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MORPHOLOGY AND SUBDIVISION OF AMANITA AND A MONOGRAPH OF ITS SECTION LEPIDELLA

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(With 382 Text-figures)

A historical survey of the delineation of the genus *Amanita* and its infrageneric classification is given. Morphological and other characters of *Amanita* are discussed, with emphasis on the characters and the behaviour of the volva. The term 'pileipellis' is proposed to replace Fayod's term 'cuticula'. In the taxonomic part synonymy and descriptions are given of the genus *Amanita* and its subgenus *Lepidella*, together with a key to the subgenera and the sections. Section *Lepidella* is provisionally monographed on the base of exhaustive examinations of type material, as far as available, and a usually limited number of additional collections. Of the 93 species recognized, sixteen are described as new, and seven provisionally as new species; three new names and four new combinations are introduced.

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PREFACE

The genus *Amanita* belongs to the oldest segregates of the Linnaean genus *Agaricus*. One of its most pronounced features is the wide variety of characters of the universal veil or volva. This makes it easy to understand why right from the earliest time that *Amanita* was recognized as a genus down to the present day the distribution and nature of the volval remnants on the mature fruit-body have played a leading part in nearly all infrageneric classifications that have been proposed for it.

Use of the characters of the volva in combination with a few other characters has resulted in an admittedly still rough—though on the other hand fairly satisfactory—sectioning of *Amanita*. If, however, an effort is made to determine the relationship between the large subdivisions and to arrange the constantly growing number of species in smaller units within these subdivisions it soon becomes evident that scarcely anything is known about the structures determining the diversity

of volval characters in *Amanita*. It is only fairly recently that a number of authors publishing on species of *Amanita* have begun including the microscopic structure of the volva in their descriptions.

When I began with the observations that resulted in the present study it was my intention to select a fair number of species of *Amanita* that represented all the different types of macroscopic volval structures that could be distinguished so that in these species I could study the connection between the microscopic and macroscopic volval structures.

Section *Lepidella*, because of its relatively wide variation in volval structures, appeared to be the most promising subdivision of *Amanita* to commence with. Moreover I supposed this section to be the most primitive in *Amanita*.

At that time I had assumed that Gilbert's (1940–41) monograph covering the entire world was a reliable source of information on specific delimitation in *Amanita*. But in 1963, during a trip of four months to the U.S.A., I became aware of the great wealth of the North American mycoflora. Soon I was forced to admit that the keys I had made for the species of *Amanita* as set forth in Gilbert's monograph, especially my key to his only five North American species in section *Lepidella*, was of no use at all![1] The material in the few American herbaria I visited also presented puzzles. In general a large number of sometimes very different forms were filed under only a few frequently used names.

Thus it became clear to me that a monographic study of *Amanita* would have to precede my morphological study of its volva, as originally planned. I decided to combine the two but to restrict the detailed descriptions to section *Lepidella*.

This of course had the disadvantage of starting from a preconceived sectioning of the genus. I had the general impression, however, that the sections as circumscribed by Corner & Bas (1962: 243) were reasonably natural and that they provided a suitable starting-point for further observations.

I have studied the type collection of most of the species and varieties treated here and when possible also some additional collections. In all the collections cited I have examined the microscopic and macroscopic structure of the volva and the covering layer of the cap, the trama of the gills and stem, and the more usual microscopic and macroscopic characters. However I did not even attempt to bring together all the material of *Amanita* section *Lepidella* preserved in herbaria throughout the world. For a monograph the average number of collections studied is therefore very low. Not only would an exhaustive study of many more collections have taken far too much time but I was also faced with the difficulty that the tissues of many of the herbarium specimens were in such poor condition that examination of them would have contributed nothing to our knowledge of the morphology of the species involved. Furthermore descriptive notes on the fresh fungus were all too often lacking.

[1] Subsequently this was no longer surprising. Here more than 35 North American species of section *Lepidella* are treated.

For these reasons I restricted my studies to types, critical collections and a small number of illustrative collections selected from the material in a number of herbaria or sent to me by fellow mycologists.

The condition of the material examined often made the complicated microscopic structures difficult to analyze so that I am well aware that many of my findings will prove to need correction or completion once they have been tested on fresh or recently well-dried collections. Nevertheless I have good hope that in the main the arrangement of the species in section *Lepidella* proposed here will turn out to be satisfactory.

It is my intention to carry out a similar series of observations on the other sections of *Amanita*. Section *Amidella* will be the next.

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My warmest thanks are extended to Prof. E. J. H. Corner, Cambridge, for putting at my disposal the extensively annotated collections, with excellent illustrations, of Asiatic species of *Amanita* that awakened my interest in the genus *Amanita* outside Europe, and to Dr. A. H. Smith, Ann Arbor, for inviting me to the U.S.A., thus giving the decisive impulse to my study of *Amanita* section *Lepidella*. The financial support for my trip in 1963 to the U.S.A. received from the Netherlands Organisation for the Advancement of Pure Research (Z.W.O.) and from American funds through Dr. A. H. Smith, Dr. L. S. Hesler, Knoxville, and the late Dr. A. H. Stockard, Ann Arbor, is gratefully acknowledged.

In a taxonomic study covering a cosmopolitan group of fleshy fungi an author must largely depend on the observations of other mycologists and collectors for the description of the characters of the fresh fruit-body. This is particularly so because in older descriptions these characters are often mentioned too briefly and because in many older collections descriptive notes are either lacking or else insufficient. To both Dr. A. H. Smith and Dr. L. R. Hesler I am therefore very much indebted for the generosity with which they put their herbaria, private notes, and photographs at my disposal. I am also greatly indebted to the following people for supplying me with valuable collections, notes, and illustrations of the species treated in this work: Dr. J. C. Aberdeen, Brisbane; Dr. S. Ahmad, Lahore; Mr. R. Bertault, Tanger; Dr. V. Demoulin, Liège; Dr. Ding Hou, Leiden; Mr. R. L. Homola, Orono (Maine, U.S.A.); Dr. T. Hongo, Ōtsu (Japan); Dr. E. Horak, Birmensdorf (Switzerland); Dr. G. Malençon, Rabat; Mr. A. Marchand, Perpignan; Mrs. M. B. Mills,

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MATERIAL, METHODS, AND PRESENTATION

Of the ninety-three taxa recognized here I studied only ten in fresh condition (three from Europe, seven from North America). Most of the collections examined were dried, some were preserved in liquid and a few of them both.

In general the tissues of well-dried material can be studied under the microscope without too much trouble. Unfortunately many old and even several recent collections have not been well dried. In these cases material preserved in liquid[2] is a great help, especially when it is the large, thin-walled elements of the trama of the gills and the stem that are to be studied. It would be advisable if future collectors of species of *Amanita* were to dry the largest part of their collections but at the same time preserve in liquid fragments of the essential parts of one fruit-body from each collection, especially when the drying conditions are not ideal.

With the fleshy fungi in dried material great reliance must be placed on collector's data for many characters of the fresh fruit-body. The collections cited here frequently proved to be incomplete, particularly as to data on colour, smell, and taste. Spore prints were often lacking and where this was not the case it was only rarely that the colour of the fresh print had been noted. Ecological data were extremely scarce.

The descriptions in this work are composed of (i) data derived from observations on the collections cited, (ii) data taken from labels, collector's notes and accompanying drawings, photographs, and colour-slides, and (iii) data borrowed from

[2] The material preserved in 25 % alcohol—4 % formalin by Prof. E. J. H. Corner, Cambridge, gave the best results.

published descriptions and illustrations relevant to the collections I myself studied. By way of exception data from other sources have been added between square brackets.

The terms referring to the size of the fruit-body have been standardized. Species of *Amanita* with caps up to 30 mm wide are called 'very small', 30–50 mm wide 'small', 50–90 mm wide 'medium-sized', 90–150 mm wide 'large' and 150 mm and wider 'very large'. For terms denoting the properties of the volva, partial veil, spores, covering layers and trama, see the relevant chapters.

Terms describing smells are so subtle in meaning that I have simply taken them over from the collectors' notes and original descriptions.

The structures of the tissues in the descriptions were studied in free-hand sections or minute, severed fragments soaked in drops of a 10 % NH_4OH solution or, if necessary, a mixture of equal parts of 10 % NH_4OH and 5 % KOH (referred to in the descriptions as 'alkaline solution') heated on a glass slide (without cover glass!). If the first results were poor the same process was repeated several times.

After the colours of the tissue in the alkaline solution had been noted the fragments were coloured by heating in an ammoniac 1 % Congo Red solution, then rinsed in 10 % NH_4OH and subsequently examined in 5 % KOH. The walls of the cells had usually turned bright red in colour and the tissues were easy to dissociate by gentle tapping on the cover glass.

Because of the large size of the cells (in the stems sometimes up to 400 × 80 μ) and their thin walls it was usually necessary to first examine rather thick fragments in order to ascertain the disposition of the elements of the tissues. Following this the tissues were crushed under a cover glass or torn with needles for further analyses.

The amyloid reaction of the spores was studied in Melzer's reagent (see recipe in Singer, 1962: 82). It turned out that it was not affected by preservation in an alcohol or alcohol-formalin solution.

Within the subsections of *Lepidella* I have arranged supposedly related species in groups called 'stirpes'. As many species are still imperfectly known various minor shifts in the present system can be expected. In order to avoid a kind of fixation of it in detail I have therefore refrained from validly publishing a large number of 'series'. The naming of each stirps after one of its species indicates which species I consider to be its 'type'.

My keys to the species of section *Lepidella* proceed step by step through subsections and stirpes. I considered adding a direct key to all the species of the section, but found that, after keying out a few species and groups of species with salient characters, I would have been left with a large group of species for subdivision for which I would have had to use the same characters that had already been used to distinguish the subsections and stirpes. This would only have made large parts of the supplementary key practically the same as those presented.

A disadvantage of the present key is that the stirpes are delimited rather vaguely so that there is a fair risk of looking for a species in the key of the wrong stirps. I have

tried to meet this objection by including in the keys to the species many references to similar species in other stirpes.

Because of the fairly large variation in habit of the fruit-body in section *Lepidella* drawings of the fruit-bodies of nearly all the taxa treated have been made. In the many cases where there was no picture of the fresh fungus available I added drawings of a preserved fruit-body.

The illustrations of the fruit-bodies were drawn in natural size and reduced to × ½ (except that of *A. nauseosa*, which was reduced to × ¼). The microscopic details of the volva were drawn with a magnification of × 650 and reduced to × 325, the spores drawn with × 2500 and reduced to × 1250. The scale of other illustrations is indicated in the legends.

Institutes from which material or documents were received on loan are indicated in the text by the following abbreviations, borrowed from Lanjouw & Stafleu (1964).

ADW	Waite Agricultural Research Institute, Adelaide, South Australia, Australia.
BAFC	Department of Botany, University of Buenos Aires, Buenos Aires, Argentina.
BO	Herbarium Bogoriense, Bogor, Indonesia.
BR	Jardin Botanique de l'Etat, Bruxelles, Belgium.
CUP	Department of Plant Pathology, Cornell University, Ithaca, New York, U.S.A.
FLAS	Herbarium, Agricultural Experiment Station, Gainesville, Florida, U.S.A.
IA	Department of Botany, State University of Iowa, Iowa City, Iowa, U.S.A.
K	The Herbarium, Royal Botanic Gardens, Kew, Great Britain.
L	Rijksherbarium, Leiden, The Netherlands.
LE	Herbarium of the Komarov Botanical Institute, Leningrad, U.S.S.R.
LG	Institut et Jardin de Botanique de l'Université de Liège, Liège, Belgium.
LPS	Instituto de Botánica C. Spegazzini, La Plata, Argentina.
MICH	University Herbarium, University of Michigan, Ann Arbor, Michigan, U.S.A.
MPU	Institut de Botanique, Université de Montpellier, Montpellier, France.
NCU	Herbarium of University of North Carolina, Chapel Hill, North Carolina, U.S.A.
NY	The New York Botanical Garden, New York, New York, U.S.A.
NYS	Herbarium of New York State Museum, Albany, New York, U.S.A.
PC	Muséum National d'Histoire Naturelle, Laboratoire de Cryptogamie, Paris, France.
PR	Botanical Department of the National Museum, Praha, Czechoslovakia.
S	Botanical Department, Naturhistoriska Riksmuseum, Stockholm, Sweden.

Other abbreviations used:

l/b	length-breadth ratio.
misappl.	misapplied.
not val. publ.	not validly published.
Spores [40/5]	Spores, forty from five specimens measured, ...

For the use of 'per' in author's citations one is referred to Donk (1957: 255).

Most of the notes of my observations on the individual collections cited in this work, together with copies of collector's notes, drawings, labels etc. are kept in files at L and are available for consultation.

For names of species mentioned in the general part of this work and not treated in the taxonomic part, full authority is given below:

Amanita ampla Pers. per Larber
A. argentea Huijsman
A. aurea (Beeli) E. J. Gilb.
A. bisporigera Atk. apud Lewis
A. caesarea (Scop. per Fr.) Grev.
A. calyptroderma Atk.
A. citrina (Schaeff.) per Roques
var. *alba* (Gill.) E. J. Gilb.
A. cocolla (Scop.) per Bertillon
A. cylindrispora Beardslee
A. excelsa (Fr.) Bertillon
A. farinosa Schw.
A. frostiana (Peck) Sacc.
A. fulva (Schaeff.) per . . . . ?
A. goossensiae Beeli
A. hemibapha (Berk. & Br.) Sacc.
'*A. inaurata* Secr.'
A. junquillea Quél.
A. lepiotoides Barla
A. muscaria (L. per Fr.) Hook.
A. ovoidea (Bull. per Fr.) Link
A. pantherina (DC. per Fr.) Krombh.
A. phalloides (Fr.) Link
A. princeps Corner & Bas
A. rhodophylla Beeli
A. rubescens (Pers. per Fr.) S. F. Gray
A. rubrovolvata Imai
A. strobilaceovolvata Beeli
A. subjunquillea Imai
A. vaginata (Bull. per Fr.) Vitt.
A. valida (Fr.) Bertillon
A. verna (Bull. per Fr.) Roques
A. virosa (Fr.) Bertillon
A. volvata (Peck) Lloyd
A. xanthella Corner & Bas
Limacella guttata (Pers. per Fr.) Konr. & Maubl.

HISTORY

THE DELINEATION OF THE GENUS AMANITA

In 1797 Persoon separated from the Linnaean genus *Agaricus* the species with a distinct, membranous to friable volva. He re-introduced for this new genus the classic name *Amanita*, although that name had formerly been applied by Dillenius (1719: 177) to the main body of the genus *Agaricus* L. By the time the name *Agaricus* had become generally accepted, however, *Amanita* had lost its original meaning. This is probably the reason why Persoon thought himself free to use it again for another genus.[3] As the presence of a distinct volva was the main character of Persoon's *Amanita*, it also included some pink-spored species at present placed in the genus *Volvariella* Speg.

At first Fries (1815: 1; 1818: 1) accepted *Amanita* Pers. in its original sense and status. But rather soon (1821: 12) he reduced it to the rank of 'tribus' of *Agaricus* and removed the pink-spored species to his 'tribus' *Volvaria*. Several other authors, however, continued to regard Persoon's *Amanita* as a distinct genus; Hooker (1821: 19) was the first to publish it as such after 1 January 1821, the nomenclatural starting-point established later.

Since Fries removed its pink-spored elements the concept of *Amanita*, treated either as a genus or as an infrageneric taxon of *Agaricus*, has been disputed remarkably seldom.

S. F. Gray's (1821: 601) attempt to remove the ringless species (still including the pink-spored ones) from *Amanita* to a new genus *Vaginata* at first met with little

[3] Persoon (1797: 65) introduced *Amanita* as though it were a completely new name, that is to say without reference to earlier authors.

approval. But in the second half of the 19th century, when great taxonomic value was attached to the presence or absence of a velar ring on the stem, Roze's (1876: 50) introduction of the genus *Amanitopsis* for the ringless species of *Amanita* was more successful. Although a fair number of authors never accepted *Amanitopsis* as generically distinct from *Amanita*, nearly all the ringless species of *Amanita* were transferred to it at one time or another. Ringless species are now admitted to all sections of *Amanita*, but the original species of *Amanitopsis* ("*Amanitae vaginatae*") represent the core of what may prove to become a subsection of section *Vaginatae*. Much later *Amanitopsis* was one of the nine genera into which Gilbert (1940: 63–79) divided *Amanita*.

In 1891 (: 867) O. Kuntze introduced *Pseudofarinaceus*[4] as generic name to replace *Amanitopsis*. A few years later (1898: 539) he rejected this name in favour of *Vaginata* S. F. Gray.

Earle (1909: 449–51) likewise replaced the name *Amanitopsis* by *Vaginata* S. F. Gray. He also created the new genus *Amanitella* for the ringless Amanitas with friable volva (type: *A. farinosa*). At the same time he introduced the new name *Venenarius* to replace *Amanita* Pers.[5] and the new genus *Leucomyces* for the annulate Amanitas with saccate volva (type: *A. cocolla* = *A. ovoidea*).

Neither Earle's genus *Amanitella* nor his *Leucomyces* has been generally accepted, even by Murrill, though he followed Earle consistently in substituting the names *Vaginata* for *Amanitopsis* and *Venenarius* for *Amanita*.[5] On one occasion Murrill (1911: 80) described a new species in *Leucomyces*,[6] viz. *L. mexicanus*, that later (Singer, 1944: 366) became the type of *Smithiomyces*, a genus not closely related to *Amanita*. *Amanitella* Earle was later taken up again by Gilbert (1940: 63, 71, 77).

Earle (1909: 447) was also the author of *Limacella*. Formerly the species of that genus, now considered to be very closely related to *Amanita*, were placed only occasionally in the latter genus, but for the most part in *Lepiota*, probably because the viscid layer on the cap and sometimes on the stem was not recognized as a volva.

Formerly a few species of the present genus *Amanita* were also placed in *Lepiota*, mainly on account of the non-gelatinizing covering layer of the cap and, consequently, adnate volval remnants on the cap. This was particularly the case with *A. vittadinii*, which owing to its cylindrical, non-bulbous stem has a very strongly lepiotoid habit. To solve this problem Gilbert (1925: 303) described the new genus

[4] This name was borrowed from Battara (1755: 29), who, however, did not use binary nomenclature. Battara's *Pseudofarinaceus* was therefore not a generic name. Later on it was also taken up by Earle (1909: 449), but then for the present genus *Volvariella*.

[5] Earle and Murrill regarded *Amanita* Pers. as a later homonym of *Amanita* [Dill.] Hall. (type: *Agaricus campestris*). The latter generic name, however, became devalidated when the later starting-points were introduced for names of fungi.

[6] From the accompanying text it appears that at that time Murrill had intended to replace the name *Amanita* Pers. by *Leucomyces* Earle. Later he changed his mind in favour of *Venenarius* Earle.

Lepidella with *A. vittadinii* as type and included *A. echinocephala* and *A. solitaria* sensu Coker in it. As characters he mentioned the usually adnate volva, the solid, squamose stem, the inflected, appendiculate margin of the cap, the coloured gills, the not truncate short gills, the bilateral trama of the gills,[7] and the subvirescent spore print. Its intermediate position between *Amanita* and *Lepiota* was stressed. By contrast *Amanita solitaria* (sensu auct. europ. = *A. strobiliformis*) was mentioned as a typical species of *Amanita*.

Gilbert & Kühner (1928: 151) also transferred the European *A. boudieri* (= *A. baccata*) and a number of American species from *Amanita* to *Lepidella* but without giving a new description of *Lepidella*. In his monograph Gilbert (1940: 63–79) proposed a division of *Amanita* into not less than nine smaller genera (viz. *Amanitopsis* Roze, *Amanita* sensu stricto, *Ariella* E. J. Gilb., *Amanitaria* E. J. Gilb., *Amanitella* Earle, *Amidella* E. J. Gilb. *Amanitina* E. J. Gilb., *Amplariella* E. J. Gilb., and *Aspidella* E. J. Gilb.).

Aspidella was the genus that Gilbert had previously named *Lepidella*, but that he had to rename because of the earlier homonym *Lepidella* Tiegh. (Loranthaceae; 1911). Without admitting it in so many words Gilbert then strongly emended this genus. This appears not only from his own words (1940: 74): "Il groupe toutes les Amanites blanches à volva non membraneuse et à spores amyloides," but also and even more clearly from the list of species he (1940: 79) admitted to *Aspidella*. Only a few authors (e.g. Maire, 1933: 85; Konr. & Maubl., 1948: 68) accepted *Lepidella* or *Aspidella* respectively, at generic level, but in 1933 (: 214) Veselý already reduced it to subgeneric rank.

Gilbert's excessive splitting up of *Amanita* has not or scarcely been followed. Probably it was Gilbert himself who was responsible for the swift degradation of his generic derivatives of *Amanita*. In the descriptive part of his monograph (1941) he continued to use the generic epithet *Amanita* in the specific names. Moreover in a paper printed privately in May 1941 he reduced nearly all the genera[8] proposed in the general part of the monograph (1940) to subgenera of *Amanita*.

Summarizing, it may be said that since the early removal of a few foreign elements the genus *Amanita* Pers. per Hook. has successfully resisted every attempt to subdivide it into smaller genera and has proved to be a very natural and easily recognizable taxon. Microscopic and ontogenetic characters that have been gradually recognized have even emphasized its oneness. Such characters are, e.g. the bilateral trama of the gills (see p. 324), the 'Amanita-structure' of the trama of the stem (see p. 328) and the schizohymenial type of development of the fruit-body (see p. 300).

[7] A character discovered by Fayod (1889: 314) in his tribus 'Amanitacés' and several other groups, that proved to be a great help in distinguishing *Amanita* and its closely related genera (his 'Amanitacés') from *Lepiota* and its close allies (his 'Lepiotés').

[8] Not all of them, since in this paper he was treating only European taxa.

THE INFRAGENERIC CLASSIFICATION OF AMANITA

The genus *Amanita* is found throughout the world and is generally easy to recognize. In large areas it is a conspicuous and attractive component of the mycoflora. It is therefore not astonishing that *Amanita* has been treated more or less extensively in a large number of floras, textbooks, monographs, etc. As, moreover, the genus is rich in striking macroscopic characters, many authors have proposed new infrageneric classifications, but unfortunately usually without taking into account earlier published subdivisions and names in *Amanita*.[9] A limited number of these infrageneric systems will be mentioned here in historical sequence in order to give a picture of the main characters on which they were based.

Persoon (1797: 66; 1801: 247) distinguished three unnamed groups of species in *Amanita*: one with a membranous volva and without a ring, a second with a membranous volva but with a ring, and a third with a friable volva and with a ring.

Fries (1821: 13) divided his *Agaricus* 'tribus' *Amanita* into four unnamed groups viz. (i) one with a saccate volva and a smooth margin of the cap, (ii) a second with a saccate volva and a striate margin of the cap; (iii) a third with a friable volva and a striate margin of the cap; and (iv) a fourth with a friable volva and a smooth margin of the cap. Later Fries (1854: 2) introduced the following names for these groups: (i) *Phalloideae*, (ii) *Vaginatae*, (iii) *Muscariae*, and (iv) *Validae*.[10] By attaching great taxonomic value to the striation of the margin of the cap Fries was remarkably 'modern'!

Rather curious was the division of *Amanita* (still including *Volvariella*) by Mladý (1838: 11), who distinguished the following sections: *Xanthispori* (only species, *A. caesarea*), *Rhodospori* (= *Volvariella*) and *Leucospori* ("*Amanitae verae*").[11] His first section was apparently based on the erroneous assumption that *A. caesarea*, with its yellow gills, produces yellow instead of white spores.

At first Quélet (1872: 65) followed Fries' division of *Amanita*. But later (1888: 302) he switched to a new classification, recognizing two subgenera, viz. *Vaginaria* Forq. ex Quél. without a ring and *Peplophora* Quél. with a ring. The latter was subdivided into the following three sections: (i) *Oblitteratae*, with a friable volva and a bulb without rim or edge, (ii) *Circumscissae*, with a friable volva and a bulb with volval rim or edge, and (iii) *Limbatae*, with a saccate volva.

[9] More than fifty sectional names have been introduced in *Amanita*. Corner & Bas (1962) chose lectotypes for many of them in such a way that they have become typonymous synonyms of older sectional names.

[10] In 1854 Fries added a fifth section, named *Denudatae*, for species with an entirely disappearing volva and a non-bulbous stem. Formerly (1849: 272) he had called this group "stirps *A. persoonii*"; therefore I propose *Agaricus persoonii* Fr. ex Fr. as lectotype for it. The identity of *A. persoonii* is uncertain. Some authors assume that it is a species of *Limacella* (e.g. Konr. & Maubl., 1948: 70), others (e.g. Gilbert, 1941: 350) that it is *Amanita excelsa*.

[11] Unfortunately these are the oldest sectional names in *Amanita* that I have been able to find. I propose *Amanita muscaria* (L. per Fr.) Hook. as lectotype for *Amanita* section *Leucospori* Mladý (1838: 15); thus it becomes a typonymous synonym of *Amanita* section *Amanita*.

Schroeter (1889: 677) treated *Amanitopsis* as a distinct genus. He divided *Amanita* into about the same three sections as Quélet had divided his subgenus *Peplophora* but gave them a new set of names, viz. (i) *Incompletae*, (ii) *Marginatae*, and (iii) *Volvati*.

Ricken's (1913: 306) sections of *Amanita* (inclusive of *Amanitopsis*) has as sole characteristic the structure of the volva; this appears clearly from the names: *Volvatae*, *Limbatae*, *Circumscissae*, *Oblitteratae*.

The only author who considered the shape of the spores to be of greater importance than the structure of the volva was Lange (1915: 5). He divided *Amanita* into the subgenera *Eu-Amanita*, *Amanitopsis*, and *Lepiotopsis* (= *Limacella*), and his subgenus *Eu-Amanita* into two sections based on the shape of the spores, viz. *Sphaerosporae* and *Ovisporae*. Both of these sections consisted of the same pair of subsections, viz. *Volvatae* and *Circumscissae*.

Noteworthy was Coker's (1917) arrangement of the species of *Amanita*. On the one hand his genus *Amanitopsis* was a heterogeneous gathering of ringless species from at least three of the present sections of *Amanita*. On the other, the arrangement of the species in his genus *Amanita* in six unnamed groups was fairly natural according to present-day standards, partly because Coker reintroduced the sulcation ('striation') of the margin of the cap as a character for some of his groups.

In 1918 Gilbert was still dividing *Amanita* into three subgenera (*Amanita*, *Amanitopsis*, *Limacella*) and his subgenus *Amanita* into three sections based on the characters of the volva (*Limbatae*, *Semi-Limbatae*, and *Floccosae*). But in 1928 Gilbert & Kühner published the results of their observations on the spores of *Amanita* in Melzer's reagent and this brought the first fundamental change in the infrageneric classification of *Amanita* since Fries. Gilbert & Kühner found that the species of *Lepidella* [12] and many species of *Amanita* combined amyloid spores with a smooth margin of the cap and that the species of *Amanitopsis* and the rest of the species of *Amanita* combined non-amyloid spores with a sulcate margin of the cap. This striking correlation between two independent characters [13] established the taxonomic value of the absence or presence of a sulcation at the margin of the cap already observed by Fries (1821, 1854), Coker (1917), and Gilbert (1925: 212).

Veselý (1933, 1934) reduced *Lepidella* E. J. Gilb. to a subgenus of *Amanita* and placed it beside *Amanitopsis* and *Amanita*. He divided his subgenus *Amanita* into three sections that were still based on volval characters only (*Volvatae*, *Limbatae*, and *Floccosae*).

In his monograph on *Amanita* Gilbert (1940) worked out the consequences of Gilbert & Kühner's discovery by splitting *Amanita* into two groups of taxa, one group with amyloid and the other with non-amyloid spores. At first (1940: 63) these were groups of genera, but in 1941 Gilbert reduced the genera to subgenera

[12] A genus segregated from *Amanita* by Gilbert in 1925 and later renamed *Aspidella* see p. 294.

[13] Meanwhile it has emerged that this correlation is not 100 %, though it is still very high.

of *Amanita*, arranging them as follows: [14]

1. Spores non-amyloid. Margin of cap sulcate.
   2. Volva membranous to submembranous.
      3. Spores rounded. Subgen. *Amanitopsis* (type: *A. vaginata*).
      3. Spores ellipsoid. Subgen. *Amanita* sensu E. J. Gilb. (type: *A. caesarea*).
   2. Volva floccose. Subgen. *Amanitaria* (type: *A. muscaria*).
1. Spores amyloid. Margin of cap smooth.
   4. Volva membranous or floccose-membranous.
      5. Spores ellipsoid to subcylindrical. Fruit-body white. Ring often disappearing. Subgen. *Amidella* (type: *A. volvata*).
      5. Spores globose to broadly ellipsoid. Cap usually coloured. Ring persistent. Subgen. *Amanitina* (type: *A. phalloides*).
   4. Volva floccose.
      6. Spores ellipsoid, medium-sized. Cap coloured. Subgen. *Amplariella* (type: *A. ampla*).
      6. Spores ellipsoid to elongate, large. Cap white. Subgen. *Aspidella* (type: *A. vittadinii*).

The delimitation of Gilbert's taxa was still rather cursory[15] and most of his names have had to be replaced by older ones. Furthermore, his subgenera were soon reduced to sections. Nevertheless his internal classification of *Amanita* sensu lato provided the pattern underlying the systems of most later authors.

Konrad & Maublanc (1948: 57) recognized two subgenera, viz. *Eu-Amanita* with non-amyloid and *Amidella* with amyloid spores, both divided into a number of sections that in the main corresponded with Gilbert's subgenera of 1941. Gilbert's *Aspidella*, however, was maintained as a distinct genus (exclusive of *A. strobiliformis*) on account of its adnate volval remnants on the cap and the virescent gills.

In 1951 Singer divided *Amanita* into three subgenera, two with non-amyloid spores, viz. *Pseudoamanita* and *Vaginaria* (the first usually with, the second usually without a ring), and one, *Euamanita*, with amyloid spores. But in 1962 he combined the first two subgenera into one. Singer's system also deviates from that of Gilbert in that *Amanitopsis* is split up into sections *Vaginatae* (with globose spores) and *Ovigerae* (with ellipsoid spores), while *Aspidella* is split up into sections *Strobiliformes*

[14] Two of Gilbert's genera of 1940, viz. *Amanitella* Earle and *Ariella* E. J. Gilb., escaped degradation because in Gilbert's paper of 1941 only European taxa were treated. *Amanitella* is monotypic and based on *A. farinacea*; in my opinion this species, with its bulbous stem and friable volva, must be placed in *Amanitaria* E. J. Gilb. (= *Amanita* section *Amanita* in my classification). *Ariella* (type: *Amanita rhodophylla*) may turn out to be a distinct taxon but it is still insufficiently known. Horak (1968: 93) described the tramal hyphae of the gills in the type of *A. rhodophylla* as regular.

[15] With the help of Gilbert's generic descriptions I made a key to his genera of 1940. Thereby several of the species in Gilbert's monograph appeared to key out in genera other than those in which Gilbert placed them!

(with wart-like volval remnants) and *Roanokenses* (with powdery volval remnants).

Corner & Bas (1962: 242) recognized the same two subgenera as Konrad & Maublanc (l.c.) and Singer. However, they rejected Singer's section *Ovigerae* as not sufficiently distinct from section *Vaginatae* and maintained *Aspidella* undivided as section *Lepidella*. Moreover they united Gilbert's *Amanita* sensu stricto (= sect. *Caesareae* Sing.) with section *Vaginatae* because they did not consider the presence or absence of a ring to be a sectional character.

Moser (1967: 125) sectioned *Amanita* in almost the same way as Corner & Bas (l.c.) except that he maintained the *Caesareae* as an independent section.

It seems that recent authors have arrived at a rather natural arrangement of the species of *Amanita*. But working with this system shows that it is still very cursory, with the delineation of the sections still vague. At the same time the number of species to be accommodated is rapidly growing.

As is apparent from the foregoing, the structure of the volva has always been a leading character within *Amanita*. Its taxonomic importance is surpassed only by that of the iodine-reaction of the spores and the sulcation of the margin of the cap. In contrast to these last two characters, those of the volva are very complex. There are good reasons for believing that a study of the microscopic structures underlying the outer appearance of the volva will provide us with a key to a better understanding of the relationship and phylogeny in *Amanita*.

TREATISES

The genus *Amanita* has frequently been monographed. As early as 1826 Vittadini published his 'Tentamen mycologicum seu *Amanitarum* Illustratio'. In 1838 this was followed by Mladý's little known publication 'Synopsis *Amanitarum* in Agro pragensi sponte nascentium'.

Later many monographs followed, that of Gilbert even covering the whole world. Naturally *Amanita* was also treated in many floras, floristic notes, etc. The most important of these publications are for:

Europe and N. Africa: Fries (1854), Quélet & Bataille (1902), Gilbert (1918), Veselý (1933, 1934), Singer (1950), Kühner & Romagnesi (1953), Parrot (1960), Bertault (1964, 1965).

North America: Peck (1883), Lloyd (1898), Murrill (1913, 1917), Coker (1917), Hesler (1930), Hotson (1936), Murrill (1948), Pomerleau (1966).

Asia: Boedijn (1951), Hongo (1959), Corner & Bas (1962).

Africa (except the northern part): Beeli (1927, 1931, 1935).

Australia and New Zealand: Cleland (1934), Gentilli (1953), Stevenson (1962).

The whole world: Gilbert (1940–41).

MORPHOLOGICAL CHARACTERS IN AMANITA

THE DEVELOPMENT OF THE FRUIT-BODY

The development of the fruit-body in *Amanita* is relatively well known; it has been studied in several species, viz. *Amanita excelsa*—Reijnders, 1963: 131; *A. muscaria*—de Bary, 1866: 70, Brefeld, 1877: 123; *A. rubescens*—de Bary, 1866: 70, Reijnders, 1963: 127; *A. strobiliformis*—Reijnders, 1963: 125; *A. vaginata*—Atkinson, 1914: 369; *A. vittadinii*—Reijnders, 1963: 121. Some of the results of these studies are of great taxonomic interest.

The development of the fruit-body in *Amanita* is hemiangiocarpous,[16] as the hymenium is endogenous and becomes exposed just before the start of sporulation. This is in the first place caused by a well-developed volva. As, moreover, primordial tissue (the "lipsanenchyme" of Reijnders, 1963: 23) is present between the primordial gills and the primordial stem, the type of development is further specified by Reijnders (1963: 235) as bivelangiocarpous.

In *Amanita* the fruit-body is initiated in a primordial bulb whose tissue gradually differentiates into the special tissues of the different parts of the fruit-body. As early as 1889 (: 290) Fayod drew attention to the fact that in *Amanita* the position of the primordial fruit-body within the bulb is not the same in all species.

In most species (e.g. *A. muscaria*, *A. rubescens*, *A. vittadinii*) the primordial fruit-body develops excentrically near the upper surface of the bulb (Reijnders, 1963: pls. 53–55), but in *A. vaginata* it develops in or near the centre of the bulb (Atkinson, 1914: pl. 17).[17] This explains why in section *Vaginatae* a basal bulb is lacking in the mature fruit-body; nearly the whole inner part of the primordial bulb is replaced by the tissues of the fruit-body.

The first tissue to differentiate from the primordial tissue of the bulb is the outer layer of its upper part; this becomes later the universal veil or volva. Usually the boundary line between the volva and the cap becomes visible at a very early stage; this is true in those species in which at later stages a distinctly gelatinized surface-layer of the cap facilitates the separation of cap and volva. In *A. vittadinii*, however, with its adnate volval remnants on the mature cap, such a boundary line is lacking during the whole development. Thus the difference between an adnate and a discrete volva is, at least sometimes, determined in early ontogeny.

In *Amanita* the first part of the fruit-body itself to differentiate is the cap; the stem and the gills soon follow.

The ontogeny of the gills is very unusual. In most Agaricales a pre-hymenial

[16] Since I find it necessary to distinguish the 'pseudoangiocarpous' and 'hemiangiocarpous' development in Agaricales from the truly 'angiocarpous' or 'endocarpous' development in Gastromycetes, I use the terminology accepted by Singer (1962: 28). In view of the confusion about the meaning of some of these terms, perhaps the time has come to introduce a new terminology, as van Brummelen (1967: 25) did for Discomycetes.

[17] Fayod (1889: 290) stated erroneously that *A. phalloides* also has a central primordial fruit-body. In this connection Vittadini's plates (1832–5: pls. 1, 2, 11, 16, 17, 39, 44) are very instructive.

palisade layer develops on the underside of the primordial cap. From this layer the lamellae originate in the shape of ridges or folds projecting downward; increase in number of the elements of the palisade layer and growth of tramal hyphae from the cap downward cause them to increase in width. These primordial gills protrude into a pre-existent, annular gill cavity between stem and cap, which means that originally, at least, they have free edges.

During the development of the fruit-body in *Amanita* no gill cavity between cap and stem ever occurs. The gills differentiate from the primordial tissue like closely packed plates of parallel hyphae separated by hymenial palisades covering their sides. On one side the trama of these plates is connected with the trama of the cap, on the other with the primordial tissue around the stem that later forms the partial veil or ring. Thus the edges of the gills in *Amanita* do not become free until the expanding cap tears them loose from the ring. This type of development of the hymenophore, named schizohymenial by Reijnders (1963: 247), seems to be the sole type in *Amanita*; it is not known in other genera. In the only species of *Limacella*, a genus considered to be closely related to *Amanita*, that has been investigated for this, the gills develop as folds with free edges. The same applies to *Termitomyces* (Heim, 1940: 46).

After comparison of the habits of fruit-bodies in many species I have come to the conclusion that in *Amanita* the stem does not always elongate in the same way.

In *A. vittadinii* (Fig. 1a) it is especially the part of the stem below the level of the margin of the primordial cap, including the primordial bulb, that elongates. The result is that in the mature fruit-body the primordial bulb cannot be distinguished from the stem and that the adnate volval remnants covering the lower part of the primordial stem and bulb become scattered over the whole part of the stem below the ring. In *Amanita* this 'base-elongating' stem is restricted to several species in subsection *Vittadiniae* and one or a few in subsection *Solitariae* (*A. timida*; see Fig. 96).

In most species of *Amanita* it is the part of the primordial stem above the level

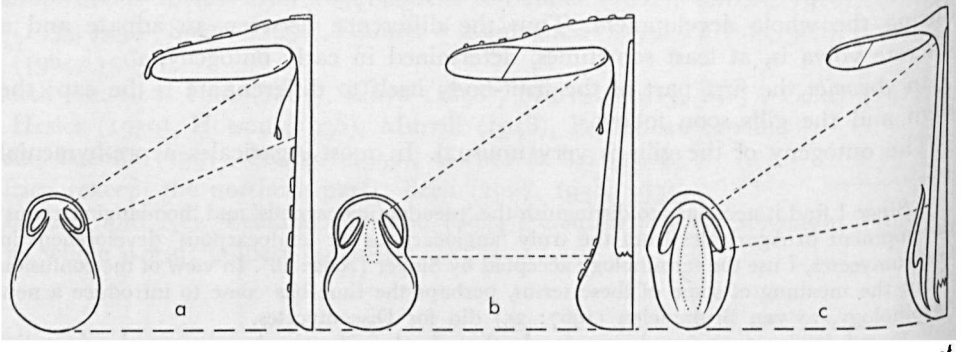


Fig. 1. Diagrammatic sections of primordia and mature fruit-bodies, illustrating zones of elongation of stems. — a. *Amanita vittadinii*. — b. *A. muscaria*. — c. *A. vaginata*.

of the margin of the primordial cap that elongates (Fig. 1b). In the 'apex-elongating' stem the lower part of the stem and the primordial bulb do not or scarcely become longer. Consequently in the mature fruit-body there is a usually distinct basal bulb (= the former primordial bulb) and the volval remnants on stem and bulb are concentrated at a narrow basal zone of the stem and/or the upper half of the bulb.

In section *Vaginatae* (Fig. 1c) the 'totally elongating' stem is found. A result of the above mentioned more or less central position of the primordial fruit-body in the primordial bulb is that the tissue of the lower part of this bulb is almost completely replaced by that of the primordial stem. Later the entire stem participates in the elongation. Consequently in the mature fruit-body the lacking basal bulb has so far appeared to be a good character for the delineation of section *Vaginatae* as opposed to section *Amanita*. The volval remnants usually have the shape of a saccate volva, rarely of floccose girdles around the base of the stem.

There are indications that the 'totally elongating' stem also occurs in another section with a usually saccate volva, viz. section *Amidella* (see Gilbert, 1941: pl. 32, 34, 35, 36). Thus far I have found no indications of this in the saccate-volvate species of section *Phalloideae*.

It should be mentioned that the three cases described here are the most extreme. Several intermediate types exist. Nevertheless knowledge of these characters will help further understanding of the pattern of relationship in *Amanita*.

In my opinion the excentric primordium combined with the 'base-elongating' stem is probably the most primitive structure; from this the excentric primordium with the 'apex-elongating' stem may have developed and later the central primordium with the 'totally elongating' stem.

CHARACTERS OF THE MARGIN OF THE CAP

The marginal sulcation.

In many species of *Amanita* the margin of the cap is radially striate with shallow grooves corresponding with the places of attachment of the gills at the underside of the cap. Although the taxonomic value of this character had been recognized by Fries, it was not fully appreciated until Gilbert & Kühner (1928: 52) demonstrated its high degree of correlation with the reaction of the walls of the spores in Melzer's reagent (see p. 320).

The biological value of the sulcate margin of the cap in agarics is evident; it facilitates a rapid expansion of the cap. It can be expected in those groups of agarics where during development a period of differentiation is distinguishable from a succeeding period of elongation and expansion (Fayod's "période primordiale" and "période d'élongation"; 1889: 279, 292). It is possible for agarics with this type of development, which Reijnders (1963: 221) called "développement concentré," to construct a complete fruit-body under the protection of possible primordial covering layers and in or near the relative safety of the substrate, under favourable conditions allowing the fruit-body to grow out in a short time. Thus the vulnerable

fruit-body is completely exposed to the hazards of the environment for a period only slightly longer than necessary for the successful liberation of the spores.

By the time the cap of an agaric has fully spread, the edge of the cap will have become about four to eight times longer than it was just before the cap started to expand. This means that in species with a smooth margin of the cap a strong intercalary growth and/or a large-scale inflation of the cells and/or a rearrangement of the hyphae is necessary; these processes take time and energy. In species with marginal sulcation a certain (in extreme cases probably very high) percentage of the increase in the length of the marginal zone of the cap is obtained by a passive opening out of the preformed grooves. This 'parasol-mechanism' occurs in several unrelated groups of agarics (e.g. *Coprinus*, *Leucocoprinus*, *Bolbitius*, *Amanita*). Its most extreme form has been described by Buller (1931: 26, 34, figs. 16, 19) for *Coprinus curtus* Kalchbr. and *C. plicatilis* (Curt. per Fr.) Fr., where upon expansion of the cap the trama of the cap splits radially from above downward, the splitting continuing downward into the trama of the gills along their median plane. To a much lesser extent this also happens in some of the most strongly sulcate species of *Amanita* section *Vaginatae*, as was previously pointed out by Huijsman (1959: 22).

Generally speaking the sulcate margin of the cap is characteristic of subgenus *Amanita*.[18] It is, however, important to mention that in all sections of subgenus *Lepidella* one or a few species occur with the same character, though usually to only a slight degree; e.g. in sect. *Lepidella*, *A. limbatula* (see p. 530); in sect. *Amidella*, *A. goossensiae* and others; in sect. *Validae*, *A. xanthella*; in sect. *Phalloideae*, *A. subunquillea*. Perhaps these species indicate the places at which connections between subgenus *Lepidella* and subgenus *Amanita* must be sought.

There is scarcely any doubt that the sulcate margin is a character derived from the smooth margin of the cap.

It should be emphasized here that in order to facilitate comparison between specimens and species a more exact method for recording the length of the marginal sulcation of the cap than is usual is needed. I found it satisfactory to measure the length of the grooves in tenths of the distance (R) from the centre of the cap to its edge.[19]

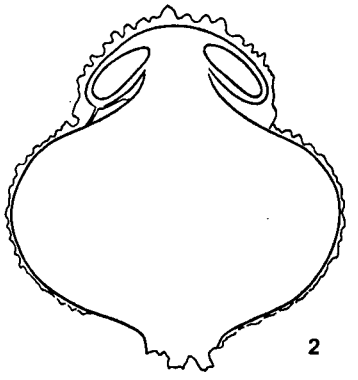
The appendiculate margin of the cap.

In many, if not all species of sections *Lepidella* and *Amidella* the edge of the freshly expanded cap is more or less conspicuously appendiculate with remnants of the partial veil. In the key to the sections of *Amanita* (p. 341) I have used this character, among others, to delimit section *Lepidella* against sections *Validae* and *Phalloideae*.

In advanced primordia cut lengthwise (Figs. 2, 3) it is easy to see that at the edge of the cap the trama of the cap corresponds with the tissue of the partial veil.

[18] The species placed by Gilbert in *Ariella* E. J. Gilb. are left out of consideration for reasons mentioned on p. 297.

[19] According to this method the length of the marginal sulcation in *A. argentea* proved to be 0.1–0.2 R and in *A. vaginata* 0.3–0.4 R (Bas, 1967: 125).



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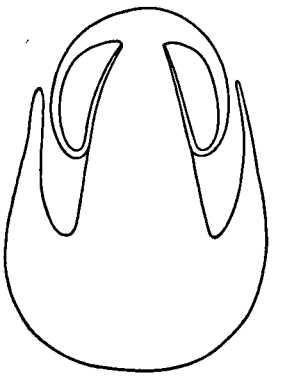

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Figs. 2, 3. — Median sections of primordia. — 2. *A. virginea* (× 3/2; after drawing in Corner's field-notes, 13 Dec. 1933, Singapore). — 3. *A. virosa* (× 3/2; from *de Cock Buning, 19 Aug. 1967, Doorn*; L).

When the margin of the cap is appendiculate, the line of separation between the margin of the cap and the partial veil is apparently not predetermined exactly. I can think of five reasons for this:

(i) The trama of the cap is relatively thick at the edge of the cap, so that the strip along which there is contact with the partial veil is broader than in a thin-fleshed cap.

(ii) In the primordium the early-developing hyphae of the margin of the cap penetrate into the lipsanenchyma (primordial tissue between stem and gills which later, to some extent at least, forms the partial veil). This was observed by Reijnders (1963: 126) in "*A. solitaria*" (sensu auct. europ. = *A. strobiliformis*). But in *A. vittadinii*, where I should have expected the same thing, Reijnders (1963: 124) found that the hyphae of the cap terminated abruptly at its edge.

(iii) The pileipellis is poorly developed. In species with a distinctly gelatinized pileipellis this layer terminates at the edge of the cap, causing a sudden change of structure whose importance increases in accordance with the thinness of the trama.

(iv) In species with a non-appendiculate margin of the cap a loose tissue with many inflated cells is formed at the junction of the trama of the cap and the partial veil; this tissue is lacking in species with an appendiculate margin. My observations on free-hand sections of young caps of *A. timida* and *A. virosa* indicate this.

(v) The partial veil is incoherent. It should be pointed out, however, that in some species with a substantial ring the cap is strongly appendiculate, while several species with a friable partial veil (e.g. in section *Validae*) have a non-appendiculate edge of the cap. The degree of coherence of the partial veil therefore seems to be of little importance for the appendiculate edge of the cap.

In my opinion the appendiculate margin of the cap is more primitive than the non-appendiculate margin, since the latter results from the greater differentiation

and independence of the parts of the fruit-body involved in its formation (partial veil, trama of cap, and pileipellis).

THE VOLVA

Terminology.

In many agarics the primordial fruit-body is surrounded by an outer veil; this may be formed by either (i) the mycelium ('primordial veil', 'protoblem'), (ii) the early differentiating outer layer of the primordium ('universal veil', 'blematogen', and 'teleoblem', 'voile inné') or, (iii) hyphae growing out from parts of the young fruit-body ('voile émané', 'universal pseudoveil').

As already mentioned in the chapter on ontogeny (p. 299), the outer veil of *Amanita* belongs to the second category, although sometimes at least, it is reinforced by elements growing out from the primordial cap (*A. vittadinii*; see Reijnders, 1963: 124, 207).

It is a long-standing tradition to name the outer veil or universal veil in *Amanita* a 'volva', irrespective of its structure. Micheli, Bulliard, Persoon, Fries, Vittadini, and others called the friable universal veil in species like *A. muscaria* and *A. rubescens* a 'volva', as they also did in the case of the saccate universal veil in *A. vaginata*.

Several recent authors (Ainsworth, Josserand) prefer to restrict the application of the term 'volva' to the saccate universal veil, others (Gilbert, Snell & Dick) to Atkinson's teleoblem (a universal veil that becomes separated from the cap by a cleavage layer); Lohwag and Singer, however, regard the term 'volva' as a synonym of 'universal veil'.

I agree with Lohwag and Singer.[20] Judging by my own experience, especially in *Amanita* section *Lepidella*, there are many intermediate forms between the saccate and the friable volva (see subsection *Limbatulae* on p. 528), just as there are all degrees of separation between the volva and the surface of the cap. Moreover, compared with 'volva', 'universal veil' is a rather clumsy term.

For the most salient modifications of the volva, even though nearly all of them are connected by intermediate forms, descriptive terms are needed.

The 'adnate volva' does not become separated from the cap by a cleavage layer. This in contrast with the 'discrete volva', which becomes more or less separated by the development of a gelatinous layer, a friable layer or both between volva and cap.

The 'saccate volva' remains behind at the base of the stem as a sac, cup, or sheath and usually leaves the cap naked, whereas the 'friable volva' breaks up into

[20] Without studying the development of the fruit-bodies of a species it is difficult to tell the origin of its outer veil. Therefore it would perhaps be useful to call any outer layer a volva. Once the origin is known it could be further specified as a 'mycelial volva' (if formed by the mycelium), a 'true volva' (if differentiated from primordial tissue) or a 'spurious volva' (if grown out from parts of the young fruit-body).

fragments, usually embossing both the stem and the cap after expansion of the fruit-body.

The 'layered volva' consists of two or more layers differing in structure.

The 'obliterate volva' leaves scarcely any remnants on the mature fruit-body.

Many different types of friable volvae can be distinguished according to the shape and structure of the volval remnants on the cap.

The 'pulverulent volva', the 'floccose volva', and the 'lanose volva' form respectively powdery, floccose or woolly layers on the whole cap, or parts of it.

The 'crust-forming volva' covers one area or more with a thin, incoherent and to the naked eye amorphous layer of volval tissue.

The 'patch-forming volva' breaks up into thin to thick, usually more or less felted patches.

The 'scale-forming volva' forms adnate, often imbricate, scale-like patches that are thin and vaguely delimited towards the centre of the cap but thick and terminating abruptly towards the margin of the cap.[21]

The 'wart-forming volva' forms remnants which are relatively narrow and high, such as pustules, warts, and spines.

The volval remnants at the base of the stem often differ in size and/or shape from those on the cap. Terms are available for a few special cases in which the upper, but not the lower part of the volva is friable.

The 'circumscissile volva' has the lower part adnate to the basal bulb. The upper part detaches itself along the relatively sharp edge of the bulb.

The 'ocreate volva' is adnate to the base of the stem, sheathing it like a stocking; often it has a rather sharp edge somewhere against the base of the stem, but no free marginal limb.

The 'limbate volva' is adnate to the base of the stem but has a narrow, free, membranous margin.

Structure and behaviour of the volva.

The unique variation in volva patterns in mature fruit-bodies of species of *Amanita* is determined by a large number of factors. First there are the properties of the volva itself, then those of other parts of the fruit-body and finally environmental influences.

Properties of the volva itself.

THE TEXTURE OF THE VOLVA.—As is the case with the tissues in nearly all the parts of the fruit-body of *Amanita*, the volva is usually composed of branching, not or slightly inflated hyphae, inflated cells single or in rows terminal on the hyphae, and fairly often also 'oleiferous hyphae'. The last mentioned elements are left out of consideration here because they rarely seem to affect the behaviour of the volva (but see *A. xanthogala* on p. 490).

[21] The term 'scale' is often used rather indiscriminately in descriptions of *Amanita*. Therefore it seemed advisable to define its meaning here.

The inflated elements in the volval tissue are either single and terminally attached to hyphae, or arranged in short to long terminal rows. Only rarely have I seen inflated intercalary cells. Sometimes, however, it is as though the inflating habit of the terminal cells also invades the hyphal system bearing these cells; in that case there are inflated branching elements and/or subcylindrical elements at the base of terminal inflated cells.

In general long rows of inflated cells will make the volval tissue looser and more friable than when the inflated cells are single and terminal, especially when the rows tend to fall apart easily. On the other hand a volva with abundant or very large, terminal inflated cells can be strongly friable, as is the case in some species of the *A. rubescens*-group, whereas in subsection *Vittadiniae* the volva consists of long rows of mainly fusiform to subcylindrical inflated cells, even though in some species it is fairly coherent.

THE RATIO OF HYPHAE AND INFLATED CELLS IN THE VOLVA.—In rare cases the volval tissue consists almost solely of one type of element. The outer limb of the saccate volva in *A. phalloides* and *A. virosa*, for instance, is composed merely of interwoven hyphae; on the contrary the wart-forming volva of *A. virginea* (p. 487) and the pulverulent volva of *A. tephrea* (p. 452) are almost completely made up of inflated cells. But most types of volval tissue are a mixture of hyphae and inflated cells.

No comment is needed to show that the ratio of hyphae and inflated cells is one of the main factors determining the degree of consistency of the volval tissue. Unfortunately it is very difficult to put this ratio into words, mainly because of the wide variability in the size and shape of the elements, especially the inflated ones. In the descriptions I have restricted myself to the application of a scale of frequency (scarce, scattered, rather or fairly abundant, abundant, very abundant) to both types of element.

THE DISPOSITION OF THE VOLVAL ELEMENTS.—The second most important structural character of the volva is the disposition of the elements which may be (i) disposed in a position perpendicular to the surface of the fruit-body (anticlinal position), (ii) interwoven in all directions, or (iii) disposed in a position parallel to the surface of the fruit-body (periclinal position). In the last case the elements are usually interwoven in periclinal directions.

(i) The volva that has its elements in anticlinal position has a tendency to split perpendicular to the surface of the expanding fruit-body; the more perfect the anticlinal position of the elements, the easier the splitting of the volva and the smaller the resulting warts (see *A. daucipes* on p. 447, *A. solitaria* on p. 394, and *A. salmonea* on p. 360). If, however, the cells in the rows easily become disconnected, the volva becomes completely pulverulent (see *A. chlorinosma* on p. 450). In subsection *Solitariae* it is not rare to find a type of volva in which the rows of inflated cells and single, elongate inflated cells have an anticlinal position even though to a certain degree the hyphae are interwoven (see *A. cokeri* on p. 390).

(ii) More common is the type of volva of which the elements are interwoven in all directions. What happens when the fruit-body expands depends entirely on the coherence of the volval tissue, its thickness, the degree of its adhesion to the surface of the fruit-body, and environmental factors. The resulting volval remnants may have any form from a pulverulent layer to large warts, or patches, or even a (sub)-membranous basal sac, though generally this type of volva will tend to break up into patches.

(iii) The type of volva with all its elements disposed in a periclinal position is probably rare. In some species (e.g. *A. vittadinii*, *A. codinae*) of subsection *Vittadiniae* I found the chains of long inflated cells in the volva in a periclinal position, at least on the limb of the cap. The margin of the volval limb of *A. phalloides* and related species consists almost solely of periclinal hyphae. Perhaps this type of volval structure is also to be found in other species with a membranous volva.

Less rare are periclinally disposed elements in layered volvas. The outer layer especially may then consist of periclinal hyphae, as is the case in most species of subsection *Limbatulae* (see p. 528). The friable layer between the cap and the solid part of the volva sometimes found in section *Amidella* consists of periclinal, large, elongate cells.

THE LAYERED VOLVA.—It is only rarely that the parts of the volva close to the surface of the cap have exactly the same structure as the parts close to its outer surface. Very often in the inner parts of the volva the hyphae are more abundant, the inflated cells larger, etc.

In a number of cases these differences in structure are so great that two or three layers are discernible in the volva.

Probably the most common type of layered volva is that in which the main part of the volva consists of intermixed hyphae and fairly to very abundant inflated cells, but the outer, or both the outer and inner surface layer of the volva mainly of periclinal hyphae.

The type of volva with only the outer layer made up chiefly of hyphae is common in subsection *Limbatulae* (Figs. 358, 359, 362, 363, 371, 372). This is intermediate between the friable, more or less homogeneous volva, composed of interwoven hyphae and inflated cells, found in many species of subsection *Solitariae*, and the saccate volva in section *Amidella*.

Preliminary observations revealed that in section *Amidella* the type of volva that mainly occurs has periclinal elements in the outer and inner layers. In some of the species of this section (e.g. *A. volvata*, *A. lepiotoides*, etc.) the inner layer of periclinal elements is friable, as it consists of few hyphae and abundant large, elongate cells (Figs. 4–6). In these species the greater part of the volva forms a sac at the base of the stem of the mature fruit-body, but the inner layer of the volva breaks up into small fragments which become scattered over the surface of the cap. Later these fragments sometimes turn rusty or red-brown after which they contrast strongly with the usually pale surface of the cap.

Quite another type of layered volva is found in stirps *Ravenelii* and, less conspicuously, also in stirps *Solitaria*, both in subsection *Solitariae*. There the volva consists of mainly anticlinal elements; the inner part of the volva contains for the most part only hyphae and the outer part chiefly inflated cells. Especially in the type specimen of *A. crassa* (Fig. 118) the contrast between the fibrillose lower part and the more or less felted upper part of the warts on the cap is very clear.

A peculiar type of layered volva has been found in an as yet undescribed species of *Amanita* from northern India (*Bas 4378*; L) in which the inner part of the volva consists of densely interwoven hyphae and scattered small inflated cells, and the outer part of very abundant globose cells and hyphae. This volva forms a sac at the base of the stem, the outside of which is covered with rather prominent brownish conical warts. The species is probably closely related to *A. strobilaceovolvata* (Beeli, 1935: pl. 1 fig. 4; Gilbert, 1941: pl. 8) from the Congo, which judging by the illustrations has a similar volva.

In species where the pileipellis gelatinizes early the volval layer close to the pileipellis as a rule also participates in this process; in that case the volva has a thin but distinct gelatinous inner layer.

THE COHERENCE OF THE VOLVAL ELEMENTS.—The elements of the volva sometimes become very easily disconnected. Naturally this affects the behaviour of the volva which in these cases tends to become pulverulent.

In *A. solitariiformis* (p. 495) it is practically impossible to examine the structure of the volva because in all mounts, no matter how carefully they are prepared, nearly all the elements are found disconnected. On the other hand even in species with very large inflated cells in the volva the connections between these and the much narrower hyphae are often fairly easy to study.

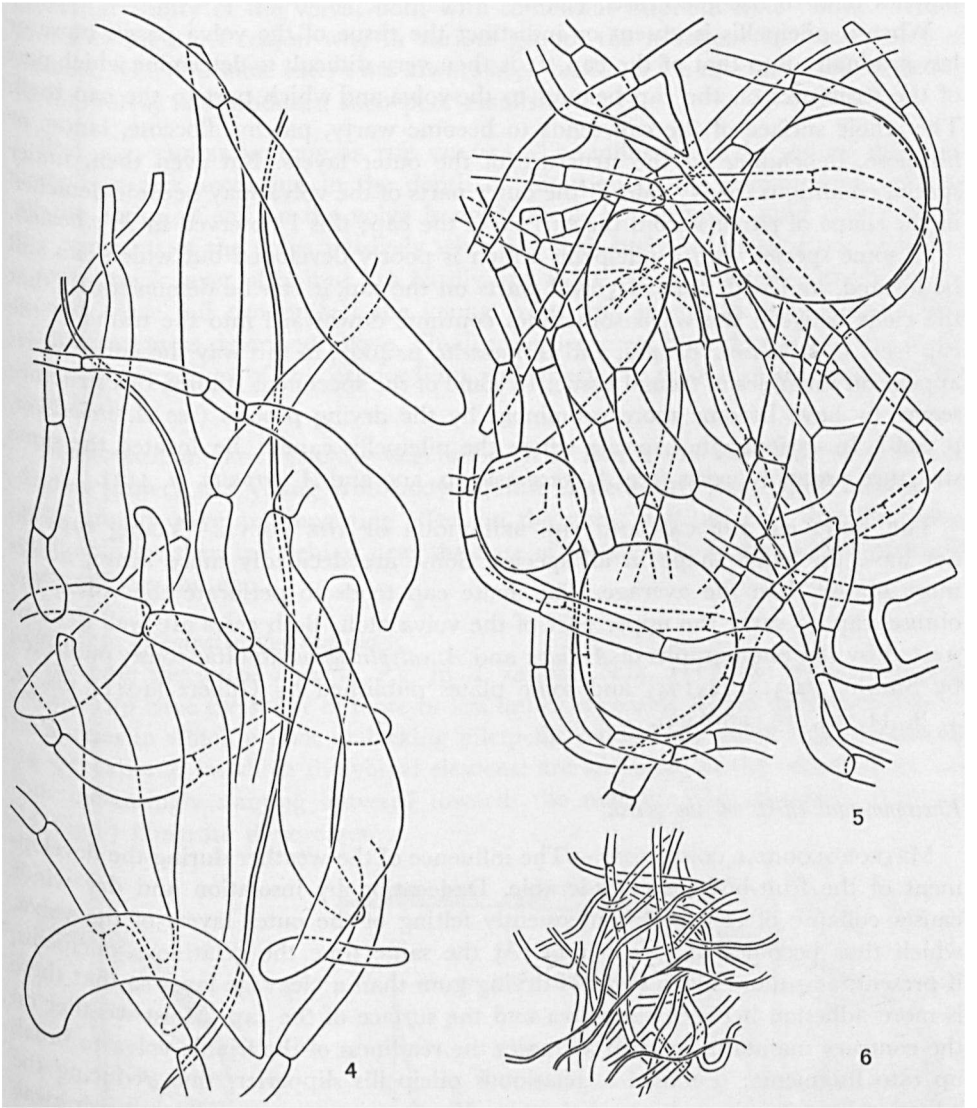
THE THICKNESS OF THE VOLVA.—In general a thin volva will be more easily disrupted than a thick volva of the same structure. Actually *Amanita* varies rather widely in the thickness of the volva; compare for instance *A. sculpta* (Fig. 242) with *A. borneensis* (Fig. 234), or *A. abrupta* (Fig. 154) with *A. onusta* (Figs. 158, 160).

Effects of other parts of the fruit-body on the volva.

THE STRUCTURE OF THE PILEIPELLIS AND THE BEHAVIOUR OF THE VOLVA.—The pileipellis may be strongly differentiated, gelatinizing very early, or well differentiated but not gelatinizing, or poorly or not differentiated and not gelatinizing. These types of pileipellis are, however, connected by intermediate forms.

The gelatinizing pileipellis tends to be slippery during the expansion of the fruit-body and unless the fruit-body has been growing under very dry conditions this will only affect the behaviour of a volva which is more or less friable. (Even in *A. phalloides*, with its membranous volva and gelatinizing pileipellis, the upper part of the volva may under certain conditions form patches on the cap.) Under normal conditions, however, the adhesion between the volva and the gelatinous pileipellis seems to be strong enough to disperse the fragments of a friable volva

over the whole surface of the cap as, for instance, is usually the case in *A. muscaria*. But under other conditions the gelatinous pileipellis may be so slippery that even a friable volva remains at the base of the stem as a sheath. Such an incidental form of *A. muscaria* has been given the name *A. aureola* Kalchbr.



Figs. 4–6. Structures of volval limb of *A. volvata*. — 4. Inner surface layer. — 5. Inner tissue. — 6. Outer surface layer (× 325; from *Bas 3799*; L).

When the pileipellis is well differentiated but does not gelatinize or else only late, the adhesion between volva and pileipellis is much stronger than in the foregoing. The parts of the remnants of the volva that are close to the pileipellis are stretched in periclinal directions when the cap expands, the closer the remnants are to the margin of the cap the more so. Thus warts tend to become low warts or scales, patches tend to become crusts, etc.

When a pileipellis is absent or indistinct the tissue of the volva passes more or less gradually into that of the cap. It is then very difficult to determine which part of the structures on the cap belongs to the volva and which part to the cap itself. The whole surface of the cap tends to become warty, patchy, floccose, lanose or fibrillose, depending on the structure of the outer layers. But even then, under special conditions (heavy rains?) the outer parts of the volva may become detached in the shape of patches from the surface of the cap; this I observed in *A. vittadinii*.

In some species with a pileipellis which is poorly developed but which can still be located, and with conical volval warts on the cap, it can be demonstrated that the clefts between the warts sometimes continue downward into the trama of the cap (see *A. strobilacea*, p. 406, and *A. ravenelii*, p. 400); in this way the volval warts appear on tubercles of tramal tissue. In some of the specimens studied this structure seems to have become more prominent by the drying process (see *A. strobilacea*, p. 406). In various other species where the pileipellis cannot be located the same structure probably exists (see *A. crassiconus*, p. 500 and *A. perpasta*, p. 412).

THE SHAPE OF THE CAP AND THE BEHAVIOUR OF THE VOLVA.—Young caps do not have the same shape in all species. Some are decidedly more acute, others more obtuse than the average. The acute cap tends to perforate the volva, the obtuse cap to carry the upper part of the volva aloft. Both cases are well demonstrated by the photographs of *A. fulva* and *A. calyptroderma* simultaneously published by Smith (1963: 172–174) and some plates published by Gilbert (1941: pls. 2, 4, 8, 11, 14, 15, and 23).

Environmental effects on the volva.

METEOROLOGICAL CONDITIONS.—The influence of the weather during the development of the fruit-body is considerable. Desiccation by insolation and dry winds causes collapse of cells and consequently felting of the outer layers of the volva, which thus becomes more coherent. At the same time the gelatinous pileipellis, if present, acts more like a layer of drying gum than a cleavage layer so that there is more adhesion between the volva and the surface of the cap. Moist weather on the contrary maintains or even increases the readiness of the friable volva to break up into fragments; it makes a gelatinous pileipellis slipperier, thus reducing the adhesion between the volva and the cap. Heavy rains may completely wash away the volval remnants from the cap, even when the pileipellis is only poorly developed.

Desiccation and humidification (together with other factors) also determine

the degree of expansion reached by the fruit-body; the expansion in turn affects the volval remnants on the cap.

During the expansion of the cap the degree of humidity may provoke two more or less contrasting processes: desiccation → greater adhesion of the volva to the cap but less friability of the volva; humidification → less adhesion to the cap but greater friability of the volva, both with somewhat unpredictable results. This is probably the chief reason why in various groups the infrageneric classification of *Amanita*, which to some extent has always been based on the macroscopical structure of the volva, has produced such poor results.

SOIL AND THE BEHAVIOUR OF THE VOLVA.—The influence of the soil on the fruit-body increases according to the depth of initiation of the primordium. First of all the action of soil on the volva is mechanical. For instance solid clay rubs off the remnants of the volva passively while the fruit-body is breaking out of it, but a loose, thick layer of humus has hardly any influence on the volva at all. In the second place soil can protect the young volva and pileipellis against the effects of desiccation as described above. Finally the degree of humidity of the soil in the wider surroundings of the primordium will affect the degree of expansion of the fruit-body.

SURROUNDING VEGETATION.—Vegetation, if it is not too low, will to a certain degree protect the young fruit-body against desiccation. Deep moss and dense grass usually have an elongating effect on the stem; it is not rare that the volval remnants are then left behind near the base of the stem in species where normally they emboss the cap.

The shape of volval scales and warts.

In some species of *Amanita*, e.g. in *A. ravenelii* (Fig. 111), the volval remnants on the cap have the shape of more or less imbricate scales. These structures develop in species in which a poor or lacking pileipellis renders the volva closely adherent to the cap and in which the volval elements are anticlinal at the centre of the cap but increasingly slanting outward towards the margin. The schematic drawings in Fig. 7 illustrate these cases.

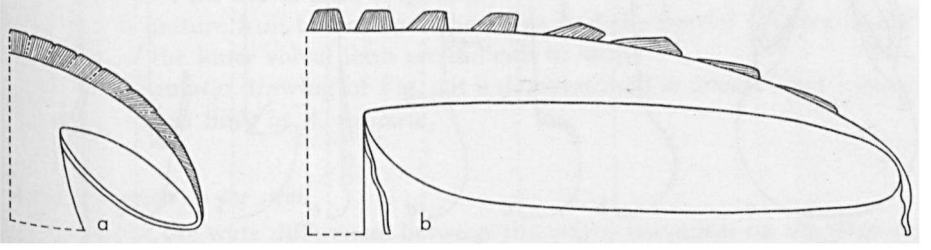


Fig. 7. Diagrammatic sections of young and mature cap, illustrating formation of volval scales; lines in volval remnants indicate main direction of elements.

Volval warts are often cone-chaped. This is probably due to one or more of the following conditions:

(i) From the beginning the volva consists of more or less periclinal elements growing out in tufts from the primordial surface, with the tips of the rows of cells and/or hyphae inclining towards each other. This would explain the conical warts on the caps of very young primordia, for instance in *A. virginea*, long before there is any sign of expansion of the cap.

(ii) If the young volva is a fairly continuous layer over the primordial cap, at a given moment the growth of probably first the outer and subsequently the inner layer stops, the continuing growth of the cap underneath causing it to break up into fragments. Especially where the volva is thick, broad-based warts would be formed like this. It would explain the large conical warts consisting of irregularly disposed elements, like in *A. crassiconus* (Fig. 269).

(iii) The tissue in the tip of a volval wart is more subject to desiccation than that in the base. Desiccation checks the inflation of cells and provokes the collapse of inflated cells.

(iv) When the adhesion of the volva to the surface of the cap is sufficiently strong the base of the warts will be stretched in periclinal directions, the closer they are to the margin of the cap the more so.

The processes described under (i), (iii), and (iv) undoubtedly take place in *Amanita*; that under (ii) very probably, but this remains to be proved.

The inner limb of the volva.

In the primordial fruit-bodies of *Amanita* a ring-like band of tissue fills up the space between the partial veil and the stem (Fig. 8a); downward it passess gradually into the tissue of the volva. Sometimes it is very strongly developed (see Fig. 2 of *A. virginea*), sometimes scarcely discernible (see Fig. 8f of *A. citrina*). It forms the rest of the primordial tissue (Reijnders' lipsanenchyma) between gills and stem after this has been partially transformed into or replaced by the partial veil.

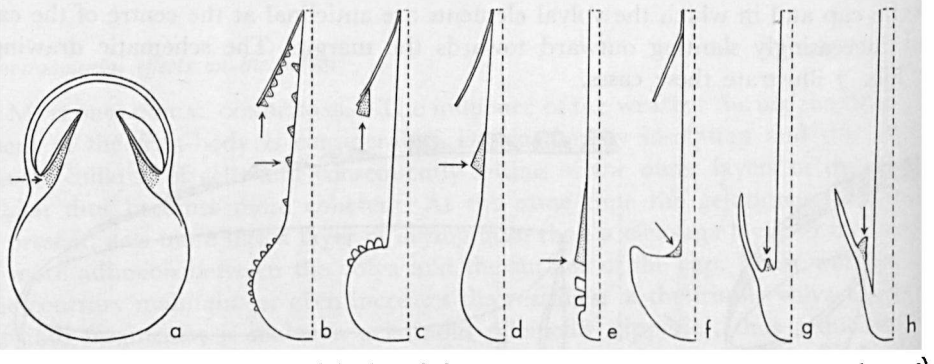


Fig. 8. Diagrams showing original and final positions of inner volval limb (dotted areas). — a. Section of primordium. — b–h. Sections of stems. — b. *Amanita virginea*. — c. *A. muscaria*. — d. *A. ochrophylla*. — e. *A. inaurata*. — f. *A. citrina*. — g. *A. argentea*. — h. *A. vaginata*.

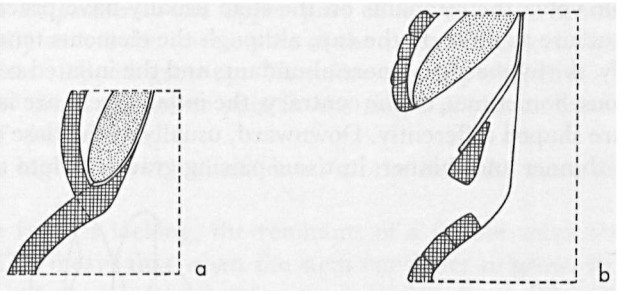


Fig. 9. Diagrammatic sections of young fruit-bodies of *Amanita muscaria*, illustrating position of inner volval limb just before and after expansion of cap (× 2).

In longitudinal sections of advanced primordia this band of tissue presents itself as an inward limb of the volva penetrating between partial veil and stem (shaded area in Fig. 8a). Since Atkinson's publication on the ontogeny of *Amanita vaginata* (1914: 383) it is usually called the inner limb of the volva (limbus internus volvae).

According to Atkinson (1914: 390) in *A. vaginata* the inner limb in the mature fruit-body has the same microscopic structure as the volva. I observed the same in some species of *Amanita* section *Lepidella*. (e.g. *A. virginea*, *A. ochrophylla*, and *A. perpasta*).

In mature fruit-bodies the remnants of the inner volval limb may end up at many different places according to the type of development of the various species. In *A. virginea* they form warts on the underside of the ring, and warts or rags on the stem (Fig. 8b). In *A. muscaria* we find them in the shape of a ring of warts on the underside of the margin of the ring (Fig. 8c). In *A. ochrophylla* they usually form a ring-like belt (spurious ring) on the stem somewhere below the (true) ring (Fig. 8d). In *A. inaurata* they are found as a belt near the base of the stem just above the remnants of the volva (Fig. 8e). In *A. citrina* they form a scarcely discernible strip of tissue at the transitional zone between stem and bulb (Fig. 8f). In *A. argentea* they are found as a circular rim situated in the angle between the base of the stem and the limb of the volva (Fig. 8g). In *A. vaginata* they form a similar rim but situated at the inside of the volval limb (Fig. 8h).

When in mature fruit-bodies both the volva and the partial veil are friable the remnants of the inner volval limb are difficult to locate.

In the schematic drawing of Fig. 9 it is demonstrated in detail, what happens to the inner volval limb in *A. muscaria*.

Volval structures on the stem.

In view of the wide differences between the volval structures on the stem caused by a friable, a circumscissile, a limbate, or a saccate volva, these four cases are taken up separately.

With a friable volva the remnants on the stem usually have practically the same microscopic structure as those on the cap, although the elements tend to be disposed more irregularly, the hyphae to be more abundant, and the inflated cells to be scarcer or less voluminous. Sometimes, on the contrary, the inflated cells are larger than those on the cap or are shaped differently. Downward, usually at the base of the stem, the volva becomes thinner and thinner, its tissue passing gradually into that of the stem.

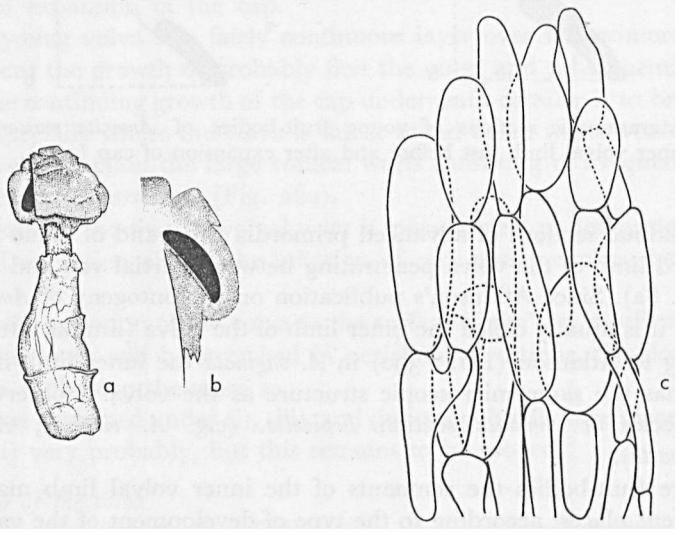


Fig. 10. Young fruit-body of unidentified species of subsection *Vittadiniae*; dotted lines in sectioned cap indicate direction of volval elements. — a. Habit (× 1/2). — b. Median section of cap (× 5/4). — c. Elements of volval remnants on cap (325 ×; all figs. from *F 38904*; FLAS).

In some species of subsection *Vittadiniae* the volval elements are disposed perpendicular to the surface at the centre of the cap of a button but towards the margin slanting outwards more and more until they are roughly parallel with the axis of the stem. Downward, in the volval tissue covering the stem, the elements continue in the same direction. This is demonstrated in Fig. 10 which represents an unidentified button of a species (*F 38904*, FLAS) of that group. This type of volva seems to be restricted to species in which it is especially the basal part of the stem that elongates (see p. 300).

The final shape of the volval remnants on the stem depends not only on the microscopic structure of the volva, but also in no small measure on the behaviour of the part of the stem to which they are attached. If, after the volva stops growing, the tissue of the stem underneath continues to elongate, the volva is stretched longitudinally, often breaking up into circular belts. If at the same time that part of the stem continues to become thicker, the volva is also stretched transversally, often breaking up into warts.

Apparently in *A. pantherina* the upper part of the volval sock around the base of the stem usually covers the lowest part of the stem, which continues to elongate after the volva has stopped growing. Therefore the upper part of the volval sock is often separated from the lower part in the shape of the circular volval rim so characteristic of this species.

In general the higher the volval remnants on the stem the more they are subject to stretching.

As a cleavage layer is lacking, the remnants of a friable volva on the stem are usually adnate. This means that when the stem continues to grow, its parts directly underneath the volval remnants become more or less fixed. Thus these parts are then separated by longitudinal clefts from the tissue of the stem, which is growing unhampered, and the volval remnants end up on the tips of scales. In this way for instance the flat membranous scales on the stem of *A. vittadinii* (Fig. 27) and the recurving scales on the base of the stem of *A. solitaria* (Fig. 104) are formed.

When the volva is circumscissile the upper part is usually friable, but the lower part is adnate to the bulb of the stem and difficult to distinguish from the covering layers of the bulb. In this case the bulb does not or scarcely participate in the elongation of the stem and it has a sharp edge along which the upper part of the volva is torn loose when the fruit-body starts to expand. This line of separation usually lies somewhat higher than the level of the margin of the cap in its original position.

Probably this type is due not so much to a specially structured volva as to a position of the young fruit-body in the primordial bulb deeper than in species with an immarginate bulb.

In section *Lepidella* a usually circumscissile volva is found in *A. silvicola* (Fig. 315) and *A. inodora* (Fig. 355).

The limbate volva is intermediate between the friable volva on the one side and the saccate volva on the other. The lower part is adnate to the base of the stem; its upper part, which originally surrounded the cap, is partly (sub)membranous (usually in the outer layer) and partly friable. Normally the mature fruit-body has volval remnants on the cap and a narrow volval limb at the base of the stem.

In the mature fruit-body the volval limb is found more or less appressed against the base of the stem (Figs. 328, 330, 361), or separated from the base of the stem by a circular groove which originally contained the margin of the cap (Figs. 336, 350). The presence of this groove seems again to depend on how deep in the primordial bulb the fruit-body is formed. Sometimes the bulb itself is apparently marginate from the beginning and the limb of the volva is inserted half-way between the base of the stem and the margin of the bulb (Fig. 321).

Within section *Lepidella* the limbate volva is here considered to be the main character of subsection *Limbatulae* (p. 528). It is very well possible, however, that this type of volva will also appear in other sections where intermediate forms between

a friable and a saccate volva may be expected, viz. in sections *Phalloideae*, *Amanita*, and *Vaginatae*.

The saccate volva is normally left behind at the base of the stem as a membranous to fleshy sac, sometimes with the exception of fragments of a friable inner layer (see p. 307) left behind on the cap. This does not necessarily mean that this type of volva is made up mainly of hyphae. My preliminary observations have shown that a saccate volva usually consists of a membranous inner and outer layer consisting mainly of hyphae, closing in an inner tissue made up of hyphae and rather abundant inflated cells; downward this inner tissue passes gradually into that of the base of the stem. The limb of the volva in mature fruit-bodies of *A. phalloides* and *A. virosa*, however, consists almost completely of hyphae.

All grades of separation between volva and base of stem occur. The lower part of the saccate volva may be completely adnate to the base of the stem, as in *A. fulvopulverulenta* (see Gilbert, 1941: pl. 38 or Beeli, 1935: pl. 3 fig. 1) and *A. ovoidea* (see Vittadini, 1832–35: pl. 2), or attached only to the outermost base of the stem, as in *A. princeps* and *A. hemibapha* (see Corner & Bas, 1962: pl. 10, 11).

These differences will certainly be important in a classification of the species in the sections of *Amanita* with a saccate volva. Huijsman (1959: 18) has pointed out that in the *Vaginatae* the position of the inner volval limb is a great help in classification. He introduced the adjectives 'unitangent' for the type of saccate volva in which the inner limb is in the angle between the volva and the stem (Fig. 8g) and 'bitangent' for that in which it is on the inside of the volva (Fig. 8h).

THE PARTIAL VEIL

In *Amanita* the primordial tissue between the primordial gills and stem usually differentiates for the greater part[22] into a veil covering the edges of the young gills from the top of the stem to the margin of the cap. This type of veil is often called 'partial veil', sometimes 'annulus superus'. In the present work it is mostly referred to as 'ring', another common term for it, convenient but just as little precise as the others.

When the partial veil in *Amanita* is well developed and sufficiently coherent it loosens from the margin of the cap[23] and the edges of the gill on expansion of the cap. Finally it generally hangs down from the top of the stem like a skirt-like ring.

When in mature, normal fruit-bodies of *Amanita* a distinct ring is lacking, this may be because it is aborted (cf. Atkinson, 1914: 386), as is the case in many species of section *Vaginatae* and probably also elsewhere in the genus, or because the tissue is so incoherent that the ring falls to pieces on expansion of the cap, as happens

[22] Usually a small, but in section *Lepidella* sometimes a fairly large part of this primordial tissue forms the inner limb of the volva; see p. 312.

[23] For some notes on the connection between the margin of the cap and the ring, see p. 302.

in several species of sections *Lepidella* and *Amidella*. Quite often the ring is both poorly developed and incoherent.

The place of a well-shaped ring on the stem depends mainly on the extent to which the upper part of the stem to which the ring is attached participates in the elongation of the stem. In section *Lepidella* this is very slight, so that the ring, if present, is usually strictly apical. Among the *Validae*, however, there are several species in which this part elongates considerably. In the mature fruit-body the ring is then subapical or even median, very rarely basal. The upper adnate part of the ring is then broken up into the small, usually transverse-elongate, irregularly shaped patches so characteristic of the upper part of the stem of species like *A. rubescens* and *A. excelsa*.

Although in the ring microscopic characters of taxonomic value are to be expected, I have not studied this part of the fruit-body systematically. Its cells often turned out to be difficult to reinflate. Moreover the ring is frequently such a delicate structure that in dried fruit-bodies it tends to fall to pieces when a section is removed for examination. Nevertheless a few remarks are called for.

In several species of *Amanita* the upper surface of the ring is marked with radial grooves and ridges corresponding with the gills. To be more precise, in the species I studied (*A. rubescens, A. phalloides, A. strobiliformis*) the edges of the gills correspond with the grooves on the ring. Before expansion of the cap the whole upper surface of the ring is covered with a loose tissue with many small inflated cells, strips of which are taken away by the edges of the gills when the cap starts to expand. The marginal tissue of the young gills (see p. 324) is in fact very similar to the tissue of the ridges on the ring.

De Bary (1866: 71) suggested that the ridges on the ring were formed by the remnants of plates of primordial tissue enclosed by the primordial gills. In view of the above this seems improbable.

In some species (e.g. in *A. muscaria, A. pantherina, A. crassa*) the smooth upper surface of the ring consists almost exclusively of hyphae, but this certainly does not hold for all species with a smooth ring.

In species where the ring is (sub)membranous in the mature fruit-body, its inner part very often, if not always, consists mainly of abundant, strongly branching and anastomosing, interwoven to radial hyphae.[24] This contradicts the statement of Singer (1962: 11) that the ring of *Amanita* consists mainly of isodiametric and inflated cells, and Gilbert (1925: 294) that the ring of *A. vittadinii* consists of only large fusiform to elongate cells similar to those in the volva. As mentioned above, it is only the upper surface layer that may often mainly consist of small inflated cells.

The tissue inside the thick but rather incoherent ring of *A. strobiliformis* appears

[24] Observations made in *A. muscaria, A. rubescens, A. solitaria, A. cokeri, A. timida*, and *A. vittadinii*.

to be composed of very irregularly shaped, branching, elongate, somewhat coralloid cells.

The structure of the lower surface layer of the ring is fairly variable. Sometimes it is made up exclusively of interwoven hyphae (e.g. in *A. phalloides*), sometimes of longitudinal hyphae and scattered elongate cells resembling those in the trama of the stem (e.g. in *A. cokeri*; there the underside of the ring is strongly fibrillose), sometimes (especially in section *Lepidella* ?) it is covered with fragments of a tissue resembling that of the volva and belonging to the inner volval limb, as discussed on p. 313, where the warts along the underside of the margin of the ring of many species are also considered.

CLAMP CONNECTIONS

Thus far the presence or absence of clamps has played scarcely any part in the taxonomy of *Amanita*, probably because in most of the common species of this genus in Europe and North America clamps are absent or difficult to find.

In section *Lepidella*, however, clamps occur rather frequently and have turned out to be a great help in disentangling the species, especially those from North America.

Looking for clamps in the tissues of dried fruit-bodies of *Amanita* is a dispiriting business. In each case it is necessary to examine many different types of tissue and their frequently largely inflated cells are often hard to reinflate. This makes it difficult to decide whether, simply because they have not been found, clamps are really lacking.

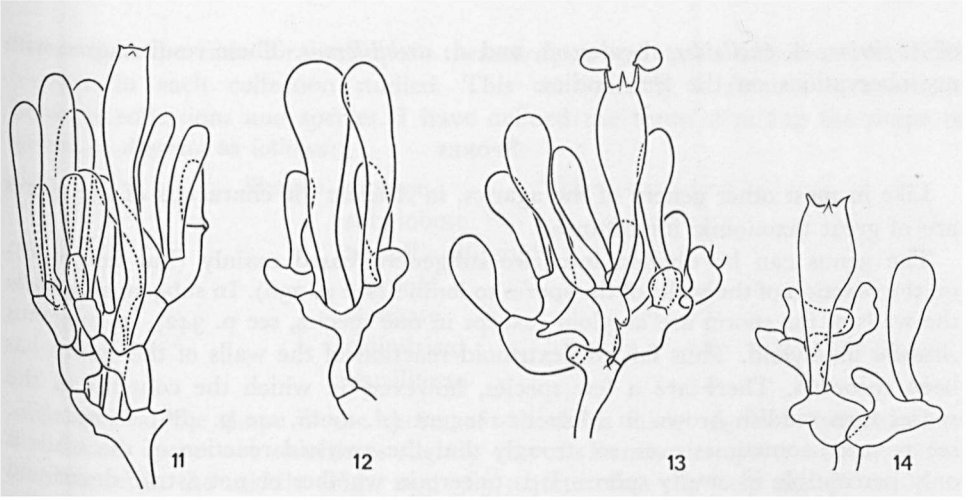
After examination of a fair number of collections, it appeared to me that in all the cases in section *Lepidella* where I had found clamps somewhere in the fruit-body,[25] they were also present on the basidia. Moreover in a number of collections I found clamps only on the basidia. It looks as though the genus *Amanita* is in the process of losing its clamps, the basidia being the slowest elements to do so.

This led me to examine especially the basal septa of the basidia[26] for the presence of clamps and to note the occurrence of clamps in other tissues only when I came across them. An additional advantage of this method is that even in poorly dried fruit-bodies it is often still possible to reinflate the basidia.

For the examination of basidia for the presence of clamps it is recommended that only very small parts of the gills be coloured in Congo Red (see p. 290), these pieces be put into a drop of 5 % KOH, and that they be torn into the smallest possible fragments with needles before they are dissociated by gentle tapping on the cover glass.

[25] Sometimes in the volva, the pileipellis, the trama of the stem or the trama of the gills, sometimes practically everywhere.

[26] Kühner & Romagnesi (1953: 179) quite successfully used the presence or absence of clamps on the basidia as a key-character in *Rhodophyllus*.



Figs. 11–14. Elements of subhymenium and hymenium. — 11. *A. subsolitaria* (× 500; from *Murrill, 28 June, Tung-oil Mill*). — 12. *A. solitariiformis* (× 850; from type). — 13. *A. polypyramis* (× 500; from *Sharp 25000*). — 14. *A. sublutea* (× 500; from type).

Sometimes the clamps at the base of older basidia have grown out to form new basidia (proliferation of clamps; see Bas, 1965: 355). Then true clamps are only to be found on the youngest basidia (Fig. 11). Usually, however, the typical shape of the base of the older basidia betrays the original presence of clamps. Their basal septa then often consist of two planes meeting at an obtuse angle (Fig. 12).

In section *Lepidella* I have met with real difficulties as to the presence or absence of clamps in only two cases.

In the type of *A. subalbida* (p. 510) most basidia were clampless but a small number showed distinct clamps; no clamps were found in other tissues. Perhaps clamps are formed here only on the first-born basidia. The species is placed here among the clamped species.

In *A. crassifolia* (p. 516) the shape of the base of the basidia intimated the presence of clamps but not a single distinct clamp was found; consequently it is placed among the clampless species. For safety's sake both *A. subalbida* and *A. crassifolia* are keyed out here among the clamped as well as the clampless species.

Aside from section *Lepidella* clamps seem to be relatively rare in *Amanita*. Thus far I have found them only in some species of section *Vaginatae* (e.g. *A. caesarea*, *A. hemibapha*, and *A. princeps*) and in the basal tomentum of *A. muscaria* of section *Amanita*.

In several genera of Basidiomycetes clamps are present in the secondary mycelium but lacking in the fruit-body. For *Amanita* Kühner (1947: 142) mentioned the presence of small clamps in the mycelium of *A. caesarea*, and clampless septa in the mycelia of *A. citrina*, *A. junquillea*, and *A. valida*, whereas Semerdžieva (1965) found some clamps in the mycelium of *A. muscaria* and only clampless septa in the mycelia

of *A. citrina*, *A. phalloides*, *A. rubescens*, and *A. strobiliformis*. These results agree with my obervations on the fruit-bodies.

SPORES

Like in most other genera of the agarics, in *Amanita* the characters of the spores are of great taxonomic importance.

The genus can be divided into two subgenera based mainly (but not only!) on the reaction of the walls of the spores to iodine (see p. 296). In subgenus *Lepidella* the walls of the spores are amyloid (except in one species, see p. 342), in subgenus *Amanita* inamyloid. Thus far no dextrinoid reaction of the walls of the spores has been recorded. There are a few species, however, in which the contents of the spores turn reddish brown in Melzer's reagent (*A. westii*, see p. 486; *A. mutabilis*, see p. 542), sometimes even so strongly that the amyloid reaction of the walls is only perceptible in empty spores. It is uncertain whether or not a true dextrinoid reaction is involved here, as the contents of the spores are yellow brown in alkaline solution.

In one species of section *Lepidella*, viz. *A. roanokensis*, the apical parts of a small to fairly large percentage of the spores appeared to be decorated with minute amyloid warts (Figs. 366, 368). In alkaline solution these warts were scarcely perceptible, even after colouring in Congo Red. The amyloid warts are probably not the result of a break-up of an amyloid layer.

The size of the spores plays an important part in distinguishing species, sometimes stirpes. The smallest and largest are found in section *Vaginatae* (from about 4.5–5.5 × 4–5 μ in *A. aurea*, up to 16 × 15 μ in some forms of the *A. vaginata*-complex); in section *Amidella* the longest bacilliform spores (up to 21 × 5.5 μ in *A. cylindrispora*) occur.

As the value of the measures recorded depends on the number of measurements, I have indicated this number in the descriptions, together with the number of fruit-bodies from which the measured spores were taken.[27] In my experience it is usually sufficient to measure ten spores per sample; in special instances (few specimens available, or great variability of spores) I measured twenty per sample; in additional collections only five when the measures found fell within the range already established. Extreme values have been placed between brackets where they represented no more than 10 % of the spores.

As the spores in 1- to 3-spored basidia tend to be larger than normal it is advisable always to examine the number of sterigmata per basidium, which is fairly variable in *Amanita* (see discussion on basidia below).

The shape of the spores in *Amanita* ranges from globose to bacilliform. As this variation is mainly due to the variation of the length-breadth ratio (l/b), I have

[27] "Spores [40/5] . . ." means: Spores, forty from five specimens measured, . .

determined the ratio for each spore measured, as well as its extreme values and average in each collection studied. This considerably facilitated comparisons between collections and species. I have defined the terms denoting the shape of spores in *Amanita* as follows:

Shape:	globose	l/b	1.0 –1.05
	subglobose		1.05–1.15
	broadly ellipsoid		1.15–1.3
	ellipsoid		1.3 –1.6
	elongate		1.6 –2.0
	cylindrical		2.0 –3.0
	bacilliform		> 3.0

In general the shape of the spores of *Amanita* is fairly regular. Cylindrical to bacilliform spores are sometimes slightly curved. Rarely the spores are somewhat constricted in the middle (Figs. 203, 365); quite often they are slightly ovoid or obovoid.

In a number of species of subsection *Vittadiniae* (Figs. 82, 86, 91, 93) the apiculus of the spores is conspicuously tapering and projecting. In the same group the walls of the spores are sometimes distinctly thickened, a character thus far not found elsewhere in *Amanita*. I have been unable to distinguish layers in these thickened walls, even after colouring them in Melzer's reagent, Congo Red, and Cresyl Blue. The amyloid reaction of the thick-walled spores is, however, somewhat more pronounced than in thin-walled spores.

The walls of the spores of *Amanita* are nearly always smooth. Exceptions are the above mentioned spores with amyloid warts of *A. roanokensis* and the minutely asperulate spores of *A. princeps* in section *Vaginatae*.

The contents of the spores of the species treated here have been described because there is a general trend towards granular-refractive contents in section *Lepidella*. The contents of the spores of any specimen, however, may vary considerably; moreover those of spores taken from the gills sometimes look different from those of spores taken from a sporeprint. The more or less dextrinoid contents of the spores of a few species of section *Lepidella* have been mentioned above.

The colour of the spore print is usually white to pale cream, but in *A. solitaria* (= *A. echinocephala*, see p. 394) it is greenish cream and in *A. pelioma* (see p. 465) cream to olive-buff. More information on the colour of fresh spore prints is badly needed.[28]

BASIDIA

Except for the presence or absence of clamps at their basal septa, as treated in the discussion on clamp connections (p. 318), the characters of the basidia are of little taxonomic importance.

[28] It is not sufficient simply to file a spore print with the dried material because the print often turns yellowish with age. The colour of the print must be noted while it is fresh.

Size and shape vary considerably, even in the same fruit-body. In general, however, there seems to be a certain correlation between the structure of the subhymenium and the shape of the basidia. In species with a ramose subhymenium, which often occurs in section *Lepidella*, the slender, tapering base tends to make the basidia relatively long and slender (Fig. 11). In species with a cellular subhymenium, found frequently for instance in section *Validae* but more rarely also in section *Lepidella*, the fairly abrupt, broad base makes the basidia relatively short (Fig. 132); intermediate forms are frequent.

Although the basic number of spores per basidium is nearly always four, species with many aberrant basidia are not rare. In one fruit-body of a species close to *A. virosa*, from Michigan (*Bas 3761*), 48 % of the basidia proved to be 4-spored, 30 % 3-spored, 20 % 2-spored and 2 % 1-spored. In species of the *A. vaginata*-complex aberrant basidia are even fairly common. Uniformly 2-spored taxa are rare (*A. bisporigera!*).

In a few species with more or less dextrinoid contents of the spores (see above), the basidia have similar contents, though mostly less conspicuously so (*A. westii*, p. 486; *A. mutabilis*, p. 542). In *A. sculpta* many elements of the young hymenium turn red-brown in Melzer's reagent, but this has not yet been investigated in mature basidia and spores.

CYSTIDIOID BODIES

Thus far no true hymenial cystidia have been found in *Amanita*, unless the marginal cells are reckoned among them (see below).

In *A. xanthogala* (p. 488) laticiferous hyphae penetrate from the trama of the gills into the hymenium, there forming a very simple type of tramal cystidia, which in agreement with Singer (1962: 41) are here called pseudocystidia (Figs. 250, 255). They have yellow, refractive contents and show no special reaction in the usual reagents (see p. 333).

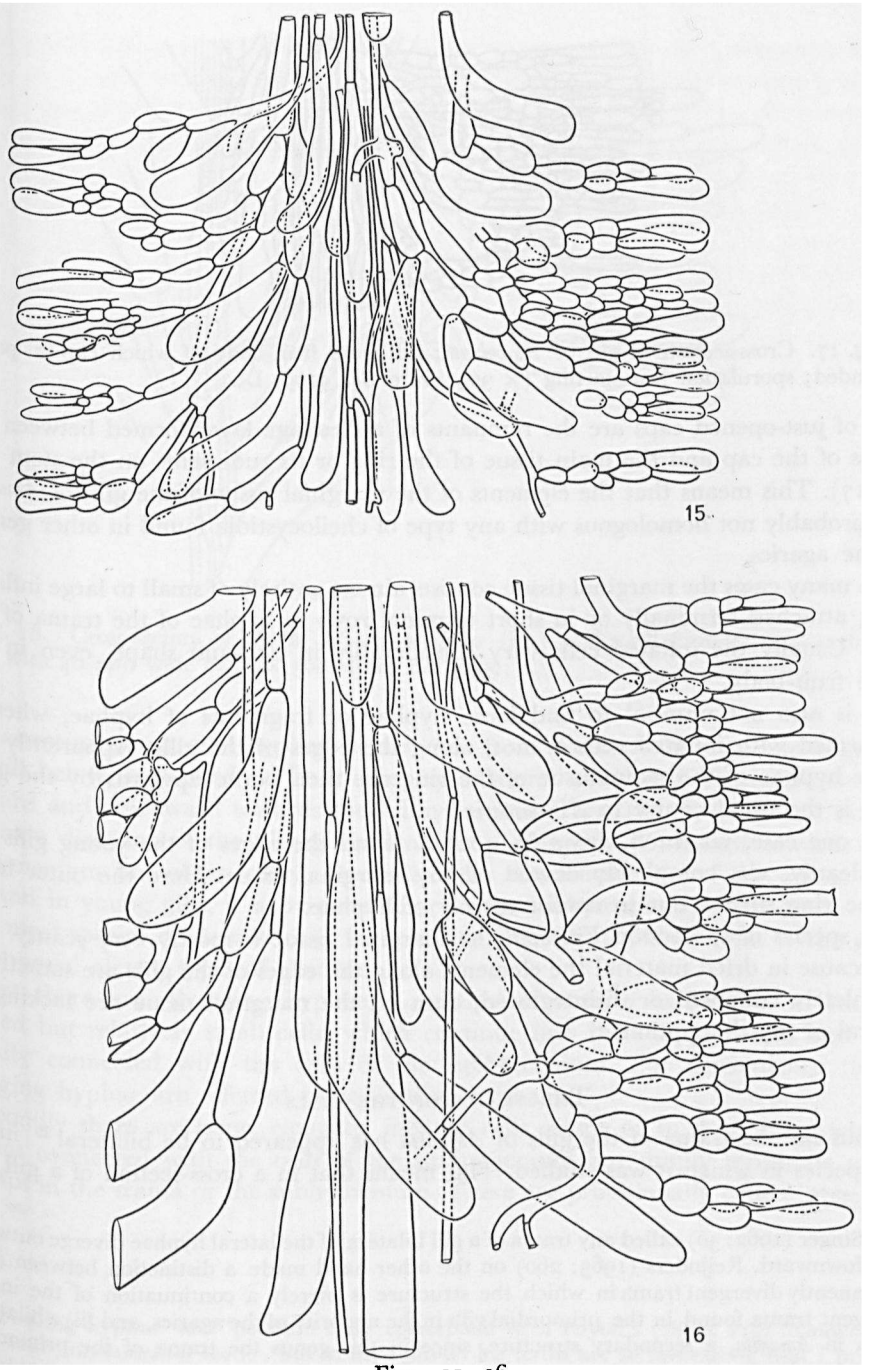
In the hymenium of *A. borneensis* (p. 477) scattered basidium-like cells with one rather thick apical appendix were found, and in that of *A. codinae* a few ventricose-fusiform cells (Figs. 33). Both cases probably represent incidentally abortive basidia.

THE MARGINAL TISSUE OF THE GILLS

Because of the schizohymenial type of development of the hymenophore in *Amanita* (see p. 300) the edges of the gills are attached to the partial veil until the expansion of the cap tears them loose. The elements found along the edges of the

EXPLANATION OF FIGURES 15,16

Figs. 15, 16. Cross-sections of gills of *A. citrina*. — 15. Gill from button of which cap is still closed and stem starts to elongate. — 16. Gill from almost completely expanded fruit-body (both figs. × 325; from *Bas 4528a*; L).



Figs. 15, 16

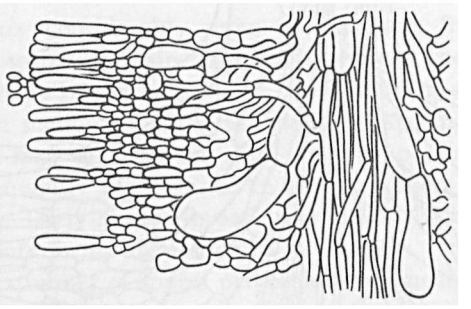


Fig. 17. Cross-section of gill of *A. volvata*; gill from fruit-body of which cap is partly expanded; sporulation just starting (× 325; from *Bas 3799*; L).

gills of just-opened caps are the remnants of a cleavage layer formed between the edges of the cap and the main tissue of the ring or its rudiments on the stem (see p. 317). This means that the elements of the marginal tissue of the gills of *Amanita* are probably not homologous with any type of cheilocystidia found in other genera of the agarics.

In many cases the marginal tissue consists almost entirely of small to large inflated cells, attached terminally or in short terminal rows to hyphae of the trama of the gills. Usually the inflated cells vary considerably in size and shape, even in the same fruit-body.

It is also not unusual to find loose hyphae or fragments of hyphae, whether connected with inflated cells or not, along the edges of the gills. Apparently the outer hyphae of the main tissue of the ring are then borne upwards by the gills. This is the usual course in *A. muscaria*.

In one case, viz. in *A. crassa* (p. 402), I found the edges of the young gills cut off cleanly, viz. completely devoid of any marginal tissue. Here the outer layer of the ring turned out to consist merely of hyphae.

In species of subsection *Vittadinii* the marginal tissue is mostly very scanty.

Because in dried material the elements along the edges of the gills are sometimes completely collapsed or disintegrated, data on the marginal tissue are lacking in several of my descriptions.

THE TRAMA OF THE GILLS

Thus far the trama of the gills of *Amanita* has appeared to be bilateral[29] in all the species in which it was studied. This means that in a cross-section of a gill the

[29] Singer (1962: 50) called any trama of a gill bilateral if the lateral hyphae diverge outward and downward. Reijnders (1963: 260) on the other hand made a distinction between (i) a permanently divergent trama in which the structure is merely a continuation of the initial divergent trama found in the primordial gills in the majority of the agarics, and (ii) a bilateral trama in *Amanita*, a secondary structure, since in this genus the trama of the primordial gills is regular.

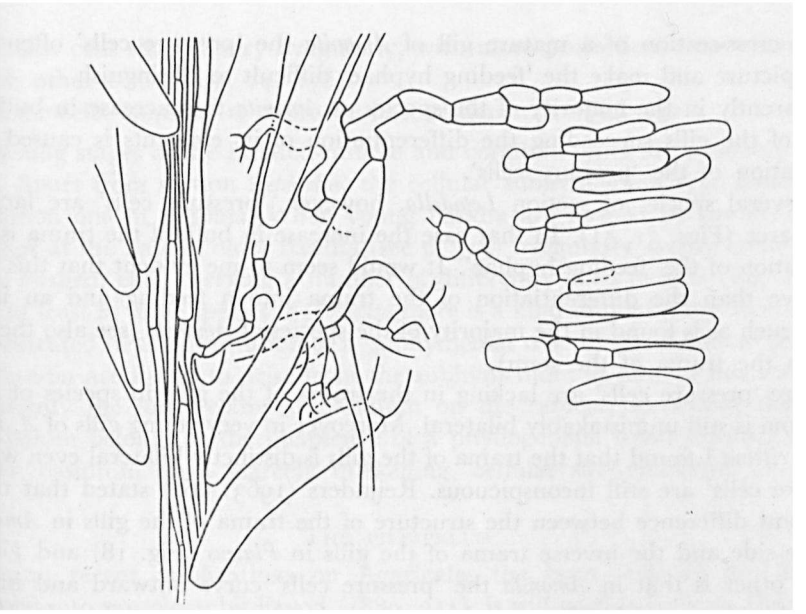


Fig. 18. Cross-section of gill of *Pluteus petasatus* (Fr.) Gill.; gill from expanding fruit-body with 40 mm wide cap (× 500; from *Bas 4509*; L).

mediostratum of parallel hyphae, which run from the cap above to the edge of the gill below, is flanked on both sides by a lateral stratum of elements curving outward and downward towards the subhymenium (Figs. 15, 16, 31, 51). Usually the main direction of the diverging elements is obliquely downward towards the subhymenium but occasionally, especially near the attachment of the gill to the cap and in young gills, it is perpendicular to the subhymenium (Fig. 17).

In most species of *Amanita*, e.g. in *A. citrina* (Fig. 15, 16) the trama of the gills is composed of two types of elements.

First there are diverging hyphae, consisting of narrow cylindrical to rather inflated but relatively small cells, which continue into the subhymenium and are actually connected with the cells of the subhymenium. For convenience these diverging hyphae are referred to as 'feeding hyphae'.

Secondly there are large, elongate, inflated cells, single or in short rows, which are not connected with the cells of the subhymenium but simply terminate with free tips in the trama or the subhymenium. These are provisionally called 'pressure cells'. [30]

[30] 'Feeding hyphae' and 'pressure cells' correspond with Fayod's (1889: 219) 'connective tissue' and 'fundamental tissue', but in my opinion his terms are so misleading that I prefer to avoid them.

In a cross-section of a mature gill of *Amanita* the 'pressure cells' often fill the whole picture and make the 'feeding hyphae' difficult to distinguish.

Apparently in the majority of the species of *Amanita* the increase in bulk of the trama of the gills succeeding the differentiation of its elements is caused mainly by inflation of the 'pressure cells'.

In several species of section *Lepidella*, however, 'pressure cells' are lacking or very scarce (Figs. 31, 51). In that case the increase in bulk of the trama is caused by inflation of the 'feeding hyphae'. It would seem to me evident that this is more primitive than the differentiation of the trama into a feeding and an inflating system such as is found in the majority of the species of *Amanita* (see also the discussion on the trama of the stem).

Where 'pressure cells' are lacking in the trama of the gills in species of *Amanita* the trama is still unmistakably bilateral. Moreover in very young gills of *A. rubescens* and *A. citrina* I found that the trama of the gills is distinctly bilateral even when the 'pressure cells' are still inconspicuous. Reijnders (1963: 262) stated that the only important difference between the structure of the trama of the gills in *Amanita* on the one side and the inverse trama of the gills in *Pluteus* (Fig. 18) and *Volvariella* on the other is that in *Amanita* the 'pressure cells' curve outward and in *Pluteus* and *Volvariella* inward. My own observations, however, suggest that the hymenophoral trama of *Amanita* is bilateral and of *Pluteus* and *Volvariella* regular before the 'pressure cells' develop.

Another dissimilarity is that in *Amanita* differentiation into a feeding and an inflation system in the trama of the gills is part of a phenomenon occurring in many tissues of the fruit-body (see below discussion on trama of stem) but that in *Pluteus* and *Volvariella* this differentiation is rectricted to the gills (Reijnders, 1963: 262). I am not completely convinced that the 'pressure cells' in *Amanita* are homologous to the inflated cells in the trama of the gills of *Pluteus* and *Volvariella*.

In the gills of dried specimens it is difficult to ascertain the presence or absence of 'pressure cells'. Information on this character is therefore often lacking in my descriptions, even though it may be of taxonomic value.

THE SUBHYMENIUM

In *Amanita* the subhymenium is usually well developed and about one to two times thicker than the hymenium. Sometimes, however, delimitation of it against the trama proper is rather difficult as its cells usually gradually increase in size inward.

In section *Lepidella* the shape of the subhymenial cells appears to be rather variable. The following main types are distinguished but intermediate types are common.

Ramose: cells relatively narrow and branching (Figs. 11, 12).

Inflated-ramose: cells inflated and branching (Fig. 13).

Coralloid: cells shaped very irregularly, with more projections than connections with other cells (Figs. 14, 178).

Cellular: cells ellipsoid to more or less isodiametric (Fig. 132).

The young stages of the inflated-ramose and coralloid types are probably always ramose. Apart from section *Lepidella*, the cellular subhymenium type seems to be the common one in *Amanita*. When young basidia are formed by proliferation of the clamps at the base of older basidia (see p. 319) irregularly shaped subhymenial cells are formed, each carrying a number of differently aged basidia (Fig. 12).

That at least in some species of *Amanita* there is a kind of thickening hymenium[31] is demonstrated in the illustration of a 'subhymenial tree' of *A. subsolitaria* (Fig. 11), where basidia are found to arise from the subhymenium at four to five levels.

Apparently the long, clamped basidium on the ramose, somewhat thickening subhymenium belongs at the incipience of a phyllogenetic trend towards a short, clampless basidium on a scarcely thickening, cellular subhymenium.

THE PILEIPELLIS

In many recent publications on Agaricales the term 'cuticle' or 'cuticula', introduced into mycology by Fayod (1889: 241), is still used to indicate the cortical layer(s) of the cap. This term has, however, a distinct meaning in the anatomy of the phanerogams: a non-cellular layer covering the epidermis. Therefore it should not be used in mycology for cellular cortical layers in general. This was already pointed out by Lohwag & Peringer (1937: 301), Lohwag (1941: 95), and Josserand (1952: 190).

For this reason I propose the Latin term 'pellis', for the cortical layers of the basidiomycetous fruit-body not belonging to the veils; consequently 'cuticle' is replaced by 'pileipellis'. This opens the way for the introduction of such terms as 'stipitipellis' and 'bulbipellis'.

It should be emphasized that these terms are purely topographical; in descriptions they would have to be followed by terms describing their structure, such as 'trichoderm', 'ixocutis', etc.

It is evident that the meaning of the terms proposed is no more precise than that of 'cuticle' in mycology. It is frequently difficult to indicate the lower (or inner) limit of a pellis because this often passes gradually into the trama underneath. Sometimes there is the same difficulty with the upper limit when there is an adnate volva, which is not rare in the species of *Amanita* treated here.

Singer (1951: 58; 1962: 59) pointed out that Lohwag, in introducing a detailed nomenclature for different parts and types of cortical layers in fungi, failed to make a sufficient distinction between topographical and descriptive terms. But Singer did not accept the consequences. If Lohwag's descriptive terms for cortical layers are admitted along general lines (as is done by Singer) 'derm' must be used for

[31] Might 'thickening subhymenium' perhaps not be a better name?

(layers of) the pellis in which the elements are arranged in an anticlinal position (e.g. hymeniderm, trichoderm, etc.) and 'cutis' for (layers of) the pellis consisting of periclinal elements. It is then simply not practicable to use 'hypoderm' or 'subcutis' for a layer following downward on the 'epicutis'. The last three terms are topographical and should be free from conspicuous, etymological connections with descriptive terms.

Disregarding their structure I therefore propose the division of a pellis of two layers into an outer 'suprapellis' and an inner 'subpellis' and a pellis of three layers into a 'suprapellis', a 'mediopellis' and a 'subpellis'. It goes without saying that use of the same topographical terms for different fungi does not imply homology.

The pileipellis of *Amanita* is a cutis or ixocutis. When a cutis it is sometimes so slightly developed as to be difficult to distinguish from the volval tissue above and the trama of the cap underneath.

When the pileipellis is an ixocutis it is especially the suprapellis that gelatinizes (often so strongly that its hyphae disintegrate completely), whereas the subpellis gelatinizes only slightly and comprises the hyphae in which the pigment, if present, is usually localized.

The hyphae of the pileipellis are usually narrow and radial to interwoven. The type of hyphal arrangement found often depends on which part of the pileipellis is examined. Nevertheless there are indications that study of the diameter and disposition of the hyphae in the pileipellis of certain groups of species of sections *Vaginatae* and *Phalloideae* will produce valuable results.

THE TRAMA OF THE STEM AND THE CAP

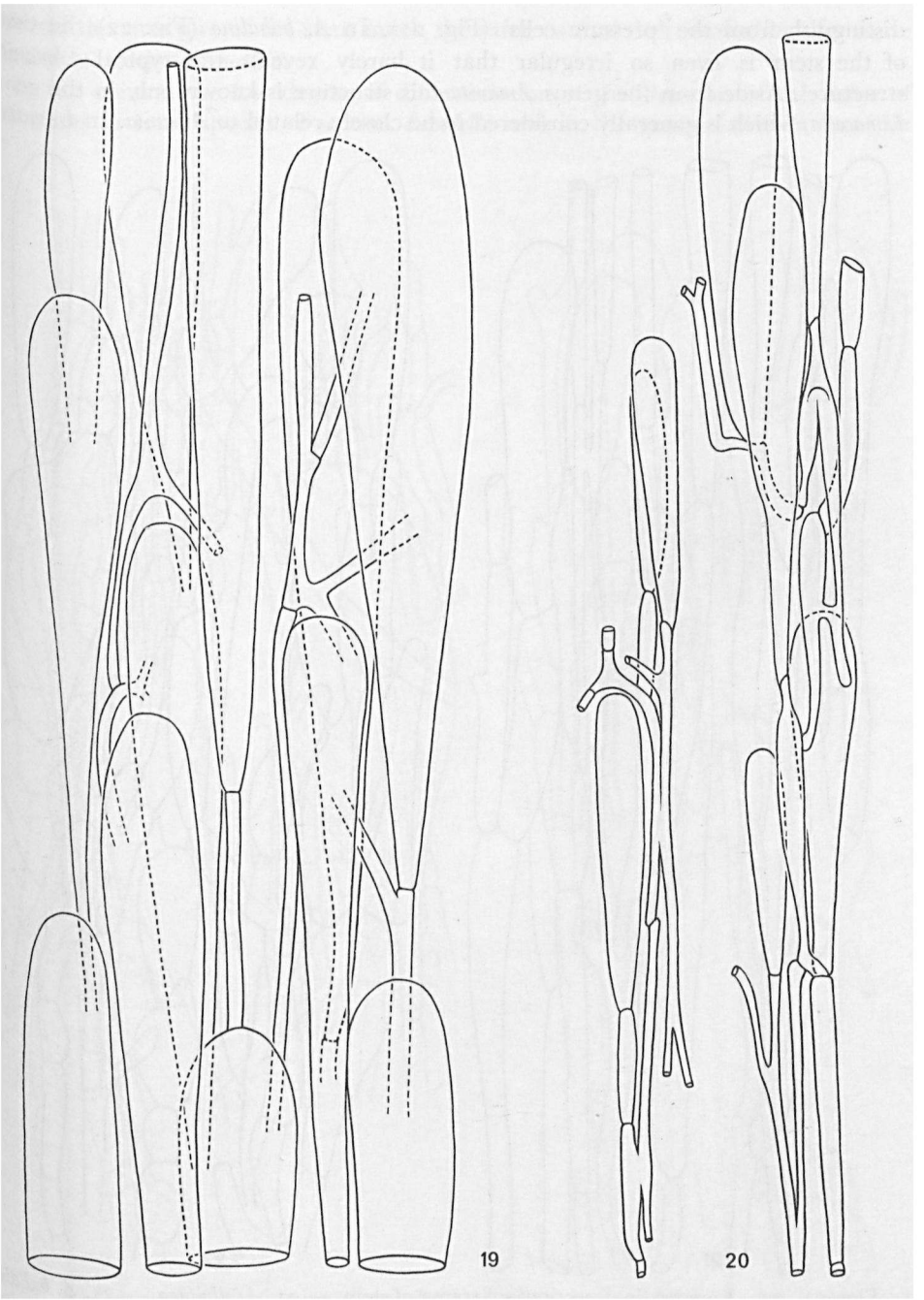
THE TRAMA OF THE STEM.—Hoffmann (1861: 11) was probably the first to describe, and Boudier (1886: pl. 1 fig. 8) the first to illustrate clearly the curious type of tissue in the stems of species of *Amanita*.

Under the microscope the tissue at first sight often seems to consist merely of large, longitudinally disposed, slenderly clavate cells. More careful examination reveals that the enormous clavate cells are usually the terminal members of short side-branches of a diffuse system of narrow, branching, predominantly longitudinal hyphae (Figs. 19, 20). Here again (compare the discussion above on the trama of the gills) the elements of the tissue are clearly differentiated in 'feeding hyphae' (connective tissue) and 'pressure cells' (fundamental tissue).

In several species of section *Lepidella* the 'feeding hyphae' and 'pressure cells' are less perfectly differentiated than those in the species of other sections of *Amanita*. Not only are the 'pressure cells' often in rows, with the intercalary cells less inflated than the terminal ones, but the 'feeding hyphae' are also wider, so less easy to

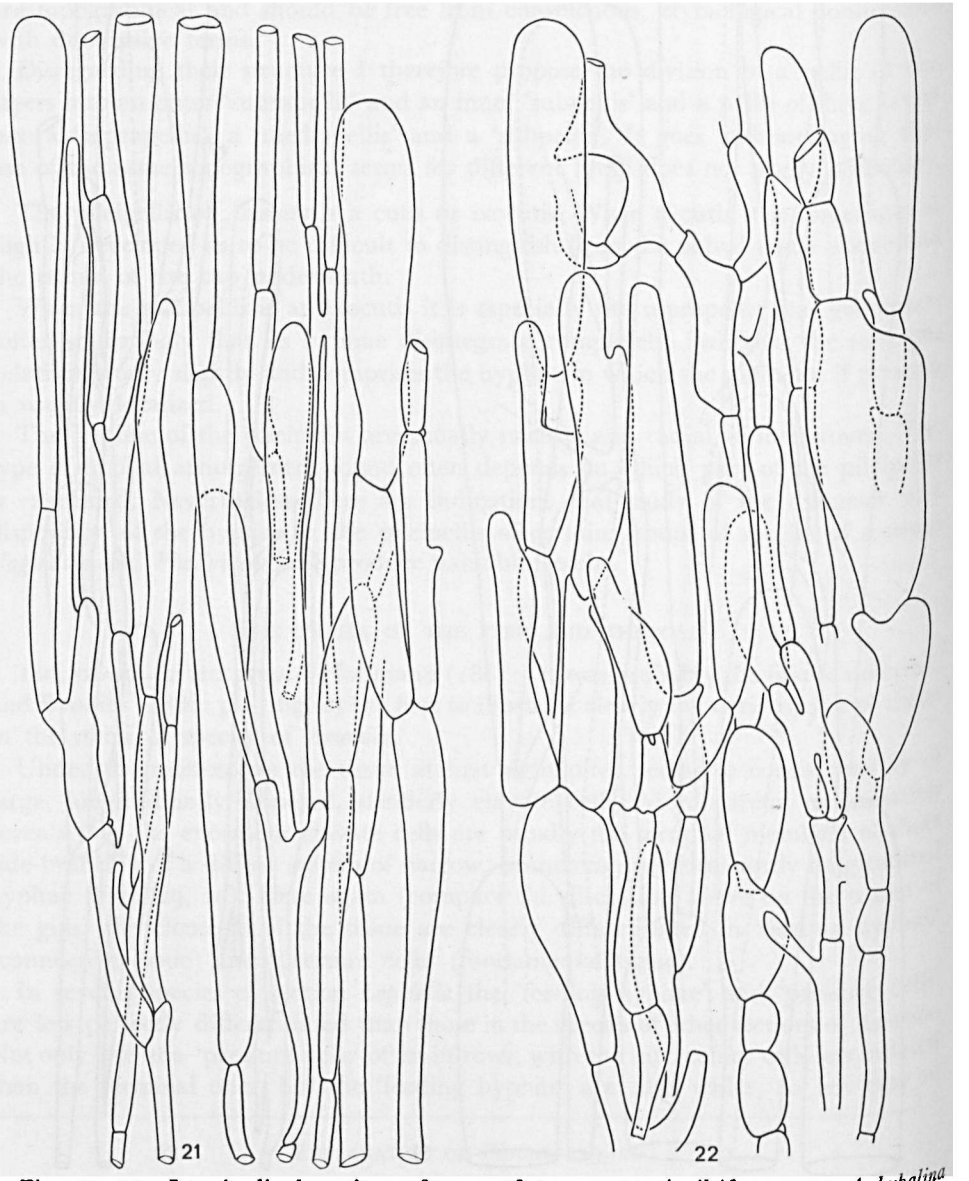
EXPLANATION OF FIGURES 19, 20

Figs. 19, 20. Longitudinal sections of trama of stem. — 19. *A. citrina* (× 325). — 20. *A. porphyria* (× 250).



