LILLOA
REVISTA DE BOTÁNICA

THE « AGARICALES » (MUSHROOMS) IN MODERN TAXONOMY

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Dedicated to the memory of Victor Fayod and Narcisse Patouillard.

GENERAL INTRODUCTION

Progress in the knowledge of the taxonomy of the *Basidiomycetes* as a whole is most evident in the *Agaricales,* a group that can be roughly characterized as consisting of « agarics » and « boletes », or, in common language « mushrooms » and « toadstools ». It may, however, be stressing a point if such minute fungi as *Flagelloscypha minutissima* — never noticed by those hunting the woods for mushrooms, and hardly recognized as mushrooms by the amateur — are put in the same category as such giants as *Phlebopus colossus* or *Leucopaxillus giganteus.* Yet they belong in the same order according to our present views on systematics, which are based on what we recognize as affinity rather than on any one specific character. Consequently, the definition of the order *Agaricales* has changed in recent years to become too complicated to be expressed in a customary short diagnosis (see however p. 129). The non-taxonomist may justly ask: Is this complication really worth while?

We taxonomists think our results are fully worth the trouble of reshifting the classification, worth the application of more and more time-absorbing methods of investigation, worth the inconvenience of the necessary changes in generic and specific names, and worth the opposition of some of our colleagues working in other fields who may denounce our inability to state shortly and simply the characters on

which the groups of fungi are separated. We think so because an approximately natural classification does not only make mycological work more precise but more applicable in neighboring fields. It makes it easier to substantiate or refute theories of evolution, or at least more nearly to achieve one of the two main objectives of systematic biology — the one usually neglected — namely the assembling of related groups and forms in taxonomic units. Accurate identification is certainly needed by physiologists, plant pathologists, medical mycologists, foresters, biochemists, plant geographers, ecologists, and mycophagists but it cannot be obtained by simplified methods. If two identical fungi are currently erroneously determined as different species, or vice versa, results of all investigations using these organisms as testing material become doubtful unless herbarium material with notes and correct data are preserved, a precaution practically never taken, or if taken, rarely used for comparative studies on the material pertaining to contradictory statements. The biologist who is not a taxonomist will either try to make his determinations by a simplified method, or call on a taxonomist for cooperation. In either case — thanks to the lack of good books for identification, and the lack of a sufficient number of able taxonomists in the *Agaricales* as well as in many other groups of the fungi — the results are not too good. Nevertheless, a good taxonomist is now able to identify a species of *Agaricales* with much more accuracy than fifty years ago. The introduction of new characters always leads to clearer delimitations between genera and more accurate distinctions between species so that more precise determinations can be made because the number of characters that must fit into a diagnosis is larger, and the characters themselves are more definitive. Consequently, the sharpness of our modern species concepts by far surpasses that of those found in the older taxonomic works. Who does not remember such characters as the incurved margin of the *Collybiae* and the straight margin of the *Mycenae* projected into groups such as *Rhodophyllus* and *Psathyrella* where they have no meaning and in which they made identification a guessing game rather than scientific work.

Advance in some related fields often depends on the right choice of material, i. e. the proper organism to start the experiment. The basidiomycetes tested previously for antibiotic substances have been shown to contain such compounds in many species and « strains » in one taxonomic group, and none in another. It is quite obvious that the question whether such a group is a natural unit or an artificial

one has some importance on practical planning for further testing. If for instance it is planned to take a number of promising organisms in culture and test them quantitatively for bacteriostatic substances after preliminary tests on various groups of representative species have already shown in which genera species of this kind occur, time and effort can be saved if the work is organized on the basis of a working hypothesis assuming that the genera known to contain some bacteriostatic forms are richer in these than are the genera where no such forms have thus far been discovered. In fact, this is approximately the way in which research is usually planned. If *Stropharia* were still combined with *Agaricus* in a single tribus *Psaliota* as it was, against all natural affinity in Fries' early classifications, it is to be expected that the promising group of *Agaricus* and the thus far not too promising group of the *Strophariae* would have been studied together in any work planned on antibiotics, thus — because of the lack of a natural classification — causing unnecessary expansion of the testing program, and more time and expenditure would have been necessary. In the *Boletaceae*, only the genus *Boletus*, as far as known, contains antibiotic substances; in the *Tricholomataceae* — *Tricholomopsis* and *Lepista* seem to be most important in this regard; all these genera are rather recently established units, and in the older units (*Boletus* sensu lato, *Tricholoma*, *Clitocybe*, etc.) the results of the testing as published by Wilkins and Harris appear to be uncorrelated and without any recognizable connection with taxonomic units. This and similar examples taken from the chemical and physiological literature show clearly enough that the more artificial a classification, the longer the pertinent facts will remain hidden; the faster the progress in taxonomy, the more guidance will be available for investigators in neighboring fields engaged in studies on organisms belonging to this particular taxonomic group. In the older classification, the specificity of the mycorrhizal relation was an unpredictable, coincidental character of the species of the *Boletaceae*. Now we know that the mycorrhiza-relationship is closely connected with the taxonomic position of a species, and the forester can be sure whenever encountering a species of the subfamily *Suilloideae* that this organism is forming mycorrhiza with certain conifers of a stand of trees, even if the forest is a mixed one. Going one step farther — when the section of the genus is known, the bolete can easily be linked with a definite genus of conifers in most cases, and many of the species are selective enough to be found, in nature, only with one species of

higher plants, or even with one race only. Here again, a hypothesis on the basis of field observations generalizing the results obtained in experimental studies on a few species of a genus will result in a wiser and more intelligent selection of the organisms when a research plan on mycorrhiza is made. Correct identification and a valid concept of affinities is also essential in the new field of ecology-geobotany.

