenues et late submersae; reversum brunneum vel hinnuleum vel griseo-sepiaceum.

Mycelium ex hyphis hyalinis, ramosis, laevibus, septatis, 1.0-5.0 (-6.5) µm diam compositum; hyphae fertiles plerumque aeriae, dense ramosae, 1.5-3.0 µm diam. Cellulae conidiogenae in hyphis gerentes, terminales vel laterales, sessiles vel saepe brevipedicellatae, ad apicem saepe inflatae usque 4.0-6.0 × 3.0-4.0 µm et ampulliformes. Blastoconidia plerumque 1-4 per cellulam conidiogenam, solitaria vel in 2-3 catenata, primo hyalina vel dilute flava et laevia, dein flavo-brunnea vel brunnea, incrassata, subglobosa vel ovata vel pyriformia, (7.0-)8.0-9.0 (-12.0) × (5.0-)6.0-7.5(-10.0) µm, ad basim cum contractis cicatricibus, irregulariter et conspicue verrucosa vel spinulosa; spinae usque 1.0-4.0 µm longae.

Holotypus No. AJ-6773, isolatus e solo sativo, Nirayama, Shizuoka, in Japonia, in 24.ii.1973, leg. T. Awao. In herb. NHL.

Etymology: lat. *hinnuleus* = fawn, referring to the colony color.

Colonies on potato-dextrose agar growing very rapidly, attaining 7.8-8.0 cm diam within 3 days at 40 C and more than 8.5 cm diam within 10 days, almost plane, consisting of a thin basal felt of vegetative mycelium and abundant conidia-bearing structures, velvety to more or less floccose, loosely covered with rather sterile aerial hyphae, at first white to dull red such as Aurora (M. 10B4; cf. Kornerup and Wanscher, 1978) or Rosy Vinaceous (Rayner, 1970), becoming grayish brown (M. 7D3) or Fawn (Rayner, 1970) in age; margin thin and broadly submerged; exudate limited, clear to pale yellow; reverse brown (M. 6E4) or Fawn to Grayish Sepia (Rayner, 1970).

Mycelium composed of hyaline, branched, smooth-walled, septate, 1.0-5.0(-6.5) µm diam hyphae; fertile hyphae mostly aerial, often densely branched, 1.5-3.0 µm diam. Racquet hyphae absent. Conidiogenous cells borne terminally or laterally as side branches on hyphae, often with short or long pedicels which are terminally inflated into ampulliform swellings measuring 4.0-6.0 × 3.0-4.0 µm. Blastoconidia usually 1-4 borne on ampulliform swellings, occasionally on short protrusions, solitary or in chains of 2-3, at first hyaline to pale yellow and smooth-walled, becoming yellowish brown to brown, thick-walled, subglobose to ovate or pyriform, (7.0-)8.0-9.0(-12.0) × (5.0-)6.0-7.5 (-10.0) µm, with narrow basal scars, irregularly and conspicuously verrucose to spinulose; spines up to 1.0-4.0 µm in length.

Colonies on YpSs agar growing very rapidly, attaining 7.5-7.7 cm diam within 3 days at 40 C and more than 8.5 cm diam within 10 days, with surface appearing more floccose, producing abundant conidia on the basal felt and aerial hyphae, at first white to reddish gray (M. 8B2) or Pale Vinaceous (Rayner, 1970), later becoming dull red to grayish brown (M. 8D3 to M. 9C4) or Vinaceous Buff (Rayner, 1970); exudate more abundantly, mostly as small droplets adherent to the mycelium, clear to pale yellow; reverse brown (M. 6E5) or Umber (Rayner, 1970).

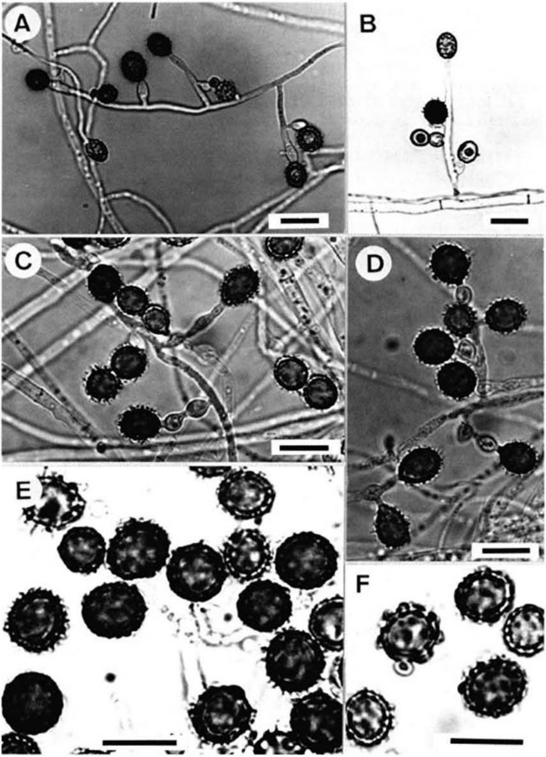

Fig. 1. Conidiogenous cells and conidia of *Myceliophthora hinnulea*, AJ-6773 strain.
A-D: conidiogenous cells. E, F: Conidia. (All scale-lines: 10 µm.)

Cellulolytic, but not distinctly keratinolytic.

Thermophilic with optimal growth at 40-45 C, minimum somewhat below 20 C, maximum somewhat above 50 C (Table 1).

Table 1. Radial growth and conidia formation of *Myceliophthora hinnulea* strain AJ-6773 at various temperatures

Temperature (C)	Growth, PDA		Conidia, PDA		Growth, YpSs		Conidia, YpSs	
	3d	10d	3d	10d	3d	10d	3d	10d
17	0	0			0	0		
20	0	3		±	0	5		±
25	10-12	65-67	-	+	12-14	65-70	±	+
30	25-26	>85	+	++	28-29	>85	+	++
35	61-63	>85	++	+++	59-60	>85	++	+++
40	78-80	>85	+++	++++	75-77	>85	++	+++
45	80-85	>85	++++	++++	72-75	>85	++	+++
50	48-50	>85	+	++	42-45	>85	±	++
55	0	0			0	0		

Growth: colony diam (mm) after 3 and 10 days.
Conidia: ++++, very abundantly produced; +++, abundant; ++, moderate; +, slight; ±, very slight; and -, not produced.

Isolation: cultivated soil, Nirayama-machi, Tagata-gun, Shizuoka-pref., Japan, 24 Feb. 1973, coll. T. Awao, No. AJ-6773 (holotype). The specimen studied is preserved at the Mycological Herbarium, National Institute of Hygienic Sciences, Tokyo (NHL). Subcultures of AJ-6773 have been deposited with the American Type Culture Collection (ATCC) and the Centraalbureau voor Schimmelcultures (CBS).

The genus *Myceliophthora* was reintroduced by van Oorschot (1977) to accommodate three *Chrysosporium*-like hyphomycetes possessing blastoconidia with narrow basal scars and often with the remains of ampulliform swellings produced as a supporting cell. Among these, two have been known as the anamorphs of two thermophilic Ascomycetes, viz. *Thielavia heterothallica* Klopotek and *Corynascus thermophilus* (Fergus & Sinden) Klopotek. She has, more recently in her taxonomic revision of *Chrysosporium* and allied genera (van Oorschot, 1980), added five species and provided a key to species currently accepted in the genus. Almost all hitherto known species are more or less thermotolerant or thermophilic, with sporulation often being good between 30 and 40 C.

Myceliophthora mostly closely resembles *M. vellerea* (Sacc. & Speg.) van Oorschot and *M. thermophila* (Apinis) van Oorschot, the anamorph of *Thielavia heterothallica*. It differs from the former in the rich pinkish color of its young colonies and the rapid growth at high temperature, because the growth temperature of *M. vellerea* ranged between 10 and 30 C. On the other hand, maximum growth of *M. thermophila* occurs at temperature of 50 C (our examined strains of *M. thermophila*: CBS 117.65 and UAMH 2015 = Semeniuk No. 200-2). In this respect, the latter is much similar to the new species but there are some discrepancies in the colonies color and the conidial morphology such as shape and ornamentation. The conidia of *M. thermophila* differs also from those of *M. hinnulea* by the hyaline color. Finally, because of the conspicuously verrucose-spinulose character of conidia, *M. hinnulea* is distinct from the another thermophilic species, *M. fergusii* (Klopotek) van Oorschot, the anamorph of *Corynascus thermophilus*, and the other species having smooth conidia.

ACKNOWLEDGMENT

We would like to thank Professor Michael R. Tansey of the Indiana University for critically reviewing the manuscript.

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OPERCULATE DISCOMYCETES FROM RANA (NORWAY) 5. RHODOSCYPHA GEN. NOV. AND RHODOTARZETTA GEN. NOV.

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ABSTRACT

Rhodoscypha gen. nov. and *Rhodotarzetta* gen. nov. are described; *Rhodoscypha ovilla* (Peck) comb. nov., *Rhodotarzetta rosea* (Rea) comb. nov., and *Neottiella aphanodictyon* (Kobayasi) comb. nov. are proposed. Delimitation of the genera *Leucoscypha*, *Neottiella* and *Rhodoscypha* is briefly discussed.

INTRODUCTION

During the 6th European Mycological Congress 1974 in Avignon, France the idea was presented that *Peziza ovilla* Peck is identical with *Humaria rhodoleuca* Bres. (Dissing 1975). From the beginning of our joint studies of the flora of Pezizales in the municipality of Rana, Norway (cf. Dissing & Sivertsen 1975) we have considered it necessary to propose a new genus for this taxon. A formal proposal of the new genus *Rhodoscypha* has until now been postponed because we wanted definitive results from cytochemical analyses of carotinoid pigments that clearly supported a separation of *Rhodoscypha ovilla* and species of the genus *Neottiella* (Cooke) Sacc.

Such evidence is hardly obtained by the preliminary results presented here, but new descriptions and proposals are the result of our desire to incorporate these new taxa in a proper way in the coming flora on "Nordic Macromycetes, order Pezizales".

MATERIALS AND METHODS

Fresh material of *Rhodoscypha ovilla*, *Rhodotarzetta rosea*, and *Neottiella aphanodictyon* has been studied. Dried material has been supplied by the following museums and herbaria: Botanical Museum, Copenhagen (C), Plant Pathology Herbarium, Cornell University, Ithaca (CUP), Rijksherbarium, Leiden (L), Herbarium, The New York Botanical Garden, New York (NY), Herbarium, New York State Museum, Albany (NYS), Botanical Museum, Oslo (O), Department of Botany, Panjab University, Chandigarh (PAN), Swedish Museum of Natural History, Stockholm (S), Institute of Zoology and Botany, Tartu (TTA), Museum of the Royal Norwegian Society for Science and Letters, Trondheim (TRH), and The Herbarium, Institute of Systematic Botany, University of Uppsala (UPS). Madam F. Candoussau, Pau, France, generously supplied material from her private herbarium.

Treatment of the material is in accordance with Dissing & Sivertsen (1980:101).

Rhodoscypha Dissing & Sivertsen *gen. nov.*

Carposoma disciforme vel cupulatum margine prominente, sessile vel substipitatum, extra pilis flexuosis membranis distromaticis vestitum; hymenium roseolum, raro albidum.

Excipulum omnino textura intricata, extra pilis obtusis saeptatis ramificatis vestitum membranis interioribus tenuibus aequalibus, exterioribus crassis inaequalibus tincturam Cotton Blue et t. carmineam declinantibus.

Asci operculati, non amyloides, maturi non prominentes. Paraphyses saeptatae, supra ramificatae, infra anastomosantes, cellula cujusque apicali guttulas exiguas numerosas continente.

Sporae uniseriatae, magnae, fusiformes, laeves vel verrucis subtilibus solitariis ornatae, quaeque guttulas primum duas magnas, matura numerosas minores continens.

Figure 1. *Rhodoscypha ovilla*.
Fruit bodies. MO 75.81 (TRH). × 1.

Nuclei omnes tincturam carmineam captantes, in sporis unici, alibi singuli - 7ni.

Habitat in humo vel frustulis plantarum, raro in ligno.

Species typifica Rhodoscypha ovilla (Peck) Dissing & Sivertsen *comb. nov., basionyma Peziza ovilla* Peck 1875 (1876) p. 66.

Fruit bodies disc-shaped or cup-shaped, with prominent margin; hymenium pinkish, rarely whitish, outside with flexuouse hairs with two-layered walls. Sessile or substipitate.

Excipulum throughout of textura intricata; outside with septate, branching, blunt hairs with a thin, regular inner wall and a whitish, thick, irregular, cyanophobic and carminophobic outer wall.

Asci operculate, non amyloid, not protruding when mature. Paraphyses septate, branching above, anastomosing below, in the uppermost cell with numerous small guttules.

Spores uniseriate, large, fusiform, smooth or delicately ornamented with isolated warts, at first with two large guttules, when mature with numerous smaller ones.

All cells with carminophilic nuclei; spores uninucleate, other cells with one to seven nuclei.

On soil or plant debris, rarely on wood.

Type species *Peziza ovilla* Peck.

DISCUSSION

Harmaja (1977) included *Peziza ovilla* in the genus *Leucoscypha* Boud. emend. Rifai (1968). Svrček (1974) did the same by including the synonymous species *Humaria rhodoleuca* Bres. Harmaja correctly argued that cytologically, *i.e.* the carminophilous nuclei of the spores and other cells and in excipular anatomy *Leucoscypha leucotricha* (Alb. & Schw. ex Fr.) Boud., the type species of *Leucoscypha*, and *P. ovilla* are much alike.

On the other hand we find the two species differing significantly in a number of other characters, viz. the hairs, paraphyses, spores, and habitat, in a way which justifies the proposal of the above new genus *Rhodoscypha* for *Peziza ovilla*.

In *L. leucotricha* the hairs are stiff, with two well-defined regular layers in the wall, in *P. ovilla* the inner layer is thin and regular, while the outer layer is unique among the Pezizales in being extremely thick, irregular, of an amorphic, unstainable substance. The paraphyses in *P. ovilla* often have the uppermost cells densely filled with numerous refractive, pale reddish brown guttules. In *L. leucotricha* there are a few, colourless guttules in the uppermost cells. In *Leucoscypha* species the spores are permanently uni- or biguttulate, in *P. ovilla* they are at first biguttulate, then multiguttulate.

Figure 2. *Rhodoscypha ovilla*.
Marginal section in Cotton Blue. MO 73.73 (C). × 200.

Finally *P. ovilla* may be characterized as a calciphilous, montaneus (Svrček 1974) and subarctic species, while *L. leucotricha* mainly is confined to acid soil in temperate areas.

Rifai (1968) and Eckblad (1968) independently circumscribed the genus *Leucoscypha* in a way which included species of the genus *Neottiella* (Cooke) Sacc. Species from these genera have the same excipular anatomy, whitish hairs on the outside, and carminophilous nuclei in spores and other cells. On the other hand they differ significantly in at least a couple of other features, viz. cytochemistry and biology.

Arpin (1969) showed *Neottiella rutilans* (Fr.) Dennis to possess β- and γ-carotenes as the quantitatively most important pigments. To our knowledge no similar analyses have been performed for *L. leucotricha*, but it appears unlikely that the above pigments, or others characteristic for *N. rutilans* (Arpin, l.c.:104) would be demonstrated in *L. leucotricha*. As pointed out above *L. leucotricha* is confined to acid substrates, often on bare soil, while *N. rutilans* and its allies always are associated with mosses, mostly species of *Polytrichum*.

It should be noted that in our preliminary analyses of pigments in *R. ovilla* (Hammerness, MO 79.60) made by thin-layer-chromatography and spectrophotometry, it was possible to demonstrate four different, unidentified, pigments. Quantitatively most important was a winered to carmin pigment with an absorbtion maximum at 490 nm. It was not possible to demonstrate β- and γ-carotenes. *N. rutilans* served as reference material.

In spite of the mentioned similarities between taxa treated by others as *Leucoscypha* species we prefer to consider the smaller, more natural genera *Leucoscypha* Boud., *Neottiella* (Cooke) Sacc. and *Rhodoscypha* Dissing & Sivertsen.

Figure 3. *Rhodoscypha ovilla*.
Nuclei in carminoaceticacid. a. Spores. b. Paraphyses. c. Hair. MO 73.73 (C). a-c, × 1085.

Rhodoscypha ovilla (Peck) comb. nov.

Peziza ovilla Peck, Ann. Rep. N.Y. State Mus. 28:66, 1875 (1876).
Neottiella ovilla (Peck) Sacc., Syll. Fung. 8:194, 1889.
Patella ovilla (Peck) Seaver, The North American Cup-fungi (Operculates):163, 1928.
Leucoscypha ovilla (Peck) Harmaja, Karstenia 17:73, 1977.
Humaria rhodoleuca Bres., Fungi Trid. II:79, 1892.
Pustularia rhodoleuca (Bres.) Boud., Hist. Class. Discom. d'Eur. 53, 1907.
Leucoscypha rhodoleuca (Bres.) Svrček, Česká Mykol. 28:132, 1974.
Figures 1-5 & 7.

Fruit bodies 0.5-1 cm broad, solitary or in small clusters, at first globose with an irregular, slit-like opening, later expanding, disc-shaped to cup-shaped, hymenium pinkish, rarely whitish, margin prominent, crenulate, irregularly dentate, whitish, outside covered by a dense mat of short, whitish hairs; sessile or substipitate.

Outer excipulum of textura intricata, individual cells 10-20 µm broad, interwoven, content staining blue in Cotton Blue; towards the margin, the cells tend to form subparallel rows with the outermost cell club-shaped.

Medullary excipulum as the outer excipulum, cells densely interwoven, 10-15 µm broad, content staining weakly blue in Cotton Blue. There is no sharp delimitation between outer and inner excipulum.

Hairs 150-230 µm long, 15-17 µm broad, flexuous, blunt, with two-layered walls; outermost wall 5-6 µm thick, whitish, continuous, surface irregular, rough; innermost wall thin, regular; content of cells staining blue in Cotton Blue and yellowish in Melzer's reagents; the outermost wall do not stain in any of the reagents; hairs with few septa, branching and sometimes anastomosing, each cell with 1-7 carminophilous nuclei. Subhymenium 60-85 µm broad, of densely interwoven cells, some of which are staining heavily blue in Cotton Blue.

Hymenium 385-425 µm high; asci 14-17 µm broad, cylindric, thick-walled, non-amyloid, the operculum being circular, 5-6 µm broad; asci not protruding when mature.

Paraphyses septate, above branching, slightly enlarged to 4-5.3 µm broad, below anastomosing; in fresh specimens the uppermost cell has numerous small pale reddish brown guttules; each cell in the paraphyses has 2-4 (rarely 1 or 5-6) carminophilic, subglobose to ellipsoid, nuclei, 2-4 × 5-7 µm.

Spores uniseriate, 33-39.7-46.2 × 10-13.4-16.5 µm, fusiform, much varying in size and shape, with one, 6-8 µm broad, carminophilous nucleus; spores at first with two guttules, when mature with many small guttules, which in dried, rehydrated material merge into one large, central guttule. In the light microscope the spores appear smooth, but in the scanning electron microscope they prove to be very delicately ornamented with low isolated warts.

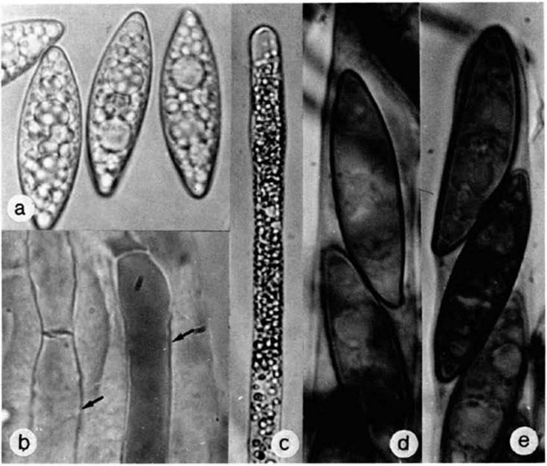

Figure 4. *Rhodoscypha ovilla*.
a. Mature spores from fresh material in H_2O. MO 75.61 (TRH). b. Hairs with thin inner wall (arrows) and thick outer wall, in 2% KOH. MO 73.73 (C). c. Paraphyses from fresh material, with numerous refractive guttules. MO 75.61 (TRH). d. Spores, in Cotton Blue, from type of *Peziza ovilla* (NYS). e. Spores, in Cotton Blue, from type of *Humaria rhodoleuca*, (S). a & c, × 800, b, d & e, × 1085.

MATERIAL

The above description is based mainly on the following collections which have been studied in detail:
Norway: Nordland, Rana, Store Alteren, map sheet 1927 I, VP 55, 9. September 1972, MO 72.137 (TRH); - ibid., 5 September 1973, MO 73.73 (C); - ibid., 8 September 1975, MO 75.61 (C,CUP,H,NY,NYS,O,S,UPS,TRH,ZT); - Ørtfjellmoen, map sheet 2027 IV, VP 86, 9 September 1975, MO 75.68 (TRH).

Additional collections:

Norway: Nordland, Rana, Store Alteren, 5 collections; - Ørtfjellmoen, 6 collections; - Hammerness, map sheet 1927 I, VP 56, 5 collections; - Ramnåga, map sheet 1927 I, VP 56, 1 collection, T. Schumacher; - Rausandaksla, map sheet 1927 I, VP 56, 1 collection; - Grønlia, map sheet 2027 IV, VP 66, 1 collection.

Sweden: Upland, Årentuna sn, Storvreta forest, N of the railway station, 10 August 1942, S. Lundell (UPS); - Västmanland, Sala, Gröna gången, close to Måns-Ols, 5 July 1945, R. Morander 89 (UPS).

Finland: Kuusamo, Liikasenvaara, lower course and mouth of the brook Sirkkapuro, 24 August 1978 (4 collections, incl. F.78.10 and F.78.11 (C)); - Juuma, The Vuomas, 25 August 1978 (C, TRH).

Estonian SSR: Rakvere, Neeruti, 4 September 1965, Raitviir (TAA 44121, C).

Switzerland: Graubünden, E of the bridge over the river Inn, 2 km SE of Ramosch, alt. 1100 m, 6 September 1979, Dissing (C).

France: Hautes Pyrénées, Le Chiroulet, Vallée de Lesponne, sous *Abies pectinata*, alt. 1100 m, 21 July 1974, F. Candoussau (C).

Italy: Trento, Tertiolasi, in silva abiegna, Junio 1880, leg. Bresadola, s.n. *Humaria rhodoleuca* Bres. n. sp. The handwriting on the label is Bresadola's (Type, ex herb. Bresadola, S); - Südtyrol, in pinetis, 1884, leg. Bresadola, s.n. *Peziza permuda* Cooke = *Pez. patavina* Sacc. The handwriting on this label is not Bresadola's (ex herb. Rehm, S).

U.S.A.: New York, Sagesville (= Lake Pleasent), August, C. H. Peck (Type, NYS, NY, slide); - Lloyd-Cornell Preserve, Slatersville, on bark of *Betula lutea* and very decaying wood, 4 October 1947, C.T. Rogersen & R.P. Korf (CUP 37139, C); - Wisconsin, Perry's woods, Algoma, Kewaunee County and vicinity, 16 August 1909, B.O. Dodge, s.n. *Humaria rhodoleuca* Bres. (NYS); - Alaska, Liberty Creek Trail near Chitine, in wet leaf mold under alder, 1 September 1963, P.E. Kempton # 9 (NY).

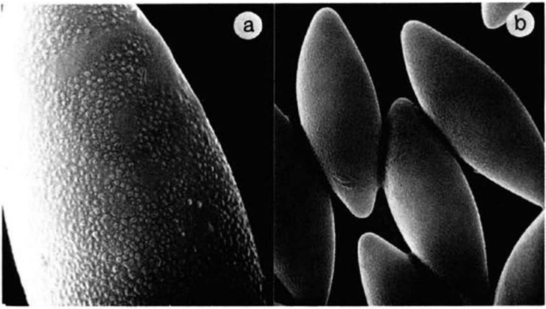

Figure 5. *Rhodoscypha ovilla*.
SEM photo of spores. MO 72.22 (TRH). a. × 4000.
b. × 1200.

India: Chankaphug, Thimhu, Bhutan, on soil in mixed forest of Blue Pine, Fir, Spruce and *Rhododendron*, alt. 9000 feet, 23 September 1980, R. Kaushal (PAN 18330, C); - Chuzom, Ha Dzong, Bhutan, on soil infested with mosses and mixed with forest litter in a mixed forest, alt. 10.000 feet, 1 October 1980, R. Kaushal (PAN 18364, C).

DISCUSSION

In the present investigation *Humaria rhodoleuca* Bres. is considered to be identical with *Peziza ovilla* Peck, with the latter name having priority (cf. Dissing 1975).

Harmaja (1977), on the basis of spore characters, viz. length, breadth, shape, content and thickness of the episporium, distinguished between the two taxa. He also paid attention to the substrate, *H. rhodoleuca* growing on soil, and *P. ovilla*, at least the material studied by him, growing on woody substrates.

However, the spore characters may vary considerably, even in the same fruit body, and at present we are not able to distinguish between two or more taxa. The results of some spore-measurements are summarized in Table 1. The variation in the number of guttules is described above.

One collection from Ørtfjellmoen (9 September 1975, (TRH)) was pure white, but otherwise typical. After treatment by an iron needle the touched and surrounding area changed very quickly to rust red. The same feature could be demonstrated on white specimens from Finland in 1978 (F.78.11 (C)).

Table 1. Spore-measurements in *Rhodoscypha ovilla*. 10 spores measured in each collection (indicated in µm).

Peziza ovilla, type, NYS	49.5-62.7 × 11.6-14.5
P. ovilla, Alaska, Kempton # 9	36.3-45.5 × 10.6-13.9
Rhodoscypha ovilla, Norway MO 75.61	33.0-46.2 × 10.0-16.5
R. ovilla, Finland F. 78.10	34.7-43.0 × 11.6-14.0
Humaria rhodoleuca Bres., type, S	48.2-56.1 × 10.6-13.9

The specimens examined by Harmaja (l.c.) from Finland were growing "on dead mossy logs of spruce (*Picea abies*)". However, the 5 collections found by Dissing (see above), also from the Kuusamo area in Finland, were fruiting on soil or soil mixed with plant debris, like all collections from Norway.

ECOLOGY

In Store Alteren, Norway (with 8 collections) *Rhodoscypha ovilla* is growing on a steep hill side in a mixed stand of *Picea abies* and *Sorbus aucuparia* with a very lush field layer consisting of *e.g. Aconitum septentrionale*, *Lactuca muralis*, *Origanum vulgare*, *Vicia sylvatica* and tall ferns (mostly *Matteuccia*). Hammernes (with 5 collections) is similar whereas most collections in Ørtfjellmoen (7 collections) have been made along the bed of an intermittent, steep brooklet. The bed rock is limestone, the surrounding vegetation is old, well-grown *Picea* forest with some *Betula*.

In order to illustrate some edaphic parametres three soil samples were taken. Collecting of the samples as well as measurements of pH and conductivity in the samples are in accordance with the methods described by Petersen (1967: 313-314). The results are summarized in Table 2.

Table 2. Edaphic factors for *Rhodoscypha ovilla*. Organic matter was determined as loss on ignition after 6 H at 400° C. Methods for measurements of pH and conductivity see Petersen (l.c.).

Collection number	pH	Lt(μS)	Loss on ignition (% of dry weight)
MO 75.68 A	6.8	380	36.7
MO 75.68 B	6.9	157	14.6
MO 73.73	5.2	470	8.1

Rhodotarzetta Dissing & Sivertsen *gen. nov.*

Carposoma primum hemisphaericum, deinde cupulatum vel disciforme, margine prominente, base lata sessile, extra glabrum, roseolum ut semper hymenium, vel albidum.

Excipulum omnino textura intricata, cellulis achrois, tincturam Cotton Blue intra paulum accipientibus. Subhymenium e cellulis dense intertextis formatum, cellulis uncificis tincturam Cotton Blue avide captantibus intermixtis.

Asci operculati, non amyloides. Paraphyses saeptatae, cellula cujusque apicali guttulas exiguas numerosas continente.

Sporae uniseriatae, laeves, ellipsoides, quaeque duas guttulas continens.

Habitat in locis deustis.

Species typifica Rhodotarzetta rosea (Rea) Dissing & Sivertsen *comb. nov., basionyma Pustularia rosea* Rea 1924, p. 20.

Fruit bodies at first hemisphaeric, then cup-shaped to disc-shaped, with a prominent margin; hymenium pinkish, outside glabrous, concolorous with hymenium or whitish; sessile on a broad base.

Excipulum throughout of textura intricata, cells colourless, with the content staining weakly blue in Cotton Blue.

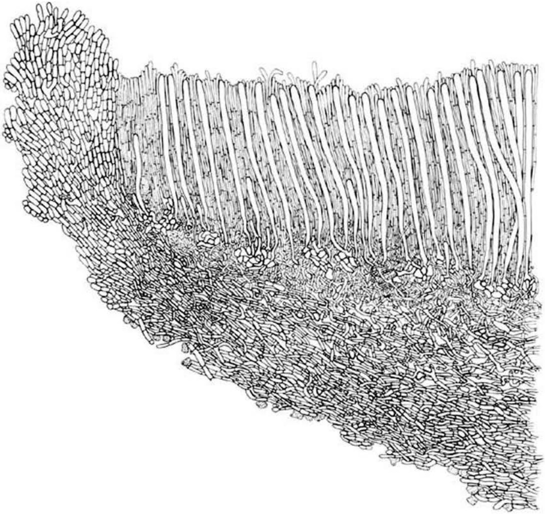

Figure 6. *Rhodotarzetta rosea*.
Marginal section. MO 75.81 (TRH,C). × 130.

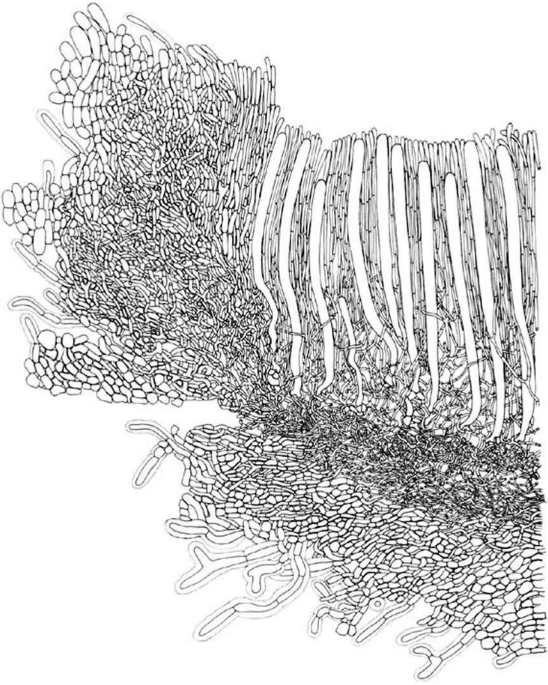

Figure 7. *Rhodoscypha ovilla*.
Marginal section. MO 73.73 (C). × 130.

Subhymenium of densely interwoven cells mixed with crozier-forming cells, deeply staining blue in Cotton Blue.

Asci operculate, non amyloid. Paraphyses septate, uppermost cell with numerous guttules.

Spores uniseriate, smooth, ellipsoid, with two guttules. On burnt areas.

Type species *Pustularia rosea* Rea.

DISCUSSION

Rhodotarzetta rosea differs from species in the genus *Tarzetta* (Cooke) Lamb. in having an excipulum which throughout is made up of textura intricata, in being glabrous, and in possessing pinkish pigments in the paraphyses.

In *Tarzetta* species the excipulum is clearly two-layered (cf. Eckblad 1968, Fig. 38 and Pant & Tewari 1970, Figs 1 and 17), the outside is furfuraceous, and all *Tarzetta* species so far described have whitish, cream or greyish pigments in the paraphyses. No *Tarzetta* species are confined to burnt areas.

Rhodotarzetta rosea (Rea) comb. nov.

Pustularia rosea Rea, Trans. Worcestershire Nat. Club 8:20, 1924.
Tarzetta rosea (Rea) Dennis, British Ascomycetes 30, 1978.
Figure 6.

Fruit bodies solitary or in small clusters, 0.4-1.2 cm broad, at first hemisphaeric, with a small circular opening, then cup-shaped to disc-shaped, with a prominent margin; hymenium pinkish, sometimes with a purplish tinge, when mature becoming pale orange; outside glabrous, concolorous with hymenium or whitish; sessile on a broad base.

Outer excipulum of textura intricata, 95-115 µm thick, individual cells 3-8.5 µm broad, densely interwoven, subparallel to outer surface, colourless, content staining blue in Cotton Blue.

Medullary excipulum also of textura intricata, of loosely interwoven cells, 5-11 µm broad, content staining weakly blue in Cotton Blue.

Subhymenium 30-65 µm thick, of short, densely interwoven cells, mixed with crozierforming cells, in which the content is staining deeply blue in Cotton Blue.

Hymenium 190-220 µm high; asci 11.6-13.2 µm broad, operculate, non amyloid.

Paraphyses septate, slightly enlarged above to 5 µm broad, uppermost cell with many small, reddish guttules.

Spores uniseriate, smooth, ellipsoid, with two guttules, 16.5-17.9-19.8 × 7.6-8.7-9.9 µm.

MATERIAL

Norway: Nordland, Rana, Ørtfjellmoen, map sheet 2027 IV, VP 86, burnt area in gravel pit, together with *Octospora rubens* (Boud.) Moser, 9 September 1975, MO 75.81 (TRH,C).

The description is based mainly on the above collection. In addition the following collections have been studied:

Denmark: Sjælland, Tureby, burnt area, 21 September 1964, P.M. Petersen & H. Dissing (C); - Jylland, Klosterhede Plantage, 8 km N of Struer, burnt area, 10 October 1969, P.M. Petersen (C).

Holland: Noord-Brabant, Groet Peel, 27 April 1961, P.B. Jansen, on burnt peat (L); - Drente, Dalen, 23 May 1961, on burnt peat, J.J. Barkman (L).

Neottiella aphanodictyon (Kobayasi) Dissing, Korf & Sivertsen comb. nov.

Aleuria aphanodictyon Kobayasi, Ann. Rep. Inst. Fermentation Osaka 3:39, 1967.
Leucoscypha borealis Eckblad, Nytt Mag. Bot. 15:52-53, 1968.

MATERIAL

Norway: Finnmark, Tana, Rustefjelbma, 22 July 1961, F.-E. Eckblad, 61.93 (Type of *Leucoscypha boreales*, O); - Nordland, Rana, Virvassdalen, map sheet 2027 I, VP 05, naked soil among scattered mosses, 12 August 1979, MO 79.15 (C), 79.96 (TRH); - ibid., 28 August 1981, 81.94 (TRH); - Jordbru, map sheet 2027 I, VP 85, 31 July 1974 (TRH); - Grunnvatn, map sheet 2027 III, VP 73, in inundation zone of reservoir 11 August 1979, 79.99 (TRH).

Greenland: Pâmiut, Frederikshåb, 62^{0}N, 49^{0}06'W, among *Polytrichum*, 7 September 1979, T. Borgen 79.129 (C).

U.S.A.: Alaska, Barrow, "plot 419, US IBP Tundra Biome Sites, 71^{0}17'N 156^{0}41'E, on soil among mosses", 19 August 1974, O.K. Miller & G.A. Laursen 11831 s.n. *Aleuria aphanodictyon* Kobayasi (CUP 58835); - Alaska, Barrow, within walking distance from the Naval Arctic Research Laboratory, on soil among *Polytrichum*, 17 August 1980, H. Knudsen (A 22,C); - ibid., M. Lange (A 25,C); - ibid., 19 August 1980, R.P. Korf (AK 30, CUP; A 29,C); - ibid., 21 August 1980, Dissing & Sivertsen (A 41, A 42,C; - ibid., B 6,9,10, TRH).