Figs. 19, 20

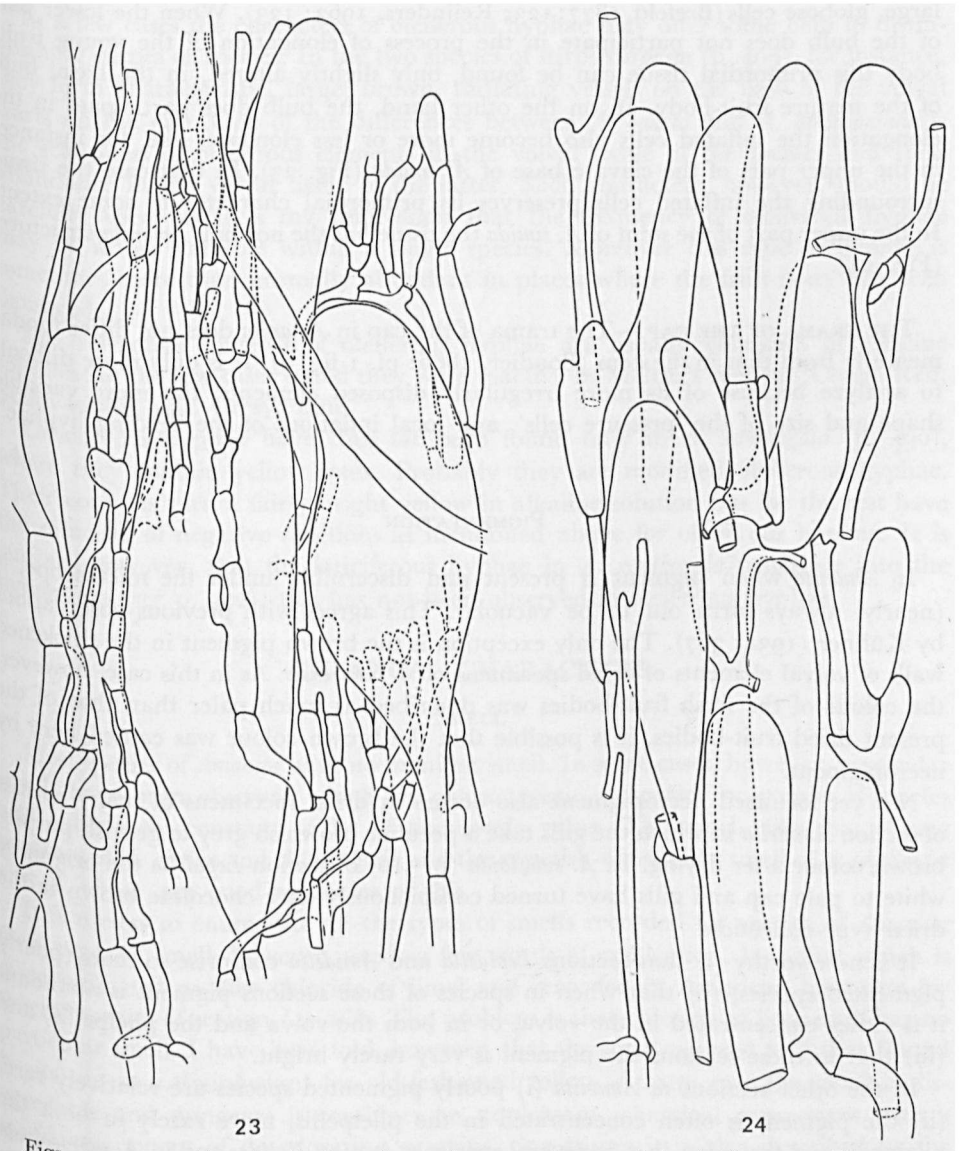
distinguish from the 'pressure cells' (Fig. 21). In *A. bubalina* (Fig. 22) the tissue of the stem is even so irregular that it barely reveals the typical '*Amanita*-structure'. Aside from the genus *Amanita* this structure is known only in the genus *Limacella*, which is generally considered to be closely related to *Amanita*. In *L. guttata*



Figs. 21, 22. Longitudinal sections of trama of stem. — 21. *A. silvifuga*. — 22. *A. bubalina* (both figs. × 325; from type).

I found the structure of the stem much the same as that described above for some species of section *Lepidella*.

In my opinion the low degree of differentiation of the elements of the tissue of the stems in some species of section *Lepidella* and in the genus *Limacella* must be



Figs. 23, 24. — Longitudinal sections of trama of stem of *A. timida*. — 23. Upper part of clavate base of stem. — 24. Apical half of stem (both figs. × 325; from type).

regarded as primitive compared with the highly differentiated tissue in the stems of most of the species of *Amanita*.

THE TRAMA OF THE BULB.—Very early the tissue of the primordial bulb of *Amanita* is made up of a dense tissue of interwoven, branching, narrow hyphae with scattered, large, globose cells (Brefeld, 1877: 123; Reijnders, 1963: 123). When the lower part of the bulb does not participate in the process of elongation of the young fruit-body this primordial tissue can be found, only slightly altered, in the basal bulb of the mature fruit-body. If, on the other hand, the bulb does participate in the elongation the inflated cells also become more or less elongate, like, for instance, in the upper part of the clavate base of *A. timida* (Fig. 23). In that case the tissue surrounding the inflated cells preserves its primordial character to some extent. In the upper part of the stem of *A. timida* the tissue has the normal '*Amanita*-structure' (Fig. 24).

THE TRAMA OF THE CAP.—The trama of the cap in *Amanita* does not differ fundamentally from that in the stem (Boudier, 1866: pl. 1 fig. 9). It is only more difficult to analyze because of its more irregularly disposed elements, the more variable shape and size of the 'pressure cells', and local inflations of the 'feeding hyphae'.

PIGMENTATION

In *Amanita* when pigment is present and discernible under the microscope, it (nearly) always turns out to be vacuolar. This agrees with previous observations by Kühner (1934: 367). The only exception is the brown pigment in the thickened walls of volval elements of dried specimens of *A. borneensis*. As in this case, however, the colour of the fresh fruit-bodies was described as much paler than that of the present dried fruit-bodies, it is possible that the brown colour was caused here by necropigment.

Not yet localized necropigment also occurs in dried specimens of many species of section *Amidella* in which the gills take a peculiar brownish grey to greyish purple brown colour after drying. In *A. subalbida* (p. 510) of section *Lepidella* the originally white to pale cap and gills have turned conspicuously dark chocolate brown in the dried type-collection.

It is noteworthy (i) that sections *Lepidella* and *Amidella* comprise so many poorly pigmented species, (ii) that when in species of these sections pigment is abundant it is either concentrated in the volva, or in both the volva and the pileipellis, and (iii) that in these sections the pigment is very rarely bright.

In the other sections of *Amanita* (i) poorly pigmented species are relatively rare, (ii) the pigment is often concentrated in the pileipellis, more rarely in both the pileipellis and the volva (e.g. in several species of section *Validae* and in *A. rubrovolvata* of section *Amanita*), and (iii) bright pigment occurs fairly frequently.

VASCULAR HYPHAE

Oleiferous hyphae are present in the trama of cap and stem of nearly every species of *Amanita* and fairly often also in the trama of the gills and in the volval tissue. Sometimes, however, they seem to be completely lacking, e.g. in *A. silvicola* (p. 526).

In a few cases the characters of oleiferous hyphae may offer some help in distinguishing stirpes or species. In the two species of stirps *Perpasta* (p. 409), for instance, they form characteristic, large, brown, radiating vessels on the base of the volval warts on the cap. One of the differences between *A. onusta* and *A. atkinsoniana* is the scantiness of oleiferous elements in the volval tissue of the former and their abundance in the volval tissue of the latter. Such characters, however, should be carefully used, as it is my impression that the frequency of oleiferous hyphae may be rather variable within a single species. Moreover this type of hyphae is sometimes more than normally abundant in places where the fruit-body has been damaged.

The refractive contents of oleiferous hyphae are usually yellowish in alkaline solution; in the few cases tested they were inactive in Melzer's reagent, Congo Red, Sulfovanillin, and Cresyl Blue.

Laticiferous hyphae have thus far been found only in *A. xanthogala* (p. 490), where they contain yellow latex. Probably they are modified oleiferous hyphae. Their contents turn a fairly bright yellow in alkaline solution but for the rest have the same set of negative reactions as mentioned above for oleiferous hyphae. It is curious, however, that the laticiferous hyphae in *A. xanthogala* penetrate into the hymenium (see p. 322); this has not been observed in oleiferous hyphae.

CHEMICAL CHARACTERS

SMELL

Most species of *Amanita* have no manifest smell. In some cases, however, particular smells have been observed which are characteristic of species or groups of species and sufficiently constant to be of taxonomic value. The smell like that of raw potatoes of *A. citrina* and *A. porphyria* and the sweetish-nauseating smell of *A. phalloides* and *A. virosa* are good examples of this.

It is useless to enumerate all the types of smells recorded for species of *Amanita*. One type of smell, however, needs a few words of explication. It is that which is often indicated as 'like chloride of lime' and recorded in American literature for several species of section *Lepidella*. The problem is that chloride of lime itself has no particular smell. I have been told, however, that the smell referred to is that caused by its use as a desinfectant for old-fashioned toilets. At any rate the smell is disagreeable and pungent; it combines an unpleasant, chemical component with a foetid component of deteriorating proteins. Sometimes it is also described as the smell of old ham, i.e. of the outside of the rind of old ham.

This particular smell is probably a character of importance in section *Lepidella*, where it occurs in about half the species. In view of the new delimitations given here for several species of *Lepidella*, especially North American ones, new and more precise records of the smell of many species is needed.

TASTE

The taste of fresh specimens of *Amanita* is rarely recorded. Where it is known it is often indistinct. The great collector, Mrs. M. Goossens-Fontana (see Beeli, 1927, 1931, and 1935), however, described several species from the Congo as being acrid (e.g. *A. rhodophylla*) or bitter (e.g. *A. odorata*, *A. amanitoides*). Dr. H. D. Thiers described *A. silvifuga* and *A. thiersii* as being bitter.

POISONOUS AND EDIBLE SPECIES

The genus *Amanita* comprises both deadly poisonous species and species highly appreciated as delicate food.

From the taxonomic point of view it is important that, at least on occasion, certain poisonous properties be registered as characteristic of groups (series ?) of closely related species, e.g. the *A. muscaria—A. pantherina*-complex and the *A. phalloides—A. verna—A. virosa*-complex.

Unfortunately for many species information on these qualities is lacking, especially for those more recently described. For species of section *Lepidella* I met with the following records:[32]

Poisonous: *A. ameghinoi* (p. 358), *A. preissii* (p. 536), *A. robusta* Bouriquet (p. 563), and *A. robusta* var. *spinosa* (p. 565).

Suspected: *A. solitaria* (see Konrad & Maublanc, 1948: 68, under *Aspidella echinocephala*).

Edible: *Amanita vittadinii* (p. 349) and *A. strobiliformis* (see Konrad & Maublanc, 1948: 67, under *A. solitaria*). *Amanita praegraveolens* (p. 375) is reported as not toxic to guinea-pigs.

There is a vast amount of literature on the poisonous agents in *Amanita*. By way of introduction I refer to Heim (1963) and the publications of Th. Wieland and his school.

CHEMICAL TESTS

Thus far macrochemical tests have played no part in the infrageneric classification of *Amanita*. On several species I have tested the chemicals used by Bataille (1948: 9) on specimens of *Amanita* and found the results very unsatisfactory. The only test I found useful is that of 10 % KOH on the cap of *A. virosa* (dried as well

[32] A number of reports on edibility or poisonous properties of species of section *Lepidella* are unreliable because the names used are probably misapplied. This is especially the case with names like '*A. solitaria*' and '*A. chlorinosma*' in American literature.

as fresh); it gives a bright yellow colour, in contrast to *A. verna* and *A. citrina* var. *alba*, which barely discolour with the same chemical. This reaction is not specific; it also occurs in *A. bisporigera*.

Sections of dried fruit-bodies of species of section *Lepidella* often turn yellow in 10 % KOH. Perhaps this reagent will give useful results when tested on fresh fruit-bodies of these species.

The only microchemical test of importance in *Amanita* is that of Melzer's reagent on the walls and sometimes the contents of the spores (see discussion on spores on p. 320).

ECOLOGY AND DISTRIBUTION

The large majority of species of *Amanita* are terrestrial, forest-inhabiting fungi. Syntheses have proved that a number of them (e.g. *A. caesarea, A. frostiana, A. muscaria, A. rubescens*) are able to form ectotrophic mycorrhizas with trees (Doak, 1934; Hacskaylo & Palmer, 1955; Hatch & Hatch, 1933; Melin, 1923, 1925, 1936 etc.). From general field-experience it may be concluded that practically all the forest-inhabiting species of *Amanita* are obligate mycorrhizal. A number of species, especially of section *Vaginatae*, venture into treeless boreal and alpine regions, but there they are almost certainly associated with dwarf-shrubs.

In section *Lepidella*, particularly in its subsection *Vittadiniae*, however, several species are reported to grow in meadows, on fields, on lawns, on prairies, on pampas, etc. It seems very probable that these species are non-mycorrhizal.

In this connection it is interesting that in large areas of South America ecto-mycorrhizal forest is absent or rare (Singer, 1964: 8; Moser, 1967: 363), and that six species of subsection *Vittadiniae* and one of subsection *Solitariae* (viz. *A. crassa*) are the only indigenous species of *Amanita* known from these regions.

In contrast to the tropical South American forests, those of south-eastern Asia are relatively rich in species of *Amanita* (see Corner & Bas, 1962); judging by their relationship these are probably mostly mycorrhizal.

See also the notes on habitat and distribution of the genus on p. 340 and of section *Lepidella* on p. 344.

It is regrettable that scarcity of data makes it so difficult to obtain a picture of the ecology of the species from study of herbarium material of agarics.

From literature and my own experience it would seem that species of the following genera of trees are potential mycorrhizal partners for species of *Amanita*:

Gymnospermae:		Angiospermae:		
Abies	*Pseudotsuga*	*Alnus*	*Corylus*	*Populus*
Cedrus	*Tsuga*	*Betula*	*Eucalyptus*	*Quercus*
Larix		*Carpinus*	*Fagus*	*Salix*
Picea		*Castanea*	*Lithocarpus*	*Shorea*
Pinus		*Castanopsis*	*Nothofagus*	*? Tilia*

RELATIONSHIP

The taxonomic affinities within the genus *Amanita* that are recognized here are founded on degrees of similarity. The sequence, however, in which the taxa are treated is also determined by the assumption that certain characters are primitive and others derived. The following hypothetical lines of development[33] have played their part:

1. Friable volva → Limbate volva → Saccate volva.
2. Volva composed mainly of rows of large, elongate, inflated cells → Volva composed either of hyphae and variously shaped inflated cells, or of relatively broad inflated cells only.
3. Volva adnate to cap → Volva separating from cap because of well-developed pileipellis.
4. Base of stem elongating → Base of stem remaining bulbous and apex of stem elongating → Totally elongating stem without bulbous base.
5. Excentric initiation of fruit-body in primordial bulb → Central initiation of fruit-body in primordial bulb.
6. Inflated elements and hyphae in trama of gills, cap, and stem poorly differentiated → Inflated elements and hyphae in trama strongly differentiated.
7. Subhymenium ramose and somewhat thickening → Subhymenium cellular and scarcely thickening.
8. Clamps abundant → Clamps locally present → Clamps absent.
9. Margin of cap appendiculate → Margin of cap not appendiculate.
10. Margin of cap smooth → Margin of cap sulcate.
11. Saprophytic → Mycorrhizal.
12. Thin-walled spores → Thick-walled spores.
13. Globose to ellipsoid spores → Bacilliform spores.

Judging by the large number of supposedly primitive characters in *Lepidella*, this would be the most primitive section in *Amanita*. Within section *Lepidella* the *Vittadiniae* would be the most primitive subsection.

Even with all the characters listed above it was not easy to find a reasonably satisfactory arrangement of the stirpes in the subsections. In the scheme given here (Fig. 25) the sequence finally adopted is elucidated by indicating which stirpes are placed together because they may represent side-lines deviating from the main line drawn from subsection *Vittadiniae* towards subsection *Limbatulae* and probably running from there to section *Amidella*.

[33] Most of the characters involved have been mentioned in the foregoing chapters.

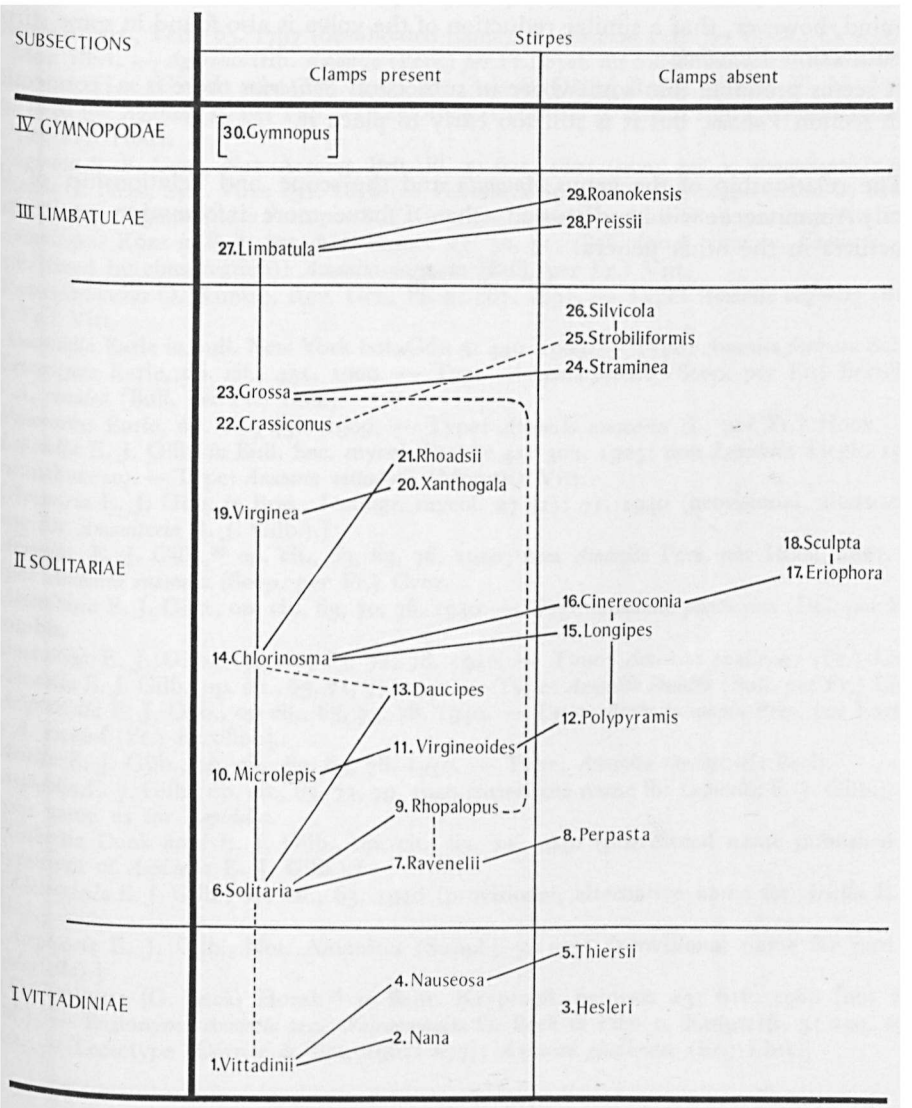


Fig. 25. Scheme of classification of subsections and stirpes of section *Lepidella*; numbers indicate sequence adopted; continuous lines and broken lines connecting names symbolize great and fairly great similarities.

Subsection *Gymnopodae* is probably a side-line of subsection *Limbatulae* from which it differs mainly in the reduction of the lower part of the volva. It should be borne in mind, however, that a similar reduction of the volva is also found in some stirpes of subsection *Vittadiniae*.

It seems probable that somewhere in subsection *Solitariae* there is a connection with section *Validae*, but it is still too early to place it.

The relationship of the genus *Amanita* and the scope and relationship of the family Amanitaceae will be discussed when I have more information on certain structures in the other genera.

TAXONOMIC PART

AMANITA Pers. per Hook.

Amanita Pers., Tent. 65. 1797 (devalidated name). — *Amanita* Pers. *per* Hook., Fl. scot. **2**: 19 May 1821. — *Agaricus* trib. *Amanita* (Pers.) *per* Fr., Syst. mycol. **1**: 12. 1821; non *Amanita* Dill., Cat. Pl. c. Gissam nasc. 177. 1719, nec *Amanita* [Dill.] Rafin., Medic. Fl. N. Amer. 189. 1830 (= *Agaricus* L. per Fr.). — Lectotype (Clements & Shear, 1931): *Amanita muscaria* (L. per Fr.) Hook.

Vaginata S. F. Gray, Nat. Arrang. Brit. Pl. **1**: 601. 1821 (nom. rej. v. *Amanitopsis*); non *Vaginata* C. Nees, Syst. Pilze 191. 1816 (= *Volvariella* Speg.). — Lectotype (fixed by listing in the Code): *Vaginata livida* Pers. per S. F. Gray [= *Amanita vaginata* (Bull. per Fr.) Vitt. s.l.].

Amanitopsis Roze *in* Bull. Soc. bot. France **23**: 50, 51. 1876. (nom. cons. v. *Vaginata*). — Type (fixed by conservation): *Amanita vaginata* (Bull. per Fr.) Vitt.

Pseudofarinaceus O. Kuntze, Rev. Gen. Pl. **2**: 867. 1891. — Type: *Amanita vaginata* (Bull. per Fr.) Vitt.

Amanitella Earle *in* Bull. New York bot. Gdn **5**: 449. 1909. — Type: *Amanita farinosa* Schw.

Leucomyces Earle, op. cit., 451. 1909. — Type: *Amanita cocolla* (Scop. per Fr.) Bertillon [= *A. ovoidea* (Bull. per Fr.) Link].

Venenarius Earle, op. cit., 450. 1909. — Type: *Amanita muscaria* (L. per Fr.) Hook.

Lepidella E. J. Gilb. *in* Bull. Soc. mycol. France **41**: 303. 1925; non *Lepidella* Tiegh. 1911 (Loranthaceae). — Type: *Amanita vittadinii* (Moretti) Vitt.

[*Amaniria* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 71. 1940 (provisional, alternative name for *Amanitaria* E. J. Gilb.).]

Amanita E. J. Gilb.,[36] op. cit., 63, 69, 76. 1940; non *Amanita* Pers. per Hook. 1821. — Type: *Amanita caesarea* (Scop. per Fr.) Grev.

Amanitaria E. J. Gilb., op. cit., 63, 70, 76. 1940. — Type: *Amanita pantherina* (DC. per Fr.) Krombh.

Amanitina E. J. Gilb., op. cit., 63, 72, 78. 1940. — Type: *Amanita phalloides* (Fr.) Link.

Amidella E. J. Gilb., op. cit., 63, 71, 77. 1940. — Type: *Amanita ovoidea* (Bull. per Fr.) Link.

Amplariella E. J. Gilb., op cit., 63, 73, 78. 1940. — Type: *Amanita ampla* Pers. per Larber [= *A. excelsa* (Fr.) Bertillon].

Ariella E. J. Gilb., op. cit., 63, 69, 76. 1940. — Type: *Amanita rhodophylla* Beeli.

Aspidella E. J. Gilb., op. cit., 63, 73, 79. 1940 (substitute name for *Lepidella* E. J. Gilb.). — Type: same as for *Lepidella*.

[*Gilbertia* Donk *apud* E. J. Gilb., op. cit., 63, 74. 1940 (provisional name published as a synonym of *Aspidella* E. J. Gilb.).]

[*Metrariella* E. J. Gilb., op. cit., 63. 1940 (provisional, alternative name for *Ariella* E. J. Gilb.).]

[*Amplopsis* E. J. Gilb., Not. Amanites (Suppl.) 7. 1941 (provisional name for part of *Amplariella*).]

[*Volvoamanita* (G. Beck) Horak[37] *in* Beitr. Kryptogfl. Schweiz **12**: 618. 1968 (not val. publ.). — Basionym: *Amanita* sect. *Volvoamanita* G. Beck *in* Pilz- u. Kräuterfr. **5**: 230, 235. 1922. — Lectotype (Corner & Bas, 1962: 277): *Amanita phalloides* (Fr.) Link.]

[36] Gilbert published a new name and a later homonym of *Amanita* Pers. per Hook. by excluding the type species of the latter name from his emended genus *Amanita*.

[37] Probably unintentionally Horak raised section *Volvoamanita* G. Beck to generic rank. In view of the synoptical character of his publication, however, I do not consider this change of rank as definitively accepted. By selecting *Amanita caesarea* (Scop. per Fr.) Grev. as type, Horak neglected the type earlier selected by Corner & Bas.

Fruit-body agaricoid, fleshy, with central, well-developed stem, small to very large, solitary, subgregarious or growing in rings, initially enveloped by a membranous, friable, floccose or pulverulent volva and this, on expansion of fruit-body, tearing at top and leaving a membranous sac at base of stem or breaking up into warts, patches belts, scales, flocks or powder on cap and/or stem. Cap with margin smooth (spores then usually amyloid) or radially sulcate[38] (spores then usually inamyloid), with pileipellis hardly differentiated to very distinct, dry to viscid, when dry with more or less adnate, when viscid with more or less detersile remnants of volva (if present). Gills usually free, more rarely somewhat adnate or narrowly adnexed, sometimes with decurrent ridges at top of stem, intermixed with scarce to very abundant, truncate to attenuate short gills of various length; edge of gills mostly granular or flocculose. Stem usually cylindrical or attenuate upward, solid, stuffed or hollow, without or with a small to very large, sometimes marginate, basal bulb, sometimes rooting. Partial veil always present but sometimes fugacious, usually forming membranous ring or fibrillose, floccose or pulverulent remnants on stem, edge of cap, and edges of gills. Flesh firm to soft, usually white or whitish, sometimes changing to pinkish, red, purplish, brownish, greyish, yellow or green when exposed, very rarely lactescent.

Spores small to very large, globose to bacilliform, thin-walled to slightly thick-walled, mostly glabrous, very rarely minutely verrucose or striolate, without germ pores, mostly white, sometimes cream, buff, olive-buff, yellowish or yellowish-greenish in spore prints, with amyloid or inamyloid walls, rarely with more or less dextrinoid contents, very rarely with small, amyloid warts. Basidia clavate, length-breadth ratio 2–6, mostly 4-spored, sometimes a number 1-, 2-, and 3-spored, rarely all 2-spored, with or without a clamp at their basal septa. True cystidia absent, very rarely laticiferous pseudocystidia present. Edges of gills sterile, covered with inflated cells and sometimes also with hyphae, being remnants of strips of loose tissue between edges of gills and partial veil. Trama of gills bilateral, with or without divergent, large, terminal inflated cells; subhymenium well developed, ramose to cellular, sometimes coralloid with age. Pileipellis consisting of interwoven to radial, repent, often gelatinizing hyphae; pigment, if present, intracellular (always?). Volva made up of irregularly disposed or periclinal or anticlinal hyphae and/or variously shaped, inflated, terminal or catenulate cells. Trama of stem consisting of longitudinal, branching hyphae and scattered to very abundant, large, slenderly clavate, longitudinal, terminal cells or short, terminal rows of such cells ('Amanita-structure'). Clamps in fruit-body abundant, scarce or absent; sometimes present only in mycelium.

TYPE OF DEVELOPMENT OF FRUIT-BODY.[39]—Hemiangiocarpous in the terminology accepted by Singer (1962: 29); bivelangiocarpous in Reijnders' (1963: 207) terminology. Development of hymenophore of special type called schizohymenial by Reijnders (1963: 247); edges of gills during their development never free before maturity.

HABITAT.—Terrestrial, mostly in woods, often forming ectotrophic mycorrhiza with trees or shrubs, sometimes probably non-mycorrhizal and then also in open fields.

[38] If the margin of the cap is 'sulcate', in other words provided with radial grooves, it is usually also 'striate' as the grooves are mostly paler than the ridges. For briefness' sake and because the sulcation seems to be the cause of the striation, the term 'sulcate' is used here, but in general 'sulcate-striate' would be more exact.

[39] For this feature Reijnders and other authors studied *Amanita excelsa* s.l., *A. muscaria*, *A. rubescens*, *A. strobiliformis*, *A. vaginata* s.l. and *A. vittadinii*.

DISTRIBUTION.—Cosmopolitan, rare however where potential mycorrhiza partners are lacking.

KEY TO THE SUBGENERA AND SECTIONS

1. Spores amyloid. Margin of cap rarely radially sulcate. Short gills often attenuate. Subgenus *Lepidella*
   2. Volva pulverulent or breaking up into flocks, warts, scales, patches, belts or crusts on cap and stem; sometimes disappearing completely from base of stem. If bulb of stem marginate, then volva floccose or forming conical warts, at least at centre of cap, and never provided with (sub)membranous outer layer.
      3. Margin of cap not appendiculate. Pileipellis often deeply coloured. Spores globose to ellipsoid, mostly < 10 μ, rarely up to 12 μ long. Ring membranous, rarely fugacious. Section *Validae* (not treated here)
      3. Margin of cap appendiculate. Pileipellis rarely deeply coloured. Spores globose to bacilliform, rather often > 10 μ. Ring membranous to friable. Section *Lepidella* in part, p. 343
   2. Volva circumscissile, limbate or saccate.
      4. Volva circumscissile or limbate, breaking up into submembranous, rarely pulverulent or floccose patches on cap and leaving a slight, (sub)membranous limb or fragments of a limb at base of stem, or else bulb distinctly marginate. Remnants of volva never conical warts.
         5. Margin of cap appendiculate. Spores broadly ellipsoid to bacilliform. Ring membranous, friable or fugacious. Section *Lepidella* in part, p. 343
         5. Margin of cap not appendiculate. Spores globose to subglobose. Ring membranous. Section *Phalloideae* in part (not treated here)
      4. Volva saccate, forming a membranous sac at base of stem and only occasionally one or a few membranous patches on cap; but sometimes inner layer of volva friable and forming scales, patches or powder on cap.
         6. Pileipellis often distinctly coloured. Spores globose to ellipsoid. Ring membranous. Volva without friable inner layer. Gills not strongly darkening after drying. Section *Phalloideae* in part (not treated here)
         6. Pileipellis usually white to brownish. Spores broadly ellipsoid to bacilliform. Ring often friable. Volva sometimes with friable inner layer. Gills often darkening strongly after drying. Section *Amidella* (not treated here)
1. Spores inamyloid. Margin of cap mostly radially sulcate. Short gills nearly always truncate. Subgenus *Amanita*
   7. Stem with bulbous base. Volva usually friable, sometimes limbate. Section *Amanita* (not treated here)
   7. Stem without bulbous base. Volva usually saccate, rarely friable. Section *Vaginatae* (not treated here)

Subgenus LEPIDELLA (E. J. Gilb.) Veselý emend. Corner & Bas

[*Amanita* subgen. *Euamanita* Lange *in* Dansk bot. Ark. **2**: 5, 7. 1915 (inadmissible name); emend. Sing. *in* Annls mycol. **24**: 352. 1926: *in* Lilloa **22**: 387. 1951. — Lectotype (Sing., 1951): *Amanita phalloides* (Fr.) Link.]

Amanita subgen. *Lepidella* (E. J. Gilb.) Veselý *in* Annls mycol. **31**: 214. 1933; *emend.* Corner & Bas *in* Persoonia **2**: 244. 1962. — Basionym: *Lepidella* E. J. Gilb. *in* Bull. Soc. mycol. France **41**: 303. 1925; non *Lepidella* Tiegh., 1911. — Type: *Amanita vittadinii* (Moretti) Vitt.

Amanita subgen. *Aspidella* (E. J. Gilb.) E. J. Gilb., Not. Amanites XXX [3]. 1941. — Basionym: *Aspidella* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 63, 73, 79. 1940 (change of name for *Lepidella* E. J. Gilb.). — Type: same as of *Lepidella* E. J. Gilb.

Amanita subgen. *Amplariella* (E. J. Gilb.) E. J. Gilb., Not. Amanites XXX: [2]. 1941. — Basionym: *Amplariella* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 63, 73, 78. 1940. — Type: *Amanita ampla* Pers. per Larber [= *A. excelsa* (Fr.) Bertillon].

Amanita subgen. *Amanitina* (E. J. Gilb.) E. J. Gilb., Not. Amanites XXX: [3]. 1941. — Basionym: *Amanitina* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 63, 72, 78. 1940. — Type: *Amanita phalloides* (Fr.) Link.

Amanita subgen. *Amidella* (E. J. Gilb.) E. J. Gilb., Not. Amanites XXX: [3]. 1941. — Basionym: *Amidella* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 63, 71, 77. 1940. — Type: *Amanita volvata* Peck.

[*Amidella* subgen. *Leucomyces* (Earle) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 72. 1940 (not val. publ.; provisional new combination). — Basionym: *Leucomyces* Earle *in* Bull. New York bot. Gdn **5**: 451. 1909. — Type: *Amanita cocolla* (Scop. per Fr.) Bertillon = *A. ovoidea* (Bull. per Fr.) Link.]

[*Aspidella* subgen. *Nitidella* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 74. 1940 (provisional name). — Type: *Amanita solitaria* sensu E. J. Gilb. = *A. strobiliformis* (Paul. ex Vitt.) Bertillon.]

Spores with amyloid walls. Margin of cap only rarely radially sulcate. Short gills often attenuate. Edge of freshly expanded cap appendiculate or not. Partial veil membranous or friable, rarely fugacious. Stem mostly solid or stuffed, occasionally hollow. Flesh sometimes colouring after cutting. Pileipellis sometimes poorly developed and rather often not or hardly coloured. Spores sometimes cylindrical or bacilliform. Mycelium either forming or not forming ectotrophic mycorrhiza.

'*Lepidella*' is the oldest epithet available in subgeneric rank among those typified by a species with amyloid spores; the circumscription of the taxon concerned has been emended by Corner & Bas (l.c.) so as to cover all species with amyloid spores.

With the help of the iodine reaction of the wall of the spores the genus *Amanita* can easily be subdivided into two subgenera that in my opinion are quite natural. This chemical character of the walls of the spores is correlated to a high degree with the nature of the margin of the cap. If the spores are inamyloid, the margin of the cap shows a short to long radial sulcation, except perhaps in one species[40]; if the spores are amyloid the cap is usually smooth, except in a few species. In cases where the spores are amyloid and the cap is nevertheless sulcate, there are other characters which by themselves are sufficient to place the species concerned in one of the sections with amyloid spores.

I know of only one case in which specimens of a species apparently belonging to subgenus *Lepidella* have inamyloid spores. In northern India I collected a specimen (*Bas 4442*) of a species which has several important characters in common with *A. volvata* Peck and *A. lepiotoides* Barla, viz. a duplex volva, a friable ring, gills turning a peculiar ashy colour when dried, and a smooth margin of the cap. However, the spores are absolutely inamyloid, as could be proved by spores from the gills as well as by spores from a spore print.[41] Yet the species concerned undoubtedly belongs to section *Amidella!*

[40] This species, *Amanita rhodophylla* Beeli, has not yet been studied in detail.

[41] Two other collections of a related species from the same region have amyloid spores. It is possible that the collection with inamyloid spores is conspecific with one or both of these collections.

This seems to me no reason for abandoning the division of *Amanita* into two subgenera as its sections are easy to arrange in two groups. That more than one character is needed to distinguish these two groups should be no reason for not calling them subgenera.

There is a possibility that after thorough study it will turn out that each of the two sections with inamyloid spores is more closely related to a section with amyloid spores of subgenus *Lepidella* than to the other section with inamyloid spores. Should this be the case, it will be necessary to raise both section *Vaginatae* (inclusive of the species around *A. caesarea!*) and section *Amanita* to subgeneric rank.

Observations of section *Lepidella* have strengthened my conviction (Corner & Bas, 1962: 242) that none of the taxa with amyloid spores distinguished by Gilbert (1940) as genera can be maintained at a level higher than that of section.

For a key to the sections, see p. 341.

Section LEPIDELLA

Amanita sect. *Lepidella*. — Type: *Amanita vittadinii* (Moretti) Vitt.

[*Amanita* sect. *Nitidella* (E. J. Gilb.) Konr. & Maubl., Agaricales 67. 1948 (not val. publ.). — Basionym: *Aspidella* subgen. *Nitidella* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 74. 1940 (provisional name). — Type: *Amanita solitaria* sensu E. J. Gilb. = *A. strobiliformis* (Paul. ex Vitt.) Bertillon.]

[*Amanita* sect. *Strobiliformes* Sing. *in* Lilloa **22**: 388. 1951 (not val. publ.). — Basionym: *Amanita* subsect. *Strobiliforminae* Sing. *in* Annls mycol. **41**: 163. 1943. — Type: *Amanita strobiliformis* (Paul. ex Vitt.) Bertillon.]

[*Amanita* sect. *Aspidella* (E. J. Gilb.) Kühn. & Romagn., Fl. anal. Champ. supér. 429. 1953 (not val. publ.). — Basionym: *Aspidella* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 63, 73, 79. 1940. — Type: *Amanita vittadinii* (Moretti) Vitt.]

Amanita sect. *Roanokenses* Sing. *in* Lilloa **22**: 388. 1951 (not val. publ.); *ex* Sing. *in* Sydowia **15**: 67. '1961' [1962]. — Type: *Amanita roanokensis* Coker [sensu Sing. = *Amanita inodora* (Murrill) Bas?].

Margin of freshly expanded cap appendiculate. Volva white or, rather frequently, coloured, completely pulverulent or breaking up into flocks, warts, scales, patches, belts or crusts on cap and stem, sometimes disappearing completely from stem, or volva circumscissile and bulb marginate or volva leaving a slight membranous limb at base of stem and breaking up into submembranous, occasionally pulverulent or floccose patches on cap. Margin of cap smooth. Pileipellis hardly differentiated to very distinct, dry to gelatinized, often whitish, sometimes with greyish, brownish, pinkish, yellowish or greenish tinges, more rarely brown or grey, only very rarely brightly coloured. Short gills truncate to attenuate. Partial veil membranous to friable, in the latter case forming pulverulent to floccose remnants on stem or falling to pieces on expansion of cap. Stem cylindrical or with small to very large, sometimes marginate bulb, sometimes rooting, usually solid, rarely stuffed or hollow. Remnants of volva scattered over whole stem or concentrated at middle part of stem, rarely concentrated near base of stem or disappearing from stem completely. Flesh sometimes colouring pinkish, red, purplish, brown, yellow or orange when exposed; very rarely lactescent. Smell rather often strong and pungent.

Spores small to large, globose to bacilliform, thin-walled to slightly thick-walled,

usually white, sometimes cream, buff, olive-buff, yellowish or yellowish-greenish in print, with amyloid, mostly smooth wall, rarely with small amyloid warts. Basidia with or without clamp. Rarely laticiferous pseudocystidia present. Trama of gills with or without terminal inflated cells; subhymenium ramose to cellular, sometimes coralloid with age. Pileipellis consisting of repent, interwoven to radial hyphae. Volva consisting of irregularly disposed, or periclinal, or anticlinal cells and very scarce to abundant hyphae, but sometimes at surface with thin layer of practically only hyphae; inflated cells catenulate or terminal. Clamps in fruit-body abundant, scarce or absent.

HABITAT & DISTRIBUTION.—Terrestrial in fields and woods, especially in warm-temperate, subtropical and tropical, often relatively dry regions. Species of at least one subsection very probably non-mycorrhizal.

Basically section *Lepidella* includes all species of *Amanita* combining the following characters: (i) spores amyloid; (ii) volva friable, or, better, not remaining in its entirety as a membranous sac at the base of the stem; (iii) edge of freshly expanded cap appendiculate.

The second character serves to distinguish section *Lepidella* from section *Amidella*. These two sections have in common that the fruit-body is often whitish or poorly pigmented, that the partial veil is often friable, that in a number of species the flesh colours on being exposed, and that several species have cylindrical to bacilliform spores. Moreover, *Amidella* and *Lepidella* are the only sections of *Amanita* in which species occur with a truly appendiculate edge of the cap, while their species are more strictly thermophilic than those of the other sections.

At first sight the saccate volva seems to be a very reliable character for separating section *Amidella* from section *Lepidella*. But my observations have made it clear that there is a series of species in which only a thin outer layer of the volva is submembranous because it consists mainly of repent, interwoven hyphae. In these cases the volva often forms a slight circular limb at the base of the stem and small submembranous patches on the cap. This limb, which is usually rather fragile, sometimes disappears completely. On the other hand, under favourable conditions (rainy weather or fruit-bodies growing in deep moss or humus), now and then a nearly saccate volva is formed.

In the present study, these species with a submembranous volva, together with a species with a circumscissile volva and marginate bulb (comparable with the group of species around *A. citrina* in section *Phalloideae*), have been placed in subsection *Limbatulae*, which is kept within section *Lepidella* because of the many transitional forms between *Limbatulae* and *Solitariae*, the latter being the subsection that represents the main body of section *Lepidella*.

It is very well possible that a critical study of the species of section *Amidella* will show that the *Limbatulae* are just as strongly connected with this section as they are with section *Lepidella*. For the time being, however, I prefer the proposed arrangement.

The third character of section *Lepidella*, viz. the appendiculate edge of the cap, makes it possible to distinguish section *Lepidella* from section *Validae*.

In general section *Validae* includes the species with a distinct, coloured pileipellis, with a rather thin volva, with a membranous but sometimes very thin and fugacious ring, with a small to medium, basal bulb mostly with scanty remnants of the volva, with globose to ellipsoid spores usually smaller than 10 μ and probably always smaller than 12 μ and with probably always clampless basidia.

However, a few white species exist in section *Validae* and these rather strongly resemble white species with a poorly developed volva of subsections *Solitariae* and *Limbatulae* of section *Lepidella*. In such cases I have placed species with large or elongate to cylindrical spores or a dry pileipellis or a friable ring or clamped basidia in section *Lepidella*. In all these cases the edge of the cap is probably appendiculate, but this character is sometimes difficult to verify in mature specimens after drying.

Similar difficulties arises in a few cases of species with a distinct and deeply coloured pileipellis. If in addition they have small spores, a relatively thin volva, a membranous ring, and clampless basidia these species are placed in section *Validae*. This is why I had to transfer *A. virella* E. J. Gilb. ex Sing. (= *A. virescens* Beeli) and *A. echinulata* Beeli from section *Lepidella*, where they were placed by Gilbert (1940: 79). to section *Validae* (see p. 566).

If section *Lepidella* is compared with its counterpart in subgenus *Amanita*, viz. section *Amanita*, it appears that the species of the latter section, apart from their inamyloid spores, also differ by the more or less sulcate margin of the cap, the non-appendiculate edge of the cap and the more consistently truncate short gills.

At first sight American white forms of *A. muscaria (Bas 3852, 3857)* show considerable resemblance to certain species of section *Lepidella*, especially on account of the edge of the cap, which sometimes seems appendiculate. But on closer view the appendices appear to be not extensions of the tissue of the cap, but fragments of the volva adhering to and projecting beyond the margin of the cap.

A close relationship between sections *Amanita* and *Lepidella* does not seem to me very probable.

KEY TO THE SUBSECTIONS OF SECTION *Lepidella*

1. Volva consisting mainly of rows of large, inflated, cylindrical, elongate-fusiform, and slenderly clavate cells, sometimes with a few ellipsoid or even subglobose cells, especially at the ends of these rows. Stem usually cylindrical, rarely with bulbous base. Remnants of volva often scattered on stem. Subsection *Vittadiniae*, p. 346

1. Volva consisting of variform elements, but rows of large, cylindrical to slenderly clavate cells never dominant. Stem usually with bulbous base and remnants of volva concentrated below.
   2. Volva not submembranous, never forming limb at base of stem, never forming patches on cap, with outer layer mainly consisting of repent hyphae. Rarely bulb of stem marginate and then volva floccose or forming conical warts, at least at centre of cap. Microscopical elements of volva on cap in parallel-erect position or irregularly disposed. Subsection *Solitariae*. p. 385
   2. At least outer layer of volva consisting mainly of hyphae, hence (sub)membranous. Stem with usually slight volval limb or with marginate bulb or with completely naked base. Volva forming on cap a few to many, more or less distinct patches, initially, at least, with (sub)membranous outer layer. Microscopical elements of volva on cap irregularly disposed or repent.

3. Volva forming at base of stem slight, sometimes torn limb, or volva circumscissile and bulb of stem distinctly marginate. Gills not ochraceous.
Subsection *Limbatulae*, p. 528

3. Volva leaving immarginate base of stem usually glabrous, rarely forming slight limb there. Gills ochraceous. Subsection *Gymnopodae*, p. 553

Subsection **Vittadiniae** Bas, *subsect. nov.*

Fragmenta volvae cellulis turgidis elongatis catenulatis composita. — Typus: *Amanita vittadinii* (Moretti) Vitt.

Remnants of volva on cap forming scales or warts or a floccose, lanose or subtomentose covering, consisting almost completely of repent, interwoven or erect rows of large, inflated, cylindrical, elongate-fusiform or slenderly clavate cells, sometimes with a few ellipsoid to subglobose cells especially at end of these rows. Pileipellis poorly developed, usually being merely a somewhat denser layer between volva and trama of cap, where exposed with age sometimes slightly gelatinizing at surface. Gills white or rather often with yellowish, pinkish, brownish or greenish tinges; short gills attenuate but very short ones sometimes truncate. Stem cylindrical or rarely attenuate downward, sometimes with slightly bulbous base. Remnants of volva on stem scattered, or concentrated at middle part, or, more rarely, concentrated near base. Spores rather small to large, globose to elongate, thin-walled or slightly thick-walled, sometimes with conspicuous large, tapering apiculus, white to greenish-yellow in print. Clamps present or absent.

HABITAT & DISTRIBUTION.—Mostly in dry woods, open fields and steppes, thermophilic. Principal distribution in warm-temperate and subtropical regions of North and South America; not yet found in eastern and south-eastern Asia and Australia.

Subsection *Vittadiniae* includes the most atypical species of *Amanita* in respect to habit. Several of them are more armillarioid or lepiotoid than amanitoid. However, because of their amyloid spores, the bilateral trama of their gills and the 'Amanita-structure' of the trama of their stem they undoubtedly belong to the genus *Amanita*.

The aberrant habit of the fruit-body of several species of the present subsection is determined in the first place by the cylindrical or even downward tapering stem without basal bulb. In these cases the entire stem participates in the process of elongation while the fruit-body is expanding. This in contrast with by far the greater part of the species of *Amanita*, where the basal part of the stem forms a primordial bulb which not or hardly elongates while the fruit-body is expanding (Fig. 1b). Thereby the remnants of the volva are usually scattered over a great part of the mature stem in the present subsection and not confined to the lower part of the stem, as in the more typical fruit-body in *Amanita*.

Yet in a few species of subsection *Vittadiniae* there is a slight but distinct basal bulb (Figs. 52, 84) and in two species, viz. *A. nana* (Fig. 65) and *A. bubalina* (Fig. 60), a distinct tendency to concentration of the remnants of the volva at the base of the stem. Moreover, in subsection *Solitariae* species occur in which the differentiation of the stem in a primordial bulb and an elongating upper part is not very distinct and where the remnants of the volva are scattered over the lower half of the stem more than is usual in *Amanita; A. timida* (Fig. 96) is a case in point.

The type of volva which characterizes subsection *Vittadiniae* is in its most typical

form very easy to recognize and I have met with no cases in which it was really difficult to decide whether a species belonged to this subsection or not. Nevertheless in some of its species the inflated cells of the volva are partly relatively small and broad (Figs. 44, 54, 57, 69). It is only a small step from this type of volva to a volva with catenulate, broadly inflated cells such as occur in some species of subsection *Solitariae*, e.g. in *A. daucipes* (Fig. 188) and *A. solitaria* (Fig. 103).

Therefore, although the most typical representatives of subsection *Vittadiniae* look rather different from most of the other species of *Amanita*, I think it is sufficiently demonstrated above that the gap between this subsection and subsection *Solitariae* is rather narrow, especially when other similarities such as poor pigmentation, appendiculate edge of cap and poorly developed pileipellis are also taken into consideration.

KEY TO THE STIRPES OF SUBSECTION *Vittadiniae*

1. Basidia with clamps.
   2. Spores broadly ellipsoid to elongate; average l/b 1.2—1.5. Remnants of volva on stem scattered or more rarely concentrated near base or indistinct.
      3. Remnants of volva on stem scattered, indistinct or concentrated below and then forming scales or warts at top of basal bulb. Stirps *Vittadinii*, p. 347
      3. Remnants of volva ocreate, viz. forming a more or less distinct sock (in dried specimens sometimes even with a narrow, free limb) around not or hardly enlarged base of stem. Stirps *Nana*, p. 366
   2. Spores globose to broadly ellipsoid; average l/b 1.05—1.15, rarely up to 1.2. Remnants of volva on stem lanose-floccose to floccose-squamulose and concentrated at middle part of stem, just below level where margin of cap has touched stem before expansion. Stirps *Nauseosa*, p. 374
1. Basidia clampless.
   4. Spores < 10 μ, globose to subglobose, slightly thick-walled. Stirps *Thiersii*, p. 378
   4. Spores > 10 μ, elongate, thin-walled. Stirps *Hesleri*, p. 370

Stirps *Vittadinii*

Basidia with clamps. Spores broadly ellipsoid to elongate (average l/b 1.2–1.5), thin-walled or slightly thick-walled, with abrupt apiculus. Remnants of volva scattered over subcylindrical stem, except in one small but thickset species with volval warts or scales at upper part of a basal bulb.

Because of the usually non-bulbous stem in this stirps, the fruit-body has a more armillarioid than amanitoid appearance. In addition, the remnants of the volva are mostly scattered over the stem and in several species they cause a downward peeling of the superficial layers of the stem, in this way forming rings of membranous scales. This contributes to the unusual habit of the species concerned.

It is possible to distinguish two groups of species in this stirps. One around *A. vittadinii*, with large spores, scaly stems and rather coarsely verrucose to scaly caps, and another around *A. lilloi*, with small spores, verrucose to floccose or fibrillose stem and verrucose-squamulose or flocculose caps. Probably in the latter group the elements of the volva are arranged in a more strictly anticlinal position than in the former group. But this was difficult to demonstrate in dried material.

The pattern is broken, however, by *A. ameghinoi* and *A. salmonea*, which have large spores but a type of covering of the cap which suggests that of the *A. lilloi*-group. The opposite is the case in *A. silvifuga*, which has the type of fruit-body of the *A. vittadinii*-group but small spores.

In the original descriptions of both *A. ameghinoi* and *A. salmonea* it is mentioned that young caps are completely smooth. Presumably in young caps the universal veil is a continuous trichodermial palisade, breaking up at least partly into small, more or less pyramidal warts when the cap expands. In *A. salmonea* I found that these small warts indeed consist of parallel-erect rows of elongate cells.

As in addition, at least in *A. salmonea*, the outer layer of the universal veil tends to gelatinize, it is hardly possible to avoid a comparison with *Limacella*.

Amanita daucipes in subsection *Solitariae* (see p. 447) suggests some of the species of this stirps because of the structure of the volva, which consists almost completely of erect rows of clavate cells. But on account of the distinct basal bulb in even the most slender specimens and the relatively broad cells in the volva, it has not been placed in the present subsection.

KEY TO THE SPECIES OF STIRPS *Vittadinii*

1. Spores > 9.5 µ.
   2. Cap and stem with pinkish, brownish pink or salmon tinges when mature.
      3. Cap smooth and white when young; surface layer breaking up into dingy brown 'scales' on a salmon pink, marmorate background with age. (Basidia 2-spored?) Argentina. *A. ameghinoi*, p. 358
      3. Cap smooth and pink when young; surface layer breaking up into small, erect, conical, brownish pink warts on a pink background with age. (Basidia 4-spored.) Texas. *A. salmonea*, p. 360
   2. Cap and stem white, pallid or dingy brown, without distinct pinkish or salmon tinges.
      4. Volva forming pale brown to dark brown warts or scales on cap and stem. Fruit-body usually thickset. S. Europe, N. Africa. *A. codinea*, p. 352
      4. Volva white to isabella. Fruit-body usually slender (cf. *A. nana*, p. 368).
         5. Fruit-body of medium to very large size. Stem with conspicuous girdles of membranous scales. Pileipellis poorly developed. Europe, N. Africa. *A. vittadinii*, p. 349
         5. Fruit-body of medium size. Stem inconspicuously scaly. Pileipellis rather distinct. Central U.S.A. *A. prairiicola*, p. 354
1. Spores < 9.5 µ.
   6. Fruit-body large. Cap white to buff with reddish brown to brown warts or scales. Stem subcylindrical, without bulb, not rooting, with incomplete girdles of submembranous scales. Texas. *A. silvifuga*, p. 356
   6. Fruit-body small to medium. Remnants of volva not or hardly darker than the white to avellaneous cap. Stem tapering downward or rooting or with bulbous base.
      7. Fruit-body completely pale ochraceous to avellaneous, or else gills salmon.
         8. Stem with distinct basal bulb. Fruit-body pale ochraceous to avellaneous. Argentina. *A. bubalina*, p. 365
         8. Stem cylindrical to subfusiform. Cap white or whitish, sometimes greyish. Gills salmon. Argentina. *A. singeri*, p. 364
      7. Fruit-body completely white or whitish.

9. Cap at first with small, erect warts, later subverrucose. Stem with distinct ring. Spores 7—8.5 × 6—7 μ. Argentina. *A. lilloi*, p. 361
9. Cap pulverulent-squamulose with small floccose patches. Stem exannulate. Spores 8—9.5 × 6.5—7.5 μ. Bolivia. *A. boliviana*, p. 362

AMANITA VITTADINII (Moretti) Vitt.—Figs. 26–31

Agaricus vittadinii Moretti *in* G. Fis. Chim. Stor. nat. Med. Arti Pavia, dec. 2, **9**: 66. 1826 (not seen); in Bot. ital. **1**: 4, pl. 1. 1826 (not seen). — *Amanita vittadinii* (Moretti) Vitt., Tent. mycol. s. Amanit. Ill. 31, pl. 1. 1826. — *Lepiota vittadinii* (Moretti) Quél. *in* Mém. Soc. Émul. Montbéliard II **5**: 338 (Champ. Jura Vosges, Suppl. 2). 1873. — *Lepidella vittadinii* (Moretti) E. J. Gilb. *in* Bull. Soc. mycol. France **41**: 304. 1925. — *Aspidella vittadinii* (Moretti) E. J. Gilb. *in* Bres., Iconogr. Mycol. **27** (1): 70. 1940. — *Armillaria vittadinii* (Moretti) Locquin in Bull. Soc. mycol. France **68**: 167. 1952. — Lectotype: Moretti, l.c., pl. 1.[42]

Agaricus colubrinus Krombh., Abb. Beschr. Schwämme **1**: 71, pl. 1 figs. 10, 11. 1831. — *Lepiota colubrina* (Krombh.) Sacc., Syll. Fung. **5**: 42. 1887. — Lectotype: Krombh., op. cit., pl. 1 figs. 10, 11.

NAME MISAPPLIED TO THE PRESENT SPECIES.—*Amanita umbella* (Paul. ex Lév.) Quél. sensu Quél., Ench. Fung. 4. 1886.

SELECTED DESCRIPTIONS & ILLUSTRATIONS.—Bertault *in* Bull. Soc. mycol. France **80**: 367. 1964; Font I Quer *in* Publcions Inst. bot., Barcelona 1937: 19; E. J. Gilb. *in* Bull. Soc. mycol. France **41**: 293, pl. 7. 1925; *in* Bres., Iconogr. mycol. **27** (2): 374, (3): pl. 59, 60. 1941; Huijsman *in* Fungus **13**: 54, photogr. 1942; Krombh., Abb. Beschr. Schwämme (1): 71, pl. 1 fig. 10, 11. 1831; (4): 17, pl. 27. 1836; Locquin *in* Bull. mens. Soc. linn. Lyon **19**: 171. 1950; Vitt., Tent. mycol. s. Amanit. Ill. 31, pl. 1. 1826.

Fruit-bodies (Figs. 27, 28) medium to very large; solitary or in rings. Cap 75–170 mm wide, fleshy, from globose via hemispherical to plano-convex, with at first inflexed, then straight, non-sulcate, appendiculate, projecting margin, white to pale dingy ochraceous, with age brownish at centre, dry, fibrillose to fibrillose-scaly, at margin sometimes excoriate with age, with adnate to detersile, white to pinkish- or greyish-brownish volval remnants; these pyramidal, subpyramidal or patch-like at centre and appressed, patch- to scale-like near margin; pileipellis not peeling. Gills rather crowded, free, rather thick, broad, up to 15 mm wide, white, cream, greenish cream or pale greenish yellow, with edge entire or eroded; short gills abundant, the longer ones attenuate, the shorter ones truncate. Stem 100–160 × 15–25 mm, subcylindrical, mostly somewhat attenuate at base, solid, white (sometimes greenish according to Gilbert, 1941: 374), slightly brunnescent, below ring with concentrically arranged, appressed to recurved, flat, membranous scales, above ring minutely fibrillose. Ring pendent, membranous, double, broad, white to straw yellow (sometimes greenish according to Gilbert, l.c.), not or vaguely striate on upperside, fibrillose, with warts along margin on underside. Flesh white, unchanging or turning slightly yellowish (sometimes turning yellow-greenish according to Gilbert, l.c.). Smell at first rather weak, later becoming both sweetish and nauseating (biscuit-like according to Bertault, 1964: 368). Taste indistinct. Spore print whitish (sometimes slightly greenish?).

Spores [90/7] (9–)10–13(–15) × (6.5–)7.5–10(–11) μ, length-breadth ratio 1.1–1.6 (averages 1.2–1.4), subglobose to ellipsoid, amyloid, with slightly thickened wall, with refractive granules or irregular bodies inside (Fig. 29). Basidia 45–60 × 11–14 μ,

[42] I have not seen Moretti's plate, but according to Gilbert (1941: 374) Vittadini's plate (1826: pl. 1) is the same.

4-spored, with clamps, with refractive granular contents. Marginal cells not found. Trama of gills (Fig. 31) bilateral, without terminal inflated cells; diverging hyphae and subcylindrical cells 4–18 μ wide; hymenopodium with cells up to 30 × 20 μ, rather broad; subhymenium rather narrow and dense, subramose to subcellular with rather small cells. Pileipellis not very well differentiated, merely a dense layer between trama of cap and volva on cap; not gelatinizing. Remnants of volva on cap (Fig. 26) consisting mainly of chains of subcylindrical to elongate-fusiform, rarely ellipsoid cells 40–125 × 12–26(–40) μ; chains probably mainly interwoven and more or less parallel to surface of cap, perhaps in central warts in a more erect position; narrow hyphae almost completely lacking. Trama of stem made up of abundant, longitudinal hyphae consisting of long, subcylindrical cells 4–16 μ wide and rather abundant, slenderly clavate, large, upright, terminal cells up to 300 × 35 or 400 × 30 μ; oleiferous elements present. Membranous scales on stem consisting of similar tissue like trama of stem but with fewer or scarcely any terminal clavate cells, at margin or tip carrying remnants of volva. Clamps abundant.

HABITAT.—Terrestrial; in fields, open woods, parks, etc.

DISTRIBUTION.—N. Africa and southern Europe; rare in central and western Europe.

COLLECTIONS EXAMINED.—NETHERLANDS: Delft, eight collections from same locality, between July 1942 and July 1956 (L); CZECHOSLOVAKIA: Bohemia, Prague, 28 Aug. 1937, *Petibok* (PR); S. Slovakia, near Komárno, 10 Oct. 1951, *M. Deyl* (PR); HUNGARY: com. Tolna, Kolësd, 2 Aug. 1960, *G. Bohus & L. Imreh* (PR).

OBSERVATIONS.—The size of the spores mentioned in the description above is larger than that recorded by Bertault (l.c.: 8–11...13 × 7–9 μ) and by Gilbert (l.c.: 8–11 × 7–10 μ). But the size of the spores of four collections depicted by Gilbert (1940: 179, 181) ranges between (8.5–)11–14 × (6.5–)9–10.5 μ.

Locquin (1950: 172) found the wall of the spores of *A. vittadinii* rather complicated in structure. I found it slightly thickened and had the impression that it may be double.

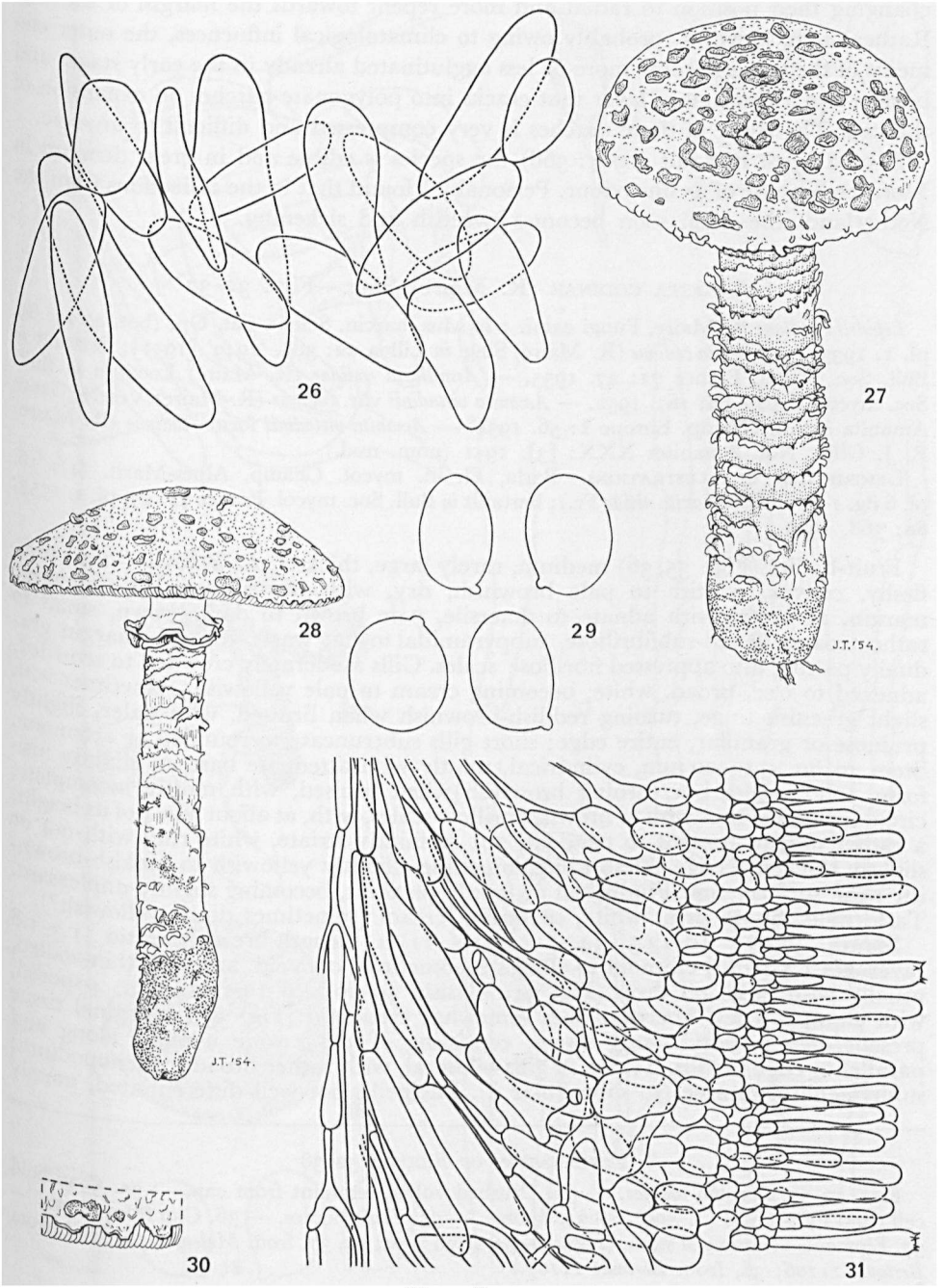
Amanita vittadinii in a well-developed stage is one of the most impressive agarics I have seen. It is pure white with a strongly verrucose to scaly cap with appendiculate or even denticulate edge and a cylindrical stem completely covered with curious, broad, membranous, recurving scales beneath a magnificent, membranous ring with warty edge. The scaliness of the stem is caused by a peeling of the surface-layer provoked by scattered, circular belts of remnants of the volva.

The type of covering of the cap is rather variable. Sometimes there are conical warts at the centre, passing gradually into scales towards the margin. But mostly the outer layer is more felted and cracks into polygonate patches which may finally disappear completely. In addition to this the surface of the cap underneath these patches is fibrillose-squamulose itself.

I am under the impression that the microscopical elements in the outer layer of the volva are parallel and arranged in a fairly erect position at the centre, gradually

EXPLANATION OF FIGURES 26–31

Figs. 26–31. *Amanita vittadinii*. — 26. Crushed volval remnant from cap. — 27, 28. Fruit-bodies. — 29. Spores. — 30. Margin of cap (× 2). — 31. Trama of gill (× 325). (Figs. 26, 27, 28, 30, from *Bas 166*; 29, from Delft collection, 30 July 1956; 31, from *Bas 1053*.)



Figs. 26–31

changing their position to radial and more repent towards the margin of the cap. Rather often, however, probably owing to climatological influences, the outer elements of the volva become more or less agglutinated already in the early stages and behave like a continuous layer that cracks into polygonate patches on expansion of the cap. The tissue of these patches is very compressed and difficult to analyze.

According to Bertault (1964: 368) the species is edible and in great demand in Morocco because of its fine odour. Personally I found that in the collections from the Netherlands the smell soon becomes sweetish and sickening.

AMANITA CODINAE (R. Maire) Sing.—Figs. 32–37

Lepidella codinae R. Maire, Fungi catal. 1 *in* Mus. barcin. Scient. nat. Op. (bot. 2) **15**: 05, pl. 1. 1933. — *Amanita codinae* (R. Maire) Sing. *in* Lilloa **22**: 388. '1949' [1951]; Bertault *in* Bull. Soc. mycol. France **71**: 27. 1955. — *Armillaria codinae* (R. Maire) Locquin *in* Bull. Soc. mycol. France **68**: 167. 1952. — *Amanita vittadinii* var. *codinae* (R. Maire) Veselý, Genre Amanita *in* Atl. Champ. Europe **1**: 56. 1934. — *Amanita vittadinii* forma *codinae* (R. Maire) E. J. Gilb., Not. Amanites XXX: [3]. 1941 (nom. nud.).

DESCRIPTIONS & ILLUSTRATIONS.—Barla, Fl. ill. mycol. Champ. Alpes-Marit. (1): 16, pl. 6 fig. 1–3. 1888 (*Amanita nitida* Fr.); Bertault *in* Bull. Soc. mycol. France **71**: 27, pl. 1. 1955; **80**: 368. 1965.

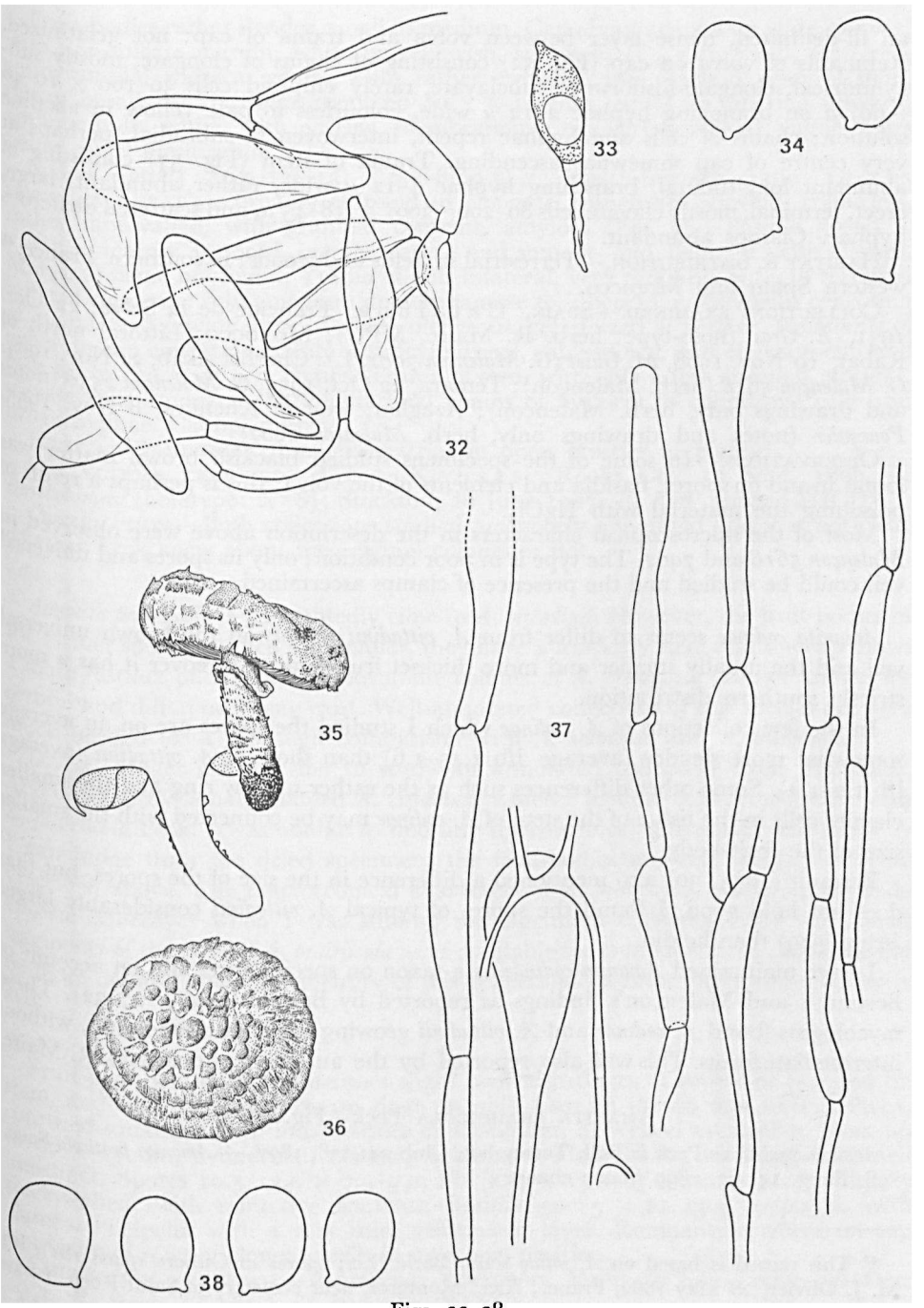
Fruit-bodies (Figs. 35, 36) medium, rarely large, thickset. Cap 50–90(–130) mm, fleshy, convex, whitish to pale brownish, dry, with non-sulcate, appendiculate margin, at centre with adnate to detersile, pale brown to dark brown, small to rather coarse, felted-subfibrillose, subpyramidal to flat warts, towards margin gradually passing into appressed fibrillose scales. Gills moderately crowded to crowded, adnexed to free, broad, white, becoming cream to pale yellowish, sometimes with slight greenish tinge, turning reddish-brownish when bruised, with paler, slightly pruinose or granular, entire edge; short gills subtruncate to rounded or attenuate. Stem 40–80 × 10–20 mm, cylindrical, mostly with attenuate base, or slightly fusiform, solid, white but turning brownish when bruised, with mostly incomplete, circular zones of brownish to brown, fibrillose scales, with, at about $\frac{1}{2}$ to $\frac{3}{4}$ of its height, a rather narrow, patent to pendent, not or faintly striate, white ring with not or slightly thickened edge. Flesh white, sometimes slightly yellowish to pinkish-brownish near surface. Smell indistinct or faintly pleasant, becoming slightly unpleasant. Taste mild. Spore print white, becoming cream (sometimes dingy yellowish?).

Spores [70/7] 10–13.5(–14.5) × 7–10(–11) μ, length-breadth ratio 1.3–1.8 (averages 1.45–1.6), ellipsoid to elongate, sometimes obovoid, amyloid, thin-walled, usually with large oil drop (Fig. 34). Basisia 40–70 × 9–13.5(–14.5) μ, 4-spored, with clamps; a few aberrant ones somewhat cystidioid (Fig. 33). Marginal tissue present only in very young stages, consisting of 3–8 μ wide hyphae, along and parallel to edge of gills. Trama of gills bilateral, with rather broad hymenopodium; subhymenium ramose (to subcellular ?). Pileipellis not well differentiated, merely

EXPLANATION OF FIGURES 32–38

Figs. 32–37. *Amanita codinae*. — 32. Crushed volval remnant from cap. — 33. Cystidioid cell from hymenium (× 500). — 34. Spores. — 35. Fruit-bodies. — 36. Cap from above. — 37. Elements of trama of stem. (Figs. 32, 34, from type; 33, 37, from *Malençon 5618*; 35, from *Bertault 11106*; 36, from *Bertault 11107*.)

Fig. 38. *Amanita prairiicola*. — Spores, from type.



Figs. 32–38

an ill-delimited, dense layer between volva and trama of cap; not gelatinized. Remnants of volva on cap (Fig. 32) consisting of chains of elongate, mostly subcylindrical, elongate-fusiform or subclavate, rarely ellipsoid cells 30–160 × 10–46 (–60) μ on branching hyphae 2–12 μ wide, colourless to pale yellow in alkaline solution; chains of cells and hyphae repent, interwoven to subradial, perhaps at very centre of cap somewhat ascending. Trama of stem (Fig. 37) consisting of abundant longitudinal, branching hyphae 4–12 μ wide, rather abundant, large, erect, terminal, mostly clavate cells 80–200(–300) × 18–45 μ, and scattered oleiferous hyphae. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in fields and woods; in southern France,[43] western Spain and Morocco.

COLLECTIONS EXAMINED.—SPAIN, Cataluna, Franciac de la Selva, 22 Oct. 1931, *E. Gros* (holo-type: herb. R. Maire, MPU); MOROCCO: Littoral north of Rabat, 10 Nov. 1968, *M. Guiet* (*G. Malençon 7002*, L); Cherf el Akab, 21 Nov. 1964, *G. Malençon 5618* (herb. Malençon); Témara, 22 Oct. 1953, *G. Malençon 2550* (notes and drawings only, herb. Malençon); Azaghar, west of Khenifra, 8 Nov. 1955, *Pourquier* (notes and drawings only, herb. *Malençon 2907*).

OBSERVATIONS.—In some of the specimens studied blackish brown matter was found in and on spores, basidia and elements of the volva; this is perhaps a result of poisoning the material with $HgCl_2$.

Most of the microscopical characters in the description above were observed in *Malençon 5618* and *7002*. The type is in poor condition; only its spores and universal veil could be studied and the presence of clamps ascertained.

Amanita codinae seems to differ from *A. vittadinii* mainly in the brown universal veil and the usually smaller and more thickset fruit-body. Moreover it has a more strictly southern distribution.

In the few collections of *A. codinae* which I studied the spores are on an average somewhat more slender (average l/b 1.45–1.6) than those of *A. vittadinii* (average l/b 1.2–1.4). Some other differences such as the rather narrow ring and the smaller clavate cells in the tissue of the stem of *A. codinae* may be connected with the smaller size of the fruit-body.

Bertault (1955: 30) also mentioned a difference in the size of the spores, but that does not hold good. I found the spores of typical *A. vittadinii* considerably larger (see p. 349) than he did.

I have maintained *Amanita codinae* as a taxon on specific level also on account of Bertault's and Malençon's findings as reported by Bertault (1955: 27–32). These mycologists found *A. codinae* and *A. vittadinii* growing together abundantly, without intermediate forms. This was also reported by the author of the species, R. Maire.

AMANITA PRAIRIICOLA Peck—Fig. 38

Amanita prairiicola Peck *in* Bull. Torrey bot. Club **24**: 138. 1897. — *Amanita praticola* Sacc., Syll. Fung. **14**: 63. 1899 (name change).

[43] This record is based on *A. nitida* sensu Barla (l.c.; spores in Gilbert 1940: 181), leg. M. J. Olivier, 28 May 1882, France, Nice, Montgros, near cemetery of Saint-Roch. I have not examined the collection in question.

Fruit-bodies rather slender, small to medium. Cap about 49–90 mm wide, convex, with non-sulcate margin, white or yellowish, subviscid (?), with small, scattered, subpyramidal warts at centre. Gills rather crowded, just reaching apex of stem, rather broad, white. Stem about 60–70 × 5–10 mm, equal or tapering upward, without bulb, white, with narrow, membranous ring, with scattered, vague scales below ring. Flesh white.

Spores [20/2] 10.5–12(–13) × 6.5–8(–9.5) μ, length-breadth ratio 1.2–1.65 (averages 1.35–1.5), broadly ellipsoid to elongate, sometimes obovoid, colourless, rather thin-walled, with granular contents, amyloid (Fig. 38). Basidia 50–60 × 11–15 μ, mainly 4-spored, but several 2-, and some 3- and 1-spored, with clamps. Marginal tissue not found. Trama of gills bilateral, very probably without terminal inflated elements; subhymenium densely ramose to subcellular. Pileipellis consisting of hyphae 2–7 μ wide some of which oleiferous, gelatinized at surface. Remnants of volva on cap consisting mainly of subcylindrical, subfusiform, and elongate-ellipsoid cells up to 120 × 45 μ in chains. Trama of stem with only a few terminal, upright, clavate cells among many longitudinal chains of fusiform to cylindrical cells and broad hyphae. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in open prairies in Kansas.

COLLECTIONS EXAMINED.—U.S.A., Kansas: Rooks Co., 17 Sept. 1896, *E. Bartholomew* (holotype: NYS); Stockton, 20 June 1927; *E. Bartholomew* (MICH).

OBSERVATION.—Both collections studied are poorly annotated and it is not clear whether Peck knew about the original colours or not.

Amanita prairiicola is undoubtedly close to *A. vittadinii*. However, the fruit-bodies of the former species studied are smaller, they have a less scaly stem and the cap shows a more distinct pileipellis. Moreover the colours of *A. prairiicola* are not known for certain and differences may exist. Well-annotated collections of this species are very much needed for a thorough comparison with *A. salmonea* and *A. vittadinii*.

Dr. R. Singer enabled me to study an annotated collection from Tucumán, Argentina, provisionally named *A. vittadinii*, which I assume to be conspecific with *A. prairiicola* Peck. I was unable to find any microscopical differences and as far as I can judge from the dried specimens the fruit-bodies are very similar to those described above. The macroscopical characters of *A. prairiicola*, however, are little known. Moreover when I was studing the Tucumán collection only very small fragments of the type of *A. prairiicola* were available for comparison, so that I cannot be more definite about the identity of this collection. Its most important characters are:

Fruit-body white with sometimes slight brownish tinges at centre of cap and on stem, and vague glaucous-cream tinge on gills. Cap up to 100 mm wide, convex, ruptured-squamose with innate scales or triangular, appressed squamules. Stem up to 90 × 15 mm, cylindrical, coarsely squamose. Flesh white, unchanging. Smell indistinct. Spores 10.5–13.5 × 7.5–9 μ, l/b (1.15–)1.3–1.65 (average 1.4), slightly thick-walled, with refractive contents. Basidia 50–65 × 12–13 μ, 4-spored, with clamps. Pileipellis with a very thin, gelatinized layer. Remnants of volva on cap consisting of rows of elongate cells in unknown position.

COLLECTION EXAMINED.—Argentina, Tucumán, Valle de San Javier, 30 Dec. 1951, *R. Singer (T 1671) & Helberger* (BAFC).

In view of the colours and the irregularly shaped remnants of the volva on the cap it does not seem likely that this collection belongs to *A. ameghinoi* (p. 358).

It should be remarked here that the scales on the stem mentioned in Dr. Singer's description are now indistinct in the dried specimens.

Amanita silvifuga Bas, *sp. nov.*—Figs. 39–41

Pileus 90–150 mm latus, convexus vel plano-concavus, margine appendiculatus neque sulcatus, albus vel pallide ochraceo-bubalinus, siccus, verrucis adnatis, minutis vel majusculis, (sub)conicis, rubro-brunneis vel concoloribus ornatus. Lamellae (sub)confertae, liberae, 18–25 mm latae, albae. Stipes 75–110 × 10–20 mm, subcylindraceus, solidus, albus, sursum glaber, sub annulo squamis submembranaceis, latis, subcirculariter superpositis ornatus. Annulus submembranaceus, albus, laevis. Caro alba. Sapor amarus. Sporae 7–9 × 5.5–7 μ, amyloideae. Fragmenta volvae cellulis elongatis, catenulatis composita. Fibulae frequentes. Typus: '*H. D. Thiers 1397*, 12 Sept. 1951, Texas, Brazos Co., College Station' (holotypus, MICH; isotypus, L).

ETYMOLOGY: silva, forest; fugere, to flee (epithet formed by analogy with adjectives like 'centrifugus' and 'lucifugus').

Fruit-bodies (Fig. 39) large, gregarious to subgregarious. Cap 90–150 mm wide, convex to plano-convex, sometimes plano-concave with age, rather fleshy, with non-sulcate, slightly projecting, eroded to appendiculate margin, white to pale ochraceous buff, dry, with scattered, adnate, felted-fibrillose, conical to subconical, small to moderately large, up to 4 mm wide, reddish brown to brown, with age concolorous warts, sometimes passing into small fibrillose scales towards margin, already in young states conspicuously areolate.[44] Gills crowded to subdistant, free to remote, broad, 18–25 mm wide, white, with entire, concolorous edge; short gills attenuate. Stem 75–110 × 10–20 mm, equal or, more rarely, slightly tapering or broadening towards base, without bulb, solid, with simple, apical, patent to pendent, white, non-striate, felted-membranous ring, glabrous above ring, with incomplete girdles of white, appressed to recurving, submembranous scales below ring. Flesh white. Smell indistinct. Taste distinctly bitter.

Spores [20/1] 7–9(–9.5) × (4.5–)5.5–7 μ, length-breadth ratio 1.15–1.5 (average 1.3), broadly ellipsoid to ellipsoid, sometimes obovoid, with moderately large, abrupt apiculus, colourless, smooth, thin-walled, with refractive, granular-guttulate contents, amyloid (Fig. 40). Basidia 30–45 × 8–10 μ, 4-spored, with clamps. Marginal tissue not found. Trama of gills bilateral, probably with a rather distinct hymenopodium of more or less ellipsoid cells up to 40 × 25 μ; subhymenium ramose to irregularly cellular. Pileipellis a difficult to delimit dense layer of narrow hyphae,

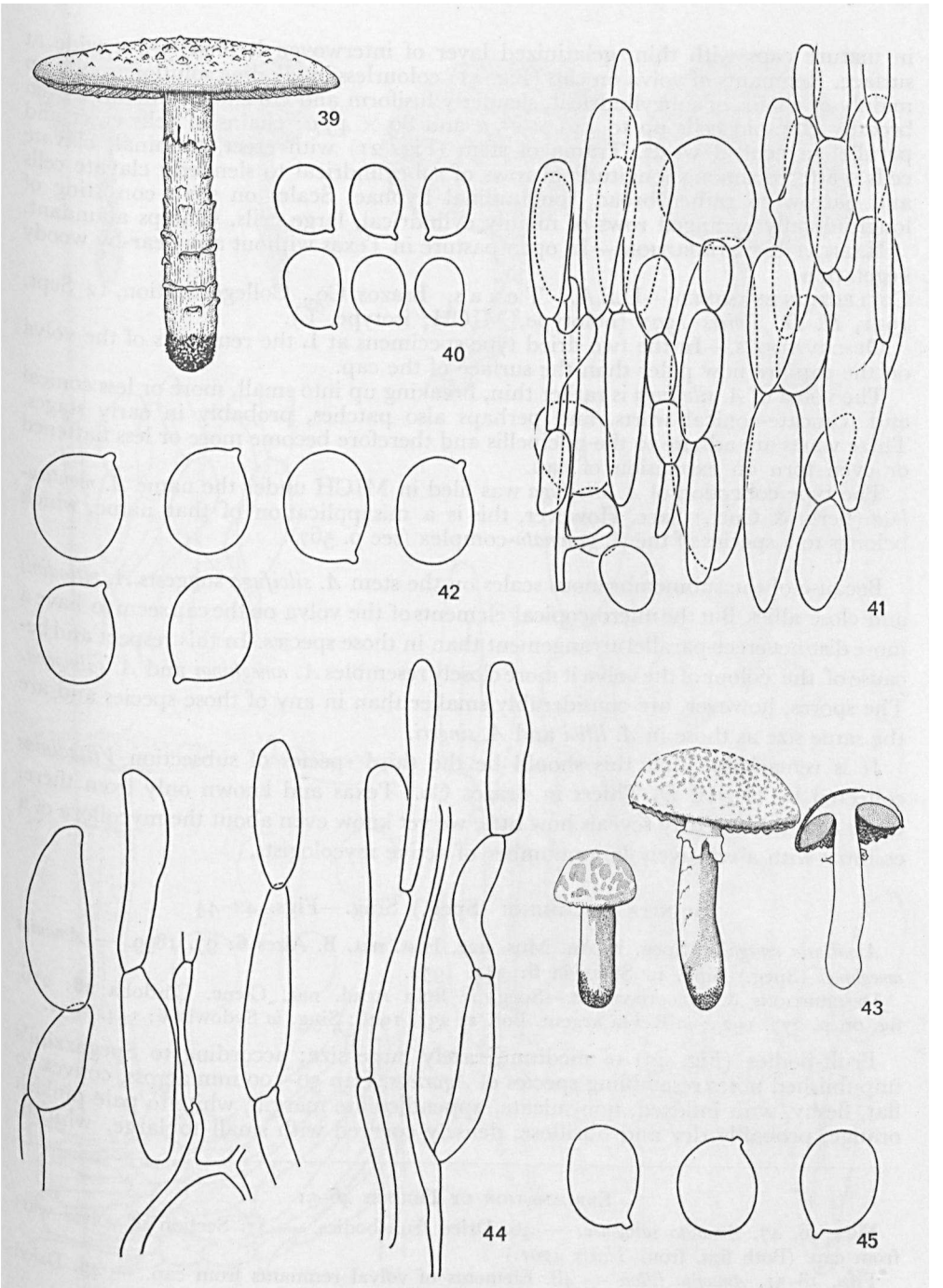
[44] This character is mentioned in Dr. H. D. Thiers' description. It probably means that the remnants of the volva are situated on rounded tubercles formed by the trama of the cap.

EXPLANATION OF FIGURES 39–45

Figs. 39–41. *Amanita silvifuga*. — 39. Fruit-body (after dried specimen). — 40. Spores. — 41. Section of volval wart from cap. (All figs. from type.)

Figs. 42–44. *Amanita ameghinoi*. — 42. Spores. — 43. Fruit-bodies. — 44. Elements of volval remnants from cap. (Figs. 42, 44, from type; 43, after Speg., 1925: 277.)

Fig. 45. *Amanita salmonea*. — Spores, from *Thiers 4701*.



Figs. 39–45

in mature caps with thin, gelatinized layer of interwoven hyphae 3–7 μ wide at surface. Remnants of volva on cap (Fig. 41) colourless in alkaline solution, made up mainly of chains of subcylindrical, slenderly fusiform and elongate, sometimes even broadly ellipsoid cells up to 140 × 25 μ and 80 × 45 μ; chains of cells erect and parallel in central warts. Trama of stem (Fig. 21) with erect, terminal, clavate cells scattered among longitudinal rows of subcylindrical to slenderly clavate cells and narrow to rather broad, longitudinal hyphae. Scales on stem consisting of longitudinally arranged rows of mainly cylindrical, large cells. Clamps abundant.

HABITAT & DISTRIBUTION.—In open pasture in Texas without any near-by woody vegetation.

COLLECTION EXAMINED.—U.S.A., Texas, Brazos Co., College Station, 12 Sept. 1951, *H. D. Thiers 1397* (holotype, MICH; isotype, L).

OBSERVATIONS.—In the two dried type specimens at L the remnants of the volva on the cap are now paler than the surface of the cap.

The volva of *A. silvifuga* is rather thin, breaking up into small, more or less conical and truncate-conical warts, and perhaps also patches, probably in early stages. These warts are adnate to the pileipellis and therefore become more or less flattened or even torn on expansion of cap.

The type collection of *A. silvifuga* was filed in MICH under the name *A. monticulosa* (Berk. & Curt.) Sacc. However, this is a misapplication of that name, which belongs to a species of the *A. gemmata*-complex (see p. 567).

Because of the submembranous scales on the stem *A. silvifuga* suggests *A. vittadinii* and close allies. But the microscopical elements of the volva on the cap seem to have a more distinct erect-parallel arrangement than in those species. In this respect and because of the colour of the volva it more closely resembles *A. ameghinoi* and *A. salmonea*. The spores, however, are considerably smaller than in any of those species and are the same size as those in *A. lilloi* and *A. singeri*.

It is remarkable that this should be the third species of subsection *Vittadiniae* collected by Dr. H. D. Thiers in Brazos Co., Texas and known only from there. Once again this clearly reveals how little we yet know even about the mycoflora of a country with a relatively large number of active mycologists.

AMANITA AMEGHINOI (Speg.) Sing.—Figs. 42–44

Armillaria ameghinoi Speg. in An. Mus. nac. Hist. nat. B. Aires **6**: 97. 1899. — *Amanita ameghinoi* (Speg.) Sing. in Sydowia **6**: 344. 1952.

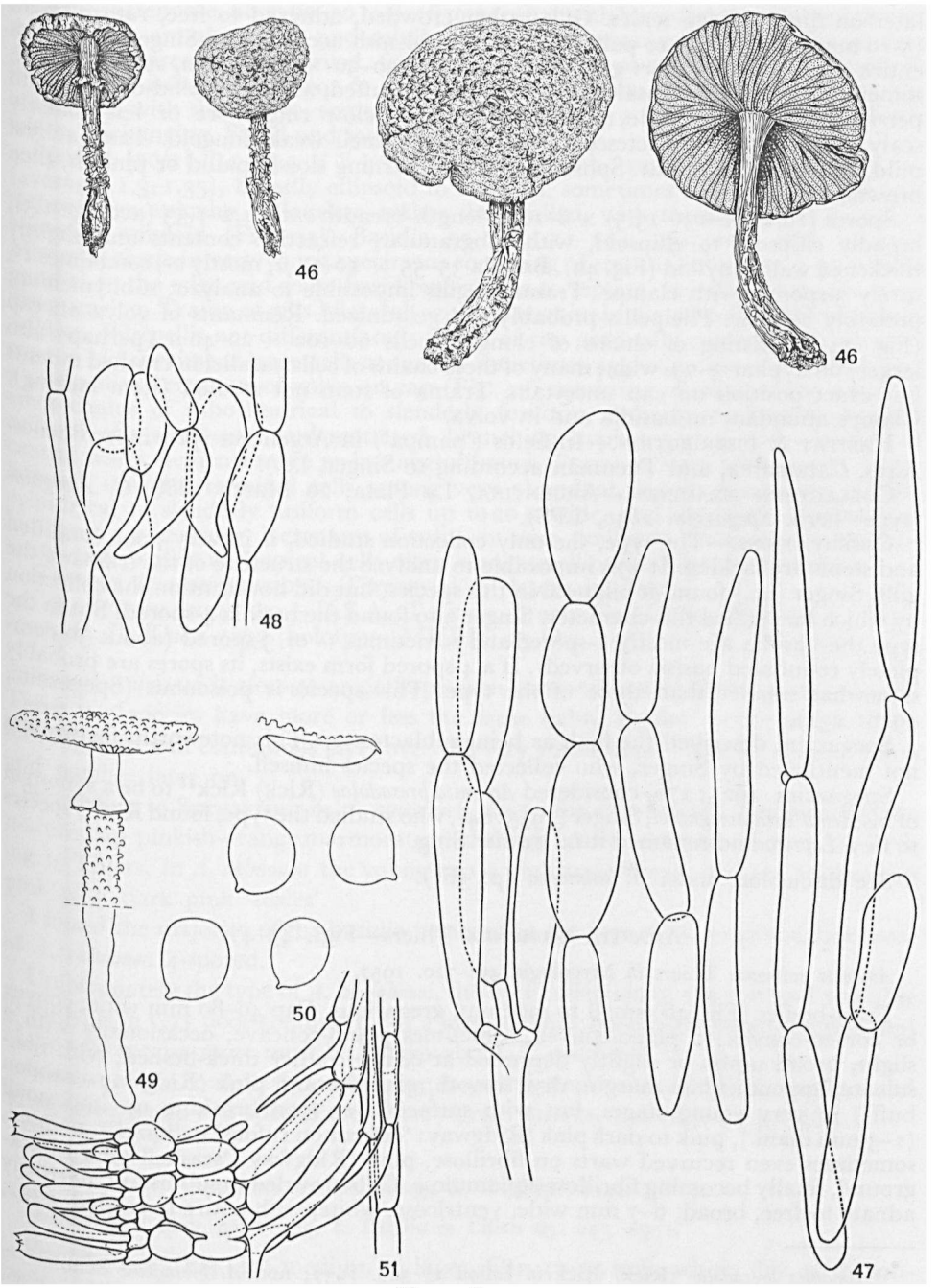
DESCRIPTIONS & ILLUSTRATIONS.—Speg. *in* Boln Acad. nac. Cienc. Córdoba **28**: 276, fig. on p. 277. 1925; *in* Revta argent. Bot. **1**: 231. 1926; Sing. *in* Sydowia **6**: 344. 1952.

Fruit-bodies (Fig. 43) of medium, rarely large size; according to Spegazzini's unpublished notes resembling species of *Agaricus*. Cap 50–100 mm across, convex to flat, fleshy, with inflexed, non-sulcate, appendiculate margin, white to pale pinkish orange, probably dry and fibrillose, densely covered with small to large, whitish,

EXPLANATION OF FIGURES 46–51

Figs. 46, 47. *Amanita salmonea*. — 46. Dried fruit-bodies. — 47. Section of volval wart from cap. (Both figs. from *Thiers 4701*.)

Figs. 48–51. *Amanita lilloi*. — 48. Elements of volval remnants from cap. — 49. Dried fruit-body. — 50. Spores. — 51. Trama of gill (× 325). (All figs. from type.)



Figs. 46-51

later on dingy brown scales. Gills rather crowded, adnexed to free, rather broad (5-10 mm wide), white to pallid (sometimes greenish according to Singer, l.c.), with entire edge; shape of short gills unknown. Stem 50–90 × 10–15 mm, subcylindrical, sometimes with slight basal bulb or inflation, stuffed, white to pallid-orange, with persistent, pendent, white, membranous ring; below ring more or less coarsely scaly. Flesh white, sublactescent, unchanging. Smell weak, fungoid. Taste at first mild, then acrid in throat. Spore print white, turning slowly pallid or pinkish, then brownish.

Spores [10/1] 11–13(–13.5) × 8–10 μ, length-breadth ratio 1.2–1.35 (average 1.3), broadly ellipsoid to ellipsoid, with subgranular, refractive contents and slightly thickened wall, amyloid (Fig. 42). Basidia 35–55 × 10–13 μ, mostly 2-, sometimes 1-, rarely 3-spored, with clamps. Trama of gills impossible to analyze; subhymenium probably cellular. Pileipellis probably not gelatinized. Remnants of volva on cap (Fig. 44) consisting of chains of elongate cells 60–100 × 20–40 μ (perhaps also larger) on hyphae 3–7 μ wide; many of these chains of cells parallel in crushed mounts but exact position on cap uncertain. Trama of stem not studied (stem lacking). Clamps abundant on basidia and in volva.

HABITAT & DISTRIBUTION.—In fields ('pampa') in Argentina (provinces Buenos-Aires, Catamarca, and Tucumán according to Singer, l.c.).

COLLECTIONS EXAMINED.—ARGENTINA, La Plata, 20 March 1888, *C. Ameghino* (type: herb. *Spegazzini 2850*, LPS).

OBSERVATIONS.—The type, the only collection studied, is in very poor condition and stems are lacking. It was impossible to analyze the structure of the trama of the gills. Singer (l.c.) found it bilateral in this species, but did not mention the collection by which he verified this character. Singer also found the basidia 4-spored. But in the type the basidia are mostly 2-spored and sometimes 1- or 3-spored (about 30 completely re-inflated basisia observed). If a 4-spored form exists, its spores are probably somewhat smaller than those of the type. This species is poisonous (Spegazzini, 1926: 231).

Spegazzini described the flesh as being sublactescent. This noteworthy feature was not mentioned by Singer, who collected the species himself.

Spegazzini (1925: 276) considered *Amanita bresadolae* (Rick) Rick[45] to be a synonym of his *Armillaria ameghinoi*, Singer (1953: 64), who studied the type, found Rick's species to be a *Lepiota* and renamed it *L. crassior* Sing.

See discussion under *A. salmonea* (p. 361).

AMANITA SALMONEA Thiers—Figs. 45–47

Amanita salmonea Thiers *in* Mycologia **49**: 720. 1957.

Fruit-bodies (Fig. 46) small to medium, gregarious. Cap 40–80 mm wide, convex or conico-convex to plano-convex, sometimes plano-concave, occasionally with a slight, broad umbo or slightly depressed at centre, rather thick-fleshed, with non-sulcate, appendiculate margin, dry, smooth, glabrous and pink (Ridgway: 'salmon buff') in very young stages, but with surface-layer soon breaking up into small (1–3 mm diam.), pink to dark pink (Ridgway: 'cinnamon rufous' to 'hazel'), pointed, sometimes even recurved warts on fibrillose, pink (Ridgway: 'seashell pink') background, finally becoming fibrillose-squamulose. Gills crowded to subdistant, narrowly adnate to free, broad, 6–7 mm wide, ventricose, white, with entire to eroded edge;

[45] *Amanita bresadolae* (Rick) Rick *in* Lilloa **1**: 308. 1937; non *A. bresadolae* Schulzer *in* Hedwigia **24**: 132. 1885. — Basionym: *Armillaria bresadolae* Rick *in* Brotéria **5**: 71. 1906.

short gills attenuate. Stem 60–90 × 8–16 mm, equal with base slightly enlarged or not, solid, above annulus white and subfibrillose, below annulus pale with incomplete girdles of appressed to recurved, ferruginous, later on pinkish to whitish, fibrillose scales. Ring subapical, patent to pendent, rather narrow, submembranous, rather often torn, with thick edge, sometimes forming merely a floccose-felted zone. Flesh white, unchanging. Smell and taste indistinct.

Spores [20/2] 11–13.5 × 8–10 μ, length-breadth ratio (1.1–)1.2–1.4(–1.55) (averages 1.3–1.35), broadly ellipsoid to ellipsoid, sometimes obovoid, with abrupt, rather large apiculus, colourless, rather thin-walled, with translucent to guttulate contents, amyloid (Fig. 45). Basidia 55–70 × 11–14 μ, 4-spored, with clamps. Marginal tissue in very young specimens consisting of strands of hyphae 3–10 μ wide parallel to the edge and some basidiomorphous to septate, hair-like elements, soon disappearing. Trama of gills bilateral, without terminal inflated cells; subhymenium cellular. Pileipellis not differentiated; trama of cap gradually passing into volva on cap; in old specimens large cells at surface sometimes agglutinating, thus simulating a pileipellis. Remnants of volva on cap (Fig. 47) consisting of more or less parallel, erect chains of subcylindrical to slenderly fusiform, sometimes elongate-ellipsoid cells 50–160 × 20–40 μ and scattered, branching hyphae 3–7 μ wide; in tips of central warts elements more or less agglutinated. Trama of stem with scarce, large, inflated, upright, terminal cells among very abundant, longitudinal rows of subcylindrical to slenderly fusiform cells up to 20 μ wide, and scattered, longitudinal hyphae 2 μ and wider. Remnants of volva on stem similar to those on cap but cells somewhat smaller and apical cells often elongate-ellipsoid. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial on lawns in Texas.

COLLECTIONS EXAMINED.—U.S.A., Texas, Brazos Co., College Station, 14 Sept. 1951, *H. D. Thiers 1393* (holotype: MICH); 23 Oct. 1957, *H. D. Thiers 4701* (L).

Amanita salmonea is close to or perhaps even conspecific with *A. ameghinoi* (p. 358). These two species have more or less the same habit, similar spores and a volva forming a smooth continuous layer over the very young caps, breaking up into warts and patches later on.

According to Spegazzini, in *A. ameghinoi* the young cap is white and smooth, the mature cap pinkish-orange marmorate with dingy brown patches, whereas, according to Thiers, in *A. salmonea* the young cap is pink and smooth, and the mature cap pink with dark pink 'scales'.

I found the majority of the basidia 2-spored in the type of *A. ameghinoi*, but those of *A. salmonea* 4-spored.

Unfortunately the type of *A. ameghinoi*, the only collection of this species I was able to study, is in very poor condition. For a more definite conclusion about the relations of the two species more must be known about *A. ameghinoi*.

Because of the completely smooth cap in young specimens of both *A. ameghinoi* and *A. salmonea*, these two species are of very great interest (see note on p. 348).

AMANITA LILLOI Sing. & Digilio—Figs. 48–51

Amanita lilloi Sing. *apud* Sing. & Digilio *in* Lilloa **25**: 245. 1951.

Fruit-bodies (Fig. 49) medium to large. Cap 40–95 mm, white, dry, with non-sulcate, appendiculate margin, at first densely covered with 3–5 mm high, floccose,

subpyramidal warts, later becoming subverrucose. Gills crowded, adnexed to nearly free, moderately broad, pale cream, pale ochraceous after drying; short gills attenuate. Stem 40–60 × 8–16 mm and cylindrical above the soil, with 35–60 mm long, tapering root in the soil, solid, white, in some specimens below ring densely covered with erect to recurved floccose warts or scales, in others merely fibrillose-squamulose, with apical, thick, striate ring with double edge. Flesh white, unchanging. Smell strongly like 'chloride of lime'. Spore print white.

Spores [25/1] (6.5–)7–8.5 × (5.5–)6–7(–7.5) μ, length-breadth ratio 1.1–1.35 (average 1.2), subglobose to broadly ellipsoid, amyloid, thin-walled (Fig. 50). Basidia 35–40(–50) × 9–11 μ, 4-spored, with clamps. Trama of gills bilateral, probably without terminal, inflated cells, consisting of 4–15 μ wide, diverging hyphae, of a cellular hymenopodium (cells up to 25 × 20 μ) about as thick as hymenium, and of a narrow, dense, inflated-ramose subhymenium (Fig. 51). Pileipellis not differentiated. Remnants of volva on cap (Fig. 48) consisting of chains of mainly elongate-fusiform cells up to 150 × 25 or 100 × 35 μ and branching hyphae 2–10 μ wide; rows of cells parallel in tips of warts, but more or less interwoven and with more slender cells in lower parts of warts; gradually passing into trama of cap. Warts on stem similar to those on cap. Trama of stem with terminal, upright, large, clavate cells among hyphae. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial (type found in garden), Argentina.

COLLECTIONS EXAMINED.—ARGENTINA, Tucumán, Ciudad, 6 Nov. 1950, *M. Grassi T. 1016* (isotype: MICH).

The often subglobose spores of this species suggest the spores in stirps *Nauseosa*. Moreover the present species has a strong and unpleasant smell.

However, in stirps *Nauseosa* at least part of the spores of each specimen are strictly globose. In addition to this, the distinct, wart- to scale-like remnants of the universal veil on cap and stem of *A. lilloi* resemble those found in stirps *Vittadinii*.

AMANITA BOLIVIANA, *nom. prov.*—Figs. 52–54

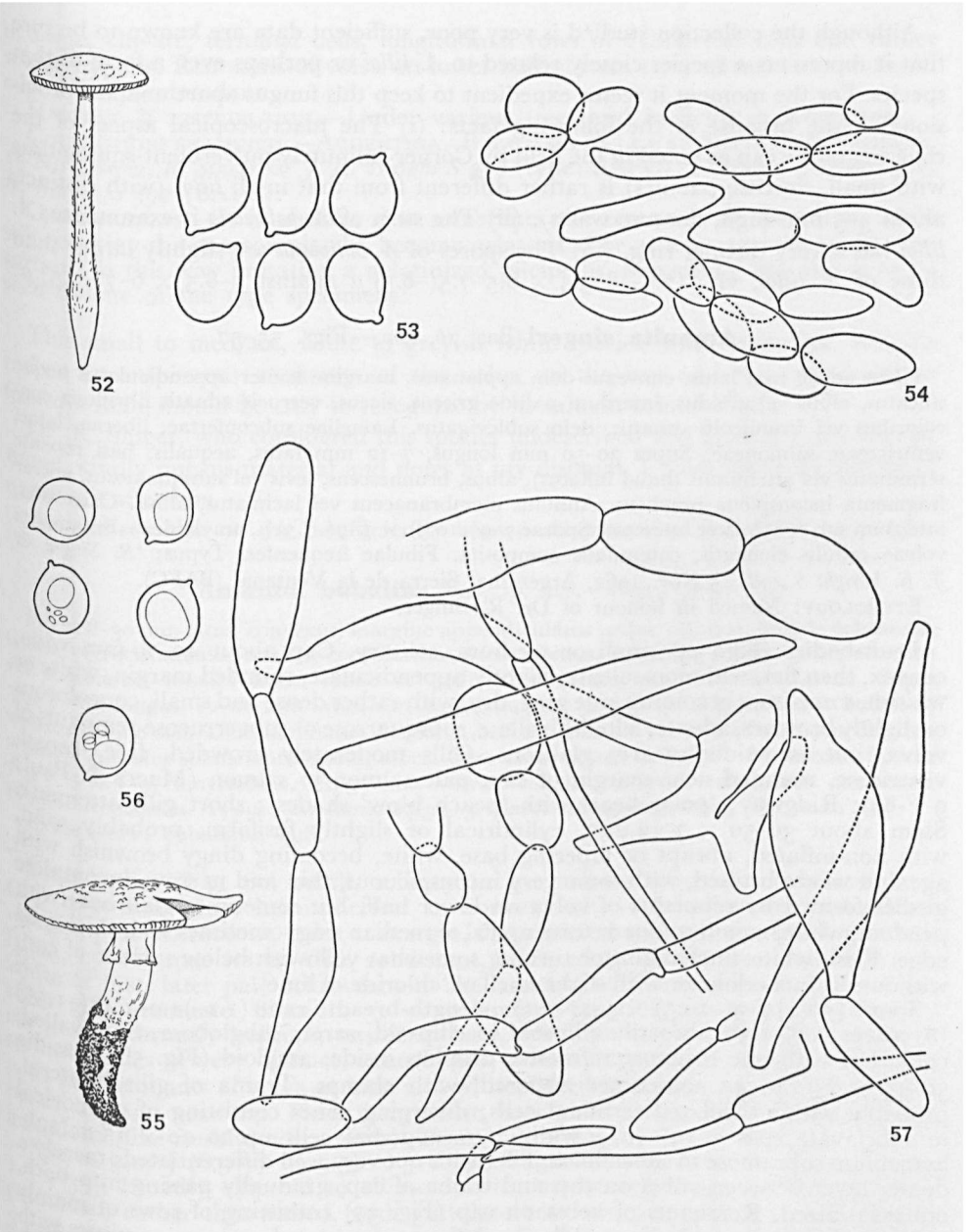
Fruit-bodies (Fig. 52) small, slender, subgregarious. Cap 25–45 mm wide, convex to plano-convex with non-sulcate margin, white, dry, minutely pulverulent-squamulose with small, white, floccose patches and flecks. Gills crowded, free; 4–6 mm wide, white. Stem 70–100 mm long, 6 mm wide above, 8–10 mm wide below at subventricose-fusiform, short-rooting base, solid, firm, white, floccose-scabrous, exannulate, without distinct remnants of volva. Flesh white, unchanging, firm.

Spores [20/1] (7.5–)8–9.5 × 6.5–7.5(–8.5) μ, length-breadth ratio 1.05–1.35 (averages 1.2–1.25), subglobose to broadly ellipsoid, seldom ellipsoid, with very slightly thickened wall, smooth, colourless to slightly yellowish, with granular, refractive contents, with abrupt apiculus, amyloid (Fig. 53). Basidia about 35–45 × 8–11 μ, 4-spored, with clamps. Pileipellis merely a somewhat denser, non-gelatinized layer of hyphae between volva and trama of cap. Remnants of volva on cap (Fig. 54) and at lower part of stem consisting mainly of rows of subcylindrical to ellipsoid cells about 30–80 × 12–35 μ; terminal members of rows sometimes broadly ellipsoid to subglobose. Trama of stem with large, clavate, cells. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in forest in Bolivia.

COLLECTION EXAMINED.—BOLIVIA, dep. Pando, Cobija, 1 Febr. 1948, *E. J. H. Corner Bol. 9* (L).

OBSERVATIONS.—The collection studied consists of two dried, longitudinal slices of a stem and one very thin, radial slice of a cap accompanied by field-notes and a rough pencil-drawing. The tissues are difficult to study. For these reasons the collection is unsuitable as type.



Figs. 52–54. *Amanita boliviana*. — 52. Fruit-body. — 53. Spores. — 54. Elements of volval remnants from cap. (All figs. from *Corner Bol. 9*; 52, after sketch in field-notes.)

Figs. 55–57. *Amanita singeri*. — 55. Dried fruit-body. — 56. Spores. — 57. Elements of volval remnants from cap. (All figs. from type.)

Although the collection studied is very poor, sufficient data are known to be sure that it represents a species closely related to *A. lilloi* or perhaps even a form of that species. For the moment it seems expedient to keep this fungus apart under a provisional name because of the following facts: (i) The macroscopical aspect of the covering of the cap as noted in the field by Corner (minutely pulverulent-squamulose with small, floccose patches) is rather different from that in *A. lilloi* (with distinct, about 3–5 mm high, floccose warts). (ii) The stem of *A. boliviana* is exannulate; *A. lilloi* has a very distinct ring. (iii) The spores of *A. boliviana* are slightly larger than those of *A. lilloi*, viz. (7.5–)8–9.5 × 6.5–7.5(–8.5) μ against 7–8.5 × 6–7(–7.5) μ.

Amanita singeri Bas, *sp. nov.*—Figs. 55–57

Pileus 40–70 mm latus, convexus dein applanatus, margine leviter appendiculatus neque sulcatus, albus vel albidus, interdum pallide griseus, siccus, verrucis adnatis fibrillosis concoloribus vel brunneolis ornatus, dein sublevigatus. Lamellae subconfertae, liberae, latae, ventricosae, salmoneae. Stipes 30–50 mm longus, 7–12 mm latus, aequalis, basi repente terminatus vel attenuatus (haud inflatus), albus, brunnescens, levis vel subsquamosus, volvae fragmenta inconspicua praebens. Annulus membranaceus vel laciniatus, albus. Caro alba, interdum sub cute leviter lutescens. Sporae 7–9(–10.5) × 5–7(–7.5) μ, amyloideae. Fragmenta volvae cellulis elongatis, catenulatis composita. Fibulae frequentes. Typus: '*R. Singer & J. E. Wright S 238*, 15 Nov. 1962, Argentina, Sierra de la Ventana' (BAFC).

ETYMOLOGY: Named in honour of Dr. R. Singer.

Fruit-bodies (Fig. 55) small or medium, solitary. Cap about 40–70 mm wide, convex, then flat, with non-sulcate, slightly appendiculate, rounded margin, white or whitish, sometimes becoming pale grey, dry, with rather dense and small, concolorous or slightly browner, adnate, felted-fibrillose, subsquarrose or subverrucose remnants of volva, but sometimes nearly glabrous. Gills moderately crowded, free, broad, ventricose, rounded near margin of cap, pale salmon to salmon (Maerz & Paul: 9 F-8/9; Ridgway: 'polar bear' with 'peach blow' shades); short gills attenuate. Stem about 30–50 × 7–12 mm, cylindrical or slightly fusiform, probably solid, with non-inflated, abrupt or tapering base, white, becoming dingy brownish with age and where bruised, with some very inconspicuous, thin and narrow, incomplete girdles formed by remnants of volva on lower half, but sometimes glabrous; with pendent, white, membranous or torn, apical to median ring sometimes with thickened edge. Flesh white, unchanging or turning somewhat yellowish below surface of cap, without distinct odour or with slight smell of 'chloride of lime'.

Spores [30/4] 7–9(–10.5) × 5–7(–7.5) μ, length-breadth ratio (1.1–)1.2–1.45(–1.55) (averages 1.25–1.35), broadly ellipsoid to ellipsoid, rarely subglobose, thin-walled, colourless with one to many refractive droplets inside, amyloid (Fig. 56). Basidia 30–45 × 8–12 μ, 4-, sometimes 2-spored, with clamps. Trama of gills bilateral, probably without inflated terminal cells; diverging zones consisting of cylindrical to subclavate cells 5–15(–20) μ wide; hymenopodial cells up to 20 × 15 μ; subhymenium subramose to subcellular. Pileipellis not very well differentiated; merely a denser layer between volva on cap and trama of cap, gradually passing into both, not gelatinized. Remnants of volva on cap (Fig. 57) consisting of rows of mainly cylindrical to elongate-fusiform cells about 60–200 × 15–30(–50) μ, sometimes with the terminal cells more ellipsoid (e.g. 70–130 × 45–50 μ); colourless to pale brownish in alkaline solution; chains of cells more or less interwoven parallel to surface of cap in inner parts, but tending towards a more erect position in outer parts, thus forming rather vague warts or scales; oleiferous elements present. Trama of stem consisting

of large, clavate, terminal cells, longitudinal rows of cylindrical cells and rather scarce hyphae. Remnants of volva on lower half of stem same structure as those on cap. Clamps abundant.

HABITAT & DISTRIBUTION.—Under various trees and in fields in Argentina.

COLLECTIONS EXAMINED.—ARGENTINA, B u e n o s A i r e s: Sierra de la Ventana, 15 Nov. 1962, *R. Singer & J. E. Wright S 238* (type: BAFC); Moreno, 9 Dec. 1962, *R. Singer S 392* (BAFC).

OBSERVATIONS.—It is possible that sometimes the remnants of the volva, while still covering the cap completely, become gelatinized or at least agglutinated at the surface, in this way imitating a gelatinized pileipellis. Something like this is to be seen in one of the type specimens.

This small to medium, white to greyish white species from Argentina, with its rather inconspicuous remnants of the volva on the cap and the cylindrical to fusiform stem, should be easy to recognize by its salmon-coloured gills.

Dr. R. Singer, who considered this species undescribed and gave it a manuscript name, kindly put his material and notes at my disposal. I have taken the liberty of naming it after him.

See the remarks on the insufficiently known *A. spissa* var. *laeta* Rick on p. 561.

Amanita bubalina Bas, *sp. nov.*—Figs. 58–61

Pileus 8–30 mm latus, convexus, margine appendiculatus neque sulcatus, pallide ochrāceus, siccus, verrucis adnatis, conicis, concoloribus dense obsitus. Lamellae subconfertae, adnexae vel subliberae, modice latae, albae vel pallide ochraceae, interdum avellaneae. Stipes 12–30 mm longus, 12–20 mm latus, sursum attenuatus, late clavatus vel abrupte bulbosus, solidus, pallide ochraceus, annulatus, floccosus, basi squamis vel verrucis adnatis concoloribus ornatus. Annulus submembranaceus, albus. Caro alba, postea in bulbo sublutescens. Sporae 7–9 × 5–6.5 μ, amyloideae. Fragmenta volvae cellulis elongatis catenulatis composita. Fibulae frequentes. Typus: '*E. Horak 64/94*, 3 March 1962, Argentina, Tucumán' (L).

ETYMOLOGY: bubalinus, buff.

Fruit-bodies (Fig. 60) small, solitary or gregarious, sometimes subfasciculate. Cap 8–30 mm wide, hemispherical to convex, with appendiculate, non-sulcate margin, pale ochraceous, paler at margin, dry, covered with adnate, small, pointed, felted, concolorous warts. Gills subdistant, adnexed to almost free, rather broad, white at first, later pale ochraceous to avellaneous; with concolorous, entire edge; short gills attenuate. Stem 12–30 × 12–20 mm, tapering upward, with broadly clavate to abruptly bulbous, napiform base, solid, pale ochraceous, floccose with several circles of very distinct, concolorous, adnate, appressed, scale-like to erect, wart-like remnants of volva at base and white, felted-membranous, pendent, rather persistent ring near top. Flesh firm, white, later yellowish in bulb. Smell strongly acidulous (like freshly mown grass). Taste mild.

Spores [20/1] (6.5–)7–9(–9.5) × 5–6.5 μ, length-breadth ratio 1.2–1.5 (averages 1.3–1.35), broadly ellipsoid to ellipsoid, with moderately large, abrupt apiculus, colourless, rather thin-walled, with guttulate contents, amyloid (Fig. 61). Basidia 33–37 × 7–9 μ, 4-spored, with clamps. Marginal tissue in very young specimens consisting of only a few scattered hyphae along edge of gill. Trama of gills bilateral, diverging hyphae up to 12 μ wide, without terminal inflated cells; subhymenium subramose. Pileipellis not differentiated. Remnants of volva on cap (Figs. 58–59) consisting mainly of long chains of subcylindrical, elongate-fusiform, slenderly

clavate, elongate-ellipsoid and sometimes even broadly ellipsoid cells up to 150 × 50 μ and scattered hyphae 4–10 μ wide; chains of cells interwoven but with preference for anticlinal direction, more or less parallel and in more erect position in tips of warts; walls very slightly thickened. Trama of stem (Fig. 22) with terminal, inflated cells (mostly <150 × 60 μ, but a few much larger) among abundant, more or less longitudinal rows of subcylindrical to rather irregularly shaped cells with very slightly thickened walls. Remnants of volva on stem made up of fasciculate chains of elongate cells up to 180 × 40 μ. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in forest at about 1000 m alt.; Argentina.

COLLECTION EXAMINED.—ARGENTINA, Tucumán, Ciudad Universitaria, 3 March 1962, *E. Horak 64/94* (holotype, L; isotype in private herbarium of Dr. E. Horak, Zürich, not studied).

OBSERVATIONS.—Most of the data on macroscopical characters in the description above have been taken from Dr. Horak's field-notes, some of them from his water-colour drawing and some from the dried type collection. The breadth of the stem mentioned is apparently that of the bulbous part. The colour of the cap and the stem in the water-colour drawing is ochraceous-buff (Munsell 2.5 Y 8/4; slightly less pink than Séguy 250).

