



Mushrooms & Toadstools

JOHN RAMSBOTTOM



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John Ramsbottom



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The aim of this series is to interest the general reader in the wild life of Britain by recapturing the inquiring spirit of the old naturalist. The Editors believe that the natural pride of the British public in the native fauna and flora, to which must be added concern for their conservation, are best fostered by maintaining a high standard of accuracy combined with clarity of exposition in presenting the results of modern scientific research. The plants and animals are described in relation to their homes and habitats and are portrayed in the full beauty of their natural colours, by the latest methods of colour photography and reproduction.

TO FORMER COLLEAGUES
BRITISH MUSEUM (NATURAL HISTORY)
1910–1950
In Friendship

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EDITORS' PREFACE

WITHOUT DOUBT, no one is better qualified to write a book on British Fungi than Dr. John Ramsbottom. The present long-awaited addition to the New Naturalist Series contains the distilled harvest of a life-time's knowledge and experience, much of it, especially in the historical field, never before published in accessible form. We say "distilled" advisably, since Dr. Ramsbottom could undoubtedly have written—in fact, did, in the first place, write—a book of more than double the present length; and, even then, he complained that much had to be omitted!

Dr. Ramsbottom has recently retired after forty years' service in the Department of Botany at the Natural History Museum, South Kensington, having been Keeper of Botany during the last twenty years. As his book shows, however, he is far from being a purely 'museum botanist.' Every aspect of Fungi has fascinated him, and he is equally at home hunting for rare toadstools in the Surrey woods, attending a conference in South America on medical mycology, ransacking old books for reference to the truffle-hunting habits of dogs, and probing the secrets of sex in moulds. He has always been willing to share his knowledge with others, and many will remember him best at his annual autumn exhibit of edible and poisonous toadstools at the Royal Horticultural Society's Shows, surrounded by crowds of eager questioners thrusting forward specimens for identification. The Editors feel fortunate in having persuaded Dr. Ramsbottom to put his unrivalled knowledge on permanent record as a volume in the New Naturalist Series.

The great group of Fungi, comprising perhaps some hundred thousand species, shows an amazing variety of form, from the minute unicellular yeasts to the Giant Puff-balls and bracket Fungi. The group touches human activities at a surprising number of points. In recent years everyone has become familiar with penicillin and other antibiotics produced from moulds, but how many fully appreciate the role of Fungi in wine and beer making, in the diseases of both plants and animals (including man), and as a human food throughout the world? Dr. Ramsbottom has not, of course, been able to deal in detail with all these aspects of Fungi; he has concentrated mainly on the larger kinds, commonly known as toadstools; but he has touched on most groups, and has a final chapter describing fully the story of the development of the penicillin industry from its beginnings in Sir Alexander Fleming's room at St. Mary's Hospital. This is the best short account of penicillin that has been written, in our opinion.

Dr. Ramsbottom, as will be seen, has paid particular attention to the history of Fungi, their names, their uses, and the beliefs and superstitions connected with them, as revealed in old books. The abundant quotations and references he has brought together can be found in no other book and give a special value to his volume. In his chapter on mushroom-growing, too, he has gathered together a mass of obscure information, including particulars of the vast cave industry under the streets of Paris.

Parts of Dr. Ramsbottom's book will be found to be more technical than the majority of New Naturalist volumes. When writing of Fungi this is inevitable. Very

few species have English names, and when describing, for example, the sexual behaviour of the 'lower' Fungi, it is impossible to avoid using technical language. With the help of the glossary-index, however, any reader should be able to understand these sections if he is willing to take the necessary trouble.

This volume is not, of course, intended as a handbook for the identification of British toadstools. Excellent books for this purpose already exist. In several chapters, however, Dr. Ramsbottom has given lists of the species occurring in different types of habitat, together with mention of their main distinguishing characters.

The book is fully illustrated with black and white and with colour plates, and the fine photographs by Mr. de Laszlo do full justice, we feel, to the fascinating colour scheme affected by so many kinds of toadstool.

The Editors, during the production of this book, have come to look upon Dr. Ramsbottom as a sort of Robert Burton of the fungal world, and, with his discursive style, "curious learning," and wide canvas, he has, we feel, given us something approaching a twentieth century "Anatomy of Toadstools."

THE EDITORS

AUTHOR'S PREFACE

THE WRITING OF THIS BOOK has presented several problems, chief of which has been that of giving a sufficiently wide view of the subject in a single volume. It seemed desirable to try to explain the modes of life of this large group, the fungi, and this in its turn meant suggesting its biological relations to other groups of organisms.

The fact had also to be faced that probably only about half a dozen of the larger fungi are recognised by people generally; and consequently there are surprisingly few common names. Names alone, therefore, are likely to mean nothing to the general reader, except irritation, so some indication of what they signify is needed. Unfortunately lack of space has prevented this being done in any detail, but the colour plates will help to determine a number of species, or give an idea of those mentioned in the text.

Doubtless others would have treated the subject differently: but having always been impressed with the influence fungi have on our very existence, I wished to convey some idea of this. Those who specialise in any branch of knowledge naturally tend to magnify its importance—but a mycologist, if he regards fungi as living organisms, can hardly fail to realise the significance of other disciplines. On the other hand scientists generally are beginning to consider that the old-time neglect of fungi—even by botanists—was short-sighted.