DISCUSSION

The collections from 1980 were all made during the First International Symposium on Arctic Mycology held at Barrow, Alaska from 16-23 August where also Dr. Kobayasi participated. Although it seems as if the holotype of *Aleuria aphanodictyon* is lost we feel sure about the identity of this species. *A. aphanodictyon* possess all characters typical for *Neottiella* species, viz. soil inhabiting, associated to *Polytrichum* species, paraphyses with carotinoid pigments, guttulate spores with cyanophilic ornamentation, spores and other cells with carminophilic nuclei, excipulum of textura intricata, and with whitish flexuous or stiff hairs on the outside.

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BASIDIOMYCETES APHYLLOPHORALES EPITHELOIDES ETALES

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The presence of sterile pegs is not a suitable character to circumscribe a natural group. The fourteen species of warm countries studied (ten of which are new) are distributed among the genera *Epithele* (Pat.) Pat. emend., *Pteridomyces* Jülich emend. and *Vesiculomyces* Hagström emend. The main results are translated into English at the end of the paper.

Patouillard (1899) propose une section *Epithele* dans le genre *Hypochnus*, section caractérisée par des "émergences qui traversent l'hyménium et qui sont comparables à celles de *Mycobonia* et de *Veluticeps* dans le groupe des *Stereum* ou d'*Heterochaete* dans les Hétérobasidiés". Cette proposition fait suite à la description d'*Hypochnus dussii* qui est comparé à *H. typhae*.

En 1900, Patouillard élève *Epithele* au rang de genre, sans désigner le type, comme cela se faisait à l'époque. Il cite les deux mêmes espèces et figure *E. typhae*. *H. dussii* ayant été transféré par von Höhnel et Litschauer (1907) dans le genre *Peniophora*, *E. typhae* est devenu, en fait, le seul représentant et a été logiquement sélectionné comme type par divers auteurs (cf. Donk 1957).

Peu à peu des *Epithele* nouveaux ont été décrits par Bresadola, Burt, Rick, Cunningham et plus récemment par Boquiren (1971) dans une révision où l'on retrouvera citées toutes ces espèces. Mais comme pour *E. dussi* qui est actuellement un *Tubulicium*, les émergences de plusieurs espèces de prétendus *Epithele* sont en fait des cystides bien différenciées enrobées d'hyphes grêles; ces espèces n'ont pas leur place ici: *E. capitata* Rogers et Boquiren, *E. macrospora* (Liberta) Boquiren, *E. vermifera* (Bourd.) Boquiren.

Ces exclusions faites, la révision de Boquiren comprend 8 espèces auxquelles il faudrait ajouter 4 espèces créées par Rick et qui n'ont pas pu être réétudiées depuis lors.

On peut s'attendre à ce qu'un regroupement basé sur un seul caractère physionomique, la présence d'émergences stériles, crée un ensemble artificiel; Patouillard avait d'ailleurs souligné lui-même des émergences de même aspect chez les Hétérobasidiés et dans le "groupe des *Stereum*"ce qui s'explique par un phénomène de convergence et n'est donc pas un témoignage de réelle parenté.

Nous traiterons ci-après de 14 espèces, récoltées en zones intertropicales, 9 africaines, 2 malaises et 2 américaines, auxquelles il faut ajouter une espèce malgache très particulière avec ses spores amyloïdes et ses énormes Gloeocystides sulfoaldéhydes positives que nous ne pouvons éloigner du genre *Gloeocystidiellum* Donk *sensu lato* malgré ses émergences stériles. C'est un exemple complémentaire de convergence!

Jülich a successivement proposé 3 genres monospécifiques: *Epithelopsis* (1976), *Pteridomyces* et *Skeletohydnum* (1979), sans parler de *Mycothele* (1976) créé pour une espèce discoïde que Patouillard aurait assigné au "groupe des *Stereum*", et dont nous ne parlerons pas ici.

On peut dresser une clé schématique des genres étalés-adhérents en sélectionnant les caractères distinctifs puisés dans les descriptions génériques et spécifiques de Jülich. Tous les représentants sont pourvus de boucles et d'émergences stériles et, semble-t-il, d'éléments dendrophysoïdes.

- Structure monomitique :
  . basides de 10-15 µm de longueur; émergences faites d'hyphes à paroi mince. *Pteridomyces* Jül.
  type: *E. galzinii* Bres.
  . grosses podobasides longues de 55-70 µm; spores à paroi épaissie à maturité, non cyanophile. *Epithele* Pat.s.str.
  type select.: *E. typhae* (Pers.) Pat.

- Contexte dimitique, et émergences faites d'hyphes squelettiques.
  . spores à paroi épaissie et cyanophile, *Epithelopsis* Jül.
  gloeocystides. type: *E. fulva* Cunn.
  . spores à paroi mince non cyanophile. *Skeletohydnum* Jül
  type: *E. nikau* Cunn.

Aucune des 13 espèces à classer n'a de spores à parois cyanophile; elles devraient donc se répartir dans les genres *Pteridomyces*, *Epithele* et *Skeletohydnum* en fonction d'une part de la taille des basides, d'autre part du mitisme. Ce sont là deux critères quantitatifs ou progressifs. Le "mitisme" a été l'objet de bien des interprétations divergentes; c'est ainsi qu'*Epithelopsis fulva* (Cunn.) Jülich est considéré par le premier auteur comme monomitique, par le second comme dimitique. Il faut rappeler que la notion de systèmes d'hyphes mono-, di-, et tri-mitiques est due à Corner qui décrivait ainsi dès 1932 la structure du contexte et des dissépiments de quelques polypores. (voir la mise au point de Corner 1953 par exemple).

Corner ne prend en compte ni le cortex et les hyphes de la face stérile, ni l'hyménium. *Faut-il ou non prendre en considération les émergences stériles des Epithele s. lato* ? Il faut en outre bien faire remarquer que la différenciation d'un deuxième système, fait d'hyphes squelettiques, c'est-à-dire d'articles terminaux longs et à paroi épaissie, peut être très affirmée ou au contraire encore peu marquée : ces deux cas ont été rencontrés dans notre étude. En fait nous avons observé les situations suivantes :

a- contexte et émergences faits uniquement d'hyphes génératrices: cas d'*E. typhae* et de *P. galzinii*, mais aussi d'*E. macarangae* n. sp. et *efibulata* n.sp., et de *P. lacteus* n.sp. et *sphaericosporus* n.sp.

b- émergences qui "naissant des parties profondes" comme l'écrit Patouillard (1900 p. 59) sont faites en grande partie d'hyphes squelettiques plus ou moins affirmées. Entre les émergences, parfois très rapprochées, le contexte ne montre que des hyphes génératrices (contexte monomitique): cas du *Skeletohydnum nikau* et des *E. guadelupensis*, *malaiensis* et *ovalispora* ainsi que de *P. roseolus* et *P. sp.* 8270.

c- émergences faites d'hyphes squelettiques,fibres nombreuses dans le contexte entre les émergences (contexte dimitique): ceci correspond à la définition du genre *Skeletohydnum* mais non à son type; c'est par contre le cas d'*E. citrispora*.

d- contexte dimitique à hyphes squelettiques dominantes mais émergences faites presqu'uniquement d'hyphes de type générateur associées à quelques hyphes axiales à tendance squelettique : cas d'*E. sp.* 5697.

e- contexte dimitique et émergences faites d'hyphes de type générateur: cas d'*E. interrupta* Bres.

Après ce constat on ne peut qu'hésiter à utiliser le mitisme pour des découpages qui seraient très certainement arbitraires. Par contre, on ne peut hésiter à répartir nos récoltes en deux groupes selon la forme et la taille des basides. Les unes ont de petites basides étroitement claviformes 14-20 x 3,8-5 µm, atteignant 30 µm de long chez le seul *P. lacteus*, sans contenu remarquable (groupe I). Les autres ont de grosses basides larges de 6-8 à 10-14 µm plus ou moins brusquement rétrécies à leur base, souvent plus larges dans leur partie moyenne ou même dans leur moitié inférieure, à (2)-4 forts stérigmates arqués, et au contenu riche en lipides comme celui des spores (groupe II).

Remarquons encore une fois que dans le groupe I,qui devrait correspondre au genre *Pteridomyces*, les hyphes sont soit du type "a" (cas de *P. galzinii*, espèce type mais aussi de *P. lacteus* sp. nov.), soit de type "b" (*P. roseolus* sp.nov. et surtout *P.* sp.n° 8270) ce qui ne cadre plus avec la définition du genre *Pteridomyces*.

Tous les cas de mitisme se rencontrent dans le groupe II (tabl. 1).

Emergences	Contexte (racines des émergences exclues)	
	monomitique	dimitique
A/ sans hyphes squelettiques	E. typhae E. effibulata E. macarangae	E. interrupta
		sp. 5697
B/ faites surtout d'hyphes squelettiques	S. nikau E. guadelupensis E. malaiensis E. ovalispora	E. citrispora

Tableau I. Champignons épithéloïdes du groupe II (à grandes basides).
On pourrait envisager au moins deux découpages 1) en fonction du contexte (colonnes verticales), 2) en fonction de la présence ou non d'hyphes squelettiques dans les émergences (ligne A: Epithele, ligne B: Skeletohydnum). Sont soulignées les espèces types.

Ces constatations peuvent amener deux types de décisions opposées:
1°- se baser sur la diversité des cas rencontrés pour poursuivre l'éclatement et, par exemple, créer un genre pour les Pteridomyces du type "b", les Skeletohydnum du type "c", ceux du type "e"... Si l'on veut en outre tenir compte des particularités des parois sporiques, des boucles... on peut envisager un plus grand nombre encore de combinaisons donc de genres nouveaux très homogènes mais souvent monospécifiques (mais alors à quoi servent les genres?).
2°- se baser sur cette même diversité pour refuser la multiplication des genres et accepter que les tendances évolutives, toujours en cours, provoquent une certaine diversification, donc une certaine hétérogénéité à l'intérieur des genres conçus plus vastes mais constitués d'espèces que l'on suppose naturellement apparentées.

Nous choisirons la prudence, c'est-à-dire la deuxième solution et ne créerons aucun genre. Le genre Pteridomyces sera ouvert aux espèces à émergences de nature squelettique.

Pour le groupe II, trois alternatives se présentent: définir 4 genres, n'en retenir que deux qui correspondraient soit aux deux colonnes verticales (l'un à contexte monomitique, l'autre à contexte dimitique) soit aux deux lignes horizontales (émergences faites ou non d'hyphes squelettiques): Epithele et Skeletohydnum ; la troisième solution consiste comme pour le groupe à petites basides à ne retenir qu'un seul genre et donc à réduire Skelethohydnum en synonymie d'Epithele.

Ceci revient à reconnaître deux lignées, l'une aux petites basides claviformes et aux spores de moins de 9 µm de longueur, l'autre aux grosses basides et aux spores de plus de 10 µm de longueur, chaque lignée ayant plus ou moins évolué vers le dimitisme. Seule l'étude d'un plus grand nombre d'espèces, récoltées en des points les plus divers du globe terrestre permettra de mieux préciser les ensembles génériques naturels à distinguer.

En attendant, nous décrirons ci-après, dans l'ordre, les espèces

1. du genre *Epithele*, 2. celles du genre *Pteridomyces* emend., et enfin 3. le *Vesiculomyces* épitheloïde.

Pour chaque espèce, dans la mesure du possible nous ajouterons les caractères culturaux qui seront en outre résumés selon le code de Nobles déjà complété par J. Boidin (1966 a, p. 6) et P. Lanquetin (1973 p. 37 note 2).

D'autres additions paraissant utiles, nous regroupons ci-après, avec ces nouvelles propositions l'ensemble des compléments antérieurement publiés.

Les numéros soulignés sont ceux qui sont proposés pour la première fois.

Oxydases

2: laccase et tyrosinase présentes simultanément
2a: laccase seule présente
2b: tyrosinase seule détectée

Boucles

3c: boucles constantes (présentes à toutes les cloisons vraies)
3i: boucles inconstantes (des cloisons simples séparent certains articles nucléés)
3r: boucles rares

Eléments dextrinoïdes

8d: fibres dextrinoïdes (ex: *Scytinostroma*)
25d: dichophyses dextrinoïdes (ex: *Vararia*, *Dichostereum*)
28: asterophyses dextrinoïdes (ex: *Asterostroma*), P. Lanquetin avait en 1973 proposé pour celles-ci le n°19, préoccupé par Nobles (1967) pour "des cellules terminales moniliformes"

Gloeocystides

15: signifie présence de gloeocystides sans précision sur la réaction du contenu. Nous proposons d'ajouter :
15a : gloeocystides sulfo-aldéhydes positives
15b : gloeocystides sulfo-aldéhydes négatives (Boidin et al.1980)
15p: gloeocystides avec schizopapille(s)

Thallie

59: signifie bipolaire (monofactorielle), 60:tétrapolaire (bifactorielle).
59A: amphithalle bipolaire
60A: amphithalle tétrapolaire (proposé in Boidin et al.1976 p. 258)

Comportements nucléaires au cours du cycle

61: normal: spore uninucléée, mycélium primaire (=myc. I), uninucléé, mycélium secondaire (myc. II) binucléé.
62: subnormal: spore binucléée, myc. I âgé uninucléé, myc. II binucléé.

63: hétérocytique : myc. I à articles terminaux plurinucléés
myc. II binucléés
64: myc. I inconnu, myc. II binucléé
65: astatocénocytique: myc. I multinucléé, myc. II binucléé ou multinucléé selon les conditions d'aération; marge formée d'hyphes axiales multinucléées. (va généralement de pair avec le caractère 4)
66: holocénocytique: myc. I et II multinucléés,
67: holomonocaryotique (Kühner 1977): mycélium (monosperme comme polysperme) uninucléé
68: holodicaryotique (Kühner 1977): spore binucléée germant en un mycélium binucléé.

Clé des champignons épitheloïdes étalés des régions intertropicales

A- Spores amyloïdes réniformes, 7-8,5 x 4,5-5,5 µm; grosses gloeocystides 150-250 x 10-20 µm sulfoaldéhyde-positives. Basidiome saumoné à bordure blanche. Madagascar.
14 Vesiculomyces epitheloides
A- Spores non amyloïdes..B
B-Spores petites n'atteignant pas 9 x 5 µm; petites basides claviformes 15-20-(30) x 4-5 µm: Pteridomyces emend..........................C
B- Spores et basides plus grandes: Epithele emend....................F
C- Spores subsphériques 4,5-5,5 x 3,8-4,8 µm, basidiome blanc grisâtre, émergences faites d'hyphes bouclées à paroi épaissie. Côte d'Ivoire.
13 P. sphaericosporus
C- Spores oblongues, ellipsoïdes ou subcylindriques..................D
D- Basidiome blanc de craie, émergences faites d'hyphes à paroi mince. Spores ellipsoïdes 6-8 x 3-4 µm. Gabon.
10 P. lacteus
D- Basidiome beige ou beige rosé, émergences faites d'hyphes à paroi épaisse et cyanophile...E
E- Spores subcylindriques 5-6 x 2-2,5 µm;
République Centrafricaine. 11 P. roseolus
E- Spores oblongues 3,5-4 x 2,5-2,8 µm;
Singapour. 12 P. sp. 8270
F- Emergences faites uniquement d'hyphes à paroi mince...............G
F- Emergences faites d'hyphes de type squelettique, raides, serrées en faisceau, parfois recouvertes d'un manchon d'hyphes bouclées...I
G- Pas de boucles; spores fusiformes, 17-21 x 7-10 µm, sur Palmae;
Gabon, Sierra Leone (?) 2 E. efibulata
G- Boucles; spores ellipsoïdes, 14-20 x 6,5-8,2 µm, émergences obtuses fragiles; République Centrafricaine..................................H
H- Contexte monomitique sans fibres. 5 E. macarangae
H- Contexte nettement dimitique, Zaïre. 4 E. interrupta Bres.
I- Spores nettement biapiculées, 14-18 x 7-8 µm; contexte dimitique;
Côte d'Ivoire, Gabon. 1 E. citrispora
I- Spores ellipsoïdes, oblongues ou ovoïdes..........................J
J- Spores larges de plus de 8 µm......................................K
J- Spores ellipsoïdes ne dépassant pas 6 µm de largeur...............L
K- Spores oblongues subelliptiques 17-21 x 8-10 µm; sur Palmae;
Singapour. 6 E. malaiensis

K- Spores ovoïdes, 13,5-17,5 x 8,5-11 µm; sur *Palmae*;
Gabon. 8 *E. ovalispora*
L- Contexte épais, lâche, riche en fibres; champignon détachable. Spores ellipsoïdes 10-12 x 5-6,5µm; Argentine. 9 *E. sp. 5697*
L- Contexte mince et dense; champignon très adhérent............M
M- Spores 10-14 x 4,5-6 µm; Gabon. 7 *E. nikau* Cunn.
M- Spores 14-18 x 4,5-5,8 µm; Guadeloupe 3 *E. guadelupensis*

I - Genre *Epithele* (Pat.) Pat. 1900.
Synonyme: *Skeletohydnum* Jülich 1979

Nous plaçons ici les espèces à grosses basides et grandes spores blanches ou crèmes, à paroi mince ou un peu épaissie, lisses et qui ne sontni amyloïdes, ni dextrinoïdes, ni cyanophiles. Les hyphes génératrices sont avec ou sans boucles. Les hyphes squelettiques sont absentes ou présentes dans le contexte, dans le contexte et les émergences, ou dans les émergences seules.

1- *Epithele citrispora* Boidin, Lanquetin et Gilles, sp. nov.
Fig. 1

Jacens, solida, adhaerens, alba vel cremea, emergentiis concoloribus, regulariter dispositis hirta, 40-50 µm crassa. Trama hyphis skeleticis permultis (praeter in parte infima). Emergentiis 75-170 x 30-80 µm transgredientibus, ex hyphis skeleticis verticalibus, tunica crassissima, praeter in superiore parte, quae speciem dendroideam accipere possunt, constantibus. Basidiis 35-50 x 9-12 µm, fibulatis. Sporis biapiculatis, 14-18 x 7-8 µm, haud amyloideis neque cyanophilis, guttulis oleaginosis completis. In ligno. Holotypus LY 8537. Gabon.

A la récolte, largement étalé, solide, adhérent, blanc un peu grisâtre (Munsell 2,5 Y 8/1 à 10 YR 8/1), tout couvert de petites aspérités concolores; marge similaire assez brusque, parfois pruineuse.

En herbier, étalé gris clair quand il est très mince (5 Y 8,5/2) à crème (5 Y 8,5/3,5) ou crème sale (2,5 Y 8,5/4), adhérent à marge brusque ou au contraire progressivement amincie et plus blanche; sous la loupe il est tout hérissé d'émergences concolores assez régulièrement disposées.

Epais de 40-100-250 µm, il est formé d'une couche inférieure dans laquelle prennent naissance les émergences entre lesquelles s'établit une couche supérieure hyméniale bien différente. La couche inférieure haute de 15-160 µm peut montrer contre le support quelques hyphes génératrices bouclées à paroi un peu épaissie, collées entre elles en une sous-couche horizontale dense de 5-15 µm d'épaisseur; très vite s'y mêlent des hyphes squelettiques larges de 2-2,8 µm non cyanophiles, à lumen subnul, les plus profondes horizontales, mais vite entrecroisées et emmêlées en tous sens, parfois ramifiées, qui forment l'essentiel de la couche inférieure; les hyphes génératrices à paroi mince ou peu épaissie, x 1,5-1,8-(3) µm semblent très rares.

Emergences subcylindriques ou un peu côniques mais obtuses, ancrées à la base du basidiome et dépassant l'hyménium de 75-170 x 30-50-80 µm; elles sont formées d'hyphes de type squelettique dressées parallèlement en faisceau; elles sont larges de 2,5-(3,8) µm, leur paroi très épaisse s'amincit à l'extrémité qui peut se ramifier et prendre un aspect dendroïde; pas ou peu de cristaux dans les émergences.

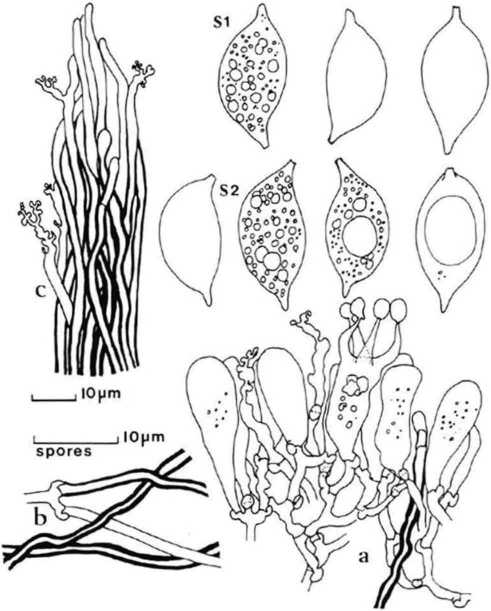

Figure 1: Epithele citrispora sp.nov. : a- hyménium, et s1, spores (holotype LY 8537); b- contexte, et c- sommet d'une émergence (LY 7158); s2- spores (LY 9013).

Les échelles sont valables pour les figures 1 à 8.

Hyménium formé de basides trapues, 35-50 x 9-10-12 µm, brusquement rétrécies à la base qui est bouclée, à 4 forts stérigmates 7-14 x 3 µm; leur contenu est guttulé gras; elles sont portées par des hyphes sous-hyméniales bouclées très ramifiées qui peuvent émettre des hyphes dendroïdes à paroi mince, souvent peu remarquables, qui atteignent la surface; dans le sous-hyménium peuvent s'engager des hyphes squelettiques verticales issues de la couche inférieure, qui montent plus ou moins haut et peuvent émerger isolément ou en groupes.

Spores citriformes biapiculées, 14-18 x 7-8-(9) µm, non amyloïdes ni cyanophiles au contenu multiguttulé. Pour le type, $\bar{x}$ = 15,17 ± 1,0 $\bar{x}$·7,14 ± 0,35, pour 9013, $\bar{x}$ = 16,06 ± 1,11 x 7,95 ± 0,41.

C'est la seule récolte africaine qui réponde tout à fait à la diagnose du genre *Skeletohydnum* Jülich. Elle ne peut cependant pas être séparée génériquement d'*E. ovalispora*, *fusispora*, *malaiensis*...etc.

Récoltes: COTE D'IVOIRE: LY 7158, forêt du Téké près d'Abidjan, 29 avril 1973 G. Gilles 210.
GABON: LY 7843, sur branchette, île aux chauves-souris, Makokou, 13 mai 1976 (*): LY 8537, HOLOTYPE, sur bois dans le fourré littoral, N. de Libreville, 21 janvier 1978, G. Gilles 1070; LY 9013, en forêt ombrophile, ibid., 3 décembre 1978, G. Gilles 1320; LY 9106, fourré littoral, 6 janvier 1979; LY 9142, forêt ombrophile, 27 janvier 1979 et LY 9199, ibid., 17 février 1979, tous trois leg. G. Gilles sans n°.

Caractères culturaux d'*E. citrispora*

SPORES.- (LY 7158-8537-9013-9106) uninucléées, mais pour un grand nombre de spores, le contenu reste très hétérogène et il est impossible de préciser.

GERMINATIONS.- Elles n'ont pas été obtenues malgré plusieurs essais avec LY 7158, 7843, 9013 et 9106.

POLYSPERME.- Seul LY 7158 s'est développé.

Croissance: très rapide (boîtes couvertes en deux semaines)

Aspect: La marge est régulière. Le mycélium présente un aspect fidèle dans toutes les boîtes: la surface de la culture est uniformément lisse, blanc pur, mate à jour frisant. Ce disque blanc est souligné, à la périphérie contre le verre, par une fine ligne presque continue brun sombre (vers5 YR 3/3 chocolat)) et il peut aussi très localement montrer de minuscules points brunâtres (5 YR 4/6 et 3/3). Dans l'une des boîtes le mycélium teinté forme une petite plage (fawn R., 5 YR 5,5/4). Après trois mois une autre boîte montrait plusieurs petites plages brunes et des zones densément piquetées de petits points bruns.

Revers des cultures: inchangé. Odeur nulle.

Microscopie:

Mycélium aérien: il forme une peau détachable à la pince mais assez cassante. Cette peau est constituée surtout d'hyphes régulières, x 1,2-2 µm, à paroi mince, bouclées, densément emmêlées avec des hyphes plus larges x3-4 µm, du côté de la gélose. Vers la bouture, quelques hyphes superficielles portent des cristaux réfringents pouvant former une gaine. Dans les petits points bruns, les hyphes, irrégulières, ont une paroi nettement brunie qui s'épaissit aux extrémités.

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* :quand le récolteur est J.Boidin,il n'est pas indiqué.

Mycélium submergé: hyphes à paroi mince, bouclées, x 2-8 µm, riches en gouttes réfringentes, les étroites bien cylindriques et les élargies plutôt irrégulières avec boucles surbaissées. Quelques hyphes régulières, x (2,5)-4-7 µm, ont une paroi nettement épaissie, x 0,5-1 µm, prenant mal le rouge Congo, elles sont bouclées et montrent aussi de nombreuses cloisons de retrait bombées.

Boucles: constantes.

Cytologie: Hyphes aux articles régulièrement binucléés, bouclés.

Oxydases: ac. gallique: +++++,0 gaïacol: ++++,0
p.-crésol: -, précipité blanc tyrosine: -, 10 mm

CODE: 2a - 3c - 32 - 36 - 38 - 42 - 54 - 64

Remarque. A part la formation d'un fin liseret brun autour des cultures très blanches, et la forme spéciale des boucles sur les hyphes submergées, le mycélium de cette espèce est très peu caractéristique.

2. Epithele efibulata Boidin, Lanquetin et Gilles sp. nov.
Fig. 2

Parvis maculis formata, deinde membranacea, alba vel cremea, emergentiis gracilibus, concoloribus praedita. Trama monomitica, sine fibulis. Emergentiis ex hyphis horizontalibus cohaerentibus, tunica tenui vel parum incrassata constantibus. Basidiis 32-52 x 8-10 µm. Sporis ellipsoideis, 17-21 x 7-10 µm, tunica paulum incrassata ac aetate luteola, haud cyanophila neque amyloidea. In Palmaceis. Holotypus LY 7863. Gabon.

A la récolte, il se présente en petite taches distinctes puis confluentes; il est membraneux, détachable sous l'aiguille, blanc puis crème (2,5 Y 8/2 à 8,5/4), crème alutacé (10 YR 8/3 et même 8/4) avec marge lisse, blanc grisâtre (2,5 Y 8/2 ou 10 YR 8/1,5); sous la loupe il est couvert d'émergences grêles, concolores.

En herbier, il apparaît mince, adhérent, fragile (pulvérulent sous le rasoir), parfois fendillé, alutacé pâle (10 YR 9/3,5 9/4) à crème (2,5 Y 8/4) avec marge amincie plus pâle et sans émergences.

Epais de 100-200 µm hors des émergences qui débordent de 70-180 x 25-35-(50) µm. Couche basale, haute de 15-50 µm, d'hyphes horizontales serrées, x 2-3 µm, à paroi mince et cloisons simples, puis hyphes obliques redressées formant une zone transitoire plus lâche: ces hyphes, x 2-2,5 µm à paroi mince, sont fréquemment ramifiées et peuvent contenir des gouttelettes lipidiques; dans cette zone se déposent parfois d'abondants amas cristallins.

Emergences constituées d'hyphes parallèles, cohérentes, à paroi mince ou peu épaissie, sans boucles; à leur surface on peut voir des extrémités dendroïdes; dans la partie profonde de ces émergences on peut trouver de rares hyphes à paroi plus épaissie et des dépôts engainants de cristaux détersiles.

Zone hyméniale dense, formée d'hyphes grêles, x 2 µm, et de basidioles claviformes riches en huile entre lesquelles peuvent émerger des hyphes dendroïdes (visibles surtout dans le bleu lactique) dans lequel on voit en outre des dépôts de fins cristaux bacillaires sur les éléments superficiels. Basides 32-52 x 8-10-(11) µm au sommet mais plus large à mi-hauteur (par ex. 13 µm) portant 4 gros stérigmates longs de 9-13 µm; elles peuvent émerger de 12-20 µm au-dessus des basidioles.

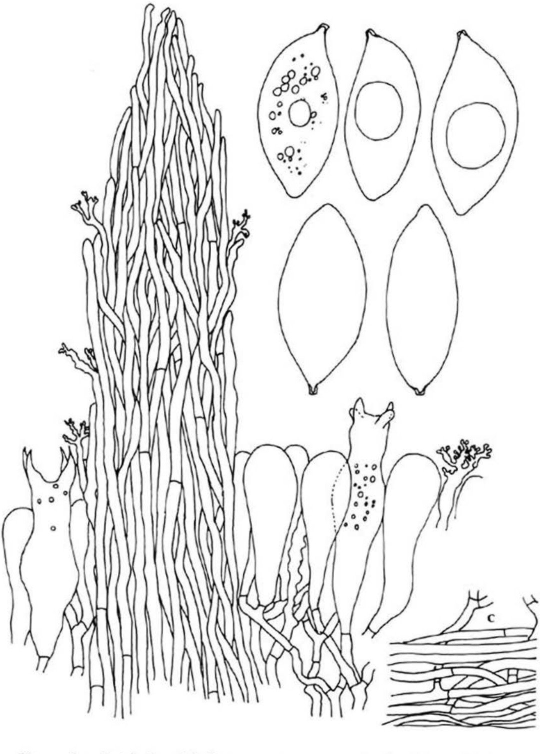

Figure 2: *Epithele efibulata* sp.nov.: coupe du basidiome (KOH-Phloxine), c- couche basale; s- spores (sporée LY 9155).

Spores fusiformes (14)-17-21-(23) x (6)-7-10-(11) µm, à sommet parfois un peu pincé (tendance biapiculée), au contenu gras, à paroi faiblement épaissie (moins de 0,5 µm). Cette paroi n'est ni amyloïde , ni cyanophile. Sur les exsiccata quelques spores semblent avoir une paroi épaissie mais c'est une impression due à la rétraction et au décollement du cytoplasme; ces spores âgées peuvent apparaître jaunâtres et flétries, elles ont une section polygonale.

Les mesures statistiques sur sporées vont de 17,23 x 7,26 pour 9146 à 20,57 x 9,28 pour 9155 mais il s'agit dans ce dernier cas d'un basidiome largement étalé, alors que 9146, jeune encore, est formé de petites taches disjointes.

Récoltes: GABON: LY 7863, HOLOTYPE, sur *Raphia* sp., marigot à Makokou, 17 mai 1976; LY 7867 ibid.; LY 9120, sur *Eremospatha macrocarpa*, La Mondah, 21 janvier 1979, G. Gilles 1407; LY 9145 et 9146, sur *Elaeis guineensis*, La Mondah, 3 février 1979, G. Gilles 1425 et 1426; LY 9155 sur *Raphia* sp., 10 février 1979, G. Gilles 1436; LY 9167 et 9168, sur *Elaeis guineensis*, 18 février 1979, G. Gilles 1447 et 1448; LY 9182, ibid. 24 février 1979, G. Gilles 1459; LY 9206 ibid., 10 mars 1979, G. Gilles 1479; LY 9277, ibid., 14 avril 1979, G. Gilles sans n°.

C'est la seule espèce d'*Epithele* qui soit dépourvue de boucles. Nous avions pensé, à la lecture de Boquiren que cette espèce pourrait être *Epithele interrupta* Bres. Il faut abandonner ce point de vue après étude du type (in BR) qui vient du Zaïre (Mayidi, 1er février 1910 leg. Vanderyst). Il s'agit d'une récolte avec émergences dispersées, peu nombreuses, courtes, obtuses, fragiles, faites d'hyphes bouclées à terminaisons dendroïdes, mais dimitique par des fibres hyalines nombreuses dans le contexte. Boquiren avait étudié une récolte de Sierra Leone déterminée *E. interrupta* (in DAOM 99.845, sur *Elaeis guineensis*) qui ne peut être l'espèce de Bresadola; bien que Boquiren ne précise ni la présence ou l'absence de boucles, ni celles d'hyphes squelettiques, certaines de ses données et figures laissent à penser qu'il pourrait s'agir d'*E. efibulata*.

Caractères culturaux d'*E. efibulata*

SPORES.- (LY 7863, 7867) uninucléées.

GERMINATIONS.- non obtenues

POLYSPERME.- (LY 7863, 7867, 9120)

Croissance: très rapide (boîtes couvertes en deux semaines)

Aspect: la marge est très régulière. Le mycélium aérien blanc pur forme une peau feutrée, appliquée, lisse, mate, pouvant toutefois montrer un ou deux plis. A la périphérie des cultures 9120, il apparaît grumeleux-floconneux et se teinte localement de crème 10 YR 9/2. A la périphérie de 7867, il se forme de petites masses de 1 à 8 millimètres de diamètre hérissées d'aiguillons un peu jaunâtres, et exsudant des gouttelettes hyalines à ambre clair.

N.B. Les cultures LY 9120 révèlent par transparence des plages un peu rosâtres, pratiquement non discernables dans les boîtes observées par dessus ou par dessous.

Le revers des cultures est inchangé, l'odeur nulle.

Microscopie:

Mycélium aérien: il est constitué d'hyphes régulières, x 1,5-2-(3) µm, à paroi mince, sans boucles. Beaucoup d'hyphes sont affaissées. La peau feutrée prélevée dans la partie âgée, est formée d'éléments solidement agglomérés, très difficiles à séparer par écrasement; il s'agit d'hyphes, x 2-3-(5) µm, sinueuses, contournées, ramifiées, emmêlées, à paroi hyaline épaisse à très épaisse, (1,2-1,5 µm par ex.) formant un puzzle dense. Les plages légèrement colorées vues par transparence sous le mycélium superficiel blanc de LY 9120, correspondent à une croûte coriace pareillement constituée en puzzle. Les émergences observées seulement dans LY 7867 sont formées d'un faisceau d'hyphes parallèles, x 1,5-2-(2,5) µm, régulières à paroi mince, sans boucles. Toutefois quelques rares hyphes ont une paroi nettement épaisse. Certaines hyphes à paroi mince, sans boucles, se ramifient vers leur extrémité mais la présence de petits cristaux gêne l'observation. Il faut utiliser le mélange KoH-Phloxine pour bien voir ces courtes ramifications à aspect de fines dendrophyses.

Mycélium submergé: Après avoit ôté la peau blanche du mycélium aérien, on peut observer de rares lignes blanches sillonnant le milieu gélosé. Une telle ligne bien visible sur une coupe transversale apparaît faite d'hyphes x 2-3 µm, à paroi épaisse très intriquée en puzzle.

Ailleurs le mycélium submergé est formé d'hyphes x 4-6 µm, assez régulières, à cloisons simples, et de rameaux, x 1,5-2 µm, assez ramifiés. Quelques hyphes, x 3-4 µm, ont une paroi épaissie à nettement épaisse, x 0,8-1 µm, ce ne sont pas des fibres.

Boucles: absentes

Cytologie: les trois polyspermes sont formés d'hyphes aux articles régulièrement uninucléés. Le croisement des deux polyspermes 7863 et 7867 a donné un mycélium aux articles également uninucléés. L'espèce pourrait être parthénogénétique.