Amanita bubalina resembles both *A. lilloi* and *A. singeri*. *Amanita lilloi* differs by its verrucose-squarrose cap, white colour, rooting, non-bulbous stem and less elongate spores; *A. singeri* by its white cap and salmon gills, the thin universal veil, forming scarcely any warts, and the non-bulbous base of the stem. Moreover, the cells of the volva and the trama of the stem seem to have thicker walls in *A. bubalina* than in the other two species.

The broadly clavate to abruptly bulbous base of the stem of *A. bubalina* is unusual in subsection *Vittadiniae*.

Stirps NANA

Basidia with clamps. Spores > 9.5 μ, ellipsoid to elongate, thin-walled, with abrupt apiculus. Remnants of volva on stem concentrated below at not or hardly enlarged base and there forming a felted-flocculose sock or perhaps sometimes a few felted-floccose girdles.

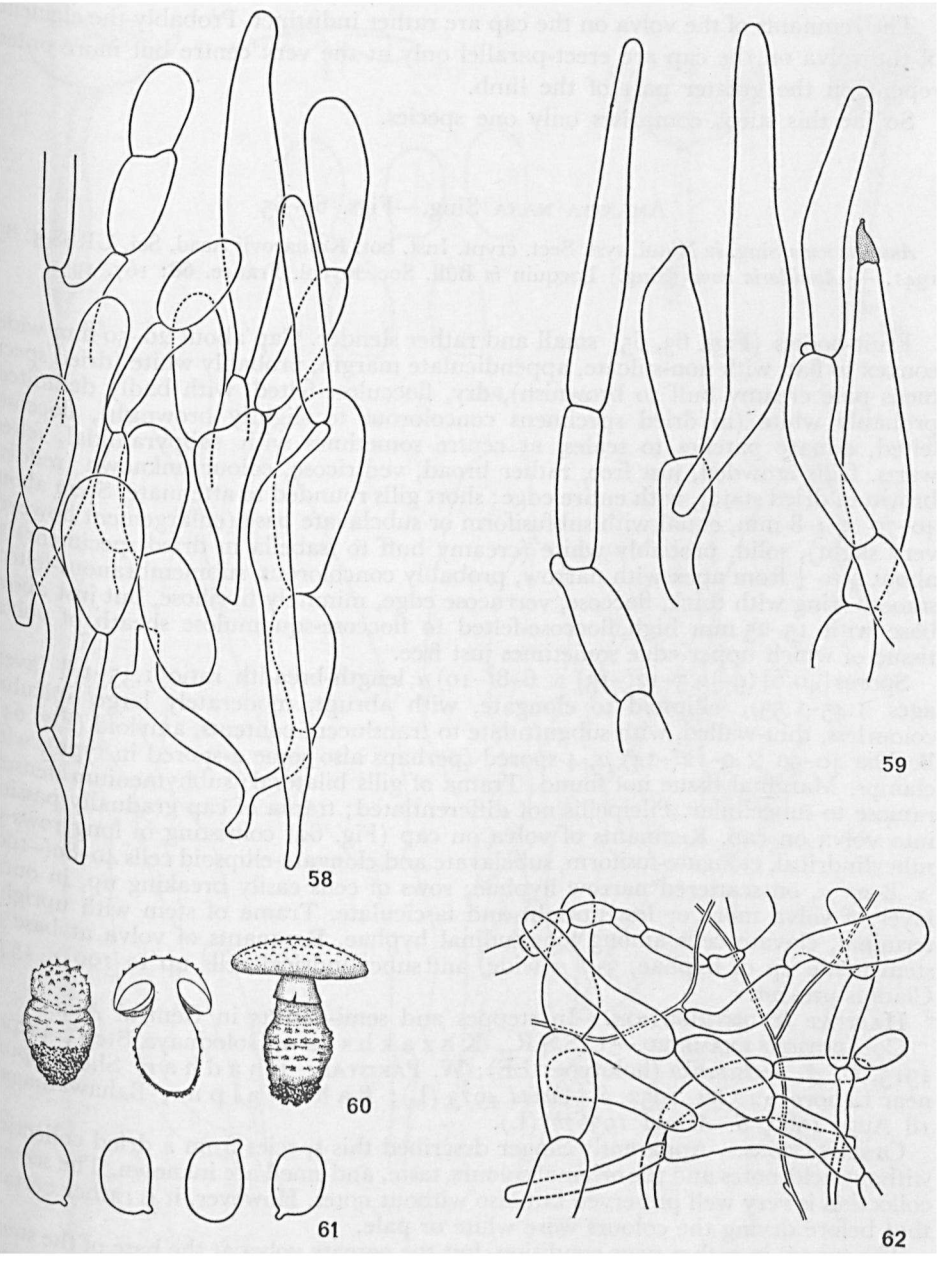
Amanita nana has the same type of fruit-body as the species of the *A. vittadinii*-group in the former stirps, but in the mature fruit-body the volva is more or less ocreate instead of scattered over the greater part of the stem. In a few dried specimens the volval sock even has a very narrow free margin.

It is not clear whether this means that the lower part of the stem does not participate in the process of elongation or that it slips out of the volva. To my mind the former is the case.

EXPLANATION OF FIGURES 58–62

Figs. 58–61. *Amanita bubalina*. — 58. Elements in base of volval wart from cap. — 59. Elements in apex of same wart. — 60. Fruit-bodies. — 61. Spores. (All figs. from type; 60 after Horak's water-colour.)

Fig. 62. *Amanita nana*. — Crushed volval remnants from cap of type.



Figs. 58–62

The remnants of the volva on the cap are rather indistinct. Probably the elements of the volva on the cap are erect-parallel only at the very centre but more or less repent on the greater part of the limb.

So far this stirps comprises only one species.

AMANITA NANA Sing.—Figs. 62–65

Amanita nana Sing. *in* Notul. syst. Sect. crypt. Inst. bot. Komarovii Acad. Sci. URSS **5**: 85. 1941. — *Armillaria nana* (Sing.) Locquin *in* Bull. Soc. mycol. France. **68**: 167. 1952.

Fruit-bodies (Figs. 63, 65) small and rather slender. Cap about 20–50 mm wide, convex to flat, with non-sulcate, appendiculate margin, probably white (dried specimens pale creamy buff to brownish), dry, flocculose-felted, with badly delimited, probably white (in dried specimens concolorous to slightly brownish), floccose-felted, adnate patches to scales, at centre sometimes with subpyramidal, felted warts. Gills crowded, just free, rather broad, ventricose, colour unknown (reddish brown in dried state), with entire edge; short gills rounded to attenuate. Stem about 40–70 × 4–8 mm, equal with subfusiform or subclavate base (enlargement however very slight), solid, probably white (creamy buff to isabella in dried specimens) at about $\frac{1}{3}$ to $\frac{1}{4}$ from apex with narrow, probably concolorous, submembranous-felted, smooth ring with thick, floccose, verrucose edge, minutely fibrillose, but just above base with 15–25 mm high, floccose-felted to floccose-squamulose sheath of volval tissue of which upper edge sometimes just free.

Spores [40/6] (9–)9.5–12(–13) × 6–8(–10) μ, length-breadth ratio 1.35–1.8 (averages 1.45–1.55), ellipsoid to elongate, with abrupt, moderately large apiculus, colourless, thin-walled, with subguttulate to translucent contents, amyloid (Fig. 64). Basidia 40–50 × 9–12(–14) μ, 4-spored (perhaps also some 2-spored in type), with clamps. Marginal tissue not found. Trama of gills bilateral; subhymenium densely ramose to subcellular. Pileipellis not differentiated; trama of cap gradually passing into volva on cap. Remnants of volva on cap (Fig. 62) consisting of long rows of subcylindrical, elongate-fusiform, subclavate and elongate-ellipsoid cells 40–80(–100) × 8–25 μ, on scattered narrow hyphae; rows of cells easily breaking up, in outer layer of volva more or less upright and fasciculate. Trama of stem with upright, terminal, clavate cells among longitudinal hyphae. Remnants of volva at base of stem made up of hyphae, 3–7 μ wide, and subcylindrical cells up to 100 × 15 μ. Clamps present.

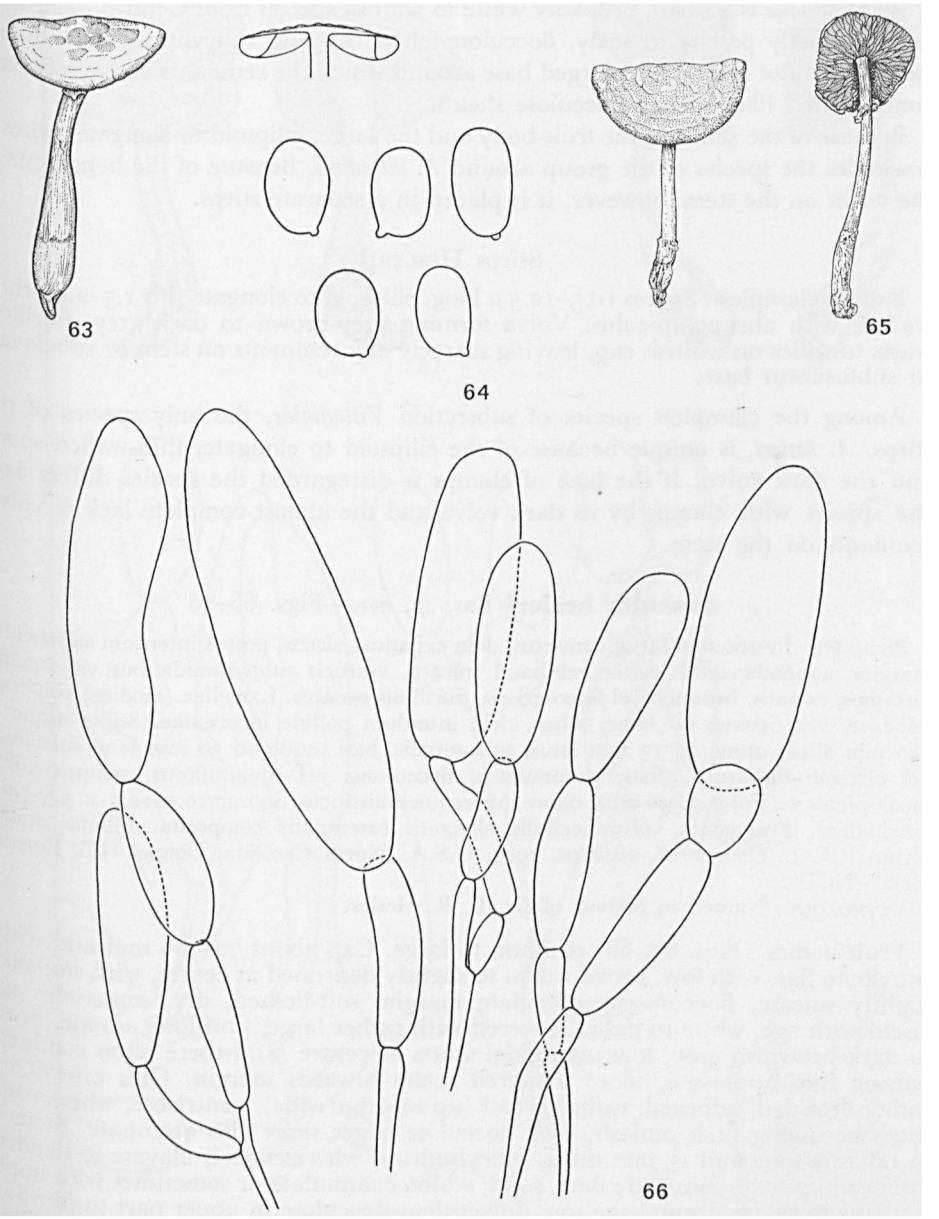
HABITAT & DISTRIBUTION.—In steppes and semi-deserts in Central Asia.

COLLECTIONS EXAMINED.—U.S.S.R., Kazakhstan, Golodnaya Step', 5 April 1915, *O. A. Fedtschenko* (holotype: LE); W. PAKISTAN: Lhadhar, Sheikhupura near Lahore, 12 Oct. 1952, *S. Ahmad 4973* (L); Bahawalpur, Bahawalnagar, 18 Aug. 1966, *S. Ahmad 19367b* (L).

OBSERVATIONS.—Apparently Singer described this species from a dried collection without field-notes and the original colours, taste, and smell are inknown. The second collection is very well preserved but also without notes. However, it is rather certain that before drying the colours were white or pale.

The type is in rather poor condition, but the ocreate volva at the base of the stem, which is very characteristic in the specimens of the second collection, is still vaguely visible.

According to S. Ahmad (1956: 76) this species is common in the north-eastern part of West Pakistan.



Figs. 63–65. *Amanita nana*. — 63. Dried fruit-body. — 64. Spores. — 65. Dried fruit-bodies. (Figs. 63, 64, from type; 65, from *Ahmad 4973*.)
Fig. 66. *Amanita hesleri*. — Elements of volval remnants from cap of type.

Amanita nana is a small, probably white to whitish species from Central Asia, with an indistinctly patchy to scaly, flocculose-felted cap and subcylindrical, annulate stem with a not or hardly enlarged base around which the remnants of the volva are concentrated like a felted-flocculose sheath.

Because of the shape of the fruit-body and the large, ellipsoid to elongate spores it resembles the species of the group around *A. vittadinii*. Because of the behaviour of the volva on the stem, however, it is placed in a separate stirps.

Stirps HESLERI

Basidia clampless. Spores 10.5–12.5 μ long, ellipsoid to elongate (l/b 1.5–2.0), thin-walled, with abrupt apiculus. Volva forming grey-brown to dark grey, fibrillose warts to scales on whitish cap, leaving scarcely any remnants on stem or subclavate to subfusiform base.

Among the clampless species of subsection *Vittadiniae*, the only species of this stirps, *A. hesleri*, is unique because of the ellipsoid to elongate, thin-walled spores and the dark volva. If the lack of clamps is disregarded the species differs from the species with clamps by its dark volva and the almost complete lack of volval remnants on the stem.

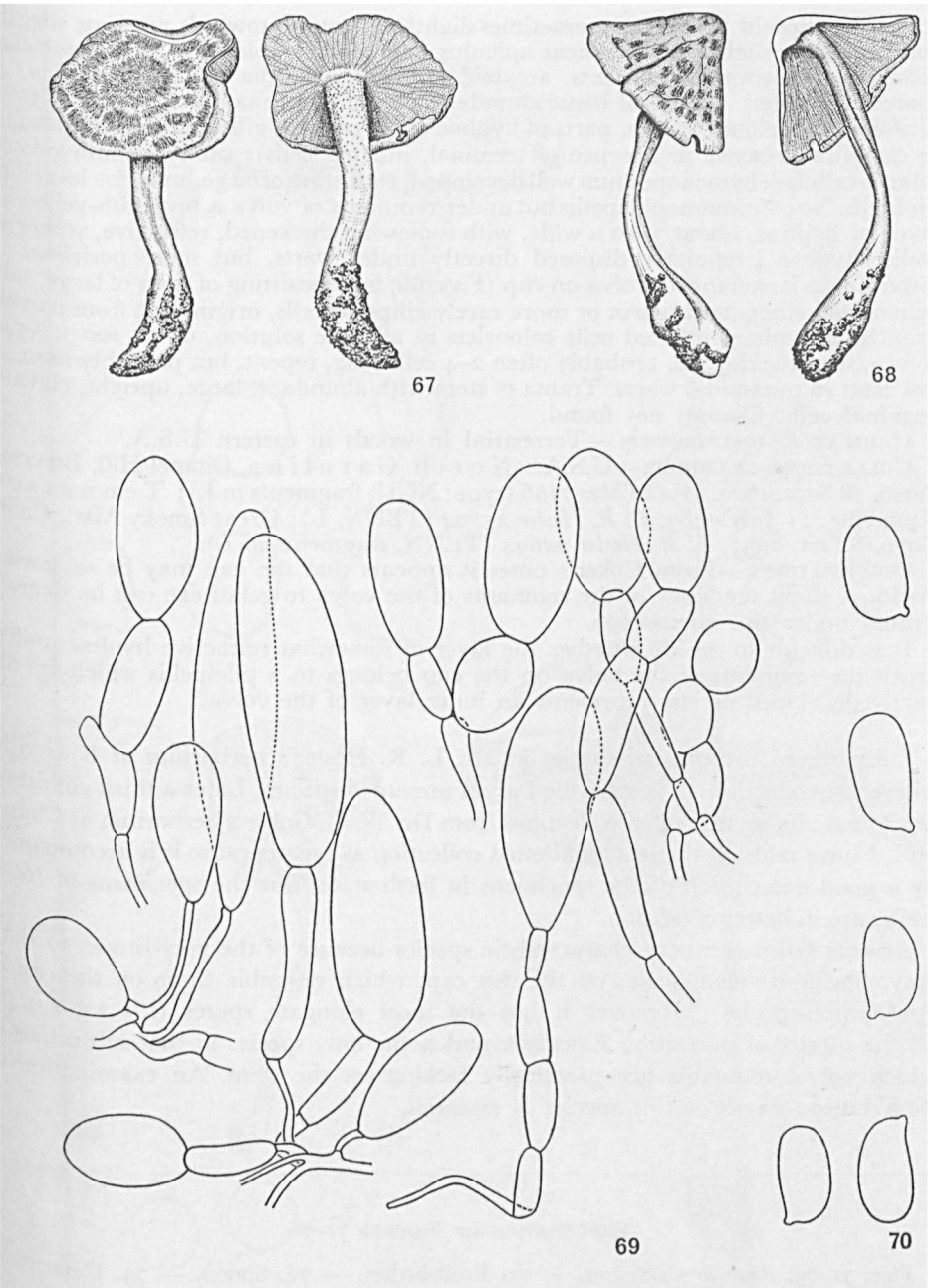
Amanita hesleri Bas, *sp. nov.*—Figs. 66–70

Pileus fere 70–100 mm latus, convexus, dein expansus, siccus, postea interdum subviscidus, margine appendiculata, leviter vel haud sulcata, verrucis subpyramidalibus vel squamiformibus, adnatis, brunneis vel fusco-griseis, fibrillosis ornatus. Lamellae (modice) confertae, adnexae, ventricosae, sat latae, albae, dein interdum pallide incarnatae. Stipes usque ad 140 mm altus, usque ad 15 mm latus, subaequalis, basi usque ad 30 mm lata, subclavata vel elongato-fusiformi, albus, exannulatus, flocculosus vel squamulosus, reliquis volvae inconspicuis vel nullis. Caro alba, odore saporeque indistincto. Sporae 10.5–12.5 × 5.5–7.0 μ, amyloideae. Fragmenta volvae cellulis elongatis catenulatis composita. Fibulae nullae. Typus: '*W. C. Coker 7166*, 28 Sept. 1923, U.S.A., North Carolina, Chapel Hill, Emerson farm' (NCU).

ETYMOLOGY: Named in honour of Dr. L. R. Hesler.

Fruit-bodies (Figs. 67, 68) medium to large. Cap about 70–100 mm and wider, convex to flat, with low, broad umbo to slightly depressed at centre, with smooth to slightly sulcate, floccose-appendiculate margin, soft-fleshed, dry, sometimes subviscid with age, white to pallid, covered with rather large, fibrillose, adnate, brown to dark brownish grey, low pyramidal warts at centre (and there often confluent) passing into appressed, more scattered scales towards margin. Gills crowded to rather crowded, adnexed, rather broad (up to 9 mm wide), ventricose, white, sometimes becoming flesh pinkish, with flocculose edge: short gills attenuate. Stem up to 140 mm long and 15 mm thick, subcylindrical with slenderly clavate to slenderly fusiform, up to 30 mm wide base, solid, white, exannulate or sometimes with imperfect ring of slivers around the top, pulverulent-flocculose in upper part to fibrillose-squamulose in lower part, sometimes with a few vague, whitish to grey, fibrillose, scale-like or wart-like remnants of volva just above enlarged base. Flesh white, unchanging, soft. Smell and taste weak or lacking. Spore print (only a very thin one from *Coker 7166* available) probably white.

Spores [40/2] 10.5–12.5 × 5.5–7.0 μ, length-breadth ratio 1.5–2.0 (averages



Figs. 67–70. *Amanita hesleri*. — 67, 68. Dried fruit-bodies. — 69. Elements of volval remnants from cap. — 70. Spores. (Figs. 67, 69, 70, from *Hesler 22694*; 68, from type.)

1.8–1.9), ellipsoid to elongate, sometimes slightly attenuate towards apex, or slightly constricted, or slightly hooked near apiculus, thin-walled, colourless, with somewhat refractive, subgranular contents, amyloid (Fig. 70). Basidia 40–50 × 9–11 μ, 4-spored, clampless. Marginal tissue abundant, consisting of many, up to 55 × 35 μ, piriform cells, elongate cells, parts of hyphae etc. Trama of gills bilateral (impossible to establish presence or absence of terminal, inflated cells); subhymenium subcellular to cellular; hymenopodium well developed, consisting of large, more or less ellipsoid cells. No continuous pileipellis but under remnants of volva a brownish-yellowish layer of hyphae, about 3–10 μ wide, with somewhat thickened, refractive, yellowish walls; hyphae irregularly disposed directly under warts, but more periclinal in lower parts. Remnants of volva on cap (Figs. 66, 69) consisting of rows of large, subcylindrical, elongate-fusiform or more rarely ellipsoid cells, originating from narrow branching hyphae; inflated cells colourless in alkaline solution, up to 200 × 55 μ; rows easily breaking up, probably often 2–4 cells long, repent, but probably more or less erect in pyramidal warts. Trama of stem with abundant, large, upright, clavate, terminal cells. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: North Carolina, Chapel Hill, Emerson Farm, 28 Sept. 1923, *W. C. Coker 7166* (type: NCU, fragments in L); Tennessee, Knoxville, 11 July 1963, *L. R. Hesler 25794* (TENN, L); Great Smoky Mts., Cades Cove, 6 Oct. 1957, *L. R. Hesler 22694* (TENN, fragments in L).

OBSERVATIONS.—From Coker's notes it appears that the cap may be somewhat viscid. A slight tendency of the remnants of the volva to gelatinize can be demonstrated under the microscope.

It is difficult to decide whether the layer of somewhat refractive hyphae underneath the remnants of the volva on the cap belongs to a pileipellis which is only partly developed or else represents an inner layer of the volva.

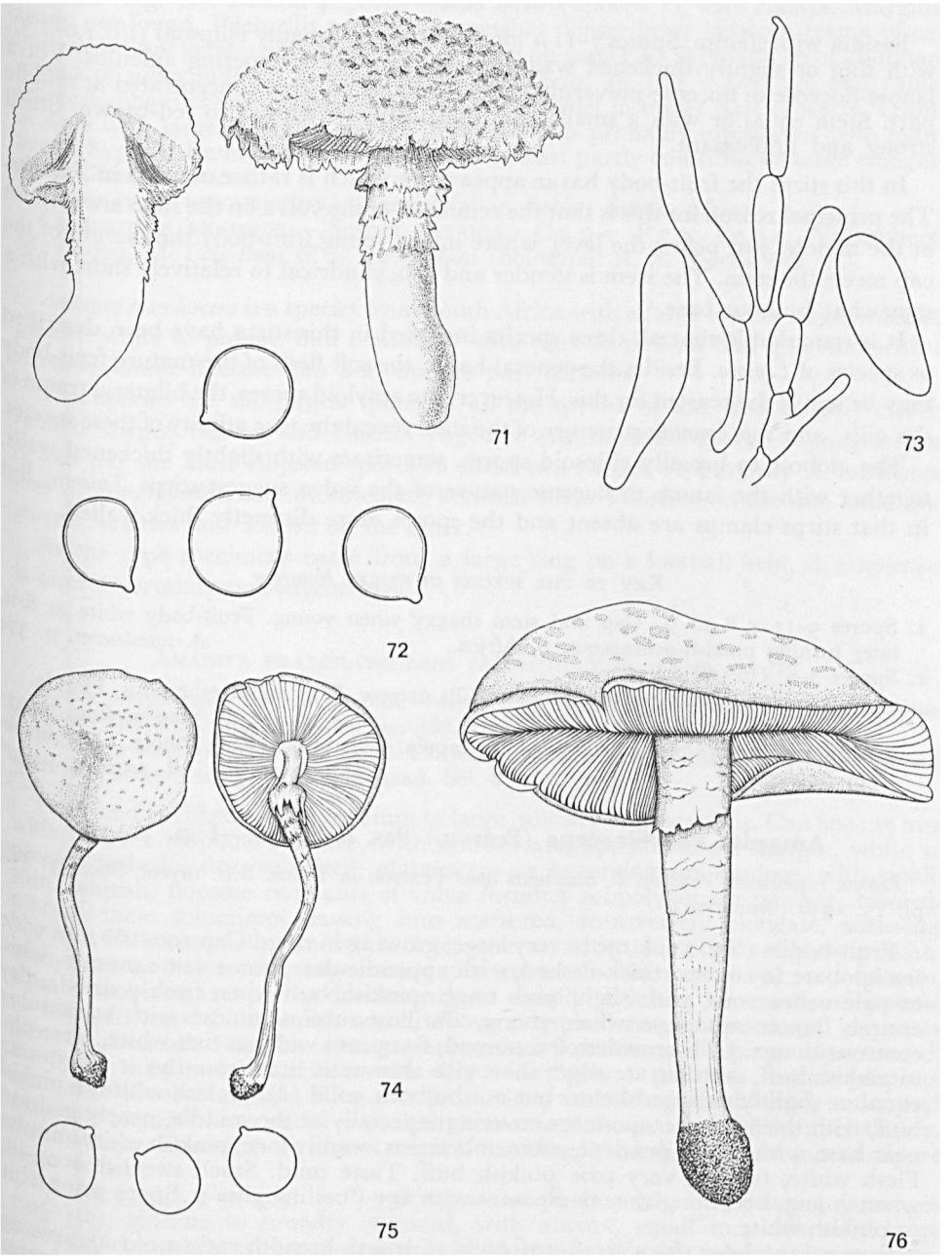
I discovered the present species in Dr. L. R. Hesler's herbarium at Knoxville, where two collections of it were filed as an unnamed species. Later a third collection was found among unnamed collections from Dr. W. C. Coker's herbarium at Chapel Hill. I have selected the last mentioned collection as type because it is accompanied by a good description of the specimens in fresh state. But the specimens of *Hesler 22694* are in better condition.

Amanita hesleri is a very characteristic species because of the grey-brown to dark grey, fibrillose volval scales on the dry cap, which resemble those on the cap of *Strobilomyces*-species. Moreover it has the most elongate spores (l/b 1.5–2.0) of all the species of subsection *Vittadiniae* and is the only species in that subsection in which volval remnants are practically lacking on the stem. An examination of fresh button-stages of this species is essential.

EXPLANATION OF FIGURES 71–76

Figs. 71–73. *Amanita roseolescens*. — 71. Fruit-bodies. — 72. Spores. — 73. Elements of volval remnants from cap. (Figs. 71, after Pearson, 1950: pl. 15; 72, 73, from type.)

Figs. 74–76. *Amanita praegraveolens*. — 74. Dried fruit-body. — 75. Spores. — 76. Dried fruit-body. (Figs. 74, 75, from type; 76, from *Murrill, 23 July 1950*.)



Figs. 71–76

Stirps NAUSEOSA

Basidia with clamps. Spores 7–11 μ long, globose to broadly ellipsoid (l/b 1.0–1.3), with thin or slightly thickened wall and with abrupt or tapering apiculus. Volva lanose-floccose to floccose-pulverulent; its remnants on stem concentrated at middle part. Stem equal or with a small basal bulb. Colours whitish to red-brown. Smell strong and unpleasant.

In this stirps the fruit-body has an appearance which is rather unusual in *Amanita*. The principal reason for this is that the remnants of the volva on the stem are thickest at the middle, just below the level where in the young fruit-body the margin of the cap meets the stem. The stem is slender and subcylindrical to relatively short with a somewhat bulbous base.

It is remarkable that all three species included in this stirps have been described as species of *Lepiota*. Besides the general habit, the soft flesh of the mature fruit-body may be one of the reasons for this. However, the amyloid spores, the bilateral trama of the gills, and the *Amanita*-structure of the stem reveal the true affinity of these species.

The globose to broadly ellipsoid spores, sometimes with slightly thickened walls, together with the lanose to floccose nature of the volva suggest stirps *Thiersii*. But in that stirps clamps are absent and the spores more distinctly thick-walled.

KEY TO THE SPECIES OF STIRPS *Nauseosa*

1. Spores 9–11 × 8–10 μ. Cap and stem shaggy when young. Fruit-body white at first, later turning pinkish-ochraceous. S. Africa. *A. roseolescens*, p. 374
1. Spores 7–9 × 6.5–8 μ.
   2. Fruit-body white to pinkish isabella. Gills narrow. Ring submembranous. Florida. *A. praegraveolens*, p. 375
   2. Cap and middle part of stem reddish brown. Gills broad. Ring friable. Greenhouses in England. *A. nauseosa*, p. 376

Amanita roseolescens (Pearson) Bas, *comb. nov.*—Figs: 71–73

Lepiota roseolescens Pearson & Stephens *apud* Pearson *in* Trans. Brit. mycol. Soc. **33**: 288, pl. 15. 1950 (basionym).

Fruit-bodies (Fig. 71) large to very large, growing in rings. Cap 100–160 mm wide, semiglobate to convex, thick-fleshed, with appendiculate, non-sulcate margin, white to pale ochraceous, with slight pink tinge (pinkish buff when freshly dried), dry, entirely lanose-squarrose when young, fibrillose-subsquamulose with squamulose centre with age. Gills crowded, free, broad, 6–13 mm wide, at first white, later pink to pinkish buff, with serrate edge; short gills attenuate. Stem 100–140 × 15–30 mm, equal or slightly enlarged below but not bulbous, solid (?), pinkish white to pinkish buff, with thick, lanose-squamose covering especially at the middle, nearly glabrous near base, with apical, pendent, submembranous, readily torn, pinkish white annulus. Flesh white, turning very pale pinkish buff. Taste mild. Smell sweetish soap-like when young, becoming very unpleasant with age ('boiling glue'). Spore print white to pinkish white.

Spores [20/1] 9–11(–12) × 8–10(–10.5) μ, length-breadth ratio 1.0–1.25 (average 1.15), globose to broadly ellipsoid, often slightly tapering towards broadly implanted, rather large apiculus, colourless, refractively guttulate, with slightly thickened wall,

amyloid (Fig. 72). Basidia 4-spored (some 2- or 3-spored ?), with clamps. Marginal tissue not found. Pileipellis merely a somewhat denser layer between trama of cap and volva; not gelatinized. Remnants of volva on cap (Fig. 73) made up of abundant chains of subcylindrical to slenderly fusiform cells, 40–130 × 15–35 μ, and rather scarce hyphae; chains probably more or less parallel in upper part of warts. Trama of stem with large, upright, clavate, terminal cells probably intermixed with many broad hyphae. Remnants of volva on stem at least partly consisting of large elongate cells. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in fields; South Africa.

COLLECTION EXAMINED.—SOUTH AFRICA, Cape Province, Valkenberg, May 1949, *M. Cole-Rous & E. L. Stephens* (holotype: *A. A. Pearson 681*, K).

Amanita roseolescens is a species from South Africa with a large to very large, thickset, pinkish white to pinkish buff fruit-body with pink to pinkish buff gills and with a strongly lanose-floccose cap and middle part of stem.

This species has the largest spores of all the species of the, undoubtedly closely related, stirpes *Nauseosa* and *Thiersii*. Together with the small-spored *A. praegraveolens* it also has the most ellipsoid spores in these two stirpes. Apparently *A. roseolescens* and *A. praegraveolens* are intermediate between stirps *Vittadinii* on the one hand and stirpes *Nauseosa* and *Thiersii* on the other.

As the type specimens came from a large ring on a football field, *A. roseolescens* is almost certainly non-mycorrhizal.

AMANITA PRAEGRAVEOLENS (Murrill) Sing.—Figs. 74–77

Lepiota praegraveolens Murrill *in* Bull. Torrey bot. Club **66**: 153. 1939. — *Amanita praegraveolens* (Murrill) Sing. *in* Lilloa **22**: 388. 1951.

Venenarius malodorus Murrill *in* Q. Jl Florida Acad. Sci. **8**: 183. 1945. — *Amanita malodora* (Murrill) Murrill *in* Q. Jl Florida Acad. Sci. **8**: 198. 1945.

Fruit-bodies (Figs. 74, 76) medium to large, solitary or gregarious. Cap 60–125 mm wide, convex to plano-concave, with non-sulcate, appendiculate margin, white to pinkish isabella, dry, subfelted, glabrescent or becoming squamulose, with small, thin, whitish, floccose remnants of volva forming subpolygonate patches; towards margin these sometimes passing into scattered, transversely elongate, scale-like patches. Gills crowded, adnexed to free, narrow, white, sometimes slightly pinkish, with more or less eroded edge; short gills attenuate. Stem 100–150 × 7–20 mm, equal or somewhat tapering downward, but usually with a rather small, subglobose to ellipsoid basal bulb, solid, white, above subapical ring glabrous and minutely grooved, beneath ring floccose-squamulose and sometimes conspicuously grooved, but lower third merely fibrillose with only a few flocks or glabrous; without distinct remnants of volva at base. Ring subapical, thin, membranous-subfelted, entire and ample or torn, white to pallid or pinkish, non-striate above. Flesh white, unchanging. Smell strong, sickening. Taste not unpleasant, fungoid or slightly adstringent. Spore print white.

Spores [35/4] 7–9(–9.5) × 6.5–8(–9) μ, length-breadth ratio 1.0–1.3 (averages 1.05–1.2), globose to broadly ellipsoid, with abrupt, small to moderately large apiculus, colourless, with not or hardly thickened wall, with subgranular to translucent contents, amyloid (Fig. 75). Basidia 35–45 × 10–13 μ, 4-spored, with clamps. Marginal tissue consisting of abundant small, basidiform to piriform cells, about

15–30 × 6–14 μ, on collapsed hyphae parallel to edge of gill. Trama of gills bilateral; subhymenium densely ramose to subcellular; hymenopodium made up of small cells; oleiferous hyphae rather abundant in central layer. Pileipellis not very well differentiated, not gelatinized, consisting of repent elements similar to those of volva. Remnants of volva on cap (Fig. 77) consisting of readily disjoining rows of mainly subcylindrical to slenderly fusiform and some ellipsoid, clavate and ellipsoid cells about 30–110 × 10–30 μ. Trama of stem with large, terminal, upright, slenderly clavate cells among abundant, longitudinal hyphae, 3–15 μ wide, and rows of cylindrical, slenderly fusiform and clavate cells. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial under hedges and on lawns in Florida.

COLLECTIONS EXAMINED.—U.S.A., Florida, Gainesville: 25 Oct. 1938, *W. A. Murrill F 18298* (holotype: FLAS); 11 Aug. 1944, *W. A. Murrill F 32707* (holotype of *Venenarius malodorus:* FLAS); 26 July 1944, *W. A. Murrill F 32728* (FLAS); 23 July 1950, *W. A. Murrill* (MICH).

OBSERVATIONS.—Murrill himself (1951: 27) established the identity of *A. malodora* and *Lepiota praegraveolens*. According to an unpublished, typewritten note of his in the library of the University Herbarium at Ann Arbor, the type of *L. praegraveolens* was collected after heavy rains that had removed all the remnants of the volva from the cap.

K. F. Cooke (1954: 28) found subcutaneous injections of an alcoholic extract of this species not toxic to guinea-pigs.

This species is close to *A. nauseosa* but differs by (i) paler colours, (ii) a membranous-subfelted ring, (iii) narrow gills, and (iv) a subbulbous base of the stem.

One of the specimens I studied closely resembled *A. foetens*, but that species lacks clamps and has a distinctly thickened spore-wall.

AMANITA NAUSEOSA (Wakef.) D. Reid—Figs. 78–80

Lepiota nauseosa Wakef. *in* Bull. misc. Inf. R. bot. Gdns Kew 1918: 230. — *Amanita nauseosa* (Wakef.) D. Reid *in* Nova Hedwigia, Suppl. **11**: 25, fig. 7, 13, pl. 7. 1966. — Holotype: *E. M. Wakefield*, Febr. 1918, Royal Botanic Gardens, Kew, England (K).

Fruit-bodies (Fig. 78) large, gregarious. Cap up to 180 mm wide, hemispherical, then conico-convex to plano-convex, finally plano-concave, usually with a low broad umbo, with non-sulcate, appendiculate margin, dry, tawny brown and pulverulent flocculose at first, later ochraceous brown fibrillose-squamulose on a pale ochraceous buff background, with scattered, small, whitish to pallid, floccose patches when very young. Gills rather crowded, free, thin, broad, up to 20 mm wide, very pale pinkish cream; short gills attenuate. Stem up to 220 × 17 mm, more or less equal but often expanded at apex, not or hardly enlarged at base, exannulate, at upper part conspicuously tawny brown floccose on pallid background, downward more appressedly fibrillose-squamulose, at lower part paler and less squamulose, at extreme base white and tomentose, turning yellow-brown when bruised. Partial veil thick, pulverulent-floccose, disrupting. Flesh white, but yellowish in apex of stem. Smell strong, sickening. Spore print white.

Spores [30/3] 7–9(–9.5) × 6.5–8(–9) μ (6–8 μ in diam. according to Reid, l.c.), length-breadth ratio 1.0–1.1(–1.15) (average 1.05), globose to subglobose, with abrupt, moderately large apiculus, with slightly thickened wall, colourless, with subgranular, somewhat refractive contents, amyloid (Fig. 79). Basidia 35–45 × 9–12 μ, mostly 4- but sometimes 2-spored, with clamps; contents granular and

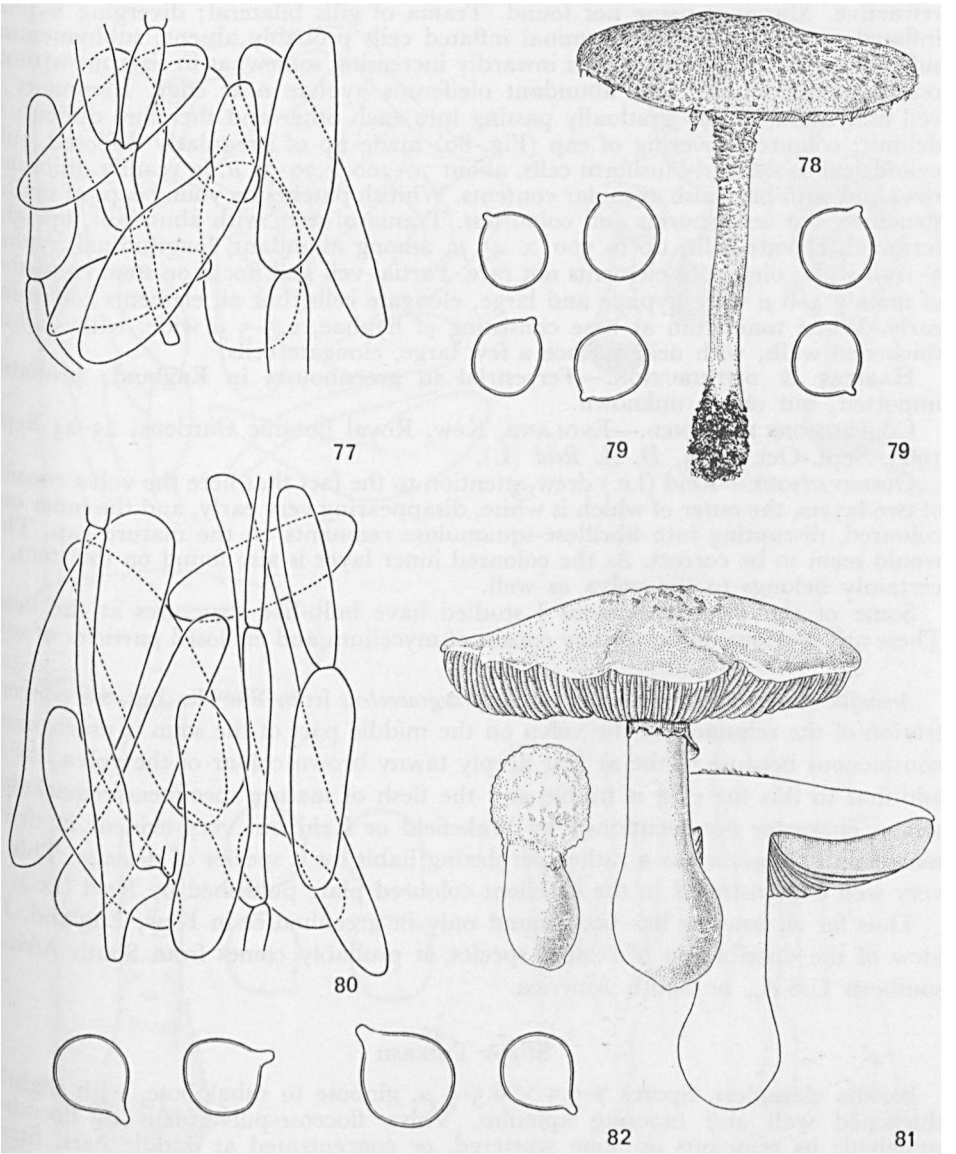


Fig. 77. *Amanita praegraveolens*. — Crushed volval remnants from cap of type.

Figs. 78–80. *Amanita nauseosa*. — 78. Fruit-body (× 1/4!). — 79. Spores. — 80. Crushed volval remnants from cap. (Figs. 78, after Reid, 1966: pl. 7; 79, 80, from *Reid, Sept.–Oct.* 1962.)

Figs. 81, 82. *Amanita praeclara*. — 81. Fruit-bodies. — 82. Spores. (Figs. 81, after Pearson, 1950: pl. 14; 82, from type.)

refractive. Marginal tissue not found. Trama of gills bilateral; diverging hyphae inflated, up to 20 μ wide; terminal inflated cells probably absent; subhymenium subcellular to cellular, with cells inwardly increasing somewhat in size but without real hymenopodium; with abundant oleiferous hyphae near edge. Remnants of veil and trama of cap gradually passing into each other and therefore difficult to delimit; coloured covering of cap (Fig. 80) made up of irregularly disposed, subcylindrical to slenderly fusiform cells, about 70–200 × 20–35 μ, in readily disjoining rows and with brownish granular contents. Whitish patches on young caps of similar structure, but cells shorter and colourless. Trama of stem with abundant, upright, terminal, clavate cells, up to 300 × 45 μ, among abundant, longitudinal hyphae 5–10 μ wide; oleiferous elements not rare. Partial veil and flocks on stem consisting of mainly 4–6 μ wide hyphae and large, elongate cells, but all elements collapsing early. White tomentum at base consisting of hyphae, 2.5–5 μ wide, with slightly thickened walls, with near surface a few large, elongate cells.

HABITAT & DISTRIBUTION.—Terrestrial in greenhouses in England; probably imported, but origin unknown.

COLLECTIONS EXAMINED.—ENGLAND, Kew, Royal Botanic Gardens, 23–24 Sept. 1963, Sept.-Oct. 1963, *D. A. Reid* (L).

OBSERVATIONS.—Reid (l.c.) drew attention to the fact that here the volva consists of two layers, the outer of which is white, disappearing very early, and the inner one coloured, disrupting into fibrillose-squamulose remnants on the mature cap. This would seem to be correct. As the coloured inner layer is also found on the stem, it certainly belongs to the volva as well.

Some of the dried specimens I studied have bulb-like structures at the base. These are spurious bulbs, as they consist of mycelium and enclosed particles of soil.

Amanita nauseosa is very similar to *A. praegraveolens* from Florida, but the concentration of the remnants of the volva on the middle part of the stem is much more conspicuous because of the at first deeply tawny brown colour of the volva. As in addition to this the ring is friable and the flesh of mature specimens remarkably soft, a character not mentioned by Wakefield or Reid but very evident in dried material, *A. nauseosa* has a rather perplexing habit for a species of *Amanita*. This is very well demonstrated in the excellent coloured plate published by Reid (l.c.).

Thus far *A. nauseosa* has been found only in greenhouses in Kew, England. In view of the distribution of related species, it probably comes from South Africa, southern U.S.A., or South America.

Stirps THIERSII

Basidia clampless. Spores 7–9.5 × 6.5–9 μ, globose to subglobose, with slightly thickened wall and tapering apiculus. Volva floccose-pulverulent to floccose-subfelted; its remnants on stem scattered, or concentrated at middle part. Stem subbulbous to bulbous, in at least some species soon hollow. Colours whitish, pinkish yellowish or bright orange-yellow. In at least one species smell strong and unpleasant.

This stirps is closely related to stirps *Nauseosa*, but clamps are lacking.

Because of the bright orange-yellow colour and the widely hollow, slender stem *A. aureofloccosa* is aberrant in respect of the whole section *Lepidella*. It resembles *A. thiersii*, however, in too many aspects to be placed separate from it.

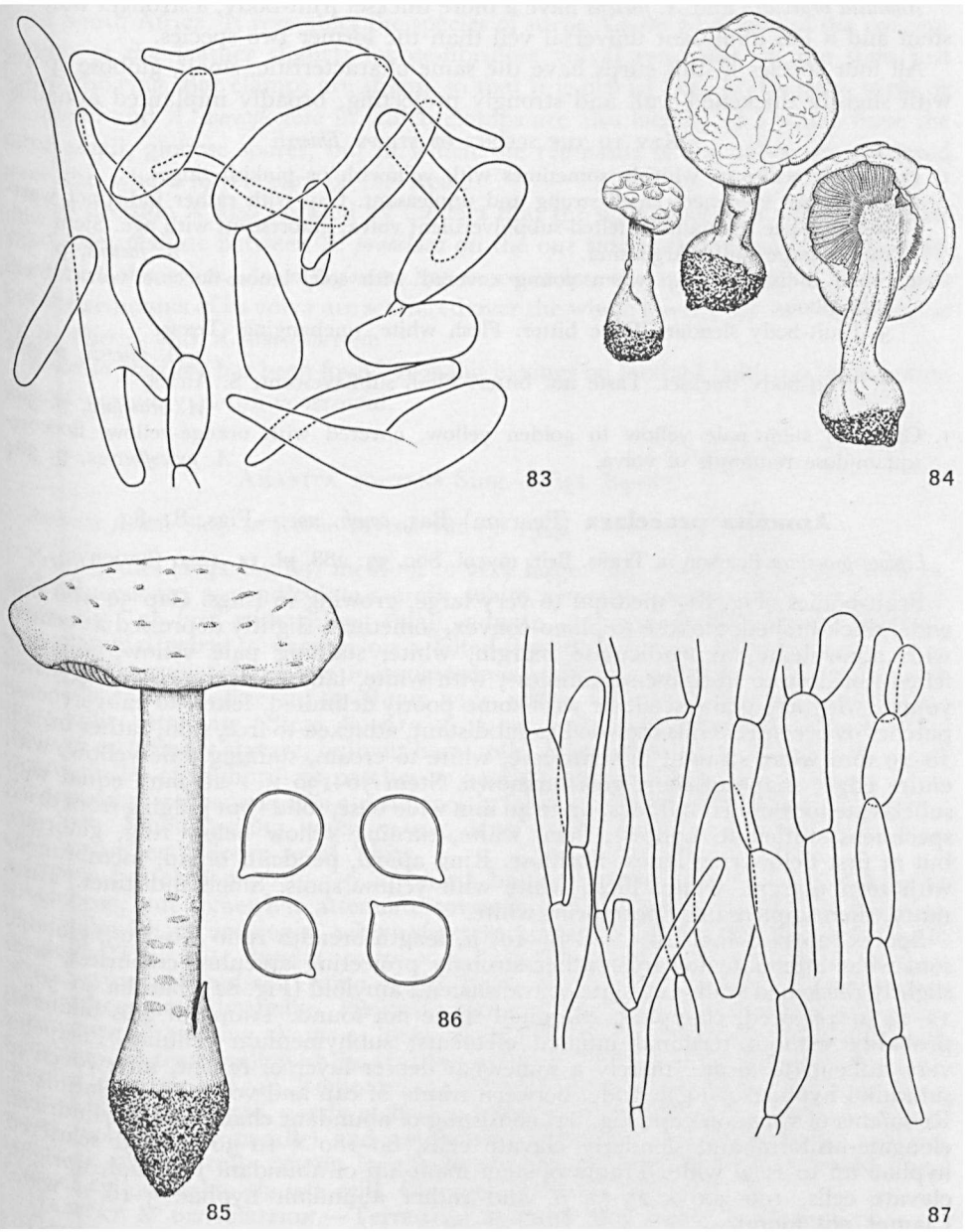


Fig. 83. *Amanita praeclara.* — Elements of volval remnants from cap of type.
Figs. 84–87. *Amanita foetens.* — 84, 85. Dried fruit-bodies. — 86. Spores. — 87. Elements of volval remnants from cap. (Figs. 84, from *Singer S 620*; 85–87, from isotype.)

Amanita praeclara and *A. foetens* have a more thickset fruit-body, a stronger bulbous stem and a less abundant universal veil than the former two species.

All four species in this stirps have the same characteristic, small, globose spores with slightly thickened wall and strongly projecting, broadly implanted apiculus.

KEY TO THE SPECIES OF STIRPS *Thiersii*

1. Fruit-body white or whitish, sometimes with yellowish or pinkish tinges.
   2. In mature specimens smell strong and unpleasant. Cap with rather indistinct wart- to patch-like remnants of felted-subpulverulent volva, glabrescent with age. Stem with rather large bulb. Argentina. *A. foetens*, p. 381
   2. Smell indistinct. Cap when young covered with soft, lanose-floccose volva. Stem subbulbous.
      3. Fruit-body slender. Taste bitter. Flesh white, unchanging. Texas. *A. thiersii*, p. 382
      3. Fruit-body thickset. Taste not bitter. Flesh subflavescent. S. Africa. *A. praeclara*, p. 380
1. Cap and stem pale yellow to golden yellow, covered with orange-yellow, floccose-squamulose remnants of volva. *A. aureofloccosa*, p. 384

Amanita praeclara (Pearson) Bas, *comb. nov.*—Figs. 81–83

Lepiota praeclara Pearson *in* Trans. Brit. mycol. Soc. **33**: 288, pl. 14. 1950 (basionym).

Fruit-bodies (Fig. 81) medium to very large, growing in rings. Cap 50–160 mm wide, thick-fleshed, globose to plano-convex, sometimes slightly depressed at centre, with non-sulcate, appendiculate margin, white, staining pale yellow, minutely felted-fibrillose to fibrillose-squamulose, with white, lanose-floccose covering when young, with age glabrescent or with some poorly delimited, felted to subverrucose patches over centre. Gills crowded to subdistant, adnexed to free, thin, rather broad, 10–20 mm wide, straight or ventricose, white to cream, staining pale yellow, with entire edge; shape of short gills unknown. Stem 70–130 × 1–20 mm, equal with subclavate to rounded bulbous, up to 40 mm wide base, solid (but judging from dried specimens stuffed to hollow), firm, white, turning yellow below ring, glabrous, but at first below ring lanose-fibrillose. Ring apical, pendent, broad, membranous with torn margin, white. Flesh white with yellow spots. Smell indistinct. Taste nutty, then unpleasant. Spore print white.

Spores [20/1] 8–9.5(–10) × 8–9(–10) μ, length-breadth ratio 1.0–1.05, globose, somewhat attenuate towards rather strongly projecting apiculus, colourless, with slightly thickened wall, guttulate or translucent, amyloid (Fig. 82). Basidia 40–50 × 12–14 μ, 4-spored, clampless. Marginal tissue not found. Trama of gills bilateral, probably without terminal inflated elements; subhymenium cellular. Pileipellis very difficult to locate, merely a somewhat denser layer of repent, interwoven to subradial hyphae 4–14 μ wide, between trama of cap and volva; not gelatinized. Remnants of volva on cap (Fig. 83) consisting of abundant chains of subcylindrical, elongate-fusiform and slenderly clavate cells, 80–180 × 10–30 μ, and scattered hyphae up to 12 μ wide. Trama of stem made up of abundant terminal, upright, clavate cells, 100–300 × 25–55 μ, and rather abundant hyphae 3–10 μ wide. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in fields and on lawns, South Africa.

COLLECTIONS EXAMINED.—SOUTH AFRICA, Cape Province: Simonstown, 22 April 1948, *A. A. Pearson 10* (lectotype: K); Somerset East, 1878, *MacOwan 1011* (K).

Amanita praeclara is a medium-sized to very large, thickset, white, flavescent species from South Africa. It resembles the species of stirps *Nauseosa* because of the concentration of the (rather slight!) lanose-fibrillose volval remnants on the stem just below the ring. But clamps are absent, so that it is placed here in the same stirps as *A. thiersii* and *A. aureofloccosa* in which clamps are also lacking and which have the same small, globose spores, but in which the remnants of the volva are scattered over the whole lower part of the stem.

This decision is also justified by the fact that the next species, *A. foetens*, is somewhat intermediate between *A. praeclara* on the one side and *A. thiersii* and *A. aureofloccosa* on the other. *Amanita foetens* has more or less the same habit as *A. praeclara* but the remnants of its volva are scattered over the whole lower part of the stem, as in *A. thiersii* and *A. aureofloccosa*.

Amanita praeclara has been found growing in rings on football fields and is therefore almost certainly non-mycorrhizal.

AMANITA FOETENS Sing.—Figs. 84–87

Amanita foetens Sing. *in* Revue Mycol. **18**: 15. 1953.

Fruit-bodies (Figs. 84, 85) medium to very large. Cap 70–260 mm wide, convex, with non-sulcate, appendiculate margin, white, sometimes with pinkish or yellowish tinge, dry, at first with rather small, adnate, pulverulent-floccose to subfelted, subpyramidal warts to patches on a felted-flocculose background, later cap completely pulverulent-flocculose to squamulose-subfelted, probably glabrescent with age. Gills crowded, free, up to 18 mm wide, white, becoming dull cream to yellow; short gills attenuate. Stem 80–210 × 11–33 mm, subcylindrical with broadly fusiform or broadly clavate, bulbous base, solid, firm, white, floccose all over or with vague girdles of subfibrillose patches or nearly glabrous. Ring apical, rather thick, cottony-submembranous, non-striate, mostly falling to pieces. Flesh white, unchanging, firm. Smell lacking when young, later strong and unpleasant, like 'urine' or 'Camembert'. Spore print white.

Spores [30/2] 8–9.5 × 7.5–9 μ, length-breadth ratio 1.0–1.1(–1.2), globose to subglobose, but somewhat attenuate towards rather strongly projecting apiculus, pale yellowish in ammonia, with refractive contents and slightly thickened wall, amyloid (Fig. 86). Basidia 40–50 × 9–11 μ, 4-spored, with refractive contents when mature, clampless. Trama of gills bilateral (in type: teste Singer); subhymenium ramose to subcellular. Pileipellis hardly differentiated, consisting of repent, interwoven, branching chains of large, elongate cells, a fair number of which with refractive contents, yellowish in alkaline solution, passing gradually into remnants of volva and trama of cap. Remnants of volva on cap (Fig. 87) made up of branching, long chains of elongate, partly oleiferous cells 50–120 × 10–35 μ; chains in tips of warts more or less parallel and ascending. Trama of stem with large, upright, terminal, clavate cells among longitudinally arranged, rather broad hyphae and rows of cylindrical to clavate cells. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in fields and forests in Argentina.

COLLECTIONS EXAMINED.—ARGENTINA: Tucumán, Pié del Periquillo, 30 Dec. 1951, *R. Singer & H. Helberger T 1672* (isotype: MICH); Buenos Aires, Santa Catalina, 27 Dec. 1965, *R. Singer S 620* (BAFC).

OBSERVATIONS.—Singer (l.c.) observed spherocyst-like cells in the remnants of the

volva on the cap. I did not find such cells there, but in related species short, broad cells are occasionally found at the end of rows of elongate cells, especially in the tips of warts.

Amanita foetens is a medium-sized to very large, white or somewhat yellowish or pinkish species from Argentina; it has the rather sturdy fruit-body with distinctly bulbous base of *A. praeclara*, but with the remnants of the volva scattered over the whole part of the stem below the ring, like in *A. thiersii* and *A. aureofloccosa*.

In the specimens examined the remnants of the volva on the mature cap were rather inconspicuous.

Amanita thiersii Bas, *nom. nov.*—Figs. 88–91

Amanita alba Thiers *in* Mycologia **49**: 719. 1957 (basionym); non *Amanita alba* Pers. *per* Vitt., Tent. mycol. s. Amanit. Ill. 18. 1826 = *A. ovoidea* (Bull. per Fr.) Link.

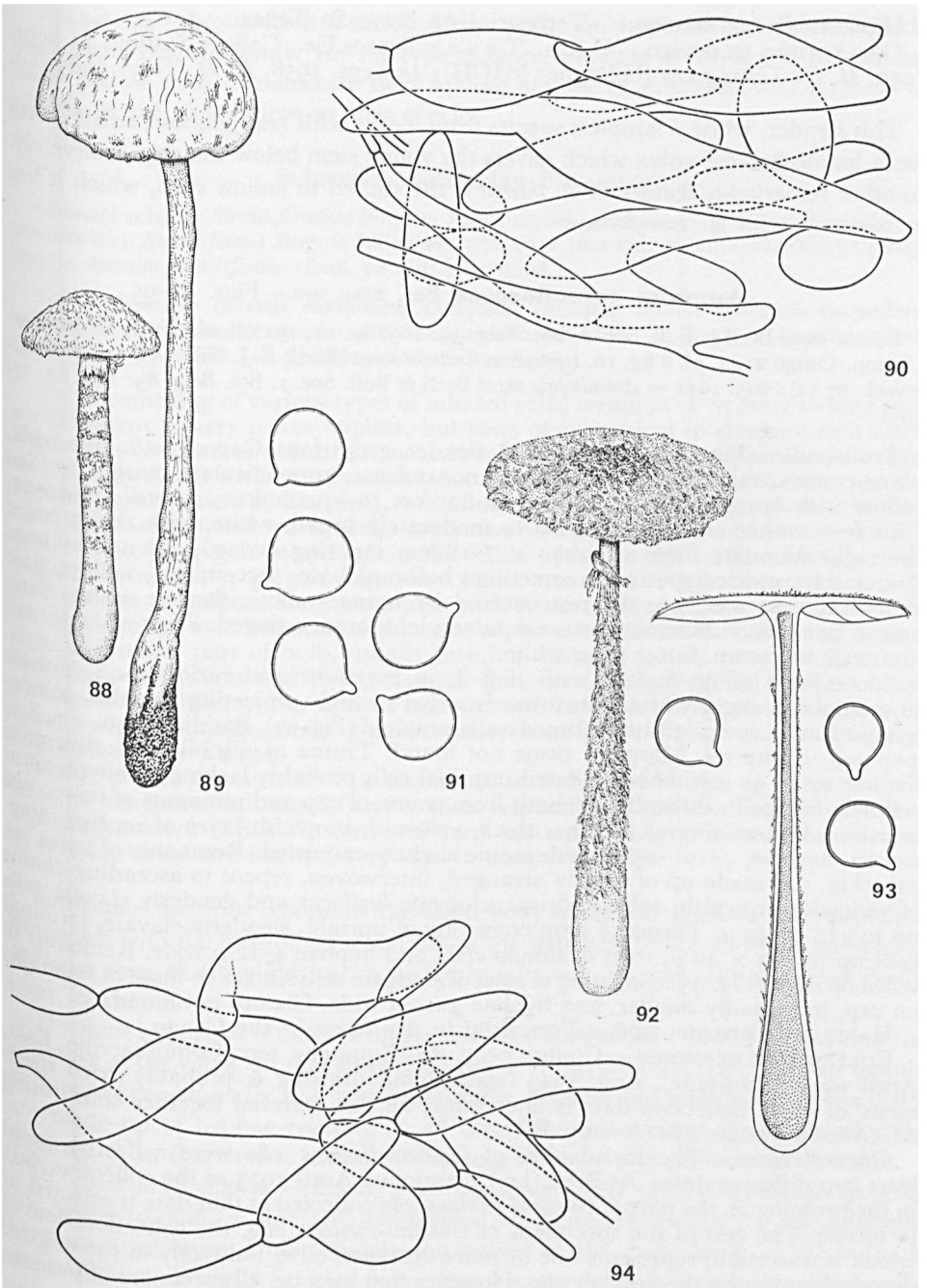
Fruit-bodies (Figs. 88–89) slender, medium to large, gregarious. Cap 35–100 mm wide, convex or conico-convex to plano-convex, mostly with low, broad umbo, rather thick-fleshed, with non-sulcate, appendiculate margin, white, dry, sometimes slightly viscid with age, at first entirely covered by soft, subpulverulent, lanose-floccose, squamulose, white volva, later becoming more or less glabrous with scattered floccose-fibrillose to felted, patch- or scale-like, at centre sometimes wart-like remnants of volva. Gills crowded to subdistant, free, rather narrow to broad, white, with entire or somewhat irregular edge; short gills attenuate. Stem 80–200 × 10–20 mm, equal, with slightly enlarged, subclavate or subfusiform base, stuffed to hollow, white, below ring at first densely covered by lanose-squamulose volva with age breaking up into easily removable, incomplete, floccose-squamose girdles, finally becoming scanty flocculose-squamulose to merely fibrillose. Ring apical, thin, white, membranous, easily torn, sometimes disappearing. Flesh white, unchanging. Smell indistinct. Taste oily-bitter.

Spores [25/2] 7.5–9.5 × 7–9 μ, length-breadth ratio 1.0–1.1, globose to subglobose, with rather large, strongly projecting, broadly implanted apiculus, colourless, guttulate, with very slightly thickened wall, amyloid (Fig. 91). Basidia about 40 × 10 μ (33–38 × 6–9 μ according to Thiers, l.c.), 4-spored, clampless. Marginal tissue not found. Trama of gills bilateral; diverging elements up to 20 μ (perhaps more) wide; subhymenium cellular. Pileipellis indistinct, merely a somewhat denser layer of repent, broad hyphae and rows of subcylindrical cells between trama of cap and remnants of volva; in old specimens surface sometimes slightly gelatinized. Remnants of volva on cap (Fig. 90) consisting of irregularly disposed rows of subcylindrical, elongate-fusiform and slenderly clavate cells, up to 110 × 30 μ, mixed with branching hyphae 5–10 μ wide. Trama of stem with large, upright, terminal, clavate cells among rows of subcylindrical (sometimes very long) cells and broad hyphae. Volval remnants on stem a rather loose tissue of branching and winding, fairly broad hyphae, abundant, subcylindrical, subclavate and slenderly fusiform cells and some small, ellipsoid cells. Clamps not found.

EXPLANATION OF FIGURES 88–94

Figs. 88–91. *Amanita thiersii*. — 88, 89. Dried fruit-bodies. — 90. Elements of volval remnants from cap. — 91. Spores. (Figs. 88, from type; 89–91 from *Thiers 5383*.)

Figs. 92–94. *Amanita aureofloccosa*. — 92. Fruit-bodies. — 93. Spores. — 94. Elements of volval remnants from cap. (All figs. from type; 92, after Mrs. Goossens' water-colour.)



Figs. 88–94

HABITAT & DISTRIBUTION.—Terrestrial on lawns in Texas.

COLLECTIONS EXAMINED.—U.S.A., Texas, Brazos Co., College Station, 11 Sept. 1952, *H. D. Thiers 1713* (holotype: MICH); 15 Sept. 1958, *H. D. Thiers 5383* (L).

This slender, white, clampless species from Texas with (sub)globose, small spores has a lanose-floccose volva which covers the young stem below the ring completely. Another remarkable feature of *A. thiersii* is the stuffed to hollow stem, which it has in common with *A. aureofloccosa*.

Amanita aureofloccosa Bas, *nom. nov.*—Figs. 92–95

Lepiota aurea Beeli *in* Bull. Soc. r. Bot. Belg. **59**: 105, fig. 11. 1927 (basionym); Fl. iconogr. Champ. Congo **2**: 44, pl. 8 fig. 10. 1936; non *Amanita aurea* (Beeli) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 205. 1941 = *Amanitopsis aurea* Beeli *in* Bull. Soc. r. Bot. Belg. **63**: 108, fig. 13. 1931.

Fruit-bodies (Fig. 92) medium-sized, slender, gregarious. Cap up to 80 mm wide, plano-convex, rather thin-fleshed, with non-sulcate, appendiculate margin, golden yellow with orange-yellow, pulverulent-floccose to squamulose, detersile covering. Gills free, rather crowded, narrow to moderately broad, white, with entire edge; short gills attenuate. Stem up to 140 × 7–18 mm, tapering upward, with non-bulbous (judging from dried specimens sometimes bulbous) base, (becoming?) hollow, pale yellow at base and top, the rest covered by orange-yellow, floccose scales. Ring apical, pendent, submembranous-subpulverulent, orange tinged. Flesh white. Smell and taste unknown. Spore print white.

Spores [20/1] (6–)7–8.5(–9) × (6–)6.5–8.5 μ, length-breadth ratio 1.0–1.1, globose to subglobose, slightly attenuate towards rather strongly projecting apiculus, colourless, guttulate, with slightly thickened walls, amyloid (Fig. 93). Basidia 35–40 × 7–8 μ, 4-spored, clampless. Marginal tissue not found. Trama of gills bilateral; divergent hyphae up to 30 μ wide but inflated terminal cells probably lacking; subhymenium cellular. Pileipellis difficult to delimit from trama of cap and remnants of volva, not gelatinized, consisting of a rather thick, yellowish-brownish layer of repent, interwoven hyphae, 4–10(–15) μ wide, some slightly encrusted. Remnants of volva on cap (Fig. 94) made up of loosely arranged, interwoven, repent to ascending chains of yellowish-brownish, subcylindrical, elongate-fusiform, and slenderly clavate cells up to 210 × 40 μ. Trama of stem consisting of upright, slenderly clavate, terminal cells up to 400 × 40 μ, rows of similar cells, and hyphae 4–12 μ wide. Remnants of volva on stem (Fig. 95) consisting of rows of elongate cells similar to those in remnants on cap, but usually smaller, and hyphae 3–10 μ wide. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in dry forest in the Congo.

COLLECTIONS EXAMINED.—CONGO, prov. de l'Equateur, terr. Coquilhatville, Eala, April 1923 (lecto-type), Aug. 1923 (watercolour drawing & probably dried specimens, of which collection date is uncertain); all this material together constituting *M. Goossens-Fontana 280* (A 2229, BR).

OBSERVATIONS.—The fruit-bodies of *Goossens-Fontana 280* were collected on at least two different dates. As Beeli (l.c.) mentioned April 1923 as the collection date in the protologue, the part of *Goossens-Fontana 280* collected at that date is selected as lectotype. The rest of the specimens of *Goossens-Fontana 280*, the collection date of which is uncertain, represents one or more syntypes, cited indirectly in the original description, viz. by the number 280. However that may be, all specimens of *Goossens-Fontana 280* appear to be conspecific.

Amanita aureofloccosa from Central Africa is the only species in section *Lepidella* with really bright colours. Yet the type of spore, the type of volva, and the slender, early hollow stem demonstrate such a close affinity to *A. thiersii* that it must be placed in the same stirps as that species.

Subsection **Solitariae** Bas, *subsect. nov.*

[*Amanita* subsect. *Strobiliforminae* Sing. *in* Annls mycol. **41**: 163. 1943 (not val. publ.). — *Amanita* sect. *Strobiliformes* Sing. *in* Lilloa **22**: 388. 1951 (not val. publ.). — Lectotype (Sing., 1951): *Amanita strobiliformis* (Paul. ex Vitt.) Bertillon.]

Volva elementis diversis composita, nunquam precipue cellulis elongatis catenulatus constructa neque strato externo submembranaceo praedita. — Typus: *Amanita solitaria* (Bull. per Fr.) Mérat [= *A. echinocephala* (Vitt.) Quél.].

Volva consisting of various types of inflated cells, terminal or in short to long rows on abundant to very scarce hyphae, but rows of cylindrical to elongate cells never dominant; elements of volva in a more or less distinct, anticlinal position or irregularly disposed, but without submembranous outer layer. Remnants of volva on cap forming a pulverulent or flocculose, continuous layer or, more often, pulverulent, floccose, fibrillose or felted warts, scales or patches on a poorly developed to very distinct, dry, subviscid or gelatinized pileipellis. Gills white or with yellowish, greenish, pinkish, brownish or greyish tinge; short gills attenuate or truncate. Stem usually with clavate or bulbous base, sometimes with slender, rooting base, rarely subcylindrical, annulate or exannulate. Remnants of volva on stem concentrated at base of stem and upper part of bulb, usually forming warts or scales, more rarely ridges; sometimes very slight and pulverulent or flocculose. Spores rather small to large, globose to bacilliform, thin-walled, smooth, with normal, abrupt apiculus, in print usually white to cream, rarely greenish-yellowish, olive buff or greyish buff. Clamps either present or absent.

HABITAT & DISTRIBUTION.—In coniferous and deciduous, dry to rather humid forest in temperate, subtropical and tropical regions. Principal distribution in eastern and south-eastern U.S.A., eastern and south-eastern Asia and Australia, rather rare to rare in Africa and Europe, very rare in South America.

Subsection *Solitariae* represents the main body of section *Lepidella*. The principal difference with the foregoing section lies in the structure of the volva. In subsection *Solitariae* rows of subcylindrical to slenderly fusiform, inflated cells are never dominant in the volva.

The most important difference from subsection *Limbatulae* is also to be found in the structure of the volva. In that subsection the outer layer of the volva consists mainly of hyphae; consequently it is submembranous, whereas the inner parts of the volva are made up of hyphae running in all directions, intermixed with inflated cells, terminal or in short rows, without preference for a certain position or direction.

In subsection *Solitariae*, especially in stirpes *Straminea* (p. 512), *Strobiliformis* (p. 518) and *Grossa* (p. 502), a similarly constructed volva occurs, except for the submembranous outer layer. Unfortunately the nature of the outer layer of the volva is rather difficult to verify in dried collections because it is often covered with moulds or particles of soil or tends to disappear early. When in doubt I have regarded a

tendency to the formation of a slight, membranous volval limb at the base of the stem or the presence of a strongly marginate bulb and apparently circumscissile volva as an indication that the species concerned must be placed in subsection *Limbatulae*.

Amanita silvicola, with its marginate bulb but distinctly floccose volva almost certainly without (sub)membranous outer layer, has been placed in the present subsection, but seems to represent a link with the *Limbatulae*.

In a large number of species of the *Solitariae*, the elements of the volva are in a more or less distinct, erect-parallel position; in other words they have grown in a direction perpendicular to the surface of the fruit-body beneath. As a consequence of this structure the volva usually breaks up into more or less conical warts. The species with this character I consider the most typical elements of subsection *Solitariae*. For this reason I have selected *A. solitaria* (= *A. echinocephala*) as its type. If I had validated Singer's subsectional name *Strobiliforminae*, the less typical *A. strobiliformis* would have become the type of the present subsection.

I considered the possibility of dividing the *Solitariae* into two groups, viz. one with a distinct, erect-parallel arrangement of the elements of the volva and another with these elements irregularly disposed. Occasionally, however, especially in species where the volva consists mainly of small inflated cells and very few hyphae, but also in a few other species, it proved rather difficult to check this character so that I had to abandon the idea. But it is very well possible that in young, fresh fruit-bodies the distinction between the two types of volval structure is much clearer.

Dividing subsection *Solitariae* into two groups based on the presence or absence of clamps is much easier and has a certain practical but little taxonomic value. Some of the clampless stirpes are probably more closely related to stirpes with clamps than to each other.

KEY TO THE STIRPES OF SUBSECTION *Solitariae*

1. Basidia with clamps.
   2. Spores cylindrical to bacilliform; average l/b 2.3–3.0. Stirps *Rhoadsii*, p. 492
   2. Spores rarely cylindrical; average l/b rarely up to 2.2.
      3. Remnants of volva on cap with few or inconspicuous hyphae, consisting mainly of small to medium-sized, inflated cells in erect-parallel or irregular rows or condensed to a pseudoparenchymatic tissue, forming a pulverulent-subflocculose to pulverulent-subverrucose layer, rather firm conical warts or slender spines sometimes aggregated to complex warts or patches.
         4. Fruit-body with yellow latex. Stirps *Xanthogala*, p. 486
         4. Coloured latex absent.
            5. Volva forming firm, rather large, pseudoparenchymatic, conical warts on cap. Stirps *Virginea*, p. 487
            5. Volva not forming such warts.
               6. Volva consisting of strictly erect-parallel rows of inflated cells, forming very slender to slender spines, complex warts or patches. Stirps *Daucipes*, p. 446
               6. Volva strongly pulverulent, consisting almost completely of irregularly disposed, easily disconnecting, small, inflated cells. Stirps *Chlorinosma*, p. 448

3. Remnants of volva consisting of rather abundant to abundant hyphae intermixed with abundant inflated cells.
   7. Fruit-body with yellow latex. Stirps *Xanthogala*, p. 488
   7. Coloured latex absent.
      8. Elements of volva, at least at centre of cap, in a distinct, erect-parallel position.
         9. Volva forming on cap small to very large, conical to truncate-conical warts with a more or less distinctly, radially fibrillose base; under microscope this base consisting mainly of often refractive and yellowish hyphae.
            10. Warts on cap coarse, 3–15 mm wide, with very distinct, radially fibrillose base, often passing into fibrillose scales towards margin. Stirps *Ravenelii*, p. 400
            10. Warts on cap medium to small, with base less conspicuously fibrillose. Stirps *Solitaria*, p. 388
         9. If volval warts present on cap, then inflated cells dominant in base of warts as well.
            11. Volva on cap usually forming medium to small, conical warts and on base of stem small warts to recurving scales. Stirps *Microlepis*, p. 423
            11. Volva consisting of a rather loose tissue, on cap usually forming imperfect, floccose warts or a floccose, floccose-verrucose, or floccose-felted layer sometimes breaking up into patches. Stirps *Rhopalopus*, p. 414
      8. Remnants of volva consisting of irregularly disposed, inflated cells intermixed with more or less abundant hyphae.
         12. Volva forming distinct conical warts on cap.
            13. Volval warts on cap coarse, greyish, and adnate. Stirps *Crassiconus*, p. 499
            13. Volval warts on cap small to medium-sized, white and detersile. Stirps *Virgineoides*, p. 434
         12. Volva forming a subfelted layer, subfelted patches, or indistinct warts. Stirps *Grossa*, p. 502

1 Basidia clampless.
   14. Hymenium (at least in dried material) with abundant, yellow-brown to brown, basidiform elements becoming red-brown in Melzer's reagent. Cap pinkish to red-brown with conical to lumpish, brown to purple-brown volval warts. Spores > 10 μ. Stirps *Sculpta*, p. 482
   14. Hymenium without such coloured cells. Cap pinkish brown only in *A. borneensis* in stirps *Eriophora*.
      15. Cap covered with medium to large, brownish to ferruginous-brown warts, apical part of which consisting of rows of small inflated cells and basal part mainly of hyphae. Spores < 10 μ, globose to broadly ellipsoid. Stirps *Perpasta*, p. 409
      15. Colour of volva different. If firm, conical warts are formed, their base not consisting mainly of hyphae.
         16. Volva mostly white or whitish,[46] rarely greyish buff to mouse grey and then forming flat, angular patches to irregularly shaped warts consisting of irregularly disposed elements, and spores then elongate, mostly > 10 μ, with l/b 1.5–2.0.
            17. Volva consisting of abundant, interwoven hyphae intermixed with inflated cells; on cap forming felted, floccose(-felted) or subpulverulent-felted patches or layer or, rarely, coarse, truncate-conical to shapeless warts.

[46] If the volva is salmon-coloured and forms a pulverulent layer or subpulverulent patches on the cap, see the note on *A. roseitincta* Murrill on p. 564.

18. Bulb of stem marginate. Volva soft, floccose.
Stirps *Silvicola*, p. 524
18. Bulb of stem submarginate to immarginate. Volva floccose, felted or pulverulent.
19. Volva forming patches or shapeless to subconical warts on cap and patches, vague warts, or ridges at base of stem.
Stirps *Strobiliformis*, p. 516
19. Volva forming a pulverulent or flocculose layer or more rarely indistinct, thin patches on cap and floccose to pulverulent or indistinct remnants at base of stem. Stirps *Straminea*, p. 512
17. Volva consisting of erect-parallel hyphae and rows of inflated cells or irregularly disposed inflated cells but in that case hyphae scarce.
20. Volva consisting of at least partly erect-parallel elements, in young specimens at any rate forming rather small to small, conical warts on cap. Stirps *Polypyramis*, p. 436
20. Volva pulverulent, consisting mainly of irregularly disposed rows of inflated cells; hyphae scarce, except close to pileipellis.
Stirps *Longipes*, p. 456
16. Volva greyish buff, grey, brown, olive-brown or pinkish brown.[46] Cap usually pulverulent or subpulverulent-verrucose, rarely with distinct patches or shapeless warts and then spores < 10 μ or globose to ellipsoid (l/b 1.0–1.3).
21. Large to very large species. Spores globose to broadly ellipsoid (average l/b 1.05–1.2). Volva and pileipellis with copious, brown pigment.
Stirps *Eriophora*, p. 474
21. Small to medium, rarely large species. Spores mostly broadly ellipsoid, ellipsoid or elongate (average l/b 1.2–1.9). If spores subglobose, then fruit-body rather small, with volva and pileipellis only slightly pigmented.
Stirps *Cinereoconia*, p. 462

Stirps SOLITARIA

Basidia with clamps. Spores 7–13 μ long, subglobose to elongate. Volva on cap usually forming medium to rather small, adnate to detersile, conical warts with rather inconspicuously fibrillose to fibrillose-arachnoid base, under microscope showing erect-parallel rows of ellipsoid to broadly clavate cells on branching hyphae in upper part, but dominant hyphae in base.

Some species of this stirps have features which are suggestive of subsection *Vittadiniae*. This is especially the case with *A. timida*, in which the lower part of the stem is fusiform or gradually enlarged towards the base, while the remnants of the volva are scattered over a large part of the lower half of the stem. This means that this part of the stem participates in the process of elongation. The type of tissue of the volva in *A. timida* proves, however, that the species does not belong to subsection *Vittadiniae*.

In *A. solitaria* (= *A. echinocephala*) and *A. cokeri* the remnants of the volva on the stem are more concentrated below, while especially in *A. cokeri* the stem has a more distinctly bulbous base.

Amanita japonica is somewhat aberrant in this stirps because of the fugacious, floccose-ring and distinctly grey coloured volva.

Stirps *Solitaria* is very close to stirps *Ravenelii* on one side and stirps *Microlepis* on the other.

KEY TO THE SPECIES OF STIRPS *Solitaria*

1. Spores 7–9 × 5.5–7 μ, l/b 1.1–1.25. Whitish, pinkish, or brownish, tropical species with flesh turning pinkish. Stem clavate to slenderly fusiform, scaly. South-eastern Asia. *A. timida*, p. 389
1. Spores at least 8.5–11 μ long, l/b 1.25–2.1. Flesh not turning pinkish.
   2. Remnants of volva on cap white to slightly yellowish or greyish.
      3. Ring floccose-fibrillose, usually torn and then edge of cap strongly appendiculate and top of stem floccose. Spores 8.5–11 × 5.5–7 μ. See *A. rhopalopus* on p. 414.
      3. Ring submembranous to membranous, striate, sometimes strongly fibrillose at underside. Spores 9–13.5 μ long.
         4. Stem with ventricose-fusiform, fusiform, or clavate base.
            5. White to whitish, rather slender species with usually medium-sized, conical warts on gelatinizing pileipellis. Spores 11–13.5 × 7–9 μ. Eastern U.S.A. *A. cokeri*, p. 390
            5. White to greyish or yellowish species with small, conical warts on not or slightly gelatinizing pileipellis. Spores 9–12 × 6–8 μ. Europe. *A. solitaria* (= *A. echinocephala*), p. 394
         4. Stem with carrot-shaped bulb about as long as subcylindrical upper part of stem. See *A. conicobulbosa* on p. 422.
   2. Remnants of volva on cap pale but distinctly grey. Ring fugacious. Fruit-body slender. Japan. *A. japonica*, p. 399

AMANITA TIMIDA Corner & Bas—Figs. 96–98

Amanita timida Corner & Bas *in* Persoonia **2**: 245, figs. 1, 2. 1962.

Fruit-bodies (Fig. 96) medium to large, slender. Cap 50–120 mm wide, globose to convex, with non-sulcate, appendiculate margin, whitish to pinkish, dry, densely set with firm, adnate, pinkish to pale brown, conical warts passing into subflocculose points towards margin. Gills rather crowded, free to narrowly adnate, white then cream, with whitish granular edge; short gills attenuate. Stem 65–180 × 10–20 mm, tapering upward, with subclavate, clavate, fusiform or elongate-fusiform base, sometimes deeply rooting, solid, whitish to pinkish or brownish, with pinkish to brownish, firm, rather large scales below and minute scales in middle. Ring pendent, membranous, whitish, pinkish or brownish, with thick, pink to pale brown warts at edge, striate. Flesh white, turning slowly pink to brownish flesh pink when cut. Smell like "fenugreek" (Corner) or "coconut oil" (Ding Hou).

Spores [54/6] (6.5–)7–9(–10) × 5.5–7(–8.5) μ length-breadth ratio (1.0–)1.1–1.25 (–1.4) (averages 1.05–1.25), globose to ellipsoid, amyloid (Fig. 97). Basidia 45–60 × 9–11 μ, 4-spored, with clamps. Marginal tissue made up of mainly piriform cells 20–55 × 12–34 μ. Trama of gills bilateral, with diverging hyphae 5–15(–20) μ wide, without terminal inflated elements; hymenopodium rather distinct, consisting of cells 20–50 × 10–15 μ, in rows perpendicular to hymenium; subhymenium narrow, dense, ramose to subcellular. Pileipellis hardly differentiated, merely a dense layer of more or less repent, interwoven hyphae, gradually passing into remnants of volva. Tips of warts on cap (Fig. 98) nearly pseudoparenchymatic, consisting of variably shaped, but mostly ellipsoid, inflated cells up to 60 × 45 μ, in more or less erect rows on branching hyphae; in base of warts hyphae more abundant, but scattered rows of inflated cells also present; tissue of volva turning golden yellow in alkaline solution, especially the scattered oleiferous elements. Trama of stem (Fig. 24) with large, upright, terminal, clavate cells among abundant, branching, often somewhat irregular hyphae 5–15 μ wide; towards top of stem hyphae scarcer. Remnants of volva on stem similar to those on cap. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in tropical forest. Singapore, N. Borneo.

COLLECTIONS EXAMINED.—SINGAPORE, Mac Ritchie Reservoir: 30 Oct. 1934, *E. J. H. Corner* (holotype, L; isotype, K); 7 Nov. 1934, *E. J. H. Corner* (L, K); SARAWAK, Bintulu, 23 June 1960, *Ding Hou 358* (L).

OBSERVATION.—Because of the pale brown rather than pinkish tinges of the cap and stem *Ding Hou 358* has a slightly different appearance from Corner's collections from Singapore. Moreover, its spores are slightly smaller and more globose (viz. 6.5–8 × 5.5–7 μ, l/b 1.0–1.25 against 7–9 × 6–8.5 μ, l/b 1.1–1.4 in Corner's material) However, in all other aspects the Sarawak collection closely resembles those from Singapore. That the warts are pale brown instead of pink does not seem very important, especially as the pinkish discoloration of the flesh is present.

Amanita timida from tropical S.E. Asia resembles *A. cokeri* in the structure of the volva, the prominent ring and the often strobiliform base of the stem. It differs from that species and other members of stirps *Solitaria* by the small spores, the blushing flesh and the stem, which has already strongly elongated before the cap starts to expand. If in future other species should be found also having this set of characters, they should be placed in a separate stirps together with *A. timida*.

For chemical reactions of oleiferous hyphae see discussion of *A. xanthogala* on p. 493.

AMANITA COKERI (E. J. Gilb. & Kühner) E. J. Gilb.—Figs. 99–101

[*Amanita solitaria* (Bull. per Fr.) Mérat sensu Coker *in* J. Elisha Mitchell scient. Soc. **33**: 68. 1917. —] *Lepidella cokeri* E. J. Gilb. *apud* E. J. Gilb. & Kühner[47] *in* Bull. Soc. mycol. France **44**: 151. 1928. — *Aspidella cokeri* (E. J. Gilb. & Kühner) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940. — *Amanita cokeri* (E. J. Gilb. & Kühner) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 372. 1941.

NAMES MISAPPLIED TO THE PRESENT SPECIES. — *Amanita monticulosa* (Berk. & Curt.) Sacc. sensu Sing. *in* Sydowia **2**: 35. 1948; *in* Lilloa **22**: 388. 1952.[48]

SELECTED ILLUSTRATIONS.—Coker *in* J. Elisha Mitchell scient. Soc. **33**: pls. 45–47; Hesler, Mushr. Great Smokies 31. 1960.

Fruit-bodies (Fig. 100) large to medium, rather slender, solitary. Cap 80–150 mm wide, at first hemispherical, later convex to plano-convex, with non-sulcate, appendiculate margin, white to ivory, shiny, viscid when moist, decorated with rather large, up to 4 mm wide and high, adnate to detersile, white to brownish, pyramidal warts over centre, these warts decreasing in size and passing gradually into a fine flocculence towards margin; base of warts minutely, radially fibrillose. Gills crowded, free to narrowly adnate, broad to very broad, white with slight, yellowish or pinkish tinge, with white, subflocculose edge, short gills subtruncate to attenuate. Stem

[47] See nomenclatural note on p. 392.

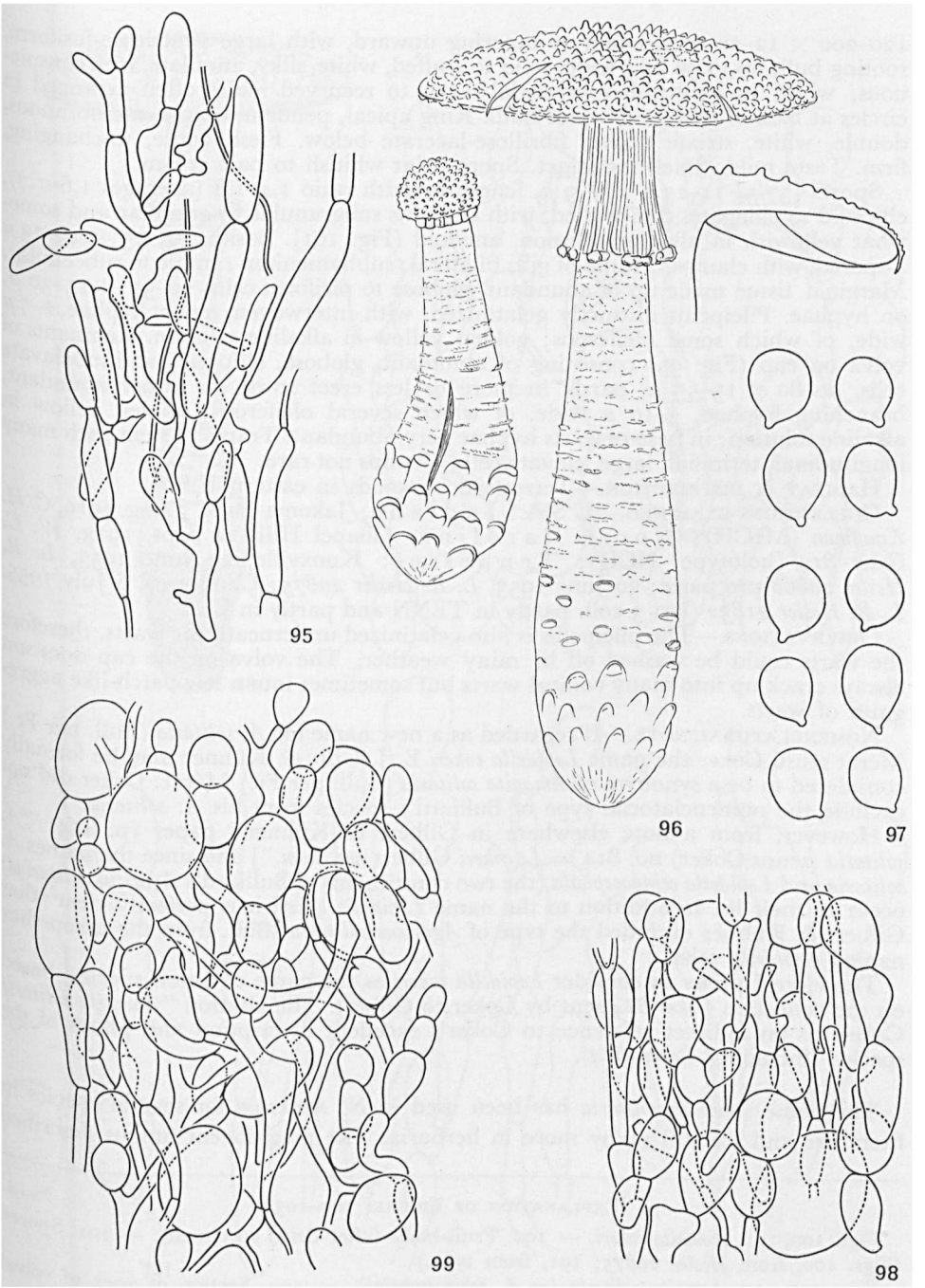
[48] See note on p. 567.

EXPLANATION OF FIGURES 95–99

Fig. 95. *Amanita aureofloccosa*. — Elements of volval remnants from lower part of stem of type.

Figs. 96–98. *Amanita timida*. — 96. Fruit-bodies preserved in liquid. — 97. Spores. — 98. Section of volval wart from cap. (All figs. from type.)

Fig. 99. *Amanita cokeri*. — Section of volval wart from cap of *Hesler 20875*.



Figs. 95–99

120–200 × 12–20 mm, equal or tapering upward, with large ventricose-fusiform, rooting bulb up to 50 mm wide, solid to stuffed, white, silky, annulate, with conspicuous, white to brownish, pyramidal warts to recurved scales often arranged in circles at base of stem and top of bulb. Ring apical, pendent, ample, membranous, double, white, striate above, fibrillose-lacerate below. Flesh white, unchanging, firm. Taste mild. Smell indistinct. Spore print whitish to pale cream.

Spores [57/5] 11–13.5 × 7–9 μ, length-breadth ratio 1.4–1.8 (averages 1.6–1.7), ellipsoid to elongate, thin-walled, with contents subgranular to granular and somewhat yellowish in alkaline solution, amyloid (Fig. 101). Basidia 55–75 × 10–13 μ 4-spored, with clamps. Trama of gills bilateral; subhymenium ramose to subcellular. Marginal tissue made up of abundant, globose to piriform cells, 20–35 × 15–30 μ, on hyphae. Pileipellis distinctly gelatinized, with interwoven, repent hyphae, 2–7 μ wide, of which some oleiferous; golden yellow in alkaline solution. Remnants of volva on cap (Fig. 99) consisting of abundant, globose, ellipsoid, and subclavate cells, 20–80 × 15–55 μ, partly in more or less erect rows, on rather abundant, branching hyphae, 3–10 μ wide, of which several oleiferous; golden yellow in alkaline solution; in base of warts hyphae very abundant. Trama of stem with many longitudinal, terminal, large, clavate cells. Clamps not rare.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Indiana, Jakoma Park, 7 Aug. 1919, *C. H. Kauffman* (MICH); North Carolina, Chapel Hill, 21 Sept. 1913, *W. C. Coker 814* (holotype: NCU); Tennessee: Knoxville, 23 June 1953, *L. R. Hesler 20868* pro parte; 30 June 1953, *L. R. Hesler 20875;* Chilhowee, 6 July 1955, *L. R. Hesler 21832* (last 3 coll. partly in TENN and partly in L).

OBSERVATIONS.—The pileipellis is also gelatinized underneath the warts, therefore the warts could be washed off in rainy weather. The volva on the cap does not always crack up into many conical warts but sometimes into a few patch-like aggregates of warts.

NOMENCLATURAL NOTE.—If regarded as a new name for *A. solitaria* (Bull. per Fr.) Mérat sensu Coker the name *Lepidella cokeri* E. J. Gilb. & Kühner may be formally considered to be a synonym of *Amanita solitaria* (Bull. per Fr.) Mérat: Coker did not exclude the nomenclatorial type of Bulliard's species from his *A. solitaria.*

However, from a note elsewhere in Gilbert & Kühner's paper [p. 154: "*A. solitaria* (sensu Coker) no. 814 = *L. cokeri* Gilbert *nov. nom.*"] and since the names *A. solitaria* and *Lepidella echinocephala* (the two constituents of Bulliard's *Agaricus solitarius*) occur in their list in addition to the name *Lepidella cokeri* it is perfectly clear that Gilbert & Kühner excluded the type of *Agaricus solitarius* Bull. from the taxon they named *Lepidella cokeri.*

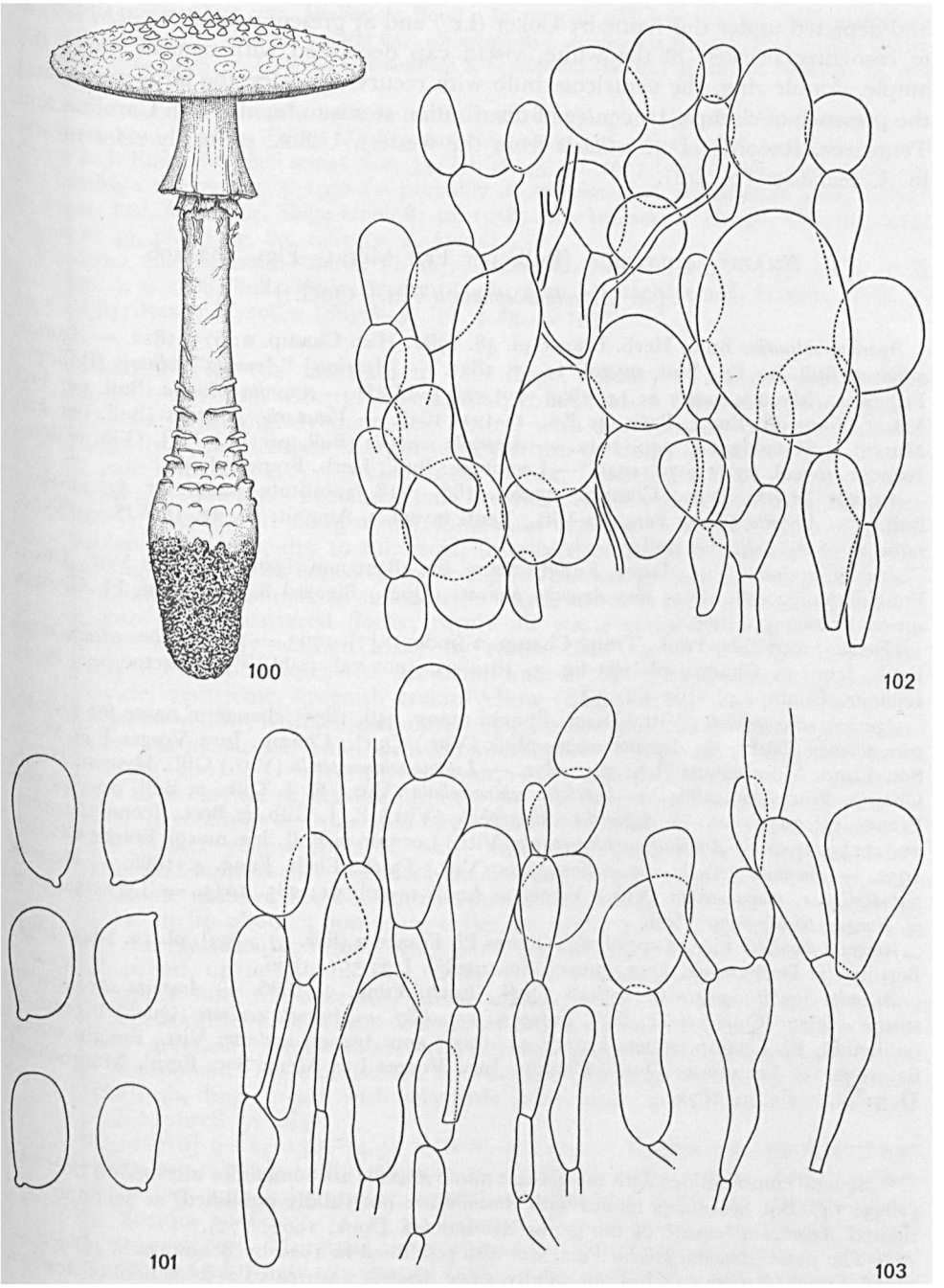
Therefore I prefer to consider *Lepidella cokeri* as the name of a new species, based on the collection *Coker 814* sent by Coker to Gilbert. The citation "*Amanita solitaria* Coker" is an indirect reference to Coker's excellent description and plates of the species (including *Coker 814*).

The name *Amanita solitaria* has been used in N. America for several species in literature and for still many more in herbaria. The magnificent fungus described

EXPLANATION OF FIGURES 100–103

Figs. 100, 101. *Amanita cokeri.* — 100. Fruit-body (after dried specimen). — 101. Spores. (Figs. 100, from *Hesler 20875*; 101, from type.)

Figs. 102, 103. *Amanita solitaria* (= *A. echinocephala*!). — 102. Section of apex of volval wart on cap. — 103. Section of base of same wart. (Both figs. from *Bas 150.*)



Figs. 100–103

and depicted under this name by Coker (l.c.) and at present named *A. cokeri* is easy to recognize because of the white, viscid cap decorated with conical warts, the ample, double ring, the ventricose bulb with recurving scales, the large spores, and the presence of clamps. Its centre of distribution seems to be in North Carolina and Tennessee. Records of *A. solitaria* from the western U.S.A. probably refer mostly to *A. smithiana* (p. 418).

AMANITA SOLITARIA (Bull. per Fr.) Mérat—Figs. 102–106

[= *A. echinocephala* (Vitt.) Quél.!]

Agaricus solitarius Bull., Herb. France pl. 48. 1780; Hist. Champ. **2**: 675. 1812. — *Agaricus solitarius* Bull. *per* Fr., Syst. mycol. **1**: 17. 1821. — [*Agaricus*] "*Amanita*" *solitaria* (Bull. per Fr.) Secr., Mycogr. suisse **1**: 14. 1833 (not val. publ.).[49] — *Amanita solitaria* (Bull. per Fr.) Mérat, Nouv. Fl. Envir. Paris, 4e Ed., **1**: 121. 1836. — *Venenarius solitarius* (Bull. per Fr.) Murrill *in* Mycologia **4**: 240. 1912. — *Aspidella solitaria* (Bull. per Fr.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940. — Lectotype: Bull., Herb. France pl. 48.

Amanita procera Pers., Champ. comest. 186. 1818 (substitute name for *Ag. solitarius* Bull.). — *Amanita procera* Pers. *per* Vitt., Tent. mycol. s. Amanit. Ill. 23. 1826.[50] — Type: same as of *Ag. solitarius* Bull.

Agaricus aculeatus Vitt., Descr. Funghi mang. 62. 1832; non *Agaricus aculeatus* Vitt., Descr. Funghi mang. 348. 1835; nec *Amanita aculeata* (Quél.) Bigeard & Guillemin, Fl. Champ. supér. France 44. 1909.

[*Fungus tricuspidatus* Paul., Traité Champ. **2** (index): [7]. 1793. — *Hypophyllum tricuspidatum* Paul., Iconogr. Champ. pl. 163 fig. 3. 1812–35 (not val. publ.).[51] — Lectotype: Paul., Iconogr. Champ. pl. 163 fig. 3.]

Agaricus echinocephalus Vitt., Descr. Funghi mang. 346. 1835 (change of name for *Hypoph. tricuspidatum* Paul.). — *Amanita echinocephala* (Vitt.) Quél., Champ. Jura Vosges I *in* Mém. Soc. Emul. Montbéliard II **5**: 321. 1872. — *Lepiota echinocephala* (Vitt.) Gill., Hymén. Descr. Champ. France 69. 1874. — *Lepidella echinocephala* (Vitt.) E. J. Gilb. *in* Bull. Soc. mycol. France **41**: 304. 1925. — *Aspidella echinocephala* (Vitt.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940. — *Armillaria echinocephala* (Vitt.) Locquin *in* Bull. Soc. mycol. France **68**: 167. 1952. — *Amanita umbella* var. *echinocephala* (Vitt.) Quél., Ench. Fung. 4. 1886. — *Amanita battadinii* var. *echinocephala* (Vitt.) Veselý *in* Annls mycol. **31**: 285. 1933. — Type: same as of *Fungus tricuspidatus* Paul.

Amanita flandinia Plée, Types Fam. Genres Pl. France **2** (livr. 57): [93], pl. 12. 1844–1864; Bertillon *in* Dechambre, Dict. encycl. Sci. medic. I **3**: 501. 1866.

Amanita strobiliformis var. *aculeata* Quél., Ench. Fung. 3. 1886. — *Amanita strobiliformis* subsp. *aculeata* (Quél.) Sacc., Syll. Fung. **5**: 15. 1887. — *Amanita aculeata* (Quél.) Bigeard & Guillemin, Fl. Champ. supér. France 44. 1909; non *Agaricus aculeatus* Vitt., Funghi mang. 62. 1832. — Lectotype: Quél., Champ. Jura Vosges I *in* Mém. Soc. Emul. Montbéliard II **5**: pl. 1 fig. 1. 1872.

[49] Several combinations with the generic name *Amanita* are sometimes ascribed to Secretan (1833: 14). But Secretan's names with *Amanita* are not validly published, as Secretan considered *Amanita* a 'classe' of the genus *Agaricus* (cf. Donk, 1962: 171).

[50] The name *Amanita procera* Pers. was also published in 1822 by Bergamaschi (Osservaz. micol. Funghi Pavese 93), but not validly, since *Amanita* was treated as a 'section' of *Agaricus*.

[51] See foot-note on p. 519.

Amanita echinocephala var. *bicollariata* Boud., Ic. mycol. III livr. 11. pl. 298 (definitive number: 4) 1906. — *Amanita umbella* var. *echinocephala* f. *bicollariata* (Boud.) E. J. Gilb., Genre Amanita 101. 1918. — *Lepidella echinocephala* f. *bicollariata* (Boud.) Konr. & Maubl., Ic. sel. Fung., fasc. 2: 38. 1926.

MISAPPLICATIONS.—*Amanita solitaria sensu* auct. europ. plur. (= *A. strobiliformis*); *sensu* Atkinson, Stud. Americ. Fungi Mushr., 2nd Ed., pl. 75, 76. 1901 (= *A. rhopalopus*); *sensu* Coker *in* J. Elisha Mitchell scient. Soc. **33**: 68, pl. 45, 46. 1917 (= *A. cokeri*); *sensu* Hotson *in* Mycologia **28**: 72, fig. 3. 1936 (= probably *A. smithiana*); *A. echinocephala sensu* Hongo *in* Mem. Fac. Arts Educ. Shiga Univ. **8**: 40. 1958; *sensu* Imazeki & Hongo, Col. Ill. Fungi Japan **2**: 43, pl. 13 fig. 80. 1965 (= *A. hongoi*).

SELECTED ILLUSTRATIONS.—Barla, Fl. mycol. Champ. Alpes-Marit. (1): pl. 4 figs. 5, 6; pl. 8 figs. 7, 9. 1888; Bull., Herb. France pl. 48. 1780; Michael-Hennig, Handb. Pilzfr. **3**: pl. 8. 1964; Revue Mycol. **2** (Suppl. 3): pl. 4 fig. 1. 1937.

Fruit-bodies (Fig. 104) medium to very large, solitary or subgregarious. Cap [50–]70–160[–200] mm wide, globose at first, convex when expanding, soon plano-convex to flat with slightly depressed centre, with non-sulcate, projecting, when young slightly appendiculate margin, dingy white or dingy cream to pale silvery grey or pale brownish grey especially near centre, [sometimes with slight greenish tinge] with age sometimes becoming pale brownish straw yellow, subfelted at centre to minutely fibrillose at margin and somewhat arachnoid around base of warts, later becoming smooth, dry to subviscid, usually decorated with small, about 0.5 to 3 mm high, whitish to concolorous or slightly darker grey, acute-conical to low conical, subfibrillose, adnate to subdetersile warts, towards margin these sometimes passing into small, scattered flocks; rarely all warts reduced to small, floccose patches or completely washed away by rains. Gills rather crowded, narrowly adnate to just free, sometimes with decurrent lines at top of stem, broad, up to about 15 mm wide, ventricose, greenish cream-yellow (Séguy 220), with age becoming brownish straw yellow, with whitish, minutely granular edge; short gills subtruncate to more or less attenuate, often with proximal part of edge very irregular. Stem [60–]100–140[–200] × [10–]15–25[–30] mm, rarely subcylindrical, usually enlarged downward to a clavate or clavate-fusiform [or fusiform or subnapiform], pointed to rounded, up to about 60 × 40 mm large bulb, solid, whitish to pale straw yellow, often with darker yellow spots at base, annulate, longitudinally sulcate-striate above ring and appressedly fibrillose to fibrillose-subsquamulose below it, also often with some more or less concentric rows of ascending, appressed to recurved, rather thick, up to about 3 mm wide scales on upper part of enlarged base, but sometimes merely subsquamulose. Ring pendent, subfelted-membranous, apical to subapical, broad, up to 25 mm wide, white when young, straw yellow with age, striate at upper side, fibrillose to cottony and with thick warts along edge at underside. Flesh rather firm, white, cream just below surface of cap, [tending to turn yellowish or greenish]. Smell moderately strong, unpleasant, subraphanoid with chemical component. Taste indistinct. Spore print [white to] cream with greenish tinge when fresh, dingy cream with very little green when dry (slightly more cream yellow than Munsell 5y 8/4).

Spores [110/10] 9–12(–13.5–14.5) × 6–8(–9–11.5) μ, length-breadth ratio 1.25–2.0, averages 1.3–1.75, broadly ellipsoid to elongate, rather often obovoid, thin-walled, colourless, with subgranular, somewhat refractive contents, amyloid (Figs. 105, 106). Basidia 40–60 × 11–13 μ, 4-spored, but sometimes partly 1-, 2- and 3-spored, with clamps. Marginal tissue consisting of tufts of slenderly to broadly clavate, piriform and irregularly shaped cells, 20–60 × 15–25 μ, and hyphae 4–12 μ wide. Trama of gills bilateral, without terminal inflated cells; subhymenium ramose

or with irregularly inflated cells. Pileipellis made up of interwoven to subradial, colourless to pale brown (intracellular pigment) or somewhat refractive, yellowish hyphae 2–8 μ wide, not or slightly gelatinized near surface. Remnants of volva on cap (Figs. 102, 103) consisting of abundant, more or less parallel, erect chains of mainly ellipsoid to clavate, but also subglobose, elongate and irregular cells up to 110 × 60 μ, rare to rather abundant, erect-parallel to interwoven hyphae and scattered to rather abundant, oleiferous hyphae; dingy yellowish to pale yellow-brown in alkaline solution, sometimes with distinct brownish, intracellular pigment; hyphae more abundant in base of warts; ellipsoid to globose cells more abundant in top of warts. Trama of stem with abundant, terminal, clavate cells up to 400 × 60 μ among hyphae 2–10 μ wide, yellowish to deep golden yellow in alkaline solution, with scattered to abundant oleiferous hyphae. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in woods on heavy, calcareous or neutral soils in Europe except northern part, with preference for alluvial woods; fruiting especially in warm, dry summers.

COLLECTIONS EXAMINED.—ENGLAND: Surrey, Horsley, 6 Sept. 1953, *R. W. G. Dennis* (L); NETHERLANDS, prov. Utrecht: Utrecht, 31 Aug. 1953, *C. Bas 150* (L); 18 Sept. 1953, *C. Bas 206* (L); Zeist, 17 Sept. 1953, *O. F. Uffelie & al.* (herb. Uffelie); FRANCE: Oise, Orry-la-Ville, Aug. 1949, *H. Romagnesi* (S); Pyrénées Orientales, near Perpignan, 11 Nov. 1966, *A. Marchand* (L); CZECHOSLOVAKIA: Bohemia; reg. Praha, Karlštejn, 5 Sept. 1952, *S. Indelka* (PR); reg. Usti nad Labem, Libochovice nad Ohří, 19 Sept. 1961, *Z. Neubauer* (PR); Slovakia, Saudorf near Bratislava, 12 Sept. 1948, *F. Drascla* (PR); AUSTRIA, near Vienna, without date, *Hagenbrünn* (PR); ITALY: Trentino, Vela NW of Trento, June 1901, *J. Bresadola* (S); Elba, Porteferrário, Oct. 1913, *Garbari* (S); YUGOSLAVIA: Dalmatia, Ugljan, 25 Nov. 1964, *M. Tortić* (fragments in L.)

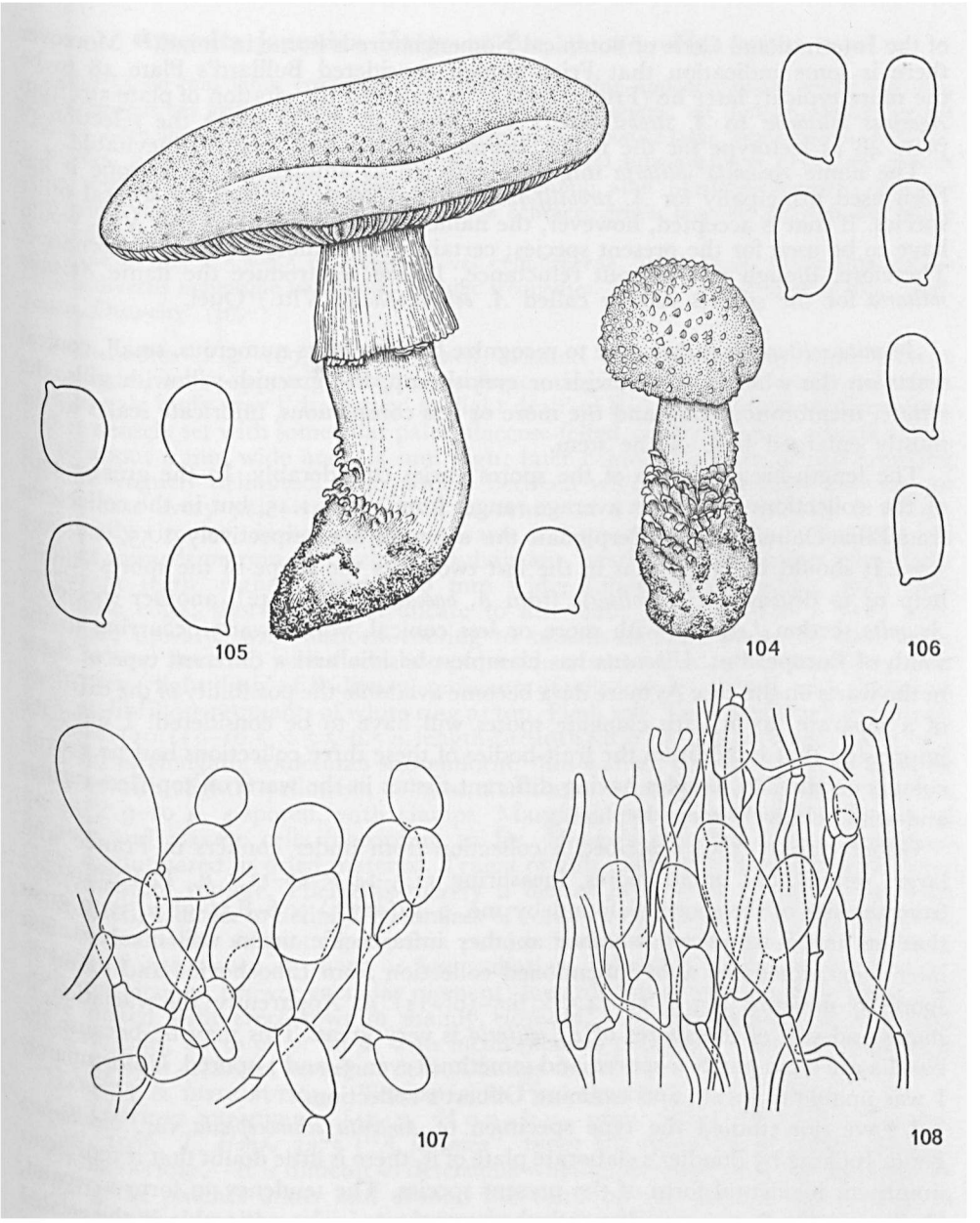
OBSERVATIONS.—The foregoing description of the macroscopical characters of *A. solitaria* is based mainly on field-notes taken from the collections I saw in a fresh state (*Bas 150* & *206*). Some additional notes taken from reliable descriptions in literature have been placed between square brackets.

NOMENCLATURAL NOTE.—The name *Agaricus solitarius* was published for the first time by Bulliard (l.c.) in 1780 on his Plate 48. This plate undoubtedly represents the species now usually called *Amanita echinocephala* (compare Gilbert, 1925: 291; 1940: 50; 1941: 369). In 1793 Bulliard (l.c.) published a second plate (Pl. 599) under the name *Agaricus solitarius*, but this time representing *Amanita strobiliformis*. From his later description (1812: 675) it appears clearly that *Agaricus solitarius* as finally conceived by Bulliard is a mixture of *Amanita echinocephala* and *A. strobiliformis*.

Fries' description accompanying the first valid publication of the name *Agaricus solitarius* in 1821 (l.c.) is rather poor, probably because he included notes on a fungus collected in Sweden that may have belonged to another species. This is difficult to prove, however, since as far as I know the material of the collection no longer exists.

From his citations in 1821 it also appears that at that time Fries' conception of *Agaricus solitarius* was still wider than that of Bulliard. But by using Bulliard's name for it (in Fries' index the name is also cited as *Agaricus solitarius* Bull.), by referring to both of Bulliard's plates and from his treatment of *A. solitarius* in his later books it is evident that Bulliard's elements are at the very core of his conception.

As there is no original material available it is logical to select one of Bulliard's two plates as lectotype for the name *Agaricus solitarius* Bull. per Fries. Bulliard's Plate 48 was the earliest publication of the name. This alone is sufficient reason to select this plate as lectotype, the more so if the second part of Note 7 of Article 7



Figs. 104–106. *Amanita solitaria* (= *A. echinocephala*!). — 104. Fruit-bodies. — 105, 106. Spores. (Figs. 104, 105, from *Bas 150*; 106 from *Marchand, Nov. 1916.*)

Figs. 107, 108. *Amanita japonica*. — 107. Section of apex of volval wart from cap. — 108. Section of base of same wart. (Both figs. from *Hongo 3275.*)

of the International Code of Botanical Nomenclature is borne in mind.[52] Moreover there is some indication that Fries himself considered Bulliard's Plate 48 to be the more typical; later he (Fries, 1838: 5) transferred the citation of plate 593 from *Agaricus solitarius* to *A. strobiliformis*! This seems to me to make the selection of plate 48 as lectotype for the name *Agaricus solitarius* Bull. per Fr. inevitable.

The name *Amanita solitaria* might be rejected as ambiguous. In Europe it has been used principally for *A. strobiliformis* and in North America for several other species. If that is accepted, however, the name *Amanita procera* Pers. per Vitt. would have to be used for the present species; certainly not a more attractive alternative. Therefore, though not without reluctance, I here reintroduce the name *Amanita solitaria* for the species usually called *A. echinocephala* (Vitt.) Quél.

Amanita solitaria is rather easy to recognize because of its numerous, small, conical warts on the whitish to yellowish or greyish cap, the greenish-yellowish gills, the striate, membranous ring and the more or less conspicuous, imbricate scales at the mostly enlarged base of the stem.

The length-breadth ratio of the spores varies considerably. In the greater part of the collections studied its average ranges from 1.3 to 1.45, but in the collections from Elba, Dalmatia, and Perpignan the averages are respectively 1.55, 1.7, and 1.75. It should be noted that in the last two cases the shape of the spores cannot help us to distinguish *A. solitaria* from *A. baccata* (see p. 442), another species of *Amanita* section *Lepidella* with more or less conical, volval warts occurring in the south of Europe. But *A. baccata* has clampless basidia and a different type of tissue in the warts on the cap. As more data become available the possibility of the existence of a separate taxon with elongate spores will have to be considered. I have the impression that in addition the fruit-bodies of these three collections had no greyish colours on the cap, besides having different tissues in the warts on top (less regular and with relatively more hyphae).

Gilbert (1941: 379) described a collection from under conifers in France with large, remarkably broad spores, measuring 11.5–14 × 10–11.5 μ. The difference from the size of the spores as found by me, 9–12(–13.5) × 6–8.5(–9) μ, is so great that at first I wondered whether another infraspecific taxon was involved. But later I examined the above mentioned collection from Libochovice and found its spores to measure [15/3] 11–14.5 × 6.5–10(–11) μ. Apparently the variation in shape and size of the spores of *A. solitaria* is very great. This may be because the basidia are often partly 2-spored and sometimes even 3- and 1-spored. Unfortunately I was unable to locate and examine Gilbert's collection.

I have not studied the type specimen of *Amanita echinocephala* var. *bicollariata* Boud. Judging by Boudier's elaborate plate of it, there is little doubt that it represents simply an incidental form of the present species. The tendency to form a second, fibrillose, imperfect ring underneath the normal one is also noticeable in the related *A. cokeri* from North America (see p. 393).

[52] The sentence referred to runs: "When valid publication is by reference to a pre-starting-point description, the latter must be used for purposes of typification as though newly published."

Amanita japonica Hongo ex Bas, *sp. nov.*—Figs. 107–110

Pileus 55–80 mm latus, convexus, dein planus, margine appendiculatus neque sulcatus, siccus, griseus vel griseo-maculatus, verrucis subconicis, adnatis, sat minutis, pallide griseis ornatus. Lamellae confertae vel subconfertae, fere liberae, modice latae, albae. Stipes 80–170 × 7–15 mm, sursum attenuatus, basi fusiformi-radicatus vel subclavatus et usque ad 25 mm latus, solidus, albus, floccosus, apice fragmentis annuli albis fibrilloso-floccosus, deorsum fragmentis volvae floccoso-pulverulentis pallide ochraceo-griseis ornatus. Caro mollis, odore saporeque indistincto.

Sporae 9–10.5 × 5.5–6.5 μ, elongatae vel cylindraceae, amyloideae. Fragmenta volvae cellulis diversis hyphisque composita. Fibulae frequentes. Typus: '*Hongo 3275*, 9 Aug. 1966, Japan, Ōtsu-city' (L).

Fruit-bodies (Fig. 109) medium-sized, slender. Cap 55–80 mm wide, convex then plane, with appendiculate, non-sulcate margin, dry, at first moderately dark grey to pale buffy grey ('drab-grey' to 'light drab' of Ridgway), felted-subflocculose, rather densely set with somewhat paler, floccose-felted, subpyramidal, adnate warts, up to about 2 mm wide and 1.5 mm high; later coloured surface of cap breaking up into vaguely delimited, thin patches between which whitish flesh showing, in which case every pale wart situated at centre of a minutely radially fibrillose, practically circular, darker grey spot; warts and spots diminishing in size and less distinct towards margin. Gills close to subdistant, nearly free, sometimes with slight decurrent teeth, rather broad, 7–8 mm wide, subventricose, white, with subflocculose edge; short gills subtruncate to attenuate. Stem 80–170 × 7–15 mm, attenuate upward, with fusiform-rooting to subclavate base up to 25 mm wide, solid, white, floccose, with flocculose-pulverulent to small, vague, scale-like, pale buffy grey ('light drab' of Ridgway) remnants of volva on lower half, with fugacious floccose-fibrillose remnants of white ring at top. Flesh soft. Taste and smell indistinct.