The taxonomists being few, and the problems being so many, it appears that there is much less justification for questioning the usefulness of the modern development of the taxonomy of the *Agaricales* and the fungi generally than there is for an answer to the question why so few able persons are attracted by this important field of natural science. In fact, taxonomy of the fungi, more than other branches of the sciences, suffers from understaffing and lack of support. This is felt even more severely since taxonomy of many cryptogamic groups has completely grown out of the reach of the type of amateur whose contributions, not so long ago, played a major part in the development of the taxonomy of the *Agaricales*. Since an accurate, methodical determination of a species of *Agaricales* now requires very high botanical and technical skill, the average mycophagist can no longer follow the development of taxonomy.

On the other hand, the talented and interested student of biology has, as a rule, little reason to become enthusiastic about systematics, at least as taught at present in the field of *Agaricales*. The matter seemed to be — and actually was, with a few notable exceptions — on a desperately non-scientific footing, and as far as college instruction goes, it persists to be essentially an assemblage of unrelated and unexplained facts, with numerous terms and scientific names (used in a different way by each author), and a few perennial myths thrown in. The anatomical features of the *Agaricales* have been neglected, and the rôle of these fungi in applied biology is represented as practically confined to wood-destroying properties and edible qualities of some of the species.

With new problems of general interest developing in the mycological field, especially the *Agaricales*, e. g. production of new antibiotics, control and application of symbiosis in forestry and horticulture, control and eradication of tropical crop diseases in plant pathology, and, to some extent, prevention of fungus-caused deterioration of fabrics, especially in the tropics, it is a matter of serious concern whether or not enough specialists can be interested in the study of the *Agaricales*, particularly in a study of their taxonomy, to cope with these new problems.

The difficulty consists mainly in the fact that the non specialist is unable to find his way in the widely scattered papers that contain fragmentary information on modern concepts of taxonomy in the *Agaricales*. Even if he knew which papers to choose, he would still have to face the tremendous task of coordinating the data obtained, and presenting them to others in a scholarly way. There has also been too much needless splitting of genera and species in the past, so much renaming and ruthless synonymizing [1] that, as a consequence, a certain hesitancy in accepting new combinations, new generic names, and new status has developed — a conservative attitude among non-specialists that is quite understandable. This must lead to a situation equally bewildering to the teacher and the student wherever the names applied in contemporary manuals and text books are at variance. This is also hindering the work of the curators in herbaria, the authors of local floras, the ecologist (especially the geobotanist), and generally anybody interested in Higher *Basidiomycetes*.

Under these circumstances the author felt that a comprehensive presentation of modern taxonomy is a definite need. The task is a large and difficult one merely from the standpoint of the time that the preparation of a book of this kind takes when compared with the pace at which taxonomy progresses. There will be those who feel that the book is not complete enough, and there will be others who disagree on certain details claiming that they do not fit into a true picture of modern taxonomy. The policy in writing this book was to indicate as facts only those data that were established as facts on authentic or otherwise reliable material by the author himself, or by other authors that the writer considered as absolutely trustworthy in a given case. The latter course, however, was seldom taken, and it may be said that the vast majority of data contained in this book are based on the author's own investigations, including the insertion of every single species at its proper place in the classification. Consequently, additional data would have required additional type studies, but it seemed desirable to set a time limit if the book was to appear in the near future. There are, of course, minor differences of opinion among the taxonomists, especially as to the conception of the genus, which the author believes is now approximately compara-

[1] The fact that we must now take up some of the names then proposed, because the rules of nomenclature force us to do so, does not justify them posthumously.

ble with the prevalent conception of the generic unit in the *Cormophyta.*

The book cannot and will not be a monograph. Complete synonymy is given only for the genera. The synonyms of the species which are indicated as examples rather than as a complete enumeration, are given in brackets and concern only the binomials most frequently found in the literature as well as those necessary for the understanding of the transfer if such a change has been made recently. The most conspicuous inconsistency will be noticed in the keys to the species. Such keys are given only if they do not duplicate good keys in easily available monographs or floras (which are cited), and if it is possible in a given genus, according to our present knowledge, to write a useful key. On the other hand, the insertion of the keys available was considered necessary because of the legitimate desire of the reader to know just how to go about the identification of the species in each genus.

The paragraphs on the limits of each genus and on the state of knowledge concerning it were introduced in order to show exactly what difficulties, if such exist, one is still likely to encounter in a given group, and along which lines an improvement is thought to be possible. This procedure will, in the author's opinion, help further monographic studies, and at the same time avoid the impression of an accomplished knowledge of all aspects of a problem — an impression so often conveyed in text books.

The modern taxonomists have a right to present with confidence a summary of their work as the interim results of various and numerous studies on an enormous amount of material. It is, however, a duty of justice and gratitude to acknowledge the invaluable work done by the great forerunners of our era. They have pioneered in the exploration of the anatomy of the *Agaricales,* and their contributions toward a natural system of classification are amazing to those who look back in the historial perspective. Only the genius inspiration of these men explains many of their discoveries in the taxonomic field — such as the recognition of the affinity between *Dictyopanus* and *Panellus* by Patouillard — that can be fully appreciated only now. These are the reasons why this book is dedicated to the memory of Victor Fayod and Narcisse Patouillard (Plate I, 2).

It is a pleasure to express the author's gratitude to the many curators of priceless collections who have furthered this work by generous loans of type material from all over the world, and also to

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