Oxydases: ac. gallique +++++,0   gaïacol: +++++, 0
p.-crésol: -, précipité blanc   tyrosine: -, 0 à 20 mm
CODE: 2a - 6 - 11 - 32 - 36 - 38 - 42 - 54 - 67

Remarque. Cette culture est faiblement caractérisée par sa croissance rapide, la présence d'hyphes agglomérées en puzzle et par ses cultures polyspermes sans boucles aux articles uninucléés. Cette espèce holomonocaryotique est vraisemblablement parthénogénétique haploïde ce qui explique l'absence de boucles. De telles espèces ne peuvent être séparées généralement des espèces parentes binucléées. C'est le cas par exemple d'*Hypodontia efibulata* Erikss. et Hjortst.,(Hassan et David, inédit), d'un *Podoscypha* centrafricain sans boucles (inédit) de *Vararia aurantiaca* Boid. et Lanq. (Boidin et al 1980).

3. *Epithele guadelupensis* Boidin et Lanquetin sp. nov.

Fig. 3 A

Jacens, tenuis, fragilis, ex alba griseola, in margine levi pallidior, 30-50 µm crassa, emergentiis albis, regulariter dispersis, 75-130 x 15-20 µm, crassamentis crystallinis vestitis, ex hyphis rigidis, refringentibus, tunica incrassata. Hyphis genetricibus fibulatis, stratum densum pseudoparenchymaticum formantibus, deinde in perpendiculum directis. Basidiis 22-35 x 6-7,5 µm, 4 sterigmatis divergentibus; adsunt nonnullae hyphae dendroideae inter basidiola et in emergentiis. Sporis ellipsoideis, 14-18 x 4,5-5,8 µm, haud amyloideis neque cyanophilis. In Palmaceis. Holotypus LY 8119. Guadeloupe.

A la récolte, étendu, mince, blanc grisâtre (neutral 8/0) avec marge atténuée pruineuse sous la loupe, lisse sur un demi mm puis à petites émergences blanches régulièrement disséminées.

En herbier, étalé, adhérent, blanc grisâtre (neutral 8/0) puis crème, atteignant (5 Y 8/3,5) avec marge amincie plus blanche; les émergences apparaissent très tôt près de la bordure et s'allongent ensuite, elles sont nombreuses, serrées. Sous le rasoir le champignon est fragile et cassant.

En coupe, très mince 30-50 µm environ avec émergences élancées, côniques, 75-100-130 x 15-20 µm, recouvertes de dépôts cristallisés, prenant naissance à la base du basidiome. Sur quelques hyphes génératrices bouclées à paroi mince, formant une mince couche d'aspect paranchymateux en coupe transversale, se dressent les éléments du sous-hyménium et de l'hyménium.

Emergences formées d'hyphes raides réfringentes x 1,8-2,2 µm, à paroi épaissie sauf vers l'extrémité effilée, assez congophile après traitement ammoniacal à 60°; elles portent souvent en surface des hyphes à paroi mince qui peuvent se redresser et montrer des terminaisons dendroïdes; à leur base les hyphes à paroi épaissie sont sinueuses parfois ramifiées.

Basides trapues, souvent un peu étranglées, 22-35 x 6-7,5 à 4 stérigmates de 7-8 x 2 µm, écartés. Des hyphes dendroïdes émergent entre les basidioles au contenu guttulé.

Spores ellipsoïdes de face, 14-18-(20) x 4,5-5,8 µm, ($\bar{x}$ = 15,97 ± 1,20 x 5,18 ± 0,32), au contenu gras, à paroi mince non amyloïde ni cyanophile; l'apicule est réfringent.

Récoltes: GUADELOUPE: LY 8119, HOLOTYPE, sur rachis de *Prestoa montana* (*Palmae*) au sol, Bras David, 4 octobre 1976.

Caractères culturaux d'*E. guadelupensis*

SPORES.- (LY 8119) uninucléées.
GERMINATIONS.- elles sont prélevées deux jours après la dispersion
MONOSPERMES.- A trois semaines, sur 22 prélèvements, 13 sont bouclés, 3 montrent localement des crochets et 3 sont à cloisons simples. La coloration cytologique de ces derniers a donné pour deux d'entre eux des plages totalement binucléées et des plages aux articles régulièrement uninucléés. Le troisième, moins développé, s'est révélé constitué d'articles très régulièrement uninucléés sans boucles, un mois plus tard, cette même culture était formée d'hyphes aux articles régulièrement binucléés bouclés. L'espèce est donc homothalle.
POLYSPERME.-
Croissance:très rapide (boîtes couvertes en deux semaines)
Aspect: marge régulière. Mycélium aérien blanc pur d'aspect typique, faisant penser à une surface farineuse laquelle aurait été balayée presque totalement à certains endroits. Il est plus dense dans la zone jeune où de nombreuses fibrilles entrecroisées forment un réticule peu mis en évidence car rigoureusement blanc sur fond blanc. A la périphérie, les fibrilles, très fines, grimpent contre le verre et vont, en s'étalant décorer la face inférieure des couvercles.

Dans une boîte, nous avons observé de très petites plages crayeuses, de 1,5-2 millimètres de diamètre, ce sont des fructifications qui donnent une sporée crème sale dans le couvercle. Le revers des boîtes est inchangé, l'odeur nulle.

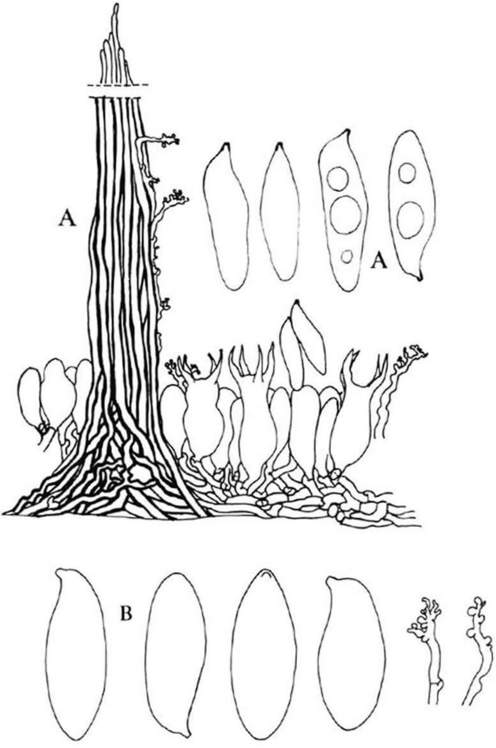

Figure 3: A- *Epithele guadelupensis* sp.nov. (holotype LY 8119).
B- *Epithele interrupta* Bres.: spores vues sur le type, et deux hyphes dendroïdes.

Microscopie:

Mycélium aérien: il est constitué par des hyphes régulières étroites, x 1,2-1,75 µm, à paroi mince, boucles constantes, (en fait beaucoup sont des hyphes collapsées) et quelques hyphes plus larges, x 4-5 µm, régulières bouclées à paroi mince et contenu homogène.

Fructifications:elles montrent de nombreuses émergences pointues de 100 à 140 µm de haut, de nombreuses basides 27-35 x 6,5-7 µm au sommet, bouclés à leur base étroite, x 2 µm, et portant sur 4 stérigmates longs jusqu'à 8 µm, des spores allongées 15 x 5 µm.

Mycélium submergé: Dans le milieu, juste vers la surface, hyphes x 2,5-4 µm, bouclés, à paroi mince, très irrégulières avec multiples bosses ou courtes excroissances; des rameaux très grêles, x 1-2 µm, sont aussi très irréguliers. Quelques axes, x 3,5-5 µm, sont réguliers, à paroi épaissie, congophile (ex. 0,5 µ sur hyphes de 4 µ, 1 µ sur hyphe de 5 µ), et portent des boucles en tibia.

Quelques rameaux bouclés très tortueux comme s'ils allaient s'imbriquer en puzzle mais sans y parvenir, ont une paroi ferme, très réfringente, qui ne prend pas le Rouge congo.

Boucles: constantes

Cytologie: hyphes aux articles binucléés, bouclés

Oxydases: ac. gallique: +++++, tr. gaïacol: ++++, 0
p.- crésol: -, léger précipité blanc tyrosine: -, tr.

CODE: 2a - 3c - 32 - 36 - 38 -42 - (48) - 54 - 57 - 61

Remarque. Culture peu caractérisée, sinon par son aspect (mais nous n'avons qu'une souche!) et son comportement homothalle lent similaire à celui d'E. nikau.

4 - Epithele interrupta Bres. ap. de Wildeman
Bull. Jard. Bot. Etat (Bruxelles) 4: 25, 1914
non E. interrupta sensu Boquiren 1971

Fig. 3 B

En herbier, étalé, mince, membranuleux fragile, crème, à marge amincie blanchâtre. Emergences peu nombreuses, courtes, irrégulièrement disséminées, détachables et laissant une cicatrice circulaire.

Epais de 90-150-250 µm avec hyphes basales distinctes, assez horizontales, régulières, x 2-3,5 µm, bouclées, à paroi mince; s'y ajoutent bientôt de nombreuses fibres hyalines x 1,5-3 µm à paroi très épaissie, s'arrêtant à la base de l'hyménium. Le contexte peut accumuler des amas de cristaux. Hyménium fait de basidioles (environ 60 x 11 µm) au contenu gras passant à des basides larges de 11-13 µm à 4 gros stérigmates; des hyphes dendrophysoïdes parfois nombreuses.

Les émergences, 200 x 150 µm, sont entièrement constituées d'hyphes bouclées à paroi mince ou presque, x 2-4 µm, parfois terminées de manière dendroïde; dépôts abondants de cristaux.

Spores fusiformes, 18-21 x 7-9-(10) µm, au contenu gras, à paroi non cyanophile ni amyloïde.

Récolte examinée: ZAIRE: Mayidi, leg. H. Vanderyst, 1er février 1910,
HOLOTYPE, (in BR).

Nous n'avons pas retrouvé cette espèce en Afrique. Elle est proche d'*E. macarangae* qui diffère surtout par l'absence d'hyphes squelettiques. L'*E. interrupta* sensu Boquiren est peut-être *E. efibulata* (voir à cette espèce).

5. *Epithele macarangae* Boidin et Lanquetin sp. nov.

Fig. 4 C

Jacens, membranacea, ex alba luteola, e parvis tuberculis, sparsis, brevibus, concoloribus, faciliter caducis, cicatrices orbiculares reliquentibus, constans. Super stratum hypharum horizontalium, x 2,5- 3 µm, fibulatarum, tunica tenui vel incrassata, adsunt hyphae subhymeniales ad perpendiculum erectae, distinctae. Emergentiis 50 x 50 µm, ex hyphis tunica tenui, superne saepe dendroideis, constantibus. Basidiis 30-45 x 10-12 µm, inferne subito angustatis, 4 grandibus sterigmatis. Sporis ellipsoideis, 14-18 x 6,5-8,2 µm, tunica tenui, haud amyloidea neque cyanophila, adipibus abundantibus. In ligno demortuo. Holotypus LY 5395. Centrafrique.

A la récolte, étalé, poruleux puis continu, membraneux, détachable par fragments, blanc un peu jaunâtre (5 Y 9/3 à 8/4), avec marge nulle ou fibrilleuse; émergences éparses, courtes.

En herbier, membranuleux mince, densément fendillé, crème (2,5 Y 8,5/4), orné de petits tubercules peu serrés, courts, concolores; fragiles et facilement caduques, ils laissent une cicatrice circulaire.

En coupe, épais de 75-100 µm; il est formé d'une couche d'hyphes horizontales x 2,5-3 µm, bouclées, à paroi mince à un peu épaissie prenant avec l'âge l'aspect d'une couche très dense aux hyphes moins distinctes à paroi souvent épaissie (la paroi peut atteindre 0,8 µm), mais ramifiées et bouclées. Cette couche basale est haute de 20-50 µm. Au-dessus se redressent les hyphes sous-hyméniales distinctes, x2-3 µm, bouclées à paroi submince portant de grosses basidioles serrées, trapues, largement claviformes puis subcylindriques parfois un peu étranglées, entre lesquelles émergent de nombreuses hyphes dendroïdes à stipe x 2 µm, à paroi mince.

Basides 30-45 x 10-12 µm au sommet, à 4 forts stérigmates longs de 10-12 µm; leur base bouclée est très fortement rétrécie, parfois avec un court stipe hyphifrome (podobaside).

Les émergences caduques, sont généralement absentes des coupes; larges de 50 µm, elles émergent aussi d'environ 50 µm et sont formées d'hyphes à paroi mince x 3-3,5 µm, souvent terminées en dendrophyses complexes; elles peuvent porter des dépôts cristallins.

Spores un peu crème en masse, ellipsoïdes de face, ellipsoïdes à subcylindriques de profil et un peu déprimées sous l'apicule, 14-18-(20) x 6,5-8,2 µm ($\bar{x}$ = 16,68 ± 1,50 x 7,42 ± 0,42 pour le type); leur paroi est mince, non amyloïde, ni cyanophile, leur contenu riche en graisses.

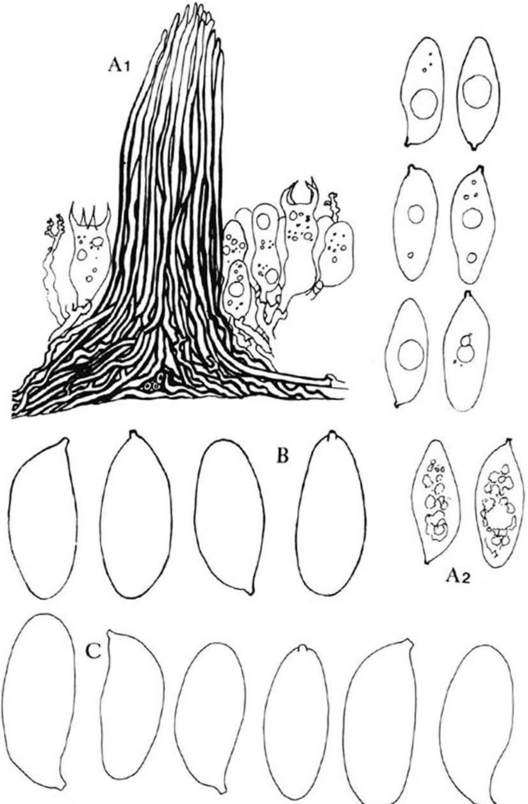

Figure 4.

Récoltes: REPUBLIQUE CENTRAFRICAINE: LY 5395, HOLOTYPE, sur branchettes mortes, forêt touchant la savane de Bébé près Boukoko, 11 mai 1945; LY 5410, sur *Macaranga spinosa* (Euphorbiacée), La Maboké, 12 mai 1965; LY 5478, sur branchette suspendue, Boukoko, 18 mai 1965.

Cette espèce est facile à reconnaître de la plupart des *Epithele* décrits ici à ses émergences éparses, obtuses, fragiles et même caduques laissant une cicatrice circulaire, et l'on pourrait hésiter à la placer dans le genre *Epithele*; Toutefois ses basides et dendrophyses sont du type habituel dans ce genre. Elle est proche d'*E. interrupta* Bres. par ses émergences et ses spores, mais ne montre aucune hyphe squelettique dans son contexte.

Caractères culturaux d'*E. macarangae*

SPORES.- uninucléées (LY 5395).

Douze jours après la dispersion des spores, de très rares germinations sont apparues. Observées un mois plus tard les 3 germinations isolées sont formées d'hyphes à cloisons simples, alors qu'à cette même date la culture polysperme montrait des hyphes étroites, régulières, x 1,5-3 µ, à boucles constantes. L'espèce est donc présumé hétérothalle. Malheureusement stockées à 4°C, ces cultures ont péri avant d'avoir pu être étudiées plus complètement.

6. *Epithele malaiensis* Boidin et Lanquetin sp. nov.

Fig. 4 B

Tenuibus maculis, bene limitatis, maxime adhaerentibus, ex albis griseis vel pallide alutaceis formata, 30-40 µm crassa inter emergentias conicas, 200-250 x 35-40 µm, quae ex hyphis skeleticis rigidis constant. Hyphis genetricibus fibulatis; inter basidia 30-45 µm longas, tetrasporas, adsunt nonnullae hyphae dendroideae. Sporis oblongis e facie visis, 17-21 x 8-10 µm, tunica paulum incrassata, haud amyloideis neque cyanophilis. In Palmaceis. Holotypus: LY 8252, Singapour.

A la récolte, en tâches bien délimitées, minces, très adhérentes, blanc grisâtre (10 YR 8/1) atteignant gris alutacé pâle (10 YR 8/2,5) au centre, à marge brusquement amincie; il est couvert dès la marge d'émergences concolores, régulières.

Figure 4: A- *Epithele nikau* Cunn.: 1- coupe du basidiome au niveau d'une émergence, et spores (LY 9119), in NH4OH 60°C- Congo; 2- spores de l'holotype (in K).
B- *Epithele malaiensis* sp. nov.: spores de l'holotype (LY 8252).
C- *Epithele macarangae* sp. nov.: spores de l'holotype (LY 5395).

En herbier, très adhérent, blanc à alutacé pâle (10 YR 8/3 à 8,5/4).

En coupe, il apparaît très mince (30-40 µm) entre les émergences côniques de longueur totale de 200-250 µm, larges de 35-40 µm à la sortie de l'hyménium, plus larges à l'enracinement qui se fait sur le substratum.

Emergences constituées d'hyphes squelettiques rigides, x 1,8-2,5 µm sensiblement congophiles après traitement ammoniacal à 60°C qui dissout un dépôt plus ou moins cristallisé qui les englue; à l'écrasement quelques hyphes dendroïdes s'en détachent et l'on voit à la base que les fibres sont un peu plus larges à paroi plus épaissie et sont sinueuses. Entre les émergences quelques hyphes génératrices peu distinctes, bouclées, portent des hyphes sous-hyméniales à paroi submince; hyménium formé de grosses basidioles ovoïdes puis claviformes à subcylindriques, riches en gouttelettes réfringentes, et d'hyphes dendroïdes grêles; basides fortes, longues de 30-45 µm brusquement rétrécies à la base qui est bouclée, portant 4 gros stérigmates; leur largeur atteint 15 µm à mi-hauteur.

Spores oblongues de face, elliptique de profil 17-21 x 8-10 µm ($\bar{x}$ = 18,45 ± 0,80 x 8,82 ± 0,50), à paroi très peu épaissie (0,3 à 0,5 µm dans KOH 3%) non cyanophile, ni amyloïde, au contenu gras.

Récoltes : SINGAPOUR: LY 8252 HOLOTYPE, sur Palmae, Mac Ritchie
reservoir, 19 août 1977.

A les plus grandes spores parmi les Epithele à émergences squelettiques

Caractères culturaux d'E. malaiensis

SPORES.- uninucléées (LY 8252)

POLYSPERME.-

Croissance: extrêmement rapide (boîtes couvertes en une semaine)

Aspect: marge régulière . Mycélium aérien, blanc peu développé dans la partie jeune où il est réduit à une grosse pruine discontinue puis forme un feutre très mince, régulier, sur lequel sont dispersées des pustules coriaces d'aspect céracé puis recouvertes d'une couche crayeuse formant souvent bourrelet circulaire quand elle n'atteint pas le sommet au centre de la pustule. Sous le couvercle, mycélium blanc à aspect rhizoïde. Observée par transparence, la culture montre en outre quelques lignes blanches plus denses. Le revers des cultures est inchangé, l'odeur nulle.

Microscopie:

Mycélium aérien: hyphes grêles, x 0,8-1,2 µm, bouclées, à paroi mince, contenu homogène, cachant des hyphes, x 1,8-4,5 µ, bouclées.

- partie hyaline coriace, céracée, des pustules: hyphes ramifiées, densément enchevêtrées mais non soudées, x 2,5-3 µm, bouclées, à paroi réfringente un peu épaissie mais plus souvent au contenu dense, homogène, réfringent.

- partie recouvrante blanche: hyphes x 2-2,5 µm à paroi submince ou parfois nettement épaissie, bouclées non soudées, mais très intriquées en sorte de puzzle.

Mycélium submergé: hyphes, x 1,5-5-(6) µm, à paroi mince, contenu homogène et boucles constantes. Toutefois quelques hyphes bouclées à paroi nettement et irrégulièrement épaissie ont été rencontrées.
Les lignes blanches s'enfonçant dans la gélose sont constituées d'hyphes, x 2-2,5 µm, très intriquées en sorte de puzzle.

Boucles: constantes.

Cytologie: hyphes aux articles binucléés.
Oxydases: ac. gallique: +++,0 gaïacol: ++++, 0
p.- crésol: -, précipité blanc tyrosine: -, 0
CODE: 2a - 3c - (11) - 32 - 36 - 38 - 41 - 54 - 64.
Remarque. Cette culture de croissance extrêmement rapide est caractérisée par la formation de pustules céracées.

7. Epithele nikau G.H. Cunn., Trans. Roy. Soc. New Zeal. 83: 629, 1956.

Fig. 4 A

A la récolte, en petites taches séparées puis largement confluent, très étalé, blanc grisâtre (10 YR 7,75/1) à bordure blanche étroite; émergences nombreuses, concolores.

En herbier, adhérent, blanc plus ou moins crème (5 Y 8,5/3) couvert de petits aiguillons concolores nombreux jusqu'à la marge qui est très étroite, atténuée, blanchâtre.

En coupe, épais de 30-50-80 µm hors des émergences qui mesurent 180-230 x 12-25 µm et dépassent l'hyménium de 70-100-190 µm. Ces émergences sont côniques dans leur partie inférieure puis subcylindriques et sont formées d'hyphes rigides à paroi épaissie, x 1,8-2,2 µm, un peu rétrécies au sommet, assez congophiles, en faisceau régulier, le plus souvent enrobées d'une substance hyaline réfringente, cassante, non biréfringente qui englue les hyphes externes du faisceau. A la base l'émergence atteint le substratum en s'élargissant; elle est alors formée d'hyphes fibroïdes congophiles mais sinueuses ramifiées rappelant parfois des binding-hyphae (cf. Corner 1953).

La base est formée sur 15-18 µm d'hyphes génératrices horizontales, x 1,8-2 µm, régulières, à paroi mince, bouclées, auxquelles se mêlent hors des émergences de rares éléments squelettiques, qui se multiplient aux abords de celles-ci avant de s'emmêler entre elles pour former leur base.

Hyménium haut de 20-35 µm, formé de basidioles et basides riches en huiles; les basides ou podobasides larges, légèrement étranglées aux 2/3 supérieurs, mesurent 18-27 x 6-8 µm au sommet, et sont plus larges au 1/3 inférieur (x 7,5-9,5 µm). Elles portent 4 forts stérigmates souvent arqués. Quelques hyphes simples ou faiblement dendroides émergent entre les basidioles riches en gouttes grasses.

Spores ellipsoïdes de face, fusiformes de profil, 10-14 x 4,5-6 µm à paroi mince non amyloïde, ni cyanophile, au contenu guttulé; l'apicule est très réfringent; $\bar{x}$ = 12,16 ± 1,10 x 5,52 ± 0,35 pour 8004
12,43 ± 0,70 x 5,01 ± 0,27 pour 9119

Récoltes: GABON: LY 8004, sur Ancistrophyllum secundiflorum, La Mondah, 30 mai 1976; LY 9119, sur Eremospatha macrocarpa, id°, 20 janvier 1978, leg. G. Gilles 1406.

Caractères culturaux d'E. nikau

SPORES.- (LY 8004) uninucléées

GERMINATIONS.- Apparues quatre jours après la dispersion des spores LY 9119, elles ont permis 25 isolements.

MONOSPERMES.- A sept jours, les cultures montrent une majorité d'hyphes à cloisons simples, mais aussi de rares petiteshyphes bouclées. A un mois la moitié des cultures sont totalement bouclées et à 2 mois, toutes les cultures sont binucléées, à boucles constantes. L'espèce est donc présumée homothalle.

POLYSPERME.- (LY 8004, LY 9119)

Croissance: rapide (boîtes couvertes en trois semaines)

Aspect: la marge est régulière. Mycélium aérien blanc pur, appliqué, peu abondant, ne cachant pas totalement le milieu. Plus dense, feutré-ruguleux vers la bouture, il est partout ailleurs un peu rayonnant (LY 9119) à nettement rayonnant chez LY 8004 où il forme d'étroites fibrilles disposées très régulièrement et dans la partie jeune des cultures, ces fibrilles, serrées, parallèles,grimpent contre le bord des boîtes pour s'étaler ensuite sous le couvercle. Le revers des cultures est inchangé, leur odeur nulle.

Microscopie:

Mycélium aérien: hyphes, x 1-2,5-(4,5) µm, régulières, à paroi mince, boucles constantes. Les hyphes grêles, x 1-1,2 µ ont souvent des boucles un peu fortes. Dans le mycélium jeune, quelques hyphes sont incrustées; dans le mycélium âgé les dépôts de cristaux biréfringents sont plus importants.

Mycélium submergé: hyphes bouclées, les unes très grêles, x 1-1,2 µm très régulières, les autres plus larges, irrégulières, x 2,5-4-6 µm, à paroi mince, à contenu hétérogène. Celles-ci surtout nombreuses à faible profondeur montrent quelques renflements atteignant 10 µm. On peut aussi observer de rares hyphes à paroi, x 0,7 µm, également bouclées.

Boucles: constantes

Cytologie: hyphes aux articles régulièrement binucléés, bouclés.

Oxydases: ac. gallique: +++++, 0 gaïacol: +++++, 0
p.- crésol: -, fort précipité blanc tyrosine: -, tr à 5 mm

CODE: 2a - 3c - 32 - 36 - 38- 43 - 54 - 57 - 61

8. Epithele ovalispora Boidin et Lanquetin sp. nov.

Fig. 5

Jacens, membranacea, alba, margine paulum sub lente fibrillosa, acubus exilibus hirta, 100-400 µm crassa. Emergentiis 150-280 x 30-35 µm, ex hyphis tunica incrassata, rigidis, tenui strato hypharum fibulatarum, tunica tenui circumdatis constantibus. Trama ex hyphis genetricibus fibulatis. Basidiis 45-55 x 10-13 µm, 4 grandibus sterigmatis. Sporis ovatis, 13,5-17,5 x 8,5-11 µm, tunica haud amyloidea neque cyanophila. In Palmaceis. Holotypus LY 7928. Gabon.

A la récolte, étalé, membraneux mais adhérent, à marge un peu fibrilleuse radiée sous la loupe, hispide par des aiguillons nombreux, longs et effilés, blanc.

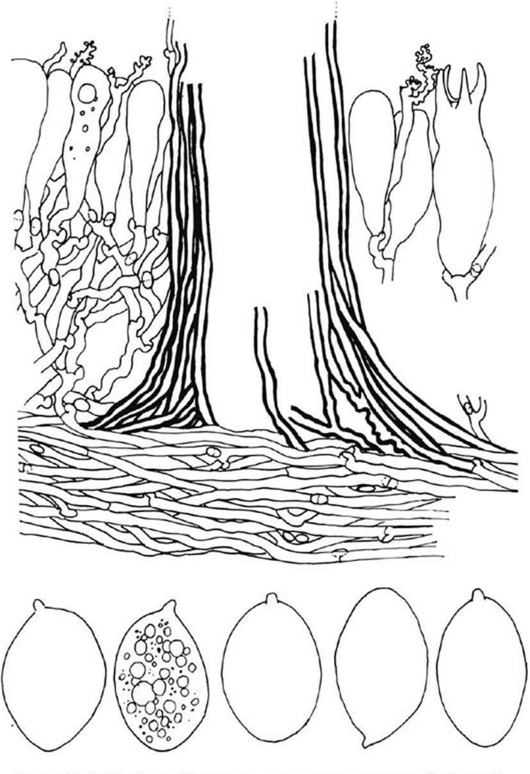

Figure 5: Epithele ovalispora sp.nov.: coupe montrant la base d' une émergence, et spores (holotype LY 7928).

En herbier, il a le même aspect mais il est teinté de crème (vers 2,5 Y 9/3) sauf à la marge blanche et sans émergence sur 0,5 mm environ.

En coupe, épais de 100-140 µm dont les 30-40 µm inférieurs forment une couche d'hyphes basales horizontales: ce sont des génératrices à paroi mince ou submince, bouclées, x 2-3-(3,8) µm. Au sommet de la couche inférieure naissent d'une part les émergences, d'autre part les hyphes sous-hyméniales assez lâches, x 2,5-5 µm bouclées.

Les émergences sont côniques, longues de 150-230-280 µm, étroites, elles débordent de 70-160-(230) µm et sont larges de 30-35 µm à la sortie de l'hyménium; elles sont constituées d'hyphes, x 2 µm environ, d'aspect fibreux, congophiles et assez dextrinoïdes et cyanophiles, à paroi assez épaissie, serrées parallèlement en faisceau dans la partie émergente; à la surface des émergences ont peut voir une mince couche d'hyphes génératrices bouclées.

Basidioles largement claviformes, larges de 10-14 µm, riches en huile. Certaines (en arrêt de végétation?) ont une paroi épaissie. Entre les basidioles émergent des hyphes dendroïdes grêles, x 2 µm environ. Basides larges, 45-55 x 10-13 µm au sommet, plus larges plus bas (x 14-15 µm), à 4 forts stérigmates 15-16 x 3,5-4 µm.

Spores ovoïdes de face, au contenu gras, 13,5-17,5 x 8,5-11 µm ($\bar{x}$ = 15,05 ± 1,12 x 9,70 ± 0,65) à paroi non amyloïde, ni cyanophile; en masse, la sporée est teintée d'orange brunâtre.

Récoltes: GABON: LY 7928 HOLOTYPE, sur Ancistrophyllum secundiflorum, rive gauche de l'Ivindo, Makokou, le 24 mai 1976.

Caractérisé par des émergences longues et côniques, insérées à mi-hauteur dans le champignon et aux hyphes congophiles et cyanophiles , et sutout, par ses spores.

9. Epithele sp. LY 5697 d'Argentine

Fig. 6 A

En herbier, membraneux, blanc crème, détachable, comme posé sur un subiculum aranéeux lâchement feutré formant une étroite marge amincie blanche; couvert sous la loupe d'aiguillons grêles, nombreux.

En coupe épais de 200-300 µm avec couche inférieure lâche très développée supportant un hyménium dense, épais de 50 µm environ.

Emergences 70-120 x 30-50 µm, formées d'hyphes x 2-3 µm bouclées, à paroi mince ou un peu épaissie parfois ramifiées, souvent terminées en éléments dendroïdes; dans l'axe de ces émergences on peut voir quelques hyphes à paroi épaisse, certaines sont des hyphes bouclées sur leur parcours, d'autres peu nombreuses sont des extrémités fibroïdes. Ces émergences portent des dépôts de cristaux.

La couche inférieure est formée d'hyphes très distinctes, les génératrices bouclées, larges de 2-5 µm, à paroi mince ou un peu épaissie, mais facilement collapsées, hyphes squelettiques régulières, x 3-3,5 µm à lumen subnul.

Basides claviformes puis subcylindriques, 28-37 x 6-7 µm, à 4 gros stérigmates.

Spores ellipsoïdes, 10-12 x 5-6,5 µm, avec apicule brillant, à paroi mince ou faiblement épaissie, non amyloïde, ni cyanophile.

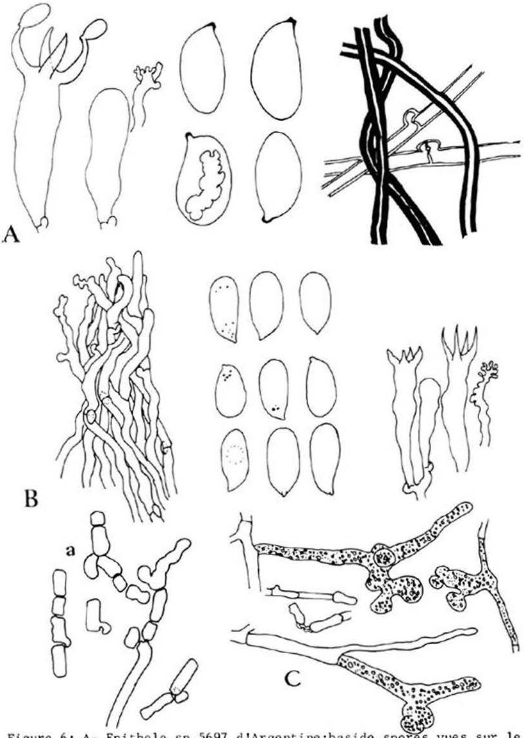

Figure 6: A- Epithele sp.5697 d'Argentine:baside,spores vues sur le basidiome et hyphes du contexte(Congo ammoniacal).
B- Pteridomyces lacteus sp.nov.:sommet d'une émergence, spores(holotype LY 9334)et basides;a-arthrospores en culture.
C- Vesiculomyces epitheloides: sulfocystides et sorte d'arthrospores en culture (LY 9677,paratype).

Récolte: ARGENTINE, sur bois sec, El Soberbio, Misiones, 28 avril 1966, leg. C.E. Gomez.

Cette espèce a été signalée ici car elle diffère assez nettement des Epithele décrits ci-dessus. Son contexte lâche avec hyphes squelettiques dominantes, ses émergences pourvues, au contraire, de quelques hyphes squelettiques enrobées d'hyphes bouclées qui ne semblent pas s'enraciner profondément, en font une espèce marginale bien typée; elle mériterait d'être décrite, mais a pu l'être dans un autre genre (Hydnum peut-être) par d'anciens auteurs latino-américains... ce qui nécessiterait une révision de nombreux types difficilement localisables.

II - Genre Pteridomyces Jülich 1979 emend.

Champignons étalés, à marge adhérente, ornés d'émergences stériles granuliformes ou odontioïdes nées soit en surface, soit plus ou moins profondément; contexte et émergences monomitiques ou dimitiques. Dendrophyses ou hyphes dendroïdes. Basides claviformes petites 15-20-(30) x 4-5 µm, à (2)-4 stérigmates. Spores petites (moins de 9 µm de longueur), à paroi mince, ni amyloïde, ni cyanophile.

10. Pteridomyces lacteus Boidin, Lanquetin et Gilles sp. nov.

Fig. 6 B

Orbicularis, deinde confluens, late expansus, adhaerens, e cretaceo albus vel pallidissime cremeus, 40-100 µm crassus. Emergentiis cylindratis, brevibus, 50-75 x 20 µm eminentibus. Trama monomitica, fibulata. Basidiis 22-30 x 5 µm, (3)-4 sterigmatis exilibus 7-8 µm longis, nonnulis hyphis dendroideis intermixtis. Sporis ellipsoideis, 6-8 x 3-4 µm, tunica tenui, haud amyloidea neque cyanophila. In ligno. Holotypus LY 9334. Gabon.

A la récolte, orbiculaire puis confluent, blanc de craie ou à peine jaunâtre (2,5 Y 8/0,5) avec marge amincie.

Emergences courtes, cylindriques, larges de 15-20 µm.

En herbier, largement étalé, mince très adhérent, blanc à crème très pâle, à marge nette, amincie sur 0,2-0,4 mm, blanche. Emergences petites, visibles sous la loupe comme de minuscules aiguillons concolores régulièrement répartis sauf vers la marge.

En coupe, épais de 40-100 µm avec émergences atteignant 100 µm de longueur totale, débordant de 50-75 x 12-20 µm. Monomitique: une couche basale haute de 10-20-(30) µm est formée d'hyphes horizontales à paroi mince ou submince, régulières, bouclées, x 2,5-3,8 µm; se dressent ensuite un sous-hyménium fait d'hyphes semblables plus ramifiées et un hyménium fait de basidioles claviformes étroites et de petites basides 22-30 x 5 µm, à 3-(4) stérigmates longs de 7-8 µm. Entre les basidioles peuvent émerger des hyphes dendrophysoïdes. Les émergences sont faites d'hyphes à paroi mince, ou à peine épaissie dans la partie immerse, un peu sinueuses, bouclées, x 2-3 µm.