Spores [20/1] 9–10.5 × 5.5–6.5 μ, length-breadth ratio 1.5–1.9 (averages 1.6–1.65), ellipsoid to elongate, sometimes subreniform, thin-walled, colourless but in alkaline solution with slightly yellowish, subgranular contents, amyloid (Fig. 110). Basidia 40–45 × 9–10 μ, 4-spored, with clamps. Marginal tissue a rather broad strip of hyphae and clavate cells (according to Dr. Hongo's description also vesiculose ones) agglutinated in dried material. Trama of gills impossible to reinflate in type; subhymenium ramose. Pileipellis merely a denser layer over trama of cap, not gelatinized, difficult to delimit. Remnants of volva on cap (Figs. 107, 108) brownish yellow in alkaline solution; grey, thin patches under and around warts consisting mainly of interwoven to more or less radiating, yellowish hyphae 3–10 μ wide, with conspicuous, brown, vacuolar pigment; towards top of warts hyphae more and more mixed with erect rows of mainly ellipsoid, but also globose, clavate and elongate cells, up to 90 × 60 μ, with inconspicuous pigment. Trama of stem with large, upright, clavate, terminal cells. Clamps frequent.

HABITAT & DISTRIBUTION.—Terrestrial in *Pinus-Quercus* forest in Japan.

COLLECTIONS EXAMINED.—JAPAN, Honshu, prov. Shiga, Ōtsu-city, Terabe, 9 Aug. 1966, *T. Hongo 3275* ("*A. japonica*", type: L); drawings of *Hongo 3293*.

OBSERVATIONS.—It is difficult to determine whether the thin, grey layer of hyphae forming the patches under and around the warts on the mature cap belongs to the pileipellis or to the volva. As it breaks up when the cap expands and as the transition into the tissue of the volval warts is very gradual, I have described it as a part of the volva.

Though the two type specimens have the appearance of being well dried, their microscopical structures are rather difficult to study. Cells and hyphae do not reinflate easily.

At first sight the present species rather strongly resembles *A. onusta* from N. America. The remnants of the volva on the cap, however, have a different structure. In *A. onusta* inflated cells are still abundant in the very base of the warts; in *A. japonica* hyphae are the most abundant elements in the base of the warts. Moreover, *A. onusta* has a more differentiated pileipellis, and more distinct and firmer volval warts or scales on the base of the stem.

In *A. japonica* the outer layer of the volva forming the warts is paler than the inner layer that forms the thin, darker grey patches on which the warts are situated.

Stirps RAVENELII

Basidia with clamps. Spores 7–11 μ long, subglobose to elongate. Volva forming at centre of cap coarse, adnate, pyramidal, to truncate-pyramidal, fibrillose warts often passing gradually into fibrillose scales towards margin.

The three species belonging to this stirps have a duplex volva the outer layer of which is felted, consisting of interwoven hyphae and more or less abundant inflated cells, while the rather thick inner layer consists mainly of hyphae and passes gradually into the trama of the cap.

In *A. ravenelii* and *A. crassa* the hyphae of the inner layer of the volva have at first a parallel and erect position; in *A. strobilacea* they seem to be more interwoven. In early stages the volva on the cap breaks up into pyramidal warts, the tops of which are felted but the lower parts distinctly fibrillose even to the naked eye.

Because of its strongly marginate bulb *A. strobilacea* is aberrant in respect of whole subsection *Solitariae*. This does not mean that the volva is circumscissile. Probably in early stages the primordial cap is separated from the margin of the bulb by a circular groove.

Stirps *Ravenelii* is closely related to stirps *Solitaria* but differs mainly in that the much more strongly pronounced duplex character of the volva results in coarser warts on the cap. Compare also stirps *Perpasta* (p. 409).

KEY TO THE SPECIES OF STIRPS *Ravenelii*

1. Bulbous base of stem immarginate.
   2. Volva forming vague zones or provoking scales on upper part of bulb. Spores 8–11 × 5.5–7 μ. Eastern U.S.A. *A. ravenelii*, p. 400
   2. Volva forming distinct circular rims (2 in type) on upper part of ventricose stem. Spores 7–9 × 4.5–6 μ. Very coarse species. Argentina. *A. crassa*, p. 402
1. Bulb strongly marginate. Spores 8–10(–12.5?) × 6.5–9(–11?) μ. South-eastern Australia. *A. strobilacea*, p. 406

AMANITA RAVENELII (Berk. & Curt.) Sacc.—Figs. 111–117

Agaricus ravenelii Berk. & Curt. *in* Ann. Mag. nat. Hist. III **4**: 284. 1859. — *Amanita ravenelii* (Berk. & Curt.) Sacc., Syll. Fung. **5**: 15. 1887.

? *Amanita muscaria* var. *major* Peck *in* Rep. N. York St. Mus. nat. Hist. **23**: 69. 1872. — See insufficiently known taxa (p. 562).

NAMES MISAPPLIED TO THE PRESENT SPECIES.—*Amanita strobiliformis* (Paul. ex Vitt.) Bertillon

sensu auct. americ. — *Amanita chlorinosma* f. *strobiliformis* (Paul. ex Vitt.) E. J. Gilb. sensu E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 393. 1941.[53]

ILLUSTRATIONS.—Coker *in* J. Elisha Mitchell scient. Soc. **33**: pl. 50. 1917; E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (3): pl. 65. 1941.

Fruit-bodies (Figs. 111, 113) large to very large and usually thickset, solitary or subgregarious. Cap 90–160 mm wide, at first globose to hemispherical, later becoming convex, sometimes with slightly flattened centre, with non-sulcate, appendiculate margin, fleshy, whitish to cream, dry, but sometimes becoming viscid with age; adnate volval layer breaking up into crowded, rather coarse, conical to truncate-conical, pale cream to avellaneous, up to 6 mm wide and 4 mm high warts with radially fibrillose sides and subfelted apex (duplex-structure usually macroscopically rather conspicuous); with age on dry caps towards margin warts passing into flat, fibrillose scales with somewhat raised, amorphous tips or, when scales transversely elongate, with amorphous ridges. Gills crowded, free, moderately broad to broad, pale cream to dark ochraceous cream, with entire, slightly paler edge; short gills subtruncate to attenuate. Stem about 100–250 × 10–25 mm, attenuate upward, with conspicuous, strongly ventricose to fusiform-subclavate, rooting, up to 110 × 60 mm large bulb, solid, white to cream, with or without apical ring, flocculose above, with cream to avellaneous, flocculose zones or scales below down to middle of bulb; upper half of bulb and base of stem often with thick, imbricate scales or sheaths pointing up- and outward. Ring thick, flocculose-subfelted, with thick, avellaneous rim, but often soon falling to pieces. Flesh white to yellowish, firm. Smell strong, unpleasant ("old ham," "chlorine").

Spores [60/5] 8–11 × (5–)5.5–7(–7.5) μ, length-breadth ratio 1.4–1.8 (averages 1.5–1.6), ellipsoid to elongate, sometimes ovoid or obovoid, thin-walled, colourless, with subgranular, refractive contents, amyloid (Fig. 112). Basidia 45–60 × 10–11 μ, 4-spored, with clamps. Marginal tissue scanty, in young specimens a narrow strip of hyphae 4–8 μ wide running more or less parallel to edge of gills and carrying many very small to small, clavate cells, 12–32 × 8–16 μ, partly in rows. Trama of gills bilateral; subhymenium ramose. Pileipellis consisting of radial to slightly interwoven, colourless hyphae 3–10 μ wide, not gelatinizing underneath warts, not or slightly between warts when exposed; with some oleiferous hyphae. Remnants of volva on cap (Figs. 115–117): at base of warts consisting of more or less parallel and upright, yellow, refractive hyphae 3–8(–10) μ wide on which scattered, upright, mainly clavate cells up to 120 × 15 μ; towards apex of wart tissue rather abruptly changing into a mixture of abundant, globose, ellipsoid and clavate cells up to 70 × 70 μ and 80 × 55 μ, terminal or in short rows on irregularly disposed, rather abundant, branching, sometimes subcoralloid hyphae; nearly all elements yellowish in alkaline solution and distinctly refractive. Trama of stem with terminal, upright, large, clavate cells partly with cloudy contents; golden yellow in alkaline solution. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Maryland, Laurel, 13 Aug. 1966, *A. Sánchez & E. Hacskaylo CU 48841* pro parte (CUP); Tennessee, Great Smoky Mountains, Cades Cove, 5 Aug. 1938, *A. H. Smith 9797* (MICH); 14 Sept. 1956, *L. R. Hesler 22418* (TENN); 26 Sept. 1963, *C. Bas 3931* (L); North Carolina,

[53] Gilbert was fully aware that the American '*A. strobiliformis*' is different from the similarly named European species. Nevertheless since he did not definitively exclude the type of the name *Ag. strobiliformis* Paul. ex Vitt. he proposed a new combination with that name as basionym.

Chapel Hill, Purefoy's Mill, 4 Oct. 1913, *W. C. Coker 878* (NCU); South Carolina, June, *H. W. Ravenel* (type: K).

OBSERVATIONS.—The type consists of four young specimens and one damaged, barely mature specimen. Characteristic are the ventricose-fusiform bulb of the short stem and the rather coarse, radially fibrillose, conical to truncate warts on the cap. The type collection of *A. ravenelii* is undoubtedly conspecific with what American authors usually call *A. strobiliformis*.

The collection *Smith 9797* cited is the one to which the photograph published by Gilbert (1941: pls. 64, 65) belongs. I have also studied one of the two specimens of *Coker 856*; unfortunately it was not the specimen pictured on Coker's plate (1917: pl. 50); moreover it appeared to belong to another species.

In *A. ravenelii* the upper part of the bulb and the lower part of the stem are often adorned with thick, fleshy, imbricate scales or sheaths. These structures come into being by splitting of the flesh of stem and bulb. The remnants of the volva are usually rather inconspicuous in this region, though initially they probably provoke the process of splitting.

The typical form of *A. ravenelii* is very distinctive because of the coarse, conical to truncate, radially fibrillose warts with felted tips or central patches, towards the margin gradually passing into broad, fibrillose scales. The pileipellis does not gelatinize, except in aging specimens, and then the outer surface of the warts may also become involved in the process. Very characteristic is usually also the broadly ventricose, sometimes even onion-shaped bulb.

The radially fibrillose structure of the warts is not always very clear, however, and then the microscope must be used to be certain that the base of the warts consists mainly of parallel, refractive, yellowish hyphae and only scattered elongate inflated cells.

Specimens with clavate-subfusiform bulbs and not very conspicuously fibrillose warts resemble *A. rhopalopus* (see discussion p. 417).

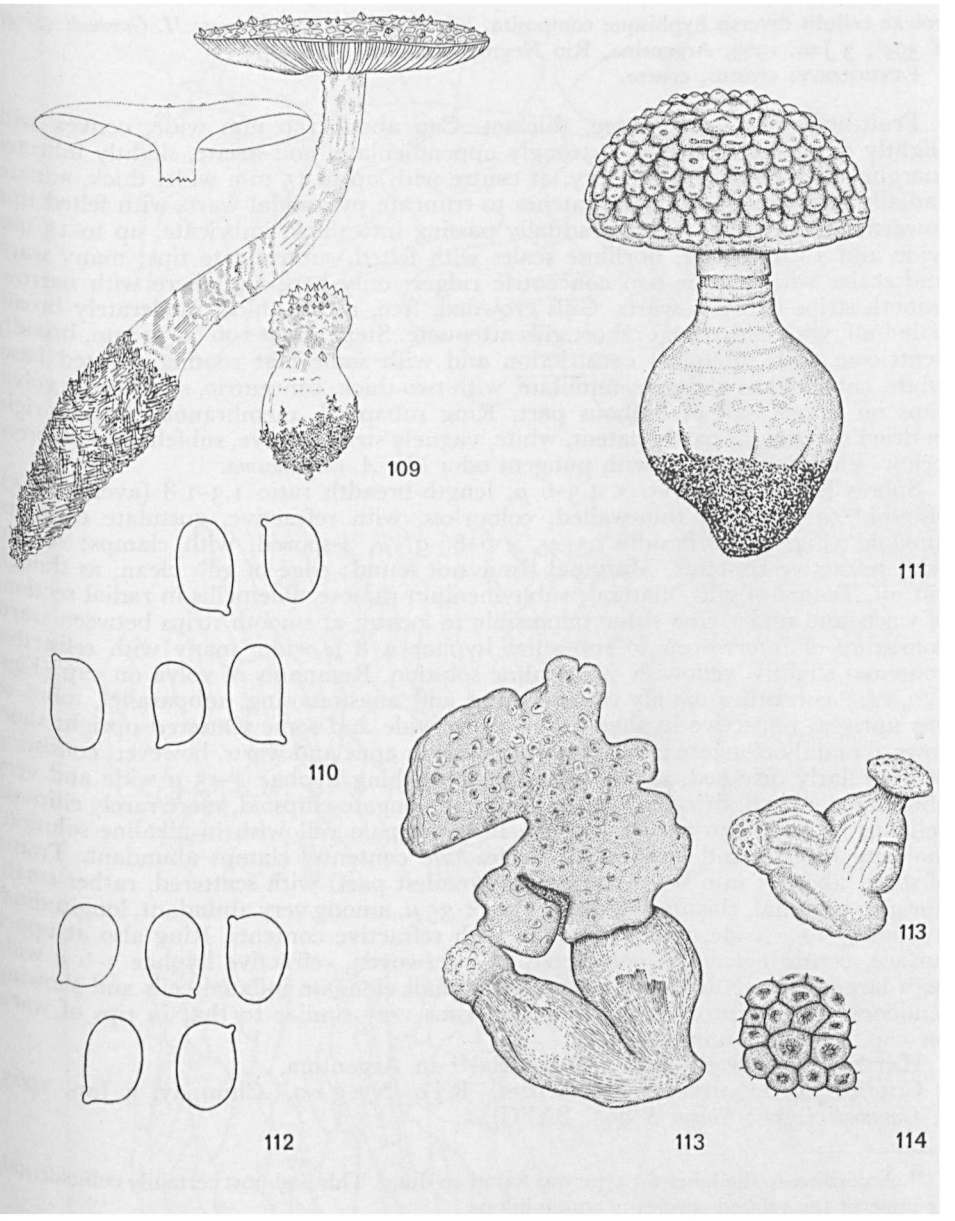
Among the clamp-bearing species *A. ravenelii*, together with *A. crassa* from S. America and *A. strobilacea* from Australia form a small group, chiefly characterized by the structure of the volva, which finds its counterpart among the clampless species in the group of *A. perpasta*.

Peck (1883: 46) was apparently the first who applied the name '*A. strobiliformis*' to the present species; as early as 1898 Lloyd (1898: 6) expressed well-founded doubts about this.

Amanita crassa Bas, *sp. nov.*—Figs. 118–121

Pileus circa 150 mm latus, convexus, centro leviter depressus, margine appendiculatus neque sulcatus, carnosus, albus, siccus, centro verrucis magnis crassisque truncato-pyramidalibus et margine squamis magnis fibrillosisque dense obsitus. Lamellae confertae, liberae, pallide bubalinae (?), modice latae. Stipes circa 100 mm longus, circa 50 mm latus, ventricoso-bulbosus, infra apicem constrictus, subradicatus, albus, dimidio superiore bulbi costis duabus volvae floccosis annularibus ornatus, apice annulo membranaceo substriato praeditus. Caro solida, alba, odore acri.

Sporae 7–9 × 4.5–6 μ, ellipsoideae vel elongato-ellipsoideae, amyloideae. Fragmenta



Figs. 109, 110. *Amanita japonica*. — 109. Fruit-bodies. — 110. Spores. (Fig. 109, from *Hongo 3293*, after Hongo's drawing; 110, from *Hongo 3275*.)

Figs. 111–114. *Amanita ravenelii*. — 111. Fruit-body. — 112. Spores. — 113. Dried fruit-bodies. — 114. Warts at centre of cap of type (× 1). (Fig. 111, from *Bas 3931*; 112, from *Coker 878*; 113, 114, from type.)

volvae cellulis diversis hyphisque composita. Fibulae praesentes. Typus: '*I. Gamundi* (*Singer S 395*), 3 Jan. 1963, Argentina, Rio Negro, Chimpay' (BAFC).

ETYMOLOGY: crassus, coarse.

Fruit-body (Fig. 118) large, thickset. Cap about 150 mm wide, convex with slightly depressed centre and strongly appendiculate, non-striate, slightly inflected margin, thick-fleshed, white, dry, at centre with up to 15 mm wide, thick, adnate, radially fibrillose, polygonate patches to truncate pyramidal warts with felted tips, towards margin these warts gradually passing into thick, imbricate, up to 15 mm wide and 10 mm long, fibrillose scales with felted, subtruncate tips; many warts and scales with one or two concentric ridges; only here and there with narrow, smooth strips between warts. Gills crowded, free, rather thick, moderately broad, pale buff, with entire edge; short gills attenuate. Stem about 100 × 50 mm, broadly ventricose with subapical constriction and with somewhat rooting pointed base, white, subfelted to glabrous, annulate, with two thick, concentric, subfloccose volval rims on upper half of bulbous part. Ring subapical, membranous (rather rigid in dried specimen), partly patent, white, vaguely striate above, subfelted to glabrous below. Flesh white, firm, with pungent odor like *A. chlorinosma*.

Spores [20/1] (6.5–)7–9 × 4.5–6 μ, length-breadth ratio 1.3–1.8 (average 1.5), ellipsoid to elongate, thin-walled, colourless, with refractive, guttulate contents, amyloid (Fig. 119). Basidia 35–45 × 6–8(–9) μ, 4-spored, with clamps; several with refractive contents. Marginal tissue not found; edge of gills clean, as though cut off. Trama of gills bilateral; subhymenium ramose. Pileipellis in radial sections of warts and underlying tissue impossible to locate; at smooth strips between warts consisting of interwoven to subradial hyphae 4–8 μ wide, many with refractive contents; slightly yellowish in alkaline solution. Remnants of volva on cap (Figs. 120, 121) consisting mainly of branching and anastomosing, subparallel, more or less upright, refractive hyphae 5–12(–15) μ wide and some scattered upright short rows of mainly elongate cells up to 100 × 30 μ; apex and warts, however, consisting of irregularly disposed, rather abundant branching hyphae 4–15 μ wide and very abundant, subcylindrical, elongate-fusiform, elongate-ellipsoid, more rarely ellipsoid cells up to 125 × 30 and 70 × 40 μ in rows; pale yellowish in alkaline solution; majority of cells and hyphae with refractive contents; clamps abundant. Trama of stem (about 5 mm below surface of broadest part) with scattered, rather small, upright, terminal, clavate cells up to 150 × 35 μ, among very abundant, longitudinal hyphae 5–10 μ wide, many of which with refractive contents. Ring also at upper surface, consisting almost completely of interwoven, refractive hyphae 3–6 μ wide with large clamps; at lower surface with small elongate inflated cells and showing tendency to gelatinize. Tissue of volval rims very similar to that in tips of warts on cap. Clamps abundant.

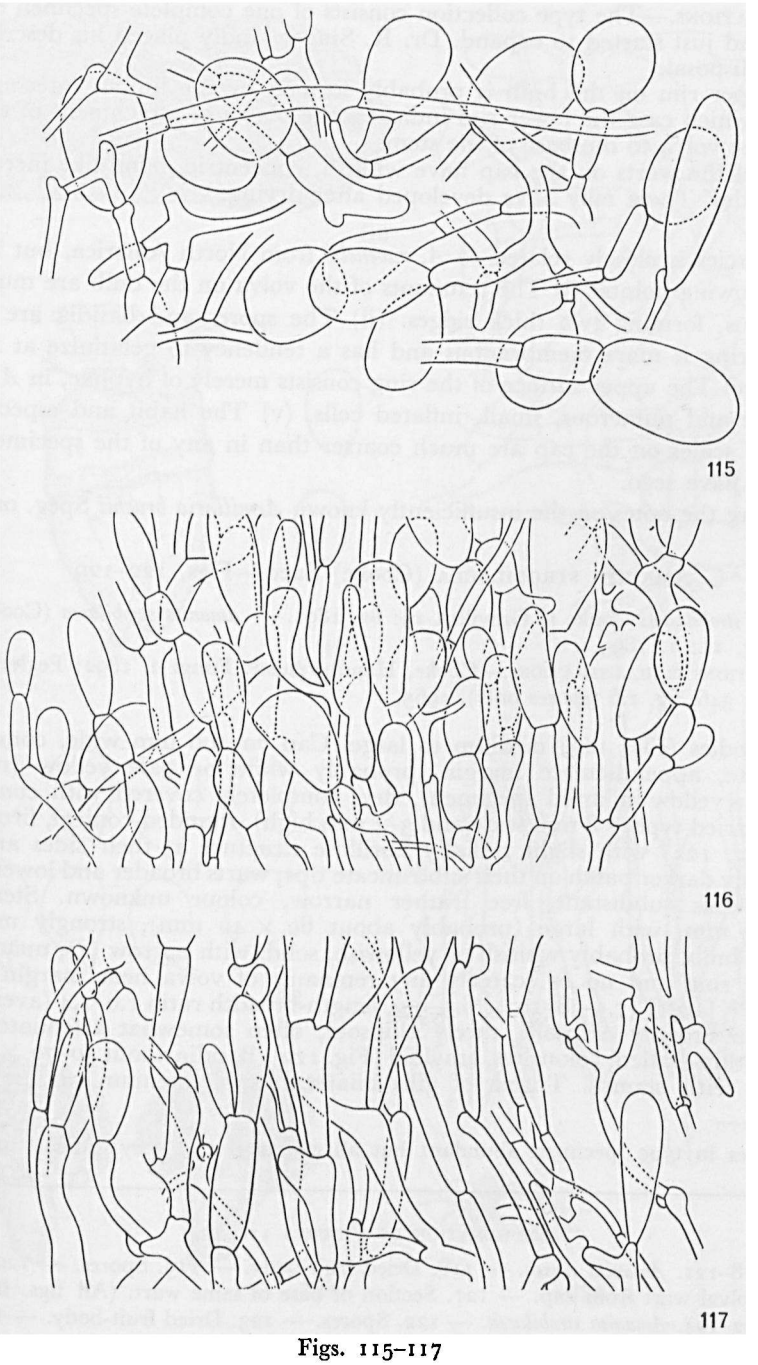
HABITAT & DISTRIBUTION.—Terrestrial[54] in Argentina.

COLLECTION EXAMINED.—ARGENTINA, Rio Negro, Chimpay, 3 Jan. 1963, *I. Gamundi* (type: *Singer S 395*, BAFC).

[54] According to the label the type was found on dung. This is almost certainly coincidental, as none of the related species is coprophilous.

EXPLANATION OF FIGURES 115–117

Figs. 115–117. *Amanita ravenelii*. — 115. Crushed apex of volval wart from cap. — 116. Section of middle part of same wart. — 117. Section of base of same wart. (All figs. from *Bas 3931*.)



Figs. 115–117

OBSERVATIONS.—The type collection consists of one complete specimen of which the cap had just started to expand. Dr. R. Singer kindly placed his description of it at my disposal.

The upper rim on the bulb is probably formed by the limbus internus of the volva, in which case the lower rim indicates the places of attachment of the outer layer of the volva to the base of the stem.

Many of the warts on the cap have whitish, concentric, band-like incrustations at their sides. These may have developed after drying.

This species is closely related to *A. ravenelii* from North America, but it differs in the following points: (i) The remnants of the volva on the bulb are much more conspicuous, forming two thick ridges. (ii) The spores and basidia are smaller. (iii) The ring is more membranous and has a tendency to gelatinize at its lower surface. (iv) The upper surface of the ring consists merely of hyphae, in *A. ravenelii* of hyphae and numerous, small, inflated cells. (v) The habit and especially the warts and scales on the cap are much coarser than in any of the specimens of *A. ravenelii* I have seen.

Compare the notes on the insufficiently known *Armillaria bruchii* Speg. on p. 560.

AMANITA STROBILACEA (Cooke) Sacc.—Figs. 122–129

Agaricus strobilaceus Cooke *in* Grevillea **19**: 82. 1891. — *Amanita strobilacea* (Cooke) Sacc., Syll. Fung. **11**: 1. 1895.

DESCRIPTIONS & ILLUSTRATIONS.—Cooke, Handb. Austr. Fungi 2. 1892; Pegler *in* Austr. J. Bot. **13**: 346, fig. 1.6 (spores only). 1965.

Fruit-bodies (Fig. 123) medium to large. Cap 70–100 mm wide, convex, with non-sulcate, appendiculate margin, probably white or pale yellow (now pale ochraceous yellow in dried specimen), dry, completely covered with concolorous, large (in dried type 3–8 mm wide and 3–4 mm high), rounded-conical, firm, adnate warts (Fig. 124) with slight radially fibrillose structure at their sides and small, flat, slightly darker patch on their subtruncate tips; warts broader and lower towards margin. Gills subdistant, free, rather narrow, colour unknown. Stem about 100 × 25 mm, with large (probably about 60 × 40 mm), strongly marginate, napiform bulb, probably whitish or yellowish, solid, with narrow (?), membranous, subapical ring and no or scarcely any remnants of volva near margin of bulb.

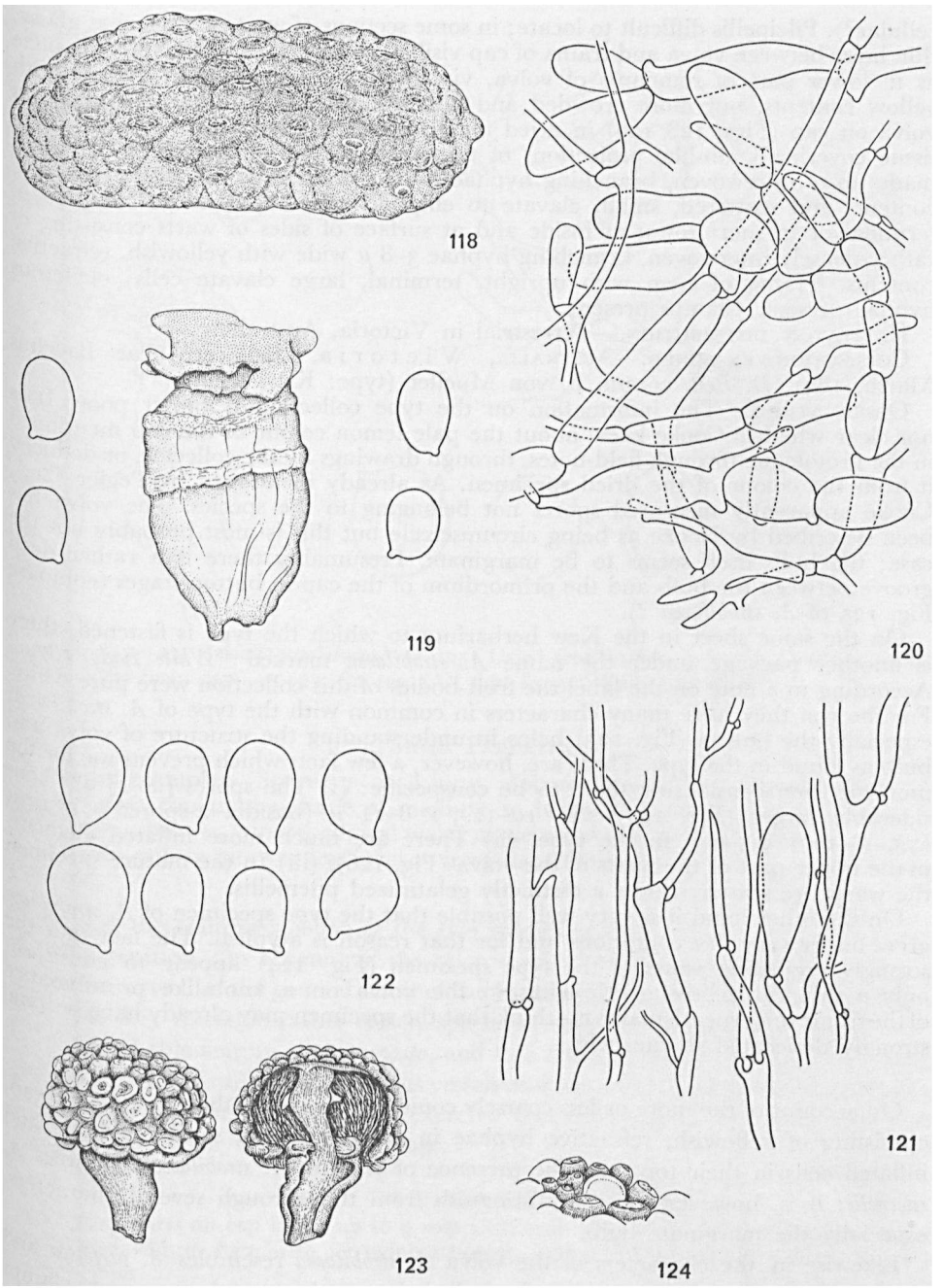
Spores[55] [10/1] (7.5–)8–10 × 6.5–9 μ, length-breadth ratio 1.0–1.4 (average 1.2), globose to broadly ellipsoid, rarely ellipsoid, often somewhat attenuate towards apiculus, thin-walled, colourless, amyloid (Fig. 122). Basidia about 50–70 × 13–15 μ, 4-spored, with clamps. Trama of gills bilateral; subhymenium ramose (to sub-

[55] Spores in type specimen abundant but all collapsed and very difficult to reinflate.

EXPLANATION OF FIGURES 118–124

Figs. 118–121. *Amanita crassa*. — 118. Dried fruit-body. — 119. Spores. — 120. Crushed apex of volval wart from cap. — 121. Section of base of same wart. (All figs. from type.)

Figs. 122–124. *Amanita strobilacea*. — 122. Spores. — 123. Dried fruit-body. — 124. Warts on cap; central wart cut in half (× 1). (All figs. from type.)



Figs. 118–124

cellular?). Pileipellis difficult to locate; in some sections of warts a somewhat glassy, thin layer between volva and trama of cap visible, consisting of same type of hyphae as in lower part of remnants of volva, viz. branching, interwoven hyphae with yellow contents, but more crowded and not or hardly gelatinized. Remnants of volva on cap (Figs. 128, 129) in dried material only a rather thin layer of volval tissue covering knob-like projections of trama of cap, at surface of top of warts made up of interwoven, branching hyphae 5–10 μ wide with yellowish, refractive contents and scattered, small, clavate to ellipsoid cells about 20–50 × 15–20 μ, terminal or in short rows; at inside and at surface of sides of warts consisting of rather densely interwoven, branching hyphae 3–8 μ wide with yellowish, refractive contents. Trama of stem with upright, terminal, large clavate cells; oleiferous hyphae present. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in Victoria, Australia.

COLLECTION EXAMINED.—AUSTRALIA, Victoria, Ballarat, near Bacchus Marsh, 1891, *D. Best*, comm. F. von Mueller (type: K).

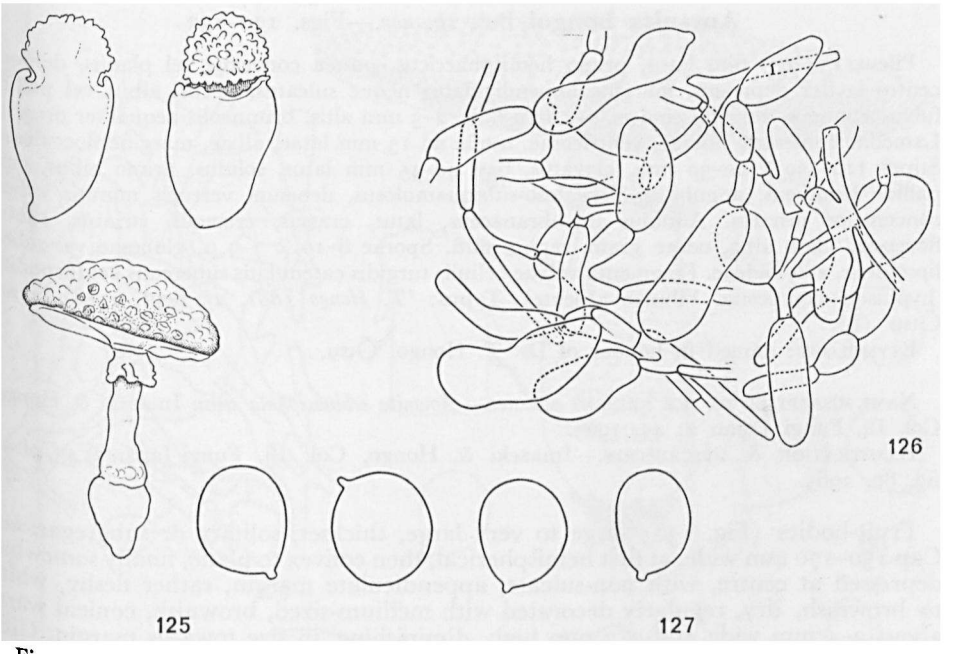
OBSERVATIONS.—The information on the type collection is rather poor. It is not clear whether Cooke knew about the pale lemon colour of the cap mentioned in the protologue through field-notes, through drawings by the collector, or deduced it from the colour of the dried specimen. As already mentioned by Pegler (l.c.), Cooke apparently measured spores not belonging to the species. The volva has been described by Cooke as being circumscissile but this is most probably not the case; the bulb itself seems to be marginate. Presumably there is a rather deep groove between the bulb and the primordium of the cap in button-stages (compare Fig. 125 of *A. strobilacea* ?).

On the same sheet in the Kew herbarium to which the type is fastened, there is another package under the name *A. strobilacea* marked "*White Lady 1874*." According to a note on the label the fruit-bodies of this collection were pure white. For the rest they have many characters in common with the type of *A. strobilacea*; especially the button (Fig. 125) helps in understanding the structure of volva and bulb as found in the type. There are, however, a few facts which prevent me for the moment from considering them to be conspecific: (i) The spores [20/1] are considerably larger (Fig. 127), viz. 10–12.5 × 8–11 μ (basidia 4-spored!) against (7.5–)8–10 × 6.5–9 μ in the type. (ii) There are much more inflated elements in the upper part of the warts of the volva (Fig. 126). (iii) In the mature specimen the warts are scattered over a distinctly gelatinized pileipellis.

On the other hand it is very well possible that the type specimen of *A. strobilacea* grew under very dry conditions and for that reason is atypical. The fact that the strongly projecting warts of the type specimen (Fig. 124) appear to consist of only a thin cap of tissue belonging to the volva on a knob-like protuberance of the trama underneath makes me think that the specimen may already have become strongly desiccated in the field.

On account of the more or less coarsely conical remnants of the volva on the cap, consisting of yellowish, refractive hyphae in their base and similar hyphae and inflated cells in their top, and the presence of clamps, *A. strobilacea* resembles *A. ravenelii*; it is, however, easy to distinguish from this through several characters, especially the marginate bulb.

Likewise in the characters of the volva *A. strobilacea* resembles *A. perpasta* and *A. hongoi*, but in these species too the bulb is immarginate and, moreover, clamps are lacking.



Figs. 125–127. *Amanita strobilacea?* — 125. Dried fruit-bodies. — 126. Crushed apex of volval wart from cap. — 127. Spores. (All figs. from "*White Lady 874.*")

Stirps PERPASTA

Basidia clampless. Spores 7–10 μ long, globose to broadly ellipsoid. Remnants of volva on cap in the shape of medium to large, brownish, or at least at apex ferruginous brown, adnate, conical warts made up of mainly small, globose, ellipsoid and ovoid cells in more or less erect to irregular rows in apex, and abundant hyphae in base.

Among the clampless *Solitariae* the two species of stirps *Perpasta* occupy a rather isolated position. On account of the microscopical and macroscopical structure of the volva as well as the general habit of the fruit-body, however, among the clamped *Solitariae* they resemble rather closely species of stirpes *Solitaria* and *Ravenelii*.

A remarkable feature of *A. perpasta*, and to a lesser degree also of *A. hongoi*, is the presence of large, radiating oleiferous vessels and patches of an amorphous, yellow to yellow-brown substance, probably excreted by these vessels, at the outside of the base of the volval warts on the cap.

KEY TO THE SPECIES OF STIRPS *Perpasta*

1. Conical warts on cap large, up to 9 mm wide and 5 mm high, with ferruginous-brown tip and whitish base with ferruginous-brown, radial streaks. Spores 7–8.5 × 6.5–8 μ. S.E. Asia *A. perpasta*, p. 412
1. Conical warts on cap medium-sized, up to 4 mm wide and 3 mm high, pale brown. Spores 8–10 × 7–9 μ. Japan. *A. hongoi*, p. 410

Amanita hongoi Bas, *sp. nov.*—Figs. 130–132

Pileus 150–170 mm latus, primo hemisphaericus, postea convexus vel planus, denique centro leviter depressus, margine appendiculatus neque sulcatus, siccus, albus vel pallide fulvo-brunneus, verrucis conicis, 2–4 mm latis, 2–3 mm altis, brunneolis aequaliter ornatus. Lamellae confertae, liberae, ventricosae, usque ad 15 mm latae, albae, margine flocculosae. Stipes 110–130 × 20–30 mm, clavatus, basi 40–45 mm latus, solidus, primo albus, dein pallide brunneus, annulatus, flocculoso-subsquamulosus, deorsum verrucis minutis volvae concentrice ornatus. Annulus membranaceus, latus, crassus, cremeus, striatus, subtus floccosus. Caro alba, odore grato, sapore miti. Sporae 8–10 × 7–9 μ, globosae vel subellipsoideae, amyloideae. Fragmenta volvae cellulis turgidis catenulatis suberectis vel inconditis hyphisque composita. Fibulae absentes. Typus: '*T. Hongo 1881*, 25 Sept. 1958. Japan, Ōtsu' (L).

ETYMOLOGY: named in honour of Dr. T. Hongo, Ōtsu.

NAME MISAPPLIED TO THE PRESENT SPECIES.—*Amanita echinocephala sensu* Imazeki & Hongo, Col. Ill. Fungi Japan **2**: 43. 1965.

ILLUSTRATION & DESCRIPTION.—Imazeki & Hongo, Col. Ill. Fungi Japan **2**: 43, pl. 13 fig. 80. 1965.

Fruit-bodies (Fig. 130) large to very large, thickset, solitary or subgregarious. Cap 150–170 mm wide, at first hemispherical, then convex to plane, finally somewhat depressed at centre, with non-sulcate, appendiculate margin, rather fleshy, white to brownish, dry, regularly decorated with medium-sized, brownish, conical warts about 2–4 mm wide and 2–3 mm high, diminishing in size towards margin. Gills crowded, free, rather broad, up to 15 mm wide, white, with minutely flocculose edge; short gills rounded-truncate (to attenuate?). Stem 110–130 mm long, clavate, 20–30 mm wide at top, 40–45 mm at rounded, clavate base, solid, white, becoming brownish with age, annulate, flocculose-squamulose, lower half with many close circles of very minute, brownish, conical to pustule-like warts. Ring pendent, apical, 25–30 mm wide, thick, membranous, cream, striate above, floccose below. Flesh white, rather soft, unchanging. Taste mild. Smell agreeable.

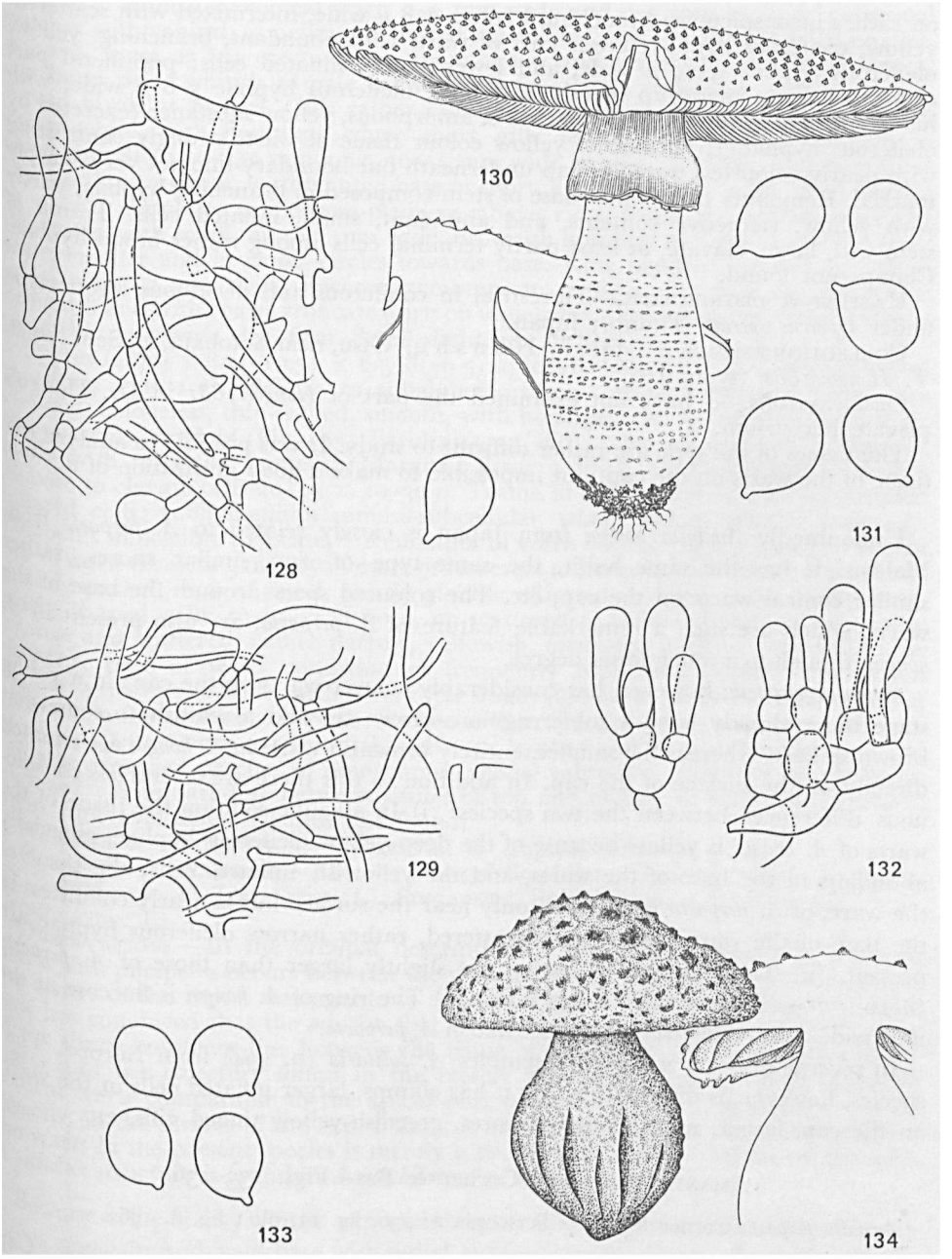
Spores [20/1] (7–)8–10(–11.5) × 7–9(–10) μ, length-breadth ratio 1.0–1.2 (average 1.1), globose to broadly ellipsoid, often more or less obpiriform, thin-walled, colourless, smooth, with homogeneous, refractive contents or guttulate, amyloid (Fig. 131). Basidia 45–55 × 11–13 μ, mostly 4-spored, but a few 2- or 1-spored, clampless, many with refractive contents. Marginal tissue scanty, consisting of small inflated cells up to 20 μ wide, mostly in short rows. Trama of gills difficult to analyze in material available; subhymenium cellular (Fig. 132). Pileipellis thin, made up of interwoven hyphae 2–10 μ wide of which many oleiferous, slightly gelatinized at shiny dark spots between warts. Remnants of volva on cap yellow in alkaline solution; upper part of warts consisting of more or less erect-parallel, irregular rows of small, mainly broadly ellipsoid, yellowish cells, 15–45 × 10–35 μ,

EXPLANATION OF FIGURES 128–134

Figs. 128, 129. *Amanita strobilacea.* — 128. Crushed upper part of volval wart from cap. — 129. Crushed tissue in base of same wart. (Both figs. from type.)

Figs. 130–132. *Amanita hongoi.* — 130. Fruit-body. — 131. Spores. — 132. Young parts of hymenium and subhymenium (× 500). (All figs. from type; 130, after Hongo's drawing.)

Figs. 133, 134. *Amanita perpasta.* — 133. Spores. — 134. Young fruit-body. (Both figs. from type; 134, after Corner's water-colour.)



Figs. 128–134

on rather inconspicuous, branching hyphae 3–8 μ wide, intermixed with scattered, yellow, oleiferous hyphae; lower part of warts with abundant, branching, yellow, oleiferous hyphae 3–20 μ wide, and fewer, small, inflated cells; peripheral part of base of warts made up merely of yellow, oleiferous hyphae 3–8 μ wide, with here and there at surface large patches of amorphous, yellow substance (excreted by oleiferous hyphae?); because of yellow colour tissue of warts strongly contrasting with nearly colourless trama of cap underneath but boundary-line not very sharply marked. Remnants of volva at base of stem composed of branching hyphae, partly with yellow, refractive contents, and abundant, small, inflated cells. Trama of stem with large, clavate, at least partly terminal cells among rather broad hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in coniferous and deciduous forest; type under *Quercus serrata* Thunb.; Japan.

COLLECTION EXAMINED.—JAPAN, H o n s h u, Ōtsu, near Sotohata, 25 Sept. 1958, *T. Hongo 1881* (type: L).

OBSERVATIONS.—I have not examined the part of *Hongo 1881* in Dr. Hongo's private herbarium.

The tissues of the type are rather difficult to study. It was possible to analyze the tissue of the warts on the cap, but impossible to make a good illustration of it.

Undoubtedly *Amanita hongoi* from Japan is closely related to *A. perpasta* from Malaya. It has the same habit, the same type of ring, similar spores, rather similar conical warts on the cap, etc. The coloured spots around the base of the warts, which are such a remarkable feature of *A. perpasta*, are also present in *A. hongoi*, though to a much lesser degree.

Amanita perpasta, however, has considerably coarser warts on the cap; in a young stage these already have a subferruginous-brown tip and a whitish to somewhat brownish base, whereas the smaller, entirely brownish warts in *A. hongoi* are situated directly on the surface of the cap. In addition to this there are several less conspicuous differences between the two species: (i) In alkaline solution the tissue of the warts of *A. hongoi* is yellow because of the deep yellow oleiferous hyphae, especially abundant in the base of the warts, and the yellowish inflated cells; the tissue of the warts of *A. perpasta* is coloured only near the surface but is nearly colourless in the base of the warts, where only scattered, rather narrow oleiferous hyphae are present. (ii) The spores of *A. hongoi* are slightly larger than those of *A. perpasta* (8–10 × 7–9 μ against 7–8.5 × 6.5–8 μ). (iii) The ring of *A. hongoi* is floccose at the underside and not coarsely verrucose like in *A. perpasta*.

In several respects *A. hongoi* resembles *A. solitaria* (p. 394) from Europe. That species, however, is different in that it has clamps, larger inflated cells in the warts on the cap, larger, more elongate spores, greenish-yellow tinged gills, etc.

AMANITA PERPASTA Corner & Bas—Figs. 133–136

Amanita perpasta Corner & Bas *in* Persoonia **2**: 250, fig. 11, pl. 1 fig. a. 1962.

Fruit-bodies (Fig. 134) large to very large, rarely small, thickset, solitary. Cap 40–170 mm wide, convex to plane, with non-sulcate ragged-appendiculate margin, fleshy, whitish to pallid cream or pale brown, dry, densely covered with adnate,

conical to truncately conical warts 2–9 mm wide and 2–5 mm high, or polygonal patches with conical, sometimes recurved appendage, towards margin with smaller, pointed, more or less erect scales; tips of warts and scales subferruginous-brown, but basal parts whitish to pale brown, sometimes with radiating, subferruginous-brown fibrils at surface. Gills rather crowded, free, thick, broad, 4–17 mm wide, cream-white, with flocculose edge; short gills rounded, obliquely truncate to attenuate. Stem 50–140 mm long, 30–55 mm wide at base, 7–16 mm at top, clavate to broadly ventricose, with pointed base or short, attenuate root, solid, firm, whitish to pallid, annulate, subfloccose-pruinose above ring, more or less concentrically decorated with small, up to 2 mm wide, brownish granules to flat scales below ring; scales smaller and in closer circles towards base. Ring pendent, apical, 20–25 mm wide, about 2 mm thick, floccose-membranous, pallid and striate on upper side brownish and with coarse truncate warts on underside. Flesh white, probably turning somewhat yellowish, dry, firm. Smell slight, not distinctive.

Spores [20/2] 7–8.5(–10.5) × 6.5–8(–9.5) μ, length-breadth ratio 1.0–1.15(–1.25) (averages 1.05–1.1), globose to subglobose, rarely broadly ellipsoid, sometimes obovoid, colourless, thin-walled, smooth, with homogeneous to subgranular, refractive contents, amyloid (Fig. 133). Basidia 45–55(–60) × 9–14 μ, 4-spored, clampless, many with refractive contents. Marginal tissue a thick, sterile margin of mainly globose to clavate cells 20–45 × 10–30 μ. Trama of gills bilateral, without terminal inflated cells; subhymenium ramose-subcellular when young, cellular with age. Pileipellis impossible to locate.[56] Remnants of volva on cap (Figs. 135, 136): brown tips of warts consisting mainly of more or less erect to irregularly disposed, branching, densely packed rows of small, mostly globose, ellipsoid or ovoid, more rarely irregularly shaped cells 10–35 × 8–30 μ, on scattered to rather abundant, branching hyphae and scattered, rather narrow, yellowish, oleiferous hyphae (especially near surface); base of warts consisting of frequently branching, loosely interwoven hyphae 4–10(–15) μ wide, with a very few small, clavate to subcylindrical, terminal cells and a few oleiferous hyphae; surface of basal part of warts, however, with very abundant, interwoven to subradial, oleiferous hyphae and large, often elongate and radially arranged patches of amorphous, yellow substance (excreted by oleiferous hyphae?); boundary-line between tissues of top and of base of warts rather sharp. Stem (not available). Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in tropical forest in Malaya.

COLLECTIONS EXAMINED.—MALAYA, Negri Sembilan, Gunong Angsi, at 500 m alt., 4 July 1930, *E. J. H. Corner* (L); SINGAPORE, Bukit Timah, 4 Sept. 1942, *E. J. H. Corner* (type: L).

OBSERVATIONS.—In the original description of the present species it is stated that a thin pileipellis occurs between the whitish base of the warts and the trama at the centre of the cap. I was unable to rediscover this structure and therefore I am now less convinced that the whitish foot of the warts belongs to the volva. In view of the sharp boundary-line between the tissue of the upper and lower parts of the warts and the structure found in the closely related *A. hongoi*, where brownish conical warts comparable to the apical part of the warts in *A. perpasta* are found directly on the surface of the cap, I think it more probable that the whitish base of the warts in the present species is merely a protuberance of the trama of the cap. A similar structure is found in *A. strobilacea* (p. 406).

Because of its fleshy, whitish cap with coarse, adnate, pyramidal warts with subferruginous tip and pale base with radial, subferruginous streaks, its thick, striate,

[56] See observations.

membranous ring and its clavate stem with many circles of minute, brownish warts, *A. perpasta* is a very characteristic species.

For a comparison with the closely related *A. hongoi* from Japan, see p. 412.

Stirps RHOPALOPUS

Basidia with clamps. Spores 8.5–13 μ long, ellipsoid to cylindrical (l/b 1.3–2.4). Remnants of volva on cap consisting of loosely arranged, more or less erect and parallel, medium to large, globose, ellipsoid or clavate cells or rows of such cells on scattered to abundant hyphae, forming floccose warts or a floccose or floccose-felted layer on cap.

This stirps is rather closely related to stirps *Solitaria*, but the tissue of the volva is less dense and less coherent and therefore the remnants of the volva on the cap are more floccose, usually forming imperfect warts or a floccose layer. But when the pileipellis becomes strongly gelatinized, real conical warts may be formed at the centre of the cap.

It is possible that some of the species in this work placed in stirps *Grossa* (see p. 502) will turn out to have erect-parallel elements in the volval remnants on young caps and will, once they are better known, have to be transferred to the present stirps.

KEY TO THE SPECIES OF STIRPS *Rhopalopus*

(With Australian species compare also the key to the species of stirps *Grossa* on p. 502.)

1. Spores 8.5–11 μ long.
   2. Stem with clavate, fusiform, or cylindrical, deeply rooting bulbous base. Eastern U.S.A. *A. rhopalopus* f. *rhopalopus*, p. 416
   2. Stem with enormous, turbinate to napiform bulb. Eastern U.S.A. *A. rhopalopus* f. *turbinata*, p. 418
1. Spores 10–13 μ long.
   3. Stem floccose-squamose to lacerate, with subclavate to fusiform base. Western U.S.A. *A. smithiana*, p. 418
   3. Stem fibrillose-squamulose to subglabrous, with abrupt, napiform to strongly elongate bulb.
      4. Spores 6–7.5 μ wide. Stem with submembranous, striate ring and strongly elongate bulb. S. Australia. *A. conicobulbosa*, p. 422
      4. Spores 5–6.5 μ wide. Stem exannulate, with large napiform bulb. See *A. ochroterrea* on p. 505.

Amanita rhopalopus Bas, *nom. nov.*

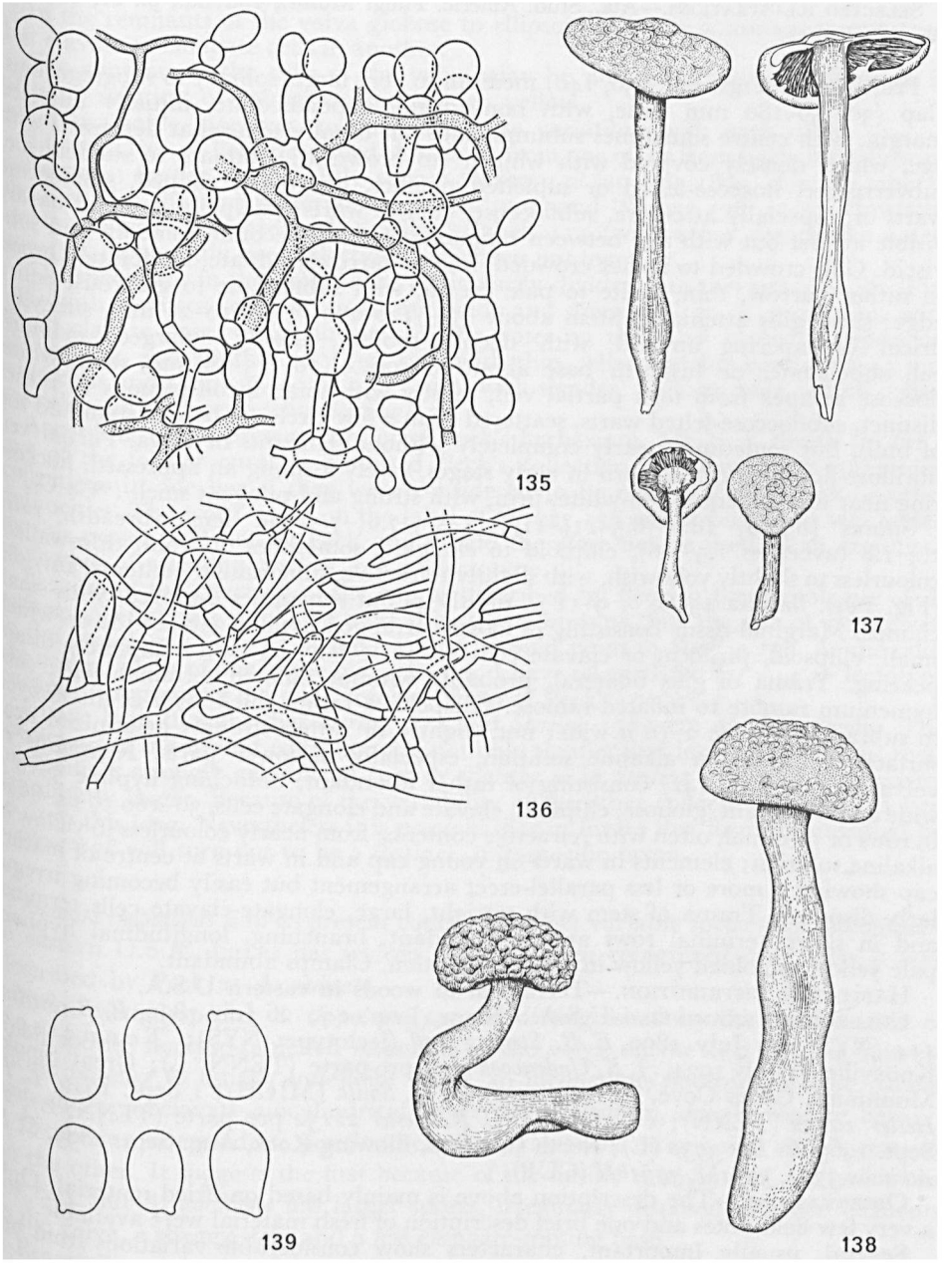
Amanita radicata Peck *in* Bull. Torrey bot. Club **27**: 609. 1900 (basionym). — *Lepiota radicata* (Peck) Morgan *in* J. Mycol. **13**: 13. 1907; non *Amanita radicata* Voglino *in* Bull. Soc. bot. ital. 1894: 120 = unknown species.

ETYMOLOGY: ῥόπᾰλον, club; πούς foot.

EXPLANATION OF FIGURES 135–139

Figs. 135, 136. *Amanita perpasta*. — 135. Crushed brown apex of volval wart from cap. — 136. Crushed tissue in white base of same wart. (Both figs. from type.)

Figs. 137–139. *Amanita rhopalopus* f. *rhopalopus*. — 137, 138. Dried fruit-bodies. — 139. Spores. (Fig. 137, from *Sterling 138*; 138, from lectotype *Sterling 114*; 139, from *Atkinson 3731*.)



Figs. 135–139

forma **rhopalopus**—Figs. 137–141

SELECTED ILLUSTRATIONS.—Atk., Stud. Americ. Fungi Mushr., 2nd Ed., pl. 21, 22. 1901 (as *A. solitaria*).

Fruit-bodies (Figs. 137, 138, 140) medium to very large, solitary to subgregarious. Cap (30–)50–180 mm wide, with non-sulcate, appendiculate, initially inflected margin, with centre sometimes subumbonate but usually somewhat depressed with age, white, densely covered with whitish (to brownish?), adnate to subdetersile, subverrucose, floccose-felted or subfelted patches, irregularly shaped, subfloccose warts or, especially at centre, subfloccose, conical warts; pileipellis dry and hardly visible at first but with age between remnants of volva becoming smooth and subviscid. Gills crowded to rather crowded, free to narrowly adnate, moderately broad to rather narrow, thin, white to pale cream, with subfloccose to glabrous, entire edge; short gills attenuate. Stem about (50–)120–200 × (4–)10–25 mm, subcylindrical or tapering upward, with deeply rooting, mostly enlarged, cylindrical, subclavate, or fusiform base about 50–100 × (10–)15–40 mm, solid, white, floccose at apex from torn partial veil, mostly with some inconspicuous to rather distinct, subfloccose-felted warts, scattered or in a few circles at base of stem and top of bulb, but sometimes nearly completely without remnants of volva. Partial veil fibrillose-floccose, usually torn in early stages, rarely forming an appressed, floccose ring near top of stem. Flesh white, firm, with strong and pungent smell ("Ca Cl_2").

Spores [85/10] (8.0–)8.5–11(–11,5) × 5.5–7.0(–7.5) μ, length-breadth ratio 1.4–1.8 (averages 1.5–1.6), ellipsoid to elongate, sometimes obovoid, thin-walled, colourless to slightly yellowish, with slightly refractive, subgranular contents, amyloid (Fig. 139). Basidia 45–60 × 9–11 μ, mostly 4- but sometimes 2-spored, with small clamps. Marginal tissue consisting of loosely arranged hyphae 3–8 μ wide on which small, ellipsoid, piriform or clavate cells 12–40 × 8–25 μ; soon completely disappearing. Trama of gills bilateral, probably without inflated terminal cells; subhymenium ramose to inflated-ramose. Pileipellis a rather thick layer of interwoven to subradial hyphae 2–10 μ wide; not, slightly, or rather strongly gelatinized near surface; yellowish in alkaline solution, especially in lower parts. Remnants of volva on cap (Fig. 141) consisting of rather abundant, branching hyphae 3–10 μ wide and abundant, globose, ellipsoid, clavate and elongate cells, 30–160 × 25–80 μ, in rows or terminal, often with refractive contents, from nearly colourless to yellow in alkaline solution; elements in warts on young cap and in warts at centre of mature cap showing a more or less parallel-erect arrangement but easily becoming irregularly disposed. Trama of stem with upright, large, elongate-clavate cells terminal and in short, terminal rows among abundant, branching, longitudinal hyphae; pale yellow to golden yellow in alkaline solution. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: New Jersey, 26 July 1899, *E. B. Sterling 114* (NYS); 29 July 1899, *E. B. Sterling 138* (lectotype: NYS); Tennessee, Knoxville, 11 July 1934, *J. K. Underwood 4074* pro parte (TENN, L); Great Smoky Mountains, Cades Cove, 13 Aug. 1938, *A. H. Smith* (MICH); 1 Sept. 1940, *L. R. Hesler 12852* (TENN); 1 Oct. 1955, *L. R. Hesler 22132* pro parte (TENN, L); 26 Sept. 1963, *C. Bas 3930* (L); North Carolina, Blowing Rock, Aug.-Sept. 1899, *G. F. Atkinson 3731, 3731bI, 3731bII* (CUP).

OBSERVATIONS.—The description above is mainly based on dried material. Only a very few field-notes and one brief description of fresh material were available.

Several, usually important, characters show considerable variations from one collection to another in *A. rhopalopus*.

In some collections the pileipellis is completely dry and the remnants of the volva

are adnate to the surface of the cap. In others the pileipellis is already distinctly gelatinized in early stages.

In the remnants of the volva globose to ellipsoid cells are dominant in one case, but clavate to elongate cells in another.

The contents of the cells of the volva may be non-refractive and colourless in alkaline solution or refractive and golden yellow.

I was unable, however, to correlate these variations with each other.

TYPIFICATION.—Peck described *A. radicata* from one of, or from both, the following collections: *Sterling 114* (26 July 1899); *Sterling 138* (29 July 1899). On the label of the box with the type material the words 'type' and '*Sterling 138*' occur. However, inside the box there are both Sterling's labels 114 (with a few descriptive notes) and 138. Apparently two collections have been put together.

The specimens in the box can be again easily divided into two sets; one set (Fig. 138) with verrucose caps up to 50 mm wide and stems 75–120 × 5–20 mm, with thick, clavate base, which in view of the notes on the label probably represents *Sterling 114*, and another set (Fig. 137) with thin, felted patches on the 20–45 mm wide caps and stems 35–90 × 3.5–7 mm, with slender, fusiform base, which consequently probably represents *Sterling 138*.

According to the present curator of Peck's herbarium, Mr. S. J. Smith (in litt.), one of the former curators mounted Peck's collection in boxes, often combining collections in one box if they were considered to be conspecific by Peck or other authorities. The word 'type' on the label of *Sterling 138* on the box-cover was added by this person and not by Peck, and should therefore not be used as an argument in favour of selecting *Sterling 138* as lectotype.

Because of the covering of the cap as described by Peck in the protologue of *A. radicata*, *Sterling 114* would be most suited for lectotype, but the size of stem given in the protologue (2.5–7.5 × 0.8—1,2 cm) would point to *Sterling 138*. As the odds are not in favour of one of the two syntypes, I have selected *Sterling 114* as lectotype because it represents the most common form of Peck's species.

I have long thought that *Sterling 114* and *Sterling 138* were not conspecific. The specimens of the second collection are not only smaller and less verrucose, but their pileipellis is strongly gelatinized (not or slightly so in *Sterling 114*) and their spores are slightly larger. Because of the variability of the other collections studied, I had to drop this idea. Nevertheless it is possible that in future the 'form' represented by *Sterling 138* will turn out to be a distinct, infraspecific taxon.

Amanita rhopalopus is in its present concept a rather variable species not uncommon in eastern U.S.A., but it has seldom or never been recognized even after it was described by Peck as *A. radicata*.

From related species *A. rhopalopus* can be distinguished by the combination of small spores, floccose-subfelted remnants of the volva on the cap forming subverrucose patches to usually indefinite warts, an incoherent, floccose-fibrillose partial veil, and a subclavate-subcylindrical to slenderly fusiform, deeply rooting base.

It takes an intermediate position between *A. smithiana* on one side and *A. ravenelii* on the other. It suggests the first because of the untidy remnants of the volva on the cap. But *A. smithiana* has larger spores, irregularly disposed, smaller elements in the volva, a shaggy stem and a less elongate-rooting base.

Especially specimens of *A. rhopalopus* with yellowish refractive elements in the volva and a dry pileipellis resemble slender specimens of *A. ravenelii*. But in that species

the conical warts at the centre of the cap are radially fibrillose. In cases of doubt the microscopical structure of the base of warts has to be studied; in *A. ravenelii* the tissue there consists nearly completely of hyphae and only scattered, sometimes very large, inflated cells.

Fortunately, the most common form of this poorly known species is very well illustrated by Atkinson (1901: pls. 21, 22); the accompanying description, however, covers more than one species.

forma **turbinata** Bas, *f. nov.*—Fig. 142

A typo differens bulbo stipitis magno turbinato vel napiforme. Typus: '*G. F. Atkinson 3731bIII*, Aug.-Sept. 1899, U.S.A., N. Carolina, Blowing Rock' (CUP).

Cap about 80–150 mm wide, convex to plano-convex with non-sulcate, appendiculate margin, covered with floccose-felted remnants of volva forming irregularly shaped, floccose warts in young and floccose-felted patches in older specimens, with age with shiny, glabrous surface between patches of volva. Gills crowded, narrowly adnate, rather narrow to moderately broad; short gills subtruncate to attenuate. Stem about 100–180 × 10–20 mm, with enormous turbinate to napiform, up to 75 × 50 mm bulb, with floccose-felted remnants of ring near top and some vague, felted, wart-like remnants of volva at base of stem and top of bulb.

Spores [20/2] 8.5–10 × 5.5–7 μ, length-breadth ratio (1.3–)1.4–1.7 (average 1.5), amyloid. Basidia 4-, rarely 2-spored, with clamps. Subhymenium inflated-ramose. Pileipellis consisting of interwoven to subradial hyphae 2–8 μ wide; gelatinized near surface. Remnants of volva on cap made up of rather scarce to rather abundant, branching hyphae 3–10 μ wide and very abundant, mostly ellipsoid, but also globose, piriform, clavate, elongate, and irregularly shaped cells up to 90 × 70 μ, mainly in irregularly disposed rows; only in warts at centre of cap a slight tendency to an upright, parallel arrangement; slightly yellowish in alkaline solution, oleiferous hyphae rare to abundant. Clamps present.

COLLECTIONS EXAMINED.—U.S.A., North Carolina, Blowing Rock, Aug.-Sept. 1899, *G. F. Atkinson 3731bIII* (type: CUP), *3731 duplicate A* (CUP).

OBSERVATION.—Field-notes are not available. The colours are probably mainly white or whitish.

This form seems to differ from typical *A. rhopalopus* only by its huge, sub-marginate, obconical bulb, but looks much different because of this character.

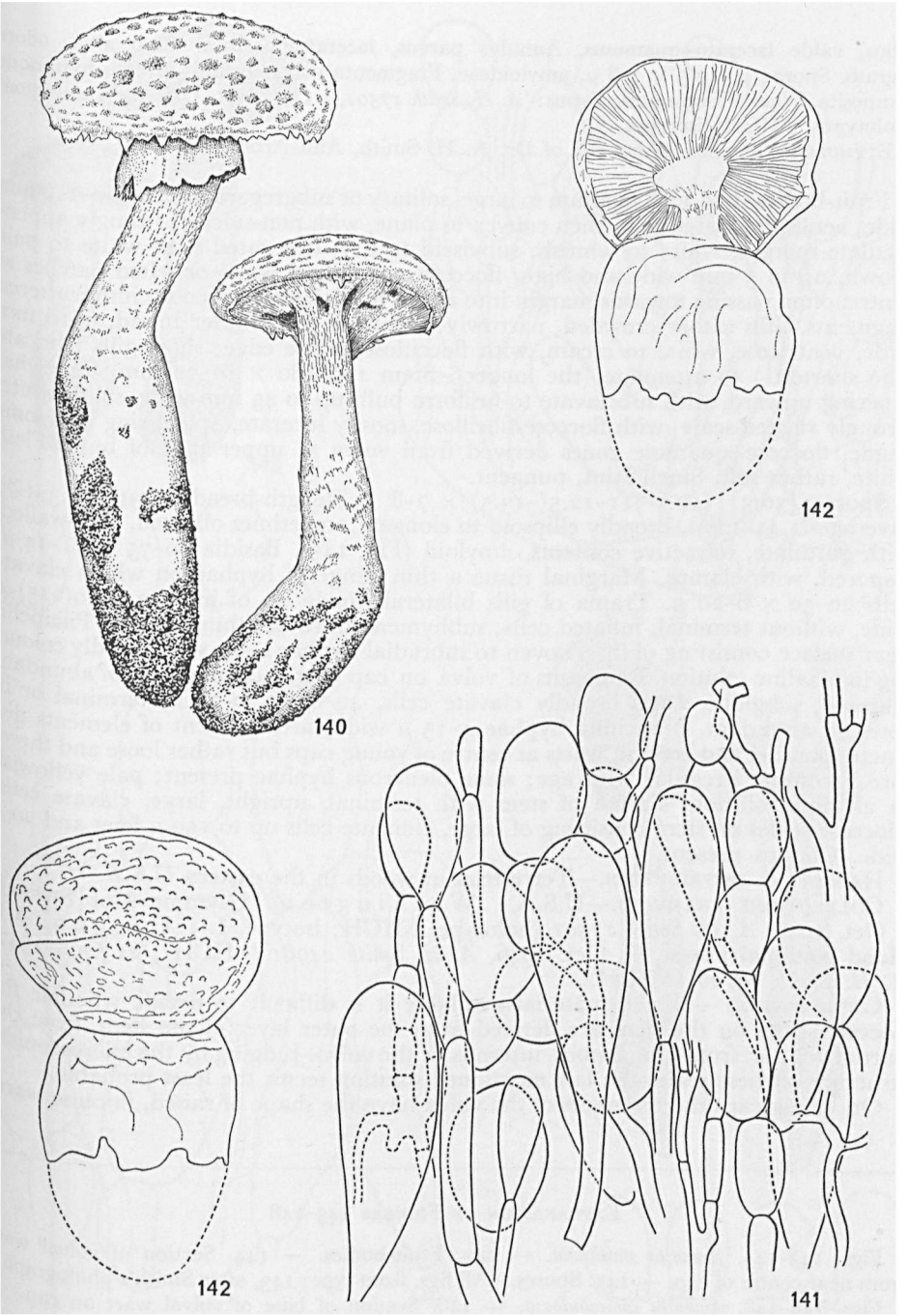
Amanita smithiana Bas, *sp. nov.*—Figs. 143–145

Pileus 60–110 mm latus, convexus vel planus, margine appendiculatus neque sulcatus, albus, subviscidus, verrucis floccosis, subconicis vel planis, albis vel brunneolis ornatus. Lamellae subconfertae, liberae vel subadnatae, modice latae, albae vel cremeae. Stipes 100–180 mm longus, 10–30 mm latus, sursum attenuatus, basi subclavatus vel fusiformis,

EXPLANATION OF FIGURES 140–142

Figs. 140, 141. *Amanita rhopalopus* f. *rhopalopus*. — 140. Fruit-bodies. — 141. Section of volval wart from cap. (Fig. 140, after photograph of *Atkinson 3731*; 141, from type.)

Fig. 142. *Amanita rhopalopus* f. *turbinata*. — Fruit-body of type.



Figs. 140–142

albus, valde lacerato-squamosus. Annulus parvus, lacerato-floccosus. Caro alba, odore ingrato. Sporae 11–12.5 × 7–8 μ, amyloideae. Fragmenta volvae cellulis diversis hyphisque composita. Fibulae frequentes. Typus: '*A. H. Smith 17501*, 2 Oct. 1941, U.S.A., Washington' (holotypus, MICH; isotypus, L).

ETYMOLOGY: Named in honour of Dr. A. H. Smith, Ann Arbor.

Fruit-bodies (Fig. 143) medium to large, solitary or subgregarious. Cap 60–110 mm wide, hemispherical at first, then convex to plane, with non-sulcate, strongly appendiculate margin, white to whitish, subviscid to dry, decorated with white to pale brown, up to 3 mm wide and high, floccose, subconical warts or felted patches at centre, often passing towards margin into a thin flocculence broken up into scattered fragments. Gills rather crowded, narrowly adnate to free, rather broad, 6–10 mm wide, ventricose, white to cream, with flocculose, white edge; short gills truncate (the shortest) to attenuate (the longer). Stem 100–180 × 10–30 mm, somewhat tapering upward, with subclavate to fusiform bulb up to 45 mm wide, solid, white, strongly ragged-scaly, with floccose-fibrillose, mostly lacerate, apical ring and some vague, floccose-squamose zones derived from volva at upper part of bulb. Flesh white, rather soft. Smell faint, pungent.

Spores [30/3] (10.5–)11–12.5(–13.5) × 7–8 μ, length-breadth ratio 1.3–1.75 (averages 1.45–1.65), broadly ellipsoid to elongate, sometimes obovoid, thin-walled, with guttulate, refractive contents, amyloid (Fig. 145). Basidia 60–75 × 11–14 μ, 4-spored, with clamps. Marginal tissue a thin fringe of hyphae on which clavate cells 20–50 × 8–20 μ. Trama of gills bilateral, made up of hyphae 3–10(–15) μ wide, without terminal, inflated cells; subhymenium rather thin, ramose. Pileipellis near surface consisting of interwoven to subradial hyphae 2–6 μ wide, hardly colouring in alkaline solution. Remnants of volva on cap (Fig. 144) made up of abundant ellipsoid, subglobose and broadly clavate cells, 40–85 × 30–75 μ, terminal or in rows on abundant, branching hyphae 4–15 μ wide; arrangement of elements distinctly parallel and erect in warts at centre of young caps but rather loose and therefore becoming irregular with age; some oleiferous hyphae present; pale yellowish in alkaline solution. Trama of stem with terminal, upright, large, clavate cells. Floccose scales on stem consisting of large, elongate cells up to 150 μ long and 20 μ wide. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in woods in the eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Washington, Olympic Hot Springs, 2 Oct. 1941, *A. H. Smith 17501* (holotype, MICH; isotype, L); Oregon, Mt. Hood National Forest, 25 Oct. 1946, *A. H. Smith 24981* (MICH); 21 Oct. 1947, *A. H. Smith 28106* (MICH).

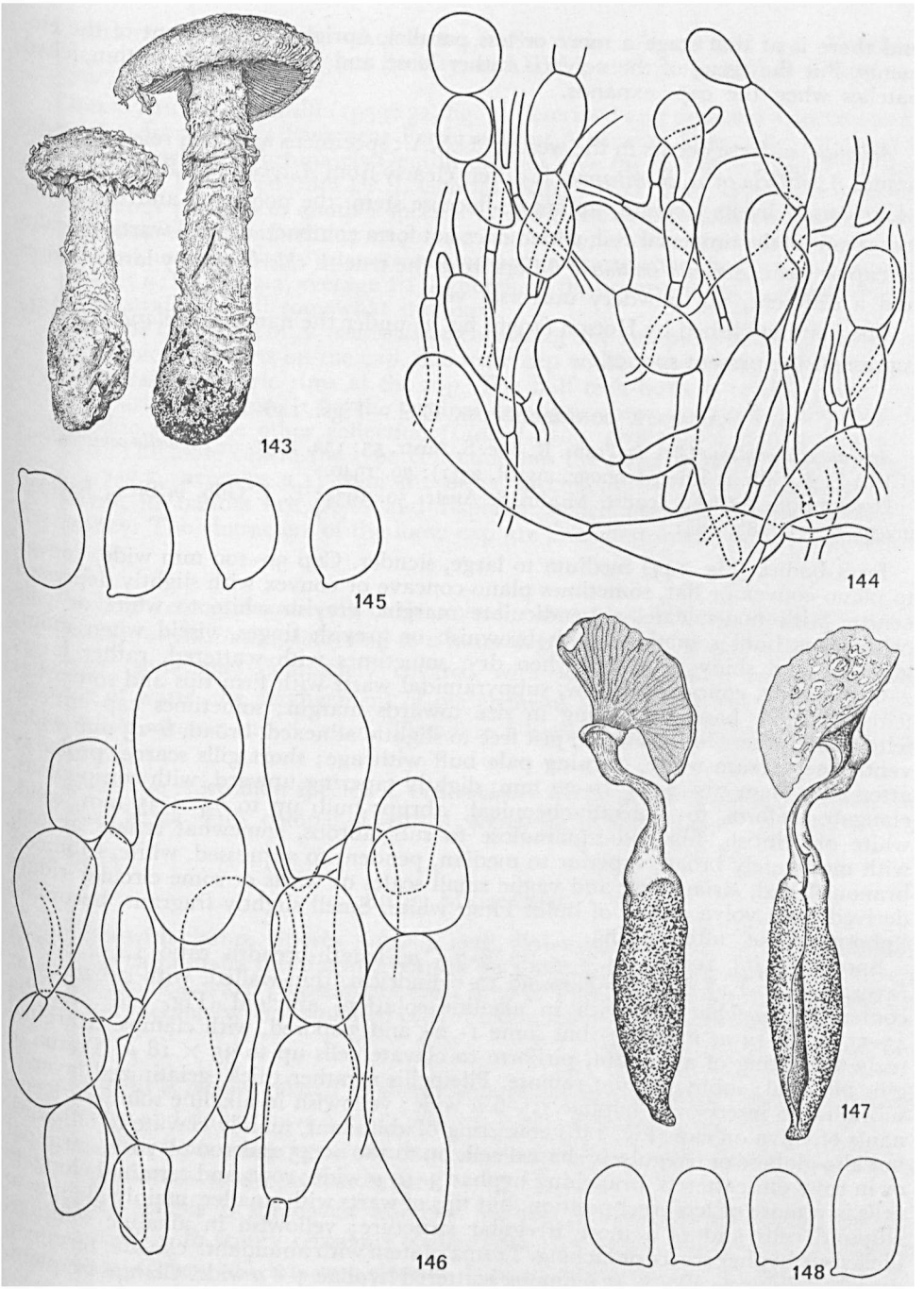
OBSERVATIONS.—In the material available it is difficult to decide whether the floccose scales on the stem are derived from the outer layer of the stem, from the partial veil, or from the limbus internus of the volva. Judging by the microscopical structure of these scales the last mentioned solution seems the least probable.

On young caps the remnants of the volva have the shape of raised, floccose warts

EXPLANATION OF FIGURES 143–148

Figs. 143–145. *Amanita smithiana*. — 143. Fruit-bodies. — 144. Section of volval wart from near centre of cap. — 145. Spores. (All figs. from type; 143, after Smith's photograph.)

Figs. 146–148. *Amanita conicobulbosa*. — 146. Section of base of volval wart on cap. — 147. Dried fruit-body. — 148. Spores. (All figs. from type.)



Figs. 143–148

and there is at that stage a more or less parallel, upright arrangement of the elements. But the tissue of the volva is rather loose and flattens easily to thin, felted patches when the caps expands.

Amanita smithiana occurs in the western U.S.A.; specimens are often referred to the names *A. solitaria* or *A. chlorinosma*. It differs clearly from *A. cokeri* (the East American '*A. solitaria*') by its lacerate, squamose-floccose stem, the poor ring and the rather loose tissue of the universal veil, which does not form compact, conical warts or scales on cap or stem. *Amanita smithiana* differs from the true *A. chlorinosma* by larger spores and a different, not powdery universal veil.

The plate published by Hotson (1936: fig. 3) under the name *A. solitaria* probably represents the present species.

AMANITA CONICOBULBOSA Clel.—Figs. 146–148

Amanita conicobulbosa Clel. *in* Trans. R. Soc. S. Austr. **55**: 152. 1931. — *Aspidella conicobulbosa* (Clel.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27**(1): 79. 1940.

DESCRIPTIONS.—Clel., Toadst. Mushr. S. Austr. 50. 1934; E. J. Gilb. *in* Bres., Iconogr. mycol. **27**(2): 387. 1941.

Fruit-bodies (Fig. 147) medium to large, slender. Cap 50–100 mm wide, convex to plano-convex or flat, sometimes plano-concave or convex with slightly depressed centre, with non-sulcate, appendiculate margin, greyish white to white or pale ochraceous buff, sometimes with brownish or greyish tinges, viscid when moist, glabrous and shiny in places when dry, sometimes with scattered, rather large, 2–6 mm wide, concolorous, low, subpyramidal warts with firm tips and somewhat felted-fibrillose base, decreasing in size towards margin; sometimes cap entirely felted-flocculose. Gills crowded, just free to slightly adnexed, broad, 6–13 mm wide, ventricose, cream-white, turning pale buff with age; short gills scarce, probably attenuate. Stem 75–125 × 10–22 mm, slightly tapering upward, with conspicuous, elongate-fusiform to elongate-obconical, abrupt bulb up to 75 × 35 mm, solid, white or whitish, fibrillose-squamulose to subglabrous, somewhat striate at top, with moderately broad, superior to median, pendent to appressed, white, submembranous-felted, striate ring and vague small scales or warts or some circular ridges derived from volva at top of bulb. Flesh white. Smell slightly fragrant, becoming "phosphor-like" after cutting.

Spores [35/5] 10–13(–14.5) × (5–)6–7.5 μ, length-breadth ratio 1.4–2.2(–2.5) (averages 1.7–2.1), broadly ellipsoid to cylindrical, thin-walled, with subgranular contents, somewhat yellowish in alkaline solution, amyloid (Fig. 148). Basidia 45–55 × 10–13 μ, mostly 4- but some 1-, 2-, and 3-spored, with clamps. Marginal tissue consisting of abundant, piriform to clavate cells up to 35 × 18 μ. Trama of gills bilateral; subhymenium ramose. Pileipellis a rather thick, gelatinized layer of subradial to interwoven hyphae 1.5–6 μ wide; yellowish in alkaline solution. Remnants of volva on cap (Fig. 146) consisting of abundant, mainly clavate to ellipsoid, but also globose or irregularly shaped cells up to 180 × 45 and 100 × 70 μ, terminal or in rows on scattered, branching hyphae 3–10 μ wide; rows and terminal elongate cells in a more or less erect position, but tips of warts with smaller, mainly globose to ellipsoid cells and of a more irregular structure; yellowish in alkaline solution; oleiferous hyphae scarce or lacking. Trama of stem with abundant, clavate, terminal, upright cells up to 380 × 45 μ among scattered hyphae 3–8 μ wide. Clamps frequent.

HABITAT & DISTRIBUTION.—Terrestrial in South Australia.

COLLECTIONS EXAMINED.—AUSTRALIA, South Australia, Kinchina, without date, *J. B. Cleland 9202* (lectotype: ADW); 10 Oct. 1925, *J. B. Cleland 9203* (ADW).

OBSERVATIONS.—Gentilli (1953: 32, fig. 4) described and depicted a species under this name from King's Park near Perth in West Australia. This could very well be Cleland's species. Unfortunately Gentilli did not give the size of the spores. A specimen which I received from Dr. J. Gentilli (King's Park, July 1953) as *A. conicobulbosa* belongs perhaps to another species. It has a somewhat different type of volva with globose to ellipsoid cells up to 70 × 60 μ in terminal or irregularly disposed, short rows on abundant, loosely interwoven hyphae, and somewhat smaller spores (9.5–12 × 4.5–5.5 μ; l/b 1.8–2.3, average 2.1). Therefore, the occurrence of *A. conicobulbosa* in West Australia is still somewhat dubious.

The type collection of *A. conicobulbosa* consists of one complete half of a fruit-body with conspicuous warts on the cap, one loose cap without warts and one loose bulb with several concentric rims at the top. The half fruit-body is certainly the most typical part of the type. It fits the original description very well and is undoubtedly conspecific with the other collection (*Cleland 9203*, probably a syntype) which I studied. The loose cap in the type collection has the spores distinctly more slender (l/b 1.7–2.5, average 2.1) than the other specimens (l/b 1.4–2.0, average 1.7). However, its basidia are 4-, 2- and 1-spored, which may be the reason for this aberrancy. The characters of the loose cap are included in the description above.

The large, erect, clavate cells in the volval remnants on the cap resemble those in *A. solitaria* (= *A. echinocephala*) and to a lesser degree those in *A. cokeri*. As the cap is, however, sometimes completely covered with felted-flocculose volval remnants instead of warts, the arrangement of the elements seems to be considerably looser than in *A. solitaria* and *A. cokeri*. Therefore I have placed *A. conicobulbosa* in stirps *Rhopalopus*.

Among the Australian species *A. conicobulbosa* seems to stand rather isolated, but it should be carefully compared with *A. ochroterrea* in stirps *Grossa* (p. 505).

Stirps MICROLEPIS

Basidia with clamps. Spores 7–11.5 μ long, globose to elongate, rarely cylindrical. Volva on cap usually forming medium to very small, sometimes adnate but mostly detersile, conical warts consisting of erect rows of small to medium, mainly ellipsoid cells on branching hyphae; inflated cells also dominant in base of warts.

This stirps is closely related to stirps *Solitaria* but in general the warts on the cap are smaller and do not have a base in which hyphae are dominant.

Stirps *Microlepis* comprises a continuous series of species with the volva ranging from pure white to deeply coloured.

Amanita abrupta is somewhat aberrant because of the usually large, abrupt, globose bulb with scanty remnants of the volva and partly globose spores. *Amanita nitida* sensu Coker, which is very close to *A. onusta*, has strikingly slender spores, viz. elongate to subcylindrical.

KEY TO THE SPECIES OF STIRPS *Microlepis*

1. Warts on cap white or whitish, sometimes brownish cream or greyish but then concolorous with cap.
   2. Remnants of volva at base of stem forming medium to very small recurving scales.
      3. Gills dingy cream to buff or greenish cream to greenish yellow. Stem without long root-like extension.
         4. Gills without greenish tinges. Stem with subglobose, ellipsoid, or subnapiform bulb with rows of small, recurving scales. Eastern U.S.A. *A. microlepis*, p. 424
         4. Gills with greenish tinges. Stem with clavate to fusiform, rarely napiform bulb and usually with medium-sized, recurving scales. See *A. solitaria* on p. 394.
      3. Gills white or cream. Stem with long root-like extension. See *A. gracilior* on p. 436.
   2. Remnants of volva at base of stem forming rows of small conical warts or vague ridges.
      5. Stem with large, abrupt, globose bulb with vague ridges of volva. Ring prominent. U.S.A. *A. abrupta*, p. 432
      5. Stem with clavate base with rows of small conical warts. Ring absent. See *A. virgineoides* on p. 434.
1. Warts on cap pale brown, pinkish brown, yellowish brown, grey-brown, pale grey, or dark grey, darker than background except sometimes at very centre of cap.
   6. Spores 7–11 × 5.5–8 μ, average l/b 1.1–1.7. Medium to large species.
      7. Spores 7–9 × 5.5–7 μ, subglobose to broadly ellipsoid, average l/b 1.1–1.25. Flesh turning pinkish. See *A. timida* on p. 389.
      7. Spores 8–11 × 5.5–8 μ, broadly ellipsoid to elongate, average l/b 1.3–1.7. Flesh unchanging or turning yellowish.
         8. Volva thick, dark grey to grey-brown, forming crowded, medium to small warts on cap. Ring usually friable. Stem often with rooting base. Eastern U.S.A. *A. onusta*, p. 428
         8. Volva rather thin, pale brown, yellowish brown, reddish brown, or grey brown, forming small, scattered warts on cap. Ring submembranous. Stem usually with napiform base. N. America. *A. atkinsoniana*, p. 427
   6. Spores 10–14.5 × 5.5–7 μ, average l/b 1.9–2.1. Small species with grey warts on cap. Eastern U.S.A. *A. nitida* sensu Coker, p. 431

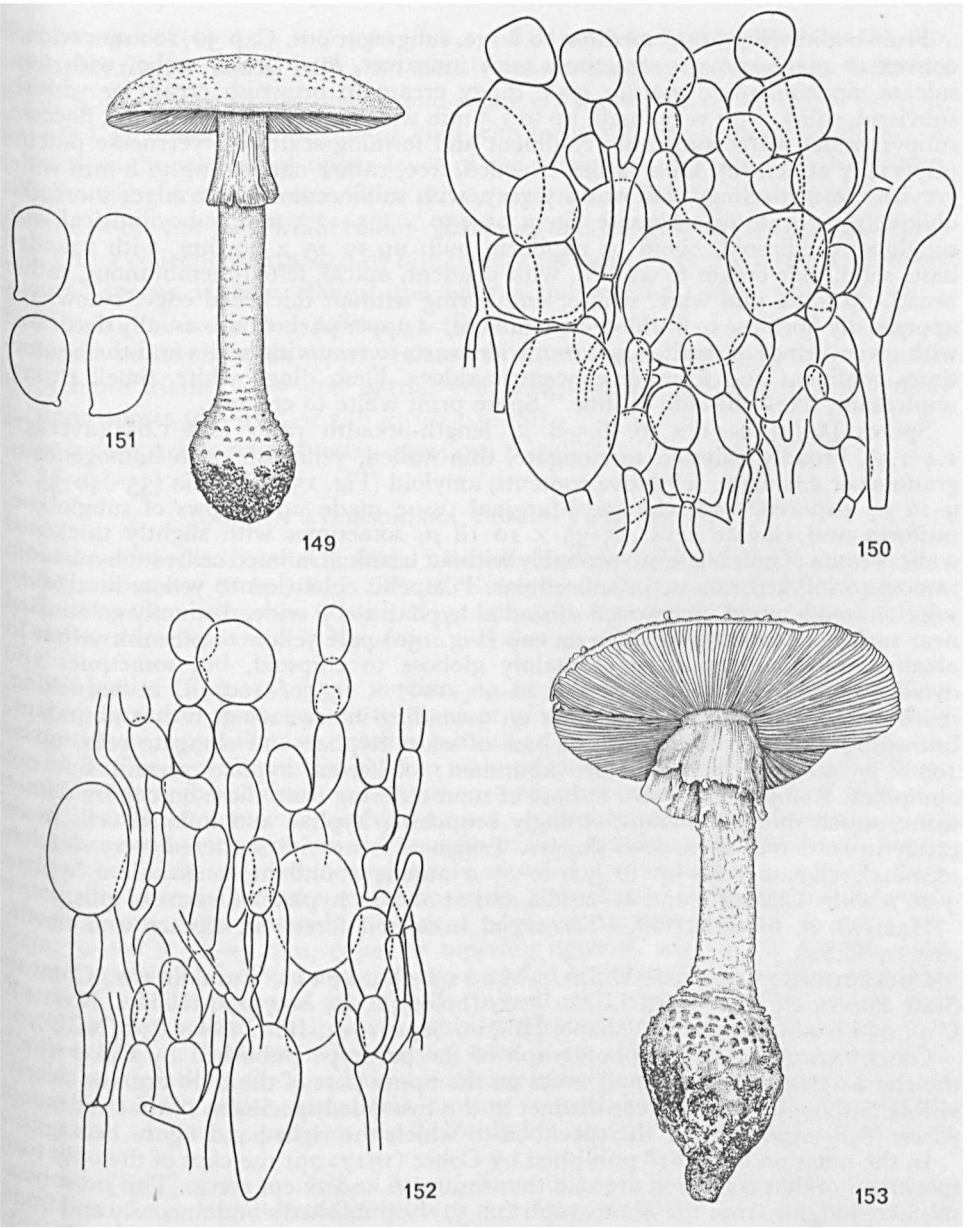
Amanita microlepis Bas, *sp. nov.*—Figs. 149–151

Pileus 50–120 mm latus, convexus vel plano-convexus, interdum subumbonatus, margine appendiculatus neque sulcatus, sordide cremeus vel pallide brunneo-cremeus vel albidus, subviscidus, verrucis floccosis, subconicis, concoloribus, interdum confluentibus ornatus. Lamellae subconfertae, liberae, subangustae, usque ad 8 mm latae, sordide cremeae vel sordide bubalinae. Stipes 95–150 × 6.5–12.5 mm, subcylindraceus, basi subglobosus vel napiformis et usque ad 30 mm latus, solidus, pallide cremeus vel albidus, annulatus, fibrillosus vel fibrilloso-subsquamulosus, basi fragmentis volvae minutis verruciformibus concentrice ornatus. Caro sordide alba, odore *A. chlorinosmae* praedita.

Sporae 9–11 × 6.5–8 μ, subellipsoideae vel elongato-ellipsoideae, amyloideae. Fragmenta volvae cellulis diversis hyphisque composita. Fibulae praesentes. Typus: '*C. Bas 3784*, 24 Aug. 1963, Massachusetts, Conway State Forest' (holotype, L; isotype, MICH).

ETYMOLOGY: μικρός, small; λεπίς, scale.

DESCRIPTIONS & ILLUSTRATIONS.—Coker *in* J. Elisha Mitchell scient. Soc. **33**: 79, 82 (notes on *Coker 858*), pl. 57 ('*A. clorinosma* form A') and probably also notes on *Coker 792* on p. 79, *Coker 729* (read 792?) on p. 81, and *Coker 1320* on p. 82. 1917.



Figs. 149–151. *Amanita microlepis*. — 149. Fruit-body (after dried specimen and Coker, 1917: pl. 57). — 150. Section of volval wart from near centre of cap. — 151. Spores. (Figs. 149, from *Coker 858*; 150, 151, from type.)

Figs. 152, 153. *Amanita atkinsoniana*. — 152. Section of volval wart from cap. — 153. Fruit-body. (Figs. 152, from type; 153, after photograph of *Smith 64127*.)

Fruit-bodies (Fig. 149) medium to large, subgregarious. Cap 50–120 mm wide,[57] convex to plano-convex, sometimes with indistinct, low, broad umbo, with non-sulcate, appendiculate margin, pale dingy cream to brownish cream or whitish, subviscid, shiny, with very small, up to 1.5 mm wide and high, concolorous, floccose, subpyramidal warts sometimes confluent and forming scattered, verrucose patches (especially at centre). Gills rather crowded, free, rather narrow, up to 8 mm wide, greyish cream to dingy buff or ashy grey, with subflocculose, pale edge; short gills obliquely truncate to attenuate. Stem 95–150 × 6.5–12.5 mm, subcylindrical with subglobose, ellipsoid, ovoid or napiform bulb up to 45 × 30 mm, with rounded base, solid, pale cream to whitish, with pendent, apical, felted-membranous, rather broad, up to 22 mm wide, striate, simple ring without thickened edge, below ring appressedly fibrillose to fibrillose-squamulose, at upper part of bulb usually decorated with several rings of small, 0.5–2 mm wide warts to recurving scales and these sometimes confluent and forming concentric ridges. Flesh dingy white. Smell strong, unpleasant, like "chloride of lime." Spore print white to cream.

Spores [50/4] 9–11 × (6–)6.5–8 μ, length-breadth ratio 1.25–1.65 (averages 1.4–1.5), broadly ellipsoid to elongate, thin-walled, yellowish, with homogeneous, granular or guttulate, refractive contents, amyloid (Fig. 151). Basidia (35–)40–55 × 9–12 μ, 4-spored, with clamps. Marginal tissue made up of rows of subglobose, piriform and clavate cells, 15–35 × 10–18 μ, sometimes with slightly thickened walls. Trama of gills bilateral, probably without terminal inflated cells; subhymenium ramose to inflated ramose or subcellular. Pileipellis colourless to yellow in alkaline solution, made up of interwoven subradial hyphae 2–7 μ wide, distinctly gelatinized near surface. Remnants of volva on cap (Fig. 150) pale yellow to greenish yellow in alkaline solution, consisting of mainly globose to ellipsoid, but sometimes also ovoid, clavate and elongate cells, 20–90(–120) × 15–70(–100) μ, in branching, more or less erect, subparallel rows on ascending-interweaving, rather abundant, branching hyphae 3–8 μ wide; in base of warts hyphae and elongate cells, up to 100 × 25–50 μ, relatively more abundant; oleiferous hyphae present but not abundant. Remnants of volva at base of stem differing from those on cap by denser tissue, much more abundant, strongly branching hyphae and inflated cells more rarely in rows and these rows shorter. Trama of stem with scattered, very slender, terminal, clavate cells up to 300 × 25 μ among abundant, longitudinal hyphae 3–10 μ wide. Clamps found at basidia and at narrow hyphae of trama of gills.

HABITAT & DISTRIBUTION.—Terrestrial in mixed forests in eastern and north-eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Massachusetts, Franklin Co., Conway State Forest, 23 Aug. 1963, *C. Bas 3784* (holotype, L; isotype, MICH); North Carolina, Orange Co., Chapel Hill, 29 Sept. 1913, *W. C. Coker 858* (NCU).

OBSERVATIONS.—On the photograph of the paratype published by Coker (l.c.) the characteristic rings of small warts on the upper part of the bulb are not clearly visible, although they are very distinct in the two dried specimens of that collection *(Coker 858)* especially in the specimen to which the right-hand figure belongs.

In the notes on *Coker 858* published by Coker (1917: 79) the caps of the only two specimens of that collection are said to measure 16 and 22 cm across. This must be a mistake, judging from the photograph (pl. 57) he published simultaneously and from the present size of the dried fruit-bodies.

In many respects *Amanita microlepis* is intermediate between *A. cokeri* (p. 390) and *A. abrupta* (p. 432), all occurring in the same regions. *Amanita cokeri* has larger, more

[57] See observations.

elongate spores (11–13.5 × 7–9 μ; l/b 1.4–1.8), larger and firmer warts on the cap, a complex ring, a rooting bulb with usually coarser warts or scales and an indistinct smell, while *A. abrupta* has smaller and relatively shorter spores (7–9.5 × 6–8.5 μ; l/b 1.0–1.4), a larger, more globose bulb with inconspicuous remnants of the volva, a less strongly gelatinized upper layer of the pileipellis, and an indistinct smell.

Coker (l.c.) arranged material of *A. microlepis* under his '*A. chlorinosma* form A' because of the not pure white colour of the cap and the greyish cream to ashy grey gills. Other collections arranged by him under that name belong to a usually stronger coloured species without clamps and with a pulverulent partial veil and volva, described in this work as *A. pelioma* (p. 465).

Amanita microlepis is not closely related to *A. chlorinosma* (p. 450), which species has a more friable volva and partial veil, and slightly smaller but considerably slenderer spores (8.5–10.5 × 5–6 μ; l/b 1.5–2.0).

For a comparison with *A. atkinsoniana* see, p. 428.

AMANITA ATKINSONIANA Coker—Figs. 152–156

Amanita atkinsoniana Coker *in* J. Elisha Mitchell scient. Soc. **33**: 84, pls. 58, 59. 1917. — *Lepidella atkinsoniana* (Coker) E. J. Gilb. & Kühner *in* Bull. Soc. mycol. France **44**: 151. 1928. — *Armillaria atkinsoniana* (Coker) Locquin *in* Bull. Soc. mycol. France **68**: 167. 1952.

DESCRIPTION.—Pomerleau *in* Naturaliste canadien **93**: 884. 1966.

Fruit-bodies (Figs. 153–155) medium to large, solitary or subgregarious. Cap 70–100(–130) mm wide, convex to plane or plano-concave, with smooth or faintly striate-sulcate, appendiculate margin, whitish to pallid, brownish buff, avellaneous, greyish buff or greyish, usually paler to white at margin, rarely with yellowish tinge, minutely felted to subviscid, at centre covered with small, 0.5–1.5 mm high and broad, adnate to detersile, reddish-brown, pale brown or grey-brown, conical, sometimes confluent warts towards margin passing into squamules or small, floccu-lose patches. Gills crowded to moderately crowded, free to narrowly adnate, mod-erately broad to rather narrow, cream-white, sometimes staining reddish-brownish or ochraceous, with minutely flocculose edge; short gills truncate to attenuate. Stem 70–200 × 10–25 mm, equal or tapering upward, with up to 40 mm wide, clavate, ventricose-fusiform or napiform, rounded or pointed bulb, whitish to pallid, flocculose, middle part and top of bulb covered with rings of reddish brown, pale brown or grey-brown, small warts to scales upward decreasing in size to minute floccose scales or flocks on lower part of stem. Ring apical, submembranous-felted, fragile, striate above, floccose below, with age usually collapsing on stem as a thin membrane. Flesh white, sometimes turning somewhat yellowish, rarely pinkish, with weak to strong, pungent smell ("chloride of lime"). Spore print white to pale cream.

Spores [65/7] 9–10.5(–12.5) × 5.5–7(–8) μ (7.4–9.2 × 5.5–7.4 μ according to Pomerleau, l.c.), length-breadth ratio 1.35–1.85 (averages 1.45–1.7), ellipsoid to elongate, thin-walled, colourless, with multi-guttulate contents, amyloid (Fig. 156). Basidia 40–60 × 9–13 μ, 4-spored, with clamps. Marginal tissue consisting mainly of abundant, ellipsoid to clavate cells, 16–40(–50) × 8–30 μ, partly in rows. Trama of gills bilateral; diverging hyphae up to 20 μ wide; hymenopodial cells up to 50 × 35 μ; subhymenium ramose to subcellular. Pileipellis consisting of interwoven to subradial hyphae (2–)4–10 μ wide, slightly to strongly gelatinized near surface, yellowish to

yellow in alkaline solution. Remnants of volva on cap (Fig. 152) a dense tissue of erect, rather long rows of mainly subglobose to ellipsoid, but also clavate and elongate cells up to 70 × 45 μ, on rather scarce hyphae about 4–8 μ wide; dingy yellow-brown in alkaline solution; with scattered to abundant oleiferous elements. Trama of stem consisting of abundant, large, clavate, erect, terminal cells and scattered hyphae. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern and southern U.S.A.; also reported from south-eastern Canada (Pomerleau, l.c.).

COLLECTIONS EXAMINED.—U.S.A.: Massachusetts, Mt. Toby, 25 Aug. 1963, *C. Bas 3801* (L); Michigan: Highlands, Haven Hill, 16 Sept. 1961, *A. H. Smith 64290* (MICH); 23 Sept. 1961, *A. H. Smith 64412* (MICH); Pickny Resort Area, 7 Oct. 1961, *A. H. Smith 64127* (MICH); Washtenaw Co., Mill Lake, 17 Sept. 1965, *A. H. Smith 72631* (MICH, L); North Carolina, Chapel Hill, Battle's Park, 14 Sept. 1913, *W. C. Coker 759* pro parte (holotype: NCU); Alabama, Elmore Co., 3 Dec. 1921, *Burke* (MICH).

OBSERVATIONS.—The type collection, *Coker 759*, consists of 3 specimens. Only one of these fits the original description. One of the other two specimens belongs to *A. cokeri*, the second, a young fruit-body without spores, probably to *A. rhopalopus*.

Because of the coloured volva *A. atkinsoniana* from eastern North America resembles *A. onusta*, which occurs in the same area, but *A. atkinsoniana* has a thinner volva breaking up earlier into smaller, more scattered warts which have more brownish and fewer greyish tinges than those in *A. onusta*. Moreover its pileipellis shows a stronger tendency to gelatinize and under the microscope the cells of the volva are paler than in *A. onusta* and usually intermixed with more abundant oleiferous elements In addition the ring of *A. atkinsoniana* is more coherent and the base of the stem rarely rooting.

Pale forms of *A. atkinsoniana* strongly resemble *A. microlepis*, also occurring in the same regions, but that species has a whitish to brownish cream or dingy cream cap with concolorous warts and greyish cream, dingy buff or ashy grey gills, whereas *A. atkinsoniana* has cream-white gills.

AMANITA ONUSTA (Howe) Sacc.—Figs. 157–160

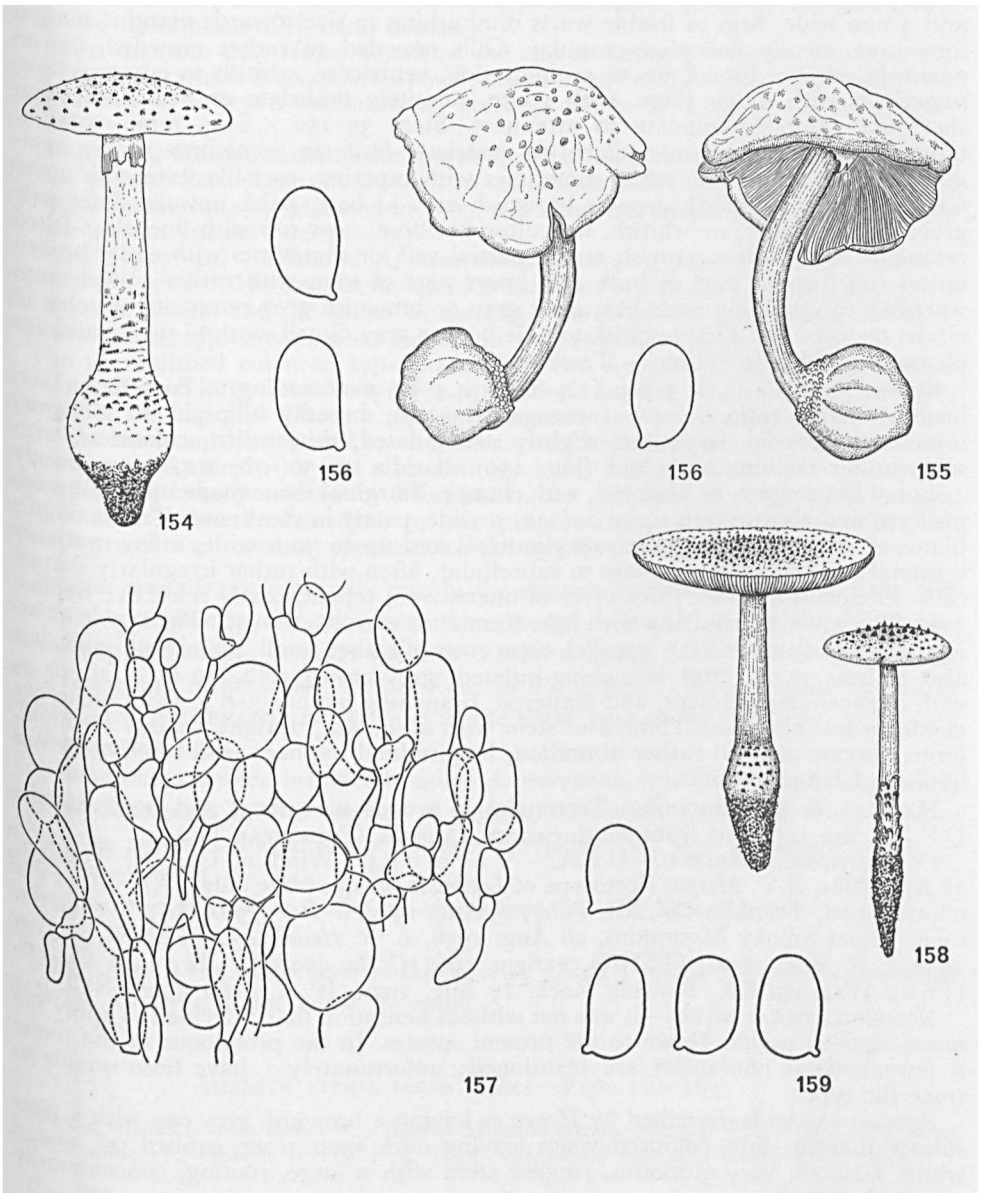
Agaricus onustus Howe *in* Bull. Torrey bot. Club **5**: 42. 1874. — *Amanita onusta* (Howe) Sacc., Syll. Fung. **9**: 1. 1891.

Lepiota drymonia Morgan *in* J. Mycol. **13**: 13. 1907. — Lectotype: Morgan's unpublished water-colour (IA).

NAMES MISAPPLIED TO THE PRESENT SPECIES.—*Amanita cinereoconia* Atk. *sensu* Hesler *in* J. Tennessee Acad. Sc. **12**: 242. 1937; *sensu* Bigelow *in* Rhodora **61**: 127. 1959; *sensu* Pomerleau *in* Naturaliste canadien **93**: 885. 1966. — *Amanita chlorinosma* f. *cinereoconia* (Atk.) E. J. Gilb. *sensu* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 395. 1941.

DESCRIPTIONS & ILLUSTRATIONS.—Bigelow, op. cit. p. 129; Hesler, op. cit. fig. 1; Morgan *in* J. Mycol. **3**: 32. 1887; Peck *in* Rep. New York St. Mus. nat. Hist. **53**: 826, 839. 1900; Pomerleau, op. cit. pl. 1.

Fruit-bodies (Figs. 158, 160) small to medium, rarely large, slender, solitary or subgregarious. Cap 25–100(–150) mm wide, convex to flat or concave, sometimes with low, broad umbo, with non-sulcate, appendiculate margin, dry to subviscid, grey, pale grey or dingy whitish, covered with adnate, dark grey to brownish grey



Figs. 154–156. *Amanita atkinsoniana*. — 154. Fruit-body. — 155. Dried fruit-body. — 156. Spores. (Fig. 154, from *Bas 3801*; 155, 156, from type.)

Figs. 157–159. *Amanita onusta*. — 157. Section of volval wart from cap. — 158. Fruit-bodies. — 159. Spores. (Fig. 157, from *Bas 3908*; 158, 159, from *Bas 3798A*.)

or grey-brown, conical to irregularly shaped, rather small to large, up to 4 mm high and 3 mm wide, firm to friable warts diminishing in size towards margin; margin sometimes merely flocculose-granular. Gills crowded to rather crowded, free to narrowly adnate, broad, up to 10 mm wide, ventricose, whitish to cream-yellow, sometimes with dingy tinge, with white, minutely fimbriate or flocculose edge; short gills rounded-truncate to attenuate. Stem 35–150 × 6–15 mm, equal or tapering upward, with subfusiform to ventricose-fusiform, sometimes nearly napiform base up to 40 mm wide, sometimes with tapering, root-like extension up to 60 mm long, solid, dark grey or brownish grey at base, paler upward, later pale grey, brownish grey, or whitish, flocculose-fibrillose, near top with flocculose-felted remnants of whitish to greyish cream partial veil, or sometimes with easily broken apical ring; upper part of bulb and lower part of stem with rather conspicuous, wart-like to recurving scale-like, dark grey or brownish grey remnants of volva in circles or scattered. Flesh whitish to pale buff or grey. Smell weak to strong and unpleasant ("chloride of lime"). Taste weak.

Spores [60/6] 8–11 × 5–8 μ (7.4–8.5 × 4.4–5.5 μ according to Pomerleau, l.c.), length-breadth ratio 1.2–2.0 (averages 1.3–1.7), broadly ellipsoid to elongate, sometimes obovoid, sometimes slightly strangulated, thin-walled, colourless, with subgranular contents, amyloid (Fig. 159). Basidia 40–50(–70) × 9–12 μ, mostly 4-spored but some 2- or 3-spored, with clamps. Marginal tissue made up of ellipsoid, piriform and clavate cells up to 20(–30) μ wide, partly in short rows. Trama of gills bilateral, with diverging cells subcylindrical and up to 30 μ wide, a few probably terminal; subhymenium ramose to subcellular, often with rather irregularly shaped cells. Pileipellis a rather thick layer of interwoven, repent, partly refractive hyphae 2–5(–8) μ wide, gelatinizing with age. Remnants of volva on cap (Fig. 157) consisting mainly of rather long, parallel, erect rows of rather small, mainly ellipsoid, but also globose, ovoid, and branching-inflated, grey-brown cells, 20–60 × 20–40 μ, with intracellular pigment, and scattered, branching hyphae 3–8 μ wide; oleiferous elements not abundant. Trama of stem with abundant, upright, mainly terminal, large, clavate cells on rather abundant, longitudinal hyphae; with some oleiferous hyphae. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern and north-eastern U.S.A.; also reported from south-eastern Canada (Pomerleau, l.c.).

COLLECTIONS EXAMINED.—U.S.A.: Vermont, Windsor Co., N. Pomfret, 18 Aug. 1881, *A. P. Morgan* (lectotype of *Lepiota drymonia*: plate only, IA); Massachusetts, Franklin Co., Mt. Toby, 25 Aug. 1963, *C. Bas 3798A* (L); Tennessee, Great Smoky Mountains, 26 Aug. 1936, *L. R. Hesler 9051* (TENN), 9 Aug. 1953, *L. R. Hesler 20962* (TENN), 23 Sept. 1963, *C. Bas 3908* (L); North Carolina, Watauga Co., Blowing Rock, 17 Aug. 1922, *W. C. Coker 5520* (NCU).

NOMENCLATURAL NOTE.—It was not without hesitation that I decided to apply the name *Agaricus onustus* Howe to the present species. In the protologue of the name a few aberrant characters are mentioned; unfortunately I have been unable to trace the type.

Agaricus onustus is described by Howe as having a brownish grey cap with a non-sulcate margin, dust coloured warts leaving dark spots when rubbed off, and a white, farinose, very glutinous, ringless stem with a large, rooting, concentrically squamulose bulb.

This description applied fairly well to the present species, except for the glutinous stem, which is a very unusual feature for any species of *Amanita*. It is remarkable that the stem is at the same time said to be farinose. I am of the opinion that these two seemingly contradictory characters refer to the subfloccose remnants of the creamy to friable ring, which in the present species sometimes covers the whole stem and

sticks to the fingers when touched. This interpretation was given by Morgan (1887: 32) in his description of *Agaricus onustus*.

I must mention that Howe described the cap as being 5–6 inches (about 12.5–15.5 cm) wide, which is considerably wider than in any of the specimens I examined. Now and then, however, extraordinary large specimens of nearly all species of agarics are found.

In applying Howe's name to the species described above, I am following Morgan (1887: 32) and Peck (1900: 826, 839; two collections in NYS). After the publication of *Amanita cinereoconia* by Atkinson in 1909, this name has frequently been misapplied to the present species (see p. 463).

Coker (1917: 40) considered *Agaricus onustus* Howe to be a synonym of *Amanita muscaria* (L. per Fr.) Hooker. In my opinion this view is difficult to defend because of the smooth margin and the colour of the cap. Also in North American forms of *A. muscaria* the margin is somewhat sulcate in well-expanded caps.

The unpublished coloured type plate of *Lepiota drymonia* Morgan is an artistic drawing of one large fruit-body of a species of *Amanita* with an appendiculate margin of the cap and lilaceous grey-brown, more or less pyramidal to recurving scale-like warts on the cap and on the ventricose-fusiform bulbous base of the stem. It has a ragged apical ring and a squamulose lower half of the stem. The type specimen has not been preserved by Morgan. In the published description the colour of the volva is described as drab to pale umber. I am convinced that Morgan's plate represents a luxuriant specimen of the species described above.

Amanita onusta is not especially rare in the eastern and north-eastern U.S.A. It is a very charcteristic species because of the crowded, more or less conical, grey warts on the cap and similar or paler warts or recurving scales at the base of the stem. It often occurs in a rather small, slender form with a slender, deeply rooting base, and conspicuous, narrow, recurving scales at the lower part of the stem and upper part of the rooting base.

Amanita onusta is often incorrectly called *A. cinereoconia* Atk. However, that species is easy to distinguish by the absence of clamps, its usually somewhat more slender spores, its powdery-flocculose to powdery-verrucose cap, and the absence of true warts or scales at the base of the stem.

See also the discussions under *A. atkinsoniana* (p. 428) and *A. nitida* sensu Coker (p. 432).

Judging by a few collections of this species which I found among his unnamed material, Coker did not know *A. onusta*.

AMANITA NITIDA sensu Coker—Figs. 161–163

Amanita nitida Fr. *sensu* Coker *in* J. Elisha Mitchell scient. Soc. **33**: 87, pl. 69. 1917; non *Amanita nitida* Fr., Observ. mycol. **1**: 4. 1815 = *A. citrina* var. *alba* (Gill.) E. J. Gilb.

Cap (Fig. 162) 35 mm wide, hemispherical then plane, with not or faintly striate-sulcate, appendiculate margin, white with greyish centre, dry, regularly covered with 1–2.5 mm wide, adnate, subpyramidal, grey warts. Gills rather crowded, just reaching stem, 5 mm wide, cream-white, with flocculose edge. Stem 38 × 8 mm, subcylindrical, with 25 × 20 mm large, elongate-napiform, rooting bulb, white, flocculose, with apical, appressed, flocculose, fugacious, striate, white ring; top of

bulb subverrucose from felted, grey remnants of volva. Flesh pale pinkish grey, with faint, unpleasant smell ("chloride of lime"), tasteless. Spore print white.

Spores [20/1] 10–14.5 × 5.5–7(–7.5) μ, length-breadth ratio 1.6–2.5 (averages 1.9–2.1), elongate to cylindrical, often with adaxial side slightly depressed, thin-walled, with slightly refractive, subgranular, yellowish contents in alkaline solution (Fig. 163). Basidia 45–55 × 11–13 μ, 4- and 2-spored, with inconspicuous clamps. Marginal tissue a fringe of partly collapsed hyphae and small piriform to clavate cells. Trama of gills bilateral; subhymenium ramose. Pileipellis a distinct, rather thick layer of interwoven, more or less gelatinized hyphae 2–5 μ wide (also present under warts), in part yellowish and somewhat refractive. Remnants of volva on cap (Fig. 161) consisting of abundant, rather long, parallel, erect rows of mainly ellipsoid, but also globose, piriform and elongate, inflated cells up to 55 × 45 μ, with vacuolar, brown pigment and scattered, branching hyphae 2–8 μ wide; oleiferous elements rather abundant. Trama of stem with terminal, upright, large, clavate cells. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern U.S.A.

COLLECTION EXAMINED.—U.S.A.: N. Carolina, Meeting of the Waters, 18 June 1917, *W. C. Coker 2525* (NCU).

Amanita nitida sensu Coker is closely related to *A. atkinsoniana* and *A. onusta*. The type of tissue in the warts on the cap, however, resembles most strongly that in *A. atkinsoniana*. Just as in that species, there are abundant oleiferous elements, especially in the base of the warts, which turn brownish yellow in alkaline solution. Therefore the rows of inflated cells are less obvious than in the warts of A. *onusta*, in which oleiferous elements are scarce and the inflated cells more strongly coloured.

The strongly elongate spores of *A. nitida* sensu Coker and the aberrant habit are reasons to keep it separate for the moment. The more so as Coker's collection consists of only one specimen, which probably is picked in bud-stage and expanded afterwards.

Because of the uncertain status of this species and the inadequate collection on which it is based, I refrain from naming it formally.

AMANITA ABRUPTA Peck—Figs. 164–166

Amanita abrupta Peck *in* Bull. Torrey bot. Club **24**: 138. 1897. — *Lepidella abrupta* (Peck) E. J. Gilb. & Kühner *in* Bull. Soc. mycol. France **44**: 151. 1928. — *Aspidella abrupta* (Peck) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

DESCRIPTION & ILLUSTRATIONS.—Coker *in* J. Elisha Mitchell scient. Soc. **33**: 71, pl. 48, 49. 1917.