Spores ellipsoïdes inégalement attenuées (de profil) vers l'apicule, 6-8 x 3-4 µm, à paroi non amyloïde. ($\bar{x}$ = 7,01 x 3,22 pour le type, 7,25 x 3,60 pour LY 9338).

Récoltes: GABON: LY 9334, HOLOTYPE, sur bois mort tombé de dicotylédone, fourré littoral à 14 km au N. de Libbreville, 5 mai 1979, leg. G. Gilles 1574 ; LY 9338, ibid., leg. G. Gilles 1576.

Caractères culturaux de Pteridomyces lacteus

SPORES.- uninucléées (LY 9334, HOLOTYPE)

GERMINATIONS.- (LY 9334 et 9338). Elles apparaissent 3 ou 4 jours après la dispersion, 30 isolements 9334 et 8 de LY 9338 ont été effectués.

MONOSPERMES.- Ils sont formés d'hyphes aux articles uninucléés, sans boucles. L'appariement des monospermes 9334 n'a pas permis de définir le type de thallie avec certitude. Il se dégage une tendance tétrapolaire. Les monospermes LY 9334 sont totalement intercompatibles avec les monospermes LY 9338.

POLYSPERME.- LY 9334.

Croissance: très rapide (boites couvertes en deux semaines)

Aspect: La marge est très régulière. A 6 semaines, sur un milieu irrégulièrement teinté de bai (2,5 YR 4/6) ou de châtain (2,5 YR 3/4), on observe un mycélium subfeutré, velouté, blanc à crème rosé (5 YR 8/3) de densité variable, beaucoup plus faible sur les zones de milieu brun rougeâtre qu'il ne cache pas totalement. Dans d'autres cultures, on observe deux parties très contrastées: une grande plage de mycélium subfeutré blanc sur milieu non teinté et une grande zone, englobant la bouture, où le milieu bruni est recouvert d'un mycélium alutacé (10 YR 8/4 à 8 YR 7/6). Le revers des cultures est teinté de brun roux par plages, l'odeur est nulle.

Microscopie:

Mycélium aérien: dans les parties blanches, il forme une peau constituée de nombreuses hyphes superficielles très grêles (qui sont en fait des hyphes collapsées) cachant des hyphes x 2-4 µm, régulières, à paroi mince et boucles constantes. Dans les jeunes cultures, certains rameaux se désarticulent en arthrospores (cf. fig. 6 B a).

Dans les parties teintées, le mycélium superficiel coloré est formé d'hyphes bouclées, parfois x 1-1,5 µm mais jusqu'à 8-9 µm. Certaines, x 1,8-4 µm, ont une paroi épaissie comme rigide, très réfringente, jaune orangé, elles portent des gouttes résinoïdes de même couleur ou sont remplies de cette substance. Elles peuvent former des amas denses brun doré sous le microscope. Après trois mois, les zones teintées montrent sous une mince couche d'hyphes affaissées, une croûte coriace, impossible à dilacérer; elle se casse montrant sur les bords des hyphes irrégulières, très intriquées, à paroi épaisse, réfringente et au contenu jaune doré.

Mycélium submergé: hyphes, x 2-5-(8) µm, souvent larges, régulières ou parfois irrégulières (difformes, renflées), à paroi mince et boucles constantes. Localement des masses compactes sont formées d'hyphes bouclées, serrées, intriquées, x 3 µm environ, hyalines à brun doré, à paroi épaisse à très épaisse plus ou moins gélifiée.

Boucles: constantes.

Cytologie: hyphes aux articles binucléés et bouclés.

Oxydases: ac. gallique: +++++, 0   gaïacol: ++++, 0
p.- crésol: -, précipité blanc   tyrosine: -, 5 mm
CODE: 2a - 3c - 35 - 37 - 39 - 42 - 54 - 58 - 61

Remarque. Cette culture est caractérisée par ses plages brun-rougeâtres, la formation d'arthrospores, et la présence d'amas denses en mycélium submergé.

11 - Pteridomyces roseolus Boidinet Lanquetin sp. nov.

Fig. 7

Erumpens, jacens, subceraceus firmus, e roseo griseus, permultis emergentiis gracillimis coopertus, 35-50 µm crassus. Emergentiis 50-65 x 15-20 µm transgredientibus, in medio ex hyphis tunica incrassata et extus ex hyphis fibulatis, tunica parum incrassata constantibus. Hyphis basalibus subhymenialibusque fibulatis, tunica tenui. Basidiis 18-20 x 3,8-5 µm. Sporis subcylindratis, 5-6 x 2-2, 5 µm, tunica haud amyloidea neque cyanophila. In ligno. Holotypus 5377. Centrafrique.

A la récolte, érompant, étalé, mince, subcéracé ferme, gris rosé (5 YR 6/2, 6/3) couvert sous une forte loupe de multiples émergences grêles, hyalines.

En herbier, aride, beige pâle (vers 10 YR 7,5/2) à émergences pâles, serrées, grêles, à peine visibles sous la loupe.

En coupe, épais de 35-50 µm entre les émergences posées sur le support et mesurant dans leur totalité 90-100 µm de longueur; elles émergent donc de 50-65 µm; leur forme est un peu cônique, leur largeur est de 15-30 µm au niveau des basides.

Les émergences sont solides, formées d'hyphes cohérentes très difficiles à écarter; elles sont formées en surface d'hyphes x 2 µm, bouclées, parfois ramifiées, à paroi un peu épaissie; les hyphes plus profondes ont une paroi plus épaisse et nacrée. Après traitement ammoniacal à 60°C les hyphes des émergences apparaissent très sinueuses à la base, larges de 1,5-2 µm, à paroi très épaissie (gonflée?), très congophile et à lumen indiscernable; si on les place dans le bleu après ce traitement ammoniacal à chaud, le lumen bleuté n'est net que sur les hyphes de surface, les autres en semblent dépourvues.

Entre les émergences on voit des hyphes grêles x 1,5-2 µm, serrées, plus ou moins ascendantes, à paroi mince ou un peu épaissie, bouclées, formant une couche basale localement bourrée d'amas de cristaux, et une zone hyméniale constituée de petites basidioles claviformes bouclées et de quelques hyphes émergentes non dendroïdes.

Basides 18-20 x 3,8-5 µm à 4 stérigmates.

Spores subcylindriques, 5-6,2 x 2-2,5 µm à paroi mince, non amyloïde, ni cyanophile.

Récolte: REPUBLIQUE CENTRAFRICAINE: LY 5377, HOLOTYPE sur bois mort,
La Maboké, 10 mai 1965.

Il est difficile ici de se prononcer sur la nature squelettique ou non des hyphes des émergences. Après traitement ammoniacal à 60°C les hyphes congophiles et à paroi très épaissie, qui constituent l'essentiel des émergences, rappellent les hyphes "squelettiques" caractéristiques des émergences de Skeletohydnum. Une observation directe à froid montre clairement que la surface des émergences est constituée d'hyphes génératrices bouclées parfois ramifiées mais l'intérieur

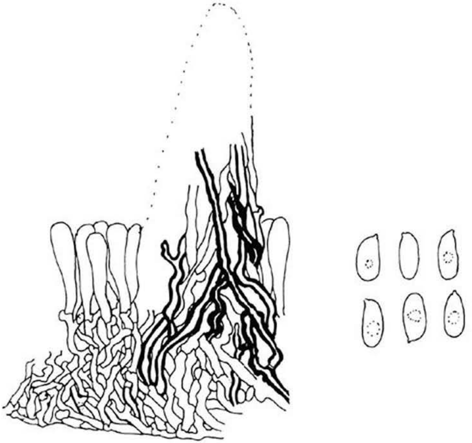

Figure 7: Pteridomyces roseolus sp.nov.: coupe du basidiome , avec détail d'une partie d'une émergence (Ammoniaque 60°C puis Bleu Coton); spores (holotype LY 5377).

est alors formé d'hyphes très réfringentes, solidement accolées, que l'on ne peut disjoindre et distinguer individuellement sur d'assez longs parcours. Basides et spores sont du type Pteridomyces.
On aurait donc ici un Pteridomyces à émergences constituées d'hyphes squelettiques ou au moins à nette tendance squelettique. Nous l'avons retenu ici, bien que nous ne disposions que d'une seule récolte, parce qu'il pose le problème de l'utilisation du "mitisme" dans la définition des genres épitheloïdes.

12. "*Pteridomyces*" *sp.* 8270 de Singapour

Cette récolte de Singapour n'est citée ici que parce qu'elle pose elle aussi le problème du mitisme chez les *Pteridomyces*. N'ayant pas sporulé après la récolte, nous ne voulons en faire une récolte type.

En herbier, étalé, très adhérent, mince, beige sale (10 YR 7/2,5) à marge amincie sur un ou deux millimètres, grisâtre (vers 5 YR 7/1), couvert sous une forte loupe de petites émergences concolores ou à sommet bruni, serrées, éparses ou alignées.

En coupe, épais de 70-170 µm entre les émergences, il est constitué d'hyphes serrées, peu distinctes, à paroi souvent épaissie, bouclées, qui portent des basidioles claviformes petites et des basides d'environ 14 x 4,5 µm, à 4 stérigmates longs de 4 à 5 µm.

Les émergences, très nombreuses, débordent de 50-70 x 15-30 µm; elles sont ancrées profondément et constituées d'hyphes squelettiques congophiles raides, x 1,5-3 µm, à lumen étroit; ces émergences sont recouvertes de dépôts cristallins.

Spores (vues en petit nombre) oblongues, 3,5-4 x 2,5-2,8 µm, non amyloïdes, ni cyanophiles.

Récoltes: SINGAPOUR: LY 8270, sur bois, Mac Ritchie Reservoir, 19 août 1977.

Cette récolte rappelle beaucoup par son aspect *P. roseolus*.

Par ses basides et ses spores il appartiendrait au genre *Pteridomyces* mais ses émergences sont constituées d'hyphes squelettiques tout à fait typiques comme chez les meilleurs *Skeletohydnum*.

13. *Pteridomyces sphaericosporus* Boidin, Lanquetin et Gilles sp. nov.

Fig. 8

Jacens, e griseolo albus, dein alutaceus, lentus, spongiosus, emergentiis albidis hirtus. 150-180 µm crassus inter emergentias, quae 60-90 x 20-30 µm transgrediuntur. Strato inferiore laxo, ex hyphis fibulatis tunica crassa sicut in emergentiis constante. Basidiis 18-20 x 4 µm. Sporis subglobosis, 4,5-5,6 x 3,8-4,8 µm, tunica paulum crassa, haud cyanophilis neque amyloideis. In ligno. Holotypus LY 7377. Côte d'Ivoire.

A l'état frais, largement étalé, blanc grisâtre (10 YR 8/1) mais devenant pâle alutacé (10 YR 8/3,5) dès qu'il sèche; coriace,spongieux, très hérissé d'émergences blanchâtres; marge concolore, abrupte ou amincie.

En herbier, étalé, adhérent, alutacé (10 YR 8/4 à 7,8/4) finement granuleux sous la loupe où il apparaît aranéeux dense plus poruleux, enfin continu avec émergences subcylindriques un peu plus pâles apparaissant dès la marge irrégulièrement groupées, parfois juxtaposées ou connées par trois ou quatre.

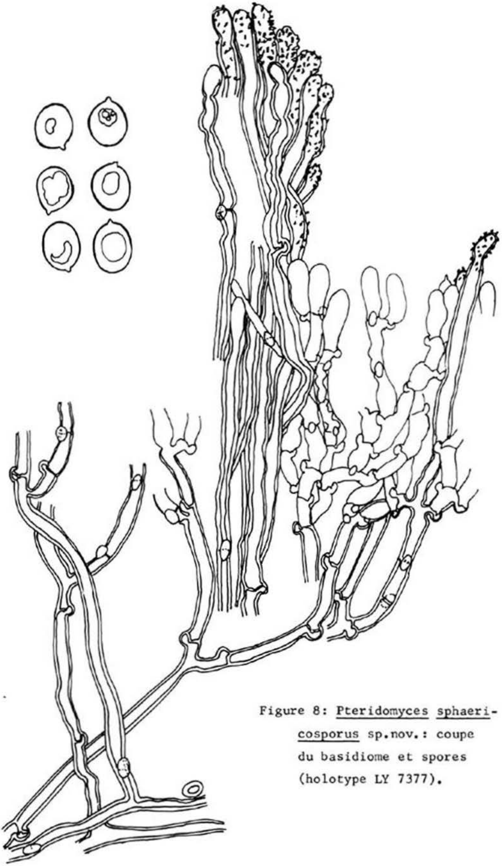

Figure 8: *Pteridomyces sphaericosporus* sp.nov.: coupe du basidiome et spores (holotype LY 7377).

En coupe, épais de 150-180 µm, sous les émergences qui mesurent 60-90 x 20-30-(40) µm; il est nettement constitué de deux parties: une couche inférieure lâche, haute de 100-120 µm, formée d'hyphes en tous sens et d'un hyménium dense épais de 60 µm environ. La couche inférieure est faite d'hyphes très distinctes, régulières, bouclées, à paroi très épaisse, hyaline, larges de 2-4 µm, ramifiées. Leur paroi reste nettement épaissie après les premières ramifications qui forment le sous-hyménium. Sous-hyménium aux articles beaucoup plus courts, à paroi mince ou un peu épaissie, aux boucles étroites.

Basides subcylindriques, 18-20 x 4 µm, à 4 stérigmates de 2-2,5 µm de longueur. Très souvent les éléments hyméniens, hors végétation, contiennent des hyphes à l'intérieur, à paroi mince, souvent ratatinées.

Emergences constituées par des faisceaux d'hyphes x 4 µm environ, à paroi hyaline très épaissie (1 à 1,5 µm), nées souvent très bas, bouclées sur leur parcours, souvent sinueuses ou étranglées et plus ou moins moniliformes, piquetées de cristaux sur les 30 µm terminaux.

Spores subsphériques à un peu ovoïdes, 4,5-5,5 x 3,8-4,8 µm, ($\bar{x}$ = 4,98 ± 0,33 x 4,20 ± 0,25) à paroi un peu épaisse, non amyloïde, ni cyanophile, contenant un globule gras.

Récolte: COTE D'IVOIRE, LY 7377, HOLOTYPE sur bois, en forêt du Téké, 7 juillet 1974, leg. G. Gilles 248.

Facile à reconnaître à ses spores et à sa structure, ce qui en fait un membre assez marginal du genre *Pteridomyces*.

III - *Un champignon épitheloïde à spores amyloïdes*

Il nous reste à décrire un champignon malgache qui n'entre pas dans les genres étudiés ci-dessus. Il possède, émergences mises à part, les caractères du genre *Gloeocystidiellum* Donk.

Ce genre était certes commode mais hétérogène comme l'ont signalé divers auteurs tel Boidin (1966) dans un tableau hypothétique (pl. II) des relations des espèces de ce genre avec diverses familles. Depuis, des coupures successives ont été proposées: genres *Scytinostromella* Parmasto (1968), *Vesiculomyces* Hagström (1977), *Megalocystidium* Jülich (1978), *Conforticium* Hallenberg (1980), *Boidinia* Stalpers et Hjortstam (1982). Il semble que le genre *Megalocystidium* comprenne les espèces à spores lisses -ce qui n'est pas dit dans la diagnose originale, qui ne signale aucun caractère distinctif par rapport à *Gloeocystidiellum porosum* type du genre démembré, mais qui a, lui, des spores ornées.- En effet le type de ce nouveau genre, *M. leucoxanthum* et les deux autres espèces transférées par Jülich, *M. lactescens* et *luridum*, ont des spores lisses. Mais c'est aussi le cas du genre *Vesiculomyces* Hagström proposé antérieurement. Son auteur le caractérise avant tout par ses gloeocystides sulfoaldéhyde négatives. *V. citrinus* possède en fait des gloeocystides très précocement vides dans le carpophore, mais qui, en culture, ont un contenu sulfo-positif (Boidin 1958 p. 109).

L'absence de boucles, autre caractère proposé comme distinctif se retrouve chez *G. lactescens* (un *Megalocystidium* pour Jülich) et *G. humile*. Nous ne voyons donc aucune raison pour ne pas synonymiser *Megalocystidium* à *Vesiculomyces* antérieur d'une année.

Genre *Vesiculomyces* Hagström (Bot. Nat. 130: 53, 1977) emend.

Ce genre est réservé aux *Gloeocystidiellum* monomitiques à spores amyloïdes lisses, pourvus de gloeocystides montrant le plus souvent un contenu riche, pouvant réagir aux sulfo-aldéhydes, contenu qui parfois cependant disparaît précocement dans le basidiome. Les hyphes sont avec ou sans boucles. Contrairement au genre *Conferticium* Hallenberg, ici les hyphes ne sont pas cyanophiles et les basides ne repoussent pas à l'intérieur de basides anciennes (répétobasides).

Le type est *Vesiculomyces citrinus* (Pers.) Hagström.

Autres espèces: *Vesiculomyces Chelidonium* (Pat. Bull. Soc. Mycol. France, 16: 180, 1900, ut *Corticium*) Boidin et Lanq. nov. comb., *V. humilis* (Boidin, Cah. Maboké, 4: 9, 1966, ut *Gloeocystidiellum*) nov. comb.; *V. leucoxanthus* (Bres. Fungi Trid. 2: 57, 1898, ut *Corticium*) nov. comb.; *V. lactescens* (Berk. ap. Smith Engl. Fl. 5,2: 169, 1836, ut *Thelephora*) nov. comb.; *V. luridus* (Bres. Fungi Trid. 2: 59, 1898, ut *Corticium*) nov. comb.; *V. sulcatus* (Rehill et Bakshi, Indian For. Bull. 242: 15, 1965, ut *Corticium*) nov. comb.

14. *Vesiculomyces epitheloides* Boidin, Lanquetin et Gilles sp. nov.

Fig. 9

Jacens, amplus, solidus, rigescens, salmoneus, ora alba fibrillosa, 300-350 µm crassus. Emergentiis granuliformibus 60-70 x 20-60 µm eminentibus, crassamentis crystallinis uberibus. Hyphis jacentibus, angustis, simplicibus septis, stratum ad 50 µm crassum constituentibus; hyphis subhymenialibus angustis, resurgentibus tunica incrassata; hymenio increscente e gloeocystidiis obtusis, 150-250 x 10-20 µm, sulfoaldehydibus nigrescentibus, atque basidiis 45-60 x 6-8 µm, tetrasporis constante. Emergentiis ex hyphis parallelis, x 2-3,25 µm, tunica subtenui, vel paulum incrassata constantibus, sporis reniformibus, 6,5-8 x 4,5-5,5 µm. Holotypus LY 9761, Madagascar.

A la récolte, étalé, étendu, solide, saumoné (7,5 YR 7/4 à 8/6, salmon buff R.) avec bordure fibrilleuse blanche pouvant atteindre 3 mm de largeur; sous la loupe il est constellé de petites émergences concolores.

En herbier, très adhérent, assez corné, uniformément isabelle (7,5 YR 6,8/4,5), avec marge amincie, ocre alutacé (10 YR 8/6, warm buff), puis fibrillo aranéeuse; sous la loupe très nombreuses émergences assez régulièrement disséminées, petites, granuliformes, concolores.

Coupe haute de 300-350 µm sans les émergences qui dépassent de 60-70 µm et sont larges de 20-60 µm, brillantes par les amas de gros cristaux qu'elles portent. Sur 50 µm environ d'hyphes horizontales, étroites, x 1,5-2,5-(3) µm à paroi mince ou un peu épaissie à cloisons simples, serrées mais non soudées entre elles, une zone de transition formée d'hyphes obliques similaires à paroi souvent plus nettement épaissie, porte un hyménium crassescent haut de 180-250 µm formé d'énormes gloeocystides obtuses, irrégulièrement subcylindriques, 150-250 x 10-20 µm, au contenu réfringent sulfoaldéhyde positif, à paroi épaissie dans la moitié inférieure, pouvant montrer quelques

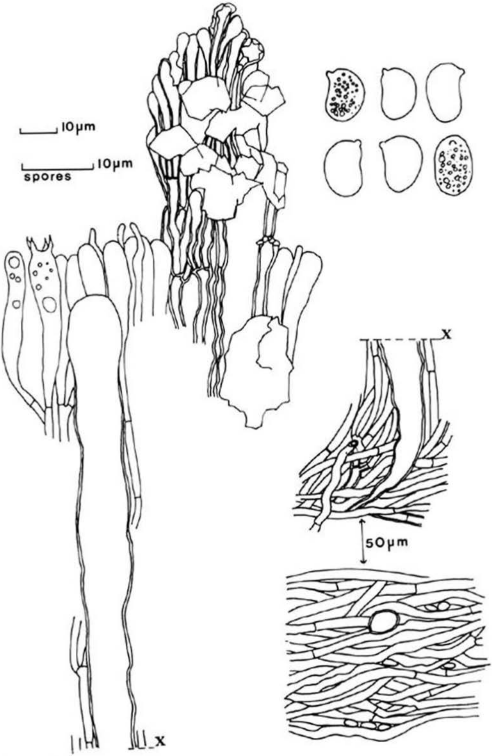

Figure 9: Vesiculomyces epitheloides sp.nov.:base du basidiome , catahyménium (X signale un raccord),émergence et spores (holotype LY 9761).Coupe montée dans le Bleu lactique.

cloisons de retrait, d'hyphes grêles x 2-3 µm à paroi mince pouvant émerger entre les basidioles, et de basides étroitement claviformes, à paroi mince, sans boucle à la base, 45-60 x 6-8 µm à 4 stérigmates.

Les émergences sont formées d'hyphes parallèles, larges de 2-3,25 µm, à paroi submince mais apparaissant épaissie (0,8 µm environ) après traitement ammoniacal à 60°C, ramifiées, parfois un peu élargies au sommet, mêlées à des amas de gros cristaux. Les émergences "s'enfoncent" dans l'hyménium jusqu'à 200 µm sous la surface.

Spores blanches en masse, réniformes, 6,5-8 x 4,5-5,5 µm, ($\bar{x}$ = 7,49 ± 0,61 x 4,95 ± 0,23), à paroi lisse, mince, amyloïde, mais non cyanophile et au contenu guttulé gras.

<u>Récolte</u>: MADAGASCAR: LY 9677, sur une souche sous un buisson, alt.
1250 m, La Mandraka, 29 mars 1981, leg. G. Gilles n° 28;
LY 9761, ibid. 11 avril 1981, leg. G. Gilles n° 46,
HOLOTYPE.

<u>Caractères culturaux de Vesiculomyces epitheloides</u>

SPORES.- (LY 9677, 9761: Holotype), binucléées

MONOSPERMES.- Très peu de spores ont germé. Deux germinations 9761 et 6 germinations 9677 ont été isolées respectivement 8 et 15 jours après la dispersion des spores. Ces cultures monospermes sont formées d'hyphes régulières, sans boucles, aux articles uninucléés. Elles montrent des éléments de forme irrégulière au contenu densément guttulé, sulfo-aldéhyde positif et des hyphes étroites qui se désarticulent en arthrospores.

<u>Tests d'intercompatibilité</u>: toutes les confrontations de monospermes 9761 avec 9677, produisent un mycélium formé d'hyphes aux articles régulièrement binucléés. L'espèce est donc hétérothalle et les deux récoltes 9761 et 9677 sont intercompatibles (cf. Lanquetin 1973).

POLYSPERMES.-

<u>Croissance</u>: extrêmement lente (ne couvre pas la moitié de la boîte en six semaines)

<u>Aspect</u>: Marge irrégulière, plus ou moins lobée puis mycélium aérien, blanc léger puis floconneux (pouvant aussi former des bourrelets concentriques) formant dans la partie âgée 1 couche lisse ou bosselée-grumeleuse, de mycélium blanc à ocre alutacé pâle (7,5 YR 7,5 à 8/4, à 10 YR 8/4) ou alutacé chamois (10 YR 8/6 à 7,5/6) sur les reliefs. Le revers des cultures est inchangé; leur odeur faible, agréable, constante.

<u>Microscopie</u>:

<u>Mycélium aérien</u>: il montre

- des hyphes, x 1,2-3-(4) µm, régulières, à paroi mince, aux cloisons simples
- de nombreuses gloeocystides de tailles et formes très variées, avec renflements: x 2,5-5-(10) µm (cf. fig. 6 C). Leur contenu réfringent, densément guttulé ou pailleté dans le rouge congo, réagit très positivement dans les sulfo-aldéhydes. Aucune schizopapille n'a été observée
- quelques hyphes avec cloisons de retrait qui se désarticulent en arthrospores (cf. dessin)

Mycélium submergé: dans le premier millimètre de gélose un peu coriace à couper, le mycélium dense montre des hyphes régulières, x 1,8-3-(4) µm, à paroi mince, sans boucles et de nombreuses gloeocystides au contenu dense ou pailleté. Plus profondément on observe encore des éléments gloeocystidiens, mais moins nombreux et de forme plutôt noduleuse.

Boucles: absentes

Cytologie: les cultures polyspermes sont constituées d'hyphes aux articles régulièrement binucléés

Oxydases: acide gallique: ++++,0   gaïacol: +++,0
p.- crésol: -   tyrosine: +++,0

CODE: 6 - 7 - 15a - 35 - 36 - 38 - 47 - 53 - 54 - 58 - 61

Remarque. Cette espèce qui exhale une nette et constante odeur agréable est caractérisée par sa croissance extrêmement lente, ses nombreuses sulfocystides irrégulières sans schizopapilles, la présence d'arthrospores (surtout visibles en culture sur lame) et son comportement hétérothalle sans boucle.

Si les myceliums des *Epithele* et *Pteridomyces* ont une croissance aisée, les germinations des spores en semis clairs ont été beaucoup plus difficilesà obtenir avec des spores qui certes avaient voyagé plusieurs jours. Notons toutefois que *E. nikau* et *guadelupensis* sont homothalles lents, *E. efibulata*, parthénogénétique et *P. lacteus*, hétérothalle. La présence de laccase laisse supposer que toutes les espèces sont à pourriture blanche quant à *Vesiculomyces epitheloides*, il est hétérothalle sans boucles, comme le type du genre *V. citrinus*, ainsi que *V. lactescens* et ses gloeocystides sulfoaldhéydes très positives en culture contiennent du stearyl-velutinal (K. Gluchoff-Fiasson, viva voce).

REMERCIEMENTS

Nos remerciements s'adressent tout d'abord à notre ami Gérard Gilles à qui nous devons de nombreuses récoltes africaines et malgaches citées ici, accompagnées de sporées, de notes sur le frais, avec données microscopiques. Nous exprimons, en outre, notre gratitude envers les directeurs du Jardin Botanique de l'Etat de Bruxelles et de l'Herbier de Kew, nos collègues R.A. Maas Geesteranus et A.L. Welden pour leur lecture critique de notre manuscrit , et à Monsieur H. Romagnesi pour les nombreuses diagnoses latines incluses ici et, pour lesquelles il a bien voulu nous faire profiter, une fois encore, de sa maîtrise de cette langue.

SUMMARY

We have studied the effused and epitheloid fungi collected in warm countries. The fourteen species described in this paper cannot be included in the four genera Epithele (Pat.) Pat. (1900). Epithelopsis Jülich (1976), Pteridomyces Jülich and Skeletohydnum Jülich (1979), as definited by Jülich.

As already noticed by Patouillard (1899), sterile pegs occur in some tremellaceous Heterobasidiomycetes (genus Heterochaete), and also in a few Homobasidiomycetes such as Mycobonia, Veluticeps and Epithele (sensu lato). We shall write only, about the last named genus, i.e. effused species with indeterminate margins. To gather all these effused species described nowadays in one genus would make this genus dissimilar, heterogeneous and unworthy. We propose to place in the genus Vesiculomyces Hagström (1977) emend., segregated from the genus Gloeocystidiellum Donk, the Malagasy Vesiculomyces epitheloides with amyloid spores and sulfoaldehyde positive gloeocystidia. We synonymise Megalocystidium (type M. leucoxanthum (Bres.) Jülich 1978) with Vesiculomyces (type V. citrinus (Pers.) Hagström), because these two genera contain some species of Gloeocystidiellum with smooth spores, with or without clamps, with gloeocystidia habitually exhibiting a positive sulfoaldehyde reaction (the gloeocystidia of V. citrinus react strongly in cultures, but appear empty in fructification). As a consequence some combinations are proposed.

The species with non-amyloid spores do not form a homogeneous group. Jülich (1976 and 1979) created successively several monospecific genera: Epithelopsis, Pteridomyces and Skeletohydnum. Their definitions are based on the cyanophily of the spores, their mono- or dimitism, and the size of the basidia. We have not collected species with cyanophilous spores (genus Epithelopsis), known only from New Zealand and Zaïre (Ryvarden 1978), but the size of the basidia, as well as the origin and development of a second hyphal system are progressive characters, and we wondered if the study of new species would not permit us to discover all kinds of intermediates. Our collections can be separated easily in two groups according to the size of basidia and the size of the spores: one group has narrow club-shaped basidia (narrower than 5 µm) and spores shorter than 8 µm; the other group has larger basidia, not club-shaped, and spores longer than 10 µm. But in these two groups, there are species without skeletal hyphae (monomitic) and species with skeletal hyphae more or less differentiated and more or less numerous. Table I shows the different localizations possible of the skeletal hyphae, -when they exist-, in the group with large spores: 1) only in pegs (should we call these species dimitic?), 2) in the pegs and in the context, 3) in the context only.

In the light of these facts it is necessary to either create several new genera with an absolute care for homogeneity (as it appears some people with probably a desire to leave their names to prosterity have done!) or accept, until a more complete knowledge of the epitheloid fungi of the world, that the kinds connected by the means of intermediates should be gathered again into a small number of less homogenous

genera. We agree with the second solution, and we includespecies with skeletal hyphae in the genus *Pteridomyces* emend., and we maintain all the large spored species, whatever their mitism should be, in the genus *Epithele*. We place also in the genus *Epithele* an unclamped species (*E. efibulata* sp. nov.). Three new African species of *Pteridomyces*, which are not growing on ferns, are proposed (*P. lacteus*, *roseolus*, *sphaericosporus*), and six new *Epithele* species (*E. citrispora*, *efibulata*, *guadelupensis*, *macarangae*, *malaiensis*, *ovalispora*). Four of these are African and most of them grow on palm-trees. Lastly, we described *Vesiculomyces epitheloides* from Madagascar.

We give cultural characters of seven species: *E. efibulata* is parthenogenetic without clamps. Such a species must not be placed in a different genus from the one with clamped species. *E. nikau* and *guadelupensis* are homothallic and clamped. *Vesiculomyces epitheloides* is heterothallic without clamps as are *V. citrinus* and *V. lactescens*.

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NEW SOUTH AMERICAN RESUPINATE POLYPORES[1]

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During a survey of the resupinate polypores in Argentina, two species pertaining to *Amylosporus* Ryv. and *Junghuhnia* Corda and a new variety of *Skeletocutis nivea* (Jungh.)Keller were found which are here described as new.

METHODS

Microscopic examinations of basidiocarps were made from freehand sections mounted in 5% KOH aqueous phloxine, in Melzer's reagent (Singer, 1949:80) and in 0,5% cotton blue in 25% lactophenol. Drawings were made with a camera lucida. Herbarium abbreviations are from Holmgren & Keuken (1974).

DESCRIPTION OF SPECIES

AMYLOSPORUS WRIGHTII sp. nov. (Fig. 1-5)

Basidiocarpus annuus vel perennis, late resupinatus, roseo-lilacinus, gossypinus vel suberosus, non xanthochrous, contextus vinaceus. Systema hypharum dimiticum. Hyphis generativis duorum typi: a)afibulatis tenuibus incrassatis, 2,1-10,5 µm diam.; b)septatus uni vel plurifibulatis verticillatisque, 5,2-10,4 µm diam., ramosis afibulatis. Hyphis skeletibus, 2,6-5,7 µm diam., parietis incrassatis hyalinis vel castaneis, dextrinoideis cyanophilisque. Hymenio basidiis afibulatis septiis basalis, claviformibus et brevi stipitatis, tetrasporis. Basidiosporis late ellipsoideis vel subglobosis, apiculatis, tenui asperulatis, 3,1-3,6 x 2,6 µm, amyloides, acyanophilis. Cystidiolis fusiformibus adsunt. Putrefactione ligno ignota.

Holotypus: Argentina, Misiones, Parque Nacional Cataratas del Iguazú, versus viam ad Apepú, leg. M.Rajchenberg M-3503, 4/III/1982, in herbario BAFC nº 28210 conservatus est.

A mycologo argentinensis J.E. Wright haec species dicata est.

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[1] This paper is part of a project on xylophilous Basidiomycetes subsidized by a grant from the Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina. It is part of a thesis submitted to the University of Buenos Aires as partial fulfillment of the requirements for the degree of Doctor in Biology.

[2] Fellow of the above Consejo.

FRUITBODY annual to perennial, widely effused, easily separable from substratum and the annual layers from each other, 25 x 10 x 0,5 cm, cottony to corky. Margin wide, irregular, velvety. Pore surface lilaceous pink when fresh, turning cream or yellowish cream when dried. Pores 7-8 per mm. Context lilaceous when fresh, turning dark chestnut or vinaceous when dried; each layer up to 2 mm wide. Tubes short, up to 1 mm long. Alkali reaction negative with 5% KOH.

HYPHAL SYSTEM dimitic. Generative hyphae of two types: a) clampless, branched and thin walled hyphae, 2,1-10,4 µm wide, found in all the fruitbody (Fig. 2); and b) with one or multiple clamps, branched or not, 5,2-10,4 µm wide, with clampless and narrower branches, only found in the context (Fig. 3). Skeletal hyphae abundant, scantily to profusely branched, 2,6-5,7 µm wide, with thickened hyaline or chestnut walls, cyanophilous and variably dextrinoid in Melzer's reagent (Fig. 4). BASIDIA claviform to shortly pedicellate, 12,0-23,4 x 5,7-6,8 µm, tetraspored, not clamped at base (Fig. 5). BASIDIOSPORES broadly ellipsoid to subglobose, thin to slightly thick walled, minutely asperulated (when observed in Melzer's reagent, Fig. 5, and SEM, Fig. 1), amyloid, noncyanophilous, 3,1-3,6 x 2,6 µm. Fusiform cystidiols present; cystidia absent.

HABITAT: on unidentified angiosperms and associated with an unknown rot. DISTRIBUTION: in the subtropical rain forest of Misiones province.

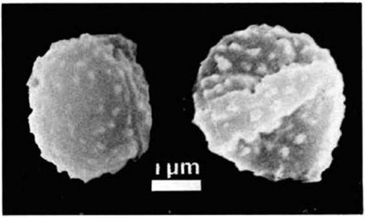
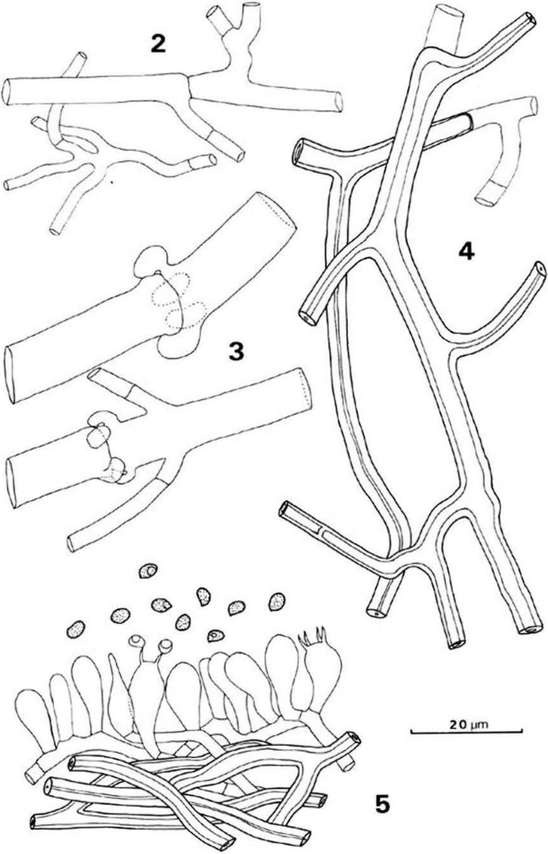


Fig. 1
SEM micrographs of basidiospores of *Amylosporus wrightii*

MATERIAL STUDIED: Argentina, Misiones, Colonia General Belgrano, Estación Forestal, leg. Wright, Deschamps and del Busto, 29/X/73 (BAFC 28211); Parque Nacional Cataratas del Iguazú, leg. M.Rajchenberg M-3503, 4/III/82 (BAFC 28210, holotype).

REMARKS: In spite of macromorphological differences with the type species of the genus *Amylosporus* Ryv., *Tyromyces graminicola* Murr. (=*Amylosporus campbelli* (Berk.)Ryv., fide Ryvarden, 1977:217) which is pileate and centrally or laterally stipitate, the peculiar hyphal system with two types of septation on the generative hyphae, the asperulated amyloid


2
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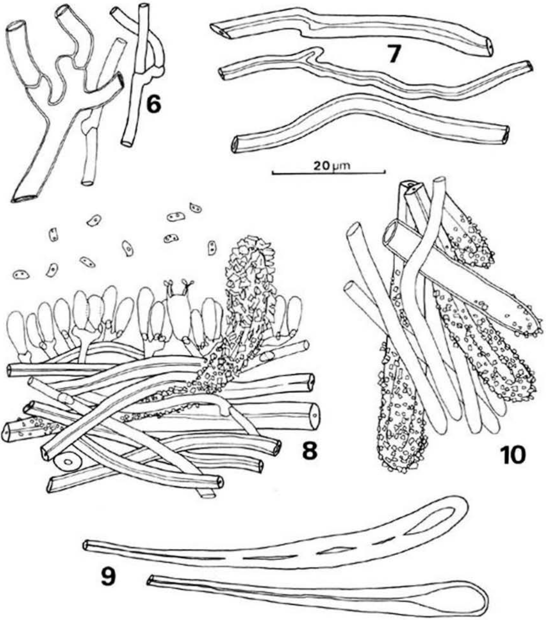

Fig. 2-5, *Amylosporus wrightii*: 2.simple septate generative hyphae; 3.simple and multiple clamped generative hyphae, unbranched or with simple septate branches; 4.skeletal hyphae; 5.hymenium and basidiospores.

Fig. 6-10, *Junghuhnia microspora*: 6.generative hyphae; 7.skeletal hyphae; 8.hymenium, cystidia and basidiospores; 9.cystidia (without crystals); 10.pore mouth with incrusted hyphae and cystidia.

spores and the pedicellate clampless basidia[3] point out to the congenerity of this new species with the latter. The skeletal hyphae with cyanophilous and variably dextrinoid walls relate this species to *Wrightoporia* Pouz. which differs in having generative hyphae and basidia with only simple clamped septa.

JUNGHUHNIA MICROSPORA sp. nov. (Fig. 6-10)

Basidiocarpus annuus, resupinatus, suberosus vel fibrillosus, cremeus, late castaneus vel fuscus, non xanthochrous; poris 5-7-(8) per mm. Systema hypharum dimiticum. Hyphis generativis fibulatis, 2,1-5,7 µm diam. Hyphis skeletibus 2,1-6,8 µm diam., parietibus incrassatis luteis. Hymenio cum basidiis claviformibus, tetrasporis. Basidiosporis ellipsoideis, hyalinis, apiculatis, parietibus angustis glabris, 2,6-3,6 x 1,0-1,6 µm, inamyloides, acyanophilis. Cystidiis incrustatis adsunt, copiosis extremitatibus disepimentiis. Putrefactione ligno alba.

Holotypus: Argentina, Misiones, Parque Nacional Cataratas del Iguazú, versus viam ad Apepú, leg. M.Rajchenberg 4/III/1982, in herbario BAFC nº 27993 conservatus est.

FRUITBODY annual, resupinate, totally attached to substrate, corky to fibrillose. Margin present or not, mycelial or velvety. Pore surface cream colour with light chestnut tints when fresh, turning beige, orange coloured or chestnut upon drying, and with the pore mouths remaining ash-coloured. Pores 5-7-(8) per mm, round to slightly angular. Context thin, cream coloured, up to 0,5 mm wide. Tubes up to 3 mm long. Alkali reaction negative with 5% KOH.

HYPHAL SYSTEM dimitic. Generative hyphae clamped, branched, hyaline, walls thin or slightly thickened, 2,1-5,7 µm wide (Fig. 6). Skeletal hyphae unbranched, thick-walled, 2,1-6,8 µm wide (Fig. 7). HYMENIUM 9,4-13,4 µm thick (Fig. 8). BASIDIA claviform, 8,3-10,4 x 3,1-4,7 µm, tetraspored. BASIDIOSPORES ellipsoid, hyaline, thin-walled, 2,6-3,6 x 1,0-1,6 µm, inamyloid, acyanophilous. CYSTIDIA few to abundant, clavate (Fig. 9), 4,2-10,4 µm wide, thick-walled, embedded in the trama or projecting up to 30 µm, abundant in the pore mouths (Fig. 10), heavily incrusted apically, arising from skeletal hyphae.

HABITAT: on angiosperms, associated with a white rot. DISTRIBUTION: in the subtropical rain forest of Misiones province.

MATERIAL STUDIED: Argentina, Misiones, Parque Nacional Cataratas del Iguazú, leg. M.Rajchenberg 5/III/80 (BAFC 27992); ibid, leg. ipse 4/III/82, M-3504 (BAFC 27993, holotype), M-3510 (BAFC 27994) and M-3511 (BAFC 27995).

REMARKS: *Junghuhnia microspora* differs from other species of the genus by its small pores and spores. *J. collabens* (Fr.)Ryv. has a typical brick-red pore surface and larger

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[3] *Tyromyces graminicola* Murr. (holotype studied, NY) also lacks clamps at the base of the basidia in the fruitbodies. Gilbertson & Lowe (1970:704) in their study of this species do not give information on this feature, but illustrate simple clamped basidia produced in culture.

allantoid to cylindric spores (3-5 x 1,2-1,7 µm). *J. nitida* (Pers.:Fr.)Ryv. differs in having larger ellipsoid spores (3,5-4,5 x 2,0-3,0 µm). *Poria novae-zelandiae* G.H. Cunn has similar pore and spore sizes, but skeletal hyphae are variably incrusted and never form true cystidia; besides, a slimy substance embeds all hyphal elements which is lacking in *Junghuhnia microspora*.

SKELETOCUTIS NIVEA (Jungh.)Keller var. *DILUTA* var. nov.
A typo differt hyphis skeletibus diffluentibus in 5% KOH et leviter amyloideis.
Holotypus: Argentina, Misiones, Iguazú, Puerto Esperanza, in satio Alto Paraná, leg. M.Rajchenberg III/1982, in herbario BAFC nº 28250 conservatus est.

FRUITBODIES and microscopical features are similar to those of the typical variety.[4] SKELETAL HYPHAE differ radically by dissolving in 5% KOH and in exhibiting a weakly amyloid reaction of their walls.

HABITAT: only found on *Pinus taeda* logs and other unknown gymnosperms, associated with a white rot. DISTRIBUTION: only found in subtropical implanted woods in Misiones province.

MATERIAL STUDIED: Argentina, Misiones, Iguazú, Puerto Esperanza, Alto Paraná plantation, leg. M.Rajchenberg III/1982 (BAFC 28250, holotype); ibid., leg. S.Blumenfeld 25/III/81 (BAFC 27657).

REMARKS: The remarkable character of this variety has only been known up to now in *Poria cinerascens* (Bres. ex Strass.)Sacc., a species that does not have an adequate generic disposition. Ryvarden (1976:82) placed it in *Antrodia* Karst. as *A. lindbladii* (Berk. & Br. ex Berk.)Ryv. (basionym:*Polyporus lindbladii* Berk. & Br. ex Berk.) but the type of wood-rot and cultural characters (Nobles, 1965:1132; Nakasone, 1981:108; and own unpublished data) show notable differences with those of *Antrodia* species (when compared with the table published by Domański, 1969:67). Whether the capacity of dissolving the walls in KOH solution may be a clue to relate *Poria cinerascens* with *Skeletocutis nivea* var. *diluta* is still a pending question, since *P. cinerascens* lacks typical incrustations present in *Skeletocutis* (=*Incrustoporia* Dom.) species (as shown by Keller, 1979:347). Besides, cultural features are different, as shown by a comparison of the principal code numbers (fide Nobles scheme, 1965:1103): 2. 4. 7. in *Poria cinerascens*, and 2. 3. (8). 9. in *Skeletocutis* species (David, 1971:95; Nobles, 1965:1129 and Stalpers, 1978:95). Notwithstanding this, there is a remarkable chemical correlation between presence of dissolving walls and amyloidity.

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[4] This striking reaction may be well observed by mounting the sections in phloxine solution and adding one drop of KOH solution while looking through the microscope. Walls evanesce, actually dissolve, and only a cellophane-like outer pellicle remains. The walls do not reconstitute when KOH solution is replaced overnight with phloxine solution.

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr. M.J. Larsen (Madison) and Dr. L. Ryvarden (Oslo) for critically reading the M.S. and making invaluable suggestions. Particularly gratifying were the discussions held with the latter.

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COLLETOTRICHUM GLOEOSPORIOIDES (PENZIG) PENZIG ET SACCARDO

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The authorities for the anamorph of the common plant pathogen *Glomerella cingulata* (Stoneman) Spaulding et Schrenk have been variously, but incorrectly, cited. The correct nomenclature is:

Colletotrichum gloeosporioides (Penzig) Penzig et Saccardo, in Penzig, Note micologiche. III. Seconda contribuzione allo studio dei funghi agrumicoli. *Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti, Serie 6, 2*(5): 670. 1884.

Basionym: *Vermicularia gloeosporioides* Penzig, Funghi agrumicoli. Contribuzione allo studio dei funghi parassiti degli agrumi. *Michelia 2*: 450. 1882.

Penzig employed the combination 9 times in his 1884 paper, but only 2 of these occurrences refer to a previously published description as required for valid publication of a new combination (International Code of Botanical Nomenclature, 1978, Article 32). The first of these, on p. 670 under "*Colletotrichum gloeosporioides* Penz. et Sacc.", not only indicates the basionym but also includes a taxonomic discussion and a redescription of the species.

Penzig's 1882 paper was also distributed as a separatum with its own pagination (see Lindau & Sydow, 1909, item 20412), so that the basionym has been cited as published in "Fung. agr., p. 66" (e.g. by Penzig, 1884, p. 671). Penzig's 1884 paper may also have been distributed as a separatum; this would account for Saccardo's (1884, p. 735) citation of the new combination as published in "F. Agrum. II. p. 6." Arx (1957a, p. 427) also cites the publication in this way, but assigns incorrect dates to both the basionym and the new combination. [Arx's annotation "teste Shear et Wood, 1913" does not assist, since Shear & Wood (1913, pp. 27, 104) refer only to Penzig's 1882 paper.] These errors have been perpetuated by Arx (1957b, p. 38; 1970, p. 59) and Sutton (1980, p. 530). The correct dates of Penzig's two papers are defined by the journal title pages and the author's prefaces ("1 Decembr. 1882" - "Giugno 1882"; and "dal Novembre 1883 all' Ottobre 1884" - "Gennajo 1884", respectively).

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ECTOMYCORRHIZAE OF SELECTED CONIFERS GROWING IN SITES WHICH SUPPORT DENSE GROWTH OF BRACKEN FERN

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SUMMARY

Fifteen ectomycorrhizae are described for *Abies concolor* of which the mycobiont is known for six and thirteen ectomycorrhizae are described for *Pseudotsuga menziesii*, of which three mycobionts were identified. The presence of these mycorrhizae on conifer seedlings located in sites overgrown by bracken fern suggests that the phytotoxins of bracken fern have little effect on ectomycorrhizae formation in nature in these areas.

INTRODUCTION

Many acres of formerly forested land in the Pacific Northwest now support dense growth of bracken fern, *Pteridium aquilinum* (L.) Kuhn (Isaac, 1940). One of the reasons bracken fern can dominate vegetation is its ability to produce allelopathic chemicals (Glass, 1976; Gliessman, 1976; Gliessman and Muller, 1972).

Bracken fern produces four phytotoxic phenolic acids: p-hydroxybenzoic acid, vanillic acid, ferulic acid, and p-hydroxycinnamic acid (Glass, 1976; Glass and Bohm, 1969). Small amounts of the toxins can be found in the rhizome but the highest concentrations are found in the fronds (Gliessman and Muller, 1972). Each fall, the current year's growth of fronds die and the toxins are released by rainfall into the soil as free phenolic acids (Glass, 1976; Whitehead, 1964). Whitehead (ibid) found that in sandy soil under bracken fern the four phenolic acids were present in the following concentrations: p-hydroxybenzoic acid, 3.9×10^{-5} M; vanillic acid, 4.9×10^{-6} M; ferulic acid, 0.4×10^{-5} M; and p-hydroxycinnamic acid, 4.2×10^{-6} M. Once in the soil they can be absorbed from the soil solution by plant roots (Glass, 1976; Gliessman and Muller, 1972).

Gliessman and Muller (1972) discovered that radicle growth of *Bromus rigida* Roth. is inhibited by water extracts of the fern fronds. They also found that shoot growth of *Avena fatua* L. is inhibited when the plants are grown in soil containing crumbled fronds. In another experiment, the four phenolic acids, in concentrations similar to those found in the soil by Whitehead (1964), were added to hydroponically grown barley, *Hordeum vulgare* L.C.V. Carlsberg & C.V. Zephyr, resulting in an overall decrease in root volume (Glass, 1976).

Ectomycorrhizae benefit their plant associates in many ways. The fungal partner of the association can increase the nutritional uptake of the plant by expanding the volume of soil the plant can exploit (Bowen, 1973; Harley, 1959). Another benefit of the mycorrhizal association for the tree is protection of the root against toxic chemicals. Mycorrhizae are considered essential in the revegetation of soil containing residual heavy metals from anthracite mining (Schramm, 1966). Toxins in bituminous mining spoils either did not affect, or increased, the growth of trees with mycorrhizae (Medve et al., 1977). The herbicides, 2,4-D, 2,4,5,-T, and amitrole, and the pesticide malathion do not affect growth of mycorrhizal fungi in culture (Dasilva et al., 1977). Simazine, a weed control herbicide, does not affect mycorrhizal development on *Pinus* seedlings (Smith and Ferry, 1979). Ectomycorrhizae also protect their associates against effects of air pollution. Carney et al. (1978) demonstrated that loblolly pine (*Pinue taeda* L.) with ectomycorrhizae were more resistant to the effects of sulfur dioxide and ozone than those seedlings without mycorrhizae.

Because mycorrhizae are known to increase the volume of soil exploited by a plant and because they are able to tolerate certain toxic effects, some mycorrhizae may enable conifer seedlings to survive among bracken fern. This project describes an attempt to explore the hypothesis that fungi form ectomycorrhizae with conifer seedlings on sites on which bracken fern are growing, and that these ectomycorrhizae protect seedlings against effects of the fern phytotoxins.

MATERIALS AND METHODS

Five sites in Humboldt County, California, were selected on the basis of presence of bracken fern and conifer seedlings and differences in elevation, slope aspect, parent material, and conifer species (Table I). A comparison of the features of the five sites shows a variation in elevation from 880 to 1370 meters, and a great diversity in slope aspects. There were three parent material types on the sites. Two were igneous in origin: the peridiotite-gabbro complex of sites I and II and the diorite-monorite-granite combination of site V. On sites I and II there is an additional component, serpentine outcrops. The third parent type, sandstone and shale on sites III and IV are sedimentary in origin. The vegetation of all five sites included *Pseudotsuga menziesii* (Mirb.) Franco. but differ in associated tree species. *Abies concolor* (Gord. & Glend.) Lindl. is an additional component on sites I, II and IV, *Pinus ponderosa* Laws. is found on sites II and IV, and *Libocedrus deurrens* is on sites I and II.

Mycorrhizal roots were collected from May to December 1979, and subsequently described in the laboratory. Descriptions were based on characters of the mantle, Hartig net, attached rhizomorphs, attached mycelium, and the rootlet. Mycorrhizae that were very similar in a number of characters were combined. Some of the fungal partners are taxonomically unknown because there were no fruiting bodies found in contact with those roots. Although no sclerotia of *Cenococcum graniforme* (Sow.) Ferd. & Winge were found, it was identified by its characteristic appearance of jet black mycelium. Voucher specimens of the roots are located in the Humboldt State University Cryptogamic Herbarium and stored in vials of 50:50 (v:v) mixture of Craf 3 solution (9:1, v:v, chromium trioxide: glacial acetic acid) and 20% formalin.

In both the spring and fall of 1979, fruiting bodies of fungal species were collected from the sites. Three criteria were used to determine mycorrhizal associations. One, as each fruiting body was found it was examined to determine if there was physical contact with or a close proximity to mycorrhizal roots. Two, macroscopic and microscopic features of the hyphae at the sporocarp base were compared to features of the hyphae attached to the mycorrhiza. Three, the literature was reviewed for reports of a mycorrhizal association between the fungal species and the conifer species. The sporocarps were dried and stored as voucher specimens.

Table I. Field Site Descriptions

Site Number	Elevation (meters)	Slope Aspect	Parent Material[a]	Conifer[b] Species
I	1370	N to E	peridiotite, gabbro, serpentine	PM, AC, LD
II	1280	W to NE	peridiotite, gabbro, serpentine	PM, AC, LD, PP
III	1010	NE to ESE	sandstone, shale	PM
IV	880	NE to SE	sandstone, shale	PM, PP
V	1280	E to SW	granodiorite, quartz diorite, quartz monorite, granite	PM, AC

[a] Jennings, Strand, and Rogers, 1977

[b] PM= *Pseudotsuga menziesii*, AC = *Abies concolor*, PP = *Pinus ponderosa*, LD = *Libocedrus decurrens*

Table II. Ectomycorrhizae associated with *Abies concolor.*

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
Hysterangium separabile Zeller (physical contact)	20-200 μm diam, ropy-wefty, white, glabrous + clamp c.	hyaline, rough-walled, - clamp c, gossamer net	white, glabrous 18-55 μm, - clamp c, prosenchyma	1-2 hyphae wide between cortical cells	.4-.8 mm diam, monopodal-open pinnate

Note: +c = clamp connections present
-c = clamp connections absent

On each site one or two root samples consisting of sixty to one hundred rootlet tips from each of twenty randomly selected seedlings were collected. Samples were collected from seedlings of *Abies concolor*, *Pseudotsuga menziesii*, and *Pinus ponderosa*. Each tip was examined and the percentage of all tips that were mycorrhizal was calculated. Tips were considered to be mycorrhizal if they were swollen, had no root hairs, were shortened, and had visible signs of hyphae on the rootlet surface. Questionable mycorrhizal roots were dissected and examined under a microscope.

RESULTS AND DISCUSSION

Examination of root samples from the field sites showed that over 90% of the roots had mycorrhizal infections on all sites. The average infection of the root samples from each site was as follows: site I, 99.7%; site II, 99.1%; site III, 98.1%; site IV, 99.4%; and site V, 91.4%.

All mycorrhizae described were ectomycorrhizae associated with either *Abies concolor* or *Pseudotsuga menziesii*. Except for *Cenococcum graniforme*, the fungal associates of *Abies concolor* mycorrhizae displayed different characteristics from those of *Pseudotsuga menziesii* mycorrhizae. A variety of mycorrhizal types found on the field sites exhibited differences in rhizomorphs, mycelium attached to the mantle, the mantle, the Hartig net and the rootlets. When compared, rhizomorphs differed in form, either ropy or ropy-wefty, in color, from white to yellow, and in diameter. In all specimens examined, the mycelium attached to the mantle consisted of hyaline hyphae that had either rough or smooth walls and was 1.5 to 4 μm in diameter. Characteristics of the mantle varied greatly in color and texture. The mantle of all but two of the types examined consisted of parenchymatous hyphae. Of the mantles made of synenchymatous hyphae, the mycobiont of one was *Cenococcum graniforme*, the other was unknown. The Hartig nets analyzed were composed of one to several hyphae between the cells of the root cortex and extended to the endodermis or to one cell layer from the endodermis. Rootlets examined were shortened and swollen but differed from one another in branching patterns, from monopodal to pinnate, remiform or tuberculate (Tables II & III).

The variety of mycorrhizal forms and mycorrhizal infection of over ninety percent on all sites indicate that formation of mycorrhizae by some fungi on the rootlets of *Abies concolor* and *Pseudotsuga menziesii* is not inhibited by the phytotoxins produced by bracken fern.

ACKNOWLEDGMENT

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Table II. Ectomycorrhizae associated with *Abies concolor* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
Rhizopogon subsalmonius Smith	90-150 μm diam, ropy, white, glabrous, - clamp c	none	white, cottony over metallic blue, glabrous, 34-39 μm, clamp c, prosenchyma	1-2 hyphae wide	ramiform
Rhizopogon parksii Smith (physical contact)	62-135μm diam, ropy-wefty, white, glabrous, - clamp c.	hyaline, rough-walled, + clamp c, 2-2.5 μm	white, cottony, 6-30 μm, + clamp c, prosenchyma	3-4 hyphae wide	.3-.5 (.6) mm diam, open pinnate-ramiform
Rhizopogon colossus Smith	none	none	white, reticulate, 18-60 μm, prosenchyma	2-3 hyphae wide	.4-.6 mm diam, open pinnate
Lactarius deliciosus (Fr.) S.F. Gray	none	none	metallic green and gray, glabrous, 32-46 μm, - clamp c, prosenchyma	2-3 hyphae wide	.5-.8 mm diam, open pinnate
Cenococcum graniforme (Sow.) Ferd. & Winge	none	none	black, crusty-bristly, 10-58 μm, - clamp c, synenchyma	1-3 hyphae wide	.3-.6 (-.7) mm diam, monopodal-ramiform
unknown	none	none	metallic silver, glabrous, 31-46 μm, prosenchyma	2-3 hyphae wide	.5-.6 mm diam, closed pinnate-tuberculate

Table II. Ectomycorrhizae associated with *Abies concolor* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
unknown	none	hyaline, 4 µm smooth-walled + clamp c, thick net	white, granular, 10-13 µm, + clamp c, prosenchyma	2-3 hyphae wide	.3-.4 mm diam, open pinnate
unknown	95-200 µm diam, ropy, yellow, glabrous, + clamp c	hyaline, smooth-walled 2-3 µm, + clamp c, gosamer net	yellow, cottony, 10-19 µm, prosenchyma	3-4 hyphae wide	.5-.6 mm diam, tuberculate
unknown	none	none	lavender, bristly, 34-50 µm, prosenchyma	1-2 hyphae wide	.3-.4 mm diam, coralloid
unknown	150-300 µm diam, ropy, pale yellow, glabrous, - clamp c	hyaline rough-walled, 1-4 µm, + clamp c, wefty	pale yellow, cottony, 16-65 µm, prosenchyma	2-3 hyphae wide	.3-.6 mm diam, monopodal-open pinnate
unknown	none	none	gold-pink, glabrous, 13 µm, prosenchyma	2-3 hyphae wide	.5-.6 mm diam, monopodal-ramiform
unknown	none	hyaline, rough-walled, 2-3 µm, + clamp c, gossamer net	blue, granular, 15-25 µm, prosenchyma	2-4 hyphae wide	.2-.4 mm diam, closed pinnate

Table II. Ectomycorrhizae associated with *Abies concolor* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
unknown	none	none	metallic gray brown, glabrous, 31-52 μm, + clamp c, prosenchyma	3-5 hyphae wide	.3-.6 mm diam, monopodal-open pinnate-ramiform
unknown	none	none	brownish red to black, glabrous-crusty, 10-26 μm, - clamp c. prosenchyma	2-4 hyphae wide	.4-.5 mm diam, monopodal

Table III. Ectomycorrhizae of *Pseudotsuga menziesii*

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
Hebeloma crustiliniforme (Bull. & Saint-Aman) Quel.	none	none	white over yellow brown, cottony, 10-18 μm, + clamp c, prosenchyma	1-2 hyphae wide	.2-.3 mm diam, open pinnate
Rhizopogon villosulus Zeller (physical contact)	10-57 μm diam, ropy, salmon, cottony, + clamp c	hyaline, smooth-walled 1.5-2.5 μm, + clamp c	metallic white-salmon, cottony, 28-51 μm, + clamp c, prosenchyma	2-3 hyphae wide	.4 mm diam, closed pinnate

Note: +c = clamp connections present
-c = clamp connections absent

Table III. Ectomycorrhizae of *Pseudotsuga menziesii* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
Cenococcum graniforme (Sow.) Ferd. & Winge	none	none	black, crusty granular 6-35 (-180) μm, - clamp c, synenchyma	3-5 hyphae wide	.3-.5 (-.8) mm diam, monopodal-ramiform
unknown	80 μm diam, ropy, white, glabrous	hyaline, smooth-walled 2.6 μm, + clamp c, gossamer net	white, glabrous, 19-22 μm, + clamp c, prosenchyma	2-3 hyphae wide	.3-.5 mm diam, dichotomous-pinnate
unknown	none	none	white over black, reticulate, 14-50 μm, prosenchyma	2-3 hyphae wide	.5-.6 mm diam, monopodal-open pinnate
unknown	13-26 μm diam, ropy, white, glabrous, + clamp c	hyaline, rough-walled, 2-3 μm, + clamp c, gossamer net	white over tan, granular over glabrous, 13-44 μm, prosenchyma	4-5 hyphae wide	.3-.4 mm diam, open pinnate
unknown	none	none	pinkish brown, granular, 16-65 μm, prosenchyma	4-5 hyphae wide	.5-.8 mm diam, ramiform

Table III. Ectomycorrhizae of *Pseudotsuga menziesii* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
unknown	71 μm diam, ropy, yellow brown, glabrous	hyaline, smooth-walled 2-3 μm, + clamp c, net	gold tan with lavender mottles, glabrous, 31-39 μm, synenchyma, scattered bristles	2-3 hyphae wide	.4-.6 mm diam, monopodal
unknown	none	none	blue gray over golden brown, glabrous, 26-52 μm, prosenchyma	3-4 hyphae wide	.3-.5 mm diam, closed pinnate-ramiform
unknown	none	hyaline, smooth-walled 2-4 μm, + clamp c, cottony	blue, cottony, 13-29 μm, prosenchyma	3-4 hyphae wide	.3-.5 mm diam, open pinnate-ramiform
unknown	none	none	pink brown-red brown, bristly, 30-34 μm, prosenchyma	2-4 hyphae wide	.5-.6 mm diam, open pinnate-ramiform
unknown	none	none	tan, glabrous, 20-52 μm, prosenchyma	3-4 hyphae wide	.3-.4 mm diam, open pyramidal-ramiform
unknown	none	none	gold brown-dark brown, 19-22 μm, prosenchyma	3-5 hyphae wide	.2-.5 mm diam, monopodal

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MYCORRHIZAE OF *ARBUTUS MENZIESII* PURSH. AND *ARCTOSTAPHYLOS MANZANITA* PARRY IN NORTHERN CALIFORNIA

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SUMMARY

51 arbutoid-, 2 arbutoid-ericoid- and 7 ecto-mycorrhizae are described as occurring on roots of either *Arbutus menziesii* Pursh. or *Arctostaphylos manzanita* Parry in 3 different sites in northern California. All sites consisted of a predominance of *Arctostaphylos manzanita* with scattered trees of two conifers, *Pinus ponderosa* Laws. and *Pseudotsuga menziesii* (Mirb.) Franco.

INTRODUCTION

Arbutus menziesii Pursh. and *Arctostaphylos* species growing in the shrublands and woodlands of Northern California commonly form mycorrhizae (Largent et al., 1980b). However, little research attention has been focused on the description of thee mycorrhizae or identification of the fungal symbiont. Several pure culture synthesis studies have established that various fungi which are known to form ectomycorrhizae with conifers can also form arbutoid mycorrhizae with *Arbutus menziesii*, *Arctostaphylos uva-ursi* (L.) Spring., and *Arctostaphylos manzanita* Parry (Comes, 1980; Molina and Trappe, 1982; Zak, 1976a, 1976b). While there is no certainty that these mycorrhizae will form under natural conditions, it demonstrates the variety of fungal species which are potential mycorrhizal formers with these plants. By tracing the rhizomorphs and mycelia between sporocarps and mycorrhizae on root samples collected in field work, three fungal symbionts have been identified: *Cortinarius aureifolius* Peck var. *hesperius* J.F. Ammirati in association with *Arctostaphylos uva-ursi* (Zak, 1973); *Cortinarius zakii* J.F. Ammirati with *Arbutus menziesii* (Zak, 1974); and *Amanita gemmata* (Fr.) Gill. with *Arctostaphylos manzanita* (Largent, et al., 1980a). A fourth fungus, *Cenococcum graniforme* (Sow.) Ferd. & Winge, identified by the appearance of the mycorrhizae, associates with *Arbutus menziesii* and several *Arctostaphylos* spp. (Largent et al., 1980b; Trappe, 1964; Zak, 1973, 1974).

The mycorrhizae formed with *Arctostaphylos* spp. and *Arbutus* spp. are predominantly arbutoid, but ericoid forms and ectomycorrhizae have also been observed (Largent et al., 1980b; Mejstrik and Hadac, 1975; Trappe, 1964; Zak, 1973, 1974). The type of mycorrhizae formed by *Cenococcum graniforme* has been placed in more than one category. Field studies show that this fungus is capable of forming ectomycorrhizae with *Arc-*

tostaphylos and *Arbutus* (Largent et al., 1980b, Mejstrik and Hadac, 1975), while in pure culture experiments it develops into an arbutoid type (Molina and Trappe, 1982; Zak, 1976a, 1976b).

Because little field work has been done on the mycorrhizae of *Arctostaphylos* spp. and *Arbutus* spp. this study was undertaken to provide more complete information on the characteristics of their mycorrhizae and to identify some of their natural fungal symbionts.

MATERIALS AND METHODS

Root specimens were collected from *Arbutus menziesii* and *Arctostaphylos manzanita* on three sites in Humboldt County, California, from 1979 to 1981. The predominant vegetation on the sites is *Arctostaphylos manzanita*, with scattered *Arbutus menziesii*, *Pinus ponderosa* Laws., and *Pseudotsuga menziesii* (Mirb.) Franco. One of the sites also has *Quercus garryana* Dougl. and *Quercus chryolepis* Liebm.

The roots were examined both macroscopically and microscopically and described using features of the mantle, attached mycelium, attached rhizomorphs, and the rootlets. The root specimens examined are stored in Craf #3 solution at Humboldt State University, Arcata, California.

Sporocarps of fungi associated with the mycorrhizae were also collected whenever observed. Fungal species were determined to be mycorrhizal symbionts if the sporocarps were in physical contact with or repeated close proximity to mycorrhizal roots, and the features of the mycelium or rhizomorphs at the sporocarp base were identical to those of the mycorrhizal root. The sporocarps were dried and are stored as voucher specimens in the Humboldt State University fungal herbarium.

RESULTS

Mycorrhizae were found on all but one of the root samples collected. Repeatedly, a number of different mycelial and rhizomorph types were noticed in the soil, concentrating in the area surrounding a rootlet complex. Root samples often had up to five different mycorrhizae on a 10-20 cm length of root.

Fifty-five mycorrhizae were described in association with *Arctostaphylos manzanita* and five with *Arbutus menziesii*. Most of the mycorrhizae examined, including *Cenococcum graniforme*, were arbutoid (Tables I-IV). Anatomically, these mycorrhizae were all very similar, with well developed mantles, a Hartig net extending between cells of the outermost layer of cortical cells, and intracellular hyphae packed into the cells of the first layer of the cortex. The morphology of the specimens was highly variable, differing in the structure, texture and color of the mantle, attached mycelium and rhizomorphs, and the branching forms of the rootlet complexes. A second type of mycorrhiza examined was intermediate between ericoid and arbutoid forms (Table V). These roots exhibited a thin mantle with a weak or nonexistent Hartig net, intracellular hyphae in the cells of the first one to two layers of cortical cells, and typical arbutoid swelling and branching patterns of the rootlets. Roots determined to be ectomycorrhizal differed from the arbutoid types only in the absence of intracellular hyphae (Table VI). The Hartig net, unlike those found in ectomycorrhizal conifer roots, extended only between the outermost one or two layers of cortical cells.

Several fungi were identified as mycorrhizal associates of *Arctostaphylos manzanita*. Species of *Cortinarius* were most common: *Cortinarius zakii*, *Cortinarius fibrillosipes* var. *fibrillosipes* J.F. Ammirati, and two unidentified species. A species of *Calocybe* and *Boletus aereus* Bull. ex Fr. were also identified. *Cenococcum graniforme*, identified by the characteristics of the mycorrhizae and the presence of black sclerotia, was found in association with both *Arbutus menziesii* and *Arctostaphylos manzanita*. *Lyophyllum* sp. was the only other fungus identified in an association with *Arbutus menziesii*.

Table I. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with known fungal symbionts.

Fungal Species	Mantle	Attached Mycelium	Rhizomorphs	Rootlet	Root Specimens
Calocybe sp. JA-319 (physical contact)	cream yellow; glabrous; < 10 μm diam; prosenchymatous; hyphae—thin, punctate walls, 2.5-3 μm diam.	hyaline; thin/thick, punctate walls; 2-3 μm diam; -c; gossamer	cream; 10-150 μm; spreading ropy; glabrous; hyphae—thick, punctate walls, 3-5 μm diam, common branching	trilobate; .17-.21 mm diam.	M30B
Cortinarius sp. JA-338 (physical contact)	white; wefty; 5-11 (-18) μm diam; prosenchymatous; hyphae—smooth walls, 2 μm diam.	hyaline; thick, smooth walls; 2-2.5 μm diam; +c; common branching; gossamer	white; 36-120 μm; spreading ropy; glabrous; hyphae—thick, smooth walls, 2-3.5 μm diam, +c	monopodal/ramiform; .20-.24 mm diam.	M16B
Cortinarius sp. JA-300 (physical contact)	white/golden brown; reticulate; 19-40 μm diam; prosenchymatous; hyphae—thick, smooth walls, 2.5-4 μm diam, +c	hyaline; thick, smooth walls; 2.5-3.5 μm diam; +c; common branching; wefty/cottony	white; 25-130 μm; spreading ropy/wefty; glabrous	bilobate; .16-.56 mm diam.	M05 M08

Note: +c = clamp connections present
-c = clamp connections absent

Table I. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with known fungal symbionts. (cont.)