Fruit-bodies (Fig. 165) medium, rarely large, rather slender. Cap 40–80(–100) mm wide, hemispherical to plano-convex, with smooth to faintly striate-sulcate, appendiculate margin, white, dry, minutely felted to smooth and shiny, adorned with small, about 0.5–1 mm high and broad, adnate to detersile, rather firm, white, conical warts. Gills moderately crowded to crowded, free to narrowly adnate, rather narrow, 6–7 mm wide, white, with subgranular edge; short gills attenuate. Stem 70–120 × 5–12 mm, equal or attenuate upward, with large, globose to subnapiform, sometimes submarginate, up to 45 mm wide bulb, solid to stuffed, white, subfibrillose to glabrous, without remnants of volva, or with a few, very small

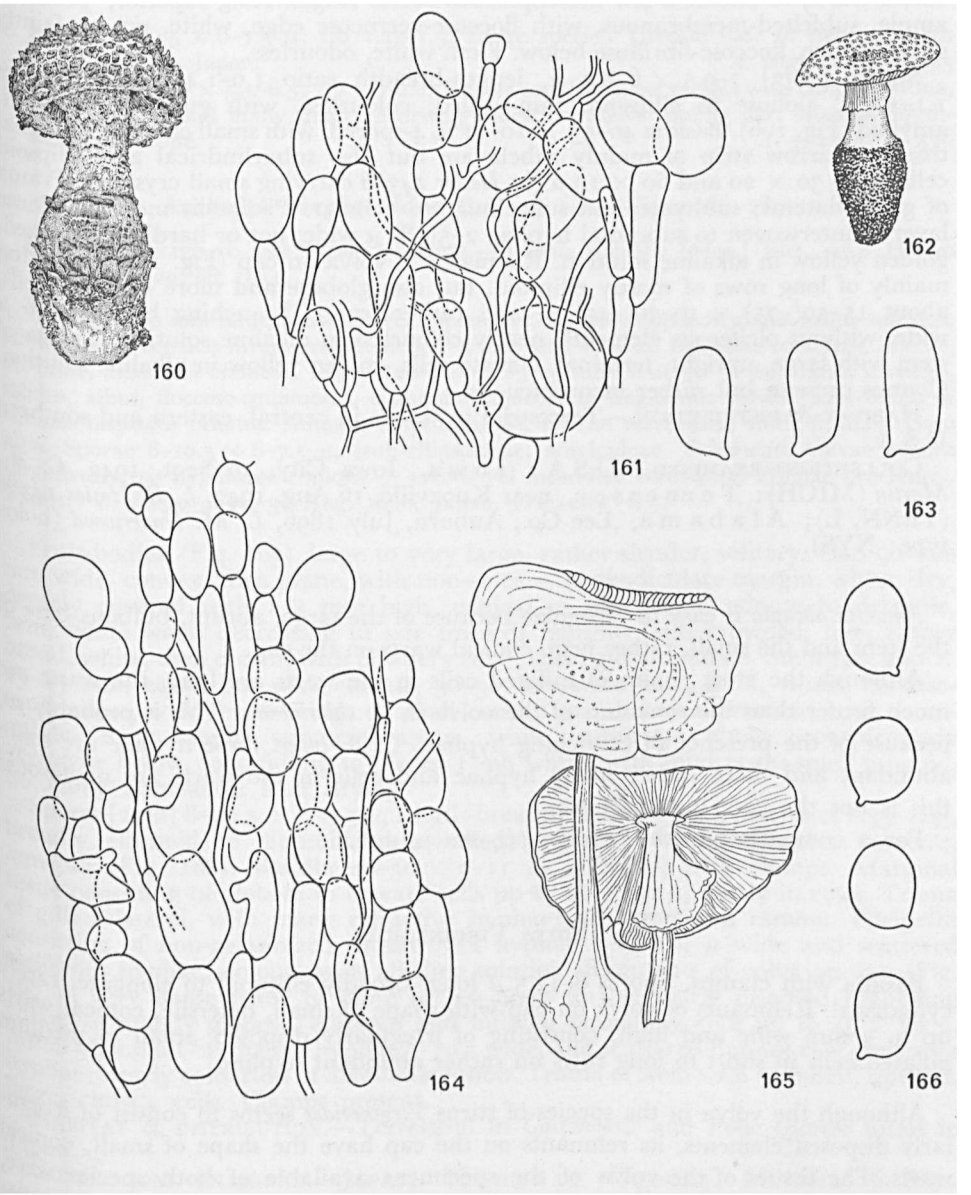


Fig. 160. *Amanita onusta*. — Young fruit-body; after Hesler's photograph of *Bas 3907*.
Figs. 161–163. *Amanita nitida* sensu Coker. — 161. Section of volval wart from cap. — 162. Fruit-body. — 163. Spores. (All figs. from *Coker 2525*; 162, after Coker, 1917: pl. 69.)
Figs. 164–166. *Amanita abrupta*. — 164. Section of volval wart from cap. — 165. Dried fruit-body. — 166. Spores. (Figs. 164, 165, from *Hesler 14388*; 166, from type.)

volval warts, or one or a few inconspicuous volval ridges. Ring superior, pendent, ample, subfelted-membranous, with floccose-verrucose edge, white, not or faintly striate above, floccose-fibrillose below. Flesh white, odourless.

Spores [40/3] 7–9.5 × 6–8.5 μ, length-breadth ratio 1.0–1.4(–1.6) (averages 1.1–1.35), globose to ellipsoid, thin-walled, colourless, with guttulate contents, amyloid (Fig. 166). Basidia 40–55 × 10–11 μ, 4-spored, with small clamps. Marginal tissue a narrow strip of mainly subclavate but also subcylindrical and ellipsoid cells up to 30 × 20 and 60 × 10 μ (in *Hesler 14388* carrying small crystals). Trama of gills bilateral; subhymenium subcellular to cellular. Pileipellis merely a dense layer of interwoven to subradial hyphae 2–5(–8) μ wide, not or hardly gelatinized, golden yellow in alkaline solution. Remnants of volva on cap (Fig. 164) consisting mainly of long rows of mostly ellipsoid, but also globose and more elongate cells, about 15–50(–75) × 10–30(–45) μ, and rather scarce, branching hyphae 3–6 μ wide, without oleiferous elements, nearly colourless in alkaline solution. Trama of stem with large, upright, terminal, clavate cells, golden yellow in alkaline solution. Clamps present, but rather inconspicuous.

HABITAT & DISTRIBUTION.—Terrestrial in woods in central, eastern and southern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Iowa, Iowa City, 19 Sept. 1942, *G. W. Martin* (MICH); Tennessee, near Knoxville, 16 Aug. 1942, *L. R. Hesler 14388* (TENN, L); Alabama, Lee Co., Auburn, July 1896, *L. M. Underwood* (holotype: NYS).

Amanita abrupta is easy to recognize because of the large, abrupt, bulbous base of the stem and the small, rather firm, conical warts on the cap.

Although the erect chains of inflated cells in the warts are long, the warts are much firmer than the remnants of the volva in *A. chlorinosma*. This is probably so, because of the presence of branching hyphae. In *A. cokeri* these hyphae are more abundant and there rather many hyphae and cells in the warts are oleiferous; this is not the case in *A. abrupta*.

For a comparison with *A. microlepis*, see p. 426.

Stirps VIRGINEOIDES

Basidia with clamps. Spores 8–11.5 μ long, broadly ellipsoid to elongate, rarely cylindrical. Remnants of volva on cap with shape of small, detersile, conical warts up to 3 mm wide and high, consisting of irregularly disposed, small to medium inflated cells in short to long rows on rather abundant hyphae.

Although the volva in the species of stirps *Virgineoides* seems to consist of irregularly disposed elements, its remnants on the cap have the shape of small, conical warts. The tissues of the volva of the specimens available of both species were, however, rather difficult to analyze. Observations on freshly collected specimens are needed.

Amanita virgineoides has several characters in common with *A. virginea* on the one side, and the clampless *A. polypyramis* on the other. *Amanita gracilior* resembles species of stirps *Microlepis* in several aspects.

KEY TO THE SPECIES OF STIRPS *Virgineoides*

1. Spores 8–10.5 × 6–7.5 μ; l/b 1.25–1.5. Large species. Clavate base of stem set with rings of warts. Japan. *A. virgineoides*, p. 435
1. Spores 10–11.5 × 5.5–6.5; l/b 1.6–2.0. Rather small, slender species with deeply rooting, tapering base and many small, recurving scales just above rooting part of stem. South-western Europe. *A. gracilior*, p. 436

Amanita virgineoides Bas, *sp. nov.*—Figs. 167–169

NAME MISAPPLIED TO THE PRESENT SPECIES.—*Amanita vittadinii* (Mor.) Vitt. *sensu* Hongo *in* J. Jap. Bot. **29**: 88. 1954.

Pileus 90–200 mm latus, convexus vel applanatus, margine appendiculatus neque sulcatus, albus, siccus, verrucis firmis, (sub)conicis, 1–3 mm altis ornatus. Lamellae confertae, liberae, sat latae, albae vel cremeae. Stipes 120–220 × 15–25 mm, basi 30–50 mm latus, clavatus, solidus, albus, floccoso-squamosus, exannulatus, deorsum fragmentis volvae (sub)conicis in circulos dispositis ornatus. Annulus amplus, albus, inferne verrucosus, valde friabilis. Caro alba. Sporae 8–10.5 × 6–7.5 μ, (sub)ellipsoideae, amyloideae. Fragmenta volvae cellulis turgidis diversis hyphisque copiosis ± erectis vel inconditis composita. Fibulae praesentes. Typus: '*T. Hongo 3293*, 30 Aug. 1966, Japan, Ōtsu-city' (L).

Fruit-bodies (Fig. 169) large to very large, rather slender, solitary. Cap 90–200 mm wide, convex, then plane, with non-sulcate, appendiculate margin, white, dry, densely covered with 1–3 mm high, conical to subconical, adnate to detersile, firm, white warts decreasing in size towards margin. Gills crowded, free, rather broad, white, then cream, with powdery edge; short gills attenuate. Stem 120–220 × 15–25 mm, equal but with clavate, 30–50 mm wide base, solid, white, floccose-squamulose, with several rings of small conical to subconical warts at base, exannulate. Ring ample, submembranous, white, substriate above, conspicuously verrucose below, soon falling to pieces. Flesh white, with mild taste; smell fungoid, becoming unpleasant after drying.

Spores [20/2] 8–10.5 × 6–7.5 μ, length-breadth ratio 1.25–1.5 (averages 1.35–1.4), broadly ellipsoid to ellipsoid, thin-walled, colourless, with refractive contents, amyloid (Fig. 168). Basidia 40–50 × 9–11 μ, 4-spored, with clamps. Marginal tissue consisting of globose to clavate cells up to 40 × 30 μ, partly in rows. Trama of gills bilateral, with many refractive hyphae; subhymenium ramose. Pileipellis consisting of non-gelatinized, interwoven hyphae 2–6(–10) μ wide and scattered oleiferous hyphae; colourless in alkaline solution. Remnants of volva on cap (Fig. 167) a very dense tissue of more or less erect to irregularly disposed branching chains of mainly globose, ellipsoid and inflated branching cells up to 45 × 30 μ, rather abundant branching hyphae 3–10 μ wide, and scattered but not rare oleiferous hyphae; nearly colourless in alkaline solution. Trama of stem with terminal, upright, large, clavate cells. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in *Castanopsis* and *Pinus-Quercus* forest in Japan.

COLLECTIONS EXAMINED.—JAPAN, Honshu; Ōtsu-city, Mii-dera, 6 Sept. 1953, *T. Hongo 750* (L); Ōtsu-city, Terabe, 30 Aug. 1966, *T. Hongo 3293* (type: L).

OBSERVATIONS.—The soft, ample ring crumbles away rather early. In young fruit-bodies where it is still present, the subconical warts on its underside are very conspicuous. These warts probably represent the limbus internus of the volva. They have nearly the same structure as the warts on the cap, but the erect, parallel position of the rows of inflated cells is more evident.

Amanita virgineoides very much resembles *A. virginea* from south-eastern Asia but it has somewhat larger, more elongate spores and a different type of tissue in the warts on the cap, viz. rather many hyphae, scattered oleiferous hyphae and a rather irregular arrangement of the branching rows of inflated cells. The type of tissue of the volva resembles that in *A. polypyramis* from N. America, but that species lacks clamps at the basidia and has larger spores.

AMANITA GRACILIOR, *nom. prov.*—Figs. 170–172

ETYMOLOGY: gracilior, slenderer.

Cap (Fig. 170) about 30–40 mm wide, soon plano-convex to flat, with non-sulcate, slightly appendiculate margin, white, tending to turn yellowish or yellowish-brownish, with scattered, small, detersile, conical to subconical, white warts up to 2 mm wide and 1.5 mm high, or glabrous, subviscid. Gills crowded, free to narrowly adnate, rather broad, ventricose, white to cream; short gills rather abundant, probably subtruncate to attenuate. Stem about 80–100 × 5–10 mm, cylindrical with long, tapering to slenderly fusiform, rooting base about 5–15 mm wide, white, with subapical, appressed, rather fragile, membranous, white, vaguely striate ring, flocculose at lower half and with many small, recurved scales provoked by remnants of volva just above rooting base.

Spores [20/1] (9.5–)10–11.5(–12) × 5.5–6.5(–8) μ, length-breadth ratio 1.6–2.0 (average 1.8), elongate, rarely subcylindrical, rather thin-walled, colourless, with a few large guttae or subgranular contents, amyloid (Fig. 171). Basidia 35–40 × 11–14 μ, 4-spored, with clamps. Marginal tissue made up of mainly clavate to piriform cells 20–55 × 10–20 μ. Trama of gills bilateral, very probably without inflated, terminal cells; subhymenium ramose to coralloid. Pileipellis consisting of interwoven hyphae 2–5 μ wide, strongly gelatinized in upper part, colourless in alkaline solution, with a few oleiferous hyphae. Remnants of volva (Fig. 171) on cap consisting of abundant, inflated, mainly ellipsoid but also globose, clavate and elongate cells, 30–80 × 15–55 μ, mostly in short to rather long rows on rather abundant, branching hyphae 3–8 μ wide; elements irregularly disposed, slightly yellowish in alkaline solution; oleiferous hyphae scarce. Trama of stem with erect, terminal, clavate cells (300 × 30 μ etc.) among rather abundant, longitudinal hyphae about 2–12 μ wide. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in Spain.

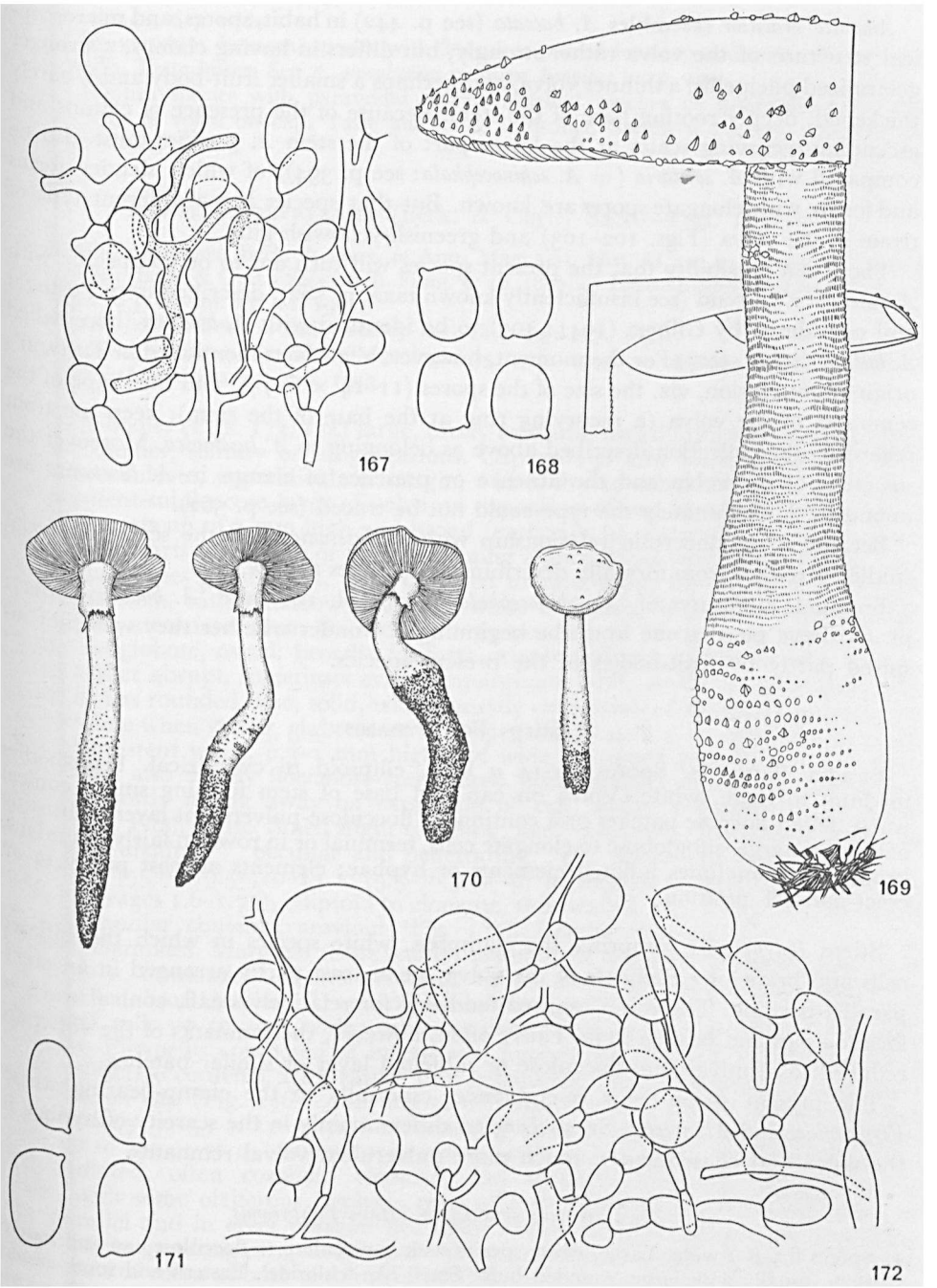
COLLECTION EXAMINED.—SPAIN, Gerona, Ampurdán, 20 Oct. 1966, *A. Marchand* (dried specimen, excellent colour-slide, L).

OBSERVATIONS.—The cap of the only specimen available bears only very few, small, conical warts. On the colour-slide the same is visible on the cap of another specimen. Apparently the volva is rather thin and breaks up early into small, more or less conical warts which because of the viscid pileipellis easily disappear.

EXPLANATION OF FIGURES 167–172

Figs. 167–169. *Amanita virgineoides*. — 167. Crushed volval wart from cap. — 168. Spores. — 169. Fruit-body. (All figs. from type; 169, after Hongo's drawing.)

Figs. 170–172. *Amanita gracilior*. — 170. Fruit-bodies. — 171. Spores. — 172. Crushed volval wart from cap. (All figs. from *Marchand, 20 X 1966*; 170, after Marchand's colour-slide.)



Figs. 167–172

Amanita gracilior resembles *A. baccata* (see p. 442) in habit, spores, and microscopical structure of the volva rather strongly, but differs in having clamps, a stronger gelatinized pileipellis, a thinner volva, and perhaps a smaller fruit-body and a barely thickened, deeply rooting base of the stem. Because of the presence of clamps and ascending-recurving scales at the lower part of the stem *A. gracilior* must also be compared with *A. solitaria* (= *A. echinocephala*: see p. 394), of which slender forms and forms with elongate spores are known. But that species has a different type of tissue in the volva (Figs. 102–103) and greenish-yellowish gills.

There is a possibility that the present species will turn out to be conspecific with *A. lusetanica* Torrend (see insufficiently known taxa, p. 562), described from Portugal and considered by Gilbert (1941: 405) to be identical with *A. boudieri* (here called *A. baccata*; see p. 442). For the moment, however, a few facts mentioned in Torrend's original description, viz. the size of the spores (11–14 × 6–7 μ) and the shape of the remnants of the volva (a recurving ring at the base of the stem), keep me from regarding the collection described above as belonging to *A. lusetanica*. Moreover the structure of the volva and the absence or presence of clamps in *A. lusetanica* are unknown. Unfortunately the type could not be traced (see p. 562).

Because of its uncertain relationship with *A. lusetanica* and the scanty material studied I refrain from formally describing this species as new.

Bresadola's pictures of '*A. echinocephala*' (1927: pl. 100) and '*A. boudieri*' (1927: pl. 99) have puzzled me from the beginning. I wonder whether they were not inspired partly by fruit-bodies of the present species.

Stirps POLYPYRAMIS

Basidia clampless. Spores 10–14 μ long, ellipsoid to cylindrical. Fruit-bodies medium to large, white. Volva on cap and base of stem forming small, conical warts, felted-floccose patches or a continuous flocculose-pulverulent layer, consisting of small to large, subglobose to elongate cells, terminal or in rows on fairly abundant, branching, sometimes inflated elements or hyphae; elements at least partly in an erect-parallel position.

Stirps *Polypyramis* comprises the clampless, white species in which the inflated cells and branching elements of the volva are at least partly arranged in an erect-parallel position. There is a marked tendency for relatively small, conical warts to form on cap and base of stem. Fairly often, however, the remnants of the volva are reduced to a pulverulent-flocculose or subfelted layer or similar patches.

The present stirps bears resemblances especially to the clamp-bearing stirpes *Virgineoides* and *Microlepis*. Stirps *Longipes* differs mainly in the scarcity of hyphae in the volva and consequently, much more pulverulent volval remnants.

KEY TO THE SPECIES OF STIRPS *Polypyramis*

1. Spores 6.5–8 μ wide. Large, white species with verruculose to flocculose cap and base of stem, usually with large, rounded bulb. Smell like 'chloride'. Eastern and south-eastern U.S.A. *A. polypyramis* p. 439

1. Spores 4.5–6 μ wide.
   2. Dingy white, lutescent species with flocculose-pulverulent cap and pale yellowish grey gills. Taste bitter. See *A. amanitoides* in stirps *Longipes* on p. 459.
   2. Whitish species with pyramidal warts, subfelted patches or subfelted-subflocculose layer of volva on cap. Taste and smell indistinct. Southern Europe, northern and central Africa. *A. baccata*, p. 442

AMANITA POLYPYRAMIS (Berk. & Curt.) Sacc.—Figs. 173–176

Agaricus polypyramis Berk. & Curt. *in* Ann. Mag. nat. Hist. II **12**: 417. 1853. — *Amanita polypyramis* (Berk. & Curt.) Sacc., Syll. Fung. **5**: 18. 1887. — *Lepiota polypyramis* (Berk. & Curt.) Morgan *in* J. Mycol. **13**: 11. 1907.

Amanita candida Peck *in* Bull. Torrey bot. Club **24**: 137. 1897.

Venenarius odoriferus Murrill *in* Mycologia **35**: 427. 1943. — *Amanita odorifera* (Murrill) Murrill *in* Mycologia **35**: 433. 1943.

Fruit-bodies (Figs. 173, 174) large, rarely medium, usually thickset but sometimes rather slender, solitary or subgregarious. Cap 70–150 mm wide, convex to plane, with non-sulcate, appendiculate margin, white, dry to subviscid, with white, soft, pulverulent-subfloccose layer of volva on expansion of cap breaking up into small, conical warts up to 2 mm high and broad (especially at centre of cap) or shapeless, small, soft warts to patches or merely forming a flocculence over whole cap or parts of it, sometimes glabrescent. Gills crowded to subdistant, free to adnexed or just touching stem, rather narrow to broad, white to cream, with subflocculose edge; short gills attenuate. Stem 80–180 × 10–35 mm, equal or tapering upward, with large, subglobose, ovoid, broadly fusiform or subnapiform, rarely broadly clavate, often rather abrupt, sometimes even submarginate bulb, 40–80 × 30–60 mm, with more or less rounded base, solid, white, usually exannulate, completely pulverulent-verruculose when young, glabrescent with age, usually with 3–10 rings of very small, more persistent warts, 0.3–1 mm high and wide, at upper part of bulb but there sometimes also merely flocculose-verruculose. Ring apical, rather thick, subfelted, friable, mostly falling away on expansion of cap, white, with floccose-verrucose underside. Flesh white. Smell slight to strong, like "old ham," "chloride of lime" or "strongly alkaline," "peculiar and penetrating," etc. Spore print pale cream.

Spores [55/6] (9.5–)10–13 × (5.5–)6.5–8(–9) μ, length-breadth ratio (1.2–)1.5–1.95 (averages 1.6–1.75), ellipsoid to elongate, thin-walled, colourless, with guttulate to subgranular contents, amyloid (Fig. 175). Basidia (45–)50–60 × 11–14 μ, 4-spored, clampless. Marginal tissue scanty, made up of clavate to ellipsoid cells up to 45 × 30 μ, terminal or in short rows on rather abundant, irregularly branching, thin-walled, broad hyphae. Trama of gills bilateral, with inflated, elongate, probably terminal cells up to 40 μ wide; subhymenium becoming inflated-ramose to subcellular. Pileipellis composed of interwoven hyphae 3–7 μ wide, sometimes partly with refractive contents, with rather thin gelatinized layer near surface. Remnants of volva on cap (Fig. 176) consisting of ellipsoid, broadly clavate and subglobose cells, mostly 30–55 × 12–35 μ, and slenderly clavate, elongate and subcylindrical cells up to 200 × 70 μ, terminal or in rows on rather abundant to abundant, branching, inflated, often coralloid elements and scattered branching hyphae 3–6 μ wide, with some oleiferous hyphae; rows of cells and elongate elements more or less parallel and in erect position but tissue rather coherent because of branching elements; large, elongate elements more abundant in part of volva close to pileipellis. Remnants of volva at base of stem resembling those on cap but with relatively more branching elements and hyphae. Trama of stem with terminal but also catenulate,

clavate cells up to 250 μ long and 50 μ wide, among rather abundant hyphae 4–10 μ wide; with oleiferous hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in dry, coniferous and deciduous woods in eastern and south-eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Maryland, Baltimore, Oct. 1925, *Kelly 1882* (MICH); Tennessee, Cumberland Co., Ozone, 13 Oct. 1962, *A. J. Sharp 25000* (TENN, L); Blount Co., Wall's Creek, 12 Nov. 1955, *L. R. Hesler 22216* (TENN, L); South Carolina, Nov. ± 1850, *M. A. Curtis 2854* (holotype: K); Alabama, Lee Co., Auburn, Oct. ± 1895, *Underwood & F. S. Earle* (holotype of *A. candida:* NYS); Louisiana, St. Tammany Parish, S. of Abita, 1 Nov. 1959, *P. Lemke & A. Welsen 23829* (TENN, L); Florida, Alachua Co., Sugarfoot near Gainesville, 7 Nov. 1938, *E. West, Arnold & W. A. Murrill F 17684* (holotype of *Venenarius odoriferus:* FLAS); Gainesville, 30 Oct. 1941, *W. A. Murrill F 19661*

Although *A. polypyramis* is a very characteristic species because of its large, sturdy, white, pulverulent-subverrucose fruit-body with its usually abruptly swollen bulbous base decorated with many rings of tiny warts, it has hardly ever been recognized as a good species. It has generally been confused with *A. chlorinosma* (p. 450), which is also white and pulverulent and has about the same smell. The latter, however, has a more slender fruit-body with a less conspicuous bulb and a thicker, more strongly pulverulent volva. Microscopically *A. chlorinosma* is easy to distinguish from *A. polypyramis* because of the presence of clamps and smaller spores (8.5–10.5 × 5–6 μ).

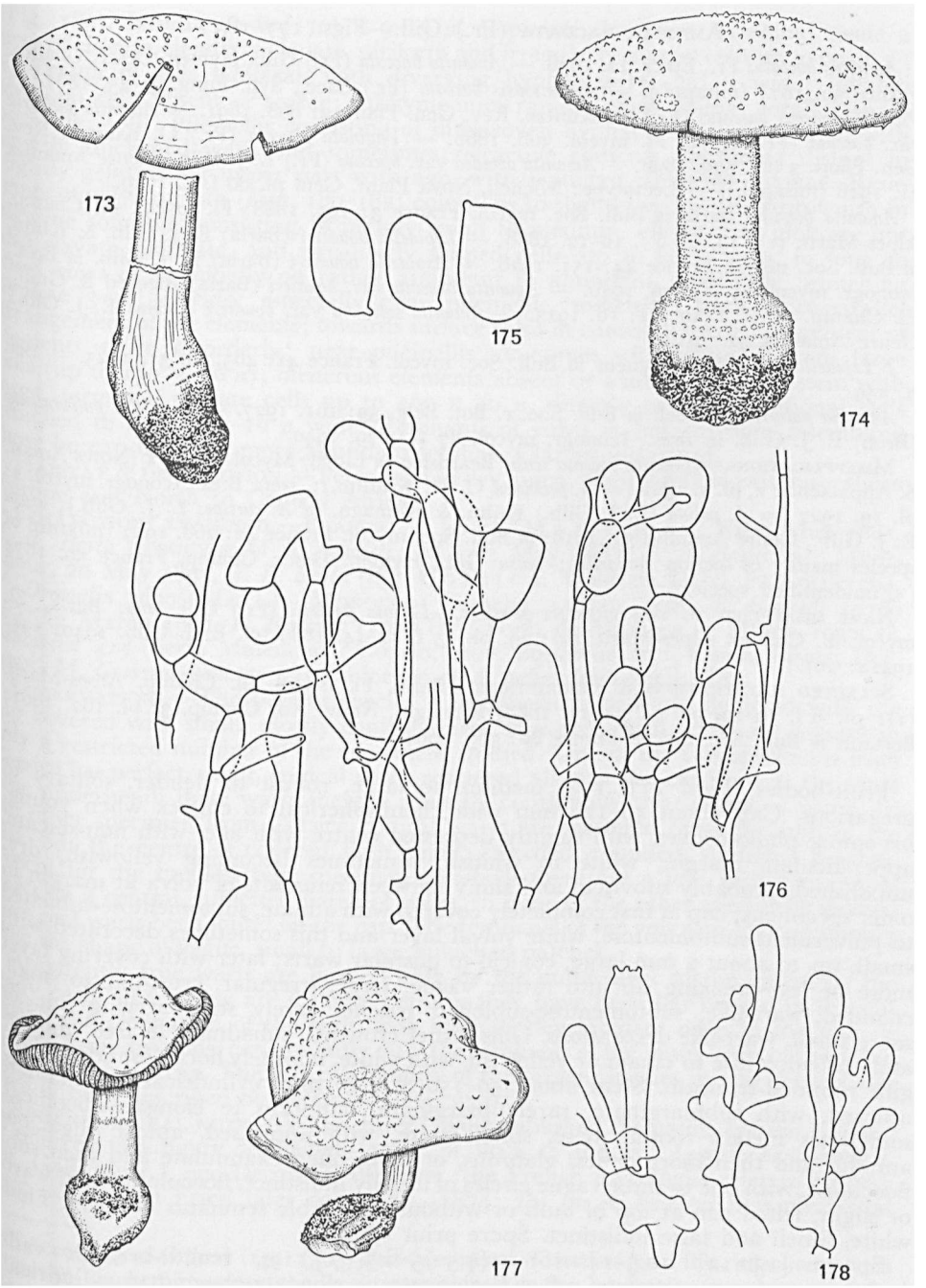
Peck was one of the few mycologists who considered the present species to be distinct from *A. chlorinosma*. The well-preserved type collection of his *A. candida* is a fine example of it.

I found the spores of *A. odorifera* Murrill larger (9.5–12 × 5.5–7 μ in the type and 10–11 × 6.5–7.5 μ in *F 19661*) than was stated in the protologue. As moreover clamps are lacking and the habit of the fruit-bodies is very similar to that of the fruit-bodies of *A. polypyramis*, I consider the name *A. odorifera* a later synonym of the latter. It should be pointed out, however, that Murrill's description of the smell is somewhat different from that of other collections, viz. "peculiar, penetrating, rather pleasant and becoming stronger and persisting in dried specimens." and "odor of soap." Moreover, in the remnants of the volva on the cap of *A. odorifera* inflated, branching elements seem less abundant than in typical *A. polypyramis*. Therefore it is possible that *A. odorifera* represents a variety of *A. polypyramis*. In this connection it is interesting that the names *A. polypyramis*, *A. chlorinosma* and *A. candida* are all lacking in Murrill's (1951) list of Florida basidiomycetes.

EXPLANATION OF FIGURES 173–178

Figs. 173–176. *Amanita polypyramis*. — 173, 174. Dried fruit-bodies. — 175. Spores. — 176. Section of volval wart from cap. (Figs. 173, 175, from type; 174, from *Hesler 22216*; 176, from *Hesler 25000*.)

Figs. 177–178. *Amanita baccata* (= *A. boudieri*!). — 177. Dried fruit-bodies. — 178. Elements from subhymenium and hymenium (× 500). (Fig. 177, from *Demoulin 3639*; 178, from *Barla, 20 May 1895*.)



Figs. 173–178

AMANITA BACCATA (Fr.) Gill.—Figs. 177–183

Agaricus baccatus Fr., Epicr. 12. 1838. — *Amanita baccata* (Fr.) Gill., Hymén. Descr. Champ. France 50. 1874 (misappl.). — *Amanitopsis baccata* (Fr.) Sacc., Syll. Fung. **5**: 25. 1887. — *Pseudofarinaceus baccatus* (Fr.) O. Kuntze, Rev. Gen. Plant. **2**: 868. 1891. — *Amanita solitaria* var. *baccata* (Fr.) Quél., Fl. mycol. 306. 1888. — *Vaginata baccata* (Fr.) O. Kuntze, Rev. Gen. Plant. **3** (2): 539. 1898. — *Amanita ovoidea* var. *baccata* (Fr.) E. J. Gilb., Genre Amanita 31. 1918 (misappl.). — Lectotype: Micheli, Nova Plant. Gen. pl. 80 f. 4. 1729.

Amanita boudieri Barla *in* Bull. Soc. mycol. France **3**: 195. 1888; Fl. mycol. ill. Champ. Alpes-Marit. (1): 19, pl. 6 f. 10–12. 1888. — *Lepidella boudieri* (Barla) E. J. Gilb. & Kühn. *in* Bull. Soc. mycol. France **44**: 151. 1928. — *Aspidella boudieri* (Barla) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940. — *Amanita baccata* var. *boudieri* (Barla) Bigeard & Guill., Fl. Champ. supér. France **1**: 16. 1913. — *Amanita solitaria* var. *boudieri* (Barla) E. J. Gilb., Genre Amanita 92. 1918.

? *Lepidella beillei* Beauseigneur *in* Bull. Soc. mycol. France **41**: 465, pl. 31. 1925. — See p. 559.

Amanita pulverulenta Beeli *in* Bull. Soc. r. Bot. Belg. **59**: 101. 1927. — *Aspidella pulverulenta* (Beeli) E. J. Gilb. in Bres., Iconogr. mycol. **27** (1): 79. 1940.

MISAPPLICATIONS.—*Amanita baccata sensu* Beardslee *in* Lloyd, Mycol. Notes **1** (Notes Aman. S. Appalach.): 2, pl. 1. 1902 (= *A. peckiana* C. H. Kauffm.); *sensu* Bres., Iconogr. mycol. **1**: pl. 19, 1927 [= *A. valida* (E. J. Gilb.) Kühn. & Romagn. or *A. curtipes* E. J. Gilb.]; *sensu* E. J. Gilb., Genre Amanita 31. 1918; *in* Bull. Soc. mycol. France **42**: 268. 1927 (mixture of species mainly of section *Amidella*); *sensu* Gill., Hymén. Descr. Champ. France 50. 1874 (= unidentified species).

NAME MISAPPLIED TO THE PRESENT SPECIES.—*Lepiota pauletii* (Fr.) Gill. *sensu* Barla, Fl. mycol. ill. Champ. Alpes-Marit. (2): 29, pl. 15 f. 12–14. 1889 (cf. E. J. Gilb. 1940: 194; 1941a: 20).

SELECTED ILLUSTRATIONS & DESCRIPTIONS.—Barla, Fl. mycol. ill. Champ. Alpes-Marit. (1): pl. 6 f. 10–12, pl. 7 f. 11–13. 1888; Romagn., Nouv. Atl. Champ. **3**: pl. 182. 1961; Bertault *in* Bull. Soc. mycol. France **80**: 369. 1964.

Fruit-bodies (Figs. 177, 179) medium to large, robust to slender, solitary to gregarious. Cap about 40–120 mm wide, hemispherical to convex when young, becoming plano-convex with slightly depressed centre with age, with non-sulcate, appendiculate margin, white to whitish, sometimes becoming yellowish, dry, unpolished, probably subviscid and shiny between remnants of volva at margin in older specimens; cap at first completely covered with adnate, subtomentose-subfelted to pulverulent-subtomentose, white volval layer and this sometimes decorated with small, up to about 2 mm large, conical to pustular warts; later with covering layer more or less breaking up into rather vague, large, irregular, crust-like to small, rounded, wart-like, subtomentose-subfelted patches rarely still carrying one or more small, wart-like decorations. Gills rather crowded, subadnate to free, moderately broad, white to cream or yellowish, with white, minutely flocculose edge; short gills rounded-truncate. Stem about 50–150 × 5–20 mm, cylindrical or attenuate upward, with submarginate, rarely marginate, napiform to elongate-obconical, sometimes merely rooting base, solid, white, with appressed, apical, fugacious annulus and then more or less glabrous, or more often exannulate and then subflocculose, with one to three vague circles of usually indistinct, flocculose-felted warts or slight, felted rim at top of bulb or without noticeable remnants of volva. Flesh white. Smell and taste indistinct. Spore print white.

Spores [130/12] 10.5–14(–16) × (4.5–)5–6.5(–7.5) μ, length-breadth ratio (1.6–)1.7–2.4(–2.7), averages 1.8–2.1, elongate or elongate-obovoid to cylindrical, thin-walled, colourless, with refractive granular or guttulate contents, amyloid

(Fig. 183). Basidia 40–60(–70) × 9–13 μ, 4-spored, clampless. Marginal tissue a strip of clavate, slenderly clavate, piriform and irregularly shaped cells up to 60 × 25 μ. Trama of gills bilateral, with diverging hyphae 2–15(–25) μ wide; inflated terminal cells absent or scarce; subhymenium ramose when young, coralloid with age (Fig. 178). Pileipellis consisting of interwoven hyphae 2–8 μ wide, often with slightly thickened walls and sometimes refractive contents, becoming distant in slightly gelatinizing upper part with age, with scattered oleiferous hyphae. Remnants of volva on cap (Figs. 180–182) colourless to slightly yellowish or brownish in alkaline solution, consisting of mainly small to medium, ellipsoid to globose, but also clavate, elongate, and irregularly shaped cells, up to 80 × 70 μ, in long to short rows or terminally on rather abundant to abundant, frequently branching hyphae 3–10 μ wide; especially near pileipellis, sometimes with erect-parallel arrangement of the elements; towards surface (also in conical warts) arrangement of elements more disorderly; near pileipellis sometimes with scattered, very large cells (up to 130 × 80 μ); oleiferous elements absent or scarce. Trama of stem with large, terminal, clavate cells up to 400 × 40 μ, directly or via transitional cells attached to hyphae 2–10 μ wide. Remnants of volva at base of stem resembling those on cap but with more abundant hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in dry, open, often sandy woods in southern Europe and North to Central Africa.

COLLECTIONS EXAMINED.—FRANCE: Alpes Maritimes, Nice, May 1881, *J. B. Barla* (lectotype of *A. boudieri:* PC) [58]; May 1887, *J. B. Barla* (S); Montdaour, 20 May 1895, *J. B. Barla* (S); Corsica, Golfe de Calvi, 22 April 1964, *V. Demoulin 3639* (LG, L); MOROCCO: Larache, 11 Jan. 1966, *R. Bertault 10789* (L); 22 March 1967, *R. Bertault 11080* (L); Forêt de Mamora, 7 March 1937, *G. Malençon 415* (herb. Malençon); CONGO, prov. Equateur, terr. Lisala, Lisala, Dec. 1925, *M. Goossens-Fontana 532* (holotype of *A. pulverulenta* Beeli: BR).

OBSERVATIONS.—The present species is usually described and depicted with the cap covered with small, mostly conical warts. However, such warts are present in only a restricted number of the specimens studied. One of the two specimens from Corsica has perfect, small, conical warts scattered all over the cap; but at the same time underneath these warts there is a nearly continuous layer of volval tissue. In the other specimen from Corsica conical warts are scattered over the limb of the cap, but the centre is covered with small, crowded, rounded, subfelted patches. Except for the smallest type specimen in which there are a few, indistinct, small warts on a central, subfelted patch of volva, in none of the other specimens studied have real warts been found on the cap. The remnants of the volva on the cap usually have the shape of vague, small to large, subfelted patches.

Apparently true warts are formed only by the outer layer of the volva. In the many cases where they are lacking, perhaps they have been left behind in the soil during the elongation of the fruit-body after its development deep in the soil, or washed away by rains, consequently only the remnants of the inner layer of the volva are found on the cap. The great variability of the present species in this respect has already been described by Bertault (1964: 370).

NOMENCLATURAL NOTE.—When Fries (1838) published the name *Agaricus baccatus*, he referred to a figure of Micheli (1729: pl. 80 f. 4) and to "*Agaricus pantherinus* s. Bot. Gall. austr.!, nec Decand." Whoever the French mycologist referred to may have been, from Fries' later comments (1874: 28) on *A. baccatus* it is clear that

[58] According to Gilbert (1941: 403) Barla described *A. boudieri* from this collection, which he sent to Boudier. However, the locality mentioned on the label (Nice) is not exactly the same as that in the protologue (Montdaour).

although Fries received material from the south of France under the name *A. pantherinus*, which he thought conspecific with Micheli's species, his concept of *A. baccatus* was based mainly on Micheli's figure and description. As, moreover, the material which Fries received is lacking in his herbarium, the selection of Micheli's figure as lectotype can hardly be avoided.

Part of the confusion around the name *A. baccatus* has arisen because in the protologue Fries mentioned varieties differing in the colour of the cap. Apparently this was because Micheli (1729: 186) placed the reference to Pl. 80 f. 4 in the margin of the text as an example of a group of four 'species' with thin volva breaking up into small fragments on the cap, an exannulate stem, and a non-sulcate margin of the cap. But in the descriptions of these four 'species', distinguished by Micheli mainly by the colours of the cap, the reference to Pl. 80 f. 4 is repeated only in the first, which runs: "Unicolores albi. Fungus totus candidus, parvus, e volva erumpens, pediculo non anulato, ac radicem versus sensim, & leviter crassescente. Tab. 80 fig. 4. Tignosa bianca, senza anello. Octobri mense, in Boboli per cupressinam sylvam prope urbis portam."

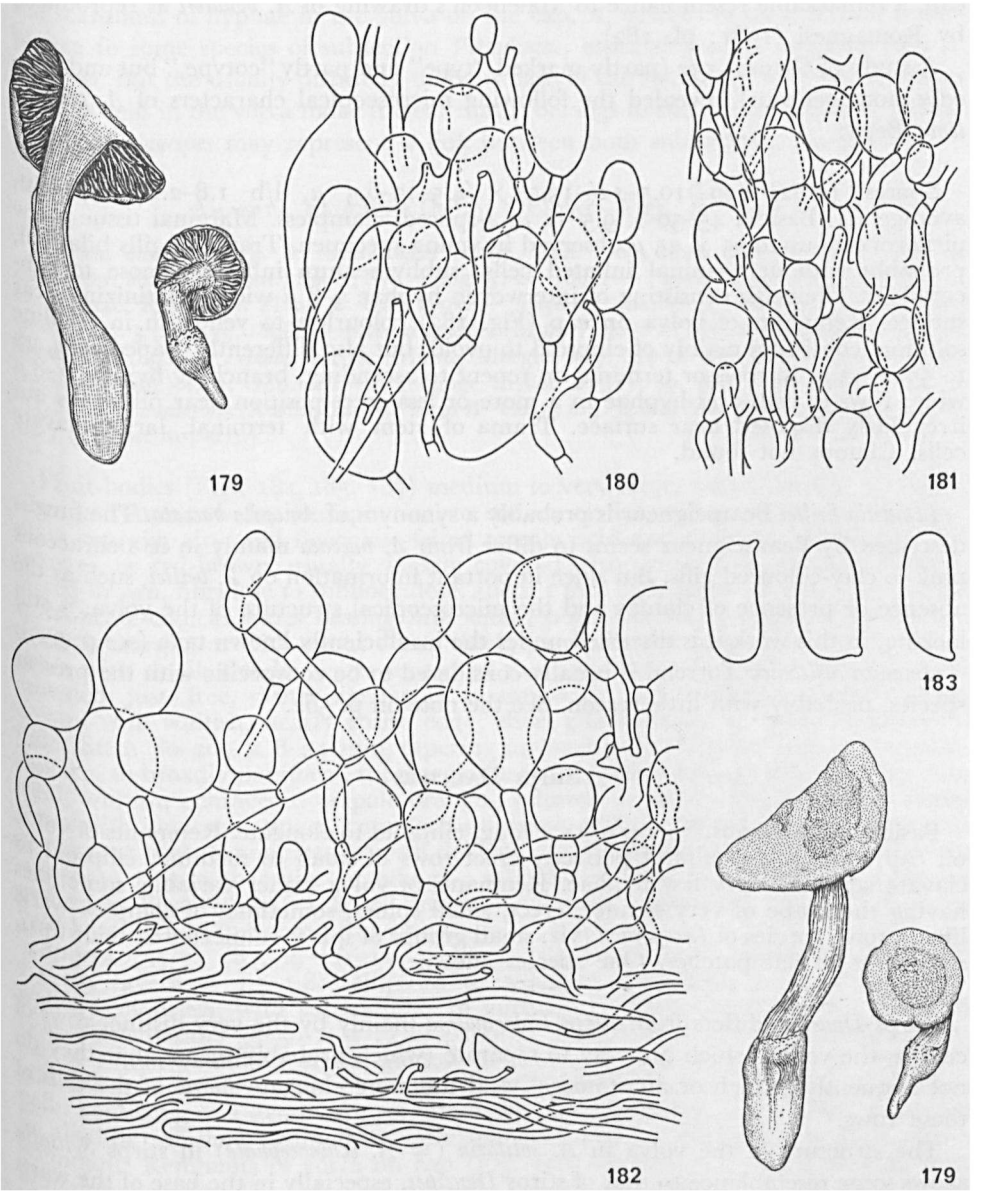
There can be scarcely any doubt that Micheli here described the species later called *Amanita boudieri* Barla, especially when the characteristics of the group in which Micheli placed his species are considered. Though rather primitive Micheli's figures show in the covering of the cap and the margin of the bulb a striking resemblance to Barla's figures of *A. baccata* and *A. boudieri*. Therefore once it has been properly typified the name *Agaricus baccatus* Fr. ceases to be ambiguous.

Several authors applied the name *Amanita baccata* (Fr.) Gill. to species of section *Amidella*, especially to those around *A. valens* and A. *volvata*. It is hard to understand how anybody can see a species of section *Amidella* in Micheli's figures, especially when the button-stage depicted is considered. It is significant that Micheli used for it the Italian name 'Tignoso', which is also used for *A. muscaria* and *A. rubescens*, instead of 'Vovola', as used for *A. ovoidea* and *A. caesarea*. It should be noted that earlier Quélet (1888: 306) adopted the name *A. baccata* for the present species and that Barla published pictures of the same species under the names *A. baccata* and *A. boudieri*.

Because of its variable appearance *A. baccata* is not easy to recognize. It is characterized by the combination of elongate to cylindrical, large spores (10.5–14 × 5–6.5 μ), clampless basidia, white to whitish colours, a fugacious ring, and a rather adnate, subtomentose-subfelted volva, occasionally with small conical to pustular warts on its surface, and more or less breaking up into large to small, vague patches on the only slightly gelatinizing pileipellis.

It was only after ample consideration that I decided to unite *A. pulverulenta* from tropical Africa and the mediterranean *A. baccata*. From studies of the type of *A. pulverulenta* and European material of *A. baccata* (the type of *A. boudieri*) it seemed as though both species were very closely related but perhaps to be distinguished by the warty outer surface of the volva in *A. baccata* and the pulverulent-subtomentose volva in *A. pulverulenta*. But study of more material of *A. baccata*, especially from North Africa, made it clear that the warts on the volva of *A. baccata* are often lacking and that in that case not a single character is left to separate the two species.

It should be noted here that Mrs. Goossens' water-colour drawing of *A. pulverulenta* as reproduced by Gilbert (1941: pl. 69) shows, except for the covering of the



Figs. 179–183. *Amanita baccata* (= *A. boudieri*!). — 179. Dried fruit-bodies. — 180. Section of volval wart from near centre of cap. — 181. Same from near margin of cap. — 182. Radial section of pileipellis and remnants of volva. — 183. Spores. (Figs. 179, 183, from type of *A. boudieri*; 180, 182, from *Demoulin 3639*; 182, from type of *A. pulverulenta*.)

cap, a remarkable resemblance to Malençon's drawing of *A. boudieri* as reproduced by Romagnesi (1961: pl. 182).

A study of *Goossens 532* (partly marked "type" and partly "cotype," but undoubtedly homogeneous) revealed the following microscopical characters of *A. pulverulenta* Beeli:

Spores [20/2] (10–)10.5–12(–13.5) × (4.5–)5–6.5 μ, l/b 1.8–2.2(–2.7) with average 2.1. Basidia 45–50 × 9.5–11 μ, 4-spored, clampless. Marginal tissue a few piriform cells up to 35 × 25 μ observed in young specimen. Trama of gills bilateral, probably without terminal inflated cells; subhymenium inflated-ramose to subcoralloid. Pileipellis consisting of interwoven hyphae 3–8 μ wide, gelatinizing near surface. Remnants of volva on cap (Fig. 182) colourless to yellowish in alkaline solution, consisting mainly of ellipsoid to ovoid, but also differently shaped cells, up to 55 × 45 μ, in rows or terminal on repent to ascending, branching hyphae 3–8 μ wide; rows of cells and hyphae in a more or less erect position near pileipellis but irregularly disposed near surface. Trama of stem with terminal, large, clavate cells. Clamps not found.

Lepidella beillei Beauseigneur is probably a synonym of *Amanita baccata*. The fungus described by Beauseigneur seems to differ from *A. baccata* mainly in its ochraceous pink to clay-coloured gills. But since important information on *L. beillei*, such as the absence or presence of clamps and the microscopical structure of the volva, is still lacking, in this work it is discussed under the insufficiently known taxa (see p. 559).

Amanita lusitanica Torrend is usually considered to be conspecific with the present species, probably with little reason. See the note on p. 562.

Stirps DAUCIPES

Basidia with clamps. Spores 9–11 μ long, ellipsoid to elongate. Remnants of volva on cap consisting of almost perfectly erect rows of small to medium, ellipsoid to clavate cells and very few hyphae. Remnants of volva rather variable, sometimes having the shape of very slender, erect, small spines, sometimes of complex warts like in some species of *Lycoperdon* (viz. small groups of spines connected at their tips), sometimes of flat patches. One species known.

Stirps *Daucipes* differs from stirps *Chlorinosma* mainly by the very distinct rows of cells in the volva, which are easy to separate (which probably means that they do not frequently branch or anastomose), and the more elongate shape of the cells of these rows.

The structure of the volva in *A. solitaria* (= *A. echinocephala*) in stirps *Solitaria* shows some resemblance to that of stirps *Daucipes*, especially in the base of the warts (Fig. 103). But in general hyphae are more abundant there and in the tips of the warts the tissue is more irregular (Fig. 102). Other characters, like the shape of the base of the stem and the type of partial veil, raise doubts about a close connection between *A. solitaria* and *A. daucipes*.

Because of the rather strictly erect rows of usually more or less elongate cells and

the scantiness of hyphae in the volva on the cap, *A. daucipes* bears a certain resemblance to some species of subsection *Vittadiniae*, especially of *A. ameghinoi* and *A. salmonea*. But the usually distinctly bulbous base of the stem and, after all, too short inflated cells in the volva make it clear that it belongs to subsection *Solitariae*. Nevertheless *A. daucipes* may represent a link between both subsections mentioned.

AMANITA DAUCIPES (Mont.) Lloyd—Figs. 184–188

Agaricus daucipes Berk. & Mont. *apud* Mont., Syll. Gen. Spec. cryptog. 96. 1856 — *Amanitopsis daucipes* (Mont.) Sacc., Syll. Fung. **5**: 26. 1887. — *Pseudofarinaceus daucipes* (Mont.) O. Kuntze, Rev. Gen. Plant. **2**: 868. 1891. — *Vaginata daucipes* (Mont.) O. Kuntze, Rev. Gen. Plant. **3** (2): 539. 1898. — *Amanita daucipes* (Mont.) Lloyd in Mycol. Writings **1** (Compil. *Volvae*): 7. 1898. — *Lepiota daucipes* (Mont.) Morgan *in* J. Mycol. **13**: 12. 1907. — *Aspidella daucipes* (Mont.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

[*Amanita chlorinosma* (Austin) Lloyd "form B" Coker *in* J. Elisha Mitchell scient. Soc. **33**: 82. 1917 (at least in part).]

Fruit-bodies (Figs. 184, 185, 187) medium to very large, rather slender to robust. Cap 50–160 mm wide, hemispherical to convex or flat, with non-sulcate, appendiculate margin, dry and flocculose-felted to subviscid and polished, whitish to pale orange-, or red-brown, usually densely covered with ochraceous, orange-, salmon- or red-brown, fibrillose to subflocculose, about 1 mm high spines or slenderly conical to truncate-conical warts passing into small, point-like warts or mere flocculence towards margin, or with about 1 mm thick, patch-like remnants of volva, or sometimes with small, slender warts united at the tips like in *Lycoperdon perlatum*. Gills crowded, just free, rather narrow, 4–12 mm wide, not ventricose, white to pale cream, with whitish, nearly entire edge; short gills truncate, rounded or subattenuate. Stem 80–200 × 8–24 mm, tapering upward, with subcylindrical or elongate-fusiform to broadly napiform, submarginate to marginate bulb 35–80 × 20–65 mm, solid, whitish, ochraceous or pale orange-, salmon- or red-brown, near base sometimes with vinaceous tinges, completely floccose, with indistinct, floccose remnants of volva at base, exannulate or with delicate, apical, pendent, whitish or yellowish, substriate ring with white to orange-, salmon- or red-brown, floccose warts on underside. Flesh white (?). Smell "sweetish nauseous" (Homola), "meaty" (Coker), "old ham" (Coker). Spore print white.

Spores [55/7] (8.5–)9–11(–11.5) × (5.0–)5.5–6.5(–7) μ, length-breadth ratio 1.4–1.9 (averages 1.5–1.8), ellipsoid to elongate, sometimes subreniform, thin-walled, colourless, with subgranular to guttulate, subrefractive contents, amyloid (Fig. 186). Basidia 35–50 × 9–12 μ, 4-spored, with clamps. Marginal tissue consisting of rather abundant, small, globose to clavate cells up to 35 × 30 μ. Trama of gills bilateral; subhymenium ramose, its cells irregularly inflated with age. Pileipellis consisting of a dense layer of interwoven hyphae mostly 2–4 μ wide, yellowish in alkaline solution, distinctly gelatinized near surface; oleiferous hyphae rather abundant. Remnants of volva on cap (Fig. 188) consisting of erect, parallel rows of mainly broadly ellipsoid, piriform and clavate cells mostly 25–70 × 18–35 μ but sometimes up to 160 × 60 μ, with scarce hyphae and oleiferous elements, pale yellow in alkaline solution; inflated cells in general more elongate in base than in top of warts. Trama of stem with abundant, upright, large, terminal, clavate cells. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Ohio, Columbus, *Sullivant 193* (holotype:

PC); Pennsylvania, Boumai Town, 22 Aug. 1963, *R. Homola* (*C. Bas 3856*, L); Maryland, Aug. 1925, *Krieger* (*Kelly 1978*, MICH); Tennessee, Knox Co., Roaring Springs, 15 July 1934, *L. R. Hesler 4213* (TENN); North Carolina, Chapel Hill, 29 Sept. 1911, *W. C. Coker 309* ("*A. chlorinosma* form B", NCU); 21 Sept. 1944, *W. C. Coker 14005* (NCU); 30 Sept. 1946, *J. N. Couch 14042* (NCU).

OBSERVATIONS.—The type consists of only one small, young, mouldy fruit-body, while the coloured plate mentioned in the original description is missing. However, the microscopic characters which I was able to check in the type specimen and the colour (croceus) and shape of the warts (like those of *Lycoperdon gemmatum*) mentioned in Montagne's description make it rather certain that the present interpretation of this old species is the right one.

Sometimes the volva does not break up into small conical warts but into larger flat patches. In that case *(Coker 14005!)* the radially fibrillose sides of these patches clearly demonstrate the structure of the volva.

This magnificent species seems to be rather rare since otherwise it is incomprehensible that it has almost completely disappeared from recent literature. It is rather closely related to *A. chlorinosma*, but easy to distinguish by the orange-brown to reddish brown volva consisting of almost perfectly erect rows of ellipsoid to clavate cells, which are larger than in *A. chlorinosma*, and by the somewhat larger spores.

This species is apparently the main component of Coker's *A. chlorinosma* form B. The collection *Coker 309*, cited under that name by Coker (1917: 83), consists of a perfect specimen of *A. daucipes*.

Stirps CHLORINOSMA

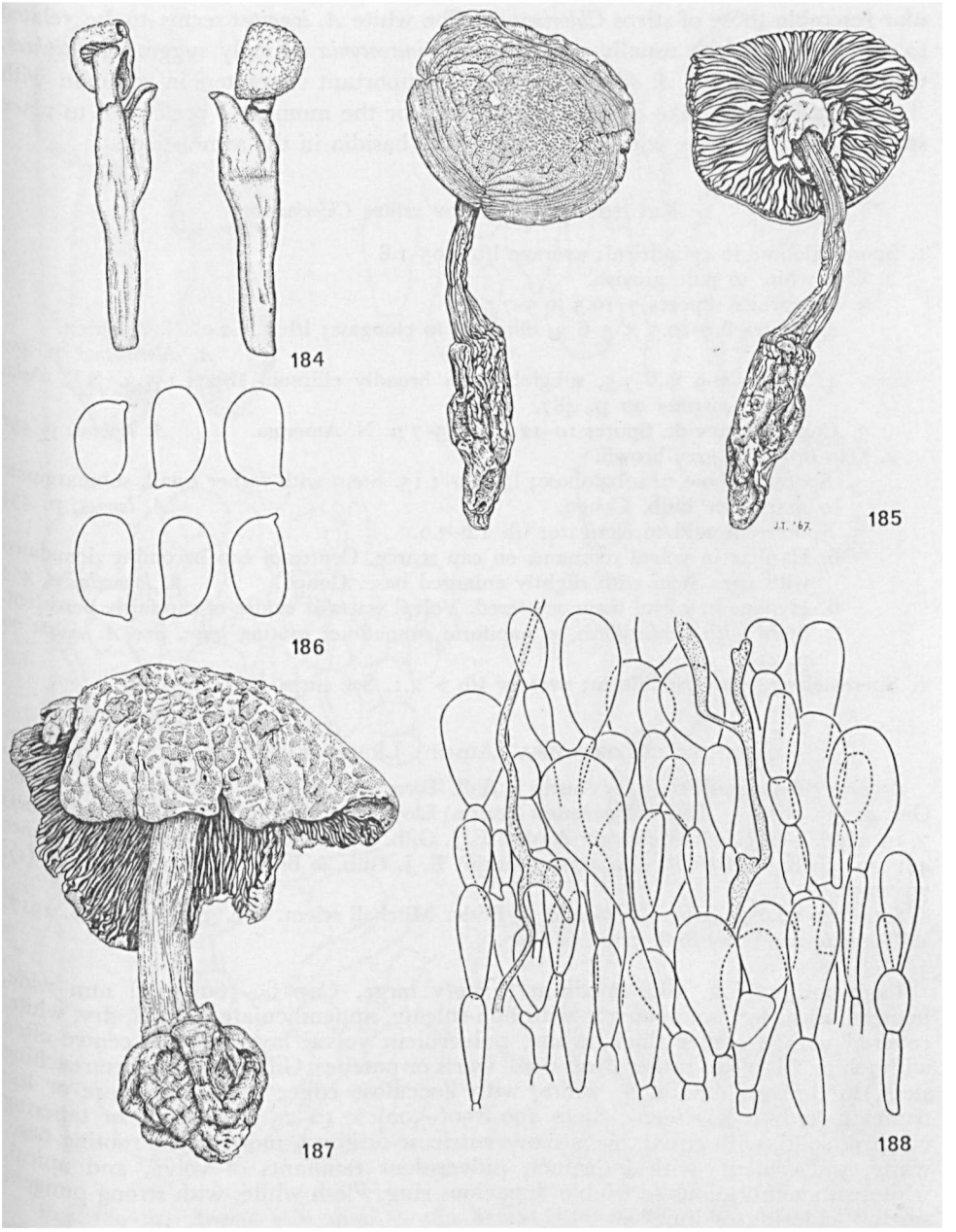
Basidia with clamps. Spores 7–12.5 μ long, globose to cylindrical (average l/b 1.05–1.08). Volva white, greyish, or dark brown, on cap forming a pulverulent-floccose to pulverulent-verrucose layer, but sometimes at centre small, friable to rather firm warts. Tissue of volva consisting mainly of small to medium-sized, inflated cells in irregularly arranged to more or less erect, sometimes branching rows and few or inconspicuous hyphae.

Basically this stirps comprises the species with clamped basidia and a distinctly pulverulent volva. The white *A. chlorinosma* and the pale grey *A. tephrea*, both from N. America, are its most typical representatives.

Amanita lanosa and *A. lanosula* from central Africa differ from the two species mentioned by a conspicuous, brown pigment in the cells of the volva, a slender habit and perhaps a slightly stronger tendency to form conical warts on the cap. Moreover, *A. lanosa* stands somewhat apart because of its globose spores, whereas those of the other species in this stirps are ellipsoid to cylindrical.

Stirps *Chlorinosma* is probably related to stirps *Microlepis*. *Amanita onusta* in the latter stirps has a volval structure rather strongly resembling that of stirps *Chlorinosma* because of its small inflated cells and rather scarce hyphae. But usually *A. onusta* has distinct conical warts on the cap and therefore I have placed this species in stirps *Microlepis*.

Among the clampless *Solitariae* species of stirpes *Longipes* and *Cinereoconia* in partic-



Figs. 184–188. *Amanita daucipes*. — 184, 185. Dried fruit-bodies. — 186. Spores. — 187. Dried fruit-body. — 188. Section of volval wart from cap. (Fig. 184, from type; 185, 186, 188, from *Bas 3856*; 187, from *Coker 14005*.)

ular resemble those of stirps *Chlorinosma*. The white *A. longipes* seems to be related to *A. chlorinosma*, the usually pale grey *A. cinereoconia* strongly suggests *A. tephrea*, while the dark brown *A. odorata* has several important characters in common with *A. lanosula*. For the sake of clarity, however, for the moment I prefer not to place species with and those without clamps at the basidia in the same stirps.

KEY TO THE SPECIES OF STIRPS *Chlorinosma*

1. Spores globose to cylindrical; average l/b 1.05–1.8.
   2. Cap white to pale greyish.
      3. Cap white. Spores 7–10.5 × 5–7.5 μ.
         4. Spores 8.5–10.5 × 5–6 μ, ellipsoid to elongate; l/b 1.5–2.0. N. America. *A. chlorinosma*, p. 450
         4. Spores 7–9 × 6–7.5, subglobose to broadly ellipsoid; l/b 1.1–1.3. S.E. Asia. See *A. virginea* on p. 487.
      3. Cap pale greyish. Spores 10–12.5 × 5.5–7 μ. N. America. *A. tephrea*, p. 452
   2. Cap brown to grey-brown.
      5. Spores globose to subglobose; l/b 1.0–1.15. Stem with rather small, submarginate to marginate bulb. Congo. *A. lanosa*, p. 454
      5. Spores ellipsoid to elongate; l/b 1.2–2.0.
         6. Hyphae in volval remnants on cap scarce. Centre of cap becoming denudated with age. Stem with slightly enlarged base. Congo. *A. lanosula*, p. 453
         6. Hyphae in volval tissue scattered. Volval warts at centre of cap fairly persistent. Stem with subfusiform to napiform, sometimes rooting base. See *A. onusta* on p. 428.
1. Spores elongate to bacilliform; average l/b > 2.1. See stirps *Rhoadsii*, p. 492.

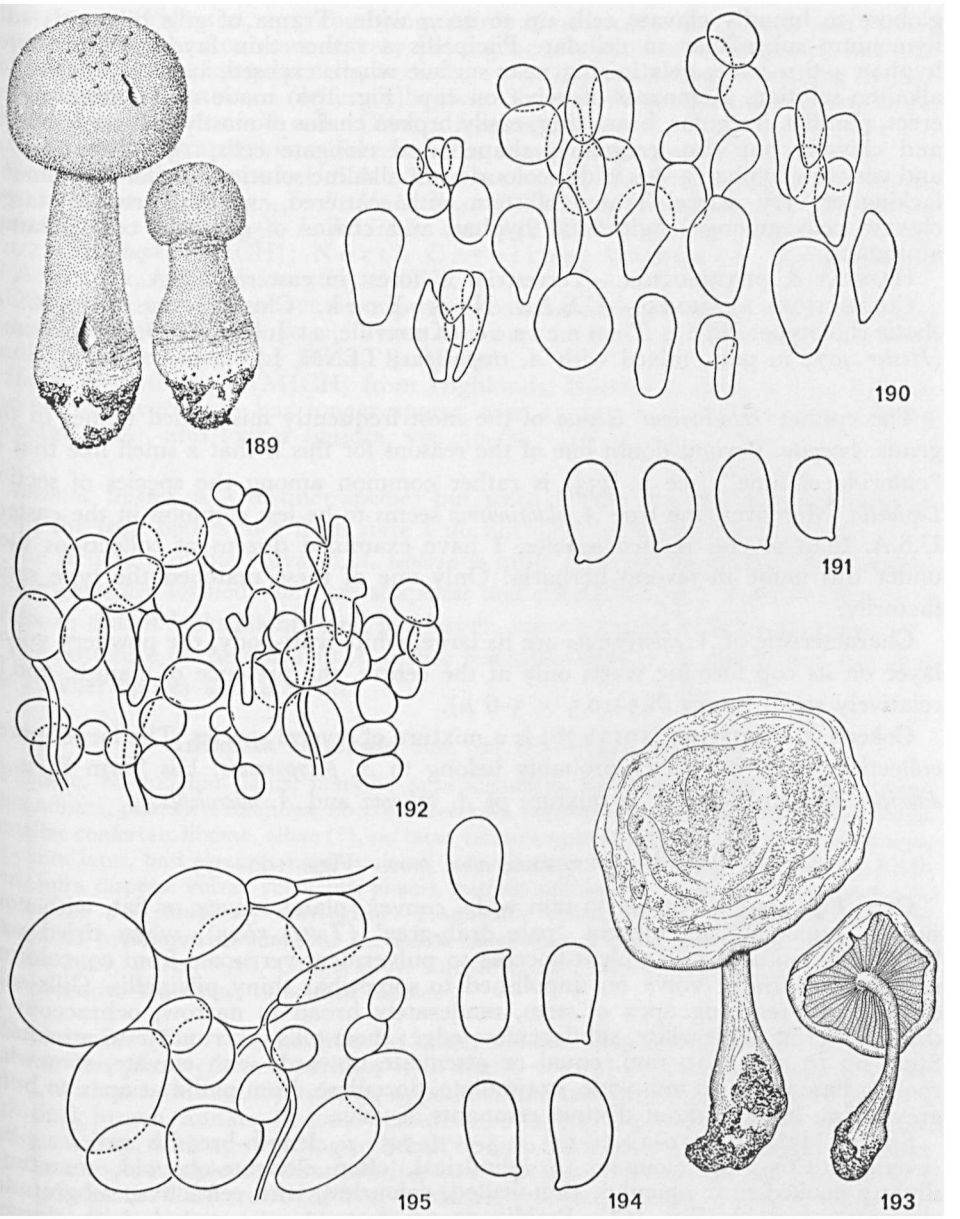
AMANITA CHLORINOSMA (Austin) Lloyd—Figs. 189–191

Agaricus chlorinosmus Peck *apud* Austin *in* Bull. Torrey bot. Club **7**: 278. 1878; Peck *in* Bot. Gaz. **4**: 137. 1879. — *Amanita chlorinosma* (Austin) Lloyd, Mycol. Writings **1** (Compil. *Volvae*): 7, 15. 1898. — *Lepidella chlorinosma* (Austin) E. J. Gilb. & Kühner *in* Bull. Soc. mycol. France **44**: 151. 1928. — *Aspidella chlorinosma* (Austin) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

SELECTED ILLUSTRATIONS.—Coker *in* J. Elisha Mitchell scient. Soc. **33**: pls. 54–56. 1917; Williams *in* Asa Gray Bull. **7**: pl. 6. 1899.

Fruit-bodies (Fig. 189) medium to very large. Cap 60–160(–300) mm wide, hemispherical to plano-convex, with non-sulcate, appendiculate margin, dry, white, covered with a rather thick, white, pulverulent volval layer, but at centre often with white, friable to rather firm, small warts or patches. Gills crowded, just reaching stem, moderately broad(?), white, with flocculose edge; short gills more or less truncate (only a few seen). Stem 100–150(–300) × 10–25 mm, equal or tapering upward, solid, with equal, clavate or ventricose-fusiform, more or less rooting base, white, pulverulent, with indistinct, pulverulent remnants of volva, and apical, white, submembranous to friable, fugacious ring. Flesh white, with strong pungent smell ("chloride of lime").

Spores [30/2] (8–)8.5–10.5(–11) × 5–6 μ, length-breadth ratio 1.5–2.0 (averages 1.7–1.8), ellipsoid to elongate, sometimes subreniform, thin-walled, colourless, with subgranular to guttulate contents, amyloid (Fig. 191). Basidia 40–55 × 8–10 μ, 4-spored, with clamps. Marginal tissue a rather broad strip of chains of small,



Figs. 189–191. *Amanita chlorinosma*. — 189. Young fruit-bodies. — 190. Elements of volval remnants from cap. — 191. Spores. (Fig. 189, after Williams, 1899: pl. 6; 190, 191, from type.)

Figs. 192–195. *Amanita tephrea*. — 192. Elements of volval remnants from cap. — 193. Dried fruit-bodies. — 194. Spores. — 195. Elements of volval remnants from cap. (Figs. 192–194, from *Hesler 8042*; 195, from *Hesler 23016*.)

globose to broadly clavate cells up to 20 μ wide. Trama of gills bilateral; subhymenium subcellular to cellular. Pileipellis a rather thin layer of interwoven hyphae 3–6 μ wide, gelatinizing near surface where exposed, hardly yellowish in alkaline solution. Remnants of volva on cap (Fig. 190) made up of more or less erect, parallel, irregular, branching, easily broken chains of mostly globose, ellipsoid and clavate, but also irregularly shaped and elongate cells, 15–45 × 10–40 μ, and very few hyphae 3–5 μ wide; colourless in alkaline solution; oleiferous elements lacking or very scarce. Trama of stem with scattered, upright, terminal, large, clavate cells among longitudinal hyphae and chains of elongate cells. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in forest in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: New York, Closter, Aug. 1877, *C. F. Austin* (holotype: NYS); Tennessee, Knoxville, 11 July 1934, *J. K. Underwood* (*Hesler 4074* in part, mixed with *A. rhopalopus*; TENN, L).

The epithet '*chlorinosma*' is one of the most frequently misapplied names in the genus *Amanita*. Beyond doubt one of the reasons for this is that a smell like that of "chloride of lime" (see p. 333) is rather common among the species of section *Lepidella*. Moreover, the true *A. chlorinosma* seems to be less common in the eastern U.S.A. than several related species. I have examined dozens of collections filed under this name in several herbaria. Only one of these matched the type satisfactorily.

Characteristic of *A. chlorinosma* are its large, white fruit-body, the powdery volval layer on its cap forming warts only at the centre, the presence of clamps, and its relatively small spores (8.5–10.5 × 5–6 μ).

Coker's *A. chlorinosma* (1917: 76) is a mixture of several species. The large-spored collections cited by Coker probably belong to *A. polypyramis*. His 'form B' is *A. daucipes*, and his 'form A' a mixture of *A. pelioma* and *A. microlepis*.

AMANITA TEPHREA, *nom. prov.*—Figs. 192–195

Cap (Fig. 193) about 40–90 mm wide, convex, plano-convex, or flat, with non-sulcate, appendiculate margin, 'pale drab-grey' (*Totten 5625*), when dried pale buffy grey, entirely pulverulent-floccose to pulverulent-verrucose from concolorous remnants of friable volva on unpolished to somewhat shiny pileipellis. Gills subdistant, just reaching apex of stem, moderately broad to narrow, ochraceous in dried material, with white, subflocculose edge; short gills subtruncate to attenuate. Stem up to 100 × 10 mm, equal or attenuate upward, with clavate, somewhat rooting base up to 25 mm wide, exannulate, flocculose, from pallid at apex to buffy grey above bulb, without distinct remnants of volva.

Spores [35/4] (9–)10–12.5(–14) × 5.5–7(–7.5) μ, length-breadth ratio 1.4–2.5 (averages 1.65–1.8), elongate to cylindrical, often elongate-obovoid, sometimes slightly hooked near apiculus, thin-walled, colourless, with refractive, subgranular contents, amyloid (Fig. 194). Basidia 35–55 × 10–12 μ, 4-spored, with clamps. Marginal tissue a narrow fringe of scattered, collapsed hyphae and basidium-like cells. Trama of gills bilateral; subhymenium at first densely ramose, later consisting of irregularly shaped, about coralloid cells. Pileipellis composed of interwoven hyphae 2–6 μ wide, thin and not or partly gelatinized in small specimens, in large ones thick and completely gelatinized, with some oleiferous hyphae. Remnants of

volva on cap (Figs. 192, 195) consisting mainly of suberect to irregularly and loosely disposed, easily broken rows of very pale, generally globose to ellipsoid, but also clavate, elongate or irregular cells, 20–60 × 15–50 μ, on scattered, branching hyphae 3–7 μ wide, and scattered oleiferous hyphae. Trama of stem with abundant, large, clavate, upright, terminal cells. Clamps frequent.

HABITAT & DISTRIBUTION.—Terrestrial in woods in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Tennessee, Carter Co., Roan Mountain, 1200 m alt., 20 July 1935, *L. R. Hesler 8042* (TENN, L); Great Smoky Mountains, Cades Cove, 18 July 1958, *L. R. Hesler 23016* (TENN); 13 Aug. 1938, *A. H. Smith (10114) & Stupka* (MICH); North Carolina: Watauga Co., Blowing Rock, 20 Aug. 1922, *H. R. Totten 5625* (NCU).

OBSERVATIONS.—The above description is based mainly on two out of a collection of nine specimens (*Hesler 8042*). These two were in excellent condition; they were kindly presented to me by Dr. L. R. Hesler.

Hesler & Smith 7536 (MICH) from Highlands, North Carolina, is very similar, but on the average it has longer spores, viz. 11–13.5 × 5.5–7.5 μ, l/b 1.8–2.4 (average 2.05), and longer basidia, viz. 50–60 × 10–11 μ.

Amanita tephrea is a distinct species but since I have scarcely any information about the fruit-bodies in a fresh state I do not wish to describe it formally.

The structure of the volva in *A. tephrea* is quite different from that in *A. onusta*; if any warts are formed, they are shapeless and subpulverulent. *Amanita cinereoconia* differs in that it lacks clamps and has larger, more variable cells in the volva.

The structure of the volva in *A. tephrea* resembles that in *A. chlorinosma*, but that has smaller spores and is white.

Amanita lanosula Bas, *sp. nov.*—Figs. 196–199

Pileus c. 60–100 mm latus, margine appendiculatus, haud vel leviter sulcatus, primo volva adnata, phaea vel fuliginea, floccoso-verrucosa perfecte indutus, dein centro denudatus. Lamellae confertae, liberae, albae (?), sat latae vel subangustae. Stipes c. 120–200 mm longus, 5–15 mm latus, basi elongato-napiformis vel subfusiformis, subradicatus, exannulatus, fibrillosus, infra disperse volvae verruculis phaeis, minutis subornatus. Sporae 8–10 × 5.5–6.5 μ, ellipsoideae vel elongatae, amyloideae. Fragmenta volvae cellulis turgidis globosis vel ellipsoideis hyphisque disseminatis inconditis composita. Fibulae praesentes. Typus: '*M. Goossens 852B*, 4 Dec. 1928, Congo, prov. Equateur, terr. Lisala, Binga' (BR).

ETYMOLOGY: lanosulus, somewhat lanose.

Fruit-bodies (Fig. 198) medium to large, slender. Cap about 60–100 mm wide, more or less plano-convex, perhaps with slight, central depression in which vague umbo, with not or vaguely sulcate, appendiculate margin, at first entirely covered with dark brown, adnate, floccose-verrucose volva (perhaps when young with more distinct warts), with age tending to break up into dark brown, small warts at centre but these soon completely disappearing and exposing a somewhat paler brown (?), shiny pileipellis. Gills crowded, free, moderately broad to rather narrow, white (?), with entire edge; short gills obliquely truncate to attenuate. Stem about 120–200 × 5–15 mm, at base with elongate-napiform to slenderly fusiform, slightly rooting bulb, exannulate, probably brown or brownish, fibrillose, probably with fibrillose remnants of partial veil at upper part; with scattered, very small, dark brown, scale-like warts at base of stem and upper part of bulb.

Spores [20/2] 8–10 × 5.5–6.5 μ, length-breadth ratio 1.4–1.7(–1.85) (averages

1.5–1.6), ellipsoid to elongate, with small apiculus, thin-walled, yellowish in ammonia, usually with refractive, granular contents, amyloid (Fig. 199). Basidia 40–55 × 10–11 μ, 4-spored, often with refractive contents, with clamps. Marginal tissue not seen. Trama of gills bilateral, with elements up to 25 μ wide; subhymenium ramose to inflated-ramose. Pileipellis consisting of interwoven, colourless to brownish hyphae, 2–8 μ wide, with upper layer only gelatinized at centre of cap if not covered by volva. Remnants of volva on cap (Figs. 196, 197) consisting almost completely of globose to ellipsoid cells up to 50 × 40 μ, rarely 80 × 70 μ, with brown, vacuolar pigment, in easily broken, branching rows and rather scattered, branching hyphae 2–10 μ wide; in layer close to pileipellis hyphae more abundant, inflated cells in general larger (up to 90 × 45 μ) and more often ovoid to broadly clavate and with rows of short, elongate cells intermediate between rows of inflated cells of volva and hyphae of pileipellis. Remnants of volva at base of stem consisting of mainly globose, but also clavate, elongate and irregularly shaped, brown cells and abundant hyphae. Trama of stem with terminal, large, clavate cells among hyphae. Remnants of partial veil at top of stem made up mainly of clavate cells up to 75 × 35 μ. Clamps present; observed at base of basidia and at hyphae of trama of gills and pileipellis.

HABITAT & DISTRIBUTION.—Terrestrial in forest of *Gilbertiodendron dewevrei* (De Wildem.) Léon. ("*Macrolobium dewevrei*") in Congo.

COLLECTION EXAMINED.—CONGO, prov. Equateur, terr. Lisala, Binga, 4 Dec. 1928, *M. Goossens 852B* (type: BR).

Amanita lanosula is based on two specimens found in the type collection of *A. lanosa* (see p. 456). It differs from *A. lanosa* in having: (i) ellipsoid to elongate spores; (ii) a pileipellis gelatinizing only at centre and not at margin of cap where the volva forms a continuous, adnate layer, and probably also in having (iii) a slenderly fusiform to elongate-napiform bulb with at the upper part small, scattered, wart-like volval remnants, and (iv) a thinner velum partiale, hence a not really lanose upper part of the stem. Judging by the two specimens available, *A. lanosula* also has less conspicuous warts on the cap than *A. lanosa*. It is possible, however, that the outer layer of the volva is more verrucose in young specimens but has disappeared in the specimens studied.

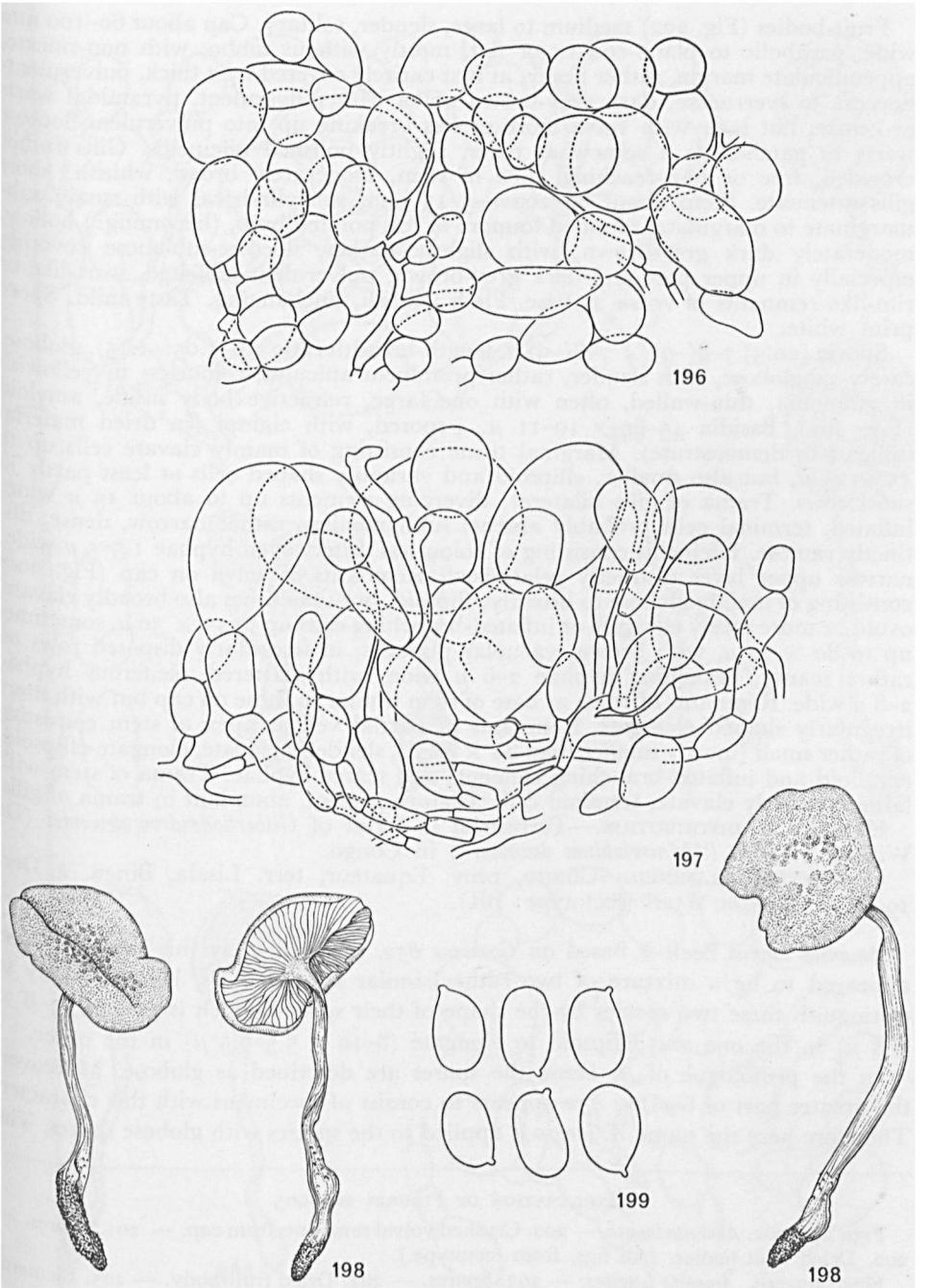
Although information on several characters of the fresh fruit-body of *A. lanosula* is still lacking, it will not be difficult to recognize it if it is collected again.

AMANITA LANOSA Beeli—Figs. 200–202

Amanita lanosa Beeli *in* Bull. Soc. r. Bot. Belg. **63**: 107, fig. 9 (right figure and spores). 1931; *in* Fl. iconogr. Champ. Congo **1**: 20, pl. 3 fig. 2 (left figure?, spores). 1935; E. J. Gilb. *in* Bres., Iconogr. mycol. **27**(2): 409, (3): pl. 71 (left and right figure), 72 (middle figure?). 1941. — *Aspidella lanosa* (Beeli) E. J. Gilb. *in* Bres., Iconogr. mycol. **27**(1): 79. 1940.

EXPLANATION OF FIGURES 196–199

Figs. 196–199. *Amanita lanosula*. — 196. Section of apex of volval wart from cap. 197. Section of base of same wart. — 198. Dried fruit-bodies. — 199. Spores. (All figs. from type.)



Figs. 196–199

Fruit-bodies (Fig. 202) medium to large, slender, solitary. Cap about 60–100 mm wide, parabolic to plano-convex or flat, mostly without umbo, with non-sulcate, appendiculate margin, rather fleshy, at first entirely covered by a thick, pulverulent-floccose to -verrucose, dark grey-brown volva with pulverulent, pyramidal warts at centre, but later with volva more or less breaking up into pulverulent-floccose warts to patches on a somewhat paler, slightly polished pileipellis. Gills rather crowded, free or just reaching apex of stem, moderately broad, whitish; short gills attenuate. Stem about 80–200 × 5–15 mm, subcylindrical with small, submarginate to marginate, rounded to more or less pointed bulb, (becoming?) hollow, moderately dark grey-brown, with slightly darker, floccose-sublanose covering especially in upper part and dark grey-brown, pulverulent-subfelted, wart-like or rim-like remnants of volva at base. Flesh whitish, unchanging. Taste mild. Spore print white.

Spores [20/3] 7–8(–9) × 7–8(–9) μ, length-breadth ratio 1.0–1.05(–1.15), globose, rarely subglobose, with slender, rather prominent apiculus, colourless to yellowish in ammonia, thin-walled, often with one large, refractive body inside, amyloid (Fig. 201). Basidia 45–60 × 10–11 μ, 4-spored, with clamps (in dried material difficult to demonstrate). Marginal tissue consisting of mainly clavate cells up to 45 × 25 μ, but also smaller, ellipsoid and variously shaped cells at least partly in short rows. Trama of gills bilateral; diverging elements up to about 15 μ wide; inflated, terminal cells probably absent; subhymenium rather narrow, dense, distinctly ramose. Pileipellis consisting of colourless, interwoven hyphae 1.5–5 μ wide; narrow upper layer distinctly gelatinized. Remnants of volva on cap (Fig. 200) consisting of mainly globose to broadly ellipsoid, but sometimes also broadly clavate, ovoid or more rarely elongate or inflated-branching cells up to 45 × 30 μ, sometimes up to 80 × 70 μ, with brown, vacuolar pigment, in irregularly disposed rows on rather scanty, branching hyphae 2–6 μ wide, with scattered oleiferous hyphae 2–8 μ wide. Remnants of volva at base of stem similar to those on cap but with more irregularly shaped elements. Remnants of partial veil at apex of stem consisting of rather small (mostly smaller than 60 × 15 μ), slenderly clavate, elongate-ellipsoid, coralloid and inflated-branching elements and scarce hyphae. Trama of stem with large, slenderly clavate, terminal cells. Clamps present, abundant in trama of gills.

HABITAT & DISTRIBUTION.—Terrestrial in forest of *Gilbertiodendron dewevrei* (De Wildem.) Léon. ("*Macrolobium dewevrei*") in Congo.

COLLECTION EXAMINED.—CONGO, prov. Equateur, terr. Lisala, Binga, 4 Dec. 1928. *M. Goossens 852A* (lectotype: BR).

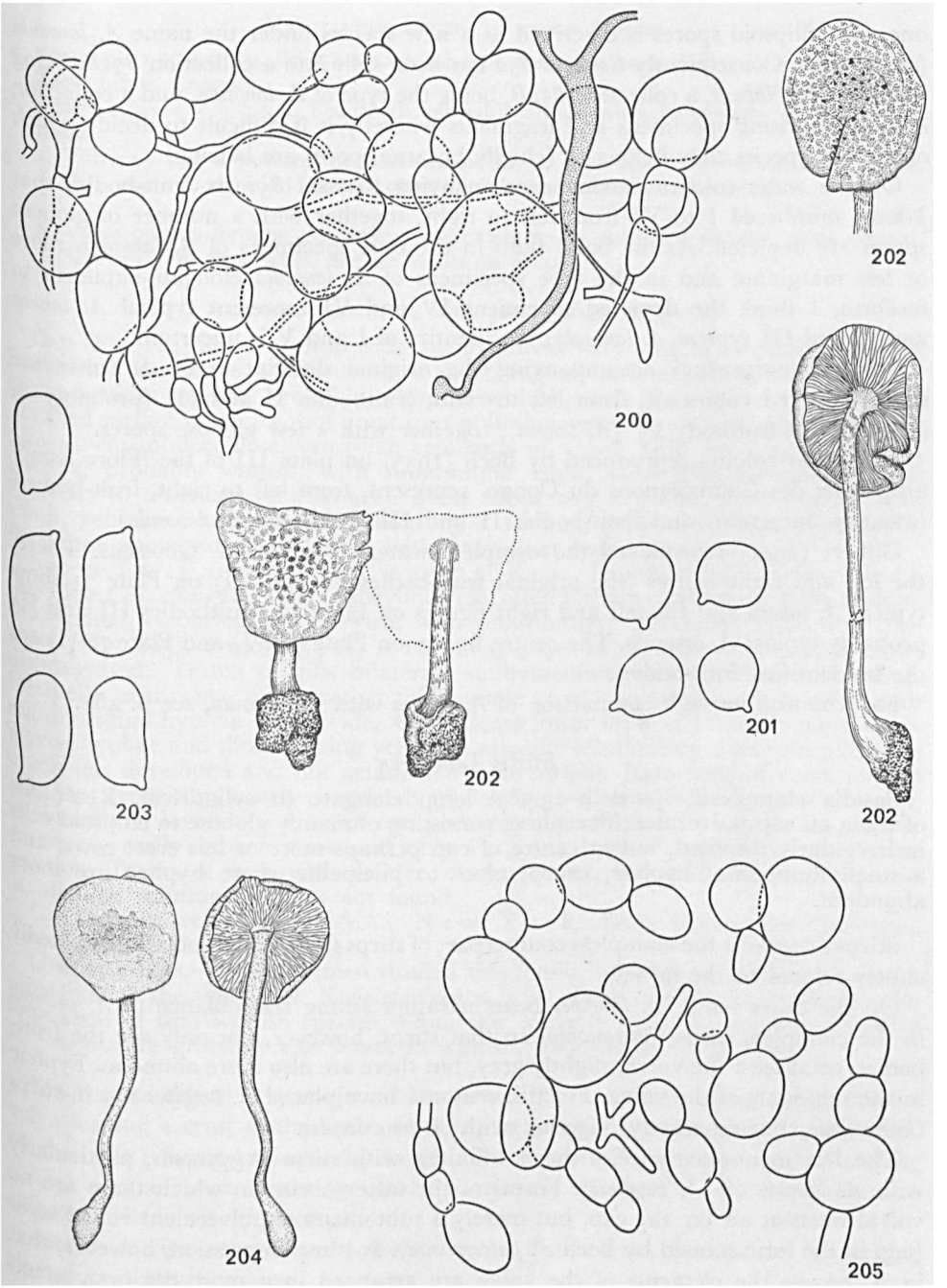
Amanita lanosa Beeli is based on *Goossens 852*. Unfortunately this rich collection appeared to be a mixture of two rather similar species. It is, however, easy to distinguish these two species by the shape of their spores, which is globose (7–8 × 7–8 μ) in the one and ellipsoid to elongate (8–10 × 5.5–6.5 μ) in the other.

In the protologue of *A. lanosa* the spores are described as globose. Moreover, the greater part of *Goossens 852* appears to consist of specimens with this character. Therefore here the name *A. lanosa* is applied to the species with globose spores. The

EXPLANATION OF FIGURES 200–205

Figs. 200–202. *Amanita lanosa*. — 200. Crushed volval remnants from cap. — 201. Spores. — 202. Dried fruit-bodies. (All figs. from lectotype.)

Figs. 203–205. *Amanita longipes*. — 203. Spores. — 204. Dried fruit-body. — 205. Elements of volval remnants from cap. (All figs. from *Peck, Aug. 1906*.)



Figs. 200–205

one with ellipsoid spores is described as a new species under the name *A. lanosula* (see p. 453). Consequently *Goossens 852* has been split into a collection *852A*, being the type of *A. lanosa*, a collection *852B*, being the type of *A. lanosula*, and a collection *852C*, comprising specimens and fragments whereby it is difficult to decide which of the two species they belong to (chiefly because spores are lacking).

On the water-colour drawing accompanying *Goossens 852* six fruit-bodies that I have numbered I to VI from left to right, together with a number of globose spores are depicted. As the basal bulb in the type specimens of *A. lanosa* is more or less marginate and in the type specimens of *A. lanosula* elongate-napiform to fusiform, I think the depicted specimens IV and VI represent typical *A. lanosa* and II and III typical *A. lanosula*; the identity of I and V is uncertain.

Beeli's line-drawings accompanying the original description of *A. lanosa* are slightly altered copies of, from left to right, fruitbodies II and III (probably *A. lanosula*) and fruitbody IV (*A. lanosa*), together with a few globose spores.

The water-colours reproduced by Beeli (1935) on plate III of the 'Flore iconographique des Champignons du Congo' represent, from left to right, fruit-body I (identity uncertain), and fruit-bodies II and III (probably *A. lanosula*).

Gilbert (1941) reproduced the complete water-colour of M. Goossens. There, the left and right figures (the original fruit-bodies IV and VI) on Plate 71 show typical *A. lanosa* and the left and right figures on Plate 72 (fruitbodies III and II) probably typical *A. lanosula*. The centre figures on Plate 71 (V) and Plate 72 (I) are the unidentified fruit-bodies.

For a more thorough comparison of *A. lanosa* with *A. lanosula*, see p. 454.

Stirps LONGIPES

Basidia clampless. Spores 9–13.5 μ long, elongate to cylindrical. Remnants of volva on cap pulverulent-flocculose, consisting of mainly globose to ellipsoid cells in irregularly disposed, but at centre of cap perhaps more or less erect rows, and a small number of hyphae, except close to pileipellis where hyphae are more abundant.

Stirps *Longipes* is the clampless counterpart of stirps *Chlorinosma* and is undoubtedly closely related to the latter.

On the other hand, *A. longipes* bears a rather strong resemblance to *A. pelioma* in the clampless stirps *Cinereoconia*. In that stirps, however, not only are the fruit-bodies, or at least the volva, slightly grey, but there are also more abundant hyphae in the remnants of the volva. For this reason I have placed *A. longipes* not in stirps *Cinereoconia*, but separately, together with *A. amanitoides*.

The last mentioned species shows affinities with stirps *Polypyramis*, particularly with *A. baccata* (= *A. boudieri*). Forms of the latter occur in which there are no volval warts at all on the cap, but merely a subtomentose-pulverulent volval layer (e.g. in the form named by Beeli *A. pulverulenta*). It is my impression, however, that in *A. baccata* the elements of the volva are arranged in a more distinctly erect-parallel position than those in *A. amanitoides*.

KEY TO THE SPECIES OF STIRPS *Longipes*

1. Spores 9–11 × 4.5–6 μ. Fruit-body whitish with yellowish stains. Gills pale yellowish grey. Taste bitter. Congo. *A. amanitoides*, p. 460
1. Spores 10.5–14 × 5–7.5 μ. Fruit-body probably always white to whitish, without yellow stains.
   2. Volva on cap a pulverulent-subflocculose layer, with age disappearing from centre. Gills narrow, crowded. Spores often slightly constricted. Eastern U.S.A. *A. longipes*, p. 459
   2. Volva on cap forming pulverulent-subtomentose to -subfelted patches. Gills normal. Spores rarely constricted. See *A. baccata* on p. 442.

AMANITA LONGIPES, *nom. prov.*—Figs. 203–205

Cap (Fig. 204) about 50 mm wide, plano-convex with a slight, central depression in which a low umbo, with smooth or short, vaguely striate-sulcate, not or slightly appendiculate margin, probably white or whitish, with glabrous, mat to slightly polished surface at centre, but great part of limb covered by thin, probably whitish, pulverulent-subflocculose, crust-like remnants of volva. Gills free, very crowded, narrow, probably whitish, with subgranular edge; short gills subtruncate (the shortest) to attenuate (the longer). Stem about 100 × 5 mm, about equal, with small, ventricose-fusiform bulb about 15 × 10 mm, probably white, exannulate, flocculose above, subfelted below, without distinct remnants of volva.

Spores [20/1] 10.5–13.5(–14) × 5.5–7.5(–8) μ, length-breadth ratio 1.6–2.0 (average 1.8), elongate, rarely subcylindrical, often slightly constricted in the middle, thin-walled, colourless to yellowish, with subgranular, somewhat refractive contents (Fig. 203). Basidia 55–65 × 14–16 μ, 4-spored, clampless. Marginal tissue disintegrated. Trama of gills bilateral; subhymenium subramose to subcellular. Pileipellis near centre of cap rather thick, made up of a gelatinous upper layer, with mainly radial hyphae 2–5 μ wide, and a dense lower layer of broader, more interwoven hyphae and those turning yellow in alkaline solution; near margin pileipellis much less developed and not gelatinized near surface. Remnants of volva on cap (Fig. 205) consisting nearly completely of globose to ellipsoid cells 20–50 × 20–40 μ, in disorderly, but near centre of cap perhaps subparallel and more or less erectly arranged, easily broken rows and only very few hyphae; yellowish in alkaline solution. Trama of stem with slender, clavate, erect, terminal cells, straw yellow in alkaline solution. Clamps not found.

COLLECTION EXAMINED.—U.S.A., New York, Long Island, Port Jefferson, Aug. 1906, *Ch. H. Peck* (NYS).

OBSERVATIONS.—The specimen studied was found, together with its label, in the same box as the type of *A. limbatula* (see p. 530). Peck considered it a form with long stem of that whitish species. From this we may deduce that the colours of *A. longipes* are probably also white to whitish. Field-notes are lacking.

Macroscopically this species is characterized by a slender habit, a pulverulent volva leaving a crust at the limb of the cap, a lacking annulus and very crowded, narrow gills; microscopically by large, often slightly constricted spores, lacking clamps and a volva consisting nearly completely of small (< 50 μ), globose to ellipsoid cells in disorderly rows.

Amanita longipes resembles *A. chlorinosma* but differs from that species in lacking clamps and larger spores.

For a comparison with *A. pelioma*, see p. 468.

Amanita amanitoides (Beeli) Bas, *comb. nov.*—Figs. 206–208

Lepiota amanitoides Beeli *in* Bull. Soc. r. Bot. Belg. **64**: 217, pl. 27 fig. 21. 1932 (basionym). — *Aspidella amanitoides* (Beeli) E. J. Gilb., Not. Amanites (Suppl.): 5. 1941 (not val. publ.)

Fruit-bodies (Fig. 206) medium-sized, rather slender, solitary. Cap 70 mm wide, plano-convex with slight umbo, with non-sulcate margin, dingy white with yellowish stains especially at centre, completely flocculose-pulverulent. Gills rather crowded, free, rather broad, pale yellowish grey; short gills irregularly attenuate. Stem 105 × 8 mm, slightly attenuate upward, with rather abrupt, ventricose-fusiform, slightly rooting bulb 30 × 22 mm, solid, dingy white with yellowish stains, glabrous but with remnants of fugacious ring near top, without remnants of volva at base. Flesh yellowish white, yellow in centre of cap and orange-yellow in middle part of stem. Taste bitter. Spore print white.

Spores [20/1] (8.5–)9–11(–12) × 4.5–6 μ, length-breadth ratio 1.6–2.3 (averages 1.9–1.95), elongate to cylindrical, thin-walled, colourless to yellowish, with guttulate to granular contents, amyloid (Fig. 207). Basidia 39–42 × 9–10 μ (only a few measurable), 4-spored, clampless. Marginal tissue not found. Trama of gills bilateral, with elongate elements up to 30 μ wide; subhymenium difficult to study. Pileipellis consisting of interwoven hyphae 2–7 μ wide, not or hardly gelatinized near surface, golden yellow in alkaline solution, with scanty oleiferous hyphae. Remnants of volva on cap (Fig. 208) consisting mainly of mostly ellipsoid but also more rarely subglobose, clavate, elongate and irregularly shaped cells, 25–60 × 20–50 μ, terminal or in branching rows on scarce, but near pileipellis more abundant, branching hyphae 2–8 μ wide; arrangement of elements irregular with a slight (?) preference for the erect position; golden yellow in alkaline solution; without oleiferous hyphae. Trama of stem with terminal, slenderly clavate cells up to 450 μ long and 55 μ wide and scattered oleiferous hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in forest in Congo.

COLLECTION EXAMINED.—CONGO, prov. Equateur, terr. Lisala, Binga, 17 Aug. 1928, *M. Goossens 805* (holotype: dried fragments of probably one specimen, water-colour drawing; A2342, BR).

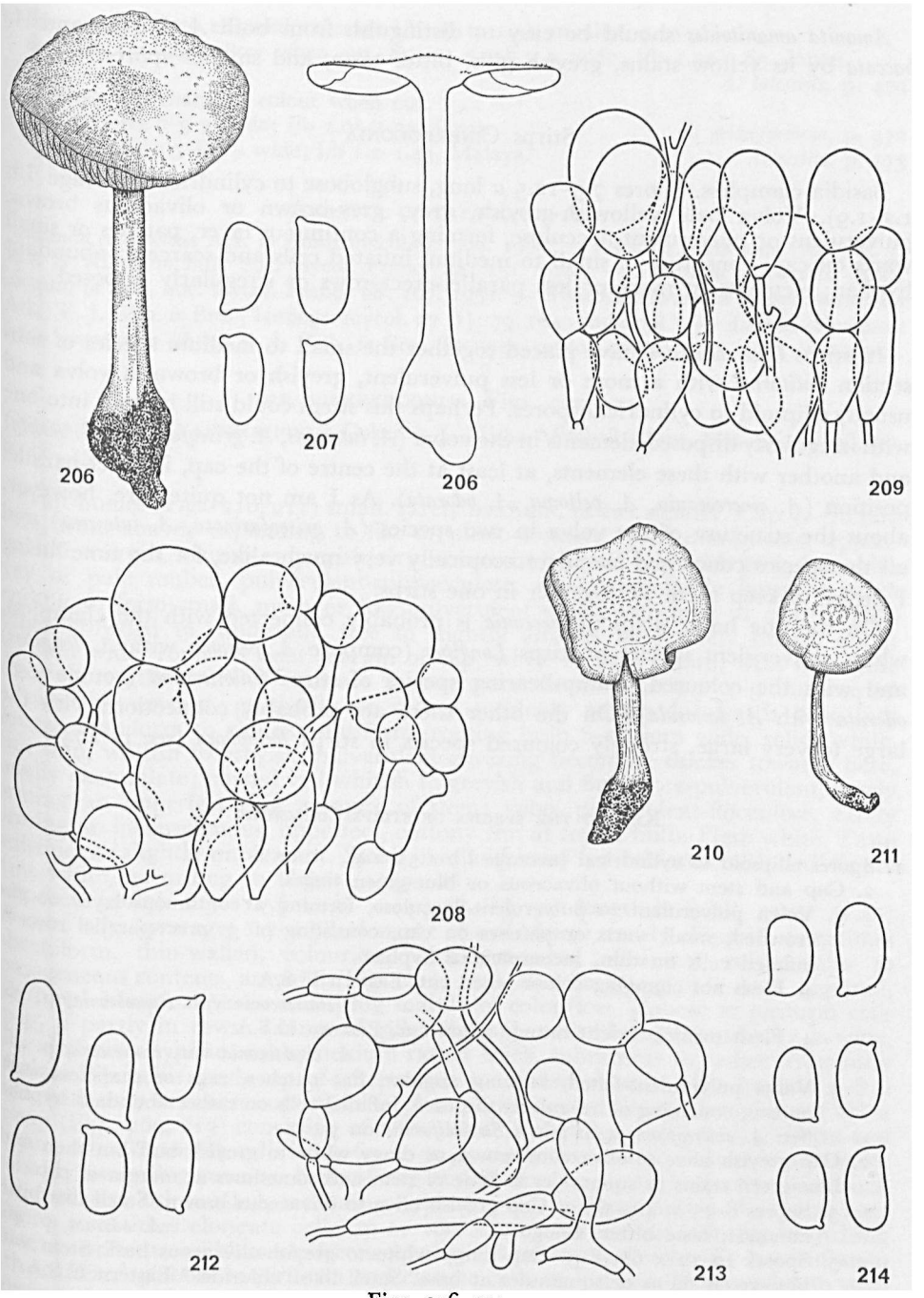
OBSERVATIONS.—Many of the microscopical data mentioned above have to be checked carefully in future collections as the tissues of the only specimen studied are difficult to analyze.

The clampless *Amanita amanitoides* is placed here in stirps *Longipes* because of the irregularly arranged, small inflated cells and scarce hyphae in the volva on the cap. Unfortunately the only fruit-body of the type collection is in poor condition. If in the future it turns out that the elements of the volva are arranged in an erect-parallel position, *A. amanitoides* will have to be placed near *A. baccata* in stirps *Polypyramis*.

EXPLANATION OF FIGURES 206–214

Figs. 206–208. *Amanita amanitoides*. — 206. Fruit-body. — 207. Spores. — 208. Crushed volval remnant from cap. (All figs. from type; 206 after Mrs. Goossens' water-colour.)

Figs. 209–214. *Amanita cinereoconia* var. *cinereoconia*. — 209. Section of volval remnant from cap. — 210, 211. Dried fruit-bodies. — 212. Spores. — 213. Elements of volval remnants from cap. — 214. Spores. (Fig. 209, from *Coker 13518*; 210, from *Coker 10873*; 211, from *Coker 10950*; 212, 213, from *Hesler 13976*; 214 from type.)



Figs. 206–214

Amanita amanitoides should be easy to distinguish from both *A. longipes* and *A. baccata* by its yellow stains, greyish gills, bitter taste, and smaller spores.

Stirps CINEREOCONIA

Basidia clampless. Spores 7.5–12.5 μ long, subglobose to cylindrical (average l/b 1.2–1.9). Volva pale yellowish-greyish, grey, grey-brown or olivaceous brown, pulverulent or pulverulent-flocculose, forming a continuous layer, patches or small warts on cap, consisting of small to medium inflated cells and scarce to abundant hyphae; elements in more or less parallel-erect rows or irregularly disposed.

In stirps *Cinereoconia* I have placed together the small to medium species of subsection *Solitariae* with a more or less pulverulent, greyish or brownish volva and usually ellipsoid to cylindrical spores. Perhaps this stirps could still be split into one with irregularly disposed elements in the volva (*A. lutescens*, *A. griseofarinosa*, *A. vestita*) and another with these elements, at least at the centre of the cap, in erect-parallel position (*A. cinereoconia*, *A. pelioma*, *A. odorata*). As I am not quite sure, however, about the structure of the volva in two species (*A. griseofarinosa*, *A. lutescens*) and all the species concerned are macroscopically very much alike, for the time being I prefer to keep them all together in one stirps.

On the one hand stirps *Cinereoconia* is probably connected with the clampless, white, pulverulent species of stirps *Longipes* (compare *A. pelioma* with *A. longipes*) and with the coloured, clamp-bearing species of stirps *Chlorinosma* (compare *A. odorata* with *A. lanosula*). On the other there are probably connections with the large to very large, strongly coloured species in stirps *Eriophora* (see p. 474).

KEY TO THE SPECIES OF STIRPS *Cinereoconia*

1. Spores ellipsoid to cylindrical (average l/b 1.55–2.4), < or > 10 μ.
   2. Cap and stem without olivaceous or blue-green tinges.
      3. Volva pulverulent to pulverulent-flocculose, forming a continuous layer or else crowded, small warts or patches on cap, consisting of ± erect-parallel rows of inflated cells on thin, inconspicuous hyphae.
         4. Flesh not changing colour when cut. Eastern U.S.A.
            A. cinereoconia var. *cinereoconia*, p. 463
         4. Flesh turning bright orange when cut. Eastern U.S.A.
            A. cinereoconia var. *croceescens*, p. 464
      3. Volva pulverulent-felted, forming angular, flat patches, rags or shapeless warts on cap, consisting of irregularly disposed, inflated cells on rather abundant hyphae. See *A. cinereopannosa* in stirps *Strobiliformis* on p. 522.
   2. Cap greyish olive to olivaceous brown, or dingy white to greyish buff but then with blue-green stains or squamules at base of stem and sometimes at margin of cap.
      5. Spores 8–13 × 4.5–5.5 μ. Cap greyish olive to olivaceous brown. Smell like bitter almonds; taste bitter. Congo. *A. odorata*, p. 468
      5. Spores 10–12 × 6.5–8 μ. Cap dingy white to greyish-olivaceous buff. Stem with blue-green stains or squamules at base. Smell like "chloride." Eastern U.S.A.
         A. pelioma, p. 465

1. Spores globose to ellipsoid (average l/b up to 1.5), usually < 10 μ.
   6. Flesh turning yellow when cut. Spores 5.5–6.5 μ wide; l/b 1.35–1.65. Japan. *A. lutescens*, p. 470
   6. Flesh not changing colour when cut.
      7. Spores 7–9 μ wide; l/b 1.05–1.35. Japan. *A. griseofarinosa*, p. 472
      7. Spores 5.5–6.5 μ wide; l/b 1.2–1.45. Malaya. *A. vestita*, p. 473

AMANITA CINEREOCONIA Atk.

Amanita cinereoconia Atk. *in* Annls mycol. **7**: 366. 1909. — *Lepidella cinereoconia* (Atk.) E. J. Gilb. & Kühn. *in* Bull. Soc. mycol. France **44**: 151. 1928. — *Armillaria cinereoconia* (Atk.) Locquin *in* Bull. Soc. mycol. France **68**: 167. 1952. — *Aspidella chlorinosma* forma *cinereoconia* (Atk.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940 (misappl.). — *Amanita chlorinosma* forma *cinereoconia* (Atk.) E. J. Gilb. *in* Bres. Iconogr. mycol. **27** (2): 395. 1941 (misappl.).

var. CINEREOCONIA—Figs. 209–214

DESCRIPTION & ILLUSTRATIONS.—Coker *in* J. Elisha Mitchell scient. Soc. **33**: 86, pl. 60, 61, 68. 1917.

Fruit-bodies (Figs. 210, 211) small, rarely medium, rather slender. Cap 30–70 mm wide, from convex expanding to flat or plano-concave, with non-sulcate, appendiculate margin, whitish to greyish, dry, covered with pale yellowish grey, brownish grey or pale umber, pulverulent-subflocculose, easily removable layer of volva tending to form small, more or less pulverulent warts, especially at centre. Gills rather crowded to subdistant, free to slightly adnate, moderately broad, about 3–7 mm wide, rounded near margin of cap, white to pale cream, with flocculose edge; short gills rounded-truncate to attenuate. Stem 50–100 × 4–9 mm, equal or tapering upward, gradually or rather suddenly enlarged towards base into elongate-napiform to elongate-fusiform, rooting bulb 6–18 mm wide, solid, white, with thin, whitish to greyish, pulverulent covering becoming thicker towards base, usually exannulate; partial veil whitish to greyish and flocculose-pulverulent, rarely forming an imperfect ring at apex of stem; volva pulverulent-flocculose, rarely forming an inconspicuous, imperfect, cottony rim at top of bulb. Flesh white. Taste indistinct or slightly unpleasant. Smell like "old ham" or "chloride of lime." Spore print white, according to Coker (1917: 86).

Spores [40/5] 8.5–11.5(–12.5) × (4.5–)5–6.5 μ, length-breadth ratio (1.4–) 1.6–2.0(–2.3) (averages 1.7–1.9), elongate to cylindrical, rarely ellipsoid, sometimes subreniform, thin-walled, colourless, with somewhat refractive, subgranular to homogeneous contents, amyloid (Figs. 212, 214). Basidia 35–55 × 8–10 μ, 4-spored, clampless. Marginal tissue consisting mainly of colourless, globose to piriform cells 15–45 μ partly in rows. Trama of gills bilateral, with elements up to 12 μ wide, with oleiferous hyphae; subhymenium rather thick, subramose to rather irregularly cellular. Pileipellis made up of interwoven to subradial, colourless hyphae 2–8 μ wide, with only at centre superficial hyphae slightly gelatinizing. Remnants of volva on cap (Figs. 209, 213) consisting of rather small, subglobose, ellipsoid, piriform and clavate, often brownish cells up to 60 × 50 μ, rarely 80 × 60 μ, in loosely arranged, probably ascending rows on limb of cap and of denser, parallel, erect rows of such cells, and very thin-walled, ascending hyphae 3–7 μ wide at centre of cap; at base of rows sometimes elongate cells up to 180 × 20 μ and some inflated, branching elements present; without oleiferous hyphae. Remnants of volva at base of stem with scattered globose to piriform and clavate cells on hyphae. Trama of stem with terminal, large, clavate cells. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in woods in the eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Virginia, Mt. Lake, 17 Aug. 1941, *L. R. Hesler 13976* (TENN); North Carolina: Orange Co., Chapel Hill, Battle's Park, 21 Sept. 1908, *W. C. Coker* (holotype: CUP 22628); Macon Co., Highlands, 7 Aug. 1938, *W. C. Coker 10873* (NCU); 19 Aug. 1938, *L. Stewart 10950* (NCU); 21 Aug. 1943, *W. C. Coker 13518* (NCU).

OBSERVATIONS.—In the type and some of the other collections studied the cap is covered by a more or less uniform, pulverulent-flocculose layer, but in *Stewart 10950* and *Coker 13518* distinct, pulverulent-flocculose warts are formed at the centre of the cap. As the pileipellis at the centre of the cap is slightly gelatinized, it is possible that there the shape of the remnants of the volva is determined by the degree of humidity during the development of the fruit-body.

The great friability of the volva is caused not only by its large number of inflated cells, but also by the fact that the hyphae are very thin-walled and therefore very fragile.

The name *A. cinereoconia* Atk. has often been erroneously applied to the grey warted species with clamps, described in this paper under the name *A. onusta* (p. 428). Perhaps one of the reasons for this is that the meaning of Atkinson's name is not understood correctly. The last part of the specific epithet is not derived from the Latin word 'conus' (= cone) but from the Greek 'κονια' which means 'dust' and refers to the completely powdery-flocculose covering of the cap of the type specimens.

In addition to the presence of clamps and firm warts on the cap, *A. onusta* often differs from *A. cinereoconia* by somewhat broader spores (5–8 μ wide; l/b 1.2–2.0), the more rooting base of the stem, and a tendency of the lower part of the stem to form recurving scales.

Amanita tephrea (p. 452) has a greyish pulverulent cap also, but is to be distinguished by the presence of clamps and the irregularly disposed, small elements of the remnants of the volva.

For a comparison with *A. vestita* (p. 473), *A. griseofarinosa* (p. 472), and *A. cinereopannosa* (p. 522), see the discussions under these names.

var. **croceescens** Bas, *var. nov.*—Figs. 215–216

Caro croceescens. Typus: '*A. Holland 9846*, 29 Aug. 1934, North Carolina, Highlands' (NCU).

ETYMOLOGY: croceescens, turning saffron-coloured.

Fruit-bodies (Fig. 215) medium to large, solitary to gregarious. Cap 60–100 mm wide, convex to plano-convex with broad, low umbo and non-sulcate, appendiculate, somewhat inflected margin, thin-fleshed, yellowish grey (exactly Ridgway's 'drab'), dry, with slightly darker, pulverulent-flocculose remnants of volva forming small, conical warts up to 2 mm high and wide, to crust-like patches at centre and small patches to a continuous layer over limb. Gills subdistant to rather crowded, slightly adnexed to narrowly adnate, often irregular and anastomosing, rather narrow, up to 7 mm wide, but intermixed with many narrower ones, whitish with creamy tinge; short gills attenuate. Stem 50–110 × 10–20 mm, mostly subcylindrical or tapering slightly downward, sometimes conspicuously expanded at top, with or

without subfusiform to subnapiform, rooting bulb 25–40 × 15–25 mm, solid, subannulate to exannulate, entirely covered with soft, yellowish grey to grey-brown (somewhat paler than on cap) flocculence, sometimes whitish at top. Ring apical, deciduous, soft, pale yellowish grey, with warty edge, soon disappearing. Flesh white, changing soon to deep bright orange when cut. Smell distinctly like that o "chlorine." Spore print pure white.

Spores [45/3] (9–)10–12 × (5.5–)6–7.5 μ, length-breadth ratio 1.4–1.9 (averages 1.55–1.6), ellipsoid to elongate, sometimes obovoid, amyloid (Fig. 216). Basidia 45–55 × 10–12 μ, 4-spored, clampless. Marginal tissue composed of mainly piriform, ellipsoid and subglobose cells up to 45 × 30 μ. Trama of gills bilateral, probably with terminal inflated cells, with scattered oleiferous hyphae; subhymenium inflated-ramose to irregularly cellular. Pileipellis made up of interwoven to subradial, slightly yellowish hyphae 3–7 μ wide, slightly gelatinized near surface at centre of cap. Remnants of volva on cap consisting of repent to ascending, very thin-walled, inconspicuous hyphae on which mainly piriform, but also ellipsoid to globose, brown cells up to 70 × 50 μ, terminal or in rows, often with slightly thickened walls; in central warts elements distinctly parallel and erect. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial; eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A., North Carolina, Macon Co., Highlands, Ravenel Lake, near Dr. Coker's house, 13 Aug. 1934, *W. C. Coker 9782* (NCU): 29 Aug. 1934, *A. Holland 9846* (type: NCU).

OBSERVATIONS.—*Coker 9782* consists of only one abnormal specimen; *Holland 9846* is a rich and well-annotated collection from the same locality.

The microscopical structures of volva and partial veil, the colours and the smell of this variety are exactly the same as in typical *A. cinereoconia*. However, the variety differs not only in that the flesh turns orange when cut, but also in having larger fruit-bodies, broader spores (6–7.5 μ wide and l/b 1.55–1.6, against 5–6.5 μ and l/b 1.7–1.9 in typical *A. cinereoconia*), and perhaps relatively narrower gills.

Macroscopically *A. lutescens* (p. 470) from Japan is very similar, but the spores of that species are about 2 μ smaller and probably the remnants of the volva on the cap have a different structure; they probably consist of irregularly disposed elements, more abundant and more conspicuous hyphae, scattered oleiferous hyphae and more inflated branching elements.

Amanita pelioma Bas, *sp. nov.*—Figs. 217–219

Pileus c. 50–90 mm latus, conico-convexus vel plano-convexus, margine appendiculatus neque sulcatus, primo siccus denique centro subviscidus, griseolo-olivaceus vel olivaceo-bubalinus, vel pallide brunneo-griseus, raro albidus, pulvereo-flocculosus, centro pulvereo-verruculosus dein glabrescens. Lamellae confertae vel subconfertae, liberae, pallide griseo-olivaceae vel -bubalinae. Stipes c. 90–150 × 8–12 mm, cylindraceus vel deorsum incrassatus, saepe bulbo 15–25 mm lato, clavato vel ventricoso praeditus, interdum radicatus, pallide griseo-olivaceo-bubalinus vel griseolus, exannulatus, pulverulentus, deorsum frequenter veneto-maculatus vel -squamulosus. Annulus apicalis, friabilis, mox evanescens. Caro odore *A. chlorinosmae*. Sporae 10–12.5 × 6.5–8 μ, ellipsoideae vel elongatae, amyloideae, in cumulo cremeae vel griseolo-olivaceo-bubalinae. Fragmenta volvae cellulis turgidis flavidis catenulatis erectis vel inconditis hyphisque composita. Fibulae absentes. Typus: '*H. R. Totten 1253*, 23 Sept. 1914, U.S.A., North Carolina, Chapel Hill' (NCU).

ETYMOLOGY: πελιωμα, bruise (because of blue-green stains at base of stem).

DESCRIPTIONS & ILLUSTRATIONS.—Coker *in* J. Elisha Mitchell scient. Soc. **33**: 80–82, pl. 1. 1917 (exclusive of comments on collections *729*, *858* and *1320*, and pl. 57, which refer to *A. microlepis*).

Fruit-bodies (Fig. 218) medium-sized, rather slender, solitary or subgregarious. Cap about 50–90 mm wide, broadly parabolic to plano-convex, with non-sulcate, appendiculate margin, from greyish olive, greyish-olivaceous buff or pale brownish grey to nearly white, at first completely covered by soft, pulverulent-flocculose, at centre sometimes pulverulent-verrucose, concolorous remnants of volva, rarely with blue-green squamules at margin, with age becoming denudated at centre, there exposing smooth and shiny pileipellis. Gills crowded to moderately crowded, free, probably rather narrow, pale greyish-olivaceous, pale greyish buff or pale brownish grey, sometimes with slight lavender tinge, with flocculose edge; short gills probably attenuate. Stem about 90–150 × 8–12 mm, subcylindrical or tapering upward, merely enlarged downward or with clavate to fusiform bulb about 15–25 mm wide, sometimes rooting, greyish buff, pale greyish-olivaceous buff to very pale greyish, with concolorous, pulverulent, in places sometimes disappearing covering, exannulate, with sometimes very inconspicuous, pulverulent-flocculose, rarely squamulose remnants of volva at base, usually with pale to deep blue-green stain at top of bulb, sometimes squamules of volva coloured blue-green too. Partial veil apical, thick but fragile, breaking and falling away on expansion of cap. Smell like "chloride of lime," or "old ham." Spore print cream, pale grey, olive buff or greyish buff.