Fungal Species	**Mantle**	**Attached Mycelium**	**Rhizomorphs**	**Rootlet**	**Root Specimens**
Cortinarius zakii cf. JA-316 (physical contact)	golden brown; wefty; 10-25 μm diam; prosenchymatous; hyphae—thin smooth walls, 3-4 μm, +c	hyaline; thick, smooth walls; 2.5-3.5 μm diam; +c; common branching; wefty	absent	monopodal/ ramiform; .21-.27	M28
Cortinarius fibrillosipes var. *fibrillosipes* AB-021 (physical contact)	yellow; wefty; 13-26 μm diam; prosenchymatous	hyaline; peglike/ coralloid wall incrustations; 2.5-4 μm diam; +c; wefty	light yellow; 58-59 μm diam; long, threadlike	pinnate; .28 mm diam.	AB021
Boletus aereus AB-016 (physical contact)	white/golden brown; cottony; 13 μm diam; prosenchymatous; aculeate setae, 52 μm long, septate base	hyaline; 2.5 μm diam; +c; common branching; pseudoclamps; wefty	absent	closed pinnate	AB016
Cenococcum graniforme (mycorrhizae characters)	black; bristly 10-33 μm diam; synenchymatous; hyphae—dark, thick, smooth walls	black; thick, smooth walls, 3.5-6 μm diam; -c; infrequent branching; bristly	absent	monopodal/ trilobate; .18-.32 mm diam.	M26A M35A M13C M32A M30A

Table II. Arbutoid mycorrhizae of *Arbutus menziesii* with known fungal symbionts.

Fungal Species	Mantle	Attached Mycelium	Rhizomorphs	Rootlet	Root Specimens
Lyophyllum sp. JA-332, JA-333 (root proximity)	gray; cottony; 17-30 μm diam; prosenchymatous; hyphae—thick, smooth walls, 2-3 (-5) μm diam, + c	hyaline; thick, smooth walls; 2.5-4 (-5.5) μm diam; + c; common branching; anastomosing; cottony	absent	monopodal/ ramiform; .21-.29 mm diam.	M33 M34
Cenococcum graniforme (mycorrhizae characters)	black; bristly; 8-28 μm diam; synenchymatous; hyphae—thick, smooth walls, 3-5 μm diam, -c	black; thick, smooth walls; 5 μm diam; -c; infrequent branching; bristly	absent	monopodal/ trilobate; .24-.32 mm diam.	M29A

Note: +c = clamp connections present
-c = clamp connections absent

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
translucent white; glabrous; 15-27 μm diam; prosenchymatous; hyphae—smooth walls, 2-2.5 μ diam, -c	hyaline; smooth/ punctate walls; 2-2.5 μm diam; +c; infrequent branching; sparse, singly attached to mantle	absent	bilobate; .25-.36 mm diam.	M02A
white; glabrous; 15-20 μm diam; prosenchymatous; hyphae—smooth walls, 3-5 μm diam.	hyaline; thin, smooth walls; 2-3 μm diam; cottony	absent	trilobate; .24-.49 mm diam.	M15A
white; granular; 15-30 μm diam; prosenchymatous; hyphae—outer layer twisted, 2.5-3.0 μm diam; inner layer rectangular 2 μm x 2.5-6 μm	absent	absent	monopodal/ trilobate; .18-.25 mm diam.	M17A
white; woolly; 10-18 μm diam; prosenchymatous; hyphae—thin, smooth walls, -c	hyaline; thin, smooth/ rough walls; 1.5 μm diam; +c; sparse, singly attached to mantle	absent	bilobate/ trilobate; .24-.28 mm diam.	AB026
white; reticulate; 6-12 μm diam; prosenchymatous	absent	absent	trilobate; .18-.27 mm diam.	M03

Note: +c = clamp connections present
-c = clamp connections absent

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
white; reticulate/cottony; 15-35 μm diam; prosenchymatous; hyphae—smooth walls, -c	hyaline; thick, smooth walls; 3-4 μm diam; +c; cottony	white; 26-40 μm diam; spreading ropy; glabrous	ramiform; .25-.33 mm diam.	M10
white; reticulate/cottony; 15-40 μm diam; prosenchymatous; hyphae—thin, smooth walls, -c	hyaline; thin, smooth walls; 2.5-3.5 (-4.5) μm diam; +c; common branching; cottony	absent	ramiform; .24-.36 (-.49) mm diam.	M12
white; cottony; 9-20 μm diam; prosenchymatous	hyaline; thick, smooth walls; 2.5-4 μm diam; +c; common branching; wefty	absent	ramiform; .15-.20 mm diam.	M01A
white; cottony; 15-25 μm diam; prosenchymatous; hyphae—smooth walls, 4-5 μm diam, -c	hyaline; thin punctate walls; 2.5-3 μm diam; +c; cottony	absent	monopodal/bilobate; .18-.26 mm diam.	M09
white/gray tinges; wefty/cottony; 10-15 μm diam; prosenchymatous; hyphae—thin smooth walls, 2-2.5 μm diam, -c	hyaline; thin, smooth walls; 2-3 μm diam; +c; common branching; gossamer	white; 12-64 μm diam; wefty/ropy; cottony	trilobate; .21-.26 mm diam.	M40

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
white/yellow tinges; reticulate/cottony; 6.5-19 μm diam; prosenchymatous; hyphae—rough walls, 2-3 μm diam; +c	hyaline; smooth walls; 2.5-3 μm diam; +c; infrequent branching; gossamer	white; 6.5 μm diam; threadlike	trilobate; .21-.52 mm diam.	AB022
white/tan; glabrous; 12-30 μm diam; prosenchymatous; hyphae—2-4 μm diam, -c	hyaline; thin, smooth walls; 2-4 μm diam; +c; sparse gossamer	absent	trilobate; .15-.28 mm diam.	M19A M26B M38
white/reddish brown/black; cottony; 19-35 μm diam; synenchymatous; hyphae—peglike incrustations	hyaline; smooth walls; 2.5 μm diam; +c; gossamer/cottony	tan/gray; 100 μm diam; threadlike; wefty	trilobate	AB018
white/blackish cast; fleecy; 20-31 μm diam; synenchymatous	hyaline; coralloid wall incrustations; 3-6.5 μm diam; -c; fine wefty	absent	bilobate/trilobate;	AB005
cream/dark yellow; wefty; 4-10 μm diam; prosenchymatous; hyphae-thin smooth walls, 1.5-2 μm diam; -c	hyaline; thin, smooth walls; 2-2.5 μm diam; common branching; wefty	cream; 25-120 μm diam; ropy/wefty; glabrous	monopodal/ramiform; .17-.29	M42

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
cream/yellow brown; glabrous; 10-15 µm diam; prosenchymatous; hyphae—thin smooth walls, 2.5 µm diam; -c	absent	absent	trilobate; .22-.28 mm diam.	M25
cream/golden brown; cottony; 10-20 µm diam; prosenchymatous; hyphae—thin smooth walls; 2-2.5 µm diam, +c	hyaline; thin, smooth walls; 2-2.5 µm diam; +c; common branching; cottony	white; 10-26 µm diam; ropy; glabrous; hyphae inflated -8 µm diam.	ramiform; .18-.24 mm diam.	M41A
cream/golden; pubescent; 15-20 µm diam; prosenchymatous; hyphae—thin smooth walls, 2-2.5 µm diam, +c	hyaline; thin, smooth walls; 2.5-3 µm diam; -c; common branching; pubescent	absent	trilobate; .23-.33 mm diam.	M36A
yellow; reticulate; 10-15 µm diam; prosenchymatous; hyphae—3.3.5 µm diam, -c	hyaline; thin, smooth walls; 2-2.5 µm diam; +c; gossamer	yellow; 50 µm diam; ropy; glabrous/cottony	monopodal; .18-.37 mm diam.	M13B

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
yellow/yellow brown; bristly; 18-30 µm diam; prosenchymatous; hyphae—thick smooth walls, 4-4.5 µm diam; acute setae, thick walls, 4-5 µm diam. at enlarged, septate base, 52-130 µm long	absent	absent	trilobate; .24-.33 mm diam.	M27
yellow/reddish brown feltlike; 26 µm diam; prosenchymatous	hyaline; spiny wall incrustations; 2.5-3 µm diam; -c	absent	monopodal/ trilobate	AB004
golden brown; glabrous; 5-10 µm diam; prosenchymatous	absent	absent	trilobate/ tuberculate .15-.35 mm diam.	M24
golden brown/reddish brown; glabrous; 7-15 µm diam; 2 layers: outer—prosenchymatous, hyphae—thick, smooth walls, 2-3 µm diam, -c; inner—synenchymatous; hyphae—thick, dark walls, -c	hyaline; thick, warty walls; 2-5 µm diam; -c; scattered, singly attached to mantle	absent	trilobate; .19-.25 mm diam.	M41B

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
golden brown/reddish brown; cottony; 5-10 μm diam; prosenchymatous; hyphae—thin smooth walls, 3-4.5 μm diam, -c	hyaline; thin, smooth walls; 2.5-3.5 μm diam; +c; common branching; cottony	golden brown; 15-25 μm diam; ropy; glabrous	bilobate .19-.26 mm diam.	M32C
golden brown/rusty brown; crusty; 20-30 μm diam; prosenchymatous; hyphae—thick walls, -c	hyaline; thick, punctate walls; 2-3 μm diam; +c; infrequent branching; sparse, gossamer	absent	bilobate; .15-.25	M26C
golden brown/brown; glabrous; 8-20 μm diam; prosenchymatous; hyphae—dark, thick, smooth walls, 4-7.5 μm diam; -c; multiple branching	absent	absent	trilobate; .22-.27 mm diam.	M16A
golden brown/dark brown; glabrous; 10-15 μm diam; prosenchymatous; hyphae—2.5-3 μm diam.	absent	absent	trilobate; .21-.37 mm diam.	M13D

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
light gray/gray brown; glabrous; 10-20 μm diam; prosenchymatous; hyphae—thin smooth walls, 2.5-5 μm diam.	hyaline; thin, smooth walls; 2.5-3 μm diam; +c; common branching; cottony	absent	trilobate; .27-.32 mm diam.	M23B
gray/gray brown; glabrous; 12-19 μm diam; prosenchymatous; hyphae—thin smooth walls, 2.5-5 μm diam, -c	hyaline; thick, smooth walls; 1.5-2.5 μm diam; -c; infrequent branching	absent	monopodal/ trilobate; .18-.24 mm diam.	M35B
rusty brown/brown; glabrous; 15-23 μm diam; synenchymatous; hyphae—dark thick smooth walls; 3-6 μm diam, -c	absent	absent	trilobate; .23-.30 mm diam.	M04B
rusty brown/reddish brown; glabrous; 15-20 μm diam; prosenchymatous; hyphae—dark thick smooth walls; 5-6 μm diam; -c	absent	absent	bilobate/ trilobate; .23-.26 mm diam.	M35C
reddish brown/brown; glabrous; 13 μm diam prosenchymatous	hyaline; thin/thick, incrusted walls; 2.6 μm diam; +c; branched	dark brown; 26 μm diam; threadlike; papillose	ramiform/ open pinnate	AB009

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
brown, metallic; cottony; 11-30 μm diam; prosenchymatous hyphae—dark, 1.5-3 μm diam; -c	brown; thin, ornamented walls; 1.5-2.5 μm diam; -c; gossamer	absent	tuberculate; .23-.30 mm diam.	M04B
brown/black; glabrous; 7.5-10 μm diam; prosenchymatous; hyphae—thin smooth walls, 1.5-2.5 μm diam, -c; bulbous cells on surface	absent	absent	bilobate/ ramiform; .15-.26 mm diam.	M04C
coffee/black; granular; 10-20 μm diam; synenchymatous hyphae—dark thick smooth walls, 4-10 μm diam; setae—thick warty walls, occasional branching	black; thick warty walls; 2-6 μm diam; +c; gossamer	absent	bilobate/ trilobate; .21-.37 mm diam.	M13A M35A M37A
olive green/black; granular; 5-6 μm diam; prosenchymatous; hyphae—dark thick walls, 2-5 μm diam, -c, common branching	absent	absent	trilobate; .23-.26 mm diam.	M20A M22A

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
black; bristly; 22-33 μm diam; prosenchymatous; hyphae—dark, thin smooth walls, 2-5 μm diam, -c	black; thin, smooth walls; 2-2.5 μm diam; +c; common branching; bristly	absent	monopodal/ trilobate; .31-.36 mm diam.	M26A
orange/brown, white patches; cottony; 19-20 μm diam; synenchymatous	absent	absent	ramiform	AB008
pinkish orange; cottony; 10-30 μm diam; prosenchymatous; hyphae—thin, smooth walls, 2-3.5 (-5) μm diam, +c	hyaline; thick, smooth walls; 2-5.5 μm diam; +c; common branching; occasional anastomosing cottony	pinkish orange; 30-60 μm diam; spreading ropy/ wefty; cottony	trilobate; .14-.37 mm diam.	M16C M18 M36B M23A M21 M31.
orange pink/orange brown; glabrous; 25-40 μm diam; prosenchymatous; hyphae—2.5-5 μm diam.	hyaline; thin, smooth walls, 3-4 μm diam; +c; common branching	absent	bilobate/ ramiform; .31-.37 mm diam.	M15B
light blue; glabrous; 18-38 μm diam; prosenchymatous; hyphae—thin, smooth walls, 2.5-3 μm diam, -c	absent	absent	tuberculate; .23-.34 mm diam.	M04A

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
metallic blue gray; glabrous; 15-30 μm diam; prosenchymatous; hyphae—2-4 μm diam, -c	absent	absent	trilobate/ tuberculate; .18-.31 mm diam.	M11

Table IV. Arbutoid mycorrhizae of *Arbutus menziesii* with unknown fungal symbionts.

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
golden brown; glabrous; 10-20μm diam; prosenchymatous; hyphae—thick, smooth walls, 2-3 μm diam, -c	absent	absent	trilobate; .23-.26 mm diam.	M39
reddish brown; bristly; 10-18 μm diam; prosenchymatous; hyphae—thin, smooth walls, 2-5 (-6) μm diam, -c	reddish brown; thin, smooth walls; 2-3 μm diam; + μm; +c; infrequent branching, gossamer	reddish brown; 4-19 μm diam; spreading ropy; cottony	monopodal/ ramiform; .19-.27 mm diam.	M29B

Note: +c = clamp connections present
-c = clamp connections absent

Table V. Arbutoid-ericoid mycorrhizae of *Arctostaphylos manzanita* and *Arbutus menziesii.*

Host[a]	Mantle	Attached Mycelium	Rhizomorphs	Rootlet	Root Specimens
ARMA	gray brown; reticulate; 5-30 μm diam; prosenchymatous; hyphae—thin smooth walls, 2-2.5 μm diam.	hyaline; thin smooth walls 2.25 μm diam; +c gossamer	absent	trilobate/ monopodal .18-.28 mm diam.	M37B
ACME	translucent pale yellow; glabrous; <5 μm diam; synenchymatous	hyaline; smooth walls; 2-2.5 μm diam; gossamer	absent	ramiform; .22-.31 mm diam.	M14

[a] ARMA = *Arctostaphylos manzanita*, ACME = *Arbutus menziesii*

Note: +c = clamp connections present
-c = clamp connections absent

Table VI. Ectomycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts.

Mantle	Attached Mycelium	Rhizomorphs	Rootlet	Root Specimens
white/reddish brown; cottony/wefty; 26 μm diam; synenchymatous	hyaline; smooth walls; 2.6 μm diam; +c; branching; wefty	white; 200 μm diam; threadlike; wefty	trilobate	AB019
white, gray brown tinges/dark green; cottony; 26-39 μm diam; synenchymatous; hyphae—peglike wall incrustations, -c	hyaline; peglike/coralloid incrustations -c	absent	closed pinnate	AB017
pale yellow; felty; 19-20 μm diam; synenchymatous	hyaline; tubercule wall outgrowths; -c; infrequent branching	absent	trilobate	AB007
burnt orange; felty; 21-26 μm diam; prosenchymatous	hyaline; incrusted walls; 2.6-3.9 μm diam; -c; branching	absent	ramiform	AB006
reddish brown/black; granular; synenchymatous; hyphae-2.5 μm diam, +c	dark; 2.5 μm diam; +c; branching	dark brown; wefty	ramiform	AB014

Note: +c = clamp connections present
-c = clamp connections absent

DISCUSSION

The amount of mycelial and rhizomorph development in the soil surrounding the roots of *Arctostaphylos manzanita* and *Arbutus menziesii* and the abundance and variety of mycorrhizae described, support the hypothesis put forward by Molina and Trappe (1980) that mycorrhizal roots of ericaceous plants may act as a reservoir of fungi that can be used by conifers in forests that are becoming re-established.

Harley (1959) proposed that arbutoid mycorrhizae are intermediate between ectomycorrhizae and ericoid mycorrhizae. Molina and Trappe (1980) hypothesized that the arbutoid form is a type of ectomycorrhiza. The results of the research done in this paper substantiate the theory of a close relationship between different types of mycorrhizae. The difference between types of mycorrhizae may be caused by any number of environmental factors tht affect the ability of the fungus to physically penetrate the cells of the cortex or affect the production of certain fungal or plant hormones. A gradient of environmental factors could result in a number of intermediate forms between two recognized categories of mycorrhizae. The arbutoid-ericoid forms described here and observed by Largent et al. (1980b) illustrate these intergrading forms.

Further research consideration should be given to the relationship between different types of mycorrhizae and to the factors that are the source of variability in types of mycorrhizae.

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CHECK-LIST OF ROMANIAN PERONOSPORALES

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Together with the Uredinales, Ustilaginales and Erysiphales, the Peronosporales have been intensively studied in Romania. The most valuable contributions are those by T. Săvulescu, T. Rayss, C.V. Oescu, I. Rădulescu and O. Săvulescu. Over the years other students have recorded many downy mildews and T. & O. Săvulescu have published a list 'Peronosporaceele din Republica Populară Romană' (Lucr. Grăd. bot. Buc. 1963: 1-146, issued 1964) based on literature data. In a recent paper (Constantinescu & Negrean, Feddes Repert. 93 (9/10) 1982, in press) 8 species and 177 fungus/host combinations were newly recorded for Romania, and 80 plants not previously recorded as hosts were listed. Both the mentioned papers include short surveys of the research done in Romania on these fungi. The available data show that 641 out of c. 3000 phanerogamic taxa of Romanian flora are parasitized by downy mildews. Romania, a relatively small territory, apparently has the richest known flora of Peronosporales.

Although our search through the literature concerning Romanian Peronosporales (about 280 publications) has been thourough, this check-list is only based on an examination of over 5000 specimens of which we collected more than 3000 between 1957-1981, particularly between 1975-1980. We have also collected and preserved new specimens for most of the known fungus/host combination which were not supported by voucher herbarium material. This work was part of a project concerning 'Cryptogamic Flora of Romania'. Almost all of

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the material studied is preserved in the herbarium BUCM and some specimens are deposited in BUC, CL, CRAF, I, IBIR and SIB herbaria.

This list comprises only Albuginaceae and Peronosporaceae, *Pythium* and *Phytophthora* (Pythiaceae) were not included because they are little known in Romania. For these two genera only a limited number of herbarium specimens and living cultures are available.

The main difficulty encountered during our study was the absence of a modern, monographic treatment of such important genera as *Peronospora* and *Plasmopara*. Consequently, we had to take some taxonomical decisions, particularly in *Peronospora*, which are not in accordance with most of the published studies. In general, we have recognized only those downy mildew species within a host family, which can be delimited by qualitative morphological features e.g. shape of conidia or sporangia (length/width ratio), oospore ornamentation, tip of ultimate branchlets, and not by quantitative characters such as the size of conidia or other organs. However, in the treatment of *Peronospora* parasitic on some host families (Boraginaceae, Caryophyllaceae, Leguminosae) this principle could not be applied consistently. The oospore ornamentation of *Peronospora* inhabiting these plants proved to have diagnostic value but in many micro-species no oospores could be found. Consequently, they were partly treated in a conservative way. These decisions can be questioned, particularly because they are not based on the study of the type specimens of taxa concerned and, actually, we changed a few times our mind during the final part of our work.

The physiological specialization below host family level, extensively used in the past but only rarely properly proved, was not taken into account for species delimitation. No infraspecific taxa are recognized in this paper and no 'formae speciales' are mentioned, though the latter are often used by plant pathologists.

As a result of a broader species concept that the one adopted by T. & O. Săvulescu (l.c.), the number of 'good' species of Peronosporales was reduced from 254 to 112, although the number of hosts has increased by c. 274 taxa (table 1).

In a few instances authors are cited according to the changed Art. 13 ICBN adopted by the Sydney Bot. Congr. (Taxon 30: 106, 905. 1981). Author's names are abbreviated

Table 1

SYNOPTIC TABLE OF ROMANIAN PERONOSPORALES

GENERA	*number of species*	number of hosts: families	genera	species & subsp.
Albugo	*6*	7	60	141
Basidiophora	*1*	1	1	1
Bremia	*1*	1	23	82
Bremiella	*1*	1	3	3
Peronospora	*88*	32	157	438
Plasmopara	*10*	9	37	57
Pseudoperonospora	*4*	4	4	7
Sclerospora	*1*	1	1	3
TOTAL				
- fungi	*112*	-	-	-
- fungus/host comb.	-	56	286	732
- hosts	-	42	231	641

according to Hawksworth (Rev. Pl. Pathol. 59: 473-480. 1980). The nomenclature of the hosts is in accordance with 'Flora Europaea'. Genera and species are arranged alphabetically, except for *Peronospora* species which are listed according to alphabetically arranged host families; a host-fungus index is added. The first author is responsible for the identification, taxonomy and nomenclature of the fungi and the second author for the same with regard to the host plants.

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ALBUGO (Pers.) Roussel

A. bliti (Biv.-Bern.) Kuntze on Amaranthus albus L., A. blitoides S. Watson, A. ? bouchonii Thell., A. graecizans L., A. hybridus L., A. lividus L., A. retroflexus L.

A. candida (J.F. Gmelin : Fr.) Kuntze on Alyssum alyssoides (L.) L., A. borzeanum E.I. Nyárády, A. caliacrae E.I. Nyárády, A. desertorum Stapf, A. hirsutum Bieb., A. linifolium Stephan ex Willd., A. minutum Schlecht. ex DC., A. murale Waldst. & Kit., A. petraeum Ard., A. saxatile L., A. tortuosum Willd.; Arabidopsis thaliana (L.) Heynh.; Arabis alpina L., A. glabra (L.) Bernh., A. hirsuta (L.) Scop., A. muralis Bertol., A. procurrens Waldst. & Kit., A. recta Vill., A. sagittata (Bertol.) DC., A. turrita L.; Armoracia rusticana P. Gaertner, B. Meyer & Scherb.; Barbarea vulgaris R. Br.; Berteroa incana (L.)DC.; Biscutella laevigata L.; Brassica elongata Ehrh. subsp. elongata; B. juncea (L.) Czern. & Coss., B. napus L. (cult.), B. nigra (L.) Koch, B. oleracea L., B. rapa L. (cult.), B. rapa L. subsp. oleifera DC. (cult.); Bunias orientalis L.; Calepina irregularis (Asso) Thell.; Camelina microcarpa Andrz. ex DC., C. rumelica Velen., C. sativa (L.) Crantz; Capsella bursa-pastoris (L.) Medicus; Cardamine amara L., C. hirsuta L., C. matthiolii Moretti, C. pratensis L.; Cardaminopsis arenosa (L.) Hayek, C. halleri (L.) Hayek subsp. halleri, C. halleri subsp. ovirensis (Wulfen) Hegi & E. Schmidt, C. neglecta (Schultes) Hayek; Cardaria draba (L.) Desv.; Cheiranthus cheiri L. (cult.); Chorispora tenella (Pallas) DC.; Cleome spinosa Jacq. (cult.); Conringia orientalis (L.) Dumort.; Coronopus squamatus (Forskål) Ascherson; Descurainia sophia (L.) Webb ex Prantl; Diplotaxis muralis (L.) DC.; Draba lasiocarpa Rochel (incl. subsp. elongata (Host) Jáv.); Erophila verna (L.) Chevall. subsp. verna; Erysimum cheiranthoides L., E. comatum Pančić, E. crepidifolium Reichenb., E. cuspidatum (Bieb.) DC., E. diffusum Ehrh., E. odoratum Ehrh., E. repandum L., E. witmannii Zawadski; Euclidium syriacum (L.) R. Br.; Hesperis matronalis (cult.); Hornungia petraea (L.) Reichenb.; Hutchinsia alpina (L.) R. Br. subsp. brevicaulis (Hoppe) Arcangeli; Hymenolobus procumbens (L.) Nutt. ex Torrey & A. Gray; Iberis saxatilis L., I. umbellata L.; Isatis tinctoria L.; Lepidium campestre (L.) R. Br., L. cartilagineum (J. Mayer) Thell. subsp. crassifolium (Waldst. & Kit.) Thell., L. densiflorum Schrader, L. latifolium L., L perfoliatum L., L. ruderale L.. Lunaria annua L. subsp. pachyrrhiza (Borbás) Hayek; Neslia paniculata (L.) Desv.; Raphanus raphaniastrum L. subsp. raphaniastrum, R. sativus L. (cult.); Rorippa amphibia (L.) Besser, R. austriaca (Crantz) Besser, R. islandica (Oeder) Borbás, R. pyrenaica (Lam.) Reichenb., R. sylvestris (L.) Besser subsp. sylvestris, R. sylvestris subsp. kerneri (Menyh.) Soó; Sinapis alba L. (cult.), S. arvensis L.; Sisymbrium altissimum L., S. loeselii L., S. officinale (L.) Scop., S. orientale L., S. polymorphum (Murray) Roth; Syrenia cana (Piller & Mitterp.) Neilr., S. montana (Pallas) Klokov; Thlaspi arvense L.; T. perfoliatum L.

A. caryophyllacearum (Wallr.) Cif. & Biga on Spergularia marina (L.) Griseb. (= S. salina J. & C. Presl.), S. media (L.) C. Presl (= S. marginata Kittel).

A. eurotiae Tranzschel on Ceratocarpus arenarius L.

A. portulacae (DC.) Kuntze on Portulaca oleracea L. subsp. oleracea, P. oleracea subsp. sativa (Haw.) Čelak. (cult.)

A. tragopogonis (Pers.) Gray on Ambrosia artemisiifolia L.; Artemisia vulgaris L.; Centaurea atropurpurea Waldst. & Kit., C. kotschyana Heuffel, C. orientalis L., C. ? scabiosa L.; Chamomilla suaveolens (Pursh) Rydb.; Cirsium alatum (S.G. Gmelin) Bobrov (= C. setigerum Ledeb.), C. arvense (L.) Scop., C. canum (L.) Scop., C. erisithales (Jacq.) Scop., C. oleraceum (L.) Scop., C. rivulare (Jacq.) All., C. vulgare (Savi) Ten.; Crepis sancta (L.) Babcock (= Lagoseris sancta (L.) K. Malý); Crupina vulgaris Cass.; Filago vulgaris Lam.; Inula britannica L., I. conyza DC., I. salicina L.; Logfia arvensis (L.) Holub; Scorzonera cana (C.A. Meyer) O. Hoffm., S. hispanica L., S. laciniata L.; Senecio vernalis Waldst. & Kit.; Serratula tinctoria L.; Tragopogon dubius Scop., T. porrifolius L. (cult.), T. pratensis L., s. l.; Xeranthemum annuum L., X. cylindraceum Sibth. & Sm.

BASIDIOPHORA Roze & Cornu

B. entospora Roze & Cornu on Conyza canadensis (L.) Cronq. (= Erigeron canadensis L.).

BREMIA Regel

B. lactucae Regel on Arctium lappa L., A. minus Bernh., A. tomentosum Miller; Carduus acanthoides L., C. crispus L., C. nutans L., C. personata (L.) Jacq., s.l. subsp. albicans (Adamović) Kazmi; Carlina acaulis L., s.l.; Centaurea cyanus L., C. jacea L., C. mollis Waldst. & Kit., C. nigrescens Willd., C. pannonica (Heuffel) Simonkai subsp. pannonica, C. phrygia L. subsp. phrygia, C. phrygia subsp. carpatica (Porcius) Dostál, C. phrygia subsp. melanocalathia (Borbás) Dostál, C. phrygia subsp. pseudophrygia (C.A. Meyer) Gugler, C. rocheliana (Heuffel) Dostál (= C. banatica Rochel ex Hayek, non A. Kerner), C. solstitialis L., s.l., C. stenolepis A. Kerner subsp. stenolepis, C. triumfetti All.; Cephalorrhynchus tuberosus (Steven) Schschian; Cicerbita alpina (L.) Wallr.; Cirsium arvense (L.) Scop., C. canum (L.) All., C. oleraceum (L.) Scop., C. palustre (L.) Scop., C. rivulare (Jacq.) All., C. vulgare (Savi) Ten.; Crepis biennis L., C. foetida L. subsp. rhoeadifolia (Bieb.) Čelak., C. paludosa (L.) Moench, C. pulchra L., C. sancta (L.) Babcock (= Lagoseris sancta (L.) K. Malý), C. setosa Haller fil.; Dimorphotheca pluvialis Moench (cult.); Gazania rigens (L.) Gaertner (= G. splendens E.G. & A. Henderson); Helichrysum bracteatum (Vent.) Andrews (cult.); Hieracium argillaceum Jordan, s.l., H. aurantiacum L., H. bifidum Kit., H. caesium (Fries) Fries, H. caespitosum Dumort., H. cymosum L., H. ? lactucella Wallr., H. lactucella Wallr. subsp. lactucella, H. murorum L., H. pilosella L. subsp. pilosella, H. pilosella subsp. micradenium Negeli & Peter, H. piloselloides Vill. subsp. piloselloides, H. praealtum Vill. ex Gochant, s.l., H. praealtum subsp. bauhinii (Besser) Petunnikov, H. praealtum subsp. thaumasium (Peter) P.D. Sell, H. rotundatum Kit. & Schultes (= H. transsilvanicum Heuffel), H. umbellatum L.; Hypochoeris radicata L.; Lactuca saligna L., L. sativa L. (cult.), L. serriola L., L. viminea (L.) J. & C. Presl; Lapsana communis L., L. intermedia Bieb.; Leontodon autumnalis L., L. hispidus L., s.l.; Mycelis muralis (L.) Dumort.; Onopordum acanthium L., O. tauricum Willd.; Picris echioides L. (= Helminthia echioides (L.) Gaertner), P. hieracioides L., s.l.; Senecio aquaticus Hill subsp. barbareifolius (Wimmer & Grab.) Walters, S. squalidus L. (= S. rupestris Waldst. & Kit.), S. subalpinus Koch, S. vernalis Waldst. & Kit., S. vulgaris L.; Sonchus arvensis L., s.l., S. arvensis subsp. uliginosus (Bieb.) Nyman, S. asper (L.) Hill subsp. asper, S. asper subsp. glaucescens (Jordan) Ball, S. oleraceus L., S. palustris L., Taraxacum 'officinale Weber'; Xeranthemum annuum L.

BREMIELLA G. Wilson

B. baudysii (Skalický) O. Const. & Negrean on Berula erecta (Hudson) Coville (= Sium erectum Hudson); Oenanthe silaifolia Bieb.; Sium latifolium L.

PERONOSPORA Corda

on BORAGINACEAE

P. asperuginis Schröter on Asperugo procumbens L.

P. cerinthe Uliyanishchev ex Jacz. & P.A. Jacz. on Cerinthe minor L.

P. cynoglossi Burrill ex Swingle on Cynoglossum hungaricum Simonkai.

P. echii (L. Krieger) Jacz. & P.A. Jacz. on Echium vulgare L.

P. echinospermi (Swingle) Swingle on Lappula barbata (Bieb.) Gürke, L. marginata (Bieb.) Gürke (= L. patula (Lehm.) Menyh.), L. squarrosa (Retz.) Dumort. subsp. squarrosa (= L. echinata Fritsch).

P. lithospermi Gäum. on Buglossoides arvensis (L.) I.M. Johnston subsp. arvensis (= Lithospermum arvense L.), B. arvensis subsp. sibthorpiana (Griseb.) R. Fernandes, B. glandulosus (Velen.) R. Fernandes (= Lithospermum glandulosum Velen.).

P. myosotidis de Bary on Myosotis alpestris F.W. Schmidt (cult.), M. arvensis (L.) Hill subsp. arvensis, M. discolor Pers. subsp. discolor (= M. versicolor Sm.), M. ramosissima Rochel subsp. ramosissima, M. scorpioides L. (= M. palustris (L.) Hill), M. sparsiflora Mikan ex Pohl, M. stricta Link ex Roemer & Schultes, M. sylvatica Hoffm subsp. sylvatica.

P. rocheliae Kalimbetov on Rochelia disperma (L. fil.) C. Koch subsp. retorta (Pallas) E. Kotejowa.

P. symphyti Gäum. on Symphytum cordatum Waldst. & Kit., S. nodosum Schur, S. officinale L., s.l., S. officinale subsp. uliginosum (A. Kerner) Nyman, S. ottomanum Friv.

on CAMPANULACEAE

P. phyteumatis Fuckel on Phyteuma vagneri A. Kerner.

on CAPPARIDACEAE

P. parasitica (Pers. : Fr.) Fr. on Cleome spinosa Jacq. (cult.).

on CARYOPHYLLACEAE

P. agrostemmatis Gäum. on Agrostemma githago L.

P. alsinearum Casp. on Stellaria media (L.) Vill.

P. arenariae (Berk.) Tul. on Moehringia trinervia (L.) Clairv.

P. campestris Gäum. on Arenaria serpyllifolia L.

P. conferta (Unger) Unger on Cerastium dubium (Bast.) O. Schwarz (= C. anomalum Waldst. & Kit.), C. fontanum Baumg. subsp. triviale (Link) Jalas.

P. gypsophilae Jacz. & P.A. Jacz. on Gypsophyla muralis L.

P. holostei Casp. ex de Bary on Holosteum umbellatum L., s. l., H. umbellatum subsp. glutinosum (Bieb.) Nyman.

P. lychnitis Gäum. on Lychnis alpina L. (cult.), L. viscaria L.

P. melandrii Gäum. on Silene alba (Miller) E.H.L. Krause, S. noctiflora L., S. otites (L.) Wibel.

P. obovata Bonorden on Spergula arvensis L.; Spergularia marina (L.) Griseb., S. media (L.) C. Presl, S. rubra (L.) J. & C. Presl.

P. parva Gäum. on Stellaria holostea L.

P. scleranthi Rabenh. on Scleranthus annuus L., s.l., S. uncinatus Schur.

P. tomentosa Fuckel on Cerastium arvense L., s.l.(cult.), C. brachypetalum Pers., C. glomeratum Thuill., C. semidecandrum L.

on CHENOPODIACEAE

P. chenopodii-glauci Gäum. on Chenopodium glaucum L.

P. farinosa (Fr.) Fr. on Atriplex hastata L., A. hortensis L. (cult.), A. nitens Schkuhr, A. oblongifolia Waldst. & Kit., A. patula L., A. rosea L., A. tatarica L.; Beta vulgaris L. (cult.); Ceratocarpus arenarius L.; Chenopodium album L., s.l., C. ambrosioides L., C. bonus-henricus L., C. ficifolium L., C. hybridum L., C. murale L., C. opulifolium Schrader ex Koch & Ziz, C. polyspermum L., C. urbicum L., C. vulvaria L.; Halimione verrucifera (Bieb.) Aellen (= Obione verrucifera (Bieb.) Moq.); Kochia scoparia (L.) Schrader (cult.); Spinacia oleracea L. (cult.).