Spores [20/1] (9–)10–12.5 × (6–)6.5–8 μ, length-breadth ratio 1.45–1.85 (average 1.65), ellipsoid to elongate, thin-walled, pale dingy yellowish, with subgranular to amorphous, somewhat refractive contents, amyloid (Fig. 217). Basidia about 45–55 × 11–13 μ, 4-spored, clampless. Marginal tissue made up of small, globose, ellipsoid and clavate cells usually smaller than 25 × 20 μ and probably in rows. Trama of gills bilateral; subhymenium ramose to subcellular (?). Pileipellis consisting of more or less interwoven to radial hyphae 2–10(–15) μ wide, at centre of cap with distinctly gelatinized upper layer with hyphae 2–5 μ wide; oleiferous hyphae present, sometimes very conspicuous. Remnants of volva on cap (Fig. 219) composed mainly of rows of yellowish to yellow, subglobose to clavate cells up to 55 × 50 μ, more rarely up to 80 × 50 μ, and scattered hyphae; in warts at centre of cap elements erect and parallel, on limb more irregularly disposed; near pileipellis hyphae and elongate cells relatively more abundant; oleiferous hyphae scarce. Remnants of volva at base of stem similar to those on cap but cells deeper yellow. Trama of stem with erect, terminal, large, slenderly clavate cells; oleiferous hyphae rather abundant.

HABITAT & DISTRIBUTION.—Terrestrial in mixed woods in eastern U.S.A.; type locality on poor, dry soil.

COLLECTIONS EXAMINED.—U.S.A.: North Carolina, Orange Co., Chapel Hill, 23 Sept. 1914, *H. R. Totten 1253* (type: NCU); Tennessee, Knoxville, 6 June 1939, *L. R. Hesler 12225* (TENN); 6 July 1943, *L. R. Hesler 15789* (TENN).

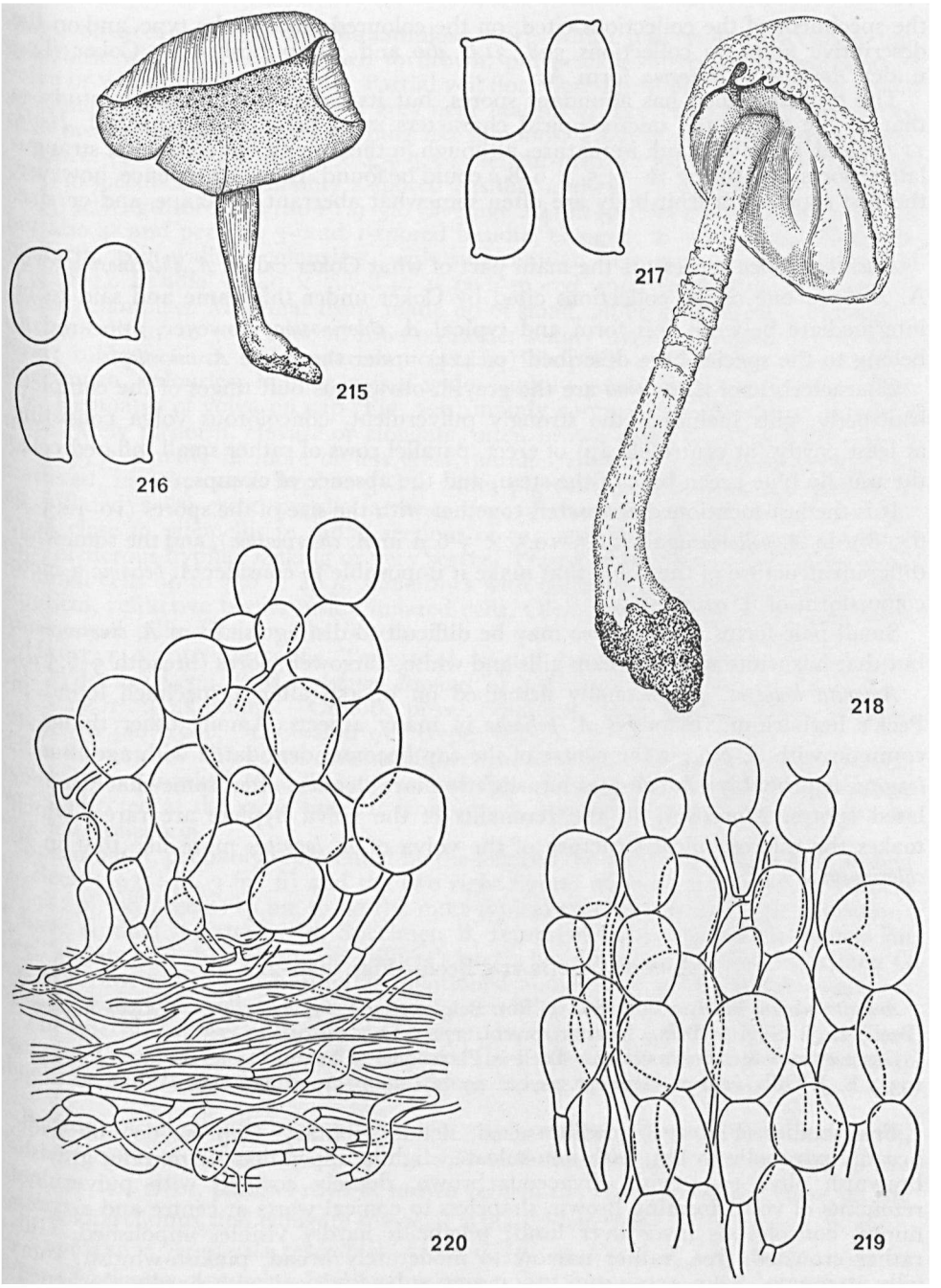
OBSERVATIONS.—The type collection consists of only the young specimen depicted on the coloured plate published by Coker (l.c.); it is not accompanied by field-notes. The foregoing description of macroscopical characters is based on observations on

EXPLANATION OF FIGURES 215–220

Figs. 215, 216. *Amanita cinereoconia* var. *croceescens*. — 215. Dried fruit-body. — 216. Spores. (Both figs. from type.)

Figs. 217–219. *Amanita pelioma*. — 217. Spores. — 218. Fruit-body. — 219. Section of volval wart on cap. (All figs. from type; 218, after Coker, 1917: pl. 1.)

Fig. 220. *Amanita odorata*. — Radial section of pileipellis with volval remnants of type.



Figs. 215–220

the specimens of the collections cited, on the coloured plate of the type, and on the descriptive notes on collections *308*, *314*, *460*, and *791* published by Coker (l.c.) under *Amanita chlorinosma* form A.

The type specimen has abundant spores, but its tissues are difficult to study so that in the future the microscopical characters must be carefully checked. *Hesler 12225* and *15789* are both immature, although in the latter a few somewhat strangulated spores, measuring 12–14.5 × 6–8 μ could be found. In my experience, however, the first spores of a fruit-body are often somewhat aberrant in shape and/or size.

Amanita pelioma represents the main part of what Coker called *A. chlorinosma* form A. At least one of the collections cited by Coker under this name and said to be intermediate between this form and typical *A. chlorinosma*, however, appeared to belong to the species here described (p. 424) under the name *A. microlepis*.

Characteristic of *A. pelioma* are the greyish-olivaceous buff tinges of the complete fruit-body, gills included, the strongly pulverulent, concolorous volva consisting at least partly (at centre of cap) of erect, parallel rows of rather small inflated cells, the usually blue-green base of the stem, and the absence of clamps.

It is the last-mentioned character, together with the size of the spores (10–12.5 × 6.5–8 μ in *A. pelioma* against 8.5–10.5 × 5–6 μ in *A. chlorinosma*), and the somewhat different structure of the volva that make it impossible to consider *A. pelioma* a mere colour-form of *A. chorinosma*.

Small pale forms of *A. pelioma* may be difficult to distinguish from *A. cinereoconia*, but that has white to pale cream gills and white, narrower spores (breadth 5–6.5 μ).

Amanita longipes, provisionally described on p. 459 after a specimen found in Peck's herbarium, resembles *A. pelioma* in many aspects. Among other things in common with *A. pelioma* the centre of the cap becomes denudated with age. But *A. longipes* is probably whitish and has slightly more slender, often somewhat strangulated spores. Moreover, in the remnants of the volva hyphae are rarer, which makes the microscopical structure of the volva of *A. longipes* more like that in *A. chlorinosma*.

AMANITA ODORATA Beeli—Figs. 220–222

Amanita odorata Beeli *in* Bull. Soc. r. Bot. Belg. **63**: 107, fig. 12. 1931. — *Aspidella odorata* (Beeli) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

DESCRIPTIONS & ILLUSTRATIONS.—Beeli *in* Fl. iconogr. Champ. Congo **1**: 21, pl. 3 fig. 6 1935; E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 399, (3): pl. 68. 1941.

Fruit-bodies (Fig. 221) medium-sized, slender, solitary. Cap. 50–60 mm wide, broadly parabolic to flat, with non-sulcate, slightly appendiculate margin, greyish-brownish olive to greyish olivaceous brown, densely covered with pulverulent remnants of volva forming brown, shapeless to conical warts at centre and a continuous, concolorous layer over limb; pileipellis hardly visible, unpolished. Gills rather crowded, free, rather narrow to moderately broad, pinkish-whitish; short gills attenuate. Stem 130–140 × 7–14 mm, subcylindrical with hardly thickened, slightly rooting to slenderly clavate base 12–14 mm wide, solid or stuffed, exannulate,

dingy olivaceous fibrillose-subsquamulose, with white pulverulent-flocculose top, near base with olivaceous brown to brown, pulverulent-subverrucose remnants of volva or without such remnants. Partial veil flocculose-fibrillose, fugacious, in young specimens whitish near stem and grey near margin of cap. Flesh firm, white, when stem broken emitting a fluid smelling like almonds. Taste bitter. Spore print white.

Spores [20/2] 8–9.5(–10.5) × 4.5–5.5 μ, lenght-breadth ratio 1.55–2.05 (average 1.85) in specimens with mainly 4-spored basidia, and [10/1] 9.5–13(–15) × 4.5–5.5 (–6.5) μ, length-breadth ratio 1.9–3.0 (average 2.4) in specimen with many 2-spored but also 4- and perhaps 3- and 1-spored basidia, elongate to cylindrical, often subreniform, thin-walled, colourless, with subgranular, refractive contents, amyloid (Fig. 222). Basidia 30–40 × 7.5–8 μ, 4- or 2-spored, sometimes perhaps 3- and 1-spored, clampless. Marginal tissue made up of small, globose, piriform and broadly clavate cells up to 30 μ wide in rows on rather scanty hyphae. Trama of cells bilateral; subhymenium rather narrow, cellular. Pileipellis rather thin, consisting of interwoven, colourless hyphae 2–6 μ wide, slightly gelatinizing near surface with age. Remnants of volva on cap (Fig. 220) mainly composed of globose to ellipsoid, more rarely piriform, clavate or elongate, often brown cells, 20–60 μ, rarely up to 80 × 55 μ, usually in more or less erect, parallel rows but sometimes directly on scattered, inconspicuous hyphae 3–8 μ wide; pigment intracellular, not present in all inflated cells; erect, parallel arrangement of elements only distinct in layer of volva close to pileipellis in radial sections of cap and in conial warts at centre of cap; oleiferous hyphae lacking or very scarce. Trama of stem with clavate-fusiform, terminal cells up to 350 × 40 μ, sometimes with conspicuous, up to 25 μ wide, flat, elliptical, refractive bodies inside inflated cells. Oleiferous hyphae present in trama of cap and gills. Clamps not observed.

HABITAT & DISTRIBUTION.—Terrestrial in dry forest of *Gilbertiodendron dewevrei* (De Wildem.) Léon. ("*Macrolobium dewevrei*") in Congo.

COLLECTION EXAMINED.—CONGO, prov. Equateur, terr. Lisala, Binga, 8 Nov. 1929—16 Jan. 1930, *M. Goossens 911* (type: BR).

OBSERVATIONS.—The type consists of three more or less complete, dried specimens, which I have marked A-C, and a great number of fragments. Not all the specimens were collected at the same time. It is, however, impossible now to reconstitute the original collection.

Specimen A, probably represented by the left and the right of the figures published by Beeli (1935: pl. 3 fig. 6) and the two right figures of those published by Gilbert (1941: pl. 68), seems to me to be the most typical specimen of the type collection: I have studied it extensively. Specimen B, represented by the middle figures on Beeli's plate and the left one on Gilbert's plate, has no mature spores. Specimen C has aberrant spores and basidia as mentioned above. The seven largest fragments of caps of the type collection have spores resembling those of specimen A.

The aberrant spores of specimen C seem to be explained sufficiently by the occurrence of abnormal basidia, but as the type does not consist of a single collection it should be kept in mind that specimen C may belong to another taxon.

Because of its greyish olive pulverulent cap, smell of almonds, and bitter taste, this tropical species from the Congo is very well characterized. On account of the more or less erect, parallel rows of brown cells in the remnants of the volva on the cap, lacking clamps, and elongate spores, it is placed here near *A. cinereoconia* (p. 463). In appearance *A. odorata* resembles *A. lanosa* (p. 454) and *A. lanosula* (p. 453) in stirps *Chlorinosma*, occurring in the same region, but in those two species clamps are present and the elements of the volva are irregularly disposed.

AMANITA LUTESCENS Hongo—Figs. 223–225

Amanita lutescens Hongo *in* J. Jap. Bot. **33**: 347, fig. 2 ç–d. 1958. — Holotype: *T. Hongo*, 20 Sept. 1956, Japan, Honshu, Ōtsu, Hiyoshi-Shrine (herb. Hongo).

ILLUSTRATION.—Imazeki & Hongo, Col. Ill. Fungi Japan **2**: pl. 12 fig. 76. 1965.

Fruit-bodies (Fig. 223) small to medium, gregarious. Cap 35–60 mm wide, convex then plano-convex or plane, finally slightly concave, with non-sulcate, appendiculate margin, grey, dry, densely covered with very small, darker, brownish grey, pulverulent-subflocculose warts. Gills rather distant, narrowly adnate to free but with corresponding, decurrent lines at top of stem, rather broad, 5–8 mm wide, ventricose, sometimes slightly intervenose, pale cream, with subflocculose edge; short gills rounded-attenuate to attenuate. Stem 35–70 × 4–8 mm, subcylindrical with globose bulb, solid, above ring white and striate, under ring grey and pulverulent-flocculose to -squamulose. Ring superior, membranous, white and striate at upperside, greyish flocculose at underside. Flesh white, turning yellow when cut or broken. Smell strong. Taste mild.

Spores [20/2] 8–10(–10.5) × 5.5–6.5 μ, length-breadth ratio (1.2–)1.35–1.65 (averages 1.45–1.5), broadly ellipsoid to ellipsoid, thin-walled, colourless, with hyaline to subgranular contents, amyloid (Fig. 224). Basidia about 40–50 × 10–12 μ, 4-spored, clampless. Marginal tissue consisting mainly of globose to ellipsoid or piriform cells up to 60 × 40 μ, probably partly in rows. Trama of gills bilateral. Pileipellis made up of interwoven, not or hardly gelatinized hyphae 3–6 μ wide. Remnants of volva on cap (Fig. 225) dingy yellow-brown in alkaline solution, composed of mainly clavate, piriform, ellipsoid, and globose cells up to 60 × 60 μ and 90 × 35 μ, often terminal but sometimes in short rows on abundant normal hyphae 3–8 μ wide of which branching parts often somewhat inflated; elements most probably irregularly disposed; large cells often attached to hyphae directly or else through intermediate, smaller, elongate cells; pigment intracellular; oleiferous hyphae present. Trama of stem with terminal, large, clavate cells; yellowish oleiferous hyphae present but not abundant. Clamps not observed.

HABITAT & DISTRIBUTION.—Terrestrial in deciduous as well as coniferous woods in Japan.

COLLECTION EXAMINED.—JAPAN, Honshu, Ōtsu-city, Terabe, 12 July 1963, *T. Hongo 2723* (L).

OBSERVATIONS.—Although the specimens examined have the appearance of being well dried, their tissues are difficult to reinflate. Therefore the description of the microscopical characters needs verification and completion.

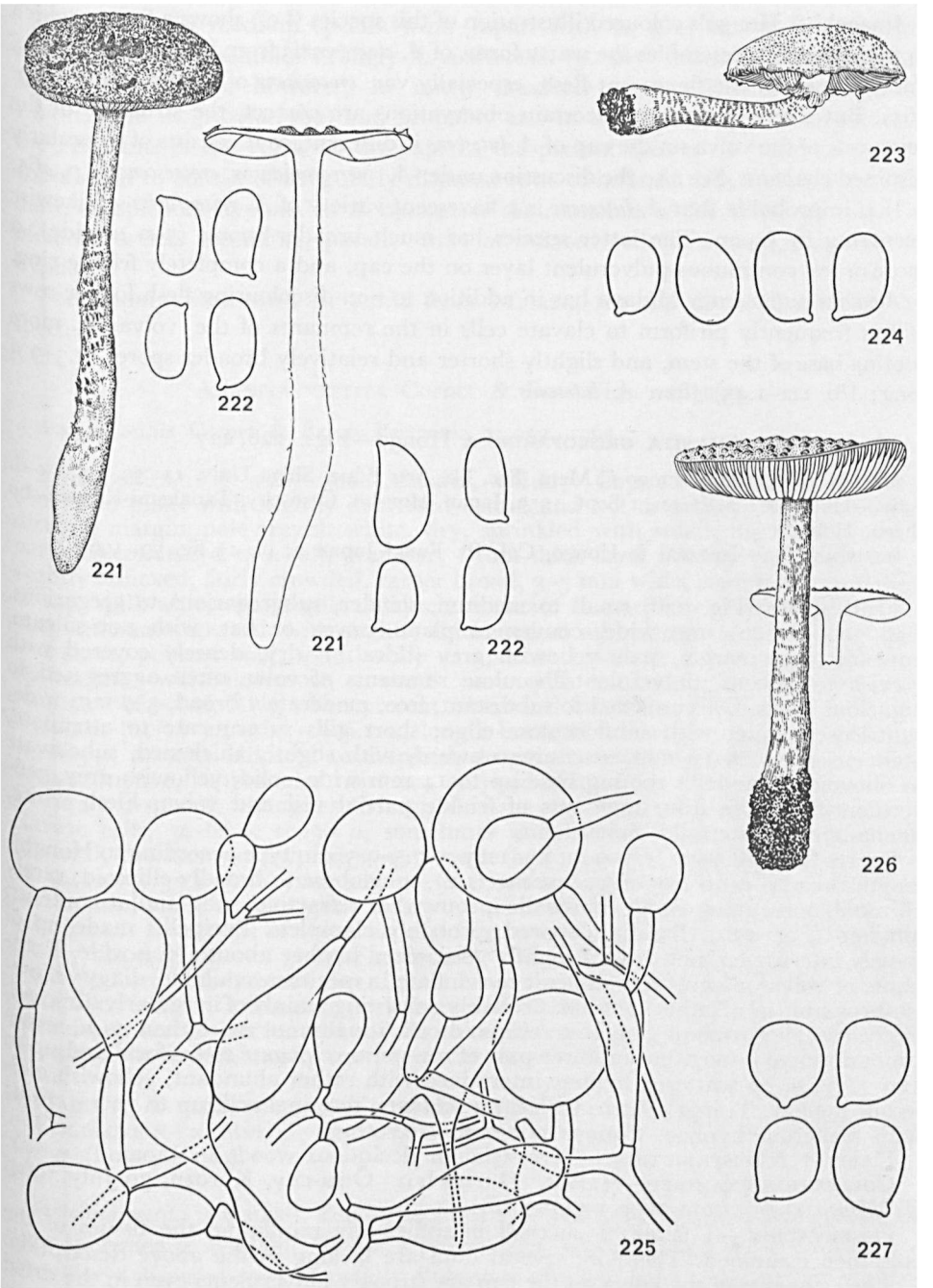
As oleiferous hyphae are not very abundant in the flesh of the cap and the stem, it is improbable that the change of colour of the flesh is caused by the contents of the oleiferous hyphae. In the preserved material all cells and hyphae of the flesh seem to have somewhat refractive, pale yellow contents.

EXPLANATION OF FIGURES 221–227

Figs. 221, 222. *Amanita odorata*. — 221. Fruit-body. — 222. Spores. (Both figs. from type; 221 after Mrs. Goossens' water colour.)

Figs. 223, 225. *Amanita lutescens*. — 223. Fruit-body. — 224. Spores. — 225. Crushed volval remnants from cap. (Fig. 223, from type; after Hongo, 1958: fig. 2; 224, 225, from *Hongo 2723*.)

Figs. 226–227. *Amanita griseofarinosa*. — 226. Fruit-body. — 227. Spores. (Fig. 226, from type; after Hongo, 1961: fig. 1; 225, from *Hongo 2915*.)



Figs. 221–227

Imazeki & Hongo's coloured illustration of this species (l.c.) shows a fungus which in many respects resembles the warty forms of *A. cinereoconia* from the eastern U.S.A., and, because of the flavescent flesh, especially var. *croceescens* of that species (see p. 464). But if my somewhat uncertain observations are correct, the structure of the remnants of the volva on the cap of *A. lutescens* is different, as it consists of irregularly disposed elements. See also the discussion under *A. cinereoconia* var. *croceescens* on p. 465.

It is improbable that *A. lutescens* is a flavescent variety of *A. griseofarinosa*, likewise occurring in Japan. The latter species has much broader spores (7–9 μ wide), a more or less continuous pulverulent layer on the cap, and a completely friable ring.

Amanita vestita from Malaya has in addition to non-discolouring flesh longer rows of less frequently piriform to clavate cells in the remnants of the volva, a more rooting base of the stem, and slightly shorter and relatively broader spores (7.5–9 μ long; l/b 1.2–1.45) than *A. lutescens*.

AMANITA GRISEOFARINOSA Hongo—Figs. 226, 227

Amanita griseofarinosa Hongo *in* Mem. Fac. lib. Arts Educ. Shiga Univ. **11**: 39, fig. 1 c–d. 1961.—Holotype: *T. Hongo*, 1 Sept. 1959, Japan, Honshu, Ōtsu-city, Tanakami-Kurozu-cho (herb. Hongo).

ILLUSTRATION.—Imazeki & Hongo, Col. Ill. Fungi Japan **2**: pl. 13 fig. 79. 1965.

Fruit-bodies (Fig. 226) small to medium, slender, subgregarious to gregarious. Cap 30–65(–100) mm wide, convex to plano-convex or flat, with non-sulcate, appendiculate margin, pale yellowish grey ("drab"), dry, densely covered with greyish to fuscous, pulverulent-flocculose remnants of volva often aggregated to fugacious warts. Gills crowded to subdistant, free, moderately broad, 3–7 mm wide, ventricose, white, with subflocculose edge; short gills subtruncate to attenuate. Stem 70–120 × 5–10 mm, attenuate upward, with slightly thickened, subclavate to obovoid, sometimes rooting base up to 14 mm wide, solid, yellowish grey, pulverulent-flocculose from remnants of friable partial veil and volva. Flesh white, unchanging. Taste mild. Smell faint.

Spores [20/2] 8.5–10 × 7–9 μ (9.5–11.5 × 7.5–9.5 μ in type according to Hongo), length-breadth ratio 1.05–1.35 (average 1.2), subglobose to broadly ellipsoid, rarely ellipsoid, sometimes ovoid, thin-walled, somewhat refractive, subgranular contents, amyloid (Fig. 227). Basidia 4-spored, probably clampless. Pileipellis made up of loosely interwoven, not to very slightly gelatinized hyphae about 4–6 μ wide. Remnants of volva on cap (very difficult to reinflate in specimen available) dingy yellowish-brownish in alkaline solution, probably consisting mainly of irregularly disposed, easily breaking rows of globose to ellipsoid cells usually not more than 40 μ, sometimes up to 70 μ long, but in lower part of rows more elongate to fusiform and up to 100 × 30 μ, on scattered hyphae intermixed with rather abundant, yellowish oleiferous hyphae. Trama of stem with large, clavate, terminal cells up to 300 × 30 μ; with oleiferous hyphae. Clamps not observed.

HABITAT & DISTRIBUTION.—Terrestrial in deciduous woods in Japan.

COLLECTION EXAMINED.—JAPAN, Honshu, Ōtsu-city, Kurozu, 30 July 1964, *T. Hongo 2915* (from type region; L).

OBSERVATION.—I failed to succeed in sufficiently reinflating the tissues of the specimen examined. Therefore several data are lacking in the above description.

The remnants of the volva on the cap are strongly pulverulent; even in the dried specimen they stick to the fingers.

This small to medium species from Japan with its grey-brown, pulverulent-flocculose volva resembles strongly *A. cinereoconia* (p. 463) from the eastern U.S.A. The latter differs, however, in much slenderer spores (l/b 1.6–2.0 against 1.05–1.35 in *A. griseofarinosa*) and probably also in a different type of structure of the remnants of the volva on the cap. In the present species the remnants of the volva seem to consist of irregularly disposed rows of inflated cells and rather abundant, conspicuous hyphae. In *A. cinereoconia* the remnants of the volva are made up of more or less ascending, parallel rows of inflated cells and very inconspicuous hyphae.

For a comparison with *A. vestita* from Malaya, see the discussion under that species.

AMANITA VESTITA Corner & Bas—Figs. 228–230

Amanita vestita Corner & Bas *in* Persoonia **2**: 252. 1962.

Fruit-bodies (Fig. 228) small, slender, solitary. Cap 20–45 mm wide, plano-convex to plane with slightly depressed centre and not or vaguely sulcate, appendiculate margin, pale greyish white, dry, sprinkled with small, micaceous, umber particles condensed to a soft, granular, 1 mm thick layer over centre. Gills free or slightly adnexed, fairly crowded, rather broad, 3–5 mm wide, rounded near margin of cap, milk-white; short gills obliquely truncate to attenuate. Stem 40–80 × 4–8 mm, attenuate upward, with slightly thickened to subbulbous base 6–10 mm wide and short, pointed root, solid, white at apex to brownish below, subannulate to exannulate, white-flocculose, towards base with umber, pulverulent-flocculose remnants of volva. Ring when present white and flocculose. Flesh white, soft.

Spores [20/1] 7.5–9 × 5.5–6.5 μ, length-breadth ratio 1.2–1.45(–1.6) (averages 1.3–1.35), broadly ellipsoid to ellipsoid, sometimes ovoid, colourless, thin-walled, with refractive, subgranular contents, amyloid (Fig. 229). Basidia 30–40 × 8–10, 4- rarely 2-spored, clampless. Marginal tissue consisting of scattered, globose to clavate cells, 30–60 × 10–30 μ, sometimes with brown contents. Trama of gills bilateral, consisting of hyphae 3–12 μ wide and scattered, terminal, inflated cells up to 110 × 35 μ; subhymenium 20–30 μ wide, subcellular to cellular. Pileipellis rather thin, made up of slightly interwoven to radial hyphae 3–7(–10) μ wide, not gelatinized. Remnants of volva on cap (Fig. 230) consisting mainly of irregularly, loosely disposed rows of globose to broadly ellipsoid, brown cells up to 70 × 55 μ, a few fusiform cells in basal part of these rows, and rather scarce hyphae 2–6(–10) μ wide with inflated branching parts here and there. Remnants of volva at base of stem nearly similar but inflated cells more rarely in rows and hyphae more abundant. Trama of stem with mostly terminal, clavate cells up to 300 × 40 μ. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in jungle; Malaya.

COLLECTION EXAMINED.—SINGAPORE, Botanic Gardens, 23 March 1943, *E. J. H. Corner* (holotype: L).

Amanita vestita is a small, slender tropical species from Malaya of which only the type specimen is available. It has a pulverulent, umber brown volva consisting of irregularly disposed rows of mainly globose to ellipsoid cells and scattered hyphae; the veil breaks into small particles on the dry cap during expansion. It seems closely

related to *A. griseofarinosa* (p. 472) from Japan, which differs mainly in slightly longer, considerably broader spores (8.5–10 × 7–9 μ; l/b 1.05–1.35).

In the protologue of *A. vestita* it is stated that the root-like extension of the base of the stem is another distinguishing character. However, Dr. Hongo, Ōtsu, kindly informed me that of *A. griseofarinosa* specimens have been collected with a rooting base as well.

Amanita vestita also resembles *A. cinereoconia* (p. 463) from the eastern U.S.A., but that species has more elongate spores (l/b 1.6–2.0) and more or less parallel, ascending elements in the remnants of the volva on the cap.

Stirps ERIOPHORA

Basidia clampless. Spores 8–11 μ long, globose to ellipsoid (average l/b 1.05–1.35). Large to very large, usually exannulate species with grey to brown volva on moderately to strongly coloured cap. Volva forming on cap a thin to fairly thick, subpulverulent to flocculose-felted layer, mostly breaking up into patches or irregular warts consisting of irregularly disposed, small to large, brown, inflated cells, terminal or in short rows on scarce to abundant, sometimes remarkably broad hyphae; sometimes volval elements with thickened walls.

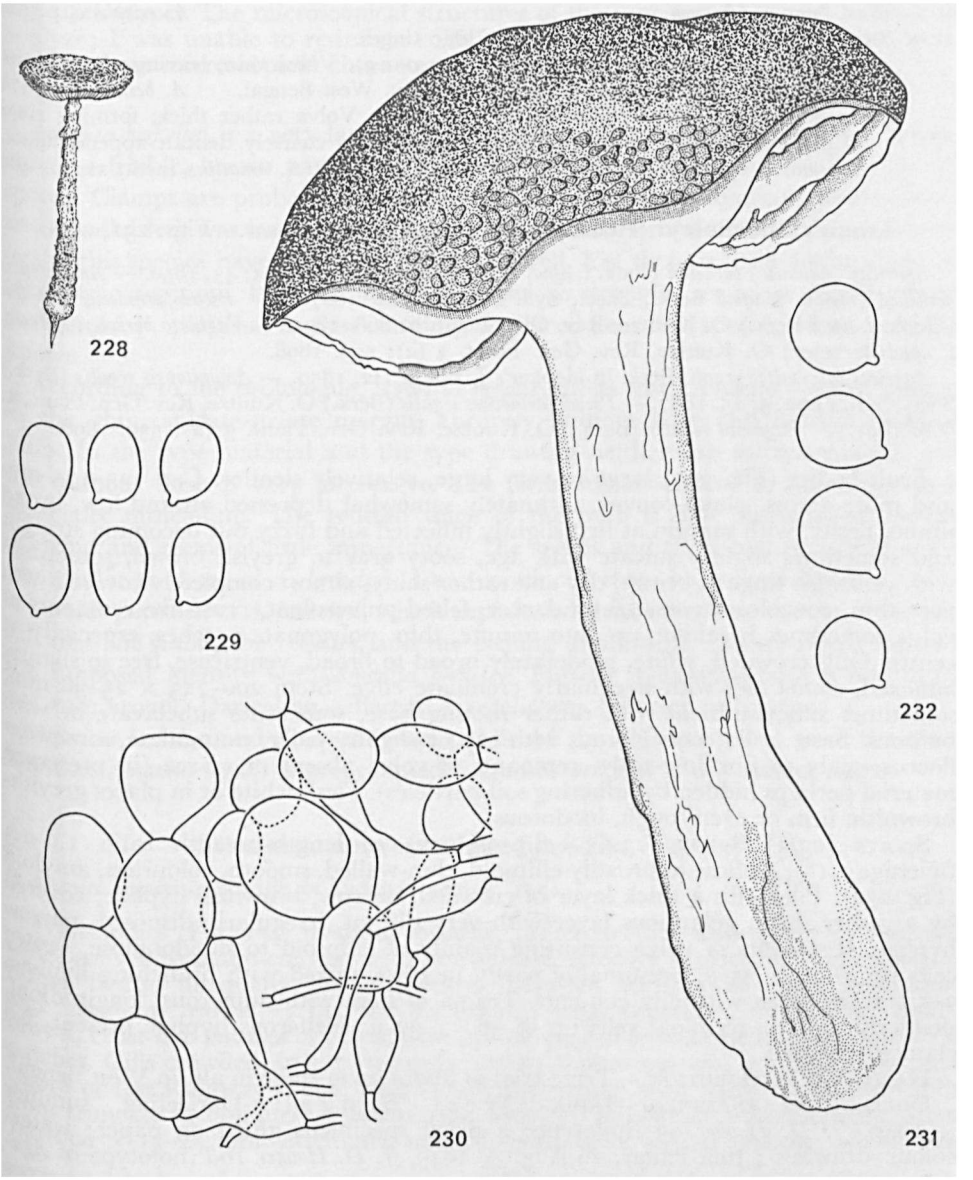
Stirps *Eriophora* comprises a small number of clampless species from tropical S. E. Asia with large to very large fruit-bodies and a coloured volva made up of irregularly disposed elements. It is probably related to stirps *Cinereoconia* which differs mainly in having smaller, often less strongly coloured fruit-bodies and mostly more elongate spores; moreover, most species of stirps *Cinereoconia* occur in temperate regions.

It should be pointed out, however, that the species in stirps *Cinereoconia* with globose to ellipsoid spores (*A. lutescens*, *A. griseofarinosa*, *A. vestita*) further resembles the species of stirps *Eriophora* in that they have a more irregular structure of the volva than the other members of stirps *Cinereoconia;* moreover they occur in Japan and Malaya.

Amanita sculpta in stirps *Sculpta* suggests the species of the present stirps because of its large fruit-body, subglobose (to ellipsoid ?) spores, and deeply coloured volva. It likewise occurs in tropical S. E. Asia. But the elements in its volva show a distinct subparallel-erect arrangement, its flesh colours strongly when exposed, and many elements of its hymenium turn brown to red-brown in KOH and Melzer's reagent. Therefore *A. sculpta* is placed in a separate stirps together with *A. westii* from Florida, with which it has these characters in common. It is possible, however, that *A. sculpta* is rather closely related to stirps *Eriophora*.

KEY TO THE SPECIES OF STIRPS *Eriophora*

1. Cap pinkish to pinkish brown with brown to purple-brown remnants of volva.
   2. Cap pale pinkish to pinkish brown with coarse, subconical to lumpish, purple-brown warts. See *A. sculpta* on p. 483.
   2. Cap pinkish brown with flat, brown patches. Borneo. *A. borneensis*, p. 477
1. Cap yellowish-brownish, brown or grey with rather pale greyish to dark greyish brown or grey remnants of volva.



Figs. 228–230. *Amanita vestita*. — 228. Fruit-body. — 229. Spores. — 230. Crushed volval remnants from cap. (All figs. from type; 228, after Corner's water-colour.)

Figs. 231. 232. *Amanita berkeleyi*. — 231. Fruit-body. — 232. Spores. (Both figs. from type; ×31, after original water-colour.)

3. Stem with greyish lilac, floccose-felted remnants of friable partial veil. Volva forming irregular, greyish brown warts or patches on pale dingy brownish to yellowish cap. West Bengal, Malaya. *A. eriophora*, p. 480
3. Stem whitish, brown or grey, without lilac tinges.
   4. Spores globose to broadly ellipsoid (l/b 1.0–1.3). Volva thin, leaving scarcely any remnants at base of stem. Edge of cap fuzzy. West Bengal. *A. berkeleyi*, p. 476
   4. Spores subglobose to ellipsoid (l/b 1.15–1.55). Volva rather thick, forming rings of prominent warts at base of stem. Edge of cap coarsely dentate-appendiculate. Borneo. *A. ornatipes* ined., see p. 480

Amanita berkeleyi (Hook. f. apud Berk.) Bas, *comb. nov.*—Figs. 231, 232

Agaricus (*Amanita*) *berkeleii* Hook. f. *apud* Berk. *in* Hooker's J. Bot. **2**: 43. 1850. — *Amanitopsis berkeleyi* (Hook. f. *apud* Berk.) Sacc., Syll. Fung. **5**: 24. 1887.[59] — *Pseudofarinaceus berkeleyi* (Hook. f. *apud* Berk.) O. Kuntze, Rev. Gen. Plant. **2**: 868. 1891. — *Vaginata berkeleyi* (Hook. f. *apud* Berkeley) O. Kuntze, Rev. Gen. Plant. **3** (2): 539. 1898.

Agaricus (*Amanita*) *regalis* Berk. in Hooker's J. Bot. **2**: 42. 1850. — *Amanitopsis regalis* (Berk.) Sacc., Syll. Fung. **5**: 25. 1887. — *Pseudofarinaceus regalis* (Berk.) O. Kuntze, Rev. Gen. Plant. **2**: 868. 1891. — *Vaginata regalis* (Berk.) O. Kuntze, Rev. Gen. Plant. **3** (2): 539. 1898.

Fruit-bodies (Fig. 231) large to very large, relatively slender. Cap 125–175 mm and more across, plano-convex, ultimately somewhat depressed around low, broad umbo, fleshy, with margin at first slightly inflected and fuzzy but becoming straight and sometimes slightly sulcate with age, sooty grey to greyish brown, sometimes with yellowish tinge at centre, dry and rather shiny, almost completely covered with very thin, concolorous or slightly darker, felted-pulverulent, crust-like remnants of volva sometimes breaking up into minute, thin, polygonate patches, especially at centre. Gills crowded, white, moderately broad to broad, ventricose, free to slightly adnexed, sometimes with irregularly crenulate edge. Stem 200–225 × 25–38 mm, sometimes subcylindrical with rather rooting base, sometimes subclavate or with bulbous base, solid, concolorous with cap or slightly paler, exannulate, somewhat floccose-scaly to fibrillose-scaly, remnants of volva absent or scarce (in preserved material perhaps hidden by adhering soil particles). Flesh white or in places greyish-brownish, firm or even tough, inodorous.

Spores [23/2] 8–10.5(–13.5) × 6.5–9.5(–12) μ, length-breadth ratio 1.0–1.3 (average 1.15), globose to broadly ellipsoid, thin-walled, smooth, colourless, amyloid (Fig. 232). Pileipellis a thick layer of crowded, narrow, brownish hyphae, covered by a rather thick, gelatinous layer with very distant, irregularly disposed, narrow hyphae. Remnants of volva consisting mainly of ellipsoid to subglobulose, brown cells up to 45 × 35 μ, presumably partly in rows, mixed with branching hyphae, 2–5 μ wide, often with oily contents. Trama of stem with numerous, longitudinal, slenderly clavate, terminal cells up to 360 × 32 μ; oleiferous hyphae present. No clamps observed.

HABITAT & DISTRIBUTION.—Terrestrial at about 2000–2500 m alt. in West Bengal.

COLLECTIONS EXAMINED.—INDIA, West Bengal: Darjeeling, summer ± 1849, *J. D. Hooker 93* (holotype: 4 dried specimens glued on paper; water-colour drawing); Jilla Pahar, 26 Aug. ± 1849, *J. D. Hooker 108* (holotype of *Agaricus regalis*: 2 incomplete specimens glued on paper; water-colour drawing; types and drawings at K, copies of drawings at L).

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[59] In accordance with the rules of botanical nomenclature, the spelling of the epithet '*berkeleii*' is considered an orthographic error so that it has been changed to '*berkeleyi*'.

OBSERVATIONS.—The foregoing description is based on the protologues and type drawings of *Agaricus berkeleyi* and *A. regalis*, and on the facts revealed by an examination of the types. The microscopical structures of the type specimens are difficult to analyze; I was unable to re-inflate sufficiently the tissues of the parts of the fruit-bodies whose microscopical characters are not described above.

Amanita berkeleyi is a very large, brown species with a rather thin, friable, brown volva, a friable, brown partial veil, and rather large, globose to broadly ellipsoid spores. Clamps are probably absent but because of the poor condition of the collections available it was impossible to examine the basidia for this. Several other characters of this species have still to be verified as well. Yet there is little doubt about its taxonomic position. It resembles *A. borneensis* so strongly (see more detailed comparison on p. 480) that it must certainly be placed near that species, which is better known.

According to the protologue, *Agaricus regalis* differs from *Amanita berkeleyi* mainly in the thin, sulcate-striate margin, abruptly bulbous base and reddish tinge of bulb. In the type material and the type drawing neither the sulcate margin nor the bulbous base is very impressive. The term 'sulcato-striate' in the diagnosis is especially misleading. The reddish tinge of the bulb is pale ferruginous in the drawing and seems of little importance. The spores and the structure of the volva are similar to those of *A. berkeleyi*. I am convinced that the type of *Agaricus regalis* is an old specimen of *A. berkeleyi*, which explains why the margin of the cap is slightly sulcate. The habit, the colours, and the lacking annulus of *Agaricus regalis* support the supposed identity with *Amanita berkeleyi*. Further *Agaricus berkeleyi* is said to be not rare around Darjeeling, whereas *A. regalis* was collected only once.

Agaricus berkeleyi and *A. regalis* were published simultaneously but since the combination *Amanita regalis* is preoccupied[60] *Agaricus berkeleyi* is the correct name.

AMANITA BORNEENSIS Boedijn—Figs. 233–237

Amanita borneensis Boedijn *in* Sydowia **5**: 324. 1951.

Fruit-bodies (Fig. 234) medium to large, rather slender. Cap about 60–130 mm wide, convex to plano-convex, with non-sulcate, strongly projecting, fuzzy margin, rather fleshy, unequally pinkish brown (between Ridgway's 'russet vinaceous' and 'sorghum brown'[61]; but see discussion), with abundant, flat, rather small, brown, crust-like patches of volva, with surface probably more or less shiny between patches. Gills crowded, free to narrowly adnate, rather narrow, 4–6 mm wide, pink (more or less Ridgway's 'buff pink' or slightly paler), with entire edge; short gills from truncate to obliquely truncate (the shortest) to attenuate (the longer). Stem 150–200 × 15–25 mm, attenuate upward, with more or less globose, 40–50 mm

[60] *Amanita regalis* (Fr.) Michael, Führ. Pilzfr. **1**: 56. 1903 (basionym: *Agaricus muscarius* var. *regalis* Fr.).

[61] 'Russet vinaceous' is approximately Munsell 10R 5/4 and Séguy 178; 'sorghum brown' approximately Munsell 2.5YR 4/2 and Séguy 691.

wide bulb, solid, concolorous with cap or slightly paler, exannulate, fibrillose to fibrillose-squamulose, flocculose at apex, with brown, rather coarse wart-like remnants of volva near base and on upper part of bulb; these warts arranged more or less in rings. Flesh whitish.

Spores [20/1] 8–10 × 7.5–10 μ, length-breadth ratio 1.0–1.1 (average 1.05), globose to subglobose, with small apiculus, thin-walled, with granular brownish-yellowish contents, amyloid (Fig. 233). Basidia 45–60 × 11–15 μ, 4-spored, clamp-less; scattered basidium-like cells with one rather thick, cylindrical appendix occurring among normal basidia. Marginal tissue a rather thick rim made up of irregularly disposed rows of globose cells 10–35 μ and terminal, mostly piriform cells up to 50 × 35 μ on hyphae 4–7 μ wide. Trama of gills bilateral, almost certainly with inflated, terminal cells up to 110 × 30 μ and terminal rows of shorter cells; subhymenium rather broad, difficult to delimit, subcellular to cellular. Pileipellis consisting of interwoven, but near margin more or less radial hyphae 2–15 μ wide, with brown, vacuolar pigment, gelatinizing near surface except near margin of cap, with scattered, brownish oleiferous hyphae. Fuzzy fringe of margin of cap composed of loosely interwoven, subradial hyphae mainly 10–20 μ wide, terminating in cylindrical, slenderly-fusiform or fusiform, more rarely ellipsoid to globose cells or short rows of such cells. Remnants of volva on cap (Figs. 235–237) consisting of irregularly disposed, up to 60 μ large, globose and up to 90 × 50 μ large, ellipsoid to ventricose-fusiform cells mostly directly on rather abundant hyphae 2–15 μ wide or connected with these through elongate-fusiform to subcylindrical cells up to 200 μ long and 15–25 μ wide; more rarely globose to ellipsoid cells in short rows; most elements with brown, granular contents and sometimes walls distinctly thickened (especially near the margin of cap). Remnants of volva at base of stem composed of abundant hyphae 6–10(–20) μ wide, often with dark brown contents and thickened walls, on which scattered, mostly elongate-ellipsoid or -fusiform, but also clavate, piriform and ellipsoid cells up to 200 × 65 μ. Trama of stem with slenderly clavate, terminal cells, 120–360 × 15–40 μ, on hyphae 5–10 μ wide. Pigment yellow-brown, granular, vacuolar, present in all parts of fruit-body. Clamps absent.

HABITAT & DISTRIBUTION.—Terrestrial, Borneo.

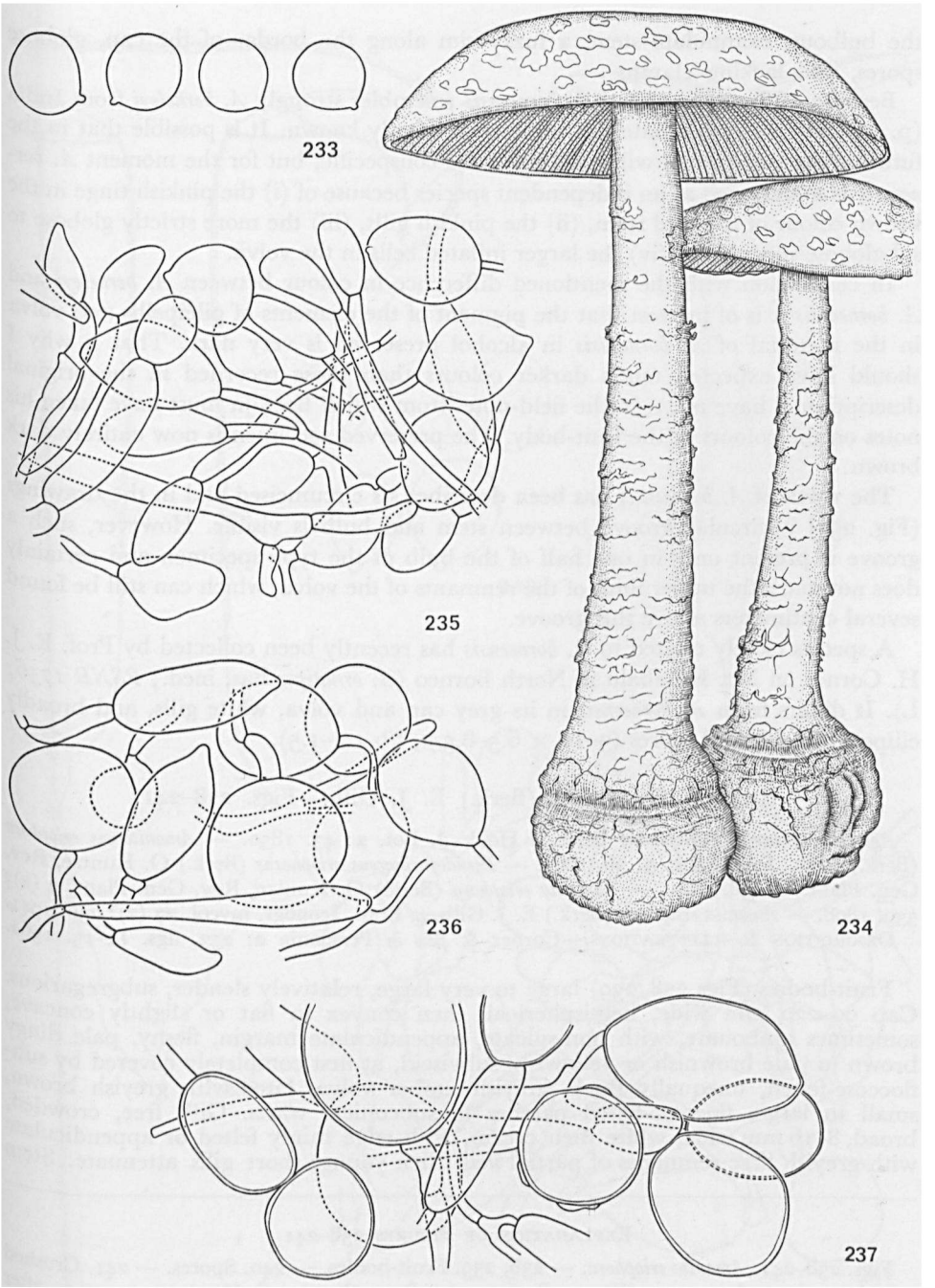
COLLECTION EXAMINED.—INDONESIA, Borneo, Schwaner Gebergte, Bukit Bidang Menabai (near Bukit Raja), ca. 700 m alt., Dec. 1924, *Hans Winkler BO 8936* (lectotype: parts of one fruit-body in liquid; BO).

OBSERVATIONS.—Boedijn (l.c.) did not mention a number for the type collection. His drawing of *A. borneensis* in the Rijksherbarium at Leiden (Fig. 234) shows three fruit-bodies and bears the numbers 8936 and 8888, with no indication to which fruit-bodies the numbers belong. On the label of the collection received on loan from the Herbarium at Bogor both the number 8936 and the indication "Borneo, Dec. 1924" occur. This collection is selected as lectotype. The syntype BO 8888 has the following data on its label: "Borneo 1924, *Hans Winkler 1117*". It is kept in Bogor, preserved in liquid in a jar too large for shipping.

Amanita borneensis is a large species with pinkish brown cap and stem, a brown, friable volva leaving small patches on the cap and rather coarse warts at the base of

EXPLANATION OF FIGURES 233–237

Figs. 233–237. *Amanita borneensis*. — 233. Spores. — 234. Fruit-bodies. — 235. Crushed volval remnants from near centre of cap. — 236. Same from half-way limb of cap. — 237. Same from near edge of cap. (All figs. from lectotype; 234, after Boedijn's drawing.)



Figs. 233–237

the bulbous, exannulate stem, a fuzzy rim along the border of the cap, globose spores, and lacking clamps.

Because of these characters *A. borneensis* resembles strongly *A. berkeleyi* from India (p. 476), which unfortunately is rather imperfectly known. It is possible that in the future these two species will turn out to be conspecific, but for the moment *A. borneensis* is maintained as an independent species because of (i) the pinkish tinge in the brown colour of cap and stem, (ii) the pinkish gills, (iii) the more strictly globose to subglobose spores, and (iv) the larger inflated cells in the volva.

In connection with the mentioned difference in colour between *A. berkeleyi* and *A. borneensis* it is of interest that the pigment of the elements of pileipellis and volva in the material of *A. borneensis* in alcohol preserved is very dark. That is why I should have expected much darker colours than those recorded in the original description. I have not seen the field-notes from which Boedijn must have taken his notes on the colours of the fruit-body. The preserved specimen is now entirely dark brown.

The volva of *A. borneensis* has been described as circumcised and in the drawings (Fig. 234) a circular groove between stem and bulb is visible. However, such a groove is present only in one half of the bulb of the type specimen and certainly does not mark the upper limit of the remnants of the volva, which can still be found several centimeters above this groove.

A species closely related to *A. borneensis* has recently been collected by Prof. E. J. H. Corner on Mt. Kinabalu in North Borneo (*A. ornatipes* Bas, ined.; *RSNB 1756*; L). It differs from *A. borneensis* in its grey cap and volva, white gills, and broadly ellipsoid to ellipsoid spores (9–11 × 6.5–8.5 μ, l/b 1.2–1.5).

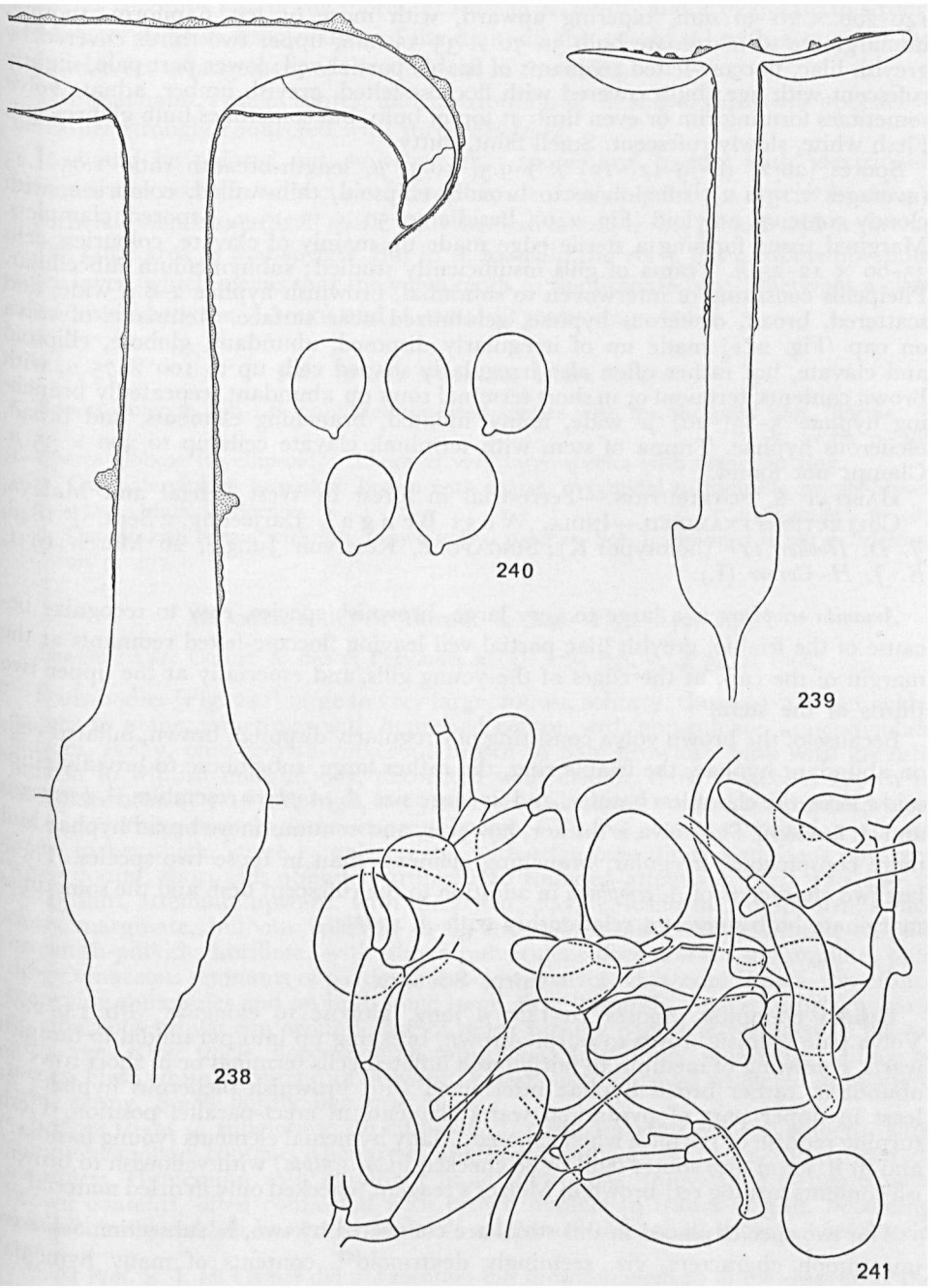
AMANITA ERIOPHORA (Berk.) E. J. Gilb.—Figs. 238–241

Agaricus (*Amanita*) *eriophorus* Berk. *in* Hook. J. Bot. **2**: 43. 1850. — *Amanitopsis eriophora* (Berk.) Sacc., Syll. Fung. **5**: 26. 1887. — *Pseudofarinaceus eriophorus* (Berk.) O. Kuntze, Rev. Gen. Plant. **2**: 868. 1891. — *Vaginata eriophora* (Berk.) O. Kuntze, Rev. Gen. Plant. **3** (2): 539. 1898. — *Amanita eriophora* (Berk.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 230. 1941.
DESCRIPTION & ILLUSTRATIONS.—Corner & Bas *in* Persoonia **2**: 253, figs. 12–15. 1962.

Fruit-bodies (Figs 238, 239) large to very large, relatively slender, subgregarious. Cap 90–220 mm wide, hemispherical, then convex to flat or slightly concave, sometimes umbonate, with non-sulcate, appendiculate margin, fleshy, pale dingy brown to pale brownish or yellowish, subviscid, at first completely covered by subfloccose-felted, unequally thick, greyish umber volva, later with greyish brown, small to large, floccose-felted patches to subconical warts. Gills free, crowded, broad, 8–16 mm wide, white then cream, with edge thinly felted or appendiculate with greyish lilac remnants of partial veil when young; short gills attenuate. Stem

EXPLANATION OF FIGURES 238–241

Figs. 238–241. *Amanita eriophora*. — 238, 239. Fruit-bodies. — 240. Spores. — 241. Crushed volval remnants from cap. (Figs. 238, 240, 241, from *Corner, 26 March 1931*; 239, after sketch in Corner's field-notes.)



Figs. 238–241

140–200 × 20–30 mm, tapering upward, with more or less napiform, rooting, immarginate to marginate bulb 30–70 × 35–55 mm, upper two thirds covered by greyish lilac, floccose-felted remnants of friable partial veil; lower part pale, slightly rufescent with age; bulb covered with floccose-felted, greyish umber, adnate volva sometimes forming rim or even limb at top of bulb, but sometimes bulb glabrescent. Flesh white, slowly rufescent. Smell faint, nutty.

Spores [20/2] (8–)9–11(–12) × 7–9.5(–10.5) μ, length-breadth ratio 1.05–1.25 (averages 1.15–1.2), subglobose to broadly ellipsoid, thin-walled, colourless, with cloudy contents, amyloid (Fig. 240). Basidia 40–50 × 11–13 μ, 4-spored, clampless. Marginal tissue forming a sterile edge made up mainly of clavate, colourless cells 35–60 × 12–25 μ. Trama of gills insufficiently studied; subhymenium subcellular. Pileipellis consisting of interwoven to subradial, brownish hyphae 2–8 μ wide, and scattered, broad, oleiferous hyphae, gelatinized near surface. Remnants of volva on cap (Fig. 241) made up of irregularly disposed, abundant, globose, ellipsoid and clavate, but rather often also irregularly shaped cells up to 100 × 75 μ, with brown contents, terminal or in short terminal rows on abundant, repeatedly branching hyphae 5–15(–20) μ wide, many inflated, branching elements, and broad, oleiferous hyphae. Trama of stem with terminal, clavate cells up to 300 × 35 μ. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in forest in West Bengal and Malaya.

COLLECTIONS EXAMINED.—INDIA, West Bengal, Darjeeling, 2 Sept. ± 1848, *J. D. Hooker 111* (holotype: K); SINGAPORE, Reservoir Jungle, 26 March 1931, *E. J. H. Corner* (L).

Amanita eriophora is a large to very large, brownish species, easy to recognize because of the friable, greyish lilac partial veil leaving floccose-felted remnants at the margin of the cap, at the edges of the young gills, and especially at the upper two thirds of the stem.

Because of the brown volva consisting of irregularly disposed, brown, inflated cells on abundant hyphae, the friable ring, the rather large, subglobose to broadly ellipsoid spores, the clampless basidia, and its large size *A. eriophora* resembles *A. borneensis* and *A. berkeleyi*. The volva is thicker, however, and contains more broad hyphae and more conspicuous, irregular, branching elements than in those two species. These last two characters of *A. eriophora* in addition to the rufescent flesh and the sometimes marginate bulb suggest a relationship with *A. sculpta*.

Stirps SCULPTA

Basidia clampless. Spores 10–14.5 μ long, globose to elongate (l/b 1.0–2.0). Volva pale reddish brown to purple-brown, breaking up into pyramidal to lumpish warts, consisting of medium to fairly large inflated cells terminal or in short rows on abundant, rather broad hyphae intermixed with brownish oleiferous hyphae; at least in upper part of pyramidal warts elements in erect-parallel position. Flesh turning reddish or purplish when exposed. Many hymenial elements (young basidia?) and in *A. westii* also spores (still to be checked in *A. sculpta*) with yellowish to brownish contents turning red-brown in Melzer's reagent (checked only in dried material !)

The two species placed in this stirps are connected by two, in subsection *Solitariae* uncommon characters, viz. seemingly dextrinoid[62] contents of many hymenial

[62] See discussion on p. 320.

elements (perhaps also of the spores, at least in *A. westii*) and a moderate to strong, reddish to purplish discoloration of the flesh, all this combined with a more or less parallel-erect arrangement of the elements in the volva.

Through habit, type of spores, and distribution of *A. sculpta* this stirps appears to be rather strongly connected with stirps *Eriophora*.

It should be pointed out, however, that spores and basidia with 'dextrinoid' contents also occur in subsection *Limbatulae*, viz. in *A. mutabilis*, a species bearing a superficial resemblance to *A. westii*, with the flesh often turning pinkish and occurring in the same area as that species. But in *A. mutabilis* the volva has a submembranous outer layer, which means that the volva tends to the limbate type. Therefore a close relationship between *A. westii* and *A. mutabilis* seems improbable.

KEY TO THE SPECIES OF STIRPS *Sculpta*

1. Spores elongate (l/b 1.6–2.0). Medium-sized species with membranous ring. Florida. *A. westii*, p. 486
1. Spores globose (to ellipsoid?). Large to very large species with fugacious ring.
   2. Cap pale pinkish to pinkish brown with coarse, pyramidal to lumpish, purple-brown warts. Malaya, Borneo. *A. sculpta*, p. 483
   2. Cap pinkish brown with flat, brown volval patches. See *A. borneensis* in stirps *Eriophora* on p. 477.

AMANITA SCULPTA Corner & Bas—Figs. 242, 243

Amanita sculpta Corner & Bas *in* Persoonia **2** (3): 255, figs. 3, 4, pl. 2. 1962.

Fruit-bodies (Fig. 242) large to very large, robust, solitary. Cap 100–240 mm wide, convex to plane, sometimes with depressed centre, with non-sulcate, appendiculate margin, fleshy, pale greyish-vinaceous brown to pale brownish pink with greyish-pinkish to whitish margin, dry, decorated with distant, dark vinaceous brown to chocolate brown, 3–16 mm high, 2–15 mm wide, slenderly conical to lumpish warts; old caps turning entirely dark vinaceous brown. Gills free, crowded, broad, 7–16 mm wide, rather thick, white to pale cream, with edge pale dingy vinaceous powdery when young; short gills obliquely truncate to rounded-attenuate. Stem 120–240 × 15–45 mm, attenuate upward, with thickened, clavate, fusiform or napiform, sometimes marginate, bulbous base up to 65 mm wide, solid, dingy whitish to pale brownish-pinkish, fibrillose, with above pulverulent-flocculose to squamulose, pale dingy vinaceous remnants of partial veil, below coarser, vinaceous brown, sometimes recurving squamules and on bulb some large, firm, lumpish, vinaceous brown warts or vinaceous brown rim around base of stem; turning completely vinaceous brown with age. Ring thick, floccose-submembranous, pale dingy vinaceous, falling to pieces. Flesh white, turning dull brownish vinaceous to purplish when cut or bruised, firm, sappy. Smell faintly like ripe pears.

Spores 10–11 μ, subglobose (to ellipsoid ?), colourless, thin-walled, smooth, with cloudy-vacuolate contents when fresh, amyloid. Basidia 45–50 × 12–13 μ, 4-spored, clampless. Hymenium with abundant basidiomorphous, thin-walled elements with brown contents, often connected with brown hyphae in trama of gills, becoming conspicuously reddish brown in Melzer's solution.[63] Marginal tissue a broad strip

[63] As Prof. E. J. H. Corner did not mention this brownish pigment in the elements of the hymenium in his notes, it is perhaps a necropigment.

consisting of often brownish, globose, ellipsoid and piriform cells, 18–40 × 16–30 μ, terminal or in rows on hyphae 2–6 μ wide. Trama of gills bilateral; diverging elements up to 20 μ, rarely 25 μ wide (perhaps wider with age); terminal, inflated cells up to 25 μ wide and short terminal rows of such cells present (these cells probably also wider with age); subhymenium subcellular to cellular; many elements with rather dark brown contents. Pileipellis a thick dense layer of interwoven hyphae 2–10(–15) μ wide, with near surface some scattered elongate cells up to 20 μ wide, and not or only slightly gelatinized hyphae 2–5 μ wide, with somewhat thickened walls. Remnants of volva on cap (Fig. 243) consisting of more or less erect-parallel to irregularly disposed, mainly globose to ellipsoid, but also piriform to elongate, inflated cells up to 90 × 90 μ, terminal or in short rows on abundant, branching hyphae 2–10(–14) μ wide, with here and there branching parts somewhat inflated; many cells and hyphae, especially near surface of warts, with pale yellowish brown to deep brown, somewhat refractive contents, difficult to distinguish from the scattered, brown, oleiferous hyphae. Remnants of volva on stem similar to those on cap. Trama of stem with terminal, clavate cells up to 300 × 50 μ. Pigment brown, intracellular, present in all parts of preserved fruit-body. Clamps not observed.

HABITAT & DISTRIBUTION.—Terrestrial in forest in Malaya and North Borneo.

COLLECTIONS EXAMINED.—SINGAPORE, Bukit Timah, 15 Oct. 1939, 9 July 1940 (holotype: L); 2 Sept. 1940, *E. J. H. Corner* (L); NORTH BORNEO, Mt. Kinabalu (at 1050 m alt.), 13 June 1961, *E. J. H. Corner RSNB 581* (L).

OBSERVATIONS.—I was unable to find mature spores in the collections available; this was apparently due to the phenomenon mentioned by Prof. Corner in his field-notes that spores do not mature until the fruit-body is at least half expanded. From the few immature spores I observed, some were globose, but others distinctly ellipsoid.

In the original description of this species I stated that the coloured cells in the hymenium are dextrinoid. This is incorrect. It is true that they are very distinct and reddish brown when observed in Melzer's reagent, but they are hardly less coloured when observed in alkaline solution.

The coloured basidiomorphous cells in the hymenium are probably not cystidioid cells, but mere young basidia. I had no opportunity to compare them with mature basidia, which were still lacking. The brown hyphae in the trama of the gills, with which they are often connected, do not look like vascular hyphae.

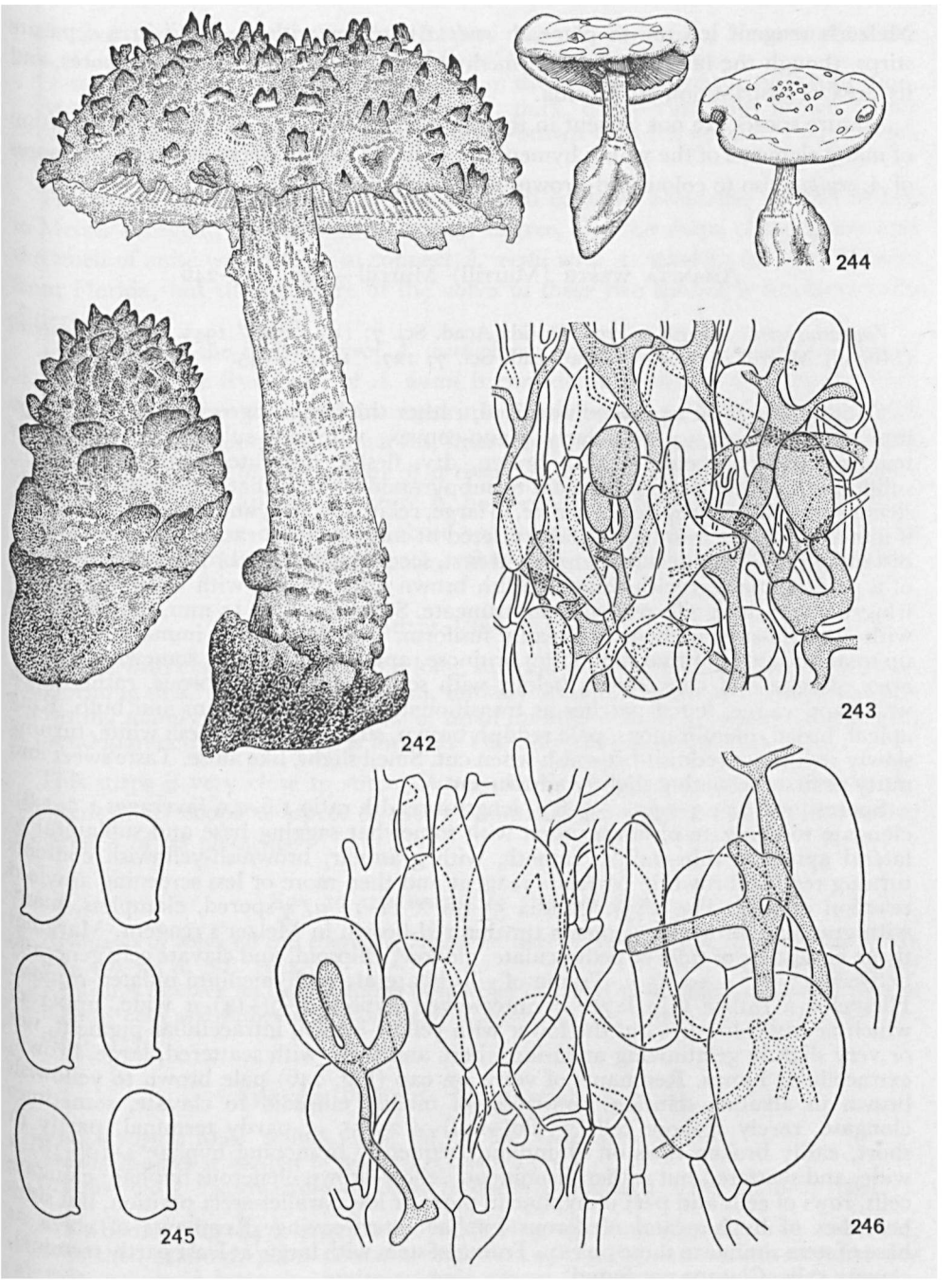
The dark colour of the preserved material is mainly caused by an abundant, intracellular, brown pigment. But it is possible that the walls of the cells are also somewhat coloured.

Because of the coarse, lumpish, purple-brown remnants of the volva, and the strong vinaceous brown discoloration of nearly all parts of the fruit-body, *A. sculpta* is a very characteristic species. It has the large fruit-body, the coloured volva, the subglobose (to ellipsoid?) spores, and the distribution of the species of stirps *Eriophora*. But the more or less erect-parallel position of the elements in the volval warts on the cap, the discoloration of the flesh, and the red-brown elements in the hymenium in

EXPLANATION OF FIGURES 242–246

Figs. 242, 243. *Amanita sculpta*. — 242. Fruit-bodies. — 243. Section of upper part of volval wart from cap. (Both figs. from type; 242, after Corner's water-colour.)

Figs. 244–246. *Amanita westii*. — 244. Dried fruit-body. — 245. Spores. — 246. Section of volval wart from cap. (All figs. from type.)



Figs. 242–246

Melzer's reagent led me to place *A. sculpta* together with *A. westii* in a separate stirps, though the latter species has medium-sized fruit-bodies, elongate spores, and its area of distribution in Florida.

Mature spores are not present in the material studied, but in view of the reaction of many elements of the young hymenium, I should expect the contents of the spores of *A. sculpta* also to colour red-brown in Melzer's reagent.

AMANITA WESTII (Murrill) Murrill—Figs. 244–246

Venenarius westii Murrill *in* Proc. Florida Acad. Sci. **7**: 115. "1944" 1945. — *Amanita westii* (Murrill) Murrill *in* Proc. Florida Acad. Sci. **7**: 127. "1944" 1945.

Fruit-bodies (Fig. 244) medium-sized, rather thickset, subgregarious. Cap 70–90 mm wide, convex to irregularly plano-convex, with non-sulcate, appendiculate margin, uniformly pale reddish brown, dry, fleshy, decorated with concolorous, subfloccose, rather firm, pyramidal to subpyramidal warts that are small, relatively slender, and rather crowded at centre, to large, relatively, low, and broad (up to about 6 mm wide and 3 mm high) and scattered at margin. Gills rather crowded to subdistant, adnate with decurrent ridges at first, seceding later on, broad, not ventricose, of a peculiar pale greyish tinge, reddish brown after drying, with thick, flocculose-fringed edge; short gills probably subtruncate. Stem 70–90 × 15 mm, subcylindrical with obovoid-subnapiform to broadly fusiform, slightly rooting, immarginate bulb up to about 40 × 30 mm, annulate, pruinose, and striate at pale, somewhat greyish apex, shaggy and concolorous below, with some vague, concolorous, rather thick warts and vague, felted patches at transitional zone between stem and bulb. Ring apical, broad, membranous, pale reddish brown, striate, simple. Flesh white, turning slowly reddish to reddish-brownish when cut. Smell slight, like anise. Taste sweet and nutty at first, becoming slightly adstringent.

Spores [20/1] 11.5–14.5 × 7–8 μ, length-breadth ratio 1.6–2.0 (averages 1.7–1.8), elongate to elongate-piriform, often with somewhat sagging base and sublateral to lateral apiculus, thin-walled, smooth, with granular, brownish-yellowish contents turning reddish brown in Melzer's reagent and then more or less screening amyloid reaction of wall (Fig. 245). Basidia 55–70 × 11–14 μ, 4-spored, clampless, many with granular, brownish contents turning red-brown in Melzer's reagent. Marginal tissue consisting of tufts of pedunculate, globose, ellipsoid, and clavate cells generally between 25–45 × 10–25 μ. Trama of gills bilateral; subhymenium inflated-ramose. Pileipellis a rather thin layer of interwoven hyphae 3–9(–14) μ wide, upper of which nearly colourless but the lower with yellow-brown, intracellular pigment, not or very slightly gelatinizing at surface, here and there with scattered, large, brown, extracellular lumps. Remnants of volva on cap (Fig. 246) pale brown to yellowish brown in alkaline solution, consisting of mainly ellipsoid to clavate, sometimes elongate, rarely globose cells 35–80(–140) × 25–55 μ, partly terminal, partly in short, easily broken rows on abundant, frequently branching hyphae 4–10(–18) μ wide, and scattered but rather prominent, yellow-brown oleiferous hyphae; elongate cells, rows of cells and part of hyphae in more or less parallel-erect position, but side-branches of hyphae and oleiferous hyphae interweaving. Remnants of volva at base of stem similar to those on cap. Trama of stem with large, at least partly terminal, clavate cells. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in forest (type under *Quercus*) in Florida.

COLLECTION EXAMINED.—U.S.A., Florida, Alachua Co., Newmann's Lake east of Gainesville, 7 July 1938, *E. West F17466* (holotype: FLAS).

OBSERVATIONS.—I have studied only one of the fruit-bodies of the type collection. At present this fruit-body has a peculiar, dark, dingy vinaceous brown colour except for the gills, which are blackish purple-brown with the flocculose edge much paler vinaceous buff.

The spores and basidia with slightly coloured contents becoming reddish brown in Melzer's reagent, the size and, to a lesser degree, also the shape of the spores and the smell of anise would seem to connect *A. westii* with *A. mutabilis* (p. 542) likewise from Florida, but the structure of the volva of these two species is fundamentally different.

The colour of the fruit-body of *A. westii* fresh or dried closely resembles that of *A. sculpta*. But the fruit-body of *A. westii* is considerably smaller and the elements of its volva are more distinctly arranged in a parallel-erect position. The very thick volva of *A. sculpta* comprises numerous, interwoven, brown, oleiferous hyphae more or less concealing the basal structure of its tissue. At least in the upper part of pyramdal warts on the cap this structure is, however, very similar to that in *A. westii*.

Therefore, in spite of the subglobose spores, the large size, and the exuberant volva of *A. sculpta*, I consider this species closely related to *A. westii*.

Stirps VIRGINEA

Basidia with clamps. Spores 7–9 μ long, subglobose to broadly ellipsoid. Volva on cap forming small to rather large, firm, initially adnate, conical to subconical warts consisting mainly of long, erect rows of small inflated cells so strongly coherent that a pseudoparenchymatic tissue is formed. The only species completely white.

This stirps is very close to stirps *Chlorinosma*. It is kept separate because of the different macroscopical aspect of the remnants of the volva caused by the strong coherence of its elements.

KEY TO THE SPECIES OF STIRPS *Virginea*

1. Remnants of volva on cap consisting almost entirely of erect rows of inflated cells. Spores 7–9 × 6–7.5 μ. S.E. Asia. *A. virginea*, p. 487
1. Remnants of volva on cap consisting of more or less erect to irregularly disposed rows of inflated cells and rather abundant hyphae. Spores 8–10.5 × 6–7.5 μ. See *A. virgineoides* on p. 435.

AMANITA VIRGINEA Mass.—Figs. 247–249

Amanita virginea Mass. *in* Bull. misc. Inf. R. bot. Gdns Kew 1908: 1.
Amanita sumatrensis Boedijn *in* Sydowia 5: 326. 1951.
DESCRIPTION & ILLUSTRATIONS.—Corner & Bas *in* Persoonia 2: 248, figs. 6–8. 1962.

Fruit-bodies (Fig. 247) large, rather thickset, gregarious. Cap 100–155 mm wide, convex then plane or plano-concave, with non-sulcate, appendiculate margin, dry at first, subviscid later on, white to pale cream, pulverulent to shiny, at centre densely set with small to rather large, firm, adnate to detersile, conical to subconical,

white warts up to 4 mm high and 3 mm wide, towards margin gradually passing into smaller and softer warts. Gills rather crowded to subdistant, free, 10–18 mm wide, white to whitish, with flocculose, sometimes denticulate edge; short gills attenuate. Stem 60–120 × 15–25 mm, equal or tapering upward, with clavate to globose base up to 50 mm wide, solid, becoming hollow with age, white, pulverulent; flocculose covering breaking up into small, transverse scales; lower part of stem and upper part of bulb with small, white, more or less conical, volval warts often in rings; mostly exannulate. Ring rather thick, but soon breaking to pieces. Flesh white. Smell lacking (Ding Hou). Spore print white (Van Overeem).

Spores [20/2] 7–9 × 6–7.5 μ, length-breadth ratio 1.1–1.3 (average 1.2), subglobose to broadly ellipsoid, thin-walled, colourless, with refractive, granular contents, amyloid (Fig. 248). Basidia 35–50 × 9–11 μ, 4-spored, with clamps. Marginal tissue consisting of globose to ellipsoid cells up to 40 × 30 μ. Trama of gills bilateral, often with many oleiferous hyphae; subhymenium cellular. Pileipellis made up of hyphae 2–8 μ wide, gelatinizing near surface, faintly yellowish in alkaline solution. Remnants of volva on cap (Fig. 249) composed of long, erect, strongly coherent chains of mainly globose to ellipsoid but also piriform, clavate and elongate cells, 20–50(–60) × 12–40 μ, not or faintly colouring in alkaline solution; in base of warts elongate elements more abundant than in top. Trama of stem with rather abundant, terminal, upright, large, clavate cells among many, rather broad, branching hyphae. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in tropical forest in S. E. Asia.

COLLECTIONS EXAMINED.—SARAWAK, Bintulu, 3 July 1966, *Ding Hou 450* (L); SINGAPORE: Botanic Gardens, *Ridley 87 I* (holotype: K); Gardens' Jungle, 1932 & 13 Dec. 1933, *E. J. H. Corner* (L); INDONESIA, Sumatra: Palembang. Talang Betulu, 12 Nov. 1939, *B. D. van 't Woudt 30* (lectotype of *A. sumatrensis*: BO 17143); Batang Palupuh, July 1924, *E. Jacobson 2614* (syntype of *A. sumatrensis*: plate in L; material in BO not examined); Java, *C. van Overeem 1495* (plate only; BO).

OBSERVATIONS.—The lectotype of *A. sumatrensis* (*Van 't Woudt 30*) is in poor condition but I was able to check the size, shape and, amyloid reaction of the spores, the presence of clamps, and the pseudoparenchymatic tissue of the warts on the cap.

Amanita virginea is related to *A. chlorinosma*. The tissue of the volva, however, is more coherent (because of branching chains of cells or anastomoses?) and it therefore forms firmer warts on cap and stem. At first sight under the microscope the tissue of the warts seems to be parenchymatic, but after careful crushing, the erect rows of small, inflated cells can be seen.

See also the discussion under *A. xanthogala* on p. 491.

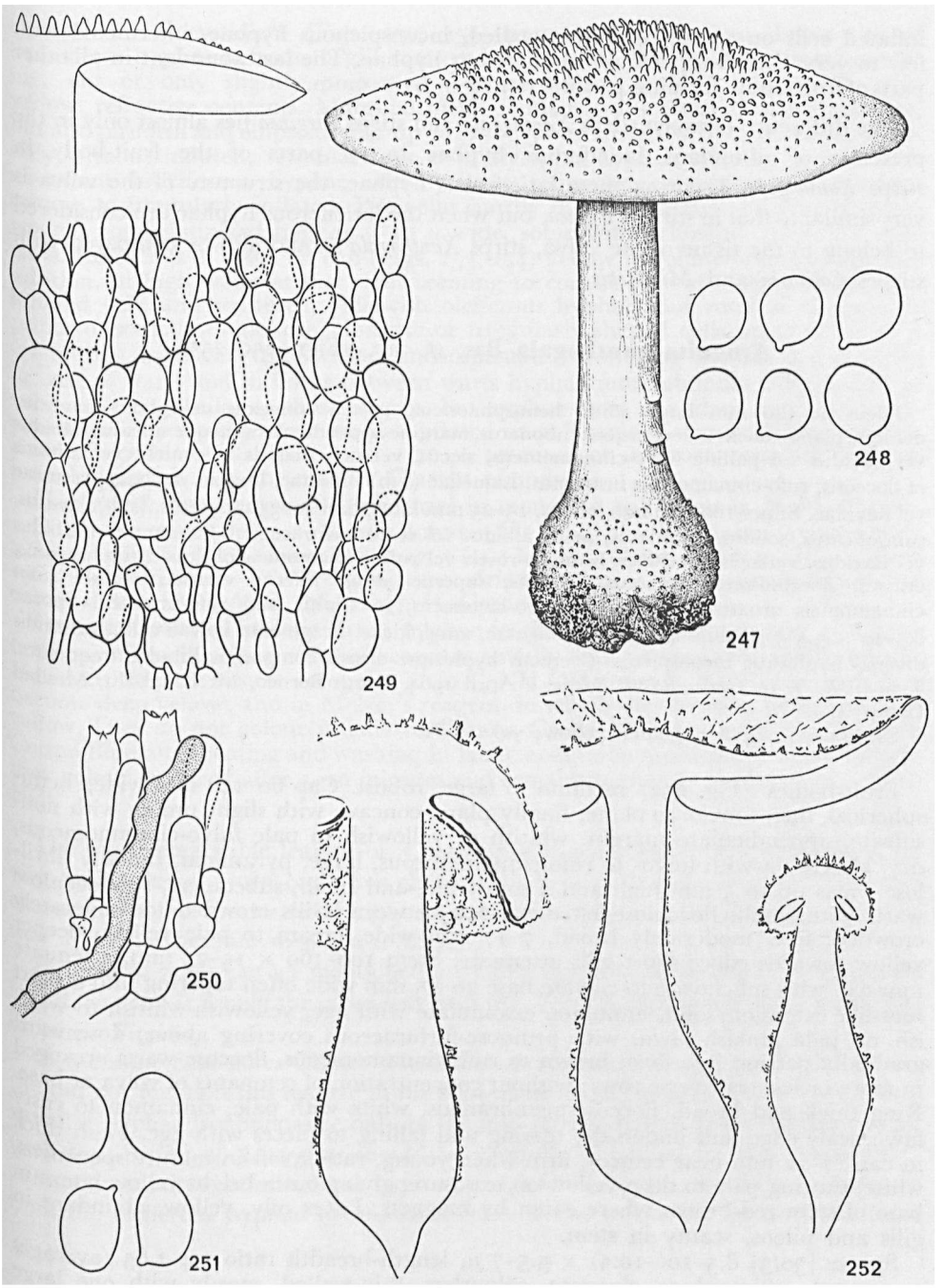
Stirps XANTHOGALA

Basidia with clamps. Spores 8.5–10 μ long, ellipsoid to elongate. Volva on cap forming large, conical warts consisting of long, erect rows of small to medium-sized

EXPLANATION OF FIGURES 247–252

Figs. 247–249. *Amanita virginea*. — 247. Fruit-body. — 248. Spores. — 249. Section of volval wart from cap. (Fig. 247, after Boedijn's type drawing of *A. sumatrensis*; 248, from type; 249, from *Corner, Singapore 1932*.)

Figs. 250–252. *Amanita xanthogala*. — 250. Pseudocystidium (× 500). — 251. Spores. — 252. Fruit-bodies. (All figs. from type; 252, after Corner's drawing.)



Figs. 247–252

inflated cells on scarce, very thin-walled, inconspicuous hyphae, intermixed with few to very abundant, coloured laticiferous hyphae. The last abundant in all other parts of fruit-body, forming pseudocystidia in hymenium.

The difference between stirps *Xanthogala* and stirps *Virginea* lies almost only in the presence of abundant laticiferous hyphae in all parts of the fruit-body in stirps *Xanthogala*. Ignoring these laticiferous hyphae, the structure of the volva is very similar to that in stirps *Virginea*, but when the laticiferous hyphae are considered to belong to the tissue of the volva, stirps *Xanthogala* should also be compared with stirpes *Solitaria* and *Microlepis*.

Amanita xanthogala Bas, *sp. nov.*—Figs. 250–255

Pileus 60–140 mm latus, initio hemisphaericus, postea convexus vel plano-convexus, denique plano-concavus leviterque umbonatus, margine appendiculatus neque sulcatus, albidus vel flavidus vel pallide fulvo-cinnamomeus, siccus, verrucis magnis et conicis, vel minutis et floccosis, rufo-cinnamomeis instructus. Lamellae (sub)confertae, liberae, sat latae, cremeae vel flavidae. Stipes 100–160 mm longus, 15–25 mm latus, basi 20–35 mm latus, (sub)clavatus, subradicatus, solidus, annulatus, apice albido- vel roseo-furfuraceus, infra annulum albidus vel flavidus, verrucis flocculosis brunneo-roseis vel rufo-cinnamomeis obsitus. Annulus latus, crassus, floccoso-membranaceus, friabilis, superne albus, inferne verrucis pallide rufo-cinnamomeis ornatus. Caro alba, flavo-lactescens, in stipitis basi rufo-brunnea. Sporae 8.5–10 × 5.5–7 μ, ellipsoideae vel elongatae, amyloideae. Fragmenta volvae cellulis turgidis diversis hyphisque inconspicuis ± erectis hyphisque oleosis composita. Fibulae frequentes. Typus: '*E. J. H. Corner RSNB 8053a*, 2 April 1964, North Borneo, Mt Kinabalu, Mesilau Camp' (L).

ETYMOLOGY: ξανθός, golden yellow; γαλα milk.

Fruit-bodies (Fig. 252) medium to large, robust. Cap 60–140 mm wide, hemispherical, then convex to plane, finally plano-concave with slight umbo, with non-sulcate, appendiculate margin, whitish or yellowish to pale fulvo-cinnamomeous, dry, closely set with fulvo- to rufo-cinnamomeous, large, pyramidal, radially fibrillose warts up to 5 mm high and 7 mm wide, and small, subconical, subflocculose warts with small, flocculose-felted patches between. Gills crowded to moderately crowded, free, moderately broad, 7–17 mm wide, cream to pale yellow, deeper yellow towards edge; short gills attenuate. Stem 100–160 × 15–25 mm, attenuate upward, with subclavate to clavate base 20–35 mm wide often tapering into a short root-like extension, solid, annulate, exannulate with age, yellowish-whitish to whitish or pale pinkish fawn, with pruinose-furfuraceous covering above, downward gradually passing into fawn brown to rufo-cinnamomeous, floccose warts arranged in more or less transverse rows; without concentration of remnants of volva at base. Ring thick and broad, floccose-membranous, white with pale, cinnamon to rusty fawn, scaly edge and underside, tearing and falling to pieces with age. Flesh thick in cap (7–12 mm near centre), firm when young, rather soft in mature specimens, white, turning pale to deep yellow on exposure, giving out a bright yellow latex; in base of stem red-brown where eaten by maggots. Latex oily, yellow, abundant in gills and pileus, scanty in stem.

Spores [30/3] 8.5–10(–10.5) × 5.5–7 μ, length-breadth ratio 1.4–1.65 (averages 1.45–1.55), ellipsoid to elongate, colourless, thin-walled, mostly with one large refractive body inside, amyloid (Fig. 251). Basidia 45–60 × 9–10 μ, 4-spored, with

clamps. Pseudocystidia[64] (Figs. 250, 255) present in hymenium, being tips of laticiferous hyphae in trama of gill, scattered, 3–8 μ wide, filiform, sometimes branching, not or only slightly projecting beyond mature basidia, thin-walled, with yellow, refractive contents. Marginal tissue consisting of scattered, mainly clavate, but also piriform and ellipsoid cells up to 50 × 30 μ. Trama of gills bilateral, probably without inflated, terminal cells, with diverging hyphae up to 25 μ wide, with abundant laticiferous hyphae with yellow, refractive contents; subhymenium ramose to irregularly inflated. Pileipellis hardly differentiated, consisting of interwoven, non-gelatinized hyphae 3–10 μ wide, some with yellowish, refractive contents. Remnants of volva on cap (Figs. 253, 254) yellow to yellow-brown in alkaline solution, in high warts at first sight seeming to consist only of long, erect rows of inflated cells and scattered, yellowish oleiferous hyphae, but rows of ellipsoid to piriform, sometimes globose, elongate or irregularly shaped cells up to 80 × 50 μ originating from very thin-walled, inconspicuous, branching hyphae 2–8 μ wide; in base of warts and in flocks between warts hyphae more abundant. Remnants of volva on stem similar to those on cap, but hyphae more abundant and more components with yellowish contents, also inflated ones. Trama of stem with longitudinal, slenderly clavate cells up to 400 × 70 μ, terminal or in short, terminal rows on branching hyphae 3–10 μ wide. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in mountain oak forest in North Borneo.

COLLECTIONS EXAMINED.—NORTH BORNEO, Mt Kinabalu: Kundasan (1500 m alt,). 5 Sept. 1961, *E. J. H. Corner RSNB 2793* (L); Mesilau Camp (1400 m alt.), 2 April 1964, *E. J. H. Corner RSNB 8053a* (type: dried specimens, fragments in liquid and colour-slides; L); 9 April 1964, E. J. H. Corner *RSNB 8053b* (L).

OBSERVATIONS.—The laticiferous hyphae in the trama of the cap and gills have been examined in a long series of reagents, usually with no very remarkable results. However, they are easy to recognize in 40 % NH_4OH and 5 % KOH, in which they become deep yellow, and in Melzer's reagent, in which they become deep brownish yellow. They do not colour in sulfovanillin or Cresyl Blue, but turn dark blue in Cotton Blue after heating and washing in lactic acid or lactophenol; in basic fuchsin they colour dark red after 5–10 minutes and remain so after 1–2 minutes in diluted HCl.

The most remarkable feature of *A. xanthogala* is undoubtedly the presence of an oily, yellow latex, given out when the fruit-body is damaged. However, the other characters of this species so strongly suggest those of species in subsection *Solitariae* that I do not hesitate to place it there.

In his field-notes Corner mentioned a general resemblance between *A. xanthogala* and *A. virginea*. It is only the lactescent flesh that keeps me from placing *A. xanthogala* in stirps *Virginea*.

In the same field-notes Corner stated that *A. virginea* is also a very sappy species (he did not mention this feature in his field-notes on *A. virginea*). But I have found vascular hyphae in abundance only in the gills of that species. Nevertheless young, fresh fruit-bodies of *A. virginea* should be carefully examined for this character.

Fundamentally the laticiferous hyphae of *A. xanthogala* are probably not different from the oleiferous hyphae in related species. Those in the pileipellis of *A. timida*

[64] See discussion on p. 322.

showed the same set of reactions as described above for the laticiferous hyphae of the present species, except for paler yellow colours in KOH and NH_4OH.

In young specimens of *A. xanthogala* the coloured, laticiferous hyphae in the volval tissue are sometimes so abundant that they more or less conceal the colourless elements. To my way of thinking, however, the laticiferous hyphae in the volva should in first instance be ignored, if volval structures are compared for possible relationships.

Stirps Rhoadsii

Basidia with clamps. Spores cylindrical to bacilliform, rarely elongate (l/b 1.8–4.2; averages 2.1–3.4). Volva pulverulent or forming small to rather coarse, conical warts on cap, leaving scarcely any remnants at base of stem, consisting of more or less parallel, erect rows of small to medium, mainly subglobose, ellipsoid or clavate cells and very scarce to rather abundant, normal and oleiferous hyphae. Partial veil friable, evanescent, or forming a flocculose annular zone on stem. Stem with cylindrical, rooting base, or fusiform to napiform, more or less rooting bulb.

The species of this stirps are characterized by the combination of cylindrical to bacilliform spores and a volva consisting mainly of more or less parallel-erect rows of inflated cells.

In *A. subsolitaria* and *A. solitariiformis* the structure of the volva with its small inflated cells and scarce hyphae resembles that in stirps *Chlorinosma* (p. 448). But in that stirps the average length-breadth ratio of the spores is always smaller than 2.0. The structure of the volva in *A. rhoadsii* with its larger cells and less rare hyphae resembles that in stirps *Microlepis* (p. 423).

The curious spores of stirps *Rhoadsii* are similar to those of stirps *Roanokensis* (p. 546) but the structure of the volva there is so different that a close relationship seems improbable.

Key to the species of stirps *Rhoadsii*

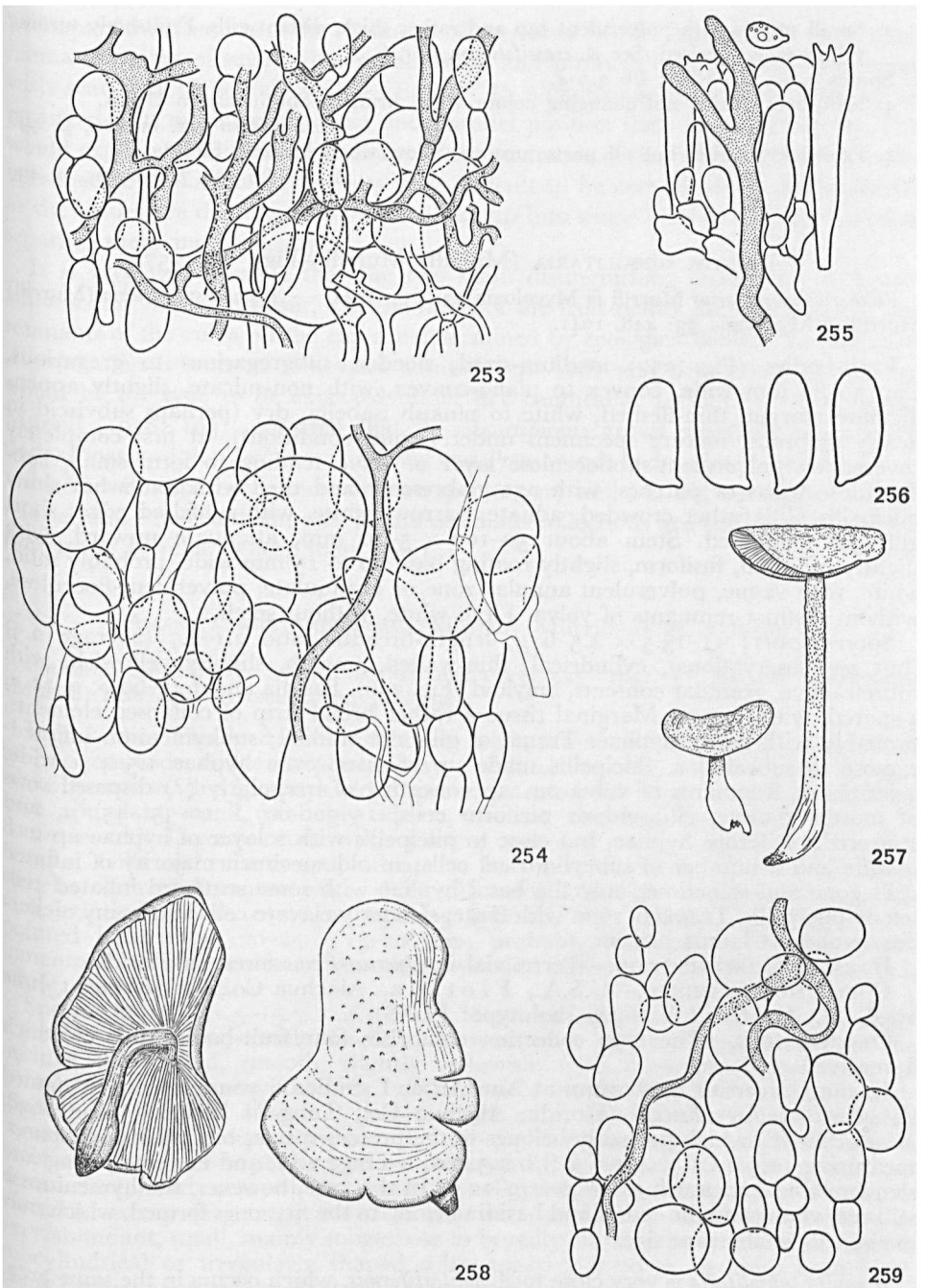
1. Spores 4.5–6 μ wide; l/b 1.5–3.
   2. Medium to large species with rather crowded gills. Fruit-body not changing colour when bruised.
      3. Fruit-body usually slender. Cap white to pinkish isabella, with pulverulent to indistinctly wart- or patch-like remnants of volva. Florida. *A. subsolitaria*, p. 494
      3. Fruit-body usually thickset. Cap white to cream, with abundant, small, conical warts at centre and small patches at limb. Florida. *A. solitariiformis*, p. 495

Explanation of Figures 253–259

Figs. 253–255. *Amanita xanthogala*. — 253. Section of volval wart from young cap. — 254. Same from mature cap. — 255. Pseudocystidium. (Fig. 253, from *Corner RSNB 2793*; 254, 255 from type.)

Figs. 256, 257. *Amanita subsolitaria*. — 256. Spores. — 257. Dried fruit-bodies. (Both figs. from type.)

Figs. 258, 259. *Amanita solitariiformis*. — 258. Dried fruit-body. — 259. Crushed volval remnants from cap. (Both figs. from *Murrill F 18109*.)



Figs. 253–259

2. Small species with pulverulent cap and rather thick, distant gills. Fruit-body turning yellow when bruised. See *A. crassifolia* on p. 516.

1. Spores 3.5–4.5 μ wide; l/b 2.5–4.

4. Fruit-body white, not changing colour when bruised. South-eastern U.S.A. *A. rhoadsii* var. *rhoadsii*, p. 496

4. Fruit-body white, but all parts turning yellow when bruised. Florida. *A. rhoadsii* var. *flavotingens*, p. 499

AMANITA SUBSOLITARIA (Murrill) Murrill—Figs. 256, 257

Venenarius subsolitarius Murrill *in* Mycologia **33**: 435. 1941. — *Amanita subsolitaria* (Murrill) Murrill *in* Mycologia **33**: 448. 1941.

Fruit-bodies (Fig. 257) medium-sized, slender, subgregarious to gregarious. Cap 50–80 mm wide, convex to plano-convex, with non-sulcate, slightly appendiculate margin, thin-fleshed, white to pinkish isabella, dry (perhaps subviscid in nearly glabrous, mature specimens under humid conditions), at first completely covered by pulverulent-subflocculose layer of volva tending to form small, subflocculose warts or patches, with age glabrescent and then with somewhat shiny pileipellis. Gills rather crowded, adnate, narrow, white, with subfelted edge; short gills not examined. Stem about 50–100 × 5–10 mm, attenuate upward, with slightly enlarged, fusiform, slightly rooting base up to 15 mm wide, probably solid, white, with vague, pulverulent annular zone or exannulate, pulverulent-flocculose, without distinct remnants of volva. Flesh white, without smell.

Spores [20/1] 11–13.5 × 4.5–6 μ, length-breadth ratio 2.1–2.7 (average 2.3) (but see observations), cylindrical, thin-walled, smooth, slightly yellowish, with subrefractive, granular contents, amyloid (Fig. 256). Basidia about 45–60 × 9–12 μ, 4-spored, with clamps. Marginal tissue a rather broad strip of collapsed elements, probably with many hyphae. Trama of gills not studied; subhymenium inflated-ramose to subcellular. Pileipellis made up of interwoven hyphae 1.5–4 μ wide, gelatinized. Remnants of volva on cap consisting of irregularly (?) disposed rows of mostly globose, ellipsoid, or piriform cells, 15–50(–60) × 10–35(–45) μ, and scattered, oleiferous hyphae, but close to pileipellis with a layer of hyphae up to 8 μ wide and a number of subcylindrical cells; in old specimen majority of inflated cells gone and sometimes only the basal hyphae with some scattered inflated cells left on pileipellis. Trama of stem with large, slenderly clavate cells and many oleiferous hyphae. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial in *Quercus-Pinus* forest in Florida.

COLLECTION EXAMINED.—U.S.A., Florida, Alachua Co., Gainesville, 1 June 1938, *W. A. Murrill F 16449* (holotype: FLAS).

OBSERVATIONS.—The type collection comprises four fruit-bodies, two of which I received on loan.

In the University Herbarium at Ann Arbor I studied a young specimen named *A. subsolitaria* by Murrill (Florida, Alachua Co., Tung-oil Mill, 28 June 1938, *W. A. Murrill*) which probably belongs to the present species but has longer spores, measuring 12.5–15.5 × 4.5–6 μ (l/b 2.3–3.0; average 2.5), and extremely long and slender basidia measuring 60–90 × 9–12 μ. In this case, however, the hymenium is still very young and the spores and basidia belong to the first ones formed, which may explain their aberrant size.

Amanita subsolitaria is very close to *A. solitariiformis*, which occurs in the same area. Microscopically these two species agree in nearly every detail, with the exception

perhaps of the structure of the remnants of the volva on the cap. In both cases these remnants consist of small, globose, ellipsoid, and piriform cells in rows, intermixed with scattered oleiferous hyphae. But in *A. solitariiformis* these rows seem to be arranged in a more strictly erect and parallel position than in *A. subsolitaria*. This would explain the difference in shape of the remnants of the volva on the cap in the two species. Unfortunately, it was very difficult to be certain about this character as the tissues are dense and the rows broke up into single cells as soon as I tried to separate them mechanically.

It is very well possible that the two main distinguishing characters of *A. subsolitaria* and *A. solitariiformis*, viz. the habit of the fruit-bodies and the shape of the remnants of the volva on the cap are determined by ecological factors. In that case, *A. solitariiformis* with its somewhat stunted fruit-body and firm warts on the cap would be the type to be expected under dry conditions. In fact in a later paper Murrill (1948: 103) indicated that *A. solitariiformis* grows especially in dry soil under *Pinus*, and *A. subsolitaria* in *Quercus* and *Pinus* woods and under *Quercus* on lawns.

As Murrill apparently knew the two species very well but did not suggest a close relationship between them, and as intermediate collections are still lacking, for the time being I prefer to keep them apart.

AMANITA SOLITARIIFORMIS (Murrill) Murrill—Figs. 258–261

Venenarius solitariiformis Murrill *in* Mycologia **33**: 435. 1941. — *Amanita solitariiformis* (Murrill) Murrill *in* Mycologia **33**: 448. 1941.

Fruit-bodies (Figs. 258, 260) medium to large, rather thickset, solitary. Cap about 60–100 mm wide, convex to plano-convex, with non-sulcate, appendiculate margin, white to cream, dry (perhaps older specimens subviscid under humid conditions), with abundant, small, probably adnate, about 1 mm high and wide, conical to truncate-conical, concolorous warts passing into very small, felted flakes towards margin. Gills rather crowded, adnate to just free, moderately broad, white to isabella, with subflocculose edge; short gills attenuate. Stem about 30–60 × 10–15 mm, relatively short, equal or tapering upward, with ellipsoid to subnapiform, pointed bulb about 20–25 × 15–20 mm, probably solid, white, flocculose-subtomentose to subflocculose, exannulate, without distinct remnants of volva. Flesh white, without smell.

Spores [40/2] 11.5–15.5 × 4.5–6 μ, length-breadth ratio 2.0–3.1 (averages 2.3–2.6), cylindrical, rarely bacilliform, sometimes slightly strangulated in the middle, thin-walled, smooth, slightly yellowish, with refractive, subgranular to guttulate contents, amyloid (Fig. 261). Basidia 50–60(–65) × 11–12(–14) μ, 4-spored, with clamps. Marginal tissue a thick strip, difficult to reinflate, probably consisting mainly of repent hyphae. Trama of gills bilateral; subhymenium ramose to inflated-ramose. Pileipellis made up of interwoven hyphae 1.5–6 μ wide, gelatinized near surface, nearly everywhere covered by collapsed, small cells of volva. Remnants of volva on cap (Fig. 259) brownish-yellowish in alkaline solution, consisting of very abundant, small, mainly subglobose to broadly ellipsoid but sometimes clavate, subcylindrical or irregularly shaped cells, 10–40 × 8–30 μ, in long, branching, easily broken, more or less erect rows intermixed with scattered, yellowish, oleiferous hyphae 3–10 μ wide, but close to surface of cap with branching, normal hyphae

2–6 μ wide, and elongate cells more abundant. Remnants of volva at base of stem consisting of cells similar to those on cap, somewhat more abundant, elongate elements and scarce hyphae up to 6 μ wide. Trama of stem with large (relatively short?), clavate, probably mainly terminal cells, and longitudinal hyphae. Clamps present.

HABITAT & DISTRIBUTION.—Terrestrial under *Quercus* and *Pinus* in Florida.

COLLECTIONS EXAMINED.—U.S.A., Florida, Alachua Co., Gainesville, 9 Aug. 1937, *W. A. Murrill F 16415* (holotype: FLAS); 15 Sept. 1938, *W. A. Murrill F 18109* (FLAS).

OBSERVATIONS.—In the collections studied it is difficult to analyze the exact structure of the warts on the cap. The tissue is rather dense but as soon as I tried to dissociate the rows of inflated cells by crushing the mounts slightly, the rows broke up.

For a comparison with the closely related *A. subsolitaria*, see p. 494.

AMANITA RHOADSII (Murrill) Murrill

Venenarius rhoadsii Murrill *in* Bull. Torrey bot. Club **66**: 30. 1939. — *Amanita rhoadsii* (Murrill) Murrill *in* Bull. Torrey bot. Club **66**: 37. 1939.

var. RHOADSII—Figs. 262–266

Fruit-bodies (Figs. 262, 263, 265) medium to large, rather slender, solitary to gregarious. Cap 50–100 mm wide, convex to plano-convex, with non-sulcate, appendiculate margin, white, dry, strongly pulverulent-flocculose and under favourable conditions with large, slender, friable, conical warts when young, but soon becoming completely pulverulent-subverrucose or volva breaking up into some pulverulent crusts or many small, pulverulent patches, or very small, flocculose-pulverulent, conical warts on somewhat shiny (probably subviscid) pileipellis. Gills moderately crowded to crowded, adnexed to adnate, rather broad, white to cream, with flocculose edge; short gills subtruncate (the shortest) to attenuate (the longer). Stem 70–180 × 7–20 mm, tapering upward or subcylindrical, with slender, deeply rooting base or with slenderly fusiform, fusiform, or napiform, up to 35 mm wide, rooting bulb, solid, white, exannulate or with subapical, fugacious, flocculose, annular zone, pulverulent to flocculose, without distinct remnants of volva or with vague, flocculose-felted ridge at top of bulb. Flesh white, unchanging. Smell like "chloride of lime" or "old ham."

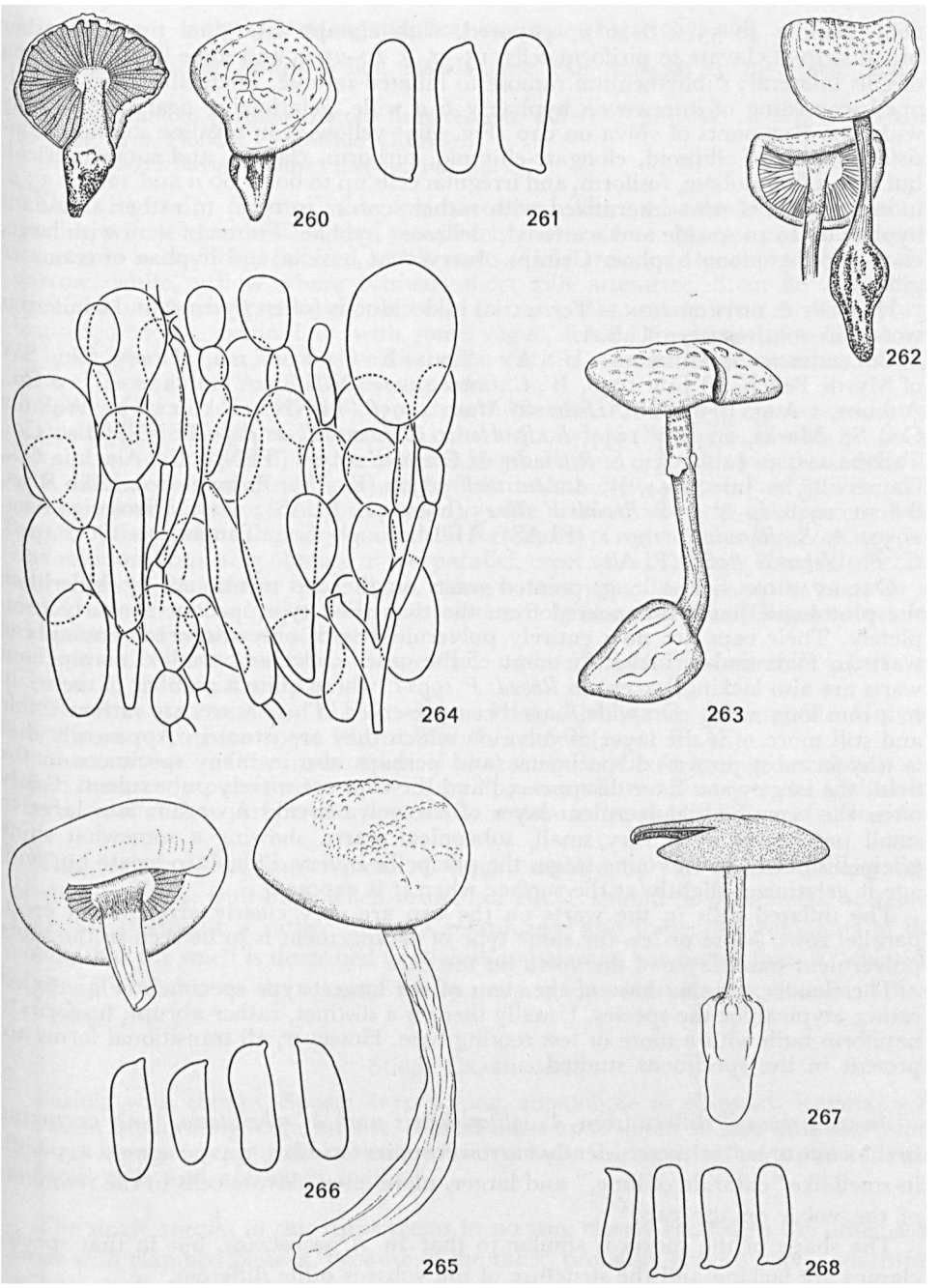
Spores [85/8] 10.5–13.5(–15.5) × 3.5–4.5 μ, length-breadth ratio 2.6–4.2 (averages 3.0–3.4), cylindrical to bacilliform, sometimes slightly curved, thin-walled, smooth, colourless to yellowish, with guttulate, refractive contents, amyloid (Fig.

EXPLANATION OF FIGURES 260–268

Figs. 260, 261. *Amanita solitariiformis*. — 260. Dried fruit-bodies. — 261. Spores. (Both figs. from type.)

Figs. 262–266. *Amanita rhoadsii* var. *rhoadsii*. — 262, 263. Dried fruit-bodies. — 264. Section of volval wart from cap. — 265. Dried fruit-bodies. — 266. Spores. (Fig. 262, from *Hesler 21429*; 263, from *Murrill F 38904*; 264–266, from type.)

Figs. 267, 268. *Amanita rhoadsii* var. *flavotingens*. — 267. Dried fruit-body. — 268. Spores. (Both figs. from type.)



Figs. 260–268

266). Basidia 40–55 × 8–10 μ, 4-spored, with clamps. Marginal tissue a rather broad strip of clavate to piriform cells, 15–55 × 10–25 μ, and some hyphae. Trama of gills bilateral; subhymenium ramose to inflated-ramose. Pileipellis poorly developed, consisting of interwoven hyphae 3–6 μ wide, gelatinizing near surface only with age. Remnants of volva on cap (Fig. 264) yellowish in alkaline solution, consisting mainly of ellipsoid, elongate-ellipsoid, piriform, clavate, and subcylindrical, but also a few globose, fusiform, and irregular cells up to 60 × 60 μ and 120 × 35 μ, in erect, parallel rows intermixed with rather scarce (in type) to rather abundant hyphae up to 10 μ wide and scattered, oleiferous hyphae. Trama of stem with large, clavate cells among hyphae. Clamps observed at basidia and hyphae of trama of gills.

HABITAT & DISTRIBUTION.—Terrestrial in deciduous (often *Quercus*) and coniferous woods in south-eastern U.S.A.

COLLECTIONS EXAMINED.— U.S.A.: South Carolina, Horry Co., SW of Myrtle Beach, 28 July 1948, *W. C. Coker 14442* (NCU); Alabama, Lee Co., Auburn, 1 Aug. 1955, *L. R. Hesler & Moore 21958* (TENN); Florida: Wakulla Co., St. Marks, 29 July 1954, *L. R. Hesler & Campbell 21425* (TENN); Leo Co., Tallahassee, 30 July 1954, *L. R. Hesler & Campbell 21429* (TENN, L); Alachua Co., Gainesville, 2 July 1944, *W. A. Murrill F 38904* (FLAS); Putnam Co., Lake Rosa, 8 Sept. 1938, *L. & A. S. Rhoads F 18125* (holotype: FLAS); near Melrose, 30 Aug. 1939, *A. S. Rhoads F 19911* (FLAS); Hillsborough Co., Tampa, 10 Oct. 1948, *G. F. Weber F 8565* (FLAS).

OBSERVATIONS.—The long, pointed warts on the cap mentioned by Murrill in the protologue have disappeared from the two dried type specimens nearly completely. Their caps are now entirely pulverulent with only scattered remnants of warts in folds and wrinkles. In most of the other collections studied consipcuous warts are also lacking, except in *Rhoads F 19911*, where quite a number of them, up to 4 mm long and 3 mm wide, have been preserved. These warts are rather friable and still more so is the layer of volva on which they are situated. Apparently that is why in most preserved specimens (and perhaps also in many specimens in the field) the large warts have disappeared and the caps are merely pulverulent. Fairly often the remaining pulverulent layer of the volva breaks up again into large to small patches or even very small, subconical warts, showing a somewhat shiny pileipellis between. In young stages the pileipellis is very difficult to locate but with age it gelatinizes slightly at the surface when it is exposed.

The inflated cells in the warts on the cap are very clearly arranged in erect, parallel rows. More or less the same type of arrangement is to be seen in the more pulverulent basal layer of the volva on the cap.

The slender, rooting base of the stem of the largest type specimen (Fig. 265) is rather atypical for the species. Usually there is a distinct, rather abrupt, fusiform to napiform bulb with a more or less rooting base. However, all transitional forms are present in the specimens studied.

Amanita rhoadsii differs from *A. solitariiformis* and *A. subsolitaria*, both occurring in the same area, by its consistently narrower spores (width 3.5–4.5 μ against 4.5–6 μ), its smell like "chloride of lime," and larger, more often clavate cells in the remnants of the volva on the cap.

The shape of the spores is similar to that in *A. roanokensis*, but in that species clamps are lacking and the structure of the volva is quite different.

var. **flavotingens** Bas, *var. nov.*—Figs. 267, 268

[*Venenarius flavescens* Murrill *in* Bull. Florida agric. Exp. Stn **478**: 24. 1951 (nom. nud.).]

A typo omnibus partibus contusis flavescentibus differt. Typus: '*W. A. Murrill F* 21676, 10 June 1950, Florida, Gainesville' (FLAS).

ETYMOLOGY: flavus, yellow; tingens, tinging.

Cap (Fig. 267) 65 mm wide, plano-convex, with non-sulcate margin, white, turning yellow when bruised, dry, completely pulverulent-subtomentose, near centre sometimes with fluffy, floccose, small warts. Gills crowded, touching stem, rather narrow, white, yellow where bruised; short gills attenuate. Stem 80 × 10 mm, equal but with elongate-napiform bulb 40 × 25 mm, solid, white, yellow where bruised, floccose, exannulate, with some vague, friable fragments of volva at top of bulb. Flesh white, turning yellow when cut, in stem at length turning reddish brown. Taste mild. Smell slightly unpleasant.

Spores [25/1] 10–12 × 3.5–4.5 μ, length-breadth ratio 2.5–3.2 (averages 2.75–3.0), slightly yellowish, with guttulate contents, amyloid (Fig. 268). Basidia 50–60 × 8–11 μ, 4- and 2-spored, with clamps. Marginal tissue difficult to study. Trama of gills difficult to study; subhymenium inflated-ramose (to subcoralloid?). Pileipellis consisting of interwoven hyphae 2–5 μ wide, rather strongly gelatinizing near surface (also under remnants of volva!). Remnants of volva on cap yellow in alkaline solution, consisting of more or less parallel, erect rows of mainly clavate, piriform and ellipsoid, but also a few globose, elongate and irregular cells up to 70 × 40 μ, rather scarce hyphae 3–8 μ wide and scattered oleiferous hyphae. Clamps observed at basidia and hyphae of pileipellis.

HABITAT & DISTRIBUTION.—Terrestrial under "*Phoenix canariensis*" [Hort. ex Chabaud] in Florida.

COLLECTION EXAMINED.—U.S.A., Florida, Alachua Co., Gainesville, University Campus, 10 June 1950, *W. A. Murrill F 21676* (type: FLAS).

OBSERVATION.— The macroscapical characters in the foregoing description are taken from an unpublished note by Murrill, present in the library of the University Herbarium at Ann Arbor and apparently meant to be published in Mycologia.

This variety differs from typical *A. rhoadsii* mainly by the yellow discoloration of all parts of the fruit-body when bruised or cut. It should be mentioned, however, that the pileipellis is rather strongly gelatinized; also under the remnants of the volva, that the smell is described as slightly unpleasant but not as that of "chloride of lime," and that on the average the spores are somewhat shorter than in typical *A. rhoadsii*.

Stirps CRASSICONUS

Basidia with clamps. Spores 8–10 μ long, subglobose to ellipsoid. Remnants of volva on cap forming large, adnate, conical warts up to about 10 mm wide and 4 mm high at centre of cap and consisting of irregularly disposed, rather small to small inflated cells and abundant hyphae.

The single species in this stirps seems in no way closely related to the other *Solitariae* with clamped basidia. Because of the thick, probably greyish volva, consisting of irregularly disposed hyphae and inflated cells, it seems to be connected with the clampless *A. strobiliformis*.

AMANITA CRASSICONUS, *nom. prov.*—Figs. 269–271

ETYMOLOGY: crassus, coarse; conus, cone.

Fruit-bodies (Fig. 269) medium-sized, rather slender. Cap about 70–90 mm wide, plano-convex with non-sulcate, appendiculate margin, rather fleshy, probably whitish or pale greyish, dry, at centre with large, up to about 10 mm wide and 4 mm high, probable pale grey,[65] adnate warts, at margin merely felted-flocculose with some scattered, crust-like, probably pale grey patches, at centre with unpolished strips between warts. Gills crowded, free, moderately broad, probably white or cream (pale ochraceous buff in dried specimens), with minutely flocculose edge; short gills attenuate. Stem about 80–100 mm long, about 8–10 mm wide, subcylindrical with clavate-fusiform bulb about 30–40 × 15–25 mm, probably solid, probably whitish with pale brownish grey tinge towards base, subfelted-flocculose, exannulate, but in youngest specimen with narrow, vague, whitish (?), flocculose zone near top, at upper part of bulb with very faint, thin, felted, incomplete, brownish-greyish volval girdles disappearing with age. Flesh in dried specimens cream.

Spores [20/2] (7–)8–10(–10.5) × 6.5–7.5(–8) μ, length-breadth ratio 1.1–1.5 (average 1.3), subglobose to ellipsoid, thin-walled, smooth, slightly yellowish, with refractive, guttulate contents, amyloid (Fig. 270). Basidia 40–50 × 9–12 μ, 4-spored but some 3- and 2-spored, with clamps. Marginal tissue made up of scattered, more or less repent, often oleiferous hyphae 2–5 μ wide, with scattered ellipsoid, clavate and irregularly shaped cells. Trama of gills bilateral; subhymenium inflated-ramose to subcoralloid. Pileipellis not differentiated. Remnants of volva on cap (Fig. 271) very pale brownish-greyish, consisting of irregularly disposed, abundant, small, mainly subglobose to ellipsoid, but also clavate, elongate, and irregularly shaped cells, 15–60 × 10–55 μ, terminal or in rows on abundant, branching hyphae 2–8 μ wide, and rather abundant, branching, sometimes subcoralloid elements; oleiferous hyphae scarce. Remnants of volva at base of stem similar to those on cap. Trama of stem with large, clavate, terminal cells among longitudinal hyphae, with many yellowish oleiferous hyphae. Clamps observed at basidia and hyphae of trama of gills.

HABITAT & DISTRIBUTION.—Terrestrial in Nigeria.

COLLECTION EXAMINED.—NIGERIA, Northern Provinces, Kantagora, Aug. 1963. *S.O. Alasoadura 117* (K).

OBSERVATIONS.—The collection studied consists of two well-dried specimens and has no field-notes or illustrations. Therefore, although I am convinced that it is distinct, I refrain from describing this species definitively as new.

The microscopical structure of the volva of *A. crassiconus* resembles that in *A. baccata* (= *A. boudieri*), but because of the greyish colour of the volva and the general habit, the species is suggestive of *A. strobiliformis*. Because of the presence of clamps, however, I have placed *A. crassiconus* not near one of these two species but in a separate stirps.

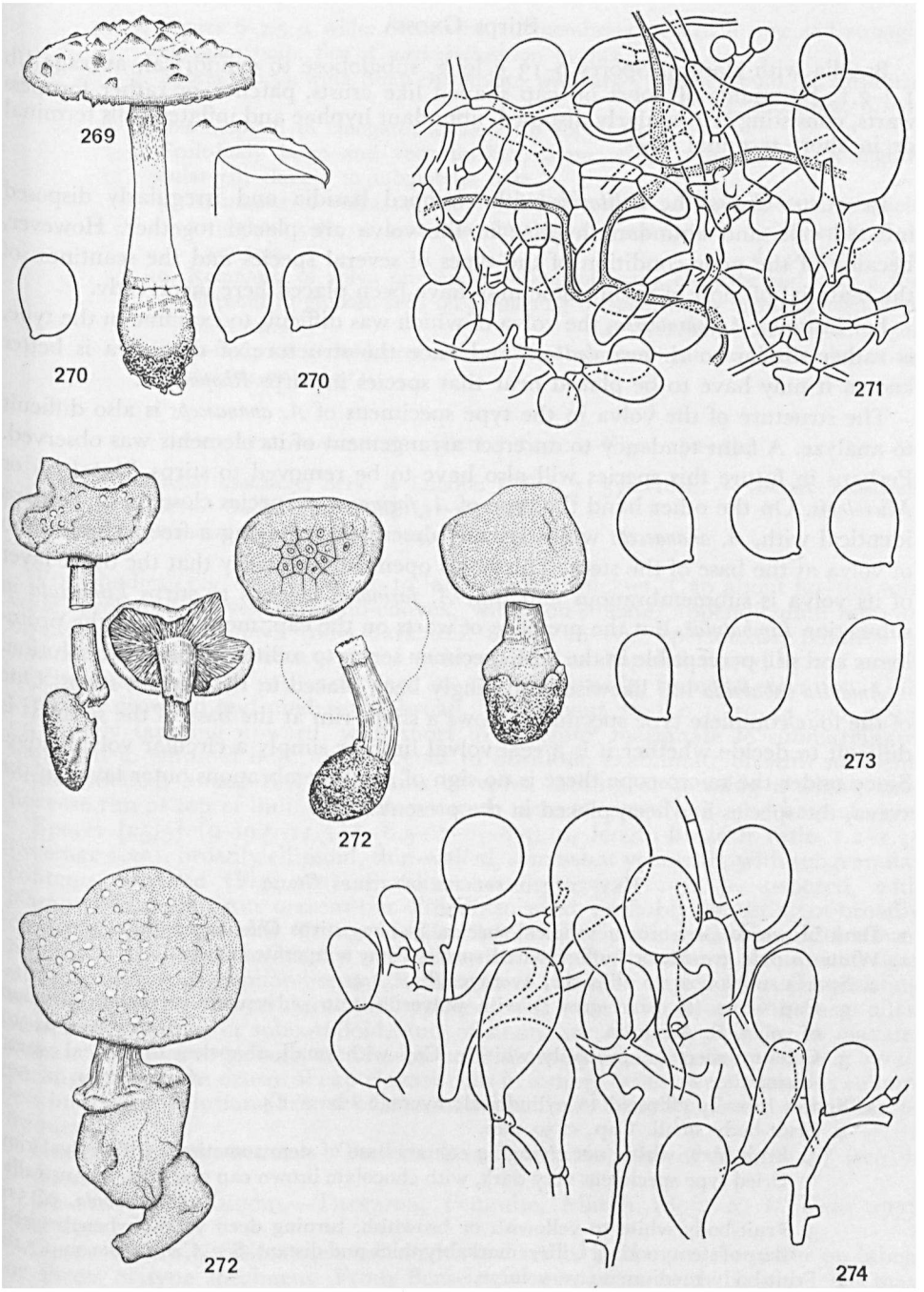
Amanita crassiconus also bears some resemblance to the insufficiently known *A. robusta* Bouriquet from Madagascar (see p. 563).

[65] In preserved specimens tips of warts dark brown-grey, but this colour caused by dark-coloured, hyphomycetous fungus.

EXPLANATION OF FIGURES 269–274

Figs. 269–271. *Amanita crassiconus*. — 269. Dried fruit-body. — 270. Spores. — 271. Crushed volval wart from cap. (All figs. from *Alasoadura 117*.)

Figs. 272–274. *Amanita ananaeceps*. — 272. Dried fruit-bodies. — 273. Spores. — 274. Elements of volval remnants from cap. (All figs. from type.)



Figs. 269–274

Stirps GROSSA

Basidia with clamps. Spores 9–13 μ long, subglobose to cylindrical, average l/b 1.3–2.1. Remnants of volva on cap shaped like crusts, patches, or rather formless warts, consisting of irregularly disposed, abundant hyphae and inflated cells terminal or in short terminal rows.

In stirps *Grossa* the *Solitariae* with clamped basidia and irregularly disposed inflated cells and abundant hyphae in the volva are placed together. However, because of the poor condition of the types of several species and the scantiness of the material of most of them, some may have been placed here incorrectly.

For instance *A. ochroterrea*, the volva of which was difficult to examine in the type, is rather similar to *A. conicobulbosa* and once the structure of the volva is better known it may have to be placed near that species in stirps *Rhopalopus*.

The structure of the volva in the type specimens of *A. ananaeceps* is also difficult to analyze. A faint tendency to an erect arrangement of its elements was observed. Perhaps in future this species will also have to be removed to stirps *Rhopalopus* or *Microlepis*. On the other hand the type of *A. farinacea*, a species close to, or perhaps identical with, *A. ananaeceps* was originally described as having a free, crisped limb of volva at the base of the stem. This holds open the possibility that the outer layer of its volva is submembranous and that *A. farinacea* belongs to stirps *Limbatula* in subsection *Limbatulae*, but the presence of warts on the cap, mentioned in the protologue and still perceptible in the type specimen seems to militate against this solution.

Amanita subalbida has likewise hesitatingly been placed in the present stirps. One of the four complete type specimens shows a slight rim at the base of the stem. It is difficult to decide whether it is a real volval limb or simply a circular volval ridge. Since under the microscope there is no sign of a submembranous outer layer in the volva, the species has been placed in the present stirps.

KEY TO THE SPECIES OF STIRPS *Grossa*

1. Dark brown to grey-brown, tropical species. See key stirps *Chlorinosma* on p. 450.
1. White to pale greyish or buff coloured species from temperate regions.
   2. Spores subglobose to ellipsoid; average l/b < 1.4.
      3. Cap white (to pearl grey ?) with pulverulent to pulverulent-verrucose remnants of volva. E. Australia. *A. farinacea*, p. 504
      3. Colour uncertain, probably whitish. Cap with small, shapeless to conical warts. Tasmania. *A. ananaeceps*, p. 503
   2. Spores broadly ellipsoid to cylindrical; average l/b > 1.4.
      4. Fruit-body small. Cap < 50 mm.
         5. Fruit-body white, not changing colour. Base of stem sometimes with volval rim. Dried type specimens very dark, with chocolate brown cap and gills. S. Australia. *A. subalbida*, p. 510
         5. Fruit-body white to yellowish or brownish, turning deep yellow when bruised. Base of stem rooting. Gills remarkably thick and distant. See *A. crassifolia* on p. 516.
      4. Fruit-body medium to very large.
         6. Spores ellipsoid to subcylindrical; average l/b > 1.65.

7. Spores 6–7.5 μ wide. Stem with submembranous, striate ring and strongly elongate bulb. See *A. conicobulbosa* on p. 422.
7. Spores 5–6.5 μ wide. Stem exannulate, with large, napiform bulb. W. Australia. *A. ochroterrea*, p. 505

6. Spores ellipsoid to elongate; average l/b 1.45–1.65.
8. Fruit-body large and very thickset. Stem 20–30 mm wide, with slightly enlarged, clavate to subglobose base.
9. Remnants of volva on cap consisting mainly of medium-sized, ellipsoid to globose cells on branching hyphae and only a few oleiferous hyphae. Tasmania. *A. grossa*, p. 508
9. Remnants of volva on cap consisting of many elongate and only a few ellipsoid to globose cells on branching hyphae; many elements oleiferous. E. Australia. *A. grossa* sensu Aberdeen, p. 508
8. Fruit-body of normal proportions. Stem up to 20 mm wide. See key stirps *Rhopalopus* on p. 414.

AMANITA ANANAECEPS (Berk.) Sacc.—Figs. 272–274

Agaricus (*Amanita*) *ananaeceps* Berk. *in* London J. Bot. **7**: 572. 1848. — *Amanita ananaeceps* ("*ananiceps*") (Berk.) Sacc., Syll. Fung. **5**: 18. 1887.
? *Agaricus farinaceus* Cooke (see p. 504).

Fruit-bodies (Fig. 272) medium to large, rather thickset. Cap about 60–100 mm wide, probably convex to plano-convex, with non-sulcate, appendiculate margin, original colour unknown (now dark dull brown in type specimens), polished in places, with small, about 1.5–3 mm wide, conical to shapeless warts; in one young specimen at centre of cap each wart on a 4–6 mm wide, rounded elevation. Gills probably crowded and moderately broad. Stem about 70–110 × 10–14 mm, equal or slightly tapering upward, with short to elongate, marginate to submarginate, napiform to ellipsoid bulb, furfuraceous to fibrillose, exannulate or with submembranous-felted, apical ring; remnants of volva lacking or forming a slight, subfloccose rim at top of bulb or a subverrucose zone at top of bulb and base of stem.

Spores [25/5] (9–)9.5–11.5 × (6.5–)7–8(–8.5) μ, length-breadth ratio 1.2–1.55 (average 1.35), broadly ellipsoid, thin-walled, somewhat yellowish, with subgranular contents, amyloid (Fig. 273). Basidia about 45–55 × 12–14 μ, 4-spored, with clamps. Marginal tissue present but difficult to swell, probably consisting of broadly clavate or vesiculose cells. Trama of gills bilateral. Pileipellis made up of interwoven hyphae 3–5(–8) μ wide, locally with yellowish, refractive contents, gelatinized near surface; oleiferous hyphae present. Remnants of volva on cap (Fig. 274) consisting of a loose net of rather abundant hyphae 3–7 μ wide with branching parts often somewhat inflated or subcoralloid, and of abundant, mainly piriform to clavate, but also ellipsoid to globose, terminal or sometimes catenulate cells up to 90 × 50 μ; perhaps in warts at centre of cap clavate cells in a more or less erect position; colourless in alkaline solution. Trama of stem with terminal, upright, clavate cells. Clamps frequent.

HABITAT & DISTRIBUTION.—Terrestrial in Tasmania; also in Australia ? (see *A. farinacea*).

COLLECTION EXAMINED.—TASMANIA, Penguite, March 1805, *R. C. Gunn 1777* (holotype: K).

OBSERVATIONS.—Colours are not mentioned either in the protologue or on labels or sheets of type specimens. From Berkeley's comparison with *A. nitida* we may assume that he probably thought the colours to be whitish.

The name of this species is somewhat misleading. The wart-like remnants on the cap are not very conspicuous. It is only at the centre of the cap of one of the type specimens that these warts occur on rounded elevations of the trama of the cap; the other four caps are practically smooth. I think that these elevations are artificial, developing especially when young caps carrying wart-like remnants are poorly dried.

At first sight the elements in the small warts on the cap appear to be irregularly disposed. It seems, however, that especially in the warts at the centre of the cap the rows of cells and elongate elements show a preference for an erect position. In that case *A. ananaeceps* would take an intermediate position between the bulk of the clamp-bearing species of subsection *Solitariae* and the small group of clamp-bearing species in which all the elements of the volva seem to be irregularly disposed.

Amanita farinacea is probably identical with *A. ananaeceps* (see discussion on p. 505).

Amanita grossa differs from the present species especially in its very sturdy habit and more felted volva.

AMANITA FARINACEA (Cooke) Clel. & Cheel—Figs. 275–277

Agaricus (*Amanitopsis*) *farinaceus* Cooke & Mass. *apud* Cooke *in* Grevillea **18**: 1. 1890. — *Amanitopsis farinacea* (Cooke) Sacc., Syll. Fung. **9**: 2. 1891. — *Vaginata farinacea* (Cooke) O. Kuntze, Rev. Gen. Plant. **3** (2): 539. 1898. — *Amanita farinaceae* (Cooke) Clel. & Cheel *in* Agric. Gaz. N.S. Wales **25**: 888, pl. 1 fig. 3. 1914. — *Aspidella farinacea* (Cooke) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

DESCRIPTIONS & ILLUSTRATIONS.—Cooke *in* Grevillea **18** (Austr. Fungi): 2, pl. 2 fig. B. 1890; Handb. Austr. Fungi 4. 1892; Clel., Toadst. Mushr. S. Austr. **1**: 51. 1934; E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 385, (3): pl. 63. 1941.

Fruit-bodies (Fig. 275) of medium size, rather slender. Cap about 60–70 mm wide, plano-convex, with non-sulcate, appendiculate margin, probably viscid when moist (judging by the gelatinized pileipellis), with centre pulverulent-verrucose from volva and margin with thin, pulverulent, crust-like areas. Gills crowded, free, moderately broad, white, becoming yellowish. Stem about 70–100 × 12 mm, equal, with small, subglobose bulb (base of only type specimen badly damaged), white, exannulate, fibrillose, with rather thick, subflocculose volval rim at top of bulb.

Spores [10/1] 9–10.5 × (6.5–)7–9 μ, length-breadth ratio 1.1–1.5 (average 1.3), subglobose to ellipsoid, thin-walled, colourless, mostly with one large, refractive body inside (Fig. 276). Basidia about 45–55 × 10–12 μ, 4-spored, with clamps. Trama of gills bilateral; subhymenium ramose. Marginal tissue consisting mainly of small, globose to clavate cells up to 30 μ wide. Pileipellis composed of interwoven hyphae 3–7(–10) μ wide with very slightly thickened walls, with almost completely gelatinized outer layer. Remnants of volva on cap (Fig. 277) made up of probably irregularly disposed, branching hyphae 3–6 μ wide and abundant, mostly piriform to clavate, but also ellipsoid to globose cells up to about 60 × 40 μ, terminal or in short rows. Trama of stem with abundant, upright, terminal, large, clavate cells among hyphae up to 12 μ wide; oleiferous hyphae present. Rim at top of bulb consisting of tissue similar to that of remnants of volva on cap. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial in eastern Australia.

COLLECTION EXAMINED.—AUSTRALIA, Queensland, Brisbane, without date,

F. M. Bailey 690 (holotype: K).

OBSERVATIONS.—The foregoing description is based only on data taken from the protologue, from a rough drawing and from the type specimen.

I have not studied the material referred to this species by Cleland & Cheel (1914: 888) and Gilbert (1941: 385). I see little reason to question these authors' interpretation of *A. farinacea*, except in the case of Cleland's (1934: 51) Mount Compass specimens, which have cylindrical spores.

It should be noted that Cleland & Cheel (l.c.) reported that their specimens matched the protologue. Nevertheless they described the cap as pearly grey, with slightly darker warts, whereas in the protologue the cap is described as white. According to them this species occurs fairly frequently around Sydney. The ring may be present and well-shaped or entirely absent. The rim on the bulb may be lacking as well.

Amanita farinacea is very closely related to or identical with *A. ananaeceps*. It has similar spores, a similar pileipellis, and the same type of tissue in the volva, while in both species clamps are present.

Judging by the original descriptions, macroscopically the main difference is to be found in the remnants of the volva on the cap. In *A. ananaeceps* the cap has been described as areolate with an angular, conical wart on each area and in *A. farinacea* as entirely farinaceous with erect, slightly projecting warts, especially at the centre of the cap.

Among the five type specimens of *A. ananaeceps*, however, there is only one in which the centre of the cap is more or less areolate, which in this case means that the warts of the volva are situated on rounded elevations of the cap. I am fairly certain that these elevations have been caused by drying. In the other type specimens of *A. ananaeceps* small warts occur scattered over a nearly smooth cap, or else the cap is glabrous.

Unfortunately the type of *A. farinacea* consists of only one specimen with a badly damaged base of the stem while we do not know the original colours of the type collection of *A. ananaeceps*. I do not wish to identify the two species before more information is available from specimens collected at or near the two type localities.

Amanita ochroterrea Gentilli *ex* Bas, *sp. nov.*—Figs. 278–281

[*Amanita preissii* forma *ochroterrea* Gentilli *in* W. Austr. Nat. **4**: 30, fig. 3. 1953 (not. val. publ.).]

Pileus c. 100 mm latus, convexus dein planus vel plano-concavus, margine appendiculatus neque sulcatus, sordide bubalinus, volvae reliquiis crustiformibus vel obscure verruciformibus obsitus. Lamellae confertae, liberae vel subadnatae, sat latae, sordide bubalinae. Stipes 160–190 mm longus, 20–30 mm latus, subcylindraceus, bulbo napiformi, 60–70 mm longo, 40–55 mm lato praeditus, sordide bubalinus, farinaceus, exannulatus, deorsum volvae reliquiis minutis squamiformibus, ± in circulos dispositis ornatus. Sporae 11–13 × 5–6.5 μ, cylindraceae, amyloideae. Fragmenta volvae cellulis turgidis diversis hyphisque copiosis inconditis composita. Fibulae praesentes. Typus: '*J. Gentilli*, June 1953, W. Australia, Perth, King's Park' (L).

Fruit-bodies (Fig. 279) large. Cap 100–110 mm wide, convex to plane or planoconcave with age, with non-sulcate, appendiculate margin, dingy buff, darker with age, covered with more or less felted-subfloccose, indistinctly delimited, patch- or crust-like, (concolorous ?) remnants of volva especially at centre. Gills crowded, free or just reaching top of stem, moderately broad, ventricose, dingy buff to dark buff; short gills truncate (only a few seen). Stem 160–190 × 20–30 mm, equal or slightly attenuate upward, with napiform bulb, 60–70 × 40–55 mm, dingy buff, farinaceous above because of friable, evanescent ring, to squamulose below; base of stem (Fig. 280) and top of bulb with a few more or less concentric rows of recurving, small scales, in places confluent to incomplete girdles. Spore print very pale buff.

Spores [20/1] (10–)11–13(–13.5) × 5–6.5 μ, length-breadth ratio 1.9–2.4 (average 2.1), cylindrical to elongate, often slightly attenuate towards base or slightly hooked near apiculus, thin-walled, colourless to very slightly yellowish, with somewhat refractive contents, amyloid (Fig. 278). Basidia about 50–55 × 11–12 μ, 4-spored (only a few with sterigmata seen), with clamps. Marginal tissue consisting of globose to clavate cells 15–35 × 15–20 μ. Trama of gills impossible to analyze; subhymenium probably ramose. Pileipellis a dense, difficult to delimit layer of interwoven hyphae 2–8 μ wide; not or slightly gelatinized near centre, but distinctly gelatinized at margin of cap. Remnants of volva on cap (Fig. 281) consisting of abundant, mainly ellipsoid to globose, more rarely piriform, clavate, ventricose-fusiform or elongate cells up to 80 x 80 or 120 x 80 μ on rather abundant, branching hyphae 4–8 μ wide; golden yellow in alkaline solution; inflated cells terminal or forming short chains; elements irregularly disposed. Trama of stem with upright, terminal, clavate cells. Scales at base of stem with tips consisting of tissue like that in remnants of volva on cap, and rest of tissue like that in cortex of stem. Clamps present; found at basidia and in pileipellis.

HABITAT & DISTRIBUTION.—Terrestrial in West Australia.

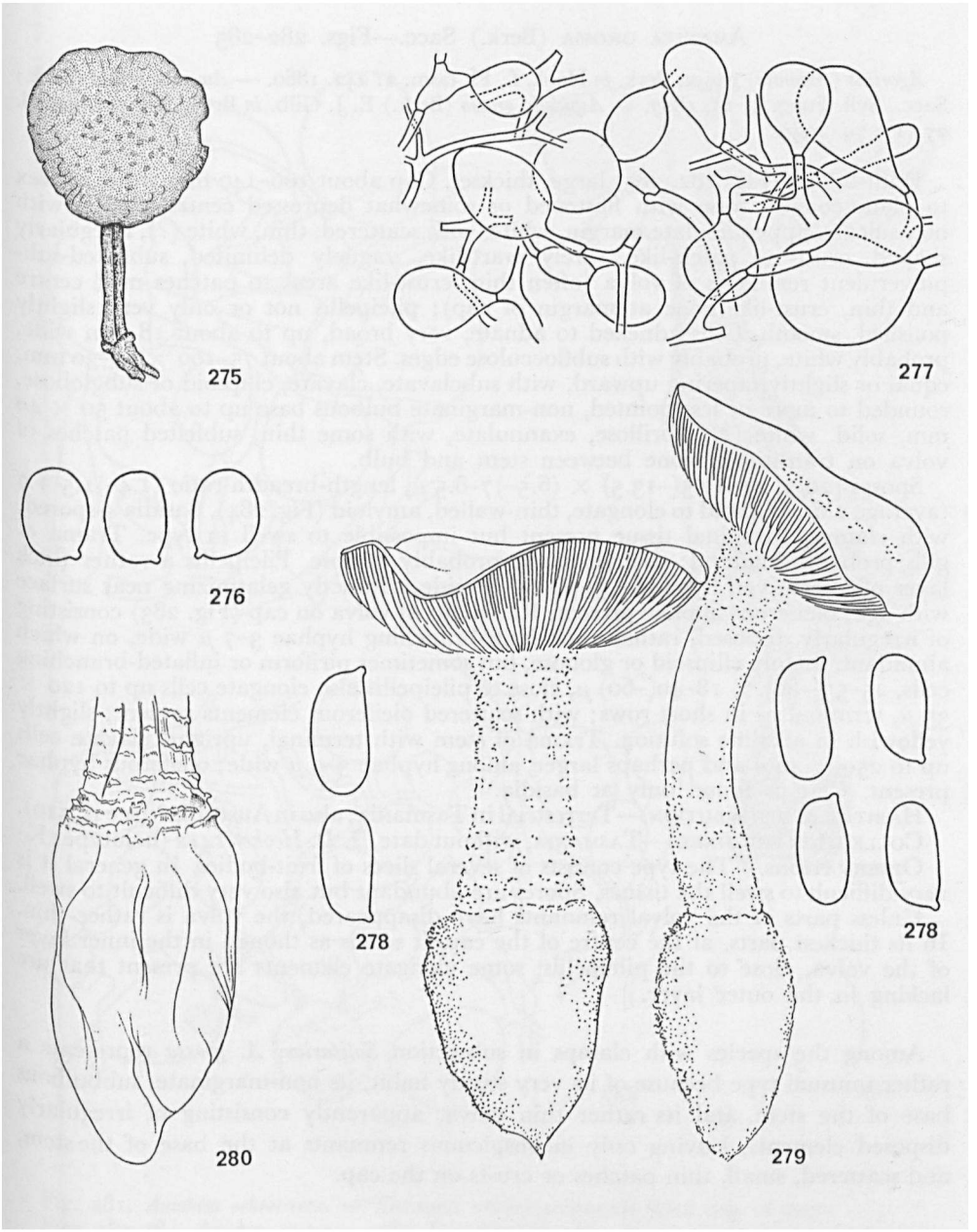
COLLECTION EXAMINED.—AUSTRALIA, W. Australia, Perth, King's Park, June 1953, *J. Gentilli* (type: L).

OBSERVATIONS.—The microscopical characters of the only specimen of the type collection are rather difficult to study; the tissues are difficult to swell and parts of the fruit-body are covered with sand. The cap is almost completely covered with a felted volval layer; only at one narrow strip near the centre and at a few places near the margin of the cap is a somewhat shiny pileipellis visible. But even there the microscope reveals the presence of scattered, very small remnants of the volva.

Gentilli (l.c.) described the present fungus as a form of *A. preissii*, but in my opinion it is not closely related to that species and deserves the rank of species, not only because clamps are obviously present in *A. ochroterrea*, but also because its volva has a different, less membranous structure, and its pileipellis is less strongly gelatinized.

Amanita ochroterrea suggests *A. conicobulbosa* in several respects but it differs from that species in having slightly narrower spores, a less elongate bulb, a less strongly gelatinized pileipellis, a more friable ring, and a somewhat different type of volva, in which the elements are probably irregularly disposed.

Because of the last character, *A. ochroterrea* must be placed near *A. ananaeceps* and *A. farinacea*, but it differs from both species in having cylindrical spores. The structure of the volval remnants on the cap of the type specimen of *A. ochroterrea* is, however, difficult to analyze. If it should turn out that they consist of erect elements, this species would have to be placed near *A. conicobulbosa* (see p. 422).



Figs. 275–277. *Amanita farinacea*. — 275. Dried fruit-body. — 276. Spores. — 277. Crushed volval remnants from cap. (All figs. from type.)

Figs. 278–280. *Amanita ochroterrea*. — 278. Spores. — 279. Fruit-bodies. — 280. Base of stem (× 2). (All figs. from type; 279, after Gentilli, 1933: fig. 3.)

AMANITA GROSSA (Berk.) Sacc.—Figs. 282–285

Agaricus (*Amanita*) *grossus* Berk. *in* Hook. f., Fl. tasm. **2**: 242. 1860. — *Amanita grossa* (Berk.) Sacc., Syll. Fung. **5**: 15. 1887. — *Aspidella grossa* (Berk.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

Fruit-bodies (Figs 282, 285) large, thickset. Cap about 100–140 mm wide, convex to plano-convex, soon with flattened or somewhat depressed centre, fleshy, with non-sulcate, appendiculate margin, white, with scattered, thin, white (?), irregularly shaped, crust- to patch-like, rarely wart-like, vaguely delimited, subfelted-subpulverulent remnants of volva (often thin, crust-like areas to patches near centre and thin, crust-like zone at margin of cap); pileipellis not or only very slightly polished, smooth. Gills adnexed to adnate, very broad, up to about 18 mm wide, probably white, probably with subflocculose edges. Stem about 75–100 × 20–30 mm, equal or slightly tapering upward, with subclavate, clavate, ellipsoid or subglobose, rounded to more or less pointed, non-marginate bulbous base up to about 50 × 40 mm, solid, white (?), fibrillose, exannulate, with some thin, subfelted patches of volva on transitional zone between stem and bulb.

Spores [20/5] 11–12.5(–13.5) × (6.5–)7–8.5 μ, length-breadth ratio (1.4–)1.5–1.7 (average 1.6), ellipsoid to elongate, thin-walled, amyloid (Fig. 284). Basidia 4-spored, with clamps. Marginal tissue present but impossible to swell in type. Trama of gills probably bilateral; subhymenium probably ramose. Pileipellis a rather thick layer of interwoven hyphae 2.5–7(–10) μ wide, distinctly gelatinizing near surface with age; oleiferous hyphae present. Remnants of volva on cap (Fig. 283) consisting of irregularly disposed, rather abundant, branching hyphae 3–7 μ wide, on which abundant, mainly ellipsoid or globose, but sometimes piriform or inflated-branching cells, 25–55(–80) × 18–40(–60) μ, close to pileipellis also elongate cells up to 120 × 35 μ, terminal or in short rows; with scattered oleiferous elements present; slightly yellowish in alkaline solution. Trama of stem with terminal, upright, clavate cells up to 250 × 40 μ and perhaps larger, among hyphae 3–9 μ wide; oleiferous hyphae present. Clamps found only at basidia.

HABITAT & DISTRIBUTION.—Terrestrial in Tasmania; also in Australia? (see p. 510).

COLLECTION EXAMINED.—TASMANIA, without date, *J. D. Hooker 1412* (holotype: K)

OBSERVATIONS.—The type consists of several slices of fruit-bodies. In general it is very difficult to swell the tissues. Spores are abundant but also very difficult to swell.

Unless parts of the volval remnants have disappeared, the volva is rather thin. In its thickest parts, at the centre of the cap, it seems as though in the inner layer of the volva, close to the pileipellis, some elongate elements are present that are lacking in the outer layer.

Among the species with clamps in subsection *Solitariae*, *A. grossa* represents a rather unusual type because of its very sturdy habit, its non-marginate, subbulbous base of the stem, and its rather thin volva, apparently consisting of irregularly disposed elements, leaving only inconspicuous remnants at the base of the stem, and scattered, small, thin patches or crusts on the cap.

AMANITA GROSSA sensu Aberdeen—Figs. 286–290

Cap (Fig. 287) 140 mm wide, flat with slightly revolute, non-sulcate margin, dingy cream, with scattered, small, irregularly shaped, raised fragments of volva. Gills crowded, adnexed, then free, cream with whitish edge, broad, about 12 mm wide;

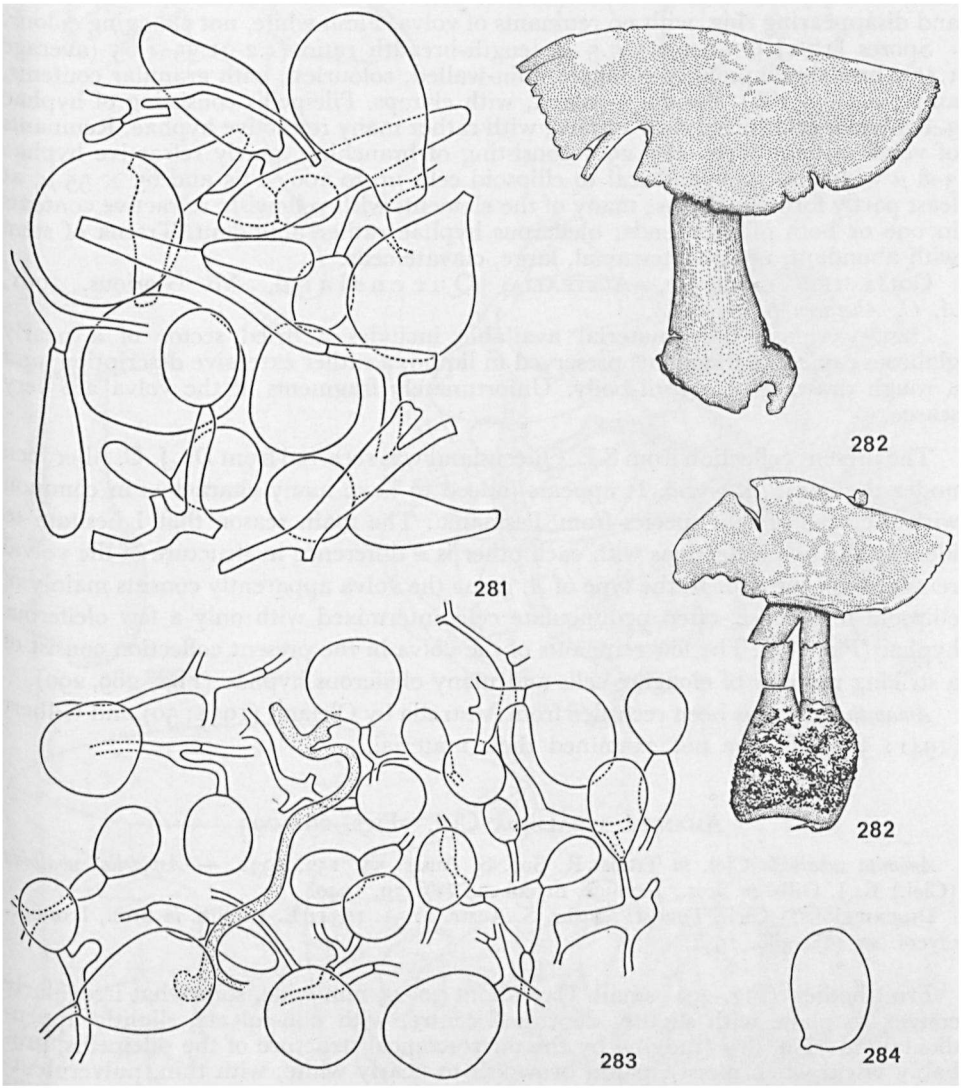


Fig. 281. *Amanita ochroterrea*. — Crushed volval remnants from cap of type.
Figs. 282–284. *Amanita grossa*. — 282. Dried fruit-bodies (white areas on cap representing volval remnants). — 283. Crushed volval remnants from cap. — 284. Spore. (All figs. from type.)

short gills rounded-attenuate. Stem about 80 × 30 mm, with only slightly expanded base, whitish, striate above attachment of pendent, submembranous, easily broken and disappearing ring, with no remnants of volva. Flesh white, not changing colour.

Spores [15/1] 9–12 × 6.5–7.5 μ, length-breadth ratio (1.2–)1.35–1.65 (average 1.45), broadly ellipsoid to elongate, thin-walled, colourless, with granular contents, amyloid (Fig. 286). Basidia 4-spored, with clamps. Pileipellis consisting of hyphae 3–8 μ wide, gelatinized near surface, with rather many refractive hyphae. Remnants of volva on cap (Figs. 289, 290) consisting of branching, partly refractive hyphae 3–8 μ wide and subcylindrical to ellipsoid cells up to 100 × 35 and 65 × 55 μ, at least partly forming chains; many of the elements with yellowish, refractive contents in one or both of their ends; oleiferous hyphae rather abundant. Trama of stem with abundant, upright, terminal, large, clavate cells.

COLLECTION EXAMINED.—AUSTRALIA, Queensland, Mt Glorious, 1961, *A. C. Aberdeen 61/133* (L).

OBSERVATIONS.—The material available includes a dried sector of a nearly glabrous cap, some fragments preserved in liquid, a rather extensive description, and a rough drawing of a fruit-body. Unfortunately fragments of the volva are very scarce.

The present collection from S.E. Queensland was received from Dr. J. C. Aberdeen under the name *A. grossa*. It appears indeed to have many characters in common with the type of that species from Tasmania. The main reason that I hesitate to identify the two collections with each other is a difference in structure of the volval remnants on the cap. In the type of *A. grossa* the volva apparently consists mainly of ellipsoid to globose, often pedunculate cells intermixed with only a few oleiferous hyphae (Fig. 283). The few remnants of the volva in the present collection consist of a striking number of elongate cells and many oleiferous hyphae (Figs. 289, 290).

Amanita grossa has been recorded from Australia by Cleland (1934: 50) and Gilbert (1941: 383). I have not examined their material.

AMANITA SUBALBIDA Clel.—Figs. 291–293

Amanita subalbida Clel. *in* Trans. R. Soc. S. Austr. **55**: 152. 1931. — *Aspidella subalbida* (Clel.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

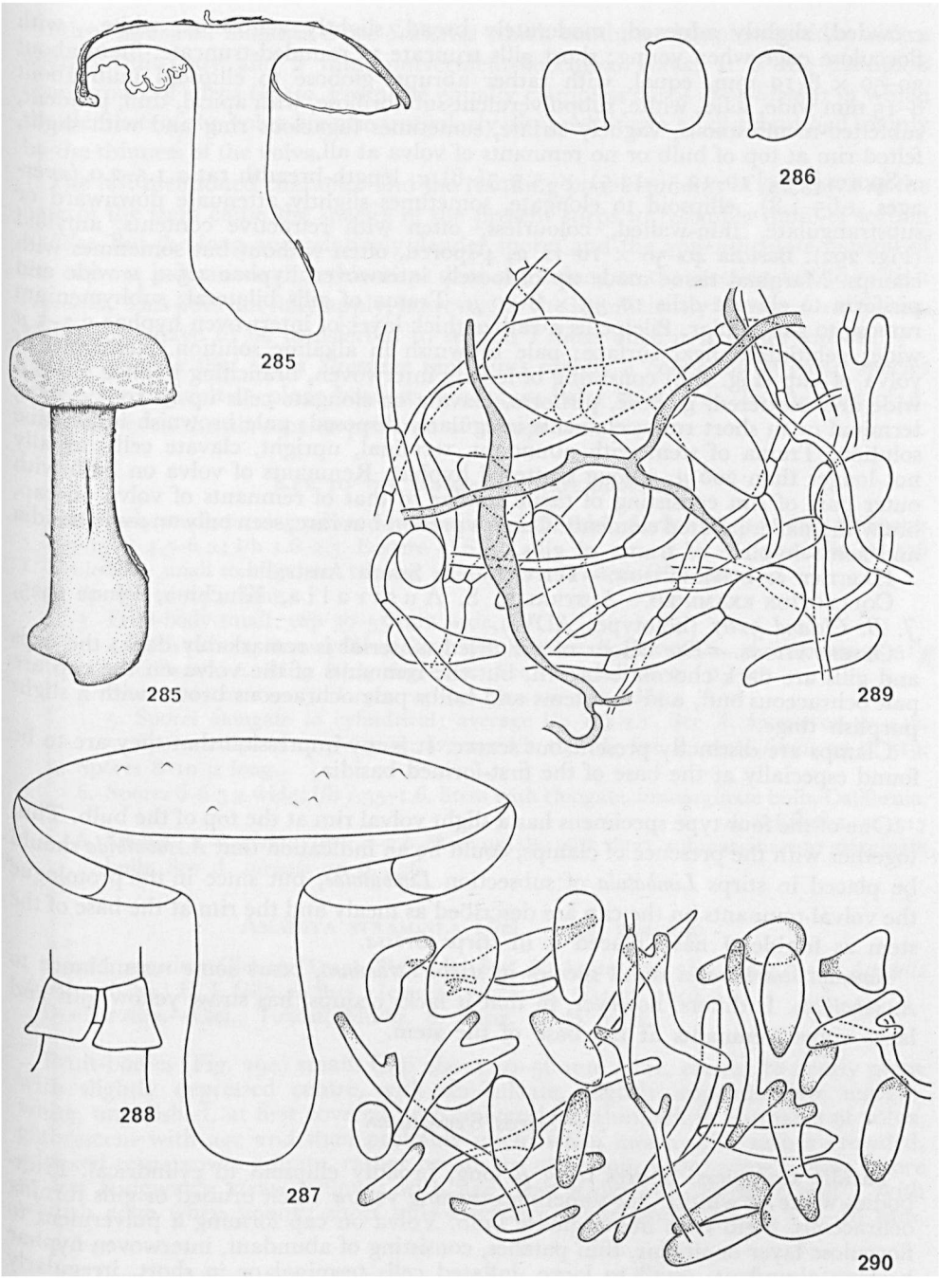
DESCRIPTIONS.—Clel., Toadst. Mushr. S. Austr. **1**: 51. 1934; E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 386. 1941.

Fruit-bodies (Fig. 291) small. Cap about 30–45 mm wide, somewhat irregularly convex to plane with slightly depressed centre, with non-sulcate, slightly appendiculate margin, dry (judging by the microscopical structure of the pileipellis, probably viscid when moist), pallid brownish to nearly white, with thin, pulverulent-subfelted, concolorous ?, crust-like remnants of volva especially over centre. Gills

EXPLANATION OF FIGURES 285–290

Fig. 285. *Amanita grossa*. — Dried fruit-bodies of type.

Figs. 286–290. *Amanita grossa* sensu Aberdeen. — 286. Spores. — 287. Fruit-body. — 288. — Ring. — 289. Crushed volval remnants from near centre of cap. — 290. Same from near margin of cap (dotted areas representing yellowish, refractive contents). (All figs. from *Aberdeen 61/133*; 287, after sketch in field-notes.)



Figs. 285–290

crowded, slightly adnexed, moderately broad, slightly ventricose, white, with flocculose edge when young; short gills truncate to rounded-truncate. Stem about 30–50 × 8–10 mm, equal, with rather abrupt, globose to ellipsoid bulb about 8–15 mm wide, solid, white, subpulverulent-subfibrillose, with apical, thin, pendent, subfelted-membranous, vaguely striate, sometimes fugacious ring and with slight, felted rim at top of bulb or no remnants of volva at all.

Spores [33/4] 10–12.5(–13.5) × 5.5–7(–8) μ, length-breadth ratio 1.5–2.0 (averages 1.65–1.8), ellipsoid to elongate, sometimes slightly attenuate downward or substrangulate, thin-walled, colourless, often with refractive contents, amyloid (Fig. 292). Basidia 40–50 × 10–12 μ, 4-spored, often without but sometimes with clamps. Marginal tissue made up of loosely interwoven hyphae 1.5–4 μ wide and piriform to clavate cells 10–35 × 8–20 μ. Trama of gills bilateral; subhymenium ramose to subcellular. Pileipellis a rather thick layer of interwoven hyphae 2.5–5 μ wide; gelatinized near surface; pale brownish in alkaline solution. Remnants of volva of cap (Fig. 293) consisting of loosely interwoven, branching hyphae 2.5–8 μ wide and scattered, globose, piriform, clavate or elongate cells up to 100 × 70 μ, terminal or in short rows; elements irregularly disposed; pale brownish in alkaline solution. Trama of stem with abundant, terminal, upright, clavate cells, usually not longer than 200 μ, among scattered hyphae. Remnants of volva on bulb with outer part of rim consisting of tissue similar to that of remnants of volva on cap, but with smaller inflated elements. Clamps present but rare, seen only on some basidia and some hyphae of trama of gills.

HABITAT & DISTRIBUTION.—Terrestrial in South Australia.

COLLECTION EXAMINED.—AUSTRALIA, S. Australia, Kinchina, 8 June 1925, *J. B. Cleland 9267* (holotype: ADW).

OBSERVATIONS.—The colour of the dried material is remarkably dark; the caps and gills are dark chocolate brown, but the remnants of the volva on the cap are pale ochraceous buff, and the stems and bulbs pale ochraceous brown with a slight purplish tinge.

Clamps are distinctly present but scarce. It is my impression that they are to be found especially at the base of the first-formed basidia.

One of the four type specimens has a slight volval rim at the top of the bulb. This, together with the presence of clamps, could be an indication that *A. subalbida* should be placed in stirps *Limbatula* of subsection *Limbutalae*, but since in the protologue the volval remnants on the cap are described as mealy and the rim at the base of the stem as friable, I have placed it in stirps *Grossa*.

Amanita straminea, a small species in stirps *Straminea*, bears some resemblance to *A. subalbida*. It differs, however, in that it lacks clamps, has straw yellow gills and lacks volval remnants at the base of the stem.

Stirps STRAMINEA

Basidia clampless. Spores 8–13 μ long, broadly ellipsoid to cylindrical. Fruitbodies white or whitish but sometimes turning yellow when bruised or gills turning ochraceous. Stem with immarginate bulb. Volva on cap forming a pulverulent to flocculose layer or similar, thin patches, consisting of abundant, interwoven hyphae bearing abundant, small to large, inflated cells terminal or in short, irregularly disposed rows.

Stirps *Straminea* includes those *Solitariae* which combine clampless basidia with a whitish fruit-body and a thin, pulverulent-flocculose volva. It is the clampless counterpart of stirps *Grossa*. From the equally clampless stirps *Strobiliformis* in which the elements of the volva are also irregularly disposed, it can be distinguished mainly by the thinness of the volva.

The last mentioned character and the resulting poor remnants of the volva at the base of the stem cause the species of the present stirps to resemble those of section *Validae*. But the long and relatively slender spores and the appendiculate margin of the cap are indications that this stirps does not belong to that section but to section *Lepidella*. This does not fully apply, however, to the insufficiently known *A. californica*, which may have to be transferred to section *Validae* once it is better known.

It is possible that stirps *Straminea* represents merely a collection of small species which are difficult to place because of obscure velar structures. In the case of *A. crassifolia* even the absence or presence of clamps is uncertain.

KEY TO THE SPECIES OF STIRPS *Straminea*

1. Fruit-body small, turning yellow when bruised. Gills thick, fairly distant to distant. Spores 8.5–13 × 4.5–6 μ; l/b 1.6–2.5. Eastern U.S.A. *A. crassifolia*, p. 516
1. Fruit-body small to large, not turning yellow when bruised. Gills normal.
   2. Spores 10–14 μ long.
      3. Fruit-body small; cap 30–55 mm wide.
         4. Gills turning straw yellow. Ring membranous. S. Australia. *A. straminea*, p. 513
         4. Gills white. Ring fairly fugacious. See *A. subalbida* on p. 510.
      3. Fruit-body medium to large; cap (40–)60–150 mm wide.
         5. Spores elongate to cylindrical; average l/b 1.8–2.1. See *A. baccata* on p. 442.
         5. Spores ellipsoid to elongate; average l/b 1.4–1.6. See *A. strobiliformis* on p. 519.
   2. Spores 8–10 μ long.
      6. Spores 6–6.5 μ wide; l/b 1.35–1.6. Stem with elongate, immarginate bulb. California. *A. californica*, p. 517
      6. Spores 4.5–6 μ wide; l/b 1.5–2.0. Stem usually with short, submarginate to marginate bulb. See *A. silvicola* on p. 526.

AMANITA STRAMINEA Clel.—Figs. 294–296

Amanita straminea Clel. *in* Trans. Proc. R. Soc. S. Austr. **51**: 299. 1927.[66] — *Aspidella straminea* (Clel.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

DESCRIPTION.—Clel., Toadst. Mushr. S. Austr. **1**: 50. 1934.

Fruit-bodies (Fig. 294) small. Cap about 40–56 mm wide, convex to nearly plane with slightly depressed centre, with non-sulcate, slightly appendiculate margin, white, unpolished, at first covered with pulverulent, thin, white remnants of volva, glabrescent with age and then probably viscid when moist. Gills rather crowded, adnexed to narrowly adnate, rather broad, up to 10 mm wide, straw yellow (more or less Ridgway's 'straw yellow'; with age near Ridgway's 'colonial buff'), with whitish edge when young; short gills attenuate. Stem about 40–58 × 6–10 mm,

[66] If *Amanita straminea* Secr., Mycogr. suisse **1**: 9, 1833, had been validly published (see foot-note 49 on p. 394) *A. straminea* Clel. would be a later homonym.

equal, with subfusiform-ellipsoid, immarginate bulb about 15–20 × 8–12 mm, solid, white, subpulverulent to subfibrillose, with pendent, membranous, subapical, white ring, without perceptible remnants of volva. Flesh white. Spore print yellowish.

Spores [30/4] 10.5–12(–13.5) × (6–)6.5–8 μ, length-breadth ratio 1.4–1.9 (averages 1.5–1.7), ellipsoid to elongate, rather thin-walled, colourless to slightly yellowish in alkaline solution, usually with refractive contents, amyloid (Fig. 295). Basidia about 45–55 × 10–12 μ, 4-spored, clampless. Marginal tissue scanty, consisting mainly of clavate cells 20–45(–80) × 12–25 μ. Trama of gills bilateral; subhymenium inflated-ramose to subcellular. Pileipellis consisting of subradial, slightly thick-walled hyphae 2.5–5(–8) μ wide, embedded in gelatinous matter; gelatinized layer rather thick; slightly yellowish in alkaline solution. Remnants of volva (Fig. 296) scattered over greater part of surface of cap, consisting of irregularly disposed, abundant hyphae, 3–9 μ wide, on which short rows of ellipsoid to globose, more rarely clavate to elongate, inflated cells up to 70 × 50 or 150 × 25 μ. Stem with abundant, upright, terminal, clavate cells among scattered hyphae. Clamps lacking.

HABITAT & DISTRIBUTION.—Terrestrial under shrubs in South Australia.

COLLECTIONS EXAMINED.—AUSTRALIA, S. Australia, Kinchina, 8 June 1926, *J. B. Cleland 9271* (lectotype: ADW).

In the original description two syntypes are mentioned, viz. one from Kinchina, June 8, 1926, and another from Encounter Bay, without date. I received on loan *Cleland 9271* (Kinchina, June 8, 1926) and *Cleland 9258* (Encounter Bay, without date). As I am fairly certain that these two collections are not conspecific, the choice of the lectotype is important. I have chosen *Cleland 9271* for the following reasons:

(i) The field-notes of *Cleland 9271* fit the protologue almost exactly.

(ii) in *Cleland 9258* the base of the stem is surrounded by a groove; hence the bulb is marginate and a narrow free limb is appressed against the base of the stem. In *Cleland 9271* the base of the stem passes gradually into the bulb and there are no discernible remnants of the volva there. In the protologue no rim or limb on the bulb is mentioned.

(iii) The spore-sizes of the two syntypes differ. In *Cleland 9258* I found 9.5–12 × 5–6.5 μ and in *Cleland 9271* 10.5–12(–13.5) × (6–)6.5–8 μ. The spore-size given in the protologue is 11–13 × 7.5 μ.

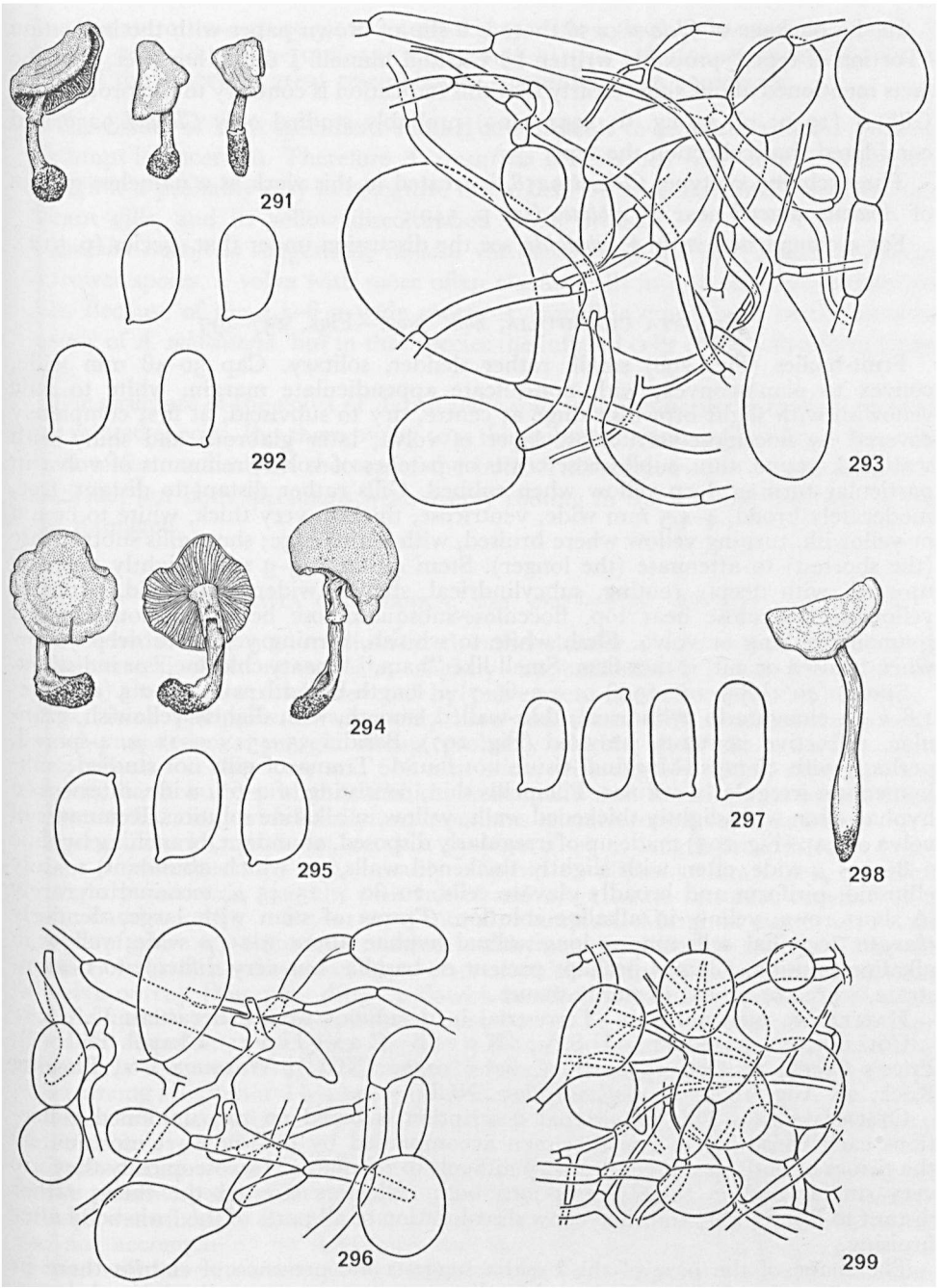
(iv) In *Cleland 9271* many basidia and spores have refractive contents which probably cause the yellow tinge of gills and spore-print. This is not the case in *Cleland 9258*.

EXPLANATION OF FIGURES 291–299

Figs. 291–293. *Amanita subalbida*. — 291. Dried fruit-bodies. — 292. Spores. — 293. Crushed volval remnants from cap. (All figs. from type.)

Figs. 294–296. *Amanita straminea*. — 294. Dried fruit-bodies. — 295. Spores. — 296. Crushed volval remnants from cap. (All figs. from type.)

Figs. 297–299. *Amanita crassifolia*. — 297. Spores. — 298. Dried fruit-body. — 299. Crushed volval remnants from cap. (All figs. from *Coker 10292*.)



Figs. 291–299

In the package of *Cleland 9258* there is a slip of brown paper with the indication "Portion of type," probably written by Cleland himself. I think, however, that the facts mentioned above show clearly that this indication is contrary to the protologue. Gilbert (1940: pl. 55 fig. 6; 1941: 400) probably studied only *Cleland 9258* and considered that collection the type.

The excluded syntype, *Cleland 9258*, is treated in this work as a nameless species of *Amanita* placed near *A. sublutea* (see p. 540).

For a comparison with *A. subalbida*, see the discussion under that species (p. 512).

AMANITA CRASSIFOLIA, *nom. prov.*—Figs. 297–299

Fruit-bodies (Fig. 298) small, rather slender, solitary. Cap 30–48 mm wide, convex to plano-convex, with non-sulcate appendiculate margin, white to pale yellowish with slight brownish tinge at centre, dry to subviscid, at first completely covered by flocculose-verruculose layer of volva, later glabrous and shiny with scattered, vague, thin, subfloccose crusts or patches of volva; remnants of volva in particular turning deep yellow when rubbed. Gills rather distant to distant, free, moderately broad, 4–4.5 mm wide, ventricose, thick to very thick, white to cream or yellowish, turning yellow where bruised, with entire edge; short gills subtruncate (the shortest) to attenuate (the longer). Stem 40–80 × 5–9 mm, slightly tapering upward, with deeply rooting, subcylindrical, slightly wider base, solid, white to yellowish, flocculose near top, flocculose-subsquamulose below, without distinct remnants of ring or volva. Flesh white to whitish, turning yellow to deep yellow when bruised or cut, rather firm. Smell like "ham," "meaty chlorine," or indistinct.

Spores [40/2] 8.5–13(–13.5) × 4.5–6(–7) μ, length-breadth ratio 1.6–2.5 (averages 1.8–2.2), elongate to cylindrical, thin-walled, smooth, with slightly yellowish, granular, refractive contents, amyloid (Fig. 297). Basidia 35–45 × 9–11 μ, 4-spored, perhaps with clamps. Marginal tissue not found. Trama of gills not studied; subhymenium irregularly cellular. Pileipellis thin, consisting of 2–6 μ wide, interwoven hyphae often with slightly thickened walls, yellow in alkaline solution. Remnants of volva on cap (Fig. 299) made up of irregularly disposed, abundant, branching hyphae 2–8(–10) μ wide, often with slightly thickened walls, on which abundant, mainly ellipsoid, piriform and broadly clavate cells, 20–80 × 15–45 μ, terminal or rarely in short rows, yellow in alkaline solution. Trama of stem with large, slenderly clavate, terminal cells among longitudinal hyphae about 3–10 μ wide; yellow in alkaline solution. Clamps perhaps present on basidia, but very difficult to demonstrate, scarce or absent in sterile tissues.

HABITAT & DISTRIBUTION.—Terrestrial in deciduous woods in eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A., North Carolina: Chapel Hill (?), Price's Creek, 11 Oct, 1936, *W. C Coker 10292* (NCU); Watauga Co., Blowing Rock, 26 Aug. 1922, *A. Holland 5805* (NCU).

OBSERVATIONS.—This provisional description is based on two unnamed collections each consisting of one specimen accompanied by field-notes. Unfortunately the tissues of both specimens are very difficult to reinflate. Macroscopically they are very similar and in their descriptions both collectors stressed the thick, rather distant to distant gills and the yellow discoloration of all parts of the fruit-body after bruising.

The shape of the base of the basidia suggests the presence of clamps there in young stages, but I did not succeed in discovering even one single distinct clamp.

The size and shape of the spores is different in the two collections. In *Coker 10292*

they measure 10–13(–13.5) × 4.5–6(–6.5) μ (l/b 1.85–2.5; average 2.2) and in *Holland 5805* (8.5–)9.5–10.5(–13) × 4.5–6.5(–7) (l/b 1.6–1.9; average 1.8). Yet in view of the otherwise great resemblance, I consider them conspecific.

The tissues of both specimens studied are difficult to reinflate and the presence of clamps is uncertain. Therefore *A. crassifolia* is described here only provisionally, though it is probably easy to recognize in the field because of its small size, its thick, distant gills, and its yellow discoloration when bruised.

Amanita crassifolia suggests *A. rhoadsii* var. *flavotingens* but this differs in having narrower spores, a volva with more often clavate cells in distinct rows, and normal gills. Because of the 4.5–6 μ wide spores *A. crassifolia* could be a small, lutescent variety of *A. subsolitaria*, but in that species the inflated cells of the volva form longer rows.

The structure of the volva of *A. crassifolia* somewhat resembles that of *A. limbatula* and related species. But there owing to a thin submembranous outer layer the volva tends to form a limb on the top of the bulb. This seems not to be the case in *A. crassifolia*, but both specimens were deeply rooting in the soil and the base of one was damaged.

AMANITA CALIFORNICA, *nom. prov.*—Figs. 300–302

Fruit-bodies (Fig. 300) medium-sized, rather slender. Cap about 60–70 mm wide, plano-convex, with non-sulcate, slightly appendiculate (?) margin, probably whitish, almost completely covered by pulverulent-flocculose layer of whitish (?) volva; shiny pileipellis showing only here and there. Gills crowded, moderately broad, rounded near margin of cap, probably whitish; short gills attenuate. Stem up to about 100 mm long and 6–8 mm wide, with slightly wider, subcylindrical, rooting, basal bulb, probably whitish, exannulate and flocculose or with subflocculose, apical ring, with hardly any remnants of pulverulent volva at base.

Spores [20/1] (7.5–)8–10(–10.5) × (5–)6–6.5(–7) μ, length-breadth ratio (1.2–)1.35–1.6 (averages 1.45–1.5), broadly ellipsoid to ellipsoid, thin-walled, colourless to slightly yellowish, smooth, with subrefractive, guttulate contents, amyloid (Fig. 301). Basidia 40–45 × 8.5–11 μ, 4-spored, clampless. Marginal tissue not found. Trama of gills very difficult to reinflate; subhymenium probably cellular. Pileipellis a rather thick layer of hyphae, upper part of which distinctly gelatinized. Remnants of volva on cap (Fig. 302) dingy yellowish in alkaline solution, consisting of abundant, ellipsoid, globose, and piriform cells, 50–100 × 30–70 μ, terminal or in short rows on abundant, branching hyphae 3–8(–12) μ wide; elements very probably irregularly disposed. Trama of stem with clavate, mostly terminal cells up to 45 μ wide among longitudinal hyphae 3–10 μ wide. Clamps not found.

COLLECTION EXAMINED.—U.S.A., California, Santa Barbara, 17 Febr. 1940 *P. M. Rea 375* (MICH).

OBSERVATIONS.—In the University Herbarium at Ann Arbor I saw two collections of the present species (*Rea 358* and *375*), both from California, filed as *A. solitaria*, which I was unable to identify with any species known. Unfortunately the collections are not accompanied by field-notes and the valid publication of a name for this species will have to await further information. From the fact that the collections were identified as *A. solitaria* by their collector we may deduce that the fruit-bodies were probably white or whitish.

On account of the rather small, ellipsoid spores, the distinctly gelatinized pileipellis, the absence of clamps, and the microscopical structure of the volva, *A. californica* could be a white species of section *Validae*. Because of the rather friable partial veil and the completely pulverulent volva combined with the probably whitish colour of the fruit-body, however, the species has been placed here in section *Lepidella* for the time being. In connection with this it would be very useful to know for certain whether the margin of the cap is appendiculate or not.

I have considered the possibility that the present fungus is a slender form with elongate bulb of *A. silvicola*, which species also occurs in western North America but more to the north. However, the spores of *A. silvicola* are narrower (4.5–6 μ wide) and relatively more slender (l/b 1.5–2.0), while the inflated cells in the remnants of its volva seem more frequently terminal than in *A. californica*.

Stirps STROBILIFORMIS

Basidia clampless. Spores 7–13.5 μ long, broadly ellipsoid to elongate (l/b 1.2–2.0). Volva white to grey, moderately to very thick, breaking up into variously shaped, flat patches to coarse, subconical, truncate, or shapeless warts, more rarely forming a more or less continuous floccose-felted layer on cap; consisting of abundant, interwoven, fairly broad hyphae bearing small to large, inflated cells terminal or in short rows. Stem with immarginate, rarely submarginate bulb.

In stirps *Strobiliformis* the clampless *Solitariae* with a fairly thick to thick, white to greyish volva consisting of irregularly disposed hyphae and inflated cells, and with an immarginate base of stem are placed together.

In one of its species, viz. *A. cinereopannosa*, the volva is sometimes distinctly grey. It can be distinguished from species with volval patches on the cap in the grey series of the clampless *Solitariae* (stirpes *Cinereoconia* and *Eriophora*) by its large, elongate spores.

Stirps *Strobiliformis* is closely related to stirps *Straminea* (p. 512) and bears, like that stirps, a certain resemblance to stirps *Grossa*, in which, however, clamps are present. But it is also conceivable that connextions exist with the clampless stirps *Polypyramis*, in which the arrangement of the volval elements is not strictly erect-parallel.

Amanita silvicola, placed in a separate stirps on account of its marginate bulb, seems to be intermediate between the present stirps and subsection *Limbatulae*.

KEY TO THE SPECIES OF STIRPS *Strobiliformis*

1. Spores 9–13.5 × 5.5–8.5 μ.
   2. Cap white, more rarely pale greyish or brownish-greyish, with thick, wart- to patch- or crust-like, about concolorous volval remnants. Spores 10–13.5 × 7–8.5 μ. Europe. *A. strobiliformis*, p. 519
   2. Cap whitish, greyish or pale greyish buff, with rather thin, angular, patch-like, sometimes irregularly wart-like, pale greyish buff to mouse grey volval remnants. Spores 9–12 × 5.5–6.5 μ. Eastern U.S.A. *A. cinereopannosa*, p. 522

1. Spores 7–10 × 4.5–6 μ.
   3. Spores 7–8.5 μ long; l/b 1.2–1.6, average 1.35. Stem becoming widely hollow. Fruit-body small to medium. Malaya. *A. centunculus*, p. 533
   3. Spores 8–10 μ long; l/b 1.5–2.0, averages 1.65–1.85. Stem solid. Fruit-body medium to large. See *A. silvicola* on p. 526.

AMANITA STROBILIFORMIS (Paul. ex Vitt.) Bertillon—Figs. 303–305

Hypophyllum strobiliforme Paul., Iconogr. Champ. pl. 162 fig. 1. 1812–35 (not val. publ.).[67] — *Agaricus strobiliformis* Paul. *ex* Vitt., Descr. Funghi manger. 59, pl. 9. 1832. — *Amanita strobiliformis* (Paul. ex Vitt.) Bertillon *in* Dechambre, Dict. encycl. Sci. médic. I **3**: 499. 1866. — *Lepidella strobiliformis* (Paul. ex Vitt.) E. J. Gilb. & Kühn. *in* Bull. Soc. mycol. France **44**: 151. 1928. — *Armillaria strobiliformis* (Paul. ex Vitt.) Locquin *in* Bull. Soc. mycol. France **68**: 167. 1952. — *Amanita solitaria* var. *strobiliformis* (Paul. ex Vitt.) Cost. & Duf., Nouv. Fl. Champ., 2e Ed., 256. 1895. — *Amanita pellita* var. *strobiliformis* (Paul. ex Vitt.) Konr. & Maubl., Ic. sel. Fung., fasc. 2: 35. 1926. — *Amanita solitaria* f. *strobiliformis* (Paul. ex Vitt.) Cost. & Duf., Nouv. Fl. Champ. 3. 1891. — *Amanita chlorinosma* f. *strobiliformis* (Paul. ex Vitt.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 393. 1941 (misappl.). — Lectotype: Paul., Iconogr. Champ. pl. 162 fig. 1.

Hypophyllum pellitum Paul., Iconogr. Champ. pl. 156bis. 1812–35 (not. val. publ.).[67] — [*Agaricus*] "*Amanita*" *pellita* (Paul.) Secr., Mycogr. suisse **1**: 13. 1833 (not val. publ.).[68] — *Amanita pellita* Paul. *ex* Bertillon *in* Dechambre, Dict. encycl. Sci. médic. **3**: 500. 1866. — *Amanita solitaria* f. *pellita* (Paul. ex Bertillon) anonym in Schweiz. Pilzt., **2**. Aufl., 2: pl. 3. 1947. — Lectotype: Paul., Iconogr. Champ. pl. 156bis.

EXCLUDED MISAPPLICATIONS.—*Amanita strobiliformis sensu* Coker *in* J. Elisha Mitchell scient. Soc. **33**: pl. 50. 1917 (= *A. ravenelii*); *A. chlorinosma* f. *strobiliformis sensu* E. J. Gilb. *in* Bres. Iconogr. mycol. **27** (2): 393. 1941 (= *A. ravenelii*).

NAME MISAPPLIED TO THE PRESENT SPECIES.—*Amanita solitaria* (Bull. per Fr.) Mérat sensu auct. europ. plur. (see p. 395).

SELECTED ILLUSTRATIONS.—Barla, Fl. mycol. ill. Champ. Alpes-Marit. (1): pl. 4bis. 1888; Schweizer Pilzt., 2. Aufl., **2**: pl. 1, 3. 1947; Veselý, *in* Annls mycol. **31**: pl. 17, 18. 1933; *in* Atl. Champ. Europe **1**: pl. 19–22, 44. 1934 (in 1933 and in 1934 same set of photographs); Vitt., Descr. Funghi manger. pl. 9. 1832.

Fruit-bodies (Fig. 303) medium to large, rarely very large, solitary or sub-gregarious. Cap (50–)70–150(–220) mm wide, convex to plano-convex, sometimes with flattened centre, white to pale grey or pale brownish grey, with non-sulcate, appendiculate margin, slightly to strongly gelatinized pileipellis, and thick remnants of white to pale grey or brownish grey, (sub)floccose-felted volva forming crusts, patches or coarse, shapeless to truncate-subpyramidal warts. Gills white to cream, crowded, moderately broad, with flocculose edge; short gills obliquely truncate to attenuate. Stem 80–180(–220) × 16–30(–40) mm, about equal, mostly thickset, white, flocculose, with clavate, fusiform, napiform to cylindrical, often rooting, small to very large bulb up to 80 × 50 mm, rarely bulb completely lacking, with subfloccose-felted volval remnants forming one or more ridges, or rows of rather

[67] I do not know the exact dates of publication of Paulet's plates. But that is of little importance as neither the generic name *Hypophyllum* has been validly published nor, consequently, the combinations with this generic name.

[68] See foot-note on p. 394.

coarse, mostly shapeless warts, or completely disappearing, with thick, soft, evanescent, apical ring. Flesh white, unchanging, with indistinct or subraphanoid smell and taste.

Spores [110/13] 10–13.5(–14.5) × 7–8.5(–9.5) μ, length-breadth ratio 1.3–1.8 (averages 1.4–1.6), ellipsoid to elongate, sometimes obovoid, thin-walled, colourless or somewhat yellowish, with refractive-guttulate contents, amyloid (Fig. 304). Basidia 50–65 × 10–14 μ, 4-spored, clampless. Marginal tissue easily collapsing, made up of abundant, rather small, ellipsoid, piriform, and clavate cells about 15–40 × 12–20 μ on hyphae running parallel to edge of gill. Trama of gills bilateral, with scattered but very conspicuous, terminal, inflated cells up to 100 × 50 μ when mature; subhymenium ramose to subcellular. Pileipellis consisting of interwoven hyphae 2–7 μ wide, dingy yellowish in alkaline solution, distinctly gelatinized near surface. Remnants of volva on cap (Fig. 305) colourless to dingy yellowish in alkaline solution, consisting of abundant, branching hyphae 3–10 μ wide on which abundant, elongate, clavate, ellipsoid, and globose cells up to 120 × 60 μ and 70 × 70 μ, terminal or in short rows; elements irregularly disposed. Trama of stem made up of abundant, large, longitudinal, clavate, terminal cells up to 350 × 35 μ on scattered hyphae 4–10 μ wide; with a few oleiferous hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in woods in Europe (except northern parts); preference for deciduous woods on heavy, calcareous soil.

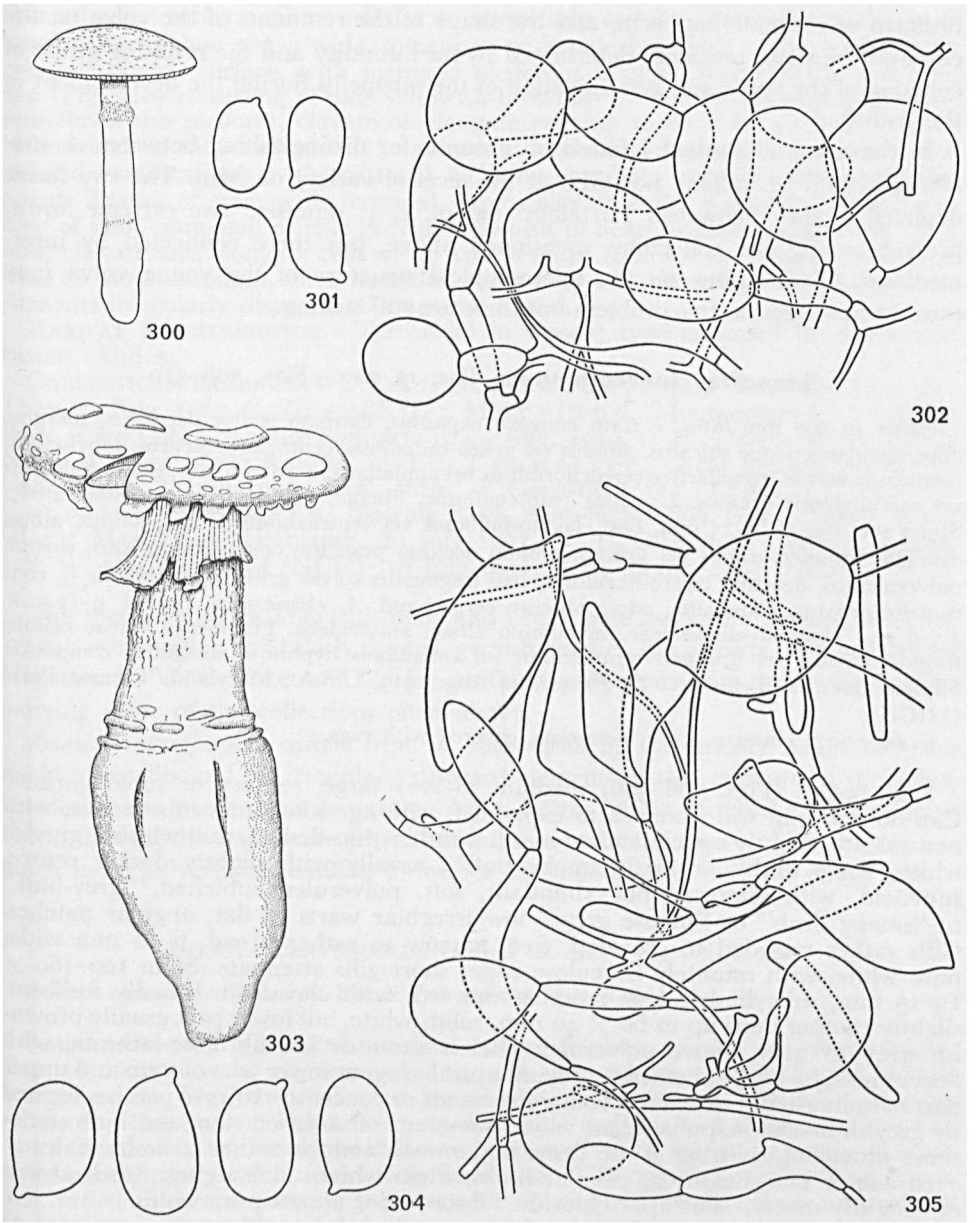
COLLECTIONS EXAMINED.—ENGLAND, Surrey, Norbury Park, 10 Oct. 1962, *R. W. G. Dennis* (L); NETHERLANDS: Noord-Holland, Heemskerk, without date, *anonym* (L); Utrecht: Bunnik, near Rhijnauwen, Sept. 1862, *Hartsen* (herb. Oudemans, L); Zeist, Wulperhorst, 21 Sept. 1925, *O. F. Uffelie* (herb. Uffelie); Gelderland: Doetinchem, Slangenburg, 29 Sept. 1953, *C. Bas 199* (L); Zeeland, Walcheren, Zeeduin, 3 Sept. 1938, *H. S. C. Huijsman 30 & 358* (L); BELGIUM, Montagne St. Pierre, 23 June 1950, *R. de Nivelle* (LG, L); FRANCE, Haute Pyrénées, St. Pé, about 1945, *anonym* (L); CZECHOSLOVAKIA: Bohemia, Prague, 20 Juli 1966, *J. Durdil* (PR); Slovakia, Zárošice, 22 June 1942, *V. Vacek* (PR); AUSTRIA, Nieder-Oesterreich, Strasshof-Silberwald, June-Aug. 1930, *Th. Cernohorsky & E. Wallauschek* (Litsch. & Lohw., Fungi sel. exsicc. europ. 95; PR); ITALY, Trentino: Trento, Gocciadoro, 23 June 1904, *J. Bresadola* (S); Margone S of Trento, Oct. 1901, *J. Bresadola* (S); Sopramonte W. of Trento, Aug. 1897, *Turco-Lazzari* (S); Vilazzona SE of Trento, July 1901, *Turco-Lazzari* (S).

OBSERVATIONS.—The present description is based on the collections mentioned above. About 20 other collections of *A. strobiliformis*, mainly from Czechoslovakia, have been compared with it.

NOMENCLATURAL NOTE.—The present species has frequently been called *A. solitaria* by European authors. The application of this name depends on its typification. On p. 396. I have explained why in my opinion Bulliard's Plate 48 (Herb. France 1781) representing '*A. echinocephala*' should be chosen as lectotype. Consequently *A. solitaria* then becomes the correct name for '*A. echinocephala*'. It should no longer be applied to the present species.

Amanita strobiliformis has an extremely variable appearance but is rather easy to recognize because of the clampless basidia, the large, ellipsoid to elongate spores, the thick, soft, incoherent, partial veil, and the thick volva made up of irregularly disposed, abundant hyphae, and medium to large, mostly terminal, inflated cells.

The great variability of the fruit-body is mainly caused by the colour, which ranges from white to brownish grey, the size and shape of the bulbous base of the stem, which varies from small and subcylindrical to very large and ventricose-



Figs. 300–302. *Amanita californica.* — 300. Dried fruit-body. — 301. Spores. — 302. Crushed volval remnants from cap. (All figs. from *Rea 375.*)

Figs. 303–305. *Amanita strobiliformis.* — 303. Fruit-body. — 304. Spores. — 305. Crushed volval remnants from cap. (All figs. from *Bas 199.*)

fusiform or elongate-napiform, and the shape of the remnants of the volva on the cap and the stem, probably determined by the humidity and the resulting grade of cohesion of the volva and gelatinization of the pileipellis during the development of the fruit-body.

In the material studied I found no grounds for distinguishing between '*A. strobiliformis*' and '*A. pellita*', not even at the level of variety or form. The two forms depicted in the "Schweizer Pilztafeln" (**2**: pl. 1, 4) represent two extreme forms, present among the collections mentioned above, but there connected by intermediates. Observations on the microscopical structure of the young volva may throw a new light on this problem but these are still lacking.

Amanita cinereopannosa Bas, *sp. nov.*—Figs. 306–310

Pileus 40–100 mm latus, e statu convexo expansus, extremo leviter depressus, margine appendiculatus neque sulcatus, albidus vel griseo-bubalinus, centro subobscurus, subviscidus, fragmentis volvae irregulariter verruciformibus vel applanatis, 2–10 mm latis, griseo-bubalinis vel subfuliginosis ornatus. Lamellae (sub)confertae, liberae, angustae vel sat latae, albae. Stipes 100–160 × 10–15 mm, basi clavato-bulbosus vel ventricoso-fusiformis, solidus, albus, deorsum brunneo-griseus vel griseus, annulo deciduo praeditus, mox exannulatus, sursum pulverulentus, deorsum lacero-fibrillosus, basi fragmentis volvae griseolis, applanatis ± concentrice ornatus. Caro alba, odore obscuro certe haud *A. chlorinosmae*. Sporae 9–12.5 × 5.5–6.5 μ, elongato-ellipsoideae, in cumulo albae, amyloideae. Fragmenta volvae cellulis turgidis flavidis vel brunneis terminalibus vel catenulatis hyphisque inconditis composita. Fibulae absentes. Typus: '*C. C. Thomas*, 24 Aug. 1919, U.S.A., Maryland, Takoma Park' (MICH).

ETYMOLOGY: cinereus, grey; pannosus, covered with rags.

Fruit-bodies (Figs. 306–308) medium to very large, solitary or subgregarious. Cap 80–160 mm wide, convex to expanded, with age sometimes subconcave, with non-sulcate, slightly appendiculate margin, rather thin-fleshed, dull whitish, greyish white, "pale drab" or "pale smoky buff", usually with slightly darker centre, subviscid, with scattered but abundant, soft, pulverulent-subfelted, "grey-buff" to "smoky drab" or "mouse grey," low irregular warts to flat, angular patches. Gills rather crowded to crowded, free, narrow to rather broad, 6–12 mm wide, pure white, with minutely flocculose edge; short gills attenuate. Stem 100–160 × 10–15 mm, subcylindrical or tapering upward, with clavate to broadly fusiform, slightly rooting bulb up to 60 × 40 mm, solid, white, but lower part usually brownish grey to grey, above pulverulent, below more or less fibrillose-lacerate, with flocculose-subfelted, ephemeral, greyish, apical ring, at lower part of stem and upper part of bulb usually with a few transverse bands or concentric rows of patches formed by greyish flocculose-pulverulent volva; remnants of volva on stem and bulb sometimes provoking splitting of the tissue underneath and formation of fleshy scales or even one or two sheathing, circular limbs. Flesh white, unchanging. Smell absent or "slightly meaty," not like "chloride." Spore print almost pure white.

Spores [80/7] 9–12.5(–14) × 5.5–6.5(–7) μ, length-breadth ratio 1.5–2.0(–2.2) (averages 1.65–1.9), elongate, sometimes ellipsoid or cylindrical, sometimes subreniform, thin-walled, colourless, with subgranular to subopaque, refractive contents, amyloid (Fig. 309). Basidia 35–50 × 9–12 μ, 4-spored, clampless. Marginal tissue consisting of mainly elongate-ellipsoid to clavate, but also piriform, ellipsoid, and subglobose cells 25–75 × 20–40 μ. Trama of gills bilateral, probably with terminal

inflated cells; subhymenium cellular to irregularly cellular. Pileipellis made up of interwoven hyphae 2–9 μ wide, sometimes with pale brownish contents, distinctly gelatinized near surface, with scattered oleiferous hyphae. Remnants of volva on cap (Fig. 310) consisting of pale yellowish-brownish to brown, ellipsoid to globose, sometimes also piriform, clavate or elongate cells up to 80 × 60 μ, in short rows or terminal on rather abundant to abundant hyphae 3–10 μ wide, sometimes with inflated ramifications, with scattered oleiferous hyphae; elements irregularly disposed. Trama of stem with terminal, large, clavate cells. Remnants of volva at base of stem composed of pale greyish-brownish to nearly colourless, globose, ellipsoid, clavate and elongate cells up to 100 × 80 μ, terminal or sometimes in short rows on very abundant, often irregular, repeatedly branching hyphae 2–10 μ wide; elements irregularly disposed. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in woods; type collected in pine-forest; easter U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: Massachusetts, Franklin Co., Mt. Toby, 25 Aug. 1963, *C. Bas 3798B* (L); Maryland, Montgomery Co., Takoma Park, Sligo Creek opposite Sanitarium, 24 Aug. 1919, *C. C. Thomas* (type: MICH under *A. cinereovolvata* Kauffm. ined.); Tennessee, Great Smoky Mountains, Cades Cove, 1 July 1955, *L. R. Hesler & Campbell 21822* (TENN, L); North Carolina: Watauga Co., Blowing Rock, Aug.-Sept. 1899, *G. F. Atkinson 3731C* CUP); Macon Co., Highlands, 29 July 1931, *W. C. Coker 8989* (NCU); 4 Aug. 938, *W. C. Coker 10858* (NCU); 10 July 1941, *W. C. Coker 12365* (NCU).

This species, with its large fruit-body and viscid, pale cap with scattered, lumpish, greyish warts to flat, irregularly shaped, greyish patches, has already been recognized as distinct by W. C. Coker and C. H. Kauffman, as appears from their notes accompanying some of the collections cited above.

Amanita cinereopannosa differs from *A. cinereoconia* in the usually larger size, the viscid pileipellis, and the irregularly disposed elements in the remnants of the volva. In colours and size it sometimes résembles *A. tephrea* (p. 452) from the same regions, but in that species clamps are present and the remnants of the volva on the cap are much more pulverulent, tending to form a continuous layer over the entire cap.

AMANITA CENTUNCULUS Corner & Bas—Figs. 311–313

Amanita centunculus Corner & Bas *in* Persoonia **2**: 258. 1962.

Fruit-bodies (Fig. 312) medium-sized, rather thickset, solitary or subgregarious. Cap 50–60 mm wide, convex to plane, with non-sulcate, slightly appendiculate margin, white, dry (when collected, but in view of structure of pileipellis probably subviscid when moist), with a few 5–15 mm wide and 1–2 mm thick, angular, flat, white then brownish, felted-membranous patches of volva, otherwise partly glabrous and smooth, partly thinly felted to furfuraceous. Gills crowded, narrowly adnate to free, rather thick and narrow, 3–4 mm wide, white, with thick, micaceous-pruinose edge; short gills truncate to obliquely truncate (the shortest) to attenuate (the longer). Stem 40–50 × 10–13 mm, subcylindrical, slightly enlarged at base or with slenderly fusiform bulb, slightly rooting, becoming widely hollow, white, wholly flocculose-pruinose, more or less annulate, at base at first with some white to brownish patches, later obscurely and thinly peronate with fading remnants of volva, finally at base merely flocculose. Ring 6–10 mm wide, apical, pendent but entirely attached

to stem, white, felted-floccose, striate on upper side, splitting and becoming lacerate with age. Flesh white, rather soft, 5–6 mm thick near centre of cap.

Spores [20/2] 7–8.5 × (4.5–)5–6(–7.5) μ, length-breadth ratio (1.05–)1.2–1.6 (average 1.35), ellipsoid, sometimes, broadly ellipsoid, rarely subglobose, thin-walled, colourless, with refractive guttulate to granular contents (cloudy vitreous when fresh), amyloid (Fig. 311). Basidia (30–)35–45 × 9–12 μ, 4-spored, clampless. Marginal tissue a thick sterile strip of clavate to globose cells mainly 20–50(–70) × 10–30 μ. Trama of gills bilateral, with up to 100 μ long and up to 35 μ wide, elongate to clavate, probably partly terminal cells; subhymenium ramose when young, becoming subcellular with age. Pileipellis rather thick, with interwoven hyphae 1.5–3 μ wide in gelatinized upper part and crowded, radial hyphae up to 8 μ wide in lower part. Remnants of volva on cap (Fig. 313) consisting of irregularly disposed, mainly ellipsoid to ovoid, but also more rarely clavate or elongate cells up to 40 × 30 μ, usually (always ?) terminal on abundant, frequently branching hyphae 2–8 μ wide, intermixed with a few oleiferous hyphae. Remnants of volva at base of stem similar to those on cap but hyphae more abundant. Trama of stem with subcylindrical to clavate, terminal (sometimes also catenulate ?) cells up to 250 × 40 μ among rather abundant hyphae 2–10 μ wide and a few oleiferous hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in tropical forest; Malaya.

COLLECTIONS EXAMINED.—SINGAPORE, Bukit Timah, 16 Aug. 1939. *E. J. H. Corner* (holotype: L, K).

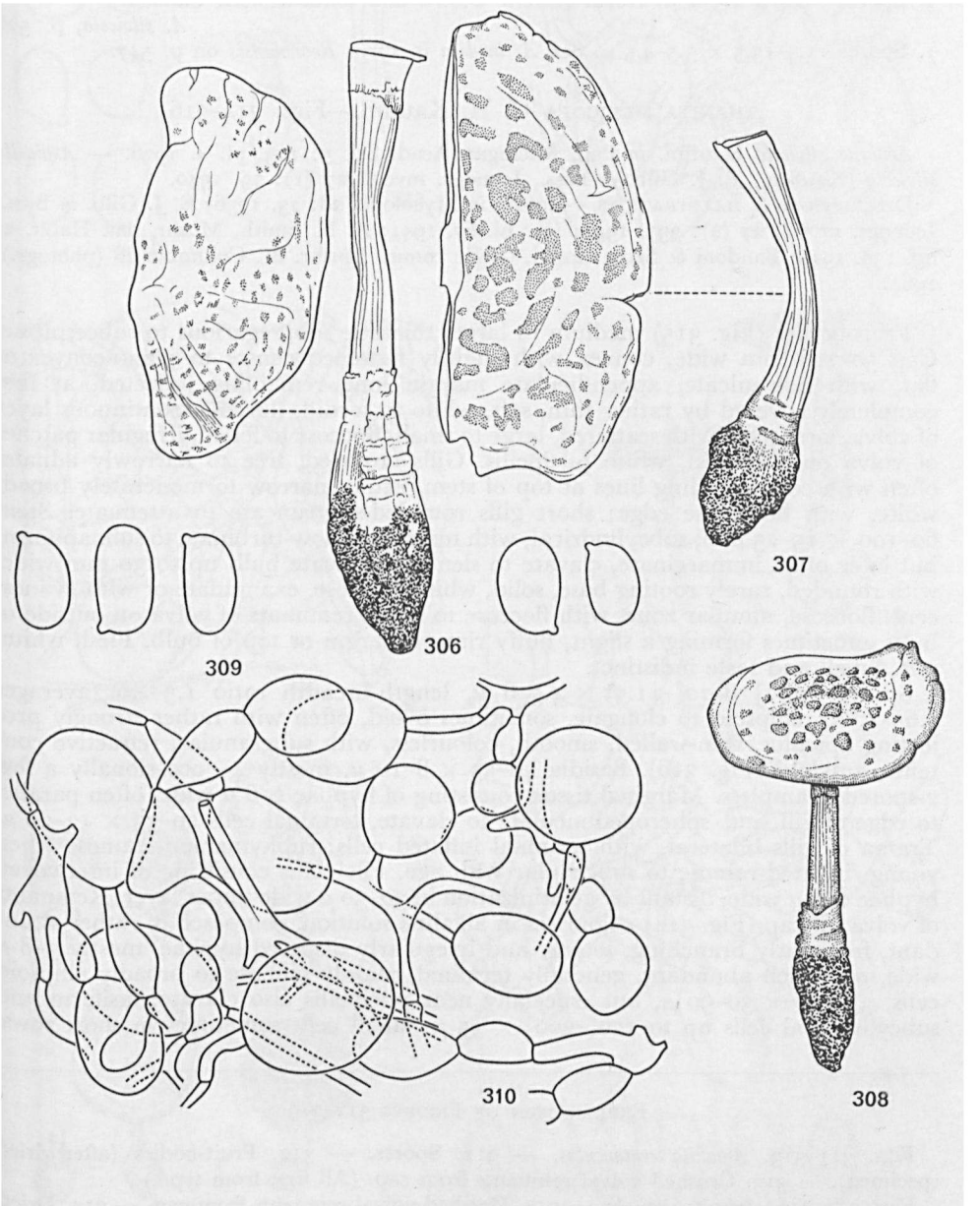
OBSERVATIONS.—I found no difference between the structure of the tissue at the surface of the volval patches on the cap and that of the tissue inside these patches. The marked coherence in the tissue of the volva seems to be due merely to the abundance of interweaving hyphae and not to a membranous outer layer.

Because of the absence of clamps, the thick volval patches on the cap, consisting of irregularly disposed hyphae and, mainly terminal, cells, the whitish colours, the ellipsoid spores and the rather incoherent ring *A. centunculus* must be placed near *A. strobiliformis* (p. 519). It differs clearly from that species, however, in having considerably smaller spores, smaller cells in the tissue of the volva, a smaller fruit-body, and a hollow stem.

Stirps SILVICOLA

Basidia clampless. Spores 8–10 μ long; l/b 1.5–2.0. White, medium to large, usually thickset fruit-body with marginate bulb without volval limb. Volva consisting of irregularly disposed, rather abundant hyphae and small to large inflated cells; without submembranous outer layer.

Because of the marginate bulb without volval limb, *Amanita silvicola*, the only species in this stirps, resembles *A. inodora* in subsection *Limbatulae* rather strongly. As I was unable to find a trace of a (sub)membranous layer at outer or inner surface of the volva of *A. silvicola*, however, I have placed stirps *Silvicola* in subsection *Solitariae*. Nevertheless it seems to represent an unmistakable link between stirpes *Straminea* and *Strobiliformis* on the one hand and subsection *Limbatulae* on the other.



Figs. 306–310. *Amanita cinereopannosa*. — 306–308. Dried fruit-bodies. — 309. Spores. — 310. Crushed volval remnants from cap. (Fig. 306, from *Coker 8989*; 307, from *Coker 10858*; 308, from *Bas 3798B*; 309, 310, from type.)

KEY TO THE SPECIES OF STIRPS *Silvicola*

1. Spores 8–10 × 4.5–6 μ. North-western U.S.A. and south-western Canada. *A. silvicola*, p. 526
1. Spores 11.5–13.5 × 3.5–4.5 μ. See *A. inodora* in stirps *Roanokensis* on p. 547.

AMANITA SILVICOLA C. H. Kauffm.—Figs. 314–316

Amanita silvicola Kauffm. *in* Pap. Michigan Acad. Sci. **5**: 123, pl. 4. 1926. — *Aspidella silvicola* (Kauffm.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

DESCRIPTIONS & ILLUSTRATIONS.—Hotson *in* Mycologia **28**: 73. 1936; E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 397. 1941; (3): pl. 67. 1941; A. H. Smith, Mushr. nat. Habit. **2**: fig. 138. 1949; Bandoni & Szczawinskii, Guide comm. Mushr. Br. Columbia 28 (photogr.). 1964.

Fruit-bodies (Fig. 315) medium to large, thickset, subgregarious to subcespitose. Cap 50–120 mm wide, convex with slightly flattened centre to plano-convex or flat, with non-sulcate, appendiculate margin long remaining inflected, at first completely covered by rather thin, soft, white to sordid, floccose, continuous layer of volva, later often with scattered, large to small, floccose to felted, irregular patches of volva on subviscid, white pileipellis. Gills crowded, free to narrowly adnate, often with corresponding lines at top of stem, rather narrow to moderately broad, white, with flocculose edge; short gills rounded-subtruncate to attenuate. Stem 60–100 × 15–25 mm, subcylindrical, with marginate, low-turbinate to subnapiform, but later often immarginate, clavate to slenderly clavate bulb up to 30 mm wide, with rounded, rarely rooting base, solid, white, floccose, exannulate or with evanescent, floccose, annular zone, with floccose to felted remnants of volva on outside of bulb sometimes forming a slight, fluffy rim at margin or top of bulb. Flesh white, soft. Smell and taste indistinct.

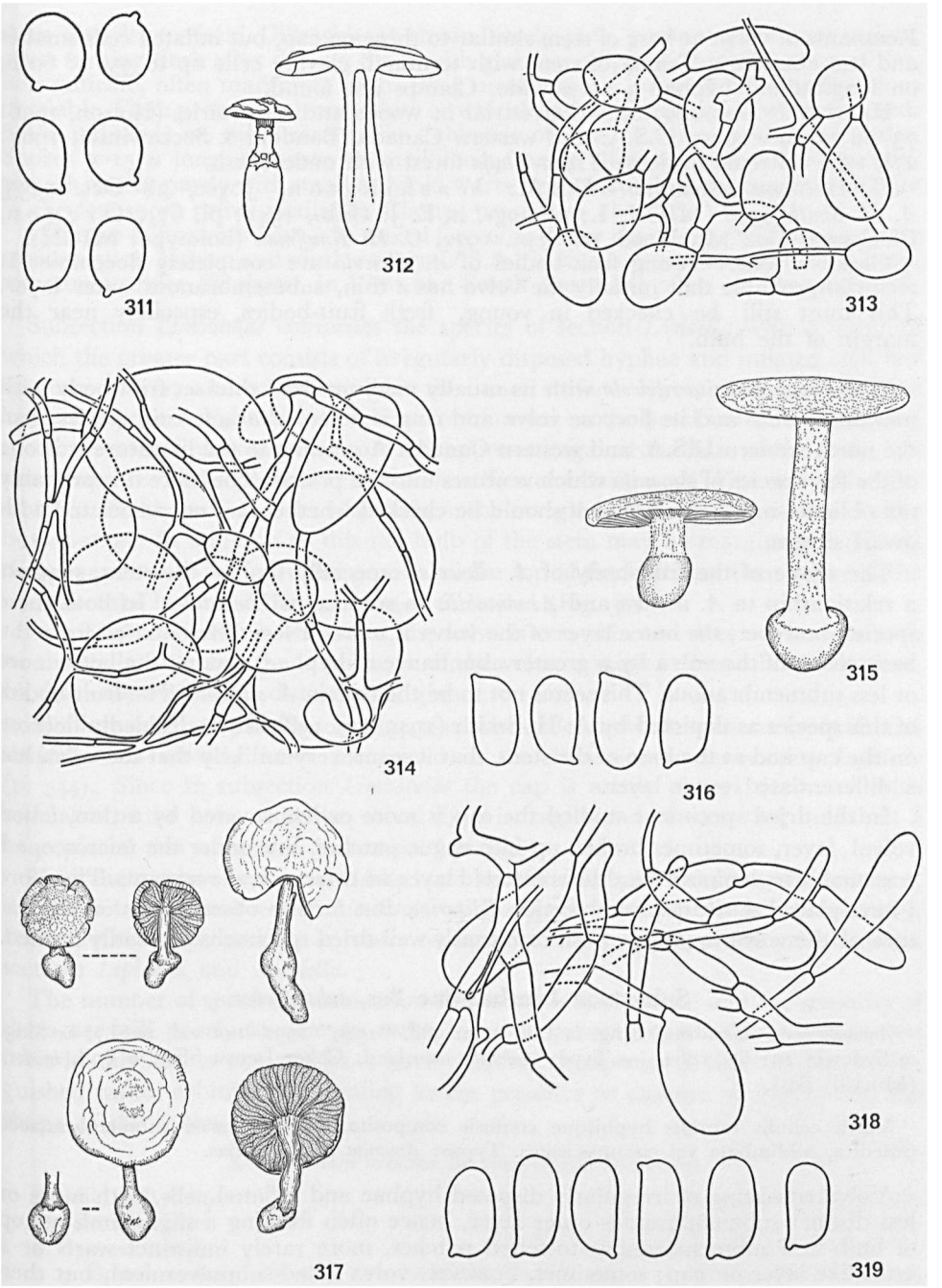
Spores [40/2] 8–10(–11.5) × 4.5–6 μ, length-breadth ratio 1.5–2.0 (averages 1.65–1.85), ellipsoid to elongate, sometimes ovoid, often with rather strongly projecting apiculus, thin-walled, smooth, colourless, with subgranular, refractive contents, amyloid (Fig. 316). Basidia 40–55 × 8–10 μ, mostly 4-, occasionally a few 2-spored, clampless. Marginal tissue consisting of hyphae 2–6 μ wide, often parallel to edge of gill and spheropedunculate to clavate, terminal cells 20–35 × 12–20 μ. Trama of gills bilateral, with terminal inflated cells; subhymenium ramose when young, inflated-ramose to subcellular with age. Pileipellis consisting of interwoven hyphae 2–6 μ wide, distant by gelatinization in 30–50 μ wide upper layer. Remnants of volva on cap (Fig. 314) colourless in alkaline solution, composed of rather abundant, frequently branching, loosely and irregularly disposed hyphae, mostly 3–8 μ wide, on which abundant, generally terminal, mainly globose to broadly ellipsoid cells, 35–100 × 30–90 μ, but especially near pileipellis also clavate, fusiform and subcylindrical cells up to 120(–200) × 35 μ; small cells sometimes in short rows.

EXPLANATION OF FIGURES 311–319

Figs. 311–313. *Amanita centunculus*. — 311. Spores. — 312. Fruit-bodies (after dried specimen). — 313. Crushed volval remnants from cap. (All figs. from type.)

Figs. 314–316. *Amanita silvicola*. — 314. Crushed volval remnants from cap. — 315. Dried fruit-bodies. — 316. Spores. (Fig. 314, from *Smith 3398*; 315, 316, from type.)

Figs. 317–319. *Amanita limbatula*. — 317. Dried fruit-bodies. — 318. Tissue of volval flakes from cap. — 319. Spores. (All figs. from type.)



Figs. 311–319

Remnants of volva at base of stem similar to those on cap, but inflated cells smaller and less abundant. Trama of stem with terminal, clavate cells up to 350 × 60 μ, on longitudinal hyphae 3–10 μ wide. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in woods and on prairies (Hotson, 1936: 73) in north-western U.S.A. and western Canada (Bandoni & Szczawinski, 1964: 27), type collected in dense *Tsuga-Thuja* forest with underbrush.

COLLECTIONS EXAMINED.—U.S.A.: Washington, Joyce, 28 Oct. 1935, *A. H. Smith 3398* (MICH, L; photogr. in E. J. Gilb., 1941: pl. 67); Oregon, Clackamas Co., Mt. Hood, 30 Sept. 1922, *C. H. Kauffman* (holotype: MICH).

OBSERVATIONS.—Young fruit-bodies of *A. silvicola* are completely flocculose. It seems improbable that initially the volva has a thin, submembranous outer layer. This must still be checked in young, fresh fruit-bodies, especially near the margin of the bulb.

The white *Amanita silvicola* with its usually medium-sized thickset fruit-body with marginate bulb and its floccose volva and ring is a very characteristic species from the north-western U.S.A. and western Canada. According to the literature it is one of the few species of *Amanita* which ventures into the prairie. Therefore it is probably not obligate-mycorrhizal. But it should be checked whether it is not associated with dwarf shrubs.

The shape of the fruit-body of *A. silvicola*, especially that of the stem, suggests a relationship to *A. inodora* and *A. mutabilis* in subsection *Limbatulae*. In both these species, however, the outer layer of the volva is more or less differentiated from the basic tissue of the volva by a greater abundance of hyphae, making the layer more or less submembranous. This seems not to be the case in *A. silvicola*. The fruit-bodies of this species as depicted by A. H. Smith (1949: fig. 138) are so decidedly floccose on the cap and at the base of the stem, that it seems very unlikely that the volva has a differentiated outer layer.

In the dried specimens studied the cap is more or less covered by a thin, felted volval layer, sometimes broken up into vague patches. But under the microscope I was unable to demonstrate a differentiated layer in these volval remnants. Therefore I have placed *A. silvicola* in subsection *Solitariae*. But further observations on the nature of the volva in young, fresh or recently well-dried specimens are badly needed.

Subsection **Limbatulae** Bas, *subsect. nov.*

Amanita sect. *Roanokenses* Sing. *in* Lilloa **22**: 388. "1949" 1951 (not val. publ.); *ex* Sing. *in* Sydowia **15**: 67. 1962. — Type: *Amanita roanokensis* Coker [sensu Sing. = ? *A. inodora* (Murrill) Bas].

Volva cellulis turgidis hyphisque confusis composita, strato externo submembranaceo praedita, sublimbata vel circumscissens. Typus: *Amanita limbatula* Bas.

Volva consisting of irregularly disposed hyphae and inflated cells, with more or less distinct submembranous outer layer, hence often forming a slight limb at top of bulb and submembranous to felted patches, more rarely indistinct warts or a crust-like layer on cap; sometimes, however, volva felted-subpulverulent, but then circumscissile and bulb distinctly marginate. Fruit-bodies small to large, white to cream or pale buff, rarely with pinkish or yellowish tinges or reddish at base of

stem. Cap dry to viscid. Gills white to cream, rarely pink, perhaps sometimes yellow, often turning dark after drying. Stem with globose, ellipsoid, fusiform or napiform, non-radicate, often marginate bulb. Ring membranous, submembranous-fugacious or friable. Flesh probably always white or whitish, rarely turning pink when exposed. Smell indistinct or, more rarely, like "chloride of lime," in one species like garlic. Spores 9–15 μ long, elongate to bacilliform, rarely ellipsoid, thin-walled, mostly, smooth, rarely partly with small amyloid warts, with normal, abrupt apiculus, white in the few spore prints available. Clamps present or absent.

HABITAT & DISTRIBUTION.—In mixed forests or under *Quercus* or *Pinus* in temperate to subtropical eastern and south-eastern U.S.A.; in shrub vegetation and savannahs, sometimes under *Eucalyptus* in West and South Australia; often on dry sandy soil.

Subsection *Limbatulae* comprises the species of section *Lepidella* with a volva of which the greater part consists of irregularly disposed hyphae and inflated cells but the outer layer, and sometimes also the inner surface layer, of more abundant hyphae. Hence a slight volval limb is often formed on the basal bulb. In expanding specimens this limb is sometimes found appressed against the base of the stem, but sometimes free and separated from the stem by a circular groove (Figs. 336, 340, 350) which probably indicates the place where the margin of the cap was situated in the button-stage. In addition to this the bulb of the stem may be marginate itself and there may be a second circular groove on the top of the bulb but then between the margin of the bulb and the insertion of the volva (Fig. 321).

In a single case, viz. in *A. inodora*, the volva is very thin and does not leave a limb on the bulb, although the outer layer of the volva is more or less submembranous. In that case the bulb is distincly marginate.

The intermediate position of subsection *Limbatulae* between sections *Lepidella* and *Amidella* has already been mentioned in the discussion under section *Lepidella* (p. 344). Since in subsection *Limbatulae* the cap is nearly always decorated with remnants of the volva and the volval limb is fragile and often rather indistinct I have placed this subsection in section *Lepidella*.

Until the species of section *Amidella* have been studied more thoroughly, however, the delimitation of subsection *Limbatulae* with respect to section *Amidella* is arbitrary. It is very well possible that in future no significant gap will prove to exist between sections *Lepidella* and *Amidella*.

The number of species in subsection *Limbatulae* is fairly small and the majority of them are still poorly known. In order to avoid presenting too many stirpes that include only one or two species, I have classified the species in three stirpes, distinguished rather arbitrarily according to the presence or absence of clamps and the shape of the spores.

KEY TO THE STIRPES OF SUBSECTION *Limbatulae*

1. Basidia with clamps. Stirps *Limbatula*, p. 530
1. Basidia clampless.
   2. Spores > 8 μ.
      3. Spores broadly ellipsoid to cylindrical; l/b 1.4–2.4. Stirps *Preissii*, p. 535
      3. Spores cylindrical to bacilliform; l/b 2.5–4.0. Stirps *Roanokensis*, p. 546
   2. Spores 6.5–7.5 × 5–5.5 μ. See *A. duplex* in excluded species on p. 566.

Stirps LIMBATULA

Basidia with clamps. Spores 9–12.5 μ long, elongate to cylindrical, more rarely bacilliform (l/b 1.7–3.2). Very small to medium, whitish or pinkish species. Volva submembranous-subpulverulent, usually forming a slight, appressed limb or a low, free collar on top of immarginate to marginate bulb, and thin flakes, patches or crusts on almost dry to subviscid surface of cap.

Stirps *Limbatula* combines all the species with clamped basidia included in subsection *Limbatulae*. There are three of them, all occurring in eastern and south-eastern U.S.A.

Probably this stirps is related to the clamp-bearing stirps *Grossa* in subsection *Solitariae*, where the volva likewise consists of irregularly disposed elements but does not have a submembranous outer layer. It is even possible that, once they are better known, a few of the Australian species, such as *A. ananaeceps*, *A. farinacea*, and *A. subalbida*, will have to be transferred to the present stirps.

On the other hand *A. praelongispora* and *A. parva*, with their often cylindrical spores rather strongly resemble the species of stirps *Roanokensis*, but in that stirps the basidia are clampless and the spores still slenderer.

KEY TO THE SPECIES OF STIRPS *Limbatula*

1. Spores 4–7 μ wide; l/b 1.5–3.2.[69]
   2. Cap completely pulverulent-subflocculose, sometimes with some flakes at centre. Ring fugacious. Spores 9–11 × 4.5–6 μ; l/b 1.7–2.2. Eastern U.S.A. *A. limbatula*, p. 530
   2. Cap with vague to distinct volval patches or more rarely crusts, warts, or scales on glabrous, subviscid or dry surface.
      3. Spores 4–5.5 μ wide; l/b 1.8–3.2. Ring submembranous.
         4. Fruit-body very small to small. Cap with distinct, about 2 mm wide, projecting, sterile margin. Spores 9.5–12 × 4–5.5 μ; l/b 1.8–2.7. Florida. *A. parva*, p. 534
         4. Fruit-body small to medium. Cap without conspicuous, sterile margin. Spores 10–12.5 × 4–5 μ; l/b 2.2–3.2 μ. South-eastern U.S.A. *A. praelongispora*, p. 532
      3. Spores 5.5–7 μ wide; average l/b 1.5–1.8.
         5. Fruit-body small. Gills white. Ring rather fugacious. See *A. subalbida* on p. 510.
         5. Fruit-body large to very large. Gills ochraceous. Ring prominent, often double. See *A. ochrophylla* on p. 556.
1. Spores 7–9 μ wide; l/b 1.0–1.55. See *A. farinacea* and *A. ananaeceps* on p. 503.

Amanita limbatula Bas, *nom. nov.*—Figs. 317–320

Amanitopsis pulverulenta Peck *in* Bull. N.Y. St. Mus. **116**: 17. 1907 (basionym); non *Amanita pulverulenta* Beeli *in* Bull. Soc. r. Bot. Belg. **59**: 101. 1927.

ETYMOLOGY: limbatulus, slightly bordered.

Fruit-bodies (Fig. 317) small. Cap 25–50 mm, convex to plano-convex, with appendiculate, smooth to slightly sulcate, somewhat inflexed margin, white to creamy white, entirely pulverulent-subflocculose, in young specimens and at centre

[69] If gills thick and distant, and flesh turning yellow, see *A. crassifolia* on p. 516.

of cap in older specimens with small, vague, concolorous to slightly paler, felted-subflocculose, adnate, flat patches of volva; only near margin in one old specimen with glabrous, slightly polished surface. Gills moderately crowded, narrowly adnate to just free, rather broad to broad, up to about 5 mm wide, broadly rounded near margin of cap, ventricose to subventricose, whitish, with subflocculose to glabrous, entire edge; short gills rounded-truncate (the shortest) to attenuate (the longer). Stem 25–50 × 5–8 mm, subcylindrical, with turbinate, subglobose or elongate-ellipsoid, submarginate to marginate bulb about 10–20 × 10–14 mm, solid, exannulate or with inconspicuous, appressed remnants of a thin, incoherent, striate, apical ring, pulverulent-flocculose, with a tender, appressed, whitish, submembranous-felted, with age sometimes disappearing volval limb up to 2 mm wide on margin of bulb. Smell weak or lacking.

Spores [70/4] 9–11(–13) × 4.5–6(–6.5) μ, length-breadth ratio 1.7–2.2(–2.4) (averages 1.8–2.1), elongate to cylindrical, but often slightly enlarged towards base or top, thin-walled, colourless, with subguttulate contents, amyloid (Fig. 319). Basidia 40–50 × 9–10 μ, 4- and 2-spored, with clamps. Marginal tissue consisting of only a few scattered, loose hyphae. Trama of gills bilateral, probably with terminal, inflated cells; subhymenium ramose, becoming more or less coralloid with age. Pileipellis a dense layer of interwoven hyphae 2–8 μ wide, slightly gelatinized near surface, with many oleiferous hyphae in inner layer. Remnants of volva on cap (Fig. 318, 320) made up of rather abundant, branching hyphae 3–8 μ wide, on which abundant globose to ellipsoid cells up to 50 × 30 μ, terminal or sometimes in short rows, and some elongate to clavate cells up to 80 × 40 μ; near surface of patches hyphae more abundant and terminal cells mostly elongate-ellipsoid to clavate; elements irregularly disposed, pale yellow to yellow in alkaline solution. Tissue of volval limb on bulb similar to that in patches on cap. Trama of stem with erect, terminal, clavate cells up to 300 × 40 μ, often with belts of colourless incrustations. Clamps rather frequent.

HABITAT & DISTRIBUTION.—Terrestrial in eastern U.S.A.

COLLECTION EXAMINED.—U.S.A., New York, Long Island, Port Jefferson, 18 Aug. 1906, *Ch. H. Peck* (holotype: NY).

OBSERVATIONS.—In the box with type material I found five specimens, one clearly distinct from the others because of a long, slender stem without a volval limb on the bulb, narrow, very crowded gills, and microscopical differences.

Inside the type box I found a loose label similar to that on the outside, except that the word "type" was lacking, the date was "Aug. 1906" instead of "18 Aug. 1906" and the words "Long stem form" were added. Apparently two collections had been put together. The loose label probably belongs to the aberrant specimen (see *A. longipes*, p. 459).

It is possible that in the tissue at the surface of the patches on the cap hyphae are still more abundant than in the tissue depicted in Fig. 318, but the outer surface is moulded and hard to analyze.

Because of the elongate to cylindrical spores, the presence of clamps, and the formation by the volva of a slight limb at the base of the stem, *A. limbatula* must be placed near *A. praelongispora* and *A. parva*. It differs from both in having a less gelatinized pileipellis in connection with which the cap is almost completely covered with pulverulent remnants of the volva, and also in having a very incoherent partial veil that does not form a true ring. Moreover, *A. limbatula* has shorter and less elongate spores than *A. praelongispora* and a very thin, appressed, somewhat irregular margin of the cap instead of a sterile, projecting margin as in *A. parva*.

AMANITA PRAELONGISPORA (Murrill) Murrill—Figs. 325–329

Venenarius praelongisporus Murrill *in* Mycologia **33**: 434. 1941. — *Amanita praelongispora* (Murrill) Murrill *in* Mycologia **33**: 448. 1941.

Fruit-bodies (Figs. 325, 328) small to medium, rather slender, subgregarious. Cap 40–70 mm wide, convex to plano-convex, with non-sulcate, appendiculate margin, white or with cream tinge, dull to shiny, subviscid, decorated with a few to several thin, white, felted to subpulverulent patches or one single, large, very thin, similar central patch of volva. Gills crowded to rather crowded, narrowly adnate, adnexed or just free, narrow to rather broad, white (in type) or flesh pink (in *Coker 13789*), turning brownish with age, with white, flocculose edge; short gills rounded-truncate (the shortest) to attenuate (the longer). Stem 50–80 × 6–12 mm, subcylindrical, with abrupt to submarginate, ellipsoid to napiform bulb 15–25 × 15–25 mm, solid, white, sometimes with yellowish tinge, flocculose-fibrillose, glabrescent, subannulate to exannulate, with very fragile, thin, white, up to 3 mm high, often somewhat fringed limb of volva (Fig. 326), or appressed remnants of this limb on top of bulb, rarely without any such remnants. Partial veil white, membranous, but very thin and mostly remaining as fringes at margin of cap and a narrow, more or less appressed ring at apex of stem. Flesh white, without smell. Spore print white.

Spores [50/3] 10–12.5(–13.5) × 4–5 μ. length-breadth ratio 2.2–3.2 (averages 2.45–2.7), cylindrical to bacilliform, thin-walled, smooth, very pale yellowish, with subgranular, refractive contents, amyloid (Fig. 329). Basidia 35–45 × 9–11 μ, 4-spored, with clamps. Marginal tissue a rather broad strip of clavate to spheropedunculate cells up to 60 × 50 and 80 × 30 μ, terminal and in short rows. Trama of gills bilateral, with elongate cells up to 30 μ wide, but probably without terminal, inflated cells; subhymenium ramose to subcellular passing into hymenopodium of subglobose cells up to 25 μ wide. Pileipellis consisting of a dense layer of interwoven, often slightly thick-walled hyphae 2–8 μ wide, covered by a thickish gelatinized layer; yellowish in alkaline solution but trama immediately under pileipellis brighter yellow. Remnants of volva on cap (Fig. 327) made up of abundant hyphae 2–10 μ wide, with sometimes slightly thickened walls, on which abundant, globose, ellipsoid and clavate cells, 30–140 × 25–75 μ, terminal or in short rows, and scattered, subcylindrical cells; elements irregularly disposed, pale yellow in alkaline solution; only here and there outer layer of patches with more abundant hyphae. Remnants of volva on bulb similar to those on cap but with inflated cells generally smaller and hyphae more abundant, especially at outer surface. Trama of stem with large, clavate, at least partly terminal cells among 4–10 μ wide hyphae. Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial under oak (type) and in open woods in dunes (*Coker 13789*) in south-eastern U.S.A.

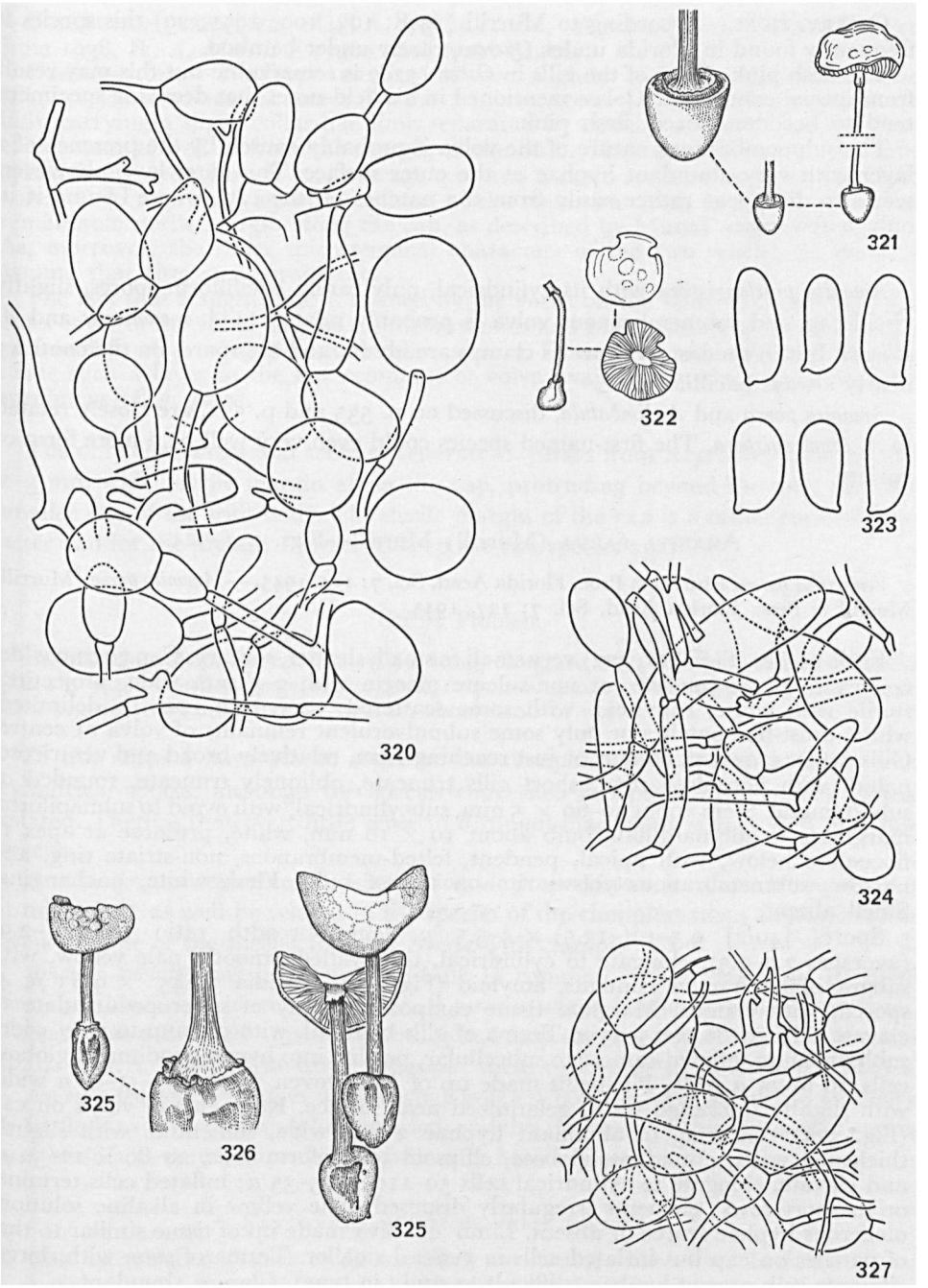
COLLECTIONS EXAMINED.—U.S.A.: South Carolina, Horry Co., Myrtle Beach, July 1945, *W. C. Coker 13789* (NCU); Florida, Alachua Co., Gainesville, 16 May 1938, *W. A. Murrill F 16108* (holotype: FLAS).