P. vistulensis Wróbl. on Corispermum nitidum Kit.; Salsola kali L., S. kali L. subsp. ruthenica (Iljin) Soó.

on CISTACEAE

P. leptoclada Sacc. on Helianthemum canum (L.) Baumg. subsp.

canum, H. nummularium (L.) Miller, s.l., H. nummularium subsp. nummularium, H. nummularium subsp. obscurum (Čelak.) J. Holub, H. oelandicum (L.) DC. subsp. alpestre (Jacq.) Breistr., H. salicifolium (L.) Miller.

on COMPOSITAE

P. leptosperma de Bary on Anthemis arvensis L., A. austriaca Jacq., A. cotula L.; Artemisia absinthium L., A. annua L.; Chamomilla recutita (L.) Rauschert, C. suaveolens (Pursh) Rydb.; Leucanthemum nipponicum Franch. (= Chrysanthemum nipponicum Matsum.) (cult.); Matricaria perforata Mérat (= M. inodora L.); Tanacetum vulgare L.

P. radii de Bary on Anthemis ruthenica Bieb.; Matricaria perforata Mérat.

on CRUCIFERAE

P. lepidii (McAlp.) G. Wilson on Coronopus squamatus (Forskål) Ascherson; Lepidium densiflorum Schrader, L. ruderale L.

P. niessleana Berl. on Alliaria petiolata (Bieb.) Cavara & Grande.

P. parasitica (Pers. : Fr.) Fr. on Alyssum alyssoides (L.) L., A. desertorum Stapf, A. hirsutum Bieb., A. linifolium Stephan ex Willd., A. minutum Schlecht. ex DC., A. murale Waldst. & Kit., A. petraeum Ard., A. saxatile L.; Arabidopsis thaliana (L.) Heynh.; Arabis alpina L., A. glabra (L.) Bernh., A. hirsuta (L.) Scop., A. turrita L.; Armoracia rusticana P. Gaertner, B. Meyer & Scherb.; Barbarea vulgaris R. Br.; Berteroa incana (L.) DC., Brassica elongata Ehrh. subsp. elongata, B. juncea (L.) Czern. & Coss., B. napus L. (cult.), B. nigra (L.) Koch, B. oleracea L., incl. cvars, B. rapa L., s.l., B. rapa subsp. oleifera DC. (cult.) Bunias orientalis L.; Calepina irregularia (Asso) Thell.; Camelina microcarpa Andrz. ex DC., C. rumelica Velen., C. sativa (L.) Crantz; Capsella bursa-pastoris (L.) Medicus; Cardamine bulbifera (L.) Crantz (= Dentaria bulbifera L.), C. flexuosa With., C. glanduligera O. Schwarz (= Dentaria glandulosa Waldst. & Kit.), C. graeca L., C. hirsuta L., C. impatiens L., C. matthiolii Moretti; Cardaminopsis arenosa (L.) Hayek; Cardaria draba (L.) Desv. subsp. draba; Cheiranthus cheiri L. (cult.); Chorispora tenella (Pallas) DC., Cochlearia pyrenaica DC., var. borzeana Coman & E.I. Nyárády, Conringia orientalis (L.) Dumort.; Descurainia sophia (L.) Webb ex Prantl (= Sisymbrium sophia L.); Diplotaxis muralis L., D. tenuifolia (L.) DC.; Draba nemorosa L.; Erophila verna (L.) Chevall., s.l.; Erucastrum nasturtiifolia (Poiret) O.E. Schulz; Erysimum cheiranthoides L., E. cuspidatum (Bieb.) DC. (= Syrenia cuspidata L.), E. diffusum Ehrh., E. odoratum Ehrh., E. repandum ;, E. witmannii Zawadski, s.l.; Euclidium syriacum (L.) R. Br.; Hesperis matronalis L., s. l., H. sylvestris Crantz subsp. velenovskyi (Fritsch) Borza; Iberis umbellata L.; Isatis tinctoria L., s.l.; Lepidium campestre (L.) R. Br., L. densiflorum Schrader, L. latifolium L., L. perfoliatum L.; Lobularia maritima (L.) Desv. (cult.); Lunaria annua L. subsp. pachyrrhiza (Borbás) Hayek, L. rediviva L.; Matthiola incana (L.) R. Br. subsp. incana (cult.), M. longipetala (Vent.) DC. subsp. bicornis (Sibth. & Sm.) P.W. Ball; Nasturtium officinale R. Br.; Neslia paniculata (L.) Desv., s.l.; Peltaria alliacea Jacq.; Raphanus raphaniastrum L. subsp. raphaniastrum, R. raphaniastrum subsp. landra (Moretti ex DC.) Bonnier & Layens, R. sativus L. (cult.); Rapistrum perenne (L.) All.; Rorippa amphibia (L.) Besser, R. x armoracioides (Tausch) Fuss, R. austriaca (Crantz) Besser, R. islandica (Oeder) Borbás, R. sylvestris (L.) Besser subsp. sylvestris; Sinapis alba L. (cult.), S. arvensis L.; Sisymbrium altissimum L., S. loeselii L., S. officinale (L.) Scop., S. orientale L., S. polymorphum (Murray) Roth, S. strictissimum L.; Syrenia montana (Pallas) Klokov; Thlaspi arvense L., T. perfoliatum L.

on DIPSACACEAE

P. cephalariae-laevigatae Săvul. & Rayss on Cephalaria laevigata (Waldst. & Kit.) Schrader, C. uralensis (J. Murray) Schrader subsp. multifida (Roman) Roman & Beldie.

P. dipsaci Tul. ex de Bary on Dipsacum fullonum L. (= D. sylvestris Hudson), D. laciniatus L., D. sativus (L.) Honckeny (cult.).

P. knautiae Fuckel ex Schröter on Cephalaria transylvanica (L.) Roemer & Schultes; Knautia arvensis (L.) Coulter, K. ? dipsacifolia Kreutzer s.l., K. drymeia Heuffel subsp. drymeia; Scabiosa columbaria L. subsp. columbaria (= S. banatica Waldst. & Kit.), S. lucida Vill. subsp. lucida, S. ochroleuca L.

P. violacea Berk. & Cooke on Knautia arvensis (L.) Coulter (in flowers); Scabiosa columbaria L. (in flowers).

on EUPHORBIACEAE

P. cyparisiae de Bary on Euphorbia amygdaloides L., E. cyparissias L., E. esula L. subsp. tommasiniana (Bertol.) Nyman (= E. virgata auct.).

P. euphorbiae Fuckel on Euphorbia ? serrulata Thuill.

P. valesiaca Gäum. on Euphorbia seguierana Necker (= E. gerardiana Jacq.).

on GENTIANACEAE

P. erythraeae Kühn ex Gäum. on Centaurium erythraea Rafn subsp. erythraea, C. pulchellum (Swartz) Druce.

on GERANIACEAE

P. conglomerata Fuckel on Erodium ciconium (L.) L'Hér., E. cicutarium (L.) L'Hér., E. hoefftianum C.A. Meyer (incl. E. neilreichii Janka); Geranium columbinum L., G. dissectum L., G. lucidum L., G. molle L., G. phaeum L., G. pusillum L., G. robertianum L., G. sylvaticum L.

on LABIATAE

P. lamii A. Braun on Acinos alpinus (L.) Moench subsp. alpinus, A. alpinus subsp. majoranifolius (Miller) P.W. Ball, A. arvensis (Lam.) Dandy; Lamium album L., L. amplexicaule L., L. garganicum L. subsp. laevigatum Arcangeli (= L. bithynicum Bentham), L. maculatum L., L. purpureum L.; Leonurus marrubiastrum L.; Stachys palustris L.; Ziziphora capitata L.

P. stigmaticola Raunkiaer on Mentha longifolia (L.) Hudson (in flowers).

on LEGUMINOSAE

P. aestivalis H. Sydow in Gäum. on Medicago falcata L., M. sativa L. (cult.); Melilotus alba Medicus, M. officinalis (L.) Pallas.

P. astragalina H. Sydow on Astragalus cicer L., A. hamosus L., A. onobrychis L.

P. coronillae Gäum. on Coronilla scorpioides (L.) Koch, C. varia L.

P. ervi A. Gust. on Vicia hirsuta (L.) S.F. Gray.

P. lotorum H. Sydow on Lotus tenuis Waldst. & Kit. ex Willd.

P. manshurica (Naum.) H. Sydow on Glycine max (L.) Merr. (cult.).

P. medicaginis-minimae Gaponenko on Medicago lupulina L., M. minima (L.) Bartal.

P. senneniana Frag. & Sacc. on Lathyrus niger (L.) Bernh. subsp. niger, L. palustris L., L. tuberosus L.

P. tetragonolobi Gäum. on Tetragonolobus maritimus (L.) Roth (= T. siliquosus (L.) Roth).

P. trifoliorum de Bary on Trifolium alpestre L., T. arvense L., T. badium L., T. campestre Schreber, T. dubium Sibth., T. echinatum Bieb., T. hybridum L., T. hybridum subsp. elegans (Savi) Ascherson & Graebner, T. medium L., s.l., T. medium subsp. banaticum (Heuffel) Hendrych, T. montanum L., T. pratense L. (cult.), T. repens L., T. spadiceum L., T. striatum L.

P. viciae (Berk.) Casp. on Galega officinalis L.; Lathyrus cicera L., L. hirsutus L., L. nissolia L., L. sphaericus Retz., L. sylvestris L.; Pisum sativum L. subsp. sativum (cult.); Vicia angustifolia L., V. cracca L., V. grandifolia Scop., V. lathyroides L., V. lutea L. subsp. lutea, V. narbonensis L., V. pannonica Crantz, s.l., V. pannonica subsp. striata (Bieb.) Nyman, V. peregrina L., V. pisiformis L., V. sativa L. (cult.), V. sepium L., V. tetrasperma L., V. villosa Roth.

on LILIACEAE

P. destructor (Berk.) Casp. in Berk. on Allium cepa L. (cult.), A. fistulosum L. (cult.).

on LINACEAE

P. lini Schröter on Linum catharticum L.

on PAPAVERACEAE

P. affinis Rossm. on Fumaria officinalis L., F. schleicheri Soyer-Willemet, F. vaillantii Loisel.

P. arborescens (Berk.) Casp. on Papaver dubium L., P. rhoeas L., P. somniferum L. (cult.).

P. corydalis de Bary on Corydalis bulbosa (L.) DC. subsp. marschalliana (Pallas) Chater, C. solida (L.) Schwarz; Glaucium corniculatum (L.) J.H. Rudolph.

P. cristata Tranzschel on Papaver hybridum L.

P. corydalis-intermediae Gäum. on Corydalis capnoides (L.) Pers.

on PLANTAGINACEAE

P. alta Fuckel on Plantago altissima L., P. cornuti Gouan, P. lanceolata L., P. major L., s.l., P. major subsp. intermedia (DC) Arcangeli, P. media L., s.l.

P. plataginis Burrill on P. arenaria Waldst. & Kit. (= P.

indica L.), P. major L., s.l.

on PLUMBAGINACEAE

P. statices Lobik on Limonium gmelinii (Willd.) Kuntze, L. vulgare Miller subsp. serotinum (Reichenb.) Gams (= Statice limonium L.)

on POLYGONACEAE

P. ducometii Siem. & Jank. on Fagopyrum esculentum Moench (cult.).

P. polygoni Thüm. ex A. Fischer on Polygonum arenarium Waldst. & Kit. subsp. arenarium, P. aviculare L.

P. polygoni-convolvuli A. Gust. on Bilderdykia convolvulus (L.) Dumort.

P. rumicis Corda on Rumex acetosa L., R. acetosella L., R. alpestris Jacq. (= R. arifolius All.), R. tuberosus L. subsp. tuberosus.

on PRIMULACEAE

P. androsaces Niessl on Androsace elongata L.; Primula veris L.

on RANUNCULACEAE

P. ficariae Tul. ex de Bary on Helleborus purpurascens Waldst. & Kit.; Ranunculus acris L. subsp. acris, R. acris subsp. strigulosus (Schur) Hyl. (= R. stevenii auct.), R. bulbosus L. subsp. bulbosus, R. cassubicus L., R. carpaticus Herbich, R. constantinopolitanus (DC.) D'Urv., R. crenatus Waldst. & Kit., R. ficaria L., R. flammula L., s.l., R. lateriflorus DC., R. oreophilus Bieb., R. oxyspermus Willd., R. pedatus Waldst. & Kit., R. platanifolius L., R. polyanthemos L. subsp. polyanthemos, R. pseudomontanus Schur, R. repens L., R. sardous Crantz.

P. illyrica Gäum. on Ranunculus illyricus L.

P. parvula A. Schneider ex Jacz. & P.A. Jacz. on Isopyrum thalictroides L.

on RESEDACEAE

P. crispula Fuckel on Reseda lutea L., R. phyteuma L.

on ROSACEAE

P. potentillae de Bary on Potentilla aurea L. subsp. aurea, P. aurea L. subsp. chrysocraspeda (Lehm.) Nyman (= P. ternata C. Koch).

P. sparsa Berk. ex Berk & Broome on Alchemilla glabra Neygenf., A. 'hybrida' auct., A. 'vulgaris' auct., A. xanthochlora Rothm.; Aremonia agrimonoides (L.) DC. subsp. agrimonoides; Fragaria vesca L.; Geum aleppicum Jacq., G. coccineum Sibth. & Sm. (cult.), G. rivale L., G. urbanum L.; Potentilla anserina L., P. reptans L.; Rosa gallica L.; Rubus caesius L., R. canescens DC., R. hirsutus Waldst. & Kit., R. idaeus L.; Sanguisorba minor Scop.

on RUBIACEAE

P. calotheca de Bary on Asperula purpurea (L.) Ehrend. subsp. purpurea (= Galium purpureum L.); Cruciata pedemontana (Bellardi) Ehrend. (= Galium pedemontanum (Bellardi) All.).; Galium album Miller, G. aparine L., G. boreale L., G. divaricatum Pourret ex Lam., G. humifusum Bieb., G. mollugo L., G. odoratum Scop. (= Asperula odorata L.), G. palustre L., G. rubioides L., G. schultesii Vest., G. spurium L., G. tricornutum Dandy, G. verum L. subsp. verum.

P. sherardiae Fuckel on Sherardia arvensis L.

on SAXIFRAGACEAE

P. chrysosplenii Fuckel on Chrysosplenium alternifolium L.

on SCROPHULARIACEAE

P. grisea (Unger) Unger on Chaenorrhinum minus (L.) Lange subsp. minus; Digitalis grandiflora Miller; Euphrasia pectinata Ten.; Linaria genistifolia (L.) Miller subsp. genistifolia, L. vulgaris Miller; Veronica anagallis-aquatica L., V. anagalloides Guss., V. becccabunga L., V. catenata Pennell (= V. aquatica Bernh., non S.F. Gray), V. officinalis L., V. scardica Griseb., V. scutellata L., V. serpyllifolia L., V. serpyllifolia subsp. humifusa (Dickson) Syme, V. spicata L. subsp. spicata, V. urticifolia Jacq.

P. melampyri (Bucholtz) J. Davis on Linaria genistifolia (L.) Miller subsp. genistifolia , L. vulgaris Miller (in flowers); Malampyrum arvense L., M. cristatum L., M. saxosum Baumg.; Rhinanthus rumelicus Velen.

P. sordida Berk. & Broome on Scrophularia nodosa L., S. scopolii Hoppe; Verbasum banaticum Schrader, V. blattaria L., V. densiflorum Bertol. (= V. thapsiforme Schrader) (cult.), V. glabratum Frib. subsp. glabratum, V. nigrum L., s.l., V. phlomoides L., V. speciosum Schrader, V. thapsus L., s.l., V. thapsus subsp. crassifolium (Lam.) Murb. (= V. montanum Schrader); Veronica arvensis L., V. austriaca L. subsp. teucrium (L.) D.A. Webb (= V. teucrium L.), V. chamaedrys L., s.l., V. hederifolia L., V. persica Poiret, V. polita Fries (= V. didyma auct., vix Ten.), V. praecox All., V. prostrata L.

on SOLANACEAE

P. **hyoscyami** de Bary on Hyoscyamus niger L.

P. **tabacina** Adam on cultivated Nicotiana alata Link & Otto, N. ipomopsiflora Dun., N. langsdorfii Schrank, N. longiflora Cav., N. nodiflora Cav., N. paniculata L., N. rustica L., N. suaveolens Lehm., N. tabacum L.

on URTICACEAE

P. **debaryi** E. Salmon & Ware on Urtica urens L.

on VALERIANACEAE

P. **valerianae** Trail on Valeriana officinalis L.

P. **valerianellae** Fuckel on Valerianella dentata Pollich, V. lasiocarpa (Steven) Betcke, V. locusta (L.) Letterade, V. pumila (L.) DC., V. rimosa Bast.

on VIOLACEAE

P. **violae** de Bary ex Schröter on Viola arvensis Murray, V. kitaibeliana Schultes, V. tricolor L. subsp. tricolor.

on ZYGOPHYLLACEAE

P. **tribulina** Pass. on Tribulus terrestris L.

PLASMOPARA Schröter

P. **densa** (Rabenh.) Schröter on Euphrasia rostkoviana Hayne, s.l., E. stricta D. Wolff ex J.F. Lehm.; Odontites verna (Bellardi) Dumort., s.l.; Rhinanthus alpinus Baumg., R. angustifolius C.C. Gmelin, R. minor L., R. rumelicus Velen., R. wagneri Degen.

P. **epilobii** (Otth) Sacc. & Sydow on Epilobium hirsutum L., E. palustre L., E. parviflorum Schreber, E. roseum Schreber, E. tetragonum L. subsp. lamyi (F.W. Schultz) Nyman.

P. **halstedii** (Farlow) Berl. & de Toni on Carthamus tinctorius L. (cult.); Dimorphotheca sinuata DC. (cult.); Helianthus annuus L. (cult.); Xanthium italicum Moretti, X. strumarium L.

P. **obducens** (Schröter) Schröter on Impatiens noli-tangere L.

P. **pusilla** (de Bary) Schröter on Geranium pratense L., G.

sylvaticum L.

P. pygmaea (Unger) Schröter on Anemone nemorosa L., A. ranunculoides L.; Helleborus odorus Waldst. & Kit. subsp. odorus , H. purpurascens Waldst. & Kit.; Isopyrum thalictroides L.

P. skvortzovii Miura on Abutilon theophrasti Medicus.

P. sphaerosperma Săvul. on Tragopogon dubius Scop.

P. umbelliferarum (Casp.) Schröter ex Wartenw. on Aegopodium podagraria L.; Ammi majus L. (cult.); Angelica archangelica L., A. sylvestris L.; Anthriscus nitida (Wahlenb.) Garcke, A. sylvestris (L.) Hoffm.; Apium graveolens L. (cult.); Caucalis platycarpos L.; Conium maculatum L.; Daucus carota L. (cult.); Ferulago campestris (Besser) Grec.; Foeniculum vulgare Miller (cult.); Laserpitium latifolium L.; Levisticum officinale Koch (cult.); Ligusticum mutellina (L.) Crantz; Meum athamanticum Jacq,; Pastinaca sativa L., s.l. (spont. & cult.); Petroselinum crispum (Miller) A.W. Hill (cult.); Peucedanum alsaticum L., P. austriacum (Jacq.) Koch, P. palustre (L.) Moench; Pimpinella major (L.) Hudson, P. saxifraga L.; Sanicula europaea L.; Silaum silaus (L.) Schinz & Thell.; Smyrnium perfoliatum L.

P. viticola (Berk. & M.A. Curtis) Berl. & de Toni on Vitis vinifera L. subsp. vinifera (cult.), V. vinifera subsp. sylvestris (C.C. Gmelin) Hegi, V. vinifera x American species (cult.).

PSEUDOPERONOSPORA Rostovtsev

P. cannabina (Otth) Curzi on Cannabis ruderalis Janisch., C. sativa L. (cult.).

P. cubensis (Berk. & M.A. Curtis) Rostovtsev on Cucumis melo L. (cult.), C. sativus L. (cult.)

P. humuli (Miyabe & Takahashi) G. Wilson on Humulus lupulus L. (cult. & spont.).

P. urticae (Lib. ex Berk.) E. Salmon & Ware on Urtica dioica L., U. kioviensis Rogow.

SCLEROSPORA Schröter

S. graminicola (Sacc.) Schröter on Setaria italica (L.) Beauv., S. verticillata (L.) Beauv., S. viridis (L.) Beauv.

HOST-FUNGUS INDEX

Host trinomials refer to subspecies. Whenever consecutive host species are parasitized by the same fungus, the fungal name is only mentioned after the last host listed. The following abbreviations are used throughout for fungal generic and specific epithets: *A.* = *Albugo*; *B.* = *Bremia*; *Ba.* = *Basidiophora*; *Bl.* = *Bremiella*; *P.* = *Peronospora*; *Pl.* = *Plasmopara*; *Ps.* = *Pseudoperonospora*; *S.* = *Sclerospora*; *cand.* = *candida*; *lact.* = *lactucae*; *paras.* = *parasitica*; *trag.* = *tragopogonis*; *umbel.* = *umbelliferarum*.

ABUTILON theophrasti: *Pl. skvortzovii*. ACINOS alpinus alpinus, alpinus majoranifolius, arvensis: *P. lamii*. AEGOPODIUM podagraria: *Pl. umbel.* AGROSTEMMA githago: *P. agrostemmatis*. ALCHEMILLA glabra, 'hybrida', 'vulgaris', xanthochlora: *P. sparsa*. ALLIARIA petiolata: *P. niessleana*. ALLIUM cepa, fistulosum: *P. destructor*. ALYSSUM alyssoides: *A. cand.*, *P. paras.*; borzeanum, caliacrae: *A. cand.*; desertorum, hirsutum, linifolium, minutum, murale, petraeum, saxatile: *A. cand.*, *P. paras.*; tortuosum: *A. cand.* AMARANTHUS albus, blitoides, ? bouchonii, graecizans, hybridus, lividus, retroflexus: *A. bliti*. AMBROSIA artemisiifolia: *A. trag.* AMMI majus: *Pl. umbel.* ANDROSACE elongata: *P. androsaces*. ANEMONE nemorosa, ranunculoides: *Pl. pygmaea*. ANGELICA archangelica, sylvestris: *Pl. umbel.* ANTHEMIS arvensis, austriaca, cotula: *P. leptosperma*; ruthenica: *P. radii*. ANTHRISCUS nitida, sylvestris: *Pl. umbel.* APIUM graveolens: *Pl. umbel.* ARABIDOPSIS thaliana: *A. cand.*, *P. paras.* ARABIS alpina, glabra, hirsuta: *A. cand.*, *P. paras.*; muralis, procurrens, recta, sagittata: *A. cand.*; turrita: *A. cand.*, *P. paras.* ARCTIUM lappa, minus, tomentosum: *B. lact.* AREMONIA agrimonoides agrimonoides: *P. sparsa*. ARENARIA serpyllifolia: *P. campestris*. ARMORACIA rusticana: *A. cand.*, *P. paras.* ARTEMISIA absinthium, annua: *P. leptosperma*; vulgaris: *A. trag.* ASPERUGO procumbens: *P. asperuginis*. ASPERULA purpurea: *P. calotheca*. ASTRAGALUS cicer, hamosus, onobrychis: *P. astragalina*. ATRIPLEX hastata, hortensis, nitens, oblongifolia, patula, rosea, tatarica: *P. farinosa*. BARBAREA vulgaris: *A. cand.*, *P. paras.* BERTEROA incana: *A. cand.*, *P. paras.* BERULA erecta: *Bl. baudysii*. BETA vulgaris: *P. farinosa*. BILDERDYKIA convolvulus: *P. polygoni-convolvuli*. BISCUTELLA laevigata: *A. cand.* BRASSICA elongata elongata, juncea, napus, nigra, oleracea, rapa, rapa oleifera: *A. cand.*, *P. paras.* BUGLOSSOIDES arvensis arvensis, arvensis sibthorpiana, glandulosus: *P. lithospermi*. BUNIAS orientalis: *A. cand.*, *P. paras.* CALEPINA irregularis: *A. cand.*, *P. paras.* CAMELINA microcarpa, rumelica, sativa: *A. cand.*, *P. paras.* CANNABIS ruderalis, sativa: *Ps. cannabina*. CAPSELLA bursa-pastoris: *A. cand.*, *P. paras.* CARDAMINE amara: *A. cand.*; bulbifera, flexuosa, glanduligera, graeca: *P. paras.*; hirsuta: *A. cand.*, *P. paras.*; impatiens: *P. paras.*; matthiolli: *A. cand.*, *P. paras.*; pratensis: *A. cand.* CARDAMINOPSIS arenosa: *A. cand.*, *P. paras.*; halleri halleri, halleri ovirensis, neglecta: *A. cand.* CARDARIA draba: *A. cand.*, *P. paras.* CARDUUS acanthoides, crispus, nutans, personata albicans: *B. lact.* CARLINA acaulis: *B. lact.* CARTHAMUS tinctorius: *Pl. halstedii*. CAUCALIS platycarpos: *Pl. umbel.* CENTAUREA atropurpurea: *A. trag.*; cyanus, jacea: *B. lact.*; kotschyana: *A. trag.*; mollis, nigrescens: *B. lact.*; orientalis: *A. trag.*; pannonica pannonica, phrygia carpatica, phrygia melanocalathia, phrygia phrygia, phrygia pseudophrygia, rocheliana: *B. lact.*; ? scabiosa: *A. trag.*; solstitialis, stenolepis, triumfetti: *B. lact.* CENTAURIUM erythraea erythraea, pulchellum: *P. erythraeae*. CEPHALARIA laevigata: *P. cephalariae-*

laevigatae; transylvanica: *P. knautiae*; uralensis multifida: *P. cephalariae-laevigatae*. CEPHALORRHYNCHUS tuberosus: *B. lact*. CERASTIUM arvense, brachypetalum: *P. tomentosa*; dubium, fontanum triviale: *P. conferta*; glomeratum, semidecandrum: *P. tomentosa*. CERATOCARPUS arenarius: *A. eurotiae*, *P. farinosa*. CERINHTE minor: *P. cerinthe*. CHAENORRHINUM minus: *P. grisea*. CHAMOMILLA recutita: *P. leptosperma*; suaveolens: *A. trag.*, *P. leptosperma*. CHEIRANTHUS cheiri: *A. cand.*, *P. paras*. CHENOPODIUM album, ambrosioides, bonus-henricus, ficifolium: *P. farinosa*; glaucum: *P. chenopodii-glauci*; hybridum, murale, opulifolium, polyspermum, urbicum, vulvaria: *P. farinosa*. CHORISPORA tenella: *A. cand.*, *P. paras*. CHRYSOSPLENIUM alternifolium: *P. chrysosplenii*.CICERBITA alpina: *B. lact*. CIRSIUM alatum: *A. trag.*; arvense, canum: *A. trag.*, *B. lact.*; erisithales: *A. trag.*; oleraceum: *A. trag.*, *B. lact.*; palustre: *B. lact.* rivulare, vulgare: *A. trag.*, *B. lact*. CLEOME spinosa: *A. cand.*, *P. paras*. COCHLEARIA pyrenaica var. borzeana: *P. paras*. CONIUM maculatum: *P. umbel*. CONRINGIA orientalis: *A. cand.*, *P. paras*. CONYZA canadensis: *Ba. entospora*. CORISPERMUM nitidum: *P. vistulensis*. CORONILLA scorpioides, varia: *P. coronillae*. CORONOPUS squamatus: *A. cand.*, *P. lepidii*. CORIDALIS bulbosa marschalliana: *P. corydalis*; capnoides: *P. corydalis-intermediae*; solida: *P. corydalis*. CREPIS biennis, foetida rhoeadifolia, paludosa, pulchra: *B. lact.*; sancta: *A. trag.*, *B. lact.*; setosa: *B. lact*. CRUCIATA pedemontana: *P. calotheca*. CRUPINA vulgaris: *A. trag*. CUCUMIS melo, sativus: *Ps. cubensis*. CYNOGLOSSUM hungaricum: *P. cynoglossi*. DAUCUS carota: *Pl. umbel*. DESCURAINIA sophia: *A. cand.*, *P. paras*. DIGITALIS grandiflora: *P. grisea*. DIMORPHOTHECA pluvialis: *B. lact.*; sinuata: *Pl. halstedii*. DIPLOTAXIS muralis: *A. cand.*, *P. paras.*; tenuifolia: *P. paras*. DRABA lasiocarpa: *A. cand.*; nemorosa: *P. paras*. DIPSACUS fullonum, laciniatus, sativus: *P. dipsaci*. ECHIUM vulgare: *P. echii*. EPILOBIUM hirsutum, palustre, parviflorum, roseum, tetragonum: *Pl. epilobii*. ERODIUM ciconium, cicutarium, hoefftianum: *P. conglomerata*. EROPHILA verna s.l.: *P. paras.*; verna verna: *A. cand.*ERUCASTRUM nasturtiifolia: *P. paras*. ERYSIMUM cheiranthoides: *A. cand.*, *P. paras.*; comatum, crepidifolium: *A. cand.*; cuspidatum, diffusum, odoratum, repandum, witmannii: *A. cand.*, *P. paras*. EUCLIDIUM syriacum: *A. cand.*, *P. paras*. EUPHORBIA amygdaloides, cyparissias, esula tommasiniana: *P. cyparissiae*; seguierana: *P. valesiaca*; ? serrulata: *P. euphorbiae*. EUPHRASIA pectinata: *P. grisea*; rostkoviana, stricta: *Pl. densa*. FAGOPYRUM esculentum: *P. ducometii*.FERULAGO campestris: *Pl. umbel*. FILAGO vulgaris: *A. trag*. FOENICULUM vulgare: *Pl. umbel*. FRAGARIA vesca: *P. sparsa*. FUMARIA officinalis, schleicheri, vaillantii: *P. affinis*. GALEGA officinalis: *P. viciae*. GALIUM album, aparine, boreale, divaricatum, humifusum, mollugo, odoratum, palustre, rubioides, schultesii, spurium, tricornutum, verum verum: *P. calotheca*. GAZANIA rigens: *B. lact*. GERANIUM columbinum, dissectum, lucidum, molle, phaeum: *P. conglomerata*; pratense: *Pl. pusilla*; pusillum, robertianum: *P. conglomerata*; sylvaticum: *P. conglomerata*, *Pl. pusilla*. GEUM aleppicum, coccineum, rivale, urbanum: *P. sparsa*. GLAUCIUM corniculatum: *P. corydalis*. GLYCINE max: *P. manshurica*. GYPSOPHILA muralis: *P. gypsophilae*. HALIMIONE verrucifera: *P. farinosa*. HELIANTHEMUM canum canum, nummularium s.l., nummularium nummularium, nummularium obscurum , oleandicum alpestre, salicifolium: *P. leptoclada*. HELIANTHUS annuus : *Pl. halstedii*. HELICHRYSUM bracteatum: *B. lact*. HELLEBORUS odorus odorus: *Pl. pygmaea*; purpurascens: *P. ficariae*, *Pl. pygmaea*. HESPERIS matronalis: *A. cand.*, *P. paras.*; sylvestris velenovskyi: *P. paras*. HIERACIUM argillaceum, aurantiacum, bifidum, caesium, caespitosum, cymosum, ? lactucella, lactucella lactucella, murorum, pilosella micradenium, pilosella pilosella, piloselloides piloselloides, praealtum s.l., praealtum bauhinii, praealtum thaumasium, rotundatum, umbellatum: *B.*

lact. HOLOSTEUM umbellatum s.l., umbellatum glutinosum: *P. holostei.* HORNUNGIA petraea: *A. cand.* HUMULUS lupulus: *Ps. humuli.* HUTCHINSIA alpina brevicaulis: *A. cand.* HYMENOLOBUS procumbens: *A. cand.* HYOSCYAMUS niger: *P. hyoscyami.* HYPOCHOERIS radicata: *B. lact.* IBERIS saxatilis: *A. cand.*; umbellata: *A. cand., P. paras.* IMPATIENS noli-tangere: *Pl. obducens.* INULA britannica, conyza, salicina: *A. trag.* ISATIS tinctoria: *A. cand., P. paras.* ISOPYRUM thalictroides: *P. parvula, Pl. pygmaea.* KNAUTIA arvensis: *P. knautiae, P. violacea*; ? dipsacifolia, drymeia drymeia: *P. knautiae.* KOCHIA scoparia: *P. farinosa.* LACTUCA saligna, sativa, serriola, viminea: *B. lact.* LAMIUM album, amplexicaule, garganicum laevigatum, maculatum, purpureum: *P. lamii.* LAPPULA barbata, marginata, squarrosa: *P. echinospermi.* LAPSANA communis, intermedia: *B. lact.* LASERPITIUM latifolium: *Pl. umbel.* LATHYRUS cicera, hirsutus: *P. viciae*; niger: *P. senneniana*; nissolia: *P. viciae*; palustris: *P. senneniana*; sphaericus, sylvestris: *P. viciae*; tuberosus: *P. senneniana.* LEONTODON autumnalis, hispidus s.l.: *B. lact.* LEONURUS marrubiastrum: *P. lamii.* LEPIDIUM campestre: *A. cand., P. paras.*; cartilagineum crassifolium: *A. cand.*; densiflorum: *A. cand., P. lepidii, P. paras.*; latifolium, perfoliatum: *A. cand., P. paras.*; ruderale: *A. cand., P. lepidii.* LEUCANTHEMUM nipponicum: *P. leptosperma.* LEVISTICUM officinale: *Pl. umbel.* LIGUSTICUM mutellina: *Pl. umbel.* LIMONIUM gmelinii, vulgare serotinum: *P. staticis.* LINARIA genistifolia genistifolia, vulgaris: *P. grisea, P. melampyri.* LINUM catharticum: *P. lini.* LOBULARIA maritima: *P. paras.* LOGFIA arvensis: *A. trag.* LOTUS tenuis: *P. lotorum.* LUNARIA annua pachyrrhiza: *A. cand., P. paras.*; rediviva: *P. paras.* LYCHNIS alpina, viscaria: *P. lychnitis.* MATRICARIA perforata: *P. leptosperma, P. radii.* MATTHIOLA incana incana, longipetala bicornis: *P. paras.* MEDICAGO falcata: *P. aestivalis*; lupulina, minima: *P. medicaginis-minimae*; sativa: *P. aestivalis.* MELAMPYRUM arvense, cristatum, saxosum: *P. melampyri.* MELILOTUS alba, officinalis: *P. aestivalis.* METHA longifolia: *P. stigmaticola.* MEUM athamanticum: *Pl. umbel.* MOEHRINGIA trinervia: *P. arenariae.* MYCELIS muralis: *B. lact.* MYOSOTIS alpestris, arvensis arvensis, discolor discolor, ramosissima ramosissima, scorpioides, sparsiflora, stricta, sylvatica sylvatica: *P. myosotidis.* NASTURTIUM officinale: *P. paras.* NESLIA paniculata s.l.: *A. cand., P. paras.* NICOTIANA alata, ipomopsifolia, langsdorfii, longiflora, nodiflora, paniculata, suaveolens, tabacum: *P. tabacina.* ODONTITES verna s.l.: *Pl. densa.* OENANTHE silaifolia: *Bl. baudysii.* ONOPORDON acanthium, tauricum: *B. lact.* PAPAVER dubium: *P. arborescens*; hybridum: *P. cristata*; rhoeas, somniferum: *P. arborescens.* PASTINACA sativa: *Pl. umbel.* PELTARIA alliacea: *P. paras.* PETROSELINUM crispum: *Pl. umbel.* PEUCEDANUM alsaticum, austriacum, palustre: *Pl. umbel.* PHYTEUMA vagneri: *P. phyteumatis.* PICRIS echioides, hieracioides s.l.: *B. lact.* PIMPINELLA major, saxifraga: *Pl. umbel.* PISUM sativum sativum: *P. viciae.* PLANTAGO altissima: *P. alta*; arenaria: *P. plantaginis*; cornuti, lanceolata: *P. alta*; major: *P. alta, P. plantaginis*; major intermedia, media s.l.: *P. alta.* POLYGONUM arenarium arenarium, aviculare: *P. polygoni.* PORTULACA oleracea oleracea, oleracea sativa: *A. portulacae.* POTENTILLA anserina: *P. sparsa*: aurea aurea, aurea chrysocraspeda: *P. potentillae*; reptans: *P. sparsa.* PRIMULA veris: *P. androsaces.* RANUNCULUS acris acris, acris strigulosus, bulbosus, cassubicus, carpaticus, constantinopolitanus, crenatus, ficaria, flammula: *P. ficariae*; illyricus: *P. illyrica*; lateriflorus, oreophilus, oxyspermus, pedatus, platanifolius, polyanthemos polyanthemos, pseudomontanus, repens, sardous: *P. ficariae.* RAPHANUS raphanistrum raphanistrum: *A. cand., P. paras.*; raphanistrum landra: *P. paras.*; sativus: *A. cand., P. paras.* RAPISTRUM perenne: *P. paras.* RESEDA lutea, phyteuma: *P. crispula.* RHINANTHUS alpinus, angustifolius, minor: *Pl. densa*; rumelicus: *P. melampyri, Pl. den-*