EXPLANATION OF FIGURES 320–327

Fig. 320. *Amanita limbatula.* — Crushed pulverulent volval remnants from cap of type.

Figs. 321–324. *Amanita parva.* — 321. Dried type specimen A. — 322. Dried type specimen B. — 323. Spores (from specimen A above, from B below). — 324. Crushed volval remnants from cap of specimen B. (All figs. from type.)

Figs. 325–327. *Amanita praelongispora.* — 325. Dried fruit-bodies. — 326. Base of stem (× 2). — 327. Crushed volval remnants from cap. (All figs. from *Coker 13789*.)



Figs. 320–327

OBSERVATIONS.—According to Murrill (1948: 103, 109; 1951: 29) this species is frequently found in Florida under *Quercus*, rarely under bamboo.

The flesh pink colour of the gills in *Coker 13789* is remarkable but this may result from special conditions. Coker mentioned in his field-notes that decaying specimens tend to become entirely flesh pink.

The submembranous nature of the volva is probably caused by the presence of a layer with very abundant hyphae at the outer surface. This outer layer, however, seems to disappear rather easily from the patches on the cap, where I found it in only a few cases.

Amanita praelongispora with its cylindrical, only rarely bacilliform spores, slightly viscid cap, and submembranous volva is probably related to *A. roanokensis* and *A. alliacea*. But in the last two species clamps are absent and the spores on the contrary nearly always bacilliform.

Amanita parva and *A. limbatula*, discussed on p. 535 and p. 531, are closely related to *A. praelongispora*. The first-named species could even very well be a mere form or variety.

AMANITA PARVA (Murrill) Murrill—Figs. 321–324

Venenarius parvus Murrill *in* Proc. Florida Acad. Sci. **7**: 114. 1945. — *Amanita parva* (Murrill) Murrill *in* Proc. Florida Acad. Sci. **7**: 127. 1945.

Fruit-bodies (Figs. 321, 322) very small to small, slender, solitary. Cap 30 mm wide, convex to plano-concave, at non-sulcate margin with 2–3 mm wide, projecting, sterile rim, white, subviscid, with some scattered, very thin, poorly delimited, white, crust-like patches or only some subpulverulent remnants of volva at centre. Gills rather crowded, adnate, or just reaching stem, relatively broad and ventricose, pallid, with flocculose edge; short gills truncate, obliquely truncate, rounded or subattenuate. Stem about 50–60 × 5 mm, subcylindrical, with ovoid to subnapiform, marginate to submarginate bulb about 10 × 10 mm, white, pruinose at apex to flocculose below, with apical, pendent, felted-membranous, non-striate ring, and narrow, submembranous volval rim on top of bulb. Flesh white, unchanging. Smell absent.

Spores [40/2] 9.5–12(–13.5) × 4–5.5 μ, length-breadth ratio 1.8–2.7(–2.9) (averages 2.0–2.5), elongate to cylindrical, thin-walled, smooth, pale yellow, with subgranular-refractive contents, amyloid (Fig. 323). Basidia 35–45 × 9–11 μ, 4-spored, with clamps. Marginal tissue composed mainly of spheropedunculate to clavate cells 20–80 × 15–45 μ. Trama of gills bilateral, with cells up to 30 μ wide; subhymenium inflated-ramose to subcellular, passing into hymenopodium of globose cells up to 25 μ wide. Pileipellis made up of interwoven hyphae 3–5(–8) μ wide, with slightly thickened walls, gelatinized near surface. Remnants of volva on cap (Fig. 324) consisting of abundant hyphae 2–8 μ wide, sometimes with slightly thickened walls, abundant, globose, ellipsoid to piriform cells, 20–80 × 12–50 μ, and clavate, elongate to cylindrical cells 50–110 × 15–35 μ; inflated cells terminal or in short rows; elements irregularly disposed, pale yellow in alkaline solution; oleiferous hyphae scarce or absent. Limb of volva made up of tissue similar to that of patches on cap but inflated cells in general smaller. Trama of stem with large, elongate cells among hyphae (difficult to study in type). Clamps abundant.

HABITAT & DISTRIBUTION.—Terrestrial under *Quercus* in south-eastern U.S.A.

COLLECTION EXAMINED.—U.S.A., Florida, Alachua Co., Gainesville, 21 June 1938, *W. A. Murrill F 17404* (holotype: FLAS).

OBSERVATIONS.—The type consists of two slightly different specimens. One (Fig. 321) has cylindrical spores (l/b 2.1–2.9, average 2.5) and a strongly marginate bulb carrying a slight collar-like limb separated by circular grooves from the base of the stem as well as from the margin of the bulb. The other (Fig. 322) has subcylindrical spores (l/b 1.8–2.2, average 2.0) and a more rounded bulb with a slight volval limb appressed against the base of the stem. But both specimens have the remarkable sterile margin along the cap, as described by Murrill in the protologue. As, moreover, the other microscopical characters of the two specimens agree, I assume that they are conspecific.

The fact that a slight limb is formed by the volva on the bulb indicates that the outer layer of the volva may be submembranous and may consist mainly of hyphae, as found in *A. praelongispora* and other species. However, I was unable to demonstrate such a layer in the few remnants of volva available on the cap of the type specimens of *A. parva*.

The only characters that seem to separate *A. parava* from *A. praelongispora* are the 2–3 mm wide, sterile margin along the cap, protruding beyond the gills, and the smaller size of the fruit-body. The sterile margin of the cap is a rather curious character and for the present I prefer to keep the two species apart.

Stirps PREISSII

Basidia clampless. Spores 9.5–13.5 μ long, elongate to cylindrical, rarely ellipsoid (l/b 1.4–2.4). Small to large, white, buff, or yellow species. Bulb of stem immarginate to marginate, with appressed to free, short limb of volva.

In this stirps I have placed together the clampless *Limbatulae* with ellipsoid to cylindrical spores, although the species concerned are probably not very closely related. There is, however, little sense in distinguishing many stirpes with only one species.

Amanita preissii resembles clamp-bearing *A. praelongispora* in stirps *Limbatula*, but it might just as well be related to the species of the clampless stirps *Strobiliformis* or even to some of the species in stirps *Grossa* with clamps.

Amanita sublutea has the marginate bulb in common with *A. mutabilis*. Its small size and thin volva, however, suggest *A. parva* in stirps *Limbatula*, which sometimes, at least, has a distinctly marginate bulb, but they also suggest *A. subalbida* in stirps *Grossa* and *A. straminea* in stirps *Straminea*; these two occur in subsection *Solitariae*.

Amanita mutabilis occupies a somewhat isolated position because of the tendency of its flesh to turn reddish when exposed, and the tendency of the contents of spores and basidia to turn yellow- or red-brown in Melzer's reagent.

KEY TO THE SPECIES OF STIRPS *Preissii*

1. Gills not remarkably thick or distant. Flesh not turning yellow when bruised.
   2. Spores with average l/b > 2.0. Cap with yolk yellow tinge. Small species with exannulate stem and ellipsoid bulb with fringed volval limb. South Australia. *A. sp. indet. 1*, p. 539

2. Spores with average l/b < 2.0. Cap whitish to pale buff or with ochraceous centre.
   3. Stem with globose, ellipsoid, or napiform, immarginate bulb, without distinct groove between insertion of volva and base of stem.
      4. Fruit-body medium-sized. Bulb napiform with limb or flaps of volva. Specimens in herbarium not very dark. West Australia. *A. preissii*, p. 536
      4. Fruit-body small. Bulb globose to ellipsoid; sometimes with slight volval rim. Specimens in herbarium dark reddish brown. See *A. subalbida* on p. 510.
   3. Stem with submarginate to marginate bulb, often with distinct groove between insertion of volva and base of stem.
      5. Spores > 10 μ.
         6. Fruit-body small. Flesh probably unchanging. Contents of spores not conspicuously colouring in Melzer's reagent.
            7. Spores 11.5–13 × 6.5–7.5 μ. Ring fugacious. Cap pale buff. South Australia. *A. sublutea*, p. 538
            7. Spores 9.5–12 × 5–6.5 μ. Ring membranous. Exact colours unknown. South Australia. *A. sp. indet. 2*, p. 540
         6. Fruit-body medium-sized. Flesh often turning red after exposure. Contents of spores yellow-brown to red-brown in Melzer's reagent, often concealing amyloid reaction of wall. South-eastern U.S.A. *A. mutabilis*, p. 542
      5. Spores < 10 μ. Fruit-body medium to large, usually with short stem, marginate bulb and floccose-felted volva not forming a limb on bulb. See *A. silvicola* on p. 526.
1. Gills thick and distant. Flesh turning yellow when exposed. Small species. See *A. crassifolia* on p. 516.

AMANITA PREISSII (Fr.) Sacc.—Figs. 330–332

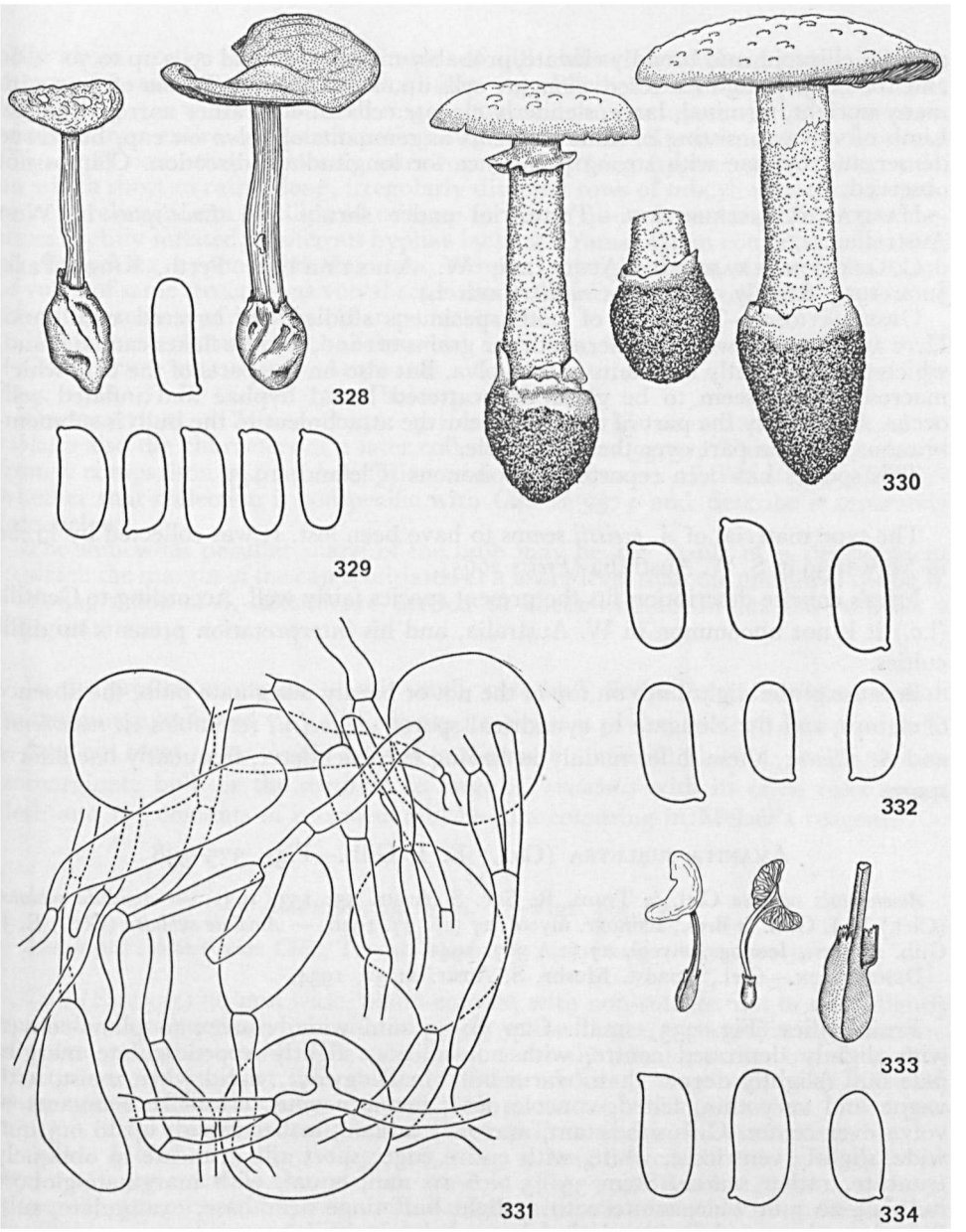
Agaricus (*Amanita*) *preissii* Fr. *in* Lehmann, Plantae Preissianae **2**: 131. 1847. — *Amanita preissii* (Fr.) Sacc., Syll. Fung. **5**: 9. 1887. — Holotype: *Preiss 2665*, May 1839, S. W. Australia.

? *Amanita preissii* f. *levis* Gentilli *in* W. Austr. Nat. **4**: 29, fig. 2. 1953 (not val. publ.; see insufficiently known taxa on p. 561).

DESCRIPTION & ILLUSTRATIONS.—Gentilli *in* W. Austr. Nat. **4**: 26, fig. 1. 1953.

Fruit-bodies (Fig. 330) medium-sized. Cap 50–80 mm wide, convex to planoconvex, finally slightly depressed at centre, with non-sulcate, slightly appendiculate margin, white to cream with pale ochraceous tinge at centre, viscid when moist, with scattered, very thin, hardly discernible patches or flakes belonging to volva, or glabrous. Gills moderately crowded, adnexed to narrowly adnate, becoming ventricose, moderately broad, white to creamy, with flocculose edge when young; short gills (only a few seen) truncate to obliquely truncate? Stem 80–120 × 8–20 mm, subcylindrical, with napiform bulb 30–50 × 20–45 mm, farinaceous, white, sometimes with rusty spots, with apical, membranous to friable, faintly striate ring; volva usually leaving on top of bulb a fragile, membranous limb 2–10 mm high. Spore print white.

Spores [20/2] (9.5–)10–12(–12.5) × 5.5–6 μ, length-breadth ratio 1.7–2.2 (averages 1.9–2.0), elongate to cylindrical, with adaxial side often slightly depressed, sometimes substrangulate, thin-walled, colourless, with slightly refractive contents, amyloid (Fig. 332). Basidia (35–)40–50 × 10–11 μ, 4-spored, clampless. Marginal tissue when young a rather broad strip of mainly piriform to clavate cells 12–30 × 8–15 μ. Trama of gills bilateral, with scattered oleiferous hyphae; subhymenium ramose to subcellular. Pileipellis consisting of interwoven hyphae 3–8 μ wide; distinctly gelatinized; hardly colouring in alkaline solution. Remnants of volva on cap (Fig. 331) consisting of abundant hyphae 5–15 μ wide, rather abundant



Figs. 328, 329. *Amanita praelongispora.* — 328. Dried fruit-bodies. — 329. Spores. (Both figs. from type.)

Figs. 330–332. *Amanita preissii.* — 330. Fruit-bodies. — 331. Crushed volval remnants from cap. — 332. Spores. (Fig. 330, after Gentilli's drawings; 331, 332, from *Gentilli, July 1953.*)

Figs. 333, 334. *Amanita, sp. indet. 1.* — 333. Dried fruit-body (× 1/2) and base of stem (× 3/2). — 334. Spores. (All figs. from *Cleland 9573.*)

globose, ellipsoid, and broadly clavate, probably mainly terminal cells up to 70 × 60 and 100 × 50 μ, and scattered, elongate cells up to 120 × 30 μ. Trama of stem with many upright, terminal, large, slenderly clavate cells among rather narrow hyphae. Limb of volva consisting of same elements as remnants of volva on cap, but tissue denser and hyphae with strong preference for longitudinal direction. Clamps not observed.

HABITAT & DISTRIBUTION.—Terrestrial under shrubs and *Eucalyptus* in West Australia.

COLLECTIONS EXAMINED.—AUSTRALIA, W. Australia, Perth, King's Park, June 1953 & July 1953, *J. Gentilli* (both L).

OBSERVATIONS.—The caps of both specimens studied are covered with sand. Here and there, however, underneath the grains of sand, minute flakes can be found, which are apparently remnants of the volva. But also on the parts of the cap, which macroscopically seem to be glabrous, scattered broad hyphae and inflated cells occur. Apparently the part of the volva near the attachment to the bulb is submembranous, but the part over the cap friable.

This species has been reported as poisonous (Cleland, 1943).

The type material of *A. preissii* seems to have been lost. It was collected by Preiss in May 1839 in S. W. Australia (*Preiss 2665*).

Fries's concise description fits the present species fairly well. According to Gentilli (l.c.) it is not uncommon in W. Australia, and his interpretation presents no difficulties.

Because of the slight limb on top of the not or hardly marginate bulb, the absence of clamps, and the elongate to cylindrical spores, *A. preissii* resembles *A. roanokensis* and *A. alliacea;* these differ mainly in having even slenderer, frequently bacilliform spores.

AMANITA SUBLUTEA (Clel.) E. J. Gilb.—Figs. 335–338

Amanitopsis sublutea Clel. *in* Trans. R. Soc. S. Austr. **55**: 153. 1931. — *Amidella sublutea* (Clel.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 77. 1940. — *Amanita sublutea* (Clel.) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 307. 1941.

DESCRIPTION.—Clel., Toadst. Mushr. S. Austr. **1**: 52, 1934.

Fruit-bodies (Fig. 335) small. Cap 30–45 mm wide, convex to plano-convex with slightly depressed centre, with non-sulcate, slightly appendiculate margin, pale buff (slightly deeper than 'warm buff' in Ridgway), viscid when moist, with vague and very thin, felted, concolorous?, inconspicuous, crust-like remnants of volva over centre. Gills subdistant, narrowly adnate, rather broad, up to 6.5 mm wide, slightly ventricose, white, with entire edge; short gills truncate to obliquely truncate, rather scarce. Stem 35–45 × 6–10 mm, equal, with marginate-globose bulb 14–20 mm wide, white with a slight buff tinge near base, exannulate, subflocculose above, subfibrillose-subglabrous below, with inconspicuous, very narrow, pale, submembranous volval limb on margin of bulb (Fig. 336). Flesh white.

Spores [20/2] (11–)11.5–13(–13.5) × 6.5–7.5(–8) μ, length-breadth ratio (1.5–)1.65–2.05 (average 1.8), elongate, rarely cylindrical, sometimes slightly obovoid, thin-walled, colourless to very slightly yellowish in alkaline solution, with slightly refractive-guttulate contents, amyloid (Fig. 337). Basidia 40–50 × 11–12 μ, 4-spored, clampless. Marginal tissue a narrow strip of small, terminal, piriform to clavate

cells about 20–45 × 12–20 μ. Trama of gills bilateral; subhymenium inflated-ramose, its cells more or less coralloid (Fig. 14). Pileipellis consisting of interwoven hyphae 1.5–5 μ wide, gelatinized in 50–100 μ wide upper layer; scattered remnants of volva over entire cap participating in gelatinization. Remnants of volva on cap (Fig. 338) consisting of loosely interwoven, branching hyphae 3–8(–12) μ wide, on which short to rather long, irregularly disposed rows of subcylindrical to clavate, more rarely piriform to ellipsoid cells up to 110 × 40 μ; branching elements sometimes slightly inflated; oleiferous hyphae lacking. Trama of stem consisting of scattered, branching hyphae and abundant, terminal, upright, large, clavate cells. Limb of volva of same structure as volval remnants on cap except gelatinized inner surface consisting mainly of hyphae. Clamps lacking.

HABITAT & DISTRIBUTION.—Terrestrial in South Australia.

COLLECTION EXAMINED.—AUSTRALIA, S. Australia, Encounter Bay, 31 Aug. 1929, *J. B. Cleland 9574* (holotype: ADW).

OBSERVATIONS.—Cleland (1934: 52) included in his second description of *A. sublutea* also the characters of a later collection *(Cleland 9573)*. This appears clearly from a comparison of that description with the field-notes of *Cleland 9573*. I doubt whether that collection is conspecific with *Cleland 9574* and describe it separately (see below).

The somewhat peculiar shape of the bulb may be the result of a development in which the margin of the cap is initiated at a lower level than the margin of the bulb.

Young stages of *A. sublutea* are needed to check whether in fact the bulb has a marginate shape of its own.

In the present arrangement this small, pale buff, South Australian species with its marginate bulb and very thin, disrupting volva is placed in stirps *Preissii*, though it does not seem to be closely related to the medium-sized, white *A. preissii* with its immarginate bulb or the medium to large *A. mutabilis* with its often roseolescent flesh and the contents of its spores and basidia colouring in Melzer's reagent.

AMANITA, *sp. indet. 1*—Figs 333, 334

Amanitopsis sublutea sensu Clel., Toadst. Mushr. S. Austr. 1: 52 (1934) pro parte.

Cap (Fig. 333) 30 mm wide, plano-convex, with non-sulcate, not or very slightly appendiculate margin, white with faint yolk yellow tinges, without distinct remnants of volva, probably viscid. Gills subdistant, narrowly adnate, rather broad, slightly ventricose, white; short gills truncate. Stem about 35 × 3 mm, with ellipsoid, immarginate bulb about 12 × 8 mm with on its top a fringed volval limb up to 2.5 mm high, with slight constriction between limb and bulb, exannulate.

Spores [10/1] 11.5–13.5(–14.5) × 5.5–6.5 μ length-breadth ratio 2.0–2.4 (average 2.15), cylindrical, thin-walled, amyloid (Fig. 334). Basidia 45–50 × 9–11 μ, 4-spored, clampless, Subhymenium subcellular, its cells somewhat irregular, but not coralloid. Pileipellis consisting of interwoven, gelatinized hyphae 1.5–5 μ wide. Remnants of volva on cap (present but macroscopically indiscernible) consisting of loosely interwoven, branching hyphae 3–8 μ wide, bearing broadly clavate to ellipsoid cells up to 110 × 50 μ or 70 × 60 μ, terminal or in short rows, scattered over surface of cap and probably participating in process of gelatinization of pileipellis. Limb of volva very thin, consisting of about the same elements as volval remnants on cap but here embedded in gelatinous matter.

COLLECTION EXAMINED.—AUSTRALIA, S. Australia, Encounter Bay, Hills Creek, 24 May 1932, *J. B. Cleland 9573* (ADW).

OBSERVATION.—In this specimen the volva is very thin. It is not clear whether it is the complete volva or only the inner layer that gelatinizes.

This collection was named *Amanitopsis sublutea* by Cleland and was included in his description of that species in his book of 1934. I found the following differences between the present collection and the type of *Amanita sublutea*: (i) Considerably narrower spores (5.5–6.5 μ here against 6–8 μ in type). (ii) A different type of bulb and attachment of volva. (iii) More ellipsoid and broadly ellipsoid elements in the remnants of the volva on the cap.

Moreover Cleland himself described the colour of the cap of the type specimens as being buff and of the present collection as being white with yolk yellow tinges. So far, therefore, these two collections are kept apart.

AMANITA, *sp. indet. 2*—Figs. 339–342

Amanita straminea Clel. *in* Trans. Proc. R. Soc. S. Austr. **51**: 299 (1927) pro parte (excluded syntype).

Cap (Fig. 339) about 35 mm wide, plano-convex with slightly depressed centre, with non-sulcate, appendiculate margin, white?,[70] with hardly discernible, very thin, small, crust-like patches of volva on somewhat shiny pileipellis. Gills rather crowded, straw-yellow?[70]; short gills attenuate. Stem about 45 × 6 mm, with napiform bulb about 18 × 9 mm, equal, solid, subfloccose above, subfibrillose below, with membranous, subapical, non-striate ring; base of stem (Fig. 340) surrounded by a groove hidden by a free, appressed limb probably formed partly by the margin of the bulb and partly by the volva.

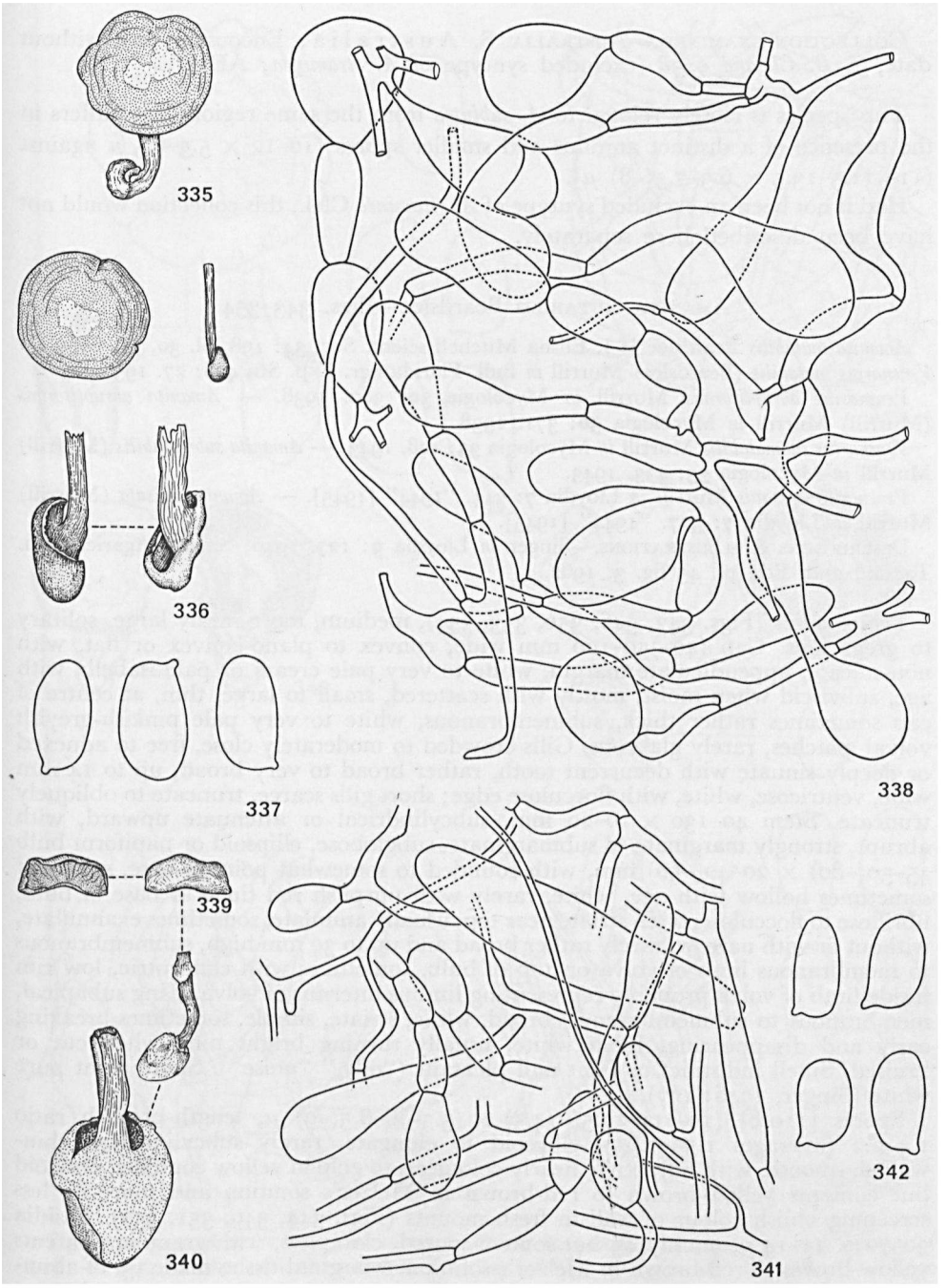
Spores [20/1] 9.5—12 × 5–6.5 μ, length-breadth ratio 1.5–2.1 (average 1.8), amyloid (Fig. 342). Basidia about 40–55 × 9–12 μ, 4-spored, clampless. Marginal tissue scanty, consisting mainly of clavate to piriform cells 15–35 × 8–20 μ. Trama of gills bilateral; subhymenium inflated-ramose to subcellular. Pileipellis somewhat yellowish in alkaline solution, consisting of interwoven hyphae 3–7 μ wide; with about 100 μ thick, gelatinized upper layer. Remnants of volva on cap (Fig. 341) composed of abundant branching hyphae 3–10 μ wide, bearing scattered, short rows of cylindrical to clavate or ellipsoid inflated cells up to 100 × 35 μ (exceptionally 160 × 40 μ).

[70] There were no field-notes in the package of *Cleland 9258* which I had on loan. But as Cleland mentioned this collection in the protologue of *A. straminea*, I gather that the colours were similar to those of the type specimens of *A. straminea*.

EXPLANATION OF FIGURES 335–342

Figs. 335–338. *Amanita sublutea*. — 335. Dried fruit-bodies. — 336. Base of stem (× 3/2). — 337. Spores. — 338. Crushed volval remnants from cap. (All figs. from type.)

Figs. 339–342. *Amanita sp. indet. 2*. — 339. Parts of dried fruit-body. — 340. Base of stem (× 3/2). — 341. Crushed volval remnants from cap. — 342. Spores. (All figs. from *Cleland 9258*.)



Figs. 335–342

COLLECTION EXAMINED.—AUSTRALIA, S. Australia, Encounter Bay, without date, *J. B. Cleland 9258* (excluded syntype of *A. straminea;* ADW).

This species is closely related to *A. sublutea* from the same region, but differs in the presence of a distinct annulus and smaller spores [10–12 × 5.5–6.5 μ against (11–)11.5–13.5 × 6.5–7.5(–8) μ].

Had it not been an excluded syntype of *A. straminea* Clel., this collection would not have been described here separately.

AMANITA MUTABILIS Beardslee—Figs. 343–354

Amanita mutabilis Beardslee *in* J. Elisha Mitchell scient. Soc. **34**: 198, pl. 30, 31. 1919. — *Venenarius mutabilis* (Beardslee) Murrill *in* Bull. Florida agr. Exp. Stn **478**: 27. 1951.

Venenarius abruptiformis Murrill *in* Mycologia **30**: 360. 1938. — *Amanita abruptiformis* (Murrill) Murrill *in* Mycologia **30**: 371. 1938.

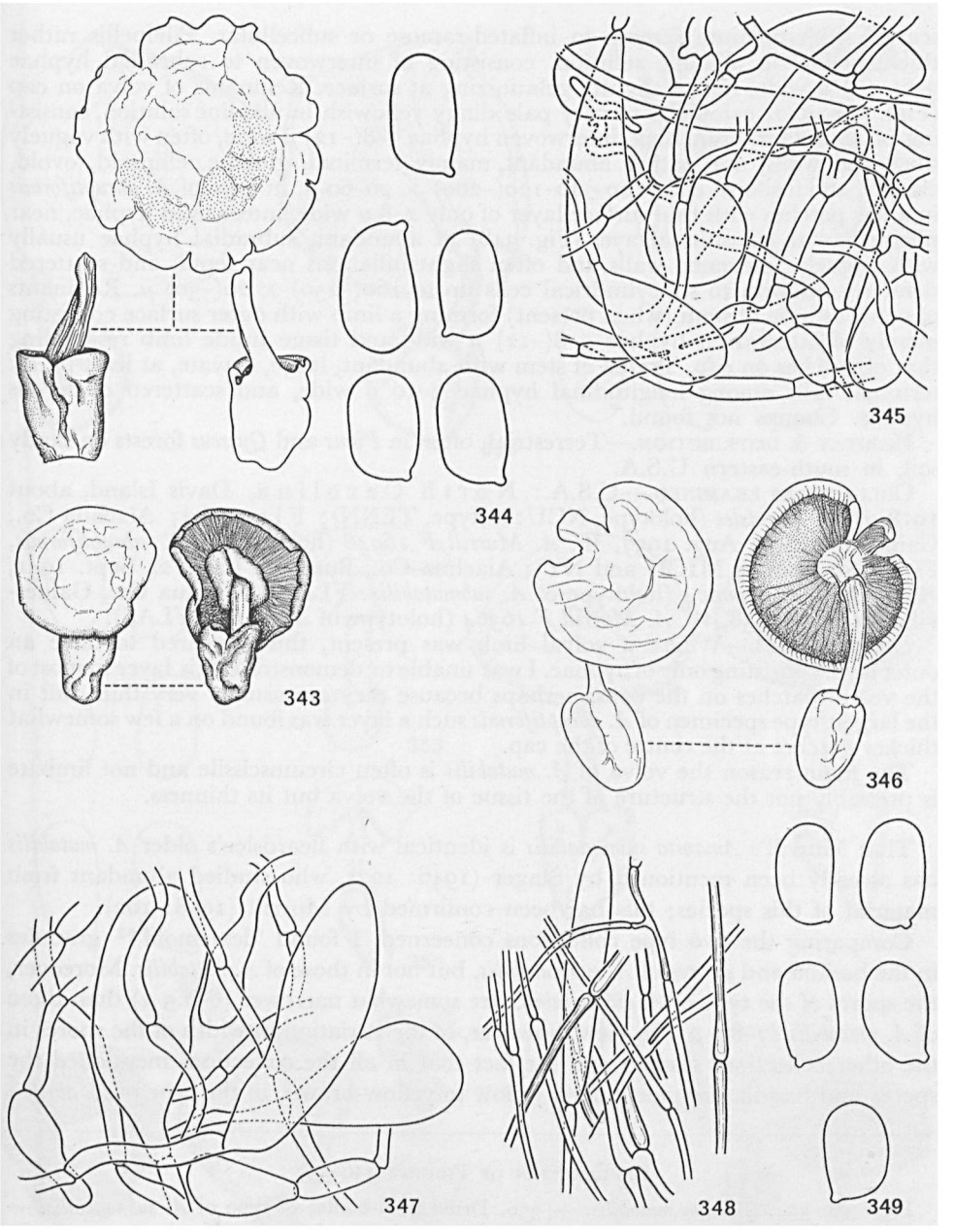
Venenarius submutabilis Murrill *in* Mycologia **35**: 428. 1943. — *Amanita submutabilis* (Murrill) Murrill *in* Mycologia **35**: 433. 1943.

Venenarius anisatus Murrill *in* Lloydia **7**: 314. "1944" [1945]. — *Amanita anisata* (Murrill) Murrill *in* Lloydia **7**: 327. "1944" [1945].

DESCRIPTIONS & ILLUSTRATIONS.—Singer *in* Lloydia **9**: 127. 1946; Singer, Agaric. mod. Taxon., 2nd. Ed., pl. 45 fig. 3. 1962.

Fruit-bodies (Figs. 343, 346, 350, 353, 354), medium, more rarely large, solitary to gregarious. Cap (40–)50–100 mm wide, convex to plano-convex or flat, with non-sulcate, appendiculate margin, white to very pale cream or pale isabella with age, subviscid when moist, mostly with scattered, small to large, thin, at centre of cap sometimes rather thick, submembranous, white to very pale pinkish-greyish volval patches, rarely glabrous. Gills crowded to moderately close, free to adnexed or deeply sinuate with decurrent tooth, rather broad to very broad, up to 14 mm wide, ventricose, white, with flocculose edge; short gills scarce, truncate to obliquely truncate. Stem 40–130 × 10–20 mm, subcylindrical or attenuate upward, with abrupt, strongly marginate to submarginate, subglobose, ellipsoid or napiform bulb 45–50(–80) × 20–40(–50) mm, with rounded to somewhat pointed base, solid but sometimes hollow with age, white, rarely with purplish red tinge at base of bulb, fibrillose to flocculose, often striate near top, usually annulate, sometimes exannulate, without or with narrow, rarely rather broad and up to 30 mm high, submembranous to membranous limb of volva on top of bulb, sometimes with concentric, low rim inside limb of volva probably representing limbus internus of volva. Ring subapical, membranous to submembranous, broad, white, striate, simple, sometimes breaking early and disappearing. Flesh white, usually turning bright pink when cut or bruised. Smell indistinct or faint and pleasant ("oily," "anise"). Spore print pure white (Singer, 1946: 127).

Spores [110/8] (10–)11–13.5(–14.5) × (5.5–)6–8.5(–9) μ, length-breadth ratio 1.4–2.2 (averages 1.55–1.95), ellipsoid to elongate, rarely subcylindrical, thin-walled, smooth, with refractive, nearly colourless to golden yellow contents, amyloid but contents yellow-brown to red-brown in Melzer's solution and more or less screening bluish colour of wall in fresh mounts (Figs. 344, 349, 351, 352). Basidia 50–70 × 11–14 μ, mainly 4-, but some 2-spored, clampless, with granular contents yellow-brown to red-brown in Melzer's solution. Marginal tissue made up of abundant, small, clavate to broadly clavate cells about 20–35 × 12–20 μ, and some hyphae, soon collapsing. Trama of gills bilateral; terminal, inflated cells absent or



Figs. 343–349. *Amanita mutabilis*. — 343. Dried fruit-bodies of type. — 344. Spores of type. — 345. Crushed volval remnants from cap of type. — 346. Dried fruit-body of type of *A. anisata*. — 347. Crushed volval remnants from cap. — 348. Transitional layer between volva and cap (× 325). — 349. Spores. (Figs. 347–349, from type of *A. anisata*.)

scarce; subhymenium ramose to inflated-ramose or subcellular. Pileipellis rather thick, yellow in alkaline solution, consisting of interwoven to subradial hyphae 3–6(–10) μ wide, not or slightly gelatinizing at surface. Remnants of volva on cap (Figs. 345, 347) colourless to very pale dingy yellowish in alkaline solution, consisting of abundant, branching, interwoven hyphae 3–8(–12) μ wide, often with vaguely thickened walls, and rather abundant, mainly terminal, globose, ellipsoid, ovoid, clavate, and fusiform cells, (20–)40–120(–200) × 20–60 μ, in type of *A. abruptiformis* in a few patches with thin surface layer of only 2–8 μ wide, interwoven hyphae, near pileipellis with transitional layer (Fig. 348) of abundant, subradial hyphae usually with vaguely thickened walls and often slight inflations near septa, and scattered slenderly fusiform to subcylindrical cells up to 160(–250) × 20(–30) μ. Remnants of volva at base of stem (when present) forming a limb with outer surface consisting merely of interwoven hyphae 3–8(–12) μ wide and tissue inside limb resembling that of patches on cap. Trama of stem with abundant, large, clavate, at least partly terminal cells among longitudinal hyphae 3–10 μ wide, and scattered oleiferous hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial, often in *Pinus* and *Quercus* forests on sandy soil, in south-eastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: North Carolina, Davis Island, about 1918, *H. C. Beardslee* (holotype, NCU; isotype, TENN); Florida; Alachua Co., Gainesville, 9–23 Aug. 1937, *W. A. Murrill F 16048* (holotype of *A. abruptiformis*, FLAS; isotypes in MICH and NY); Alachua Co., Burnett's Lake, 24 Sept. 1941, *W. A. Murrill F 20004* (holotype of *A. submutabilis:* FLAS); Alachua Co., Gainesville, 25 June 1938, *W. A. Murrill F 16364* (holotype of *A. anisata*: FLAS).

OBSERVATIONS.—Where a volval limb was present, this appeared to have an outer layer consisting only of hyphae. I was unable to demonstrate this layer in most of the volval patches on the caps, perhaps because they are usually very thin. But in the largest type specimen of *A. abruptiformis* such a layer was found on a few somewhat thicker patches at the centre of the cap.

The main reason the volva of *A. mutabilis* is often circumscissile and not limbate is probably not the structure of the tissue of the volva but its thinness.

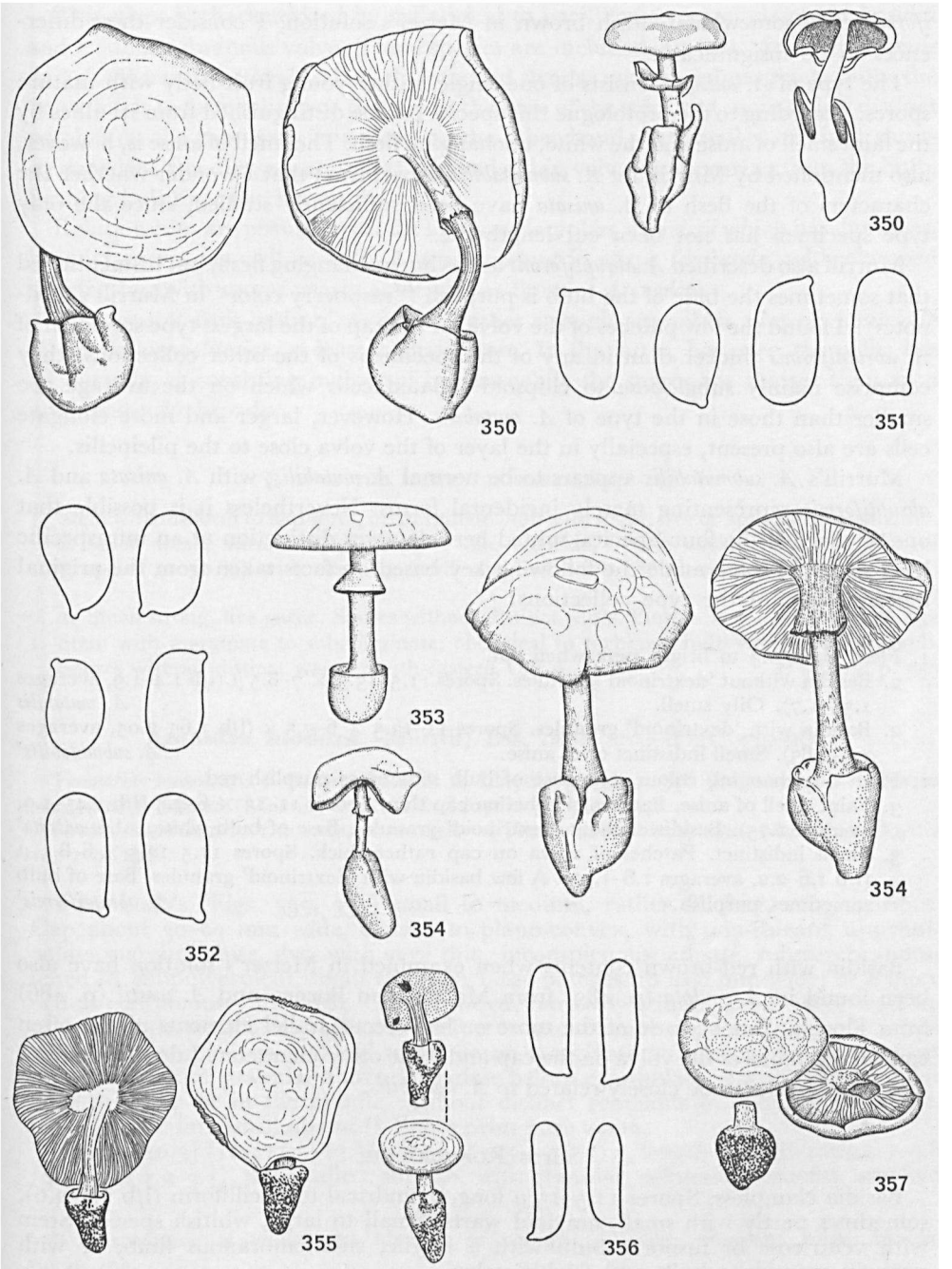
That Murrill's *Amanita submutabilis* is identical with Beardslee's older *A. mutabilis* has already been mentioned by Singer (1946: 127), who studied abundant fresh material of this species; this has been confirmed by Murrill (1948: 102).

Comparing the two type collections concerned, I found 'dextrinoid'[62] granules in the basidia and spores of *A. submutabilis*, but not in those of *A. mutabilis*. Moreover, the spores of the type of *A. submutabilis* are somewhat narrower (6–7.5 μ) than those of *A. mutabilis* (7–8.5 μ). In view, however, of the variation in width of the spores in the other collections studied and the fact that in all the collections mentioned the spores and basidia are pale golden yellow to yellow-brown, in the type of *A. abrupt-*

EXPLANATION OF FIGURES 350–357

Figs. 350–354. *Amanita mutabilis.* — 350. Dried fruit-bodies of type of *A. submutabilis.* — 351. Spores of same type collection. — 352. Spores of type of A. *abruptiformis.* — 353. Fruit-body of type of *A. abruptiformis* after sketch in field-note. — 354. Dried fruit-bodies of same type collection.

Figs. 355–357. *Amanita inodora.* — 355. Dried fruit-bodies of type. — 356. Spores. — 357. Dried fruit-body. (Figs. 355, 356 from type; 357, from *Coker 13718.*)



Figs. 350–357

iformis even somewhat reddish brown in Melzer's solution, I consider these differences to be insignificant.

The type of *A. anisata* consists of one single, rather young fruit-body with mature spores. According to the protologue this species can be distinguished from its allies by the faint smell of anise and the white, unchanging flesh. The smell of anise is, however, also mentioned by Murrill for *A. submutabilis*. Apart from that I wonder whether the characters of the flesh of *A. anisata* have been sufficiently studied, since the only type specimen has not been cut lengthwise.

Murrill also described *A. abruptiformis* as having unchanging flesh, but he mentioned that sometimes the base of the bulb is purplish ("raspberry color" in Murrill's fieldnotes)! I found the few patches of the volva on the cap of the largest type specimen of *A. abruptiformis* thicker than in any of the specimens of the other collections; they comprise mainly subglobose to ellipsoid inflated cells which on the average are smaller than those in the type of *A. mutabilis*. However, larger and more elongate cells are also present, especially in the layer of the volva close to the pileipellis.

Murrill's *A. submutabilis* appears to be normal *A. mutabilis*, with *A. anisata* and *A. abruptiformis* representing merely incidental forms. Nevertheless it is possible that one or more of the four 'species' united here deserves distinction at an infraspecific level so that I have made the following key based on facts taken from the original descriptions and the type collections:

1. Flesh changing to bright pink when cut.
   2. Basidia without 'dextrinoid' granules. Spores 11.5–13.5 × 7–8.5 μ (l/b 1.4–1.9, averages 1.55–1.7). Oily smell. *A. mutabilis*
   2. Basidia with 'dextrinoid' granules. Spores 11–13.5 × 6–7.5 μ (l/b 1.65–2.05, averages 1.8–1.85). Smell indistinct or of anise. '*A. submutabilis*'
1. Flesh not changing colour, but base of bulb sometimes purplish red.
   3. Faint smell of anise. Patches of volva on cap thin. Spores 11–13 × 6–7.5 (l/b 1.45–1.9, average 1.75). Basidia without 'dextrinoid' granules. Base of bulb white. '*A. anisata*'
   3. Smell indistinct. Patches of volva on cap rather thick. Spores 11.5–13.5 × 6–8.5 μ (l/b 1.6–2.2, averages 1.8–1.95). A few basidia with 'dextrinoid' granules. Base of bulb sometimes purplish. '*A. abruptiformis*'

Basidia with red-brown contents when examined in Melzer's solution have also been found in *A. sculpta* (p. 483) from Malaya and Borneo and *A. westii* (p. 486) from Florida. But because of the more or less erect-parallel elements of the often conical remnants of the volva on the cap and some other characters I do not consider these two species to be closely related to *A. mutabilis*.

Stirps ROANOKENSIS

Basidia clampless. Spores 11.5–15 μ long, cylindrical to bacilliform (l/b 2.7–3.9), sometimes partly with small, amyloid warts. Small to large, whitish species. Stem with ventricose or fusiform bulb with a fragile, submembranous limb, or with strongly marginate bulb and friable volva.

This stirps is characterized by cylindrical to bacilliform spores, clampless basidia and a submembranous volva. Three species are included. In two, viz. *A. roanokensis* and *A. alliacea*, the stem is relatively long and slender with an immarginate bulb; the volva tends to form a limb or patches at the base of the stem and more or less distinct patches on the cap. *Amanita inodora*, on the other hand, has small to medium, short-stemmed fruit-bodies, a marginate bulb, and a thin volva disappearing from the bulb, forming indistinct patches on the cap.

Relationships are possible with the likewise clampless *A. preissii* which has, however, broader spores, as well as with *A. praelongispora* in stirps *Limbatula*, with clamped basidia, but with spores nearly as slender as those of *A. inodora*.

The type of fruit-body of *A. inodora* rather strongly resembles that of *A. silvicola* in subsection *Solitariae*, at least in dried state. In the latter, however, the volva has no outer layer consisting mainly of hyphae while the spores are shorter than 10 μ and relatively broader.

KEY TO THE SPECIES OF STIRPS *Roanokensis*[71]

1. Stem with fusiform to napiform, immarginate bulb with slight, free or appressed volval limb.
   2. Smell weak, variable ("pleasant," "like chloride," "like cooking meat"). Part of spores (1–50 %) with distinct, small, amyloid warts. South-eastern U.S.A. *A. roanokensis*, p. 550
   2. Smell strong, like garlic. Spores without distinct warts. Florida. *A. alliacea*, p. 552
1. Stem with marginate to submarginate, obconical to turbinate bulb without volval limb. Spores without distinct warts. South-eastern U.S.A. *A. inodora*, p. 547

Amanita inodora (Murrill) Bas, *comb. nov.*—Figs. 355–360

Venenarius roanokensis f. *inodorus* Murrill *in* Lloydia **9**: 324. 1946 (basionym). — *Amanita roanokensis* f. *inodora* (Murrill) Murrill *in* Lloydia **9**: 330. 1946.

NAME MISAPPLIED TO THE PRESENT SPECIES.—? *Venenarius roanokensis sensu* Murrill *in* Lloydia **11**: 100. 1948.

Fruit-bodies (Figs. 355, 357) small to medium, rather thickset, subgregarious. Cap about 30–60 mm wide, convex to plano-convex, with non-sulcate, appendiculate margin, white, dry, with very thin, inconspicuous, adnate, submembranous-felted to subpulverulent, small to rather large patches up to 8 mm wide, or a more or less continuous, thin crust. Gills crowded, narrowly adnate, adnexed or free, up to 9 mm wide, white; short gills obliquely truncate. Stem short, about 35–55 × 10–16 mm, with conspicuous, obovoid to napiform, marginate bulb about 20–30 × 15–25 mm, solid, white, granular above, flocculose below, exannulate or with fluffy annular zone near top or in the middle, without distinct remnants of volva. Flesh white, firm. Taste faint. Smell absent.[72] Spore print pure white.

Spores [40/3] (11–)11.5–13.5(–15.5) × 3.5–4.5(–5) μ, length-breadth ratio 2.7–3.8 (averages 2.9–3.1), thin-walled, smooth, with granular, refractive contents, amyloid

[71] If structure of volva and absence of clamps uncertain, compare stirps *Rhoadsii* on p. 492.

[72] But see discussion on p. 548.

(Fig. 356). Basidia 40–50 × 8–11 μ, 4-spored, clampless. Marginal tissue made up of entangled hyphae bearing spheropedunculate to elongate cells up to 50 × 35 and 80 × 15 μ. Trama of gills bilateral; subhymenium ramose to inflated-ramose. Pileipellis composed of interwoven hyphae 1.5–5 μ wide, with distinctly gelatinized upper layer, with scattered, large, broadly clavate to fusiform cells of volva at surface. Remnants of volva on cap (Figs. 358–360) consisting of rather abundant to abundant, interwoven hyphae 2–10 μ wide on which globose, piriform, clavate, and fusiform cells up to 100 × 70 and 180 × 45 μ, terminal or in rows of two; in *Coker 13718* with relatively more abundant hyphae at surface of patches on cap, but in type this submembranous outer layer probably gone. Trama of stem consisting mainly of abundant large upright, probably terminal, clavate cells; oleiferous hyphae abundant. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial under *Quercus* and in mixed forest in southeastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: South Carolina, Horry Co., Myrtle Beach, 22 July 1946, *W. C. Coker 13718* (NCU); Florida, Alachua Co., Gainesville, 29 Aug. 1944, *W. A. Murrill F 20091* (holotype: FLAS).

Because of the shape of the bulb and the nature of the remnants of the volva the types of *A. roanokensis* (Fig. 361) and its forma *inodora* (Fig. 355) are so much different in appearance, that it is difficult to believe they represent forms of a single species.

When it turned out that the patches of the volva on the cap have a distinct, membranous, outer layer in the type of *A. roanokensis* and not in that of forma *inodora*, it even seemed as though they were not closely related. However, in the specimens of *Coker 13718*, a collection which is described by Coker as odourless and which at first sight strongly resembles the type of *A. inodora*, the thin patches on the cap appeared to have a thin, submembranous, outer layer, just as in *A. roanokensis*. Therefore it seems probable that in the type of *A. inodora* the outer, submembranous layer of the patches of the volva has disappeared. In fact, there are some patches on the cap of the type specimen of *A. roanokensis* to which the same has happened.

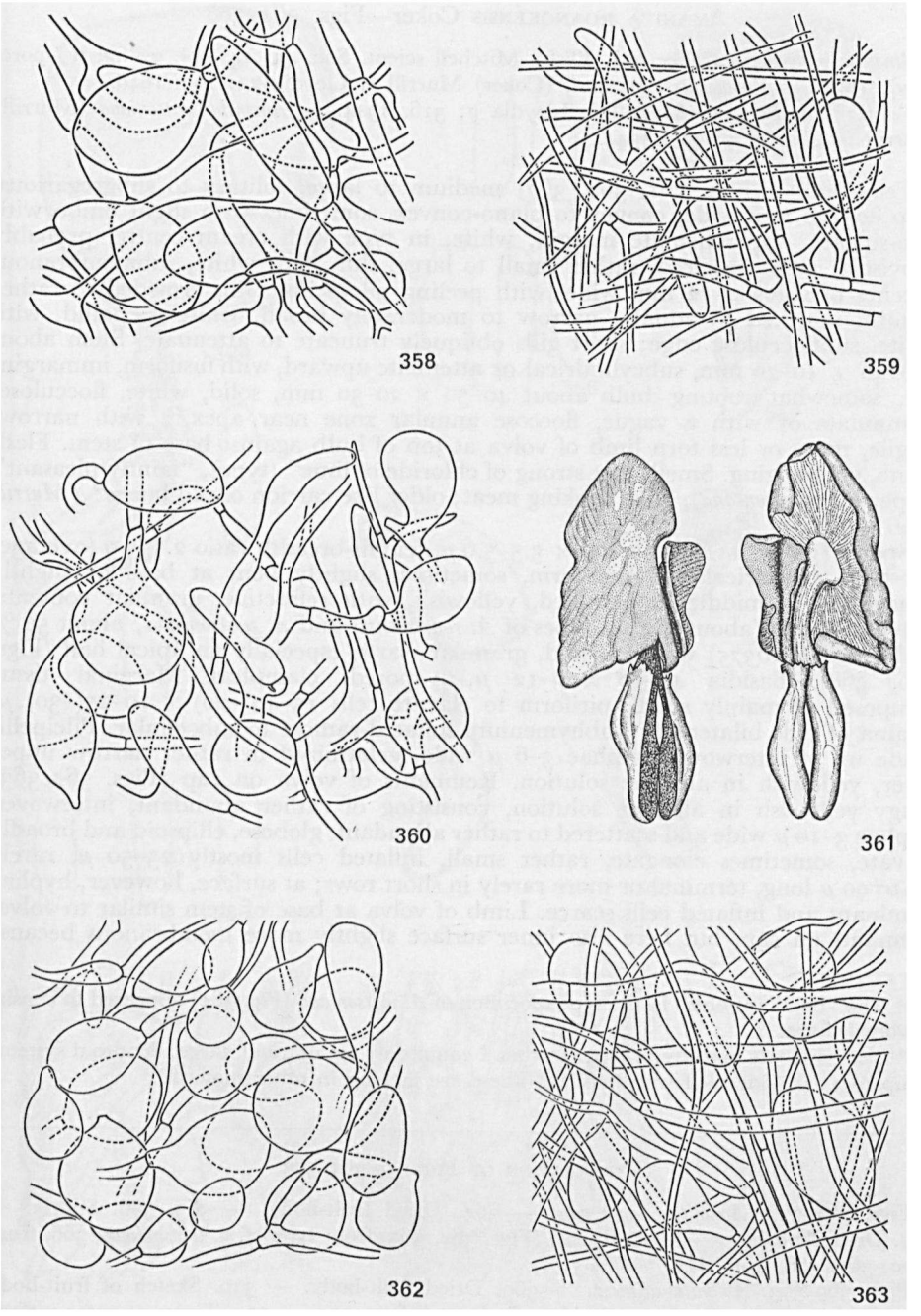
Nevertheless, the rather small size, the distinctly marginate bulb, the relatively incoherent remnants of the volva on the cap, the larger inflated cells in these remnants, the lack of any trace of a volval limb on the margin of the bulb, and the somewhat smaller spores led me to decide to raise Murrill's 'forma *inodora*' to specific rank.

Since Murrill described the true *A. roanokensis* as a new species *(A. watsoniana)* and placed his *A. roanokensis* together with forma *inodora* in a group of species with friable volva (Murrill, 1948: 100) it would seem that *A. roanokensis* sensu Murrill is probably a form of *A. inodora* with a smell!

EXPLANATION OF FIGURES 358–363

Figs. 358–360. *Amanita inodora.* — 358. Tissue inside volval patch from cap of *Coker 13718.* — 359. Tissue at outer surface of same patch. — 360. Crushed volval remnants from cap of type.

Figs. 361–363. *Amanita roanokensis.* — 361. Dried fruit-body. — 362. Tissue inside volval patch from cap. — 363. Tissue at outer surface of same patch. (All figs. from type.)



Figs. 358–363

AMANITA ROANOKENSIS Coker—Figs. 361–368

Amanita roanokensis Coker *in* J. Elisha Mitchell scient. Soc. **43**: 141, pl. 22 fig. 6 (spores only). 1927. — *Venenarius roanokensis* (Coker) Murrill *in* Lloydia **11**: 103. 1948.
Venenarius watsonianus Murrill *in* Lloydia **7**: 316. 1944. — *Amanita watsoniana* (Murrill) Murrill *in* Lloydia **7**: 327. 1944.

Fruit-bodies (Figs. 361, 364, 367) medium to large, solitary to subgregarious. Cap 80–120 mm wide, convex to plano-convex, sometimes with slight umbo, with non-sulcate, appendiculate margin, white, in type with cream centre, probably subviscid, with scattered, rather small to large, thin, flat, white, submembranous patches of volva 4–12 mm wide, with peeling pileipellis. Gills crowded to rather distant, adnexed to adnate, narrow to moderately broad, white to pallid, with white, subflocculose edge; short gills obliquely truncate to attenuate. Stem about 90–140 × 10–20 mm, subcylindrical or attenuate upward, with fusiform, immarginate, somewhat rooting bulb about 40–50 × 20–30 mm, solid, white, flocculose, exannulate or with a vague, floccose annular zone near apex,[73] with narrow, fragile, more or less torn limb of volva at top of bulb against base of stem. Flesh white, unchanging. Smell "not strong of chloride of lime" (type), "faintly pleasant" (type of *A. watsoniana*), "like cooking meat; older like carrion or old bones" (*Murrill F 21875*).

Spores [30/3] (11.5–)12.5–15 × 3.5–5.0 μ, length-breadth ratio 2.7–3.9 (averages 3.2–3.4), cylindrical to bacilliform, sometimes slightly bent at base or slightly constricted in middle, thin-walled, yellowish, with refractive, granular contents, amyloid; some (about 1 % in types of *A. roanokensis* and *A. watsoniana;* about 50 % in Murrill *F 10375*) with amyloid, granular warts, especially on apical half (Figs. 366, 368). Basidia 40–50 × 9–12 μ, 4-spored, clampless. Marginal tissue composed of mainly small, piriform to clavate cells 15–40(–60) × 10–25(–30) μ. Trama of gills bilateral[74]; subhymenium inflated-ramose to subcellular. Pileipellis made up of interwoven hyphae 3–6 μ wide, gelatinized in rather narrow upper layer, yellowish in alkaline solution. Remnants of volva on cap (Figs. 362, 363) dingy yellowish in alkaline solution, consisting of rather abundant, interwoven hyphae 3–10 μ wide and scattered to rather abundant, globose, ellipsoid and broadly clavate, sometimes elongate, rather small, inflated cells mostly 25–50 μ, rarely up to 90 μ long, terminal or more rarely in short rows; at surface, however, hyphae dominant and inflated cells scarce. Limb of volva at base of stem similar to volval remnants on cap, but here also inner surface slightly more membranous because

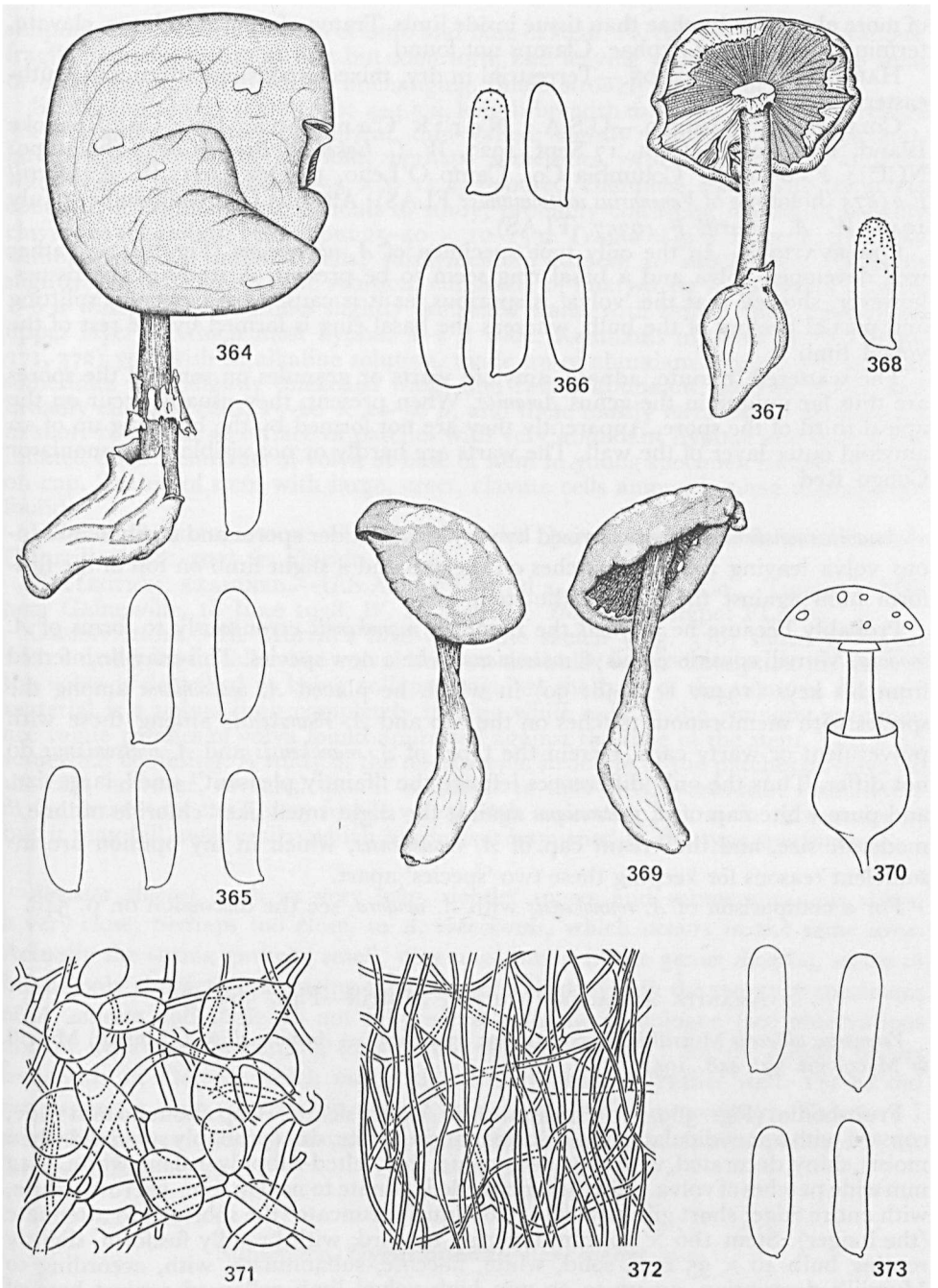
[73] The "basal annulus" in the type specimen of *A. watsoniana* (Fig. 364) appeared to consist of volval tissue.

[74] Very difficult to study in type. In that I could only see unusual, large, dendroid systems of up to 15 μ wide oleiferous hyphae. These are lacking in other material.

EXPLANATION OF FIGURES 364–373

Figs. 364–368. *Amanita roanokensis*. — 364. Dried fruit-body. — 365, 366. Spores. — 367. Dried fruit-body. — 368. Spore. (Figs. 364, 365, from type of *A. watsoniana*; 366, from type; 367, 368, from *Murrill F 10357*.)

Figs. 369–373. *Amanita alliacea*. — 369. Dried fruit-body. — 370. Sketch of fruit-body from field-notes. — 371. Tissue inside volval patch from cap. — 372. Tissue at outer surface of same patch. — 373. Spores. (All figs. from type.)



Figs. 364–368

of more abundant hyphae than tissue inside limb. Trama of stem with large, clavate, terminal cells among hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial in dry, mixed woods in eastern and southeastern U.S.A.

COLLECTIONS EXAMINED.—U.S.A.: North Carolina, Dare Co., Roanoke Island, near Fort Raleigh, 17 Sept. 1927, *W. C. Coker & Braxton 8255* (holotype: NCU); Florida, Columbia Co., Camp O'Leno, 19 Oct. 1941, *W. A. Murrill F 21875* (holotype of *Venenarius watsonianus:* FLAS); Alachua Co., Gainesville, 1 July 1942, *W. A. Murrill F 10357* (FLAS).

OBSERVATIONS.—In the only type specimen of *A. watsoniana* (Fig. 364) a rather well developed volva and a basal ring seem to be present. A study of the tissues, however, showed that the 'volva' is spurious, as it is caused by a circular splitting and partial peeling of the bulb, whereas the basal ring is formed by the rest of the volval limb.

The scattered, minute, adnate, amyloid warts or granules on some of the spores are thus far unique in the genus *Amanita*. When present, they usually occur on the apical third of the spore. Apparently they are not formed by the breaking up of an amyloid outer layer of the wall. The warts are hardly or not visible in ammonia or Congo Red.

Amanita roanokensis is characterized by very long, slender spores and a submembranous volva leaving flat, thin patches on the cap and a slight limb on top of the fusiform bulb against the base of the stem.

Probably because he applied the name *A. roanokensis* erroneously to forms of *A. inodora*, Murrill considered his *A. watsoniana* to be a new species. This may be inferred from his keys (1942: 1; 1948: 99) in which he placed *A. watsoniana* among the species with membranous patches on the cap and *A. roanokensis* among those with pulverulent or warty caps. Herein the types of *A. roanokensis* and *A. watsonianus* do not differ. Thus the only differences left are the "faintly pleasant" smell, large size, and pure white cap of *A. watsoniana* against the slight smell like "chloride of lime," moderate size, and the cream cap of *A. roanokensis*, which in my opinion are insufficient reasons for keeping these two 'species' apart.

For a comparison of *A. roanokensis* with *A. inodora*, see the discussion on p. 548.

AMANITA ALLIACEA (Murrill) Murrill—Figs. 369–373

Venenarius alliaceus Murrill *in* Mycologia **33**: 434. 1941. — *Amanita alliacea* (Murrill) Murrill *in* Mycologia **33**: 448. 1941.

Fruit-bodies (Figs. 369, 370) medium-sized, rather slender. Cap about 80 mm wide, convex, with appendiculate, non-sulcate margin, white, dry (probably subviscid when moist), shiny, decorated, with scattered, vague, thin, felted-subpulverulent, white, 4–12 mm wide patches of volva. Gills rather crowded, adnate to nearly free, narrow, white, with entire edge; short gills truncate to obliquely truncate (the shortest) to attenuate (the longer). Stem 100 × 20 mm, tapering upward, with broadly fusiform, slightly rooting bulb 40 × 35 mm, solid, white, floccose, subannulate, with, according to Murrill's description, an up to 20 mm high volval limb collapsed against base of stem, but in dried type material only in young specimen with some vague felted-

subpulverulent patches at top of bulb and base of stem. Partial veil submembranous, fragile, forming a ring at first but soon torn, and leaving an annular zone on stem or disappearing. Flesh white, unchanging. Smell strongly like garlic.

Spores [20/1] (12–)13–14.5 × 4–4.5 μ, length-breadth ratio (2.7–)3.0–3.5 (average 3.2), bacilliform, rarely cylindrical, thin-walled, slightly yellowish, with subgranular-refractive contents, amyloid, perhaps sometimes with very minute amyloid warts (Fig. 373). Basidia 40–55 × 9–11 μ, 4-spored, clampless, many with refractive contents. Marginal tissue difficult to study, probably consisting mainly of broadly clavate to subglobose cells about 25–40 × 12–25 μ. Trama of gills bilateral, probably without terminal inflated cells; subhymenium ramose to subcellular. Pileipellis slightly yellowish in alkaline solution, consisting of interwoven to subradial hyphae 1–6 μ wide, with sometimes slightly thickened walls, with rather thick, gelatinized upper layer in which most hyphae 1–2 μ wide. Remnants of volva on cap (Figs. 371, 372) yellowish in alkaline solution, made up of abundant hyphae 2–6 μ wide, sometimes with slightly thickened walls, and rather abundant, globose, ovoid, and broadly ellipsoid cells, 25–60 × 20–50 μ, and these mostly terminal or more rarely in short rows, but at surface of patches with very abundant hyphae and only a few inflated cells. Remnants of volva at base of stem in young specimen similar to those on cap. Trama of stem with large, erect, clavate cells among hyphae. Clamps not found.

HABITAT & DISTRIBUTION.—Terrestrial under *Quercus* (type) and in mixed woods (Murrill, 1948: 107) in Florida.

COLLECTION EXAMINED.—U.S.A.: Florida, Alachua Co., Tung-oil Mill near Gainesville, 18 June 1938, *W. A. Murrill F 16418* (holotype: FLAS).

OBSERVATIONS.—In Murrill's field-notes the sketch (Fig. 370) shows a fungus with a rather high, collar-like volval limb on the bulb; in his description the limb of the volva is described as being collapsed against the base of the stem; in the type material is a volval limb completely lacking while only in the youngest specimen are vague patches of volva found appressed against the base of the stem. This is all somewhat confusing. A study of the microscopic structure of the patches of volva on the cap, however, revealed that it is similar to that in *A. roanokensis*. Presumably in the present species a very fragile volval limb is present, just as in *A. roanokensis*, but it may fall away easily, which has in fact happened in the type specimens.

Amanita alliacea, with its very long, slender spores and submembranous volva, is very close, perhaps too close, to *A. roanokensis*, which occurs in the same area. Actually the strong garlicky smell, very uncommon in the genus *Amanita*, seems to be the only character separating the two, but I studied only the two type specimens of *A. alliacea* and these do not fully agree with the protologue (see observations above). Moreover, according to Murrill (1948: 107; 1951: 20) the species occurs frequently in Florida, which means that Murrill knew it rather well. Yet he did not suggest a close relationship with *A. roanokensis* (his *A. watsonianus*). Therefore I think that any proposal to change the taxonomical position of *A. alliacea* should await further information.

Subsection **Gymnopodae** Bas, *subsect. nov.*

Volva submembranacea vel membranacea, hyphis confusis copiosis cellulisque turgidis sparsis composita, stipitis basi evanida. Typus: *Amanita gymnopus* Corner & Bas.

Volva at least near surface consisting mainly of interwoven hyphae and only few inflated cells (sometimes, however, in inner parts inflated cells more abundant), on cap forming thin patches, flat scales, or shapeless to low, broadly conical warts, but disappearing mostly completely from base of stem. Fruit-bodies medium to large, whitish to pale yellow-brown or buff, sometimes with faint pinkish or salmon tinges. Cap dry. Gills soon becoming deep ochraceous. Stem with clavate, more rarely subglobose or subnapiform, immarginate base, sometimes with conspicuous rhizoids, with membranous, striate, sometimes disappearing ring; sometimes with second ring-like zone formed by volva somewhere below one formed by partial veil. Flesh white to yellowish, turning pinkish or reddish brown when exposed. Smell strong, unpleasant. Spores 5–11 μ long, globose to elongate, thin-walled, smooth, with normal, abrupt apiculus, white in spore print. Clamps present.

HABITAT & DISTRIBUTION.—In open forest in eastern and south-eastern Australia and in jungle in Malaya.

This new subsection includes only two species, placed together because of the unusual behaviour of the volva.

The structure of the volva resembles that in subsection *Limbatulae* in that at least the outer layer consists mainly of hyphae. Around the base of the stem, however, the volva seems to be very weakly developed or lacking, since in mature fruit-bodies the bulbous base of the stem is usually completely naked. The pileipellis is dry or only very slightly gelatinized. Consequently the volva on the cap breaks up into adnate patches, scales, or low warts.

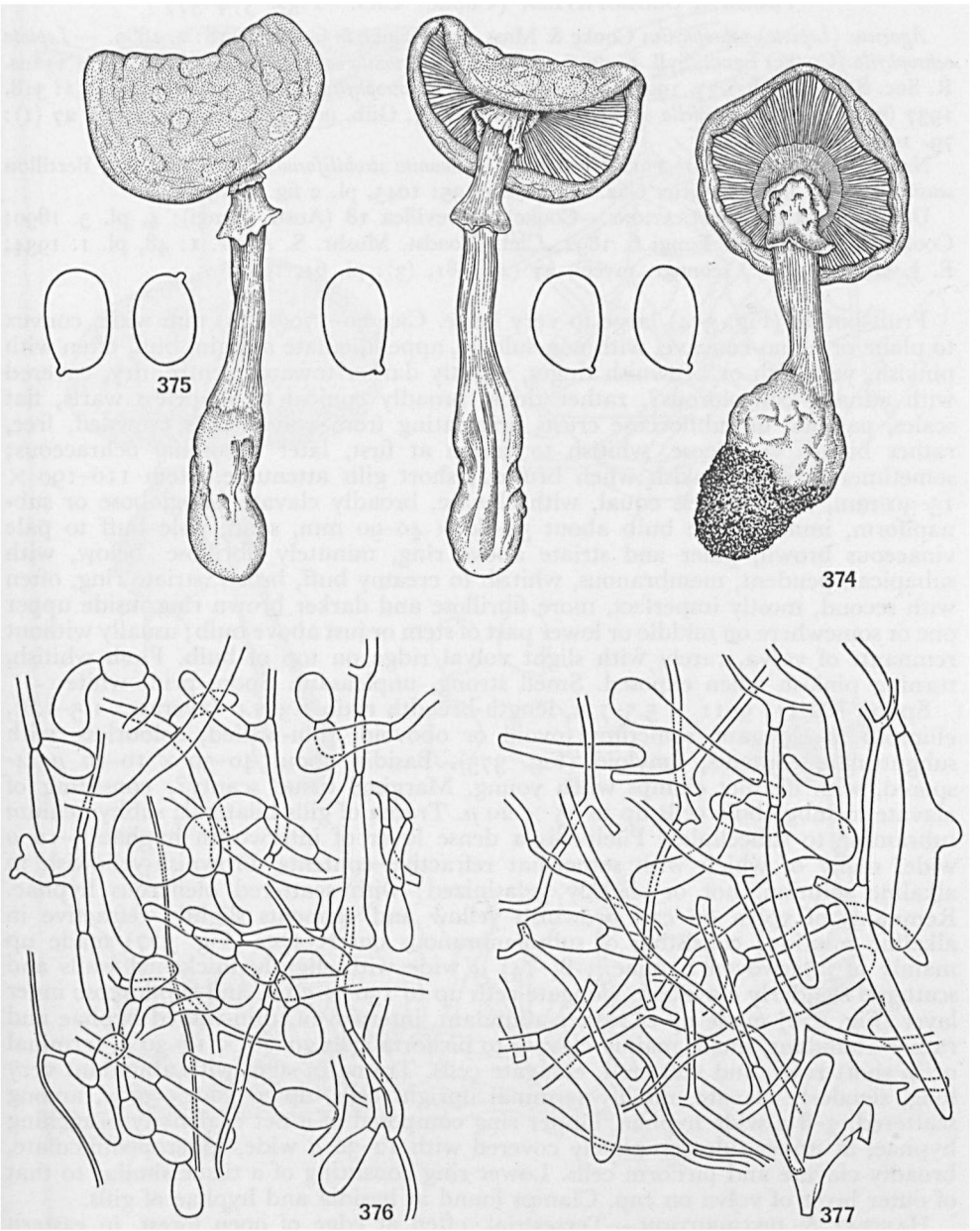
The two species have also a few other characters in common, such as ochraceous gills, rubescent flesh, and a strong, unpleasent smell. Yet they differ so widely (the small, subglobose spores and conspicuous, white rhizoids of *A. gymnopus;* the often present extra ring on the stem of *A. ochrophylla*) that they could be placed in different stirpes.

In view of the submembranous to membranous nature of the volva and the fact that in one of the specimens studied of *A. ochrophylla ("Sydney, No. 58")* a slight volval ridge was found at the base of the stem it is very probable that subsection *Gymnopodae* is closely related to subsection *Limbatulae.*

There is great need for information on the volval structure in button-stages and just expanding fruit-bodies of both species in the present subsection.

KEY TO THE SPECIES OF SUBSECTION *Gymnopodae*

1. Spores 9–11 × 5.5–7 μ. Ring often double. Stem without rhizoids. Remnants of volva on cap rather thick, shaped like patches, scales, or broadly conical warts, consisting of abundant hyphae on which rather abundant, inflated cells 20–60 × 12–30 μ, but with outer layer consisting of very abundant hyphae and scarce, elongate, inflated cells. Eastern and south-eastern Australia. *A. ochrophylla*, p. 556
1. Spores 5–7 × 5–6.5 μ. Ring simple, sometimes disappearing. Stem with conspicuous rhizoids. Remnants of volva on cap shaped like thin, membranous patches consisting of very abundant, interwoven hyphae and only a few slenderly clavate to cylindrical inflated cells. Malaya. *A. gymnopus*, p. 558



Figs. 374–377. *Amanita ochrophylla*. — 374. Dried fruit-bodies. — 375. Spores. — 376. Tissue inside volval patch from cap. — 377. Tissue at surface of same patch. (All figs. from *Cleland 8.*)

AMANITA OCHROPHYLLA (Cooke) Clel.—Figs. 374–377

Agaricus (*Lepiota*) *ochrophyllus* Cooke & Mass. *apud* Cooke *in* Grevillea **18**: 2. 1889. — *Lepiota ochrophylla* (Cooke) Sacc., Syll. Fung. **9**: 4. 1891. — *Amanita ochrophylla* (Cooke) Clel. *in* Trans. R. Soc. S. Austr. **48**: 237. 1924. — *Lepiota procera* f. *ochrophylla* (Cooke) Rick *in* Lilloa **1**: 318. 1937 (misappl.). — *Aspidella ochrophylla* (Cooke) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940.

NAME MISAPPLIED TO THE PRESENT SPECIES.—*Amanita strobiliformis* (Paul. ex Vitt.) Bertillon *sensu* Clel. & Cheel *in* Agric. Gaz. N.S. Wales **25**: 1045, pl. 2 fig. 1. 1914.

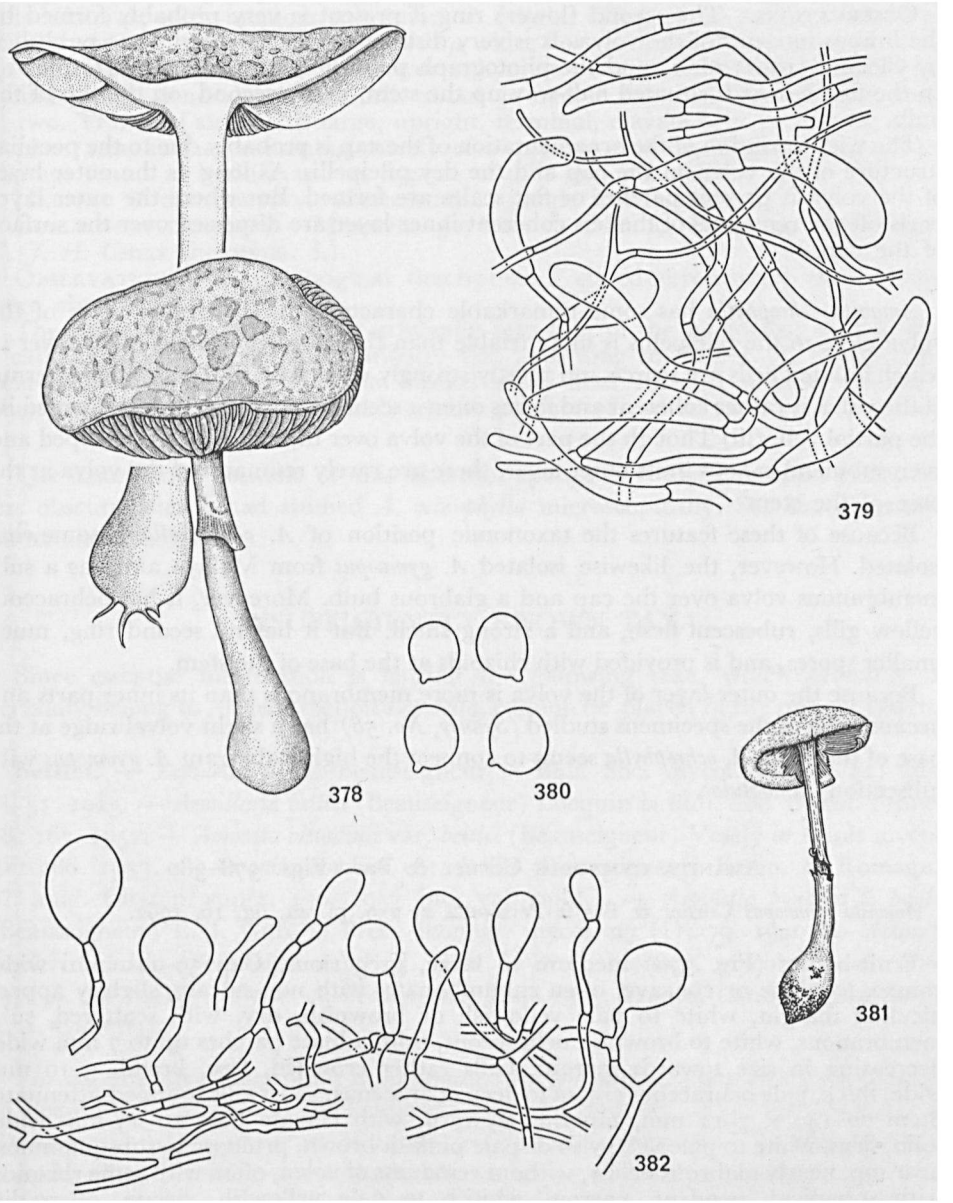
DESCRIPTIONS & ILLUSTRATIONS.—Cooke *in* Grevillea **18** (Austr. Fungi): 4, pl. 5. 1890; Cooke, Handb. Austr. Fungi 6. 1892; Clel., Toadst. Mushr. S. Austr. **1**: 48, pl. 1. 1934; E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 381, (3): pl. 61. 1941.

Fruit-bodies (Fig. 374) large to very large. Cap 90–170(–240) mm wide, convex to plane or plano-concave, with non-sulcate, appendiculate margin, buff, often with pinkish, yellowish or brownish tinges, slightly darker towards centre, dry, covered with adnate, concolorous?, rather thick, broadly conical to shapeless warts, flat scales, patches, or subfloccose crusts originating from volva. Gills crowded, free, rather broad, ventricose, whitish to cream at first, later becoming ochraceous; sometimes turning pinkish when bruised; short gills attenuate. Stem 110–190 × 15–30 mm, more or less equal, with clavate, broadly clavate, subglobose or subnapiform, immarginate bulb about 50–80 × 40–90 mm, solid, pale buff to pale vinaceous brown, paler and striate above ring, minutely fibrillose below, with subapical, pendent, membranous, whitish to creamy buff, broad, striate ring, often with second, mostly imperfect, more fibrillose and darker brown ring inside upper one or somewhere on middle or lower part of stem or just above bulb; usually without remnants of volva, rarely with slight volval ridge on top of bulb. Flesh whitish, turning pinkish when exposed. Smell strong, unpleasant. Spore print white.

Spores [80/11] 9–11 × 5.5–7 μ, length-breadth ratio 1.3–2.0 (averages 1.5–1.8), ellipsoid to elongate, sometimes ovoid or obovoid, thin-walled, colourless, with subguttulate contents, amyloid (Fig. 375). Basidia about 40–50 × 10–20 μ, 4-spored, with distinct clamps when young. Marginal tissue scanty?, consisting of clavate to subglobose cells up to 35 × 20 μ. Trama of gills bilateral; subhymenium subramose to subcellular. Pileipellis a dense layer of interwoven hyphae 3–10 μ wide, many of which with somewhat refractive contents, brownish-yellowish in alkaline solution, not or slightly gelatinized; with scattered oleiferous hyphae. Remnants of volva on cap brownish yellow and elements slightly refractive in alkaline solution; consisting of submembranous outer layer (Fig. 377) made up mainly of interwoven hyphae 3–8(–14) μ wide with slightly thickened walls and scattered slenderly clavate to elongate cells up to 130 × 30 μ, and subfloccose inner layer (Fig. 376) made up of rather abundant, interwoven, thin-walled hyphae and rather abundant, small, mainly clavate to piriform cells 20–60 × 12–30 μ, terminal or in short rows, and scattered, elongate cells. Trama of stem with abundant very long, slenderly clavate, mainly terminal upright cells, up to 500 × 30 μ, among scattered, 3–8 μ wide hyphae. Upper ring composed of a net of densely branching hyphae, at upper side completely covered with 12–30 μ wide, spheropedunculate, broadly clavate and piriform cells. Lower ring consisting of a tissue similar to that of outer layer of volva on cap. Clamps found at basidia and hyphae of gills.

HABITAT & DISTRIBUTION.—Terrestrial, often at edge of open forest, in eastern and south-eastern Australia.

COLLECTIONS EXAMINED.—AUSTRALIA: Queensland, Brisbane, without date, *F. M. Bailey 655* (holotype: K); National Park on Dave's Creek, 22 March 1952, *J. E. C. Aberdeen 482* (K); N. S. Wales, Sydney, without date & collector's



Figs. 378–380. *Amanita gymnopus*. — 378. Fruit-bodies. — 379. Crushed volval remnants from cap. — 380. Spores. (All figs. from type; 378, after Corner's water-colour.)

Figs. 381, 382. *Amanita roseitincta*. — 381. Dried fruit-body. — 382. Radial section of volval remnants on cap. (Both figs. from type.)

name, *No. 58* (K); N. S. Wales ?, North Bay, Febr. 1916, *J. B. Cleland 8* (K).

OBSERVATIONS.—The second (lower) ring if present is very probably formed by the limbus internus of the volva. It is very distinct on the coloured plate published by Cleland (1934: pl. 1) and the photograph published by Gilbert (1941: pl. 61). In the first case it is situated half-way up the stem, in the second, on the top of the bulb.

The wide variation of the ornamentation of the cap is probably due to the peculiar structure of the volva on the cap and the dry pileipellis. As long as the outer layer of the volva is present patches or flat scales are formed. But where the outer layer peels off the remnants of the less coherent inner layer are dispersed over the surface of the cap.

Amanita ochrophylla has some remarkable characters: (i) The inner layer of the volva close to the pileipellis is more friable than the submembranous outer layer in which inflated cells are scarce and mostly strongly elongate. (ii) The limbus internus of the volva is rather coherent and forms often a second ring below the one formed by the partial veil. (iii) Though the part of the volva over the cap is well-developed and even submembranous in its outer layer, there are rarely remnants of the volva at the base of the stem.

Because of these features the taxonomic position of *A. ochrophylla* is somewhat isolated. However, the likewise isolated *A. gymnopus* from Malaya also has a submembranous volva over the cap and a glabrous bulb. Moreover, it has ochraceous yellow gills, rubescent flesh, and a strong smell. But it has no second ring, much smaller spores, and is provided with rhizoids at the base of the stem.

Because the outer layer of the volva is more membranous than its inner parts and because one of the specimens studied *(Sydney, No. 58)* has a slight volval ridge at the base of the stem, *A. ochrophylla* seems to connect the highly aberrant *A. gymnopus* with subsection *Limbatulae*.

AMANITA GYMNOPUS Corner & Bas—Figs. 378–380

Amanita gymnopus Corner & Bas *in* Persoonia **2**: 259, pl. 4a, fig. 16. 1962.

Fruit-bodies (Fig. 378) medium to large, gregarious. Cap 50–110 mm wide, convex to plane or concave, often subumbonate, with non-sulcate, slightly appendiculate margin, white to pale yellowish or brownish, dry, with scattered, submembranous, white to brownish ochraceous, thin, adnate patches up to 7 mm wide, decreasing in size towards margin. Gills rather crowded, free, broad, 5–10 mm wide, thick, pale ochraceous cream to deep ochraceous; short gills rounded-attenuate. Stem 60–140 × 7–11 mm, tapering upward, with clavate base 16–25 mm wide, solid, firm, white to pale yellowish or pale pinkish brown, pruinose to subsquamulose near top, nearly glabrous below, without remnants of volva, often with some rhizoids, with subapical, pendent, narrow, whitish to pale yellowish, striate, often disappearing ring. Flesh white to yellowish, turning slowly reddish brown when exposed. Smell strong, unpleasant. Spore print white.

Spores [10/1] 5–7 × 5–6.5 μ, length-breadth ratio 1.0–1.25 (average 1.15), globose to broadly ellipsoid, thin-walled, colourless, with granular, subrefractive contents, amyloid (Fig. 380). Basidia 45–50 × 6.5–9 μ, 4-spored, with clamps.

Marginal tissue: only a few, up to 30 μ wide, inflated cells observed. Trama of gills bilateral; subhymenium subramose to cellular. Pileipellis a rather thick layer of interwoven to subradial hyphae 3–10 μ wide; not gelatinized. Remnants of volva on cap (Fig. 379) consisting of interwoven hyphae 3–10 μ wide, on which scattered, cylindrical to slenderly clavate cells about 30–110 × 8–20 μ, terminal or in rows of two. Trama of stem with large, upright, terminal, clavate cells among scattered hyphae; near surface consisting merely of 2–14(–20) μ wide, longitudinal hyphae. Clamps found at basidia and at hyphae of gills and pileipellis.

HABITAT & DISTRIBUTION.—Terrestrial in jungle in Malaya.

COLLECTION EXAMINED.—MALAYA, Johore, Gunong Panti, 21 April 1941, *E. J. H. Corner* (holotype: L).

OBSERVATIONS.—In the original description I stated erroneously that clamps were absent.

The tissue of the volva passes gradually into that of the pileipellis; that is why I call the patches of the volva adnate. Yet, according to Prof. E. J. H. Corner's field-notes these patches may be washed away after rains. I noticed the same phenomenon in other species with adnate patches of the volva, e.g. *A. vittadinii*.

The taxonomic position of this aberrant species of *Amanita* became somewhat less obscure after I had studied *A. ochrophylla* microscopically. See the discussion under this species.

INSUFFICIENTLY KNOWN TAXA

Since essential information is lacking the following taxa, which probably or certainly belong to *Amanita* section *Lepidella*, cannot be placed in the present system.

beillei. — *Lepidella beillei* Beauseigneur *in* Bull. Soc. mycol. France **41**: 465, pl. 31. 1925. — *Armillaria beillei* (Beauseigneur) Locquin *in* Bull. Soc. mycol. France **68**: 167. 1952. — *Amanita vittadinii* var. *beillei* (Beauseigneur) Veselý *in* Annls mycol. **31**: 286. 1933. — *Amanita boudieri* var. *beillei* (Beauseigneur) Kühn. & Romagn., Fl. anal. Champ. supér. 430. 1953 (not val. publ.). — *Aspidella boudieri* f. *beillei* (Beauseigneur) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940. — *Amanita boudieri* f. *beillei* (Beauseigneur) E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 406; (3): pl. 70. 1941. — Type: *A. Beauseigneur*, June 1925, France, Landes, Léon (herb. E. J. Gilbert).

For an extensive description accompanied by a coloured plate reference is made to Beauseigneur's original publication. Generally (Gilbert, 1941: 406; Kühner & Romagnesi, 1953: 430; Parrot, 1960: 40; Bertault, 1964: 370) *Lepidella beillei* is considered to represent an infraspecific taxon or a mere ecological form of *A. boudieri* (= *A. baccata* in the present work). Comparing the protologue of *Lepidella beillei* with my description of *Amanita baccata* (p. 442), I found the following differences: (i) Gills when young already ochraceous pink, later becoming clay-coloured, against white to cream or yellowish in *A. baccata*. (ii) Stem solid but becoming hollow, dingy cream-white, squamose below ring, against solid, white,

glabrous to subflocculose in *A. baccata*. (iii) Flesh of cap dingy white, of stem pale 'café au lait', against white in *A. baccata*. (iv) Spore print Naples yellow, against white in *A. baccata*. (v) Spores 11–14 × 7–8 μ, against 10.5–14 × 5–6.5 μ in *A. baccata*; but Gilbert (1941: 406) found the spores in the type collection of *Lepidella beillei* 12–14 × 6–7 μ. Some differences are to be found also in Beauseigneur's description of other microscopical characters, but these must be checked in the type. Beauseigneur mentioned the absence of clamps from hyphae in the pileipellis, the volval remnants and the tissue of the stem.

Unfortunately I was unable to study the type of *Lepidella beillei*, as I failed to locate Gilbert's herbarium in which it is kept (Gilbert, 1941: 406).

Especially in view of the observations of Parrot (1960: 40) and Bertault (1964: 370) I am inclined to believe that *L. beillei* is in fact an ecological form of *A. baccata*. But for a conclusive judgement the microscopical structure of the volva and the presence or absence of clamps at the basidia must be known (preferably from the type collection!). *Lepidella* beillei might appear to be more closely related to clamp-bearing *A. gracilior* (p. 436).

bruchii. — *Armillaria bruchii* Speg. *in* Boln Acad. nac. Cienc. Córdoba **28**: 276, photogr. on p. 278. 1926. — Holotype: *C. Bruch*, February 1914, Argentina, prov. San Luis, Alto de Pencoso (on label: "Mendoza, Alto Pencoso") (herb. Spegazzini 2853, LPS).

According to Singer (1952: 345) the type, consisting of a fragment of a blackened cap accompanied by a drawing on the original envelope, is in very poor condition, but it certainly has nothing to do with the photograph and the notes on the spores published by Spegazzini (l.c.). Further there are distinct discrepancies between the macroscopical characters as described by Spegazzini and those of the fruit-bodies on the published photograph.

The fruit-bodies of the type collection were white, almost gigantic, had a short and thick stem, 80–100 × 50 mm, and were growing on ant hills. Singer (l.c.) found the spores 7–8.3 × 4.8–5.5 μ, ellipsoid, hyaline, smooth and thin-walled, but did not mention the reaction with Melzer's reagent; he suggested a relationship with *A. chlorinosma* in its widest sense.

Singer's report reveals that it is impossible to determine the true identity of *Armillaria bruchii* from the type. The habit of the fruit-body and the size of the spores suggest *Amanita crassa* described here (p. 402), but it is very improbable that in that species the cap is ever smooth and silky at first, as is described for *Armillaria bruchii*.

gemmiferus. — *Aspidella gemmifera* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (1): 79. 1940 (nom. nud.). — *Amanita gemmifera* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 380. 1941 (nom. prov.). — 'Type': *P. M. Tixier*, 2 May 1923, Cochin China ("Cocincina") (herb. E. J. Gilbert teste Gilbert, 1941: 411).

Of this provisionally named species only a water-colour, a spore print, and notes are known. These documents are kept in Gilbert's untraced private herbarium. Gilbert's description runs (abridged and rearranged):

Cap 65 mm wide, fleshy, white with slightly yellowish centre, covered with white, at centre more crowded warts. Gills free, white, pinkish with age. Stem 85 mm long, without bulb, solid, annulate, white, below somewhat yellowish, above ring decorated with pearly (? "margaritaceus") scales. Ring membranous, thin, white. Taste and smell weak. Spores about 13 × 10 μ, ellipsoid, hyaline, smooth, amyloid. In grass along road.

I have no opinion about this species; Gilbert placed it in *Aspidella*.

laetus.—*Amanita spissa* var. *laeta* Rick *in* Brotéria **5**: 25. 1906. — Type locality: Brazil, Rio Grande do Sul.

The important characters in the short protologue are:

Cap and scales isabella-grey. Gills bright yellow. Stem attenuate downward, without bulb, from base upward covered with concentric scales.

Singer (1953) studied Rick's types but did not report on that of the present taxon. Probably it does not exist. Rick's description suggests a species of subsection *Vittadiniae*, especially *A. singeri* (see p. 364).

levis.—*Amanita preissii* f. *levis* Gentilli *in* W. Austr. Nat. **4**: 29, fig. 2. 1953. (not val. publ.). — Type locality: West Australia, Perth, King's Park.

Judging from the description and drawings published by Gentilli this is a mere form of *A. preissii* (see p. 536), differing only in having somewhat smaller, relatively slenderer, thinner-fleshed fruit-bodies with smaller, often rounded bulb, growing near *Banksia* and *Casuarina* rather than *Eucalyptus*.

Dr. J. Gentilli (Nedlands, W. Australia) kindly presented his dried specimens of *Amanita* to the Rijksherbarium, Leiden. Material of *A. preissii* f. *levis*, however, is lacking. As long as the exact size and shape of its spores and the absence or presence of clamps at its basidia are unknown, I prefer to range it under the insufficiently known taxa.

loricatus.—*Amanita loricata* Gentilli *in* W. Austr. Nat. 4: 59, fig. 5. 1953 (not val. publ.). — Holotype: *J. Gentilli*, June ± 1950, West Australia, Perth, King's Park (not preserved ?).

Gentilli collected two single specimens of this somewhat peculiar species at different times and different places in King's park, but the species is lacking in his collection of Amanita's at L. The most important characters in the protologue are:

Cap 50–60 mm wide, plano-convex with broadly depressed centre, uniformly biscuit-coloured, covered with patches of small, pointed, concolorous warts and

outer ring of thick, raised, angular, concolorous warts. Gills adnexed, crowded, strongly ventricose, over 10 mm wide, white. Stem 100–120 × 20–22 mm, subcylindrical, sometimes flattened, stuffed, with strangulate, napiform ("glandiform"), (sub)marginate bulb, with white flakes above and biscuit-coloured, fibrillose flakes below, with zone-like remnants of evanescent cream-white ring; with several rings of fibrillose volval remnants near base. Smell yeast-like. Spore print white. Spores ellipsoid to ovoid.

lusitanicus.—*Amanita lusitanica* Torrend *in* Brotéria **8**: 94, pl. 4 fig. 3. 1909. — Type locality: Portugal (in littoral).

The diagnosis, translated and slightly abridged, runs:

Cap 50–70 mm wide, fleshy, convex to flat, naked, smooth, white. Gills white, ventricose, with entire edge. Stem 80–100 × 6–10 mm, stuffed to somewhat hollow, white, striate at apex, furfuraceous below ring, with very slightly thickened base. Ring apical, thin, persistent. Volva thin, fugacious, forming reflected ring at base of stem. Flesh white, turning somewhat reddish. Spores ellipsoid, 11–14 × 6–7 μ. In sandy pine woods and at uncultivated places in littoral in "regione transtagana."

The description is accompanied by a very poor photograph that adds nothing to our knowledge. The type has not been found either in the Botanical Institute of the University of Coimbra or in the Institute of Botany in Lisbon.

Gilbert (1941: 403), who did not study the type either, considered *A. lusitanica* conspecific with *A. boudieri* (= *A. baccata;* see p. 442). In my opinion the naked cap, the volval rim at the base of the stem, and the rubescent flesh are reasons for believing that it is a species of the *Amanita valens*-group in section *Amidella*. Without an examination of the type, however, it is impossible to decide.

major. — *Amanita muscaria* var. *major* Peck *in* Rep. N. York St. Mus. nat. Hist. **23**: 69. 1872. — Type locality: U.S.A., New York, Catskill Mts.

In the original description only the following characters are mentioned: Very large, about 30 cm high, cap 20–25 cm wide, with thick bulb above the surface of the ground, its upper part being split into thick appressed truncate rays.

Peck (1883: 46) referred this record later to his '*A. strobiliformis*', which is at least partly the same as *A. ravenelii* as conceived in the present work (see p. 400). The few characters mentioned above suggest that species. Unfortunately the type of *A. muscaria* var. *major* has not been found in Peck's herbarium.

martinianus. — *Amanita solitaria* var. *martiniana* Roumeguère *in* Revue mycol. **8**: 201, pl. 60 fig. 2. 1886. — Holotype: *G. Marty*, Aug. 1885, France, Tarn, Montcere.

This peculiar fungus was found in total darkness at a depth of more than 100 m in a phosphate-mine. Its somewhat shortened original description runs as follows:

Cap 40–50 mm wide, spherical-convex, greyish white, covered with abundant,

thick, regular, membranous patches, greenish at centre.[75] Gills attached, abundant, white. Stem short, firm, thickened to a bulb in the middle, attenuate up- and downward, with concentric lines on bulb, annulate. Volva persistent, enveloping half the fruit-body. Spores rounded, very small (half the diam. of spores of type).

One of the two specimens collected was sent to Bresadola, who considered it a form of *A. solitaria* (sensu auct. europ. = *A. strobiliformis*). But if there really was a membranous volva present, this is not plausible. I do not know if the type collection still exists. The specimen sent to Bresadola is not under *A. solitaria* in his herbarium at S.

minor. — [*Agaricus solitarius*, "var. *minor*, *sine verrucis*. Batt. pl. 6 fig. A." Fr., Epicr. Syst, mycol. 6. 1838. —] *Amanita solitaria* var. *minor* Sacc., Syll. Fung. **5**: 15. 1887. — Lectotype: Batt., Fung. Agri arimin. Hist. pl. 6 fig. A. as *Leucomyces speciosior* (non-Linnaean name).

It is fairly certain Fries (l.c.) did not intend to publish a new varietal name, as Saccardo (l.c.) apparently supposed, but merely to draw the attention to an aberrant form of *Amanita solitaria.*

The most important characters of the fungus described and depicted by Battara (l.c.) are:

Cap with appendiculate, smooth margin, white, viscid, glabrous. Gills crowded, broad. Stem with subterranean bulb, stuffed, with apical, thin ring and below with scaly girdles.

The white colour of the cap and the strongly appendiculate margin are indications that Battara's fungus belongs to *Amanita* section *Lepidella*, but because of the denudated cap it is hard to tell to which species. The thin, apparently (sub)membranous ring seems to militate against identification with *A. strobiliformis.*

odettae. — *Amanita solitaria* subsp. *odettae* Foley *in* Bull. Soc. Hist. nat. Afr. N. **44**: 248. 1953 (nom. nud.). — 'Type locality': Algeria, prov. Alger, Djebel Mouzaïa or Sidi Ferruch (respect. 50 km S. W. and 20 km W. of Alger-city).

This name was published without a single descriptive note for a fungus collected the same day (1 Nov. 1953) at two different places. It is worth mentioning that according to Bertault (1965: 370) typical *A. solitaria* (sensu auct. europ. = *A. strobiliformis*) has not yet been found in Morocco.

robustus. — *Amanita robusta* Bouriquet *in* Bull. Acad. malgache II **24**: 61, fig. 1–2, 1942; non *Amanita robusta* Beeli *in* Bull. Soc. r. Bot. Belg. **63**: 105. 1931. — Type locality: Madagascar, Tananarive.

[75] It is not clear whether the cap was greenish at the centre or the patches.

Although the spores are described as non-amyloid, this name very probably refers to a species of *Amanita* section *Lepidella*. As I was not successful in contacting the Institut National Agronomique at Ambatobe-Tananarive, where according to information received from Dr. E. R. Brygoo, Director of the Institut Pasteur at Tananarive, Bouriquet's specimens are kept, the species must be ranged among the insufficiently known species. Its most important characters are:

Cap more than 150 mm wide, convex to plano-convex, with appendiculate, non-sulcate margin, pale yellow with russet centre, partly covered with powdery layer and, at centre, coarse, russet warts. Gills moderately crowded, cream. Stem more than 120 × 25 mm, with large bulb deep in soil, young white and completely pulverulent, later with scarcely visible remnants of ring, without volval remnants. Flesh white, slightly yellowish under pileipellis, with pleasant smell and mild taste. Spore print white. Spores 8.5–11.5 × 5–7 μ. Common in January and February around Tananarive, mainly under *Eucalyptus*. Poisonous to dogs.

The description was accompanied by excellent drawings of the fruit-bodies and spores. This species resembles clamp-bearing *A. crassiconus* (p. 500) from Nigeria, but that seems to have more distinct and more conical warts on the cap, more greyish colours and relatively broader spores. Among the clampless species *A. robusta* Bouriquet especially resembles *A. strobiliformis* (p. 519) from Europe, which differs mainly in having paler colours and larger spores (10–13.5 × 7–8.5 μ).

roseitinctus. — *Venenarius roseitinctus* Murrill *in* N. Americ. Fl. **10**: 75. 1914. — *Amanita roseitincta* (Murrill) Murrill *in* Mycologia **6**: 269. 1914. — Holotype: *F. S. Earle 182*, 13 Sept. 1904, U.S.A., Mississippi, Harrison Co., Biloxi (NY).

The type of this species consists of one immature fruit-body without spores. Murrill (l.c.) described the spores as globose, measuring 7–9 μ. Hesler (notes on folder of type) observed a few globose, amyloid spores. I found only globose oil drops and not a single mature spore or basidium.

The most important characters mentioned in the protologue or observed in the type specimen are:

Fruit-bodies (Fig. 381) solitary in dry pine or mixed woods. Cap 40–60 mm wide, convex, rarely expanded, with non-sulcate margin, salmon-coloured, dry, pulverulent, with early disappearing volval patches. Gills crowded, free, white. Stem 80–150 × 15–20 mm, cylindrical, with more or less ellipsoid bulb with slightly pointed base, solid, white but tinged with salmon, pulverulent, annulate, with salmon-coloured (? powdery) remnants of volva at upper part of bulb. Ring (sub?)membranous, easily disappearing, apical, white with salmon tinge.

Spores absent (7–9 μ, globose according to Murrill, amyloid to Hesler). Basidia 44–53 × 11–10 μ (not mature!), 4-spored, clampless. Marginal tissue a strip of thin-walled hyphae and small, terminal, piriform cells ± 15–35 × 10–30 μ. Trama of gills irregularly bilateral (still very dense); subhymenium still branching but in view of short cells probably becoming cellular. Pileipellis a dense layer of 1.5–4 μ wide hyphae between volva and trama of cap; hyphae interwoven in upper, more subradial in lower part, gelatinizing only at centre of cap. Remnants of volva (Fig. 382) on cap made up of loosely interwoven to suberect hyphae, 2–5 μ wide, carrying

clavate to globose cells, 25–45 × 18–40 μ, terminal or in short rows; elements yellowish in alkaline solution but without refractive contents. Trama of stem with terminal, clavate cells among longitudinal hyphae.

It is possible that originally the pulverulent volval layer on the cap was thicker than it is now and that I have examined only its basal layer.

A second collection[76] named *A. roseitincta*, glued with the type on the same sheet, consists of one broken specimen resembling that of the type but differing in the presence of clamps at the basidia. Because of the clamps it is probably not conspecific with *A. roseitincta*. Its spores measure 12.5–14.5(–16.5) × 5–6.5 μ. Perhaps it represents *A. subsolitaria* (see p. 494) which also has a pulverulent cap, clamped basidia and sometimes pinkish tinges. There is alas no description of this collection.

If the spores of *A. roseitincta* prove to be globose, the salmon pigment and globose spores require that the species be placed in stirps *Cinereoconia* or stirps *Straminea*, or perhaps better in a stirps of its own.

spinosus. — *Amanita robusta* var. *spinosa* Bouriquet *in* Bull. Acad. malgache II **24**: 62, fig. 3, 4. 1941. — Type locality: Madagascar, Tananarive.

Very probably the fungus described under this varietal name is a distinct species. The excellent drawings accompanying the description show fruit-bodies resembling thickset specimens of *A. solitaria* (= *A. echinocephala*). Because of the short, clavate stem, the volval spines on the cap, and the very distinct membranous ring I believe that this fungus is not closely related to *A. robusta* Bouriquet. For the same reasons as mentioned for *A. robusta*, i.e. lack of contact with the Institut National Agronomique at Ambatobe-Tananarive, I was unable to study the type.

The most important characters of this fungus abstracted from the protologue are:

Cap hemispherical when young, conico-convex to plano-convex with broadly depressed centre with age, with non-sulcate margin, fleshy, covered with reddish brown, 3–4 mm high, acute warts. Gills free, broad; short gills truncate. Stem short, thick, with clavate base, with broad, membranous, pendent, striate, apical ring, without distinct remnants of volva. Spores ellipsoid or elongate, guttulate. Occurring in the same places as *A. robusta* Bouriquet but less frequently. Poisonous to dogs.

virosus. — '*Amanita virosa* Fr.' *sensu* Coker *in* J. Elisha Mitchell scient. Soc. **33**: 83, figs. of spores on pl. 68. 1917. — 'Type': *W. C. Coker*, 9 Sept. 1916, U.S.A., South Carolina, Hartsville (only spore print preserved).

The fungus described under this name, with its smooth, viscid, white cap 50 mm wide, its friable ring, its ovoid basal bulb with 3 mm high volval rim, and its smell of 'chlorine', could very well represent a member of subsection *Limbatulae*. The size of the spores as given by Coker (7.5–8 × 4.5–5.5 μ) is, however, different from that of any of the present members of that subsection.

[76] *F. S. Earle & C. T. Baker*, 7 Aug. 1897, U.S.A., Alabama, Lee Co., Auburn, Vaughns Mill (NY).

EXCLUDED TAXA

At one time or another either the following taxa have been placed in *Amanita* section *Lepidelia*, or else it has been suggested that they either belong to this section or strongly resemble one or more of its species.

duplex. — *Amanita duplex* Corner & Bas *in* Persoonia **2**: 275. 1962. — Holotype: *E. J. H. Corner*, 4 Sept. 1942, Singapore (L).

This species has a duplex volva the inner layer of which consists of mainly globose to piriform cells up to 45 × 35 μ forming subpulverulent patches on the cap, whereas the outer layer is membranous and forms a short limb at the base of the stem and a membranous patch at the centre of the cap.

When the membranous patch has disappeared from the cap, as unfortunately is now the case in the only fruit-body of the type collection, *A. duplex* looks like a member of subsection *Limbatulae* of section *Lepidella*. However, in view of (i) the apparently thin but strictly membranous outer layer of the volva, (ii) the isolated position this species would occupy in section *Lepidella*, and (iii) its resemblance to the truly volvate *A. olivacea* Beeli, which has a similar inner layer of the volva (teste Gilbert, 1941: 312) and rather similar small spores, *A. duplex* is to be maintained in section *Amidella*, where it was placed with some doubt by Corner & Bas (l.c.).

echinulatus. — *Amanita echinulata* Beeli *in* Bull. Soc. r. Bot. Belg. **59**: 102, fig. 3. 1927; *in* Fl. iconogr. Champ. Congo **1**: 19, pl. 2 fig. 9. 1935. — Holotype: *M. Goossens-Fontana 214*, June-July 1923, Congo, prov. Equateur, terr. Coquilhatville, Eala (BR).

Gilbert (1940: 79) placed this species in his genus *Aspidella*, the name of which is a synonym of *Amanita* section *Lepidella*. However, the type material of *A. echinulata* has amyloid spores 5.5–6.5 × 4.5–5.5 μ, a very thin cap which is smooth in fresh, but striate-sulcate in dried condition, a non-appendiculate margin of the cap, a deeply coloured pileipellis, a volva which leaves scarcely any remnants at the base of the stem, and a membranous, substriate ring. Therefore this species must be placed in *Amanita* section *Validae* near *A. fritillaria* (Berk.) Sacc. and allied species (see Corner & Bas, 1962: 261). Compare also the note on *A. fuliginosa* Beeli below.

fuliginosus. — *Amanita fuliginosa* Beeli *in* Bull. Soc. r. Bot. Belg. **59**: 102, fig. 8. 1927; *in* Fl. iconogr. Champ. Congo **1**: 19, pl. 2 fig. 8. 1935. — Holotype: *M. Goossens-Fontana 359*, Aug. 1923, Congo, prov. Equateur, terr. Bokungu, Valley of the Tshuapa (BR).

Initially Beeli described this fungus, represented in Mrs. Goossens' collection by a single dried fruit-body and a good water-colour, as a distinct species, but later (1931: 107) he suggested its identity with *A. echinulata* Beeli (see notes above). Gilbert (1940: 37; 1941: 40) inclined to take the same point of view.

The spores of the type of *A. fuliginosa* proved to measure (7–)7.5–9 × 7–8.5 μ,

against those of *A. echinulata* 5.5–6.5 × 4.5–5.5 μ. Moreover the volval remnants on the cap of *A. fuliginosa* consist of irregularly disposed, abundant hyphae carrying, terminally or in terminal short rows, abundant inflated cells; in *A. echinulata* the volval remnants consist of parallel-erect rows of inflated cells. Therefore I am convinced that *A. fuliginosa* is not even closely related to *A. echinulata*, although in view of the friable volva, the non-appendiculate margin of the cap, the deeply coloured pileipellis, and the small, amyloid spores, it, like *A. echinulata*, belongs to section *Validae* and certainly not to section *Lepidella*.

gemmatus. — *Lepiota gemmata* Morgan *in* J. Mycol. **12**: 202. 1906. — Holotype: *A. P. & L. Morgan 35*, 1906, U.S.A., Ohio, Preston (IA).

Because of Morgan's description, Murrill (1917: 77) considered *L. gemmata* to be a probable synonym of "*Venenarius solitarius*."

According to my findings the type has ellipsoid, dextrinoid spores 4.4–5.6 × 2.6–3.2 μ, slenderly clavate cheilocystidia 20–45 × 6–8 μ; regular trama in the gills and a covering of the cap consisting of globose cells 15–30(–50) μ in rows. Apparently Morgan's species is a true *Lepiota*, belonging to section *Micaceae* Lange and close to or identical with *L. petasiformis* Murrill as redescribed by H. V. Smith (1954: 319).

luteovirens. — *Agaricus luteovirens* Alb. & Schw., Consp. Fung. 168. 1805; *per* Fr., Syst. mycol. **1**: 41. 1821. — *Armillaria luteovirens* (Alb. & Schw. per Fr.) Sacc., Syll. Fung. **5**: 75. 1887. — *Amanita luteovirens* (Alb. & Schw. per Fr.) Moser *in* Gams, Kl. Kryptogfl. IIb, 2. Aufl., 128. 1955 (not val. publ.). — *Floccularia luteovirens* (Alb. & Schw. per Fr.) Pouzar *in* Česká Mykol. **11**: 49, 1957. — Type locality: Germany, Ober Lausitz.

Locquin (1952: 167) regarded *Agaricus luteovirens* as belonging to the genus *Aspidella* E. J. Gilb., the name of which is a synonym of *Amanita* section *Lepidella*. As, however, Singer (1951: 207) selected *Agaricus luteovirens* as lectotype for the name *Armillaria* Kummer and as Locquin considered *Aspidella* to be an independent genus, the latter transferred a number of species from *Amanita* and/or *Aspidella* to *Armillaria*. Moser (l.c.) did not accept *Aspidella*, or *Armillaria* sensu Locquin, as a genus distinct from *Amanita* and consequently transferred *Agaricus luteovirens* to *Amanita*.

As pointed out earlier (Bas, 1965: 358), Locquin's view is quite rightly not generally accepted. The structure of the trama of the gills and the stem makes it clear that *F. luteovirens* belongs to the Tricholomataceae, not to the Amanitaceae.

monticulosus. — *Agaricus monticulosus* Berk. & Curt. *in* Ann. Mag. nat. Hist. II **12**: 418. 1853. — *Amanita monticulosa* (Berk. & Curt.) Sacc., Syll. Fung. **5**: 18. 1887. — Lectotype: *M. A. Curtis 2853*, South Carolina (K).

In a few American herbaria I found collections under this name that appeared to belong to species of *Amanita* section *Lepidella*. This is probably because Singer (1948: 35) once applied this name to the species now called *A. cokeri*, earlier described under

the name '*A. solitaria* Bull.' by Coker (1917: 68) with the name '*A. monticulosa* B. & C.' as synonym. After examination of the type collection, which appeared to have non-amyloid spores, Singer (1955: 399) changed his mind.

A check of this character of the type showed Singer's statement to be correct. *Amanita monticulosa* represents one of the taxa belonging to the *A. gemmata*-group, which in North America is particularly polymorphous and confusing.

strobiliformis. — *Lepiota strobiliformis* Gill., Hymén. Descr. Champ. France 69. 1874; pl. 431, 1874–1890. — *Lepiota friesii* var. *strobiliformis* (Gill.) Gill., Tabl. anal. Hymén. 9. 1884. — Type locality: France (type probably represented by Gill., Hyménom. Descr. Champ. France pl. 431).

Gilbert (1940: 52) referred the fungus described under this name to *A. echinocephala* (= *A. solitaria* in the present work). There is, however, scarcely any doubt that it belongs to the group of taxa around the species often called *Lepiota acutesquamosa* (Weinm.) Kummer, since in the original description the gills are described as pale, very crowded, rather narrow and furcate. Gillet's plate supports this assumption.

umbella. — [*Fungus umbella* Paul., Traité Champ. **2** (index): 7. 1793. — *Hypophyllum umbella* Paul., Iconogr. Champ. pl. 149. 1812–35 (not val. publ.).[77]] — *Agaricus umbella* Paul. *ex* Lév. Iconogr. Champ. Paul. 80. 1855. — *Amanita umbella* (Paul. ex Lév.) Quél., Ench. Fung. 4. 1886 (misappl.). — Lectotype: Paulet, Iconogr. Champ. pl. 149.

The name *Amanita umbella* was applied rather often to species of *Amanita* (for *A. umbella* sensu Quél., see p. 349) but it is hard to understand how anyone could recognize an *Amanita* in Paulet's plate and description. There is no trace at all of a volva on cap or stem. It is significant that Paulet classified this species among "Les Bulbeux nus." The most important characters abstracted from the plate and the description are:

Cap ± 11–13 cm wide, white but slightly rubescent, humid, naked, smooth. Gills narrowly adnate, ± 1 cm wide, white but tending towards apple green; short gills present. Stem ± 13–16 × 2.5 cm, with ± 4 cm wide, clavate, naked base, stuffed, white, with early collapsing or disappearing ring. Flesh soft, easily broken, with smell of damp earth, soon deteriorating.

In my opinion Paulet's fungus is identical with *Limacella guttata* (Pers. ex Fr.) Konr. & Maubl. It is true that my collections of that species showed the gills to be cream to dingy cream, sometimes with a slight pinkish tinge, but others have observed them with a greenish tinge (e.g. Ricken, 1910–15: 315).

virellus. — *Amanita virescens* Beeli *in* Bull. Soc. r. Bot. Belg. **63**: 106, fig. 11. 1931 (basionym); *in* Fl. iconogr. Champ. Congo **1**: 20, pl. 3 fig. 5. 1935; non *Amanita*

[77] See foot-note on p. 519.

virescens Pers. *per* Opiz, Böheims phän. crypt. Gew. 156. 1823 (= unknown species). — *Amanita virella* E. J. Gilb. *in* Bres., Iconogr. mycol. **27** (2): 384. 1941 (substitute name; not val. publ.); *ex* Sing. *in* Lilloa **22**: 38. 1951. — Holotype: *M. Goossens-Fontana 614*, 22 May 1927, Congo, prov. Equateur, terr. Lisala, Binga (BR).

Gilbert (1940: 70) placed this species in his genus *Aspidella*, which is identical with *Amanita* section *Lepidella* in the present work, but the type material revealed a distinctly coloured pileipellis combined with a non-appendiculate, subsulcate margin of the cap, a membranous ring, a volva which leaves only fugacious remnants on the small to medium-sized bulb of the stem, and ellipsoid, amyloid spores 9–11 × 6.5–8 μ on 2-spored, clampless basidia. It is clear that *A. virella* belongs to *Amanita* section *Validae*.

virescens. — *Amanita virescens* Beeli, see *virellus*.

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