sa; wagneri: *Pl. densa*. ROCHELIA disperma retorta: *P. rocheliae*. RORIPPA amphibia: *A. cand.*, *P. paras.*; x armoracioides: *P. paras.*; austriaca, islandica: *A. cand.*, *P. paras.*; pyrenaica: *A. cand.*; sylvestris sylvestris: *A. cand.*, *P. paras.*; sylvestris kerneri: *A. cand.* ROSA gallica: *P. sparsa*. RUBUS caesius, canescens, hirtus, idaeus: *P. sparsa*. RUMEX acetosa, acetosella, alpestris, tuberosus tuberosus: *P. rumicis*. SALSOLA kali s.l., kali ruthenica: *P. vistulensis*. SANGUISORBA minor: *P. sparsa*. SANICULA europaea: *Pl. umbel*. SCABIOSA columbaria columbaria: *P. knautiae*; columbaria s.l.: *P. violacea*; lucida lucida, ochroleuca: *P. knautiae*. SCLERANTHUS annuus, uncinatus: *P. scleranthi*. SCORZONERA cana, hispanica, laciniata: *A. trag*. SCROPHULARIA nodosa, scopoli: *P. sordida*. SENECIO aquaticus barbareifolius, squalidus, subalpinus: *B. lact.*; vernalis: *A. trag.*, *B. lact.*; vulgaris: *B. lact*. SERRATULA tinctoria: *A. trag*. SETARIA italica, verticillata, viridis: *S. graminicola*. SHERARDIA arvensis: *P. sherardiae*. SILAUM silaus: *Pl. umbel*. SILENE alba, noctiflora, otites: *P. melandrii*. SINAPIS alba, arvensis: *A. cand.*, *P. paras*. SISYMBRIUM altissimum, loeselii, officinale, orientale, polymorphum: *A. cand.*, *P. paras.*; strictissimum: *P. paras*. SIUM latifolium: *Bl. baudysii*. SMYRNIUM perfoliatum: *Pl. umbel*. SONCHUS arvensis s.l., arvensis uliginosus, asper, asper glaucescens, oleraceus, palustris: *B. lact*. SPERGULA arvensis: *P. obovata*. SPERGULARIA marina, media: *A. caryophyllacearum*, *P. obovata*; rubra: *P. obovata*. SPINACIA oleracea: *P. farinosa*. STACHYS palustris: *P. lamii*. STELLARIA holostea: *P. parva*; media s.l.: *alsinearum*. SYMPHYTUM cordatum, nodosum, officinale s.l., officinale uliginosum, ottomanum: *P. symphyti*. SYRENIA cana: *A. cand.*; montana: *A. cand.*, *P. paras*. TANACETUM vulgare: *P. leptosperma*. TARAXACUM 'officinale': *B. lact*. TETRAGONOLOBUS maritimus: *P. tetragonolobi*. THLASPI arvense, perfoliatum: *A. cand.*, *P. paras*. TRAGOPOGON dubius: *A. trag.*, *Pl. sphaerosperma*; porrifolius, pratensis s.l.: *A. trag*. TRIBULUS terrestris: *P. tribulina*. TRIFOLIUM alpestre, arvense, badium, campestre, dubium, echinatum, hybridum s.l., hybridum elegans, medium s.l., medium banaticum, montanum, pratense, repens, spadiceum, striatum: *P. trifoliorum*. URTICA dioica, kioviensis: *Ps. urticae*; urens: *P. debaryi*. VALERIANA officinalis: *P. valerianae*. VALERIANELLA dentata, lasiocarpa, locusta, pumila, rimosa: *P. valerianellae*. VERBASCUM banaticum, blattaria, densiflorum, glabratum glabratum, nigrum s.l., phlomoides, speciosum, thapsus s.l., thapsus crassifolium: *P. sordida*. VERONICA anagallis-aquatica, anagalloides: *P. grisea*; arvensis, austriaca teucrium: *P. sordida*; beccabunga, catenata: *P. grisea*; chamaedrys s.l., hederifolia: *P. sordida*; officinalis: *P. grisea*; persica, polita, praecox, prostrata: *P. sordida*; scardica, scutellata, serpyllifolia serpyllifolia, serpyllifolia humifusa, spicata spicata, urticifolia: *P. grisea*. VICIA angustifolia, cracca, grandiflora: *P. viciae*; hirsuta: *P. ervi*; lathyroides, lutea lutea, narbonensis, pannonica s.l., pannonica striata, peregrina, pisiformis, sativa, sepium, tetrasperma, villosa: *P. viciae*. VIOLA arvensis, kitaibeliana, tricolor tricolor: *P. violae*. VITIS vinifera sylvestris, vinifera vinifera, vinifera x American species: *Pl. viticola*. XANTHIUM ? italicum, strumarium: *Pl. halstedii*.XERANTHEMUM annuum: *A. trag.*, *B. lact.*; cylindraceum: *A. trag*. ZIZIPHORA capitata: *P. lamii*.

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SARCINULELLA BANKSIAE GEN. ET SP. NOV., A COELOMYCETE WITH A UNIQUE METHOD OF CONIDIAL DISPERSAL

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SUMMARY

Sarcinulella banksiae gen. et sp. nov. is described and illustrated from bark of *Banksia integrifolia* collected in Queensland. The genus is characterized by pycnidial conidiomata and phialidic hyaline aseptate conidia. Tendrils issuing from the ostiole are comprised of catenate sacci of mucilage each containing 40 or more conidia. The individual sacci retain their integrity during dispersal. Periphyses lining the base of the ostiolar channel are thought to be involved in saccus formation.

Amongst many interesting collections of microfungi made in Queensland following the XIII International Botanical Congress in Sydney, Australia, 1981, was a minute coelomycete. This proved to have a conidial dispersal method previously unknown in the Deuteromycotina.

Sarcinulella gen. nov.

(etym. *sarcinula* (L) - a little pack or bundle + *ella* (L) diminutive)

Mycelium immersum. Conidiomata conica, separata, superficialia vel semi-immersa, atro brunnea vel nigra; parietes crassi, ex textura angulari brunnea sed in regione ostioli ex textura porrecta verticali compositi; ostiolum centrale, circulare, canali cylindrico ad basim periphysibus instructi. Conidiophora absentia. Cellulae conidiogenae discretae, determinatae, hyalinae, cylindricae, canalibus apicalibus phialidicis conspicuis, spissescentibus periclinalibus distinctis sed collis notatis absentibus , ex parietibus basalibus et lateralibus conidiomatorum formatae. Conidia phialidica, hyalina, aseptata, laevia, (1)-2 guttulata, ellipsoidea; plus 40 conidia in saccis cylindricis aggregata, in catenis longis nonramosis e ostiolo emergentia.

Sp. typ. *S. banksiae*

Mycelium immersed. Conidiomata conical, separate, superficial to semi-immersed, dark brown to black; walls thick, of brown textura angularis except in the ostiolar region which is of vertically-orientated textura porrecta; ostiole central, circular, with a cylindrical channel, the base of which is lined with periphyses. Conidiophores absent. Conidiogenous cells discrete, determinate, hyaline, cylindrical, each with an apical phialidic aperture, channel, and periclinal thickening but without a collarette, formed from the basal and lateral walls of the conidiomata. Conidia phialidic, hyaline, aseptate, smooth (1)-2 guttulate, ellipsoid; 40 or more grouped in cylindrical sacci which emerge from the ostiole in long unbranched chains.

Sarcinulella banksiae sp. nov.

Mycelium immersum. Conidiomata conica vel fere rostrata, separata, superficialia vel semi-immersa, atro brunnea vel nigra, laevia, nitida, usque ad 90 um diam x 150 um alta; parietes 15 um crassi, ad basim stratum exteriorius ex textura angulari medio brunnea, 4-5 cellulis crassis et stratum interiorius ex textura angulari pallide brunnea, usque ad 10 cellulis parvioribus crassis, faciebus ex textura angulari fuscioribus; canalis ostioli cylindricus, 7-8 um diam, textura porrecta verticaliter disposita brunnea circumcinctus, apicem versus pallidiore hyphis plus separatis; periphyses hyalinae, deminutae, aseptatae, 10-12 x 1 um in fimbria ad basim canalis ostioli in lumen conidiomatis projectae; ostiolum singulum, circulare, centrale, apicibus libris hypharum texturae porrectae fimbriatum, 7-10 um diam. Conidiophora absentia. Cellulae conidiogenae discretae, determinatae, hyalinae, cylindricae, raro lageniformes, 4.5-7 x 2-3 um, canalibus apicalibus phialidicis conspicuis,

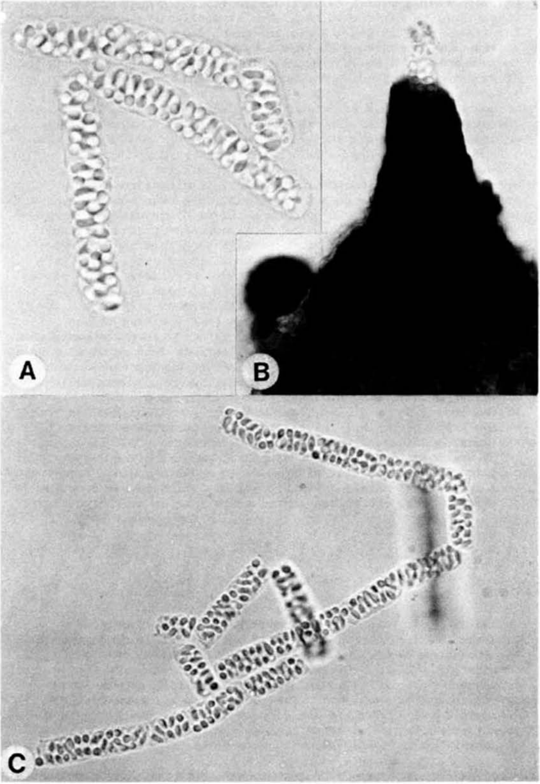

Fig. 1. *Sarcinulella banksiae*. A, vertical median section of a conidioma; B, conidia; C, conidiogenous cells lining the inner face of the conidiomatal wall; D, ostiolar region of conidioma with emerging sacci; E, vertical section of ostiolar region; F, chain of sacci. D-F, conidia in sacci depicted at varying optical levels.

spissescentibus periclinalibus distinctis sed collis notatis absentibus, ex parietibus basalibus et lateralibus conidiomatorum formatae. Conidia 4-6 x 2-2.5 um, phialidica, hyalina, aseptata, laevia, saepe 2-guttulata, raro 1-guttulata, ellipsoidea; plus 40 conidia in saccis cylindricis, 14-21 x 8.5-9 um aggregatis, usque ad 20 in catenis longis non ramosis e ostiolo emergentia.

In corticis emortuis *Banksiae integrifoliae*, Peregian Beach, Queensland, Australia, B.C. Sutton & J.L. Alcorn, 29 Aug. 1981, holotypus IMI 263392*b*; isotypus BRIP 13683.

Mycelium immersed. Conidiomata conical to almost rostrate, separate, superficial to semi-immersed, dark brown to black, smooth, shining, up to 90 um wide x 150 um high; walls several cells thick, 15 um wide, at the base composed of an outer layer 4-5 cells thick of medium brown textura angularis and an inner layer up to 10 cells thick of pale brown smaller-celled textura angularis, at the sides of darker textura angularis; the ostiolar channel is cylindrical, 7-8 um diam, and bounded by vertically orientated brown textura porrecta which becomes paler, with the hyphae more separated, towards the apex; at the base of the ostiolar channel a fringe of hyaline, tapered, aseptate periphyses, 10-12 x 1 um, project into the lumen; ostiole 7-10 um diam, single, circular, fringed by the free apices of the hyphae forming the textura porrecta. Conidiophores absent. Conidiogenous cells discrete, determinate, hyaline, cylindrical, more rarely lageniform, 4.5-7 x 2-3 um, each with an apical phialidic aperture, channel, and periclinal thickening but no collarette, formed from the basal and lateral walls of the conidiomata. Conidia 4-6 x 2-2.5 um, phialidic, hyaline, aseptate, smooth, often 2-guttulate, occasionally 1-guttulate, ellipsoid; 40 or more conidia are grouped into cylindrical sacci, 14-21 x 8.5-9 um, which emerge from the ostiole in long, unbranched chains comprising up to 20 individual sacci.

DISCUSSION

In conidial morphology, conidiogenesis and some aspects of conidiomatal structure *Sarcinulella* differs little from many of the known genera of coelomycetes (Sutton, 1980). Conidia are comparatively small, unicellular and hyaline; they are formed from short cylindrical conidiogenous cells which show a typical apical phialidic apparatus. The conidiomata are pycnidial with a single locule and walls are several cells thick. It is in the organization of the ostiolar tissues and the method of dispersal of conidia that *Sarcinulella* is quite unusual.

Comparatively few genera of coelomycetes have rostrate conidiomata in which the walls surrounding the ostiolar channel are of textura

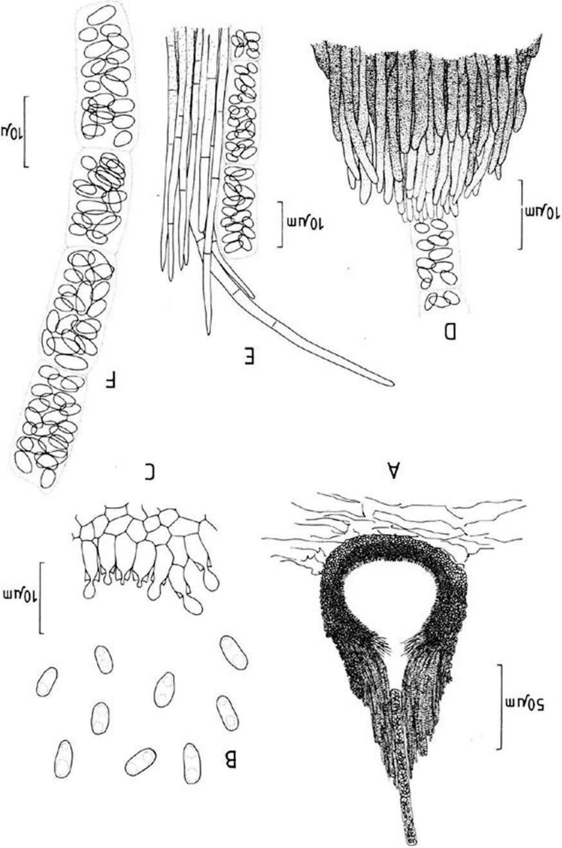

Fig. 2. *Sarcinulella banksiae*. A,C, chains of sacci containing conidia (A, x 1000; C, x 650); B, ostiolar region of conidioma with emerging sacci (x 650).

porrecta (Sutton, 1973, 1975, 1980). It is only in *Nanoschema* Sutton and *Cornucopiella* Höhn. where loose textura porrecta forms the upper part of the conidioma and even in these genera the ostiole and ostiolar channel are not well-differentiated. In *Sarcinulella* the channel is up to 65 um long and the tissue surrounding it becomes progressively less compact towards the apex though still retaining its structural integrity. This results in an ostiolar channel of constant diameter throughout its length. At the base of the channel a fringe of short sterile periphyses projects into the lumen. Although paraphyses interspersed with conidiophores are documented for a few genera of coelomycetes (Sutton, 1980 ; Nag Raj, 1981), periphyses are even less frequent. Nag Raj & DiCosmo (1978) report the ostiole in *Melanconiopsis inquinans* Ell. & Ev. as lined with simple or branched, septate, subhyaline, smooth-walled, sterile hyphae invested in a mucilaginous matrix. Apart from this example *Sarcinulella* appears to be the only other coelomycete in which such sterile elements have been confirmed.

The mechanism of conidial dispersal in *Sarcinulella* is quite remarkable. The majority of coelomycetes produce conidia in slimy mucilaginous material, and under suitable conditions of temperature and especially humidity, the conidia suspended in the mucilage are dispersed through the ostiole, raphe, irregular tear or overlying host tissues in either distinct tendrils (as in *Cytospora* Ehrenb.: Fr. or *Libertella* Desm.) or in effuse or compact conidial masses (as in *Phoma* Westd. and *Melanconium* Lk: Fr.). The common features of these different modes of dispersal is that the conidia lie at random and are not particularly orientated in any direction in the supporting mucilaginous material. On mounting conidial tendrils or masses in aqueous or phenolic preparations, the mucilage dissipates, thus allowing the conidia to become scattered. In *Sarcinulella* however, the conidia fill the conidiomatal locule and subsequently become aggregated into groups of 40 or more in the ostiolar channel after passing the periphyses. The individual sacci of conidia emerge from the ostiole in long unbranched chains which, even under the dissecting microscope, can be seen as quite different from normal conidial tendrils because of their segmented appearance. When chains are prepared in aqueous or phenolic mountants they may break at the junctions between sacci but the individual sacci do not lose their integrity. Erythrosin, acid fuchsin, trypan blue and cotton blue fail to stain either the mucilaginous sacci or the contained conidia.

It seems most probable that the periphyses are involved either in production of mucilage or the chemical modification of mucilage formed in the conidiomatal locule because sections of conidiomata always show the locule to be filled to capacity with conidia, and these are randomly distributed. It is only after passing the lining of periphyses that a) the conidia become aggregated into sacci and b) the mucilage becomes altered to form the rigid cylindrical matrix in which the conidia are held. The diameter of the ostiolar channel clearly imposes a structural limitation on the width of the conidial sacci, but the mechanism(s) regulating the length of sacci is not known. Conidial sacci vary from 14 to 21 um in length and a combination of temperature, humidity and diurnal periodicity may be involved in determining not only the numbers of conidia produced but also the length of the sacci.

Reports of the aggregation of conidia in this very precise manner have not so far been made for any genera of coelomycetes or hyphomycetes other than *Sarcinulella*. To differentiate this type of arrangement from that known in the majority of slimy-spored coelomycetes and many hyphomycetes, and from production of strong and weak chains of connected and disconnected conidia (Minter et al., 1982, 1983), it is proposed to introduce the term *saccus* (sac, L). This describes the individual cylindrical packets of conidia bound in rigid mucilaginous material. They are distinct from the random suspension of conidia in mucilaginous tendrils or effuse masses formed by other fungi, and which vary according to the humidity to which the fungus may have been subjected.

The sacci in *Sarcinulella* raise interesting questions concerning production of conidia, their dispersal and germination, and the establishment of new mycelium capable of forming conidiomata. What is the composition of the mucilaginous matrix in which conidia are dispersed and how does it differ from that in other coelomycetes and hyphomycetes? How and where is it formed? What factors determine the length of the sacci and the number of conidia included in each saccus? Initial formation of conidia from phialides is accompanied by production of normal mucilage but the elements for dispersal, the sacci, may well be dry and are presumably dispersed by wind. It is possible that the sacci may be moist and therefore sticky if humidity is high. Do these factors give an increased survival value to this method of dispersal, and if so why is it apparently unique? Once the sacci have been dispersed how is the matrix broken down and what proportion of conidia are capable of germination? Such questions cannot be effectively answered unless more material is obtained and the organism is brought into culture and stimulated to sporulate. Further efforts in these directions are being made.

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MYCOTAXON

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CULTURAL STUDIES IN HYPOCHNICIUM

(CORTICIACEAE, BASIDIOMYCETES)

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ABSTRACT: Hypochnicium karstenii (Bres.) Hallenb. nov. comb. is segregated from H. bombycinum (Sommerf. ex Fr.) John Erikss. on the basis of incompatibility. The closely related species H. eichleri (Bres.) Erikss. & Ryv. and H. punctulatum (Cke) John Erikss. are found to be incompatible.

Hypochnicium bombycinum (Sommerf. ex Fr.) John Erikss. has been treated as one taxon with a noticeable internal variation (Erikss. & Ryv., 1976): The hymenium may be smooth to more or less tuberculate or even irpicoid and the spores may be characteristically ovoid or ellipsoid - - subglobose. In. N. Europe, this variation in morphology seems to be correlated to the occurrence on different kinds of substrates.

Specimens collected on Pinus or Picea have membranaceous fruitbodies and a high ratio of ellipsoid-subglobose spores compared with the ovoid spore shape. Such specimens have been described as H. bombycinum var. pinicola Lundell (Lundell & Nannfeldt, 1941).

The collections from deciduous wood are usually more crustaceous and varyingly tuberculate. Spores with an ovoid shape are almost as common as ellipsoid-subglobose ones. No other differences in basidiocarp morphology have been found. For further descriptions of these taxa, see Eriksson and Ryvarden (1976).

In the present study it is shown that var. pinicola is incompatible with var. bombycinum and thus represents an independent species. Hypochnicium bombycinum var. pinicola has earlier incorrectly been referred to Corticium molle Fr. (Karsten, 1882) - a species nowadays placed in Leucogyrophana. Bresadola (1911) noticed this missapplication and described Corticium karstenii Bres. as a new species.

Hypochnicium karstenii (Bres.) Hallenb. n. comb. is herewith proposed as a new combination. Basionym: Corticium karstenii Bres., Ann. myc. 9: 427 (1911).

Holotype: Mustiala, in corticem Pini, Karsten (S).

Holotype of H. bombycinum (Sommerf. ex Fr.) John Erikss. is the following specimen: Thelephora bombycina, Saltdalen ("Saltadalen"), in cortice subputr. Alni 11/23, Sommerfelt (O).

A closer investigation of the variation in spore size and shape has been made (Fig. 1).

In H. karstenii the spores are 7—10x6.5—9.5 µm, average 8.7x7.6 µm; in H. bombycinum 7.5—11x6—7.5 µm, average 8.7x6.3 µm.

In H. karstenii, the ratio ellipsoid/ovoid spores varies between 2.0—4.3; in H. bombycinum 1 — 1.3.

In the tests for extracellular oxidases, H. karstenii gave negative results, thus differing clearly from H. bombycinum. Concerning other cultural characteristics, no noticeable differences could be found.

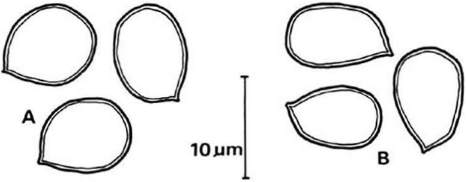

Fig. 1. A) Ellipsoid - subglobose spores in Hypochnicium karstenii GB 79. B) Ovoid spores in H. bombycinum. GB 253.

MATERIALS AND METHODS. Monosporous mycelia have been obtained from the following specimens:

Culture no.	
GB 37	Hypochnicium bombycinum/Sweden, Västergötland, Göteborg Botanical Garden/1974-08-15/ T. Hallingbäck.
GB 253	H. bombycinum/Sweden, Torne Lappmark, between Björkliden and Abisko/On a leaning log of Salix/ 1981-08-11/ N. Hallenberg 3766.
GB 66	H. karstenii/Denmark, Jutland, Mols Bjerge, N. of Tinghulen/On a leaning log of Pinus/1979-10-16/ N. Hallenberg 3153.
GB 79	H. karstenii/Sweden, Östergötland, Omberg, Storpissan nature reserve/1979-11-09/ K. Hjortstam 11301.

Two monosporous mycelia from each specimen were crossed in all combinations. The mycelia were checked for the presence of clamps since they had been in contact with each other for 4 weeks.

	GB 37/1	GB 37/2	GB 66/1	GB 66/2	GB 79/1	GB 79/2	GB 253/1	GB 253/2
GB 37/1		-	-	-	-	-	+	+
GB 37/2			-	-	-	-	+	+
GB 66/1				+	+	+	-	-
GB 66/2					+	+	-	-
GB 79/1						-	-	-
GB 79/2							-	-
GB 253/1								-
GB 253/2								

CULTURAL CHARACTERISTICS FOR H. BOMBYCINUM (GB 253).

Margin submerged, mat appressed, aerial mycelium absent; hyphae with clamps, ordinarily branched, thin-walled, 2-5 µm in diam.

NOBLES' CODE (Nobles 1965, with emendations by Boidin, 1966):

2a. (2b). 3c. 7. 32. 36. 38. 45. 54. 58. 61.

OXIDASE REACTIONS:

gallic acid	+	tyrosine	-
guaiacol	+++	para-cresol	L (milk white)

Gradation according to Boidin (1958).

The number of monosporous mycelia present in 37 and 253 was too small to evaluate the polarity: Boidin (1956) reports H. bombycinum var. irpicoides Bourd. & Galz. as tetrapolar. Confrontations between the latter and GB 37, 66, and 253 gave negative results. However, the still present strain of H. bombycinum var. irpicoides (LY 1402/C) was probably too old to allow any conclusions about the compatibility.

CYTOLOGY: Spores are uninucleate, monosporous mycelia uninucleate, and polysporous mycelium regularly dicaryotic. Staining methods according to Boidin (1958).

CULTURAL CHARACTERISTICS FOR H. KARSTENII (GB 66).

The investigated polysporous mycelium was made artificially by inoculating the 6 available monosporous mycelia on the same plate. Nodose-septate mycelium was isolated after 4 weeks.

Margin submerged, mat appressed, aerial mycelium sparsely present, downy; hyphae with clamps, ordinarily branched, thin-walled, 2–7 µm in diam.

NOBLES' CODE;

1. 3c. 7. 32. 36. 38. 44. 55. 60. 61.

OXIDASE REACTIONS: No staining occurred in media containing gallic acid, guaiacol, tyrosine or para-cresol. However, when drop-tests (according to Currie D. Marr, 1979) were used, a very weak staining occurred with guaiacol and 1--naphtol (after 2 hours). More oxidase tests with true polysporous mycelia ought to be done to make this result more certain.

POLARITY: A_1B_1: 1 A_2B_1: 3, 5, 6
A_1B_2: 4 A_2B_2: 2

CYTOLOGY: Spores are uninucleate, monosporous mycelia uninucleate.

--- ooo ---

Hypochnicium eichleri (Bres.) Erikss. & Ryv. is very close to H. punctulatum (Cke) John Erikss. Compatibility tests between the species have long been desired to ascertain their independency from each other. Eriksson and Ryvarden (1976) keep them apart on the following basis:

H. eichleri has a spore size of 8–10(–12)x6–7(–7.5) µm; the main distribution area in Europe is in the N. parts.

H. punctulatum has spores of a smaller size (5–)5.5–6.6 (–7.7)x4.5–5 µm. It is widely distributed in C. Europe and with very few records in the N. parts.

Both species have been collected on coniferous as well as deciduous wood. For further descriptions of the species, see Eriksson and Ryvarden (1976).

In this study it is shown that *H. eichleri* is incompatible with *H. punctulatum*. *H. punctulatum* is found to be heterothallic and tetrapolar, while *H. eichleri* seems to be homothallic. Further, the culture tests show that the mycelium in *H. punctulatum* grows faster than in *H. eichleri*. Hyphal tips in *H. eichleri* are partly sulfo-positive, while not stained at all in *H. punctulatum*.

MATERIAL AND METHODS. The following specimens were used in culture tests:

Culture no.	
GB 29	*Hypochnicium eichleri*/Sweden, Västergötland, Göteborg, Rya Skog nature reserve/1973–12–11/ T. Hallingbäck.
GB 269	*H. eichleri*/Sweden, Torne Lappmark, Jieprenjåkk/ On a fallen brown-rotted log of Betula/1981–08–09--10/ N. Hallenberg 3688.
GB 160	*H. punctulatum*/Denmark, Lolland, Fuglesang Storskov/On a fallen log of Abies/1980–09–18/ N. Hallenberg 3406.

5 monosporous cultures from 269 were regularly clamped and dicaryotic after 7 weeks, as well as the only one available from GB 29. This indicates that *H. eichleri* might be homothallic.

The identity of *H. eichleri* as a species distinct from *H. punctulatum* is confirmed by di-mon tests between clamped, dicaryotic cultures from *H. eichleri* and monosporous, haploid cultures from *H. punctulatum*:

Dicaryotic x haploid cultures

GB 29/1 x GB 160/2 = -
GB 269/1 x GB 160/1 = -
GB 269/1 x GB 160/4 = -
GB 269/2 x GB 160/1 = -
GB 269/2 x GB 160/4 = -

In all confrontations clamps were completely absent in the haploid side and a barrier zone was developed between the mycelia.

CULTURAL CHARACTERISTICS FOR H. EICHLERI (GB 269).

Mat appressed, downy; hyphae with clamps at all septa, ordinarily branched, thin-walled, in the margin 4–7.5 µm in diam., in old parts of the mycelium 2–8 µm in diam., partly widened to gloeocystidium-like structures, up to 50x8 µm. After 6 weeks growth on an agar plate, some parts of the hyphae were sulfo-positive – especially the hyphal tips.

CYTOLOGY: Spores uninucleate, monosporous mycelia dicaryotic.

NOBLES' CODE:

2a. (2b). 3c. (7). (26). 32. 36. 38. 47. 54. 55. (57).

OXIDASE REACTIONS:

gallic acid	+++	tyrosine	-
guaiacol	++++	para-cresol	L

CULTURAL CHARACTERISTICS FOR H. PUNCTULATUM (GB 160).

Margin submerged, mat appressed, aerial mycelium downy; hyphae with clamps, 2–5 µm in diam., the wider hyphae straight, sparsely septated, from them branching densely ramified, narrow hyphae. In old parts of the mycelium some hyphae are irregularly widened, forming gloeocystidium-like structures, 22–42x5–8 µm. All parts of the mycelium are sulfo-negative.

POLARITY: A_1B_1: 1 A_1B_2: 4
A_2B_1: 3 A_2B_2: 2

CYTOLOGY: Spores uninucleate, monosporous mycelia with uninucleate cells, polysporous mycelia dicaryotic.

NOBLES' CODE:

2a. 3c. 26. 32. 36. 38. 45. 54. 55. 60. 61.

OXIDASE REACTIONS:

gallic acid	+++++	tyrosine	-
guaiacol	++++	para-cresol	-

DISCUSSION. Both *Hypochnicium karstenii* and *H. punctulatum* are tetrapolar. This is in accordance with previous results in the genus, i.e. *H. bombycinum* var. *irpicoides* Bourd. & Galz. (Boidin, 1956), *H. cystidiatum* Boid. & Gilles (Boidin and Lanquetin, 1971), and *H. vellereum* (Ell. & Crag.) Parm. (Nobles and Nordin, 1955). On the contrary, it is indicated that *H. eichleri* is homothallic. Hyphal tips in cultivated mycelium of *H. eichleri* were found to be sulfo-positive – a reaction previously found only in the basidiocarps (gloeocystidia) of *H. analogum* (Bourd. & Galz.) John Erikss. within the genus.

ACKNOWLEDGEMENTS

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MYCOTAXON

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NOTICE

MSA PLANS FOR IMC^3

The Mycological Society of America has announced their appointment of Garber Travel, Box 404, Brookline, MA 02146 as their official agents for travel arrangement to the Third International Mycological Congress to be held in Tokyo, Japan, August 28-September 3, 1983. A brochure is available detailing a Congress Program (August 26-September 4th) only, a Congress and Japan Pre-tour (August 20-September 4th), and a Congress and China Pre-tour (August 18-September 4th). Connections for those also planning on attending the Fourth International Congress on Plant Pathology in Melbourne, Australia, in August are also arranged by Garber Travel. Because of airline pricing, air fares for the Congress Program alone are higher ($1413) than for the Congress plus Japan Pre-tour ($961) or the Congress plus China Pre-tour ($1196). For those who wish to stay in Japan beyond 14 days, Garber Travel will arrange an APEX air fare of $930. (All prices based on West Coast departures.)

The Mycological Society of America will also be awarding a limited number of Travel Grants, each in the amount of $500, to qualified members of the Society attending and participating in the Tokyo meetings. Particulars concerning elegibility and dates of application will be announced in mid-January, 1983, by Dr. R. L. Shaffer, Chairman, MSA Travel Awards Committee for IMC^3, The Herbarium, University of Michigan, Ann Arbor, MI 48109, in a mailing to MSA members residing in the U.S. Should MSA members not have received information on application procedures by mid-February, they should write to Dr. Shaffer directly.

AUTHOR INDEX, VOLUME SIXTEEN

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME SIXTEEN

This index includes genera, infrageneric taxa, species, and infraspecific taxa. New taxa are in **boldface** as are the pages where they are published. New suprageneric taxa are in bold **CAPITALS.** The fungus/host "Check-list of Romanian Peronosporales" is itself an index, reference to which is indicated by "**see 540-556.**"

ERRATA, VOLUME ELEVEN

Page 381, last line: *for* 637. *read* 367.

ERRATA, VOLUME FOURTEEN

14(2) cover line 27: *for* 1981 *read* 1982

ERRATA, VOLUME FIFTEEN

Page 197, *add:*	leaves of Ammophila arenaria, 17.VII.1963, leg. O.E. no. 2160p (S).
Pages 529, 530:	omitted

ERRATA, VOLUME SIXTEEN

Page 35,	line 23:	for *S.* read *Stenella*
80	13:	for *C.* read *Cercoseptoria*
153	35:	for *S.* read *Sclerotinia*
174	44:	for *P.* read *Polyporus*
176	10:	for *P.* read *Polyporus*
180	18:	for *subsperpens* read *subserpens*
204	38:	for *P.* read *Pseudocyphellaria*
233	12:	for *Sp.* read *Sporotrichum*
	28:	for *S. schenkii* and *Sp.* read *Sporothrix schenkii* and *Sporotrichum*
234	11:	for *Sp.* read *Sporotrichum*
235	23:	for *S.* read *Sporothrix*
236	1:	for *Sp.* read *Sporotrichum*
278	38:	for *E.* read *Erynia*
282	38:	for *E.* read *Entomophthora*
	39:	for *E.* read *Erynia*
283	33:	for *grylly*-type, *E.* read *grylli*-type, *Erynia*
284	28, 32:	for *E.* read *Entomophthora*
286	3:	for *E.* read *Entomophthora*
287	38:	for *E.* read *Erynia*
293	13:	for *tuberculatum* read *tuberculosum*
297	7:	for *F.* read *Fomes*
333	20:	for *THE PYTHIUM* read *THE GENUS PYTHIUM*
462	27, 33:	for *E.* read *Epithele*
464	4:	for *effibulata* read *efibulata*
472	34:	for *E.* read *Epithele*
473	41:	for Hypodontia read Hyphodontia
492	34:	for *Conforticium* read *Conferticium*

PUBLICATION DATES FOR MYCOTAXON

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Volume 16, No. 1	October 27, 1982

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