The writing of the book has taken far longer than I expected, and when first written greatly exceeded the required length! To preserve some sort of balance meant the cutting out of some portions (which probably will be published elsewhere) and the cutting down of others. The result is, however, somewhat uneven: the chapters on Grasslands (17) and Woodlands (19) are but shadows of their former selves; though what is little more than a list of species should serve as an introduction to their descriptions in systematic works. There is abundant scope for original observations, but it must be stressed that these can have no scientific value without correct identifications. The Penicillin chapter was included at the request of the Editors.

As far as possible scientific terms have been kept to a minimum and all except those which are explained are to be found in standard dictionaries. "*Difficile est de scientiis inscientur loqui*; which is as much as to say, that, 'in treating of scientific matters, it is difficult to avoid the use of scientific terms.' But I shall endeavour to be as plain as possible."*

After this apologia there remains the pleasure of thanking those who have been of help. It is not possible to list all those to whom I am under obligation; for it has been my good fortune to be in close touch with amateur and professional mycologists, both here and abroad, for many years—and as Linnaeus remarked, "Sometimes a blind hen meets with a grain of corn," and I must have gleaned.

More particularly I wish to express my indebtedness to Mr. Paul de Laszlo, O.B.E., who, though then serving as Lieut.-Commander in the R.N.V.R. spent much of his leisure time photographing for me; most of his kodachromes were duplicated and together with many others were generously given to me for use in Museum lectures: to

my old friend Mr. Somerville Hastings, M.P., who kindly gave me leave to use his large collection of excellent photographs: and to Dr. Erik Björkman, Mr. J. A. Crabbe, The Director, Forest Products Research Station, Sir Alexander Fleming, Glaxo Laboratories, Mr. H. J. Howard, Prof. C. T. Ingold, Mr. H. Meyer, Mr. D. A. Pickford, Prof. A. Stoll, Mr. W. H. T. Tams and The Trustees, British Museum (Natural History), who allowed me the use of their photographs.

I wish to thank many who answered my queries and particularly Mr. Arthur Collins for his notes on truffle-hunting at Winterslow.

I am under many obligations to my former colleagues in the Department of Botany who were willing to help in tracking down some obscure reference, and in every possible way: to Mrs. F. L. Balfour-Browne, my assistant for many years, who helped in numerous ways with the manuscript as it took form, and with the proofs; also to Mr. A. C. Townsend, Museum Librarian, who read much of the manuscript and has applied his wide experience to the proofs; and to Mr. T. C. Denston, Secretary of the British Pharmacopœia Commission who read and advised me upon the pharmaceutical aspects of some of the chapters.

The *Oxford English Dictionary* has been most useful in providing clues to the old literature.

The book has many shortcomings but if it succeeds in adding to the goodly company of those interested in matters mycological it will serve its purpose.

12 March 1953 J. R.

CHAPTER 1

GENERAL INTRODUCTION

SINCE THE SECOND WORLD WAR the British public appears have to become fungus conscious. This is not to suggest that it was previously unaware of these organisms or that it was entirely ignorant of mushrooms and toadstools, of moulds and mildews, of yeasts and of dry rot, but rather that events brought the group as a whole more into public notice.

The most outstanding of these was the discovery that *Penicillium notatum*, a green mould of a very common type, is able to produce penicillin, the most valuable antibacterial substance known, which, because it is non-toxic to animal tissues, was of supreme importance in the treatment of war wounds. The so-called food-yeast, which was destined to play an important role in the feeding of starving nations, also impressed the public. A third factor has been a more general realisation that many toadstools may be eaten with perfect safety and can add a spice of variety to diets requiring only this to make them satisfying.

Fungi form a vast assemblage of organisms, probably greater in the number of species and individuals than are flowering plants. They include Moulds, Mildews, Rusts, Smuts, Mushrooms and Toadstools, from extremely small microscopic forms to large bracket fungi the width of a man's height. There is a great variety of structure and texture.

From a physiological standpoint the essential characteristic of all fungi is that they are without chlorophyll, the green-colouring matter of plants. By the aid of this complex chemical substance, the protoplasm of green plants is able in sunlight to build up, from water and the carbon dioxide of the air, the carbohydrates essential for life and growth. The process is not a simple one and its details are still matters of controversy. However, the important point is that only organisms with chlorophyll* are able to carry out this fundamental process, the building up of organic from inorganic substances. Fungi, not having chlorophyll, must obtain organic material already prepared. In this they resemble animals, but they are much more catholic in their tastes. It is in their search for food that they cause disease, decay and destruction, but they also bring about changes beneficial to man and other organisms.

As a nation we have certain characteristics apart from those wished upon us by continental writers. One of them, which does not appear to have called for comment, is our dread of eating any fungus other than the Common Mushroom, either wild or cultivated, though during the friendly invasion by foreigners in the past few years the peculiarity has certainly been remarked.

The general belief that only one, or at most a very few species, are safe to eat, has led to the words mushroom and toadstool being used to denote edible and poisonous fungi respectively. This differentiation takes no account of the large number of species which are so leathery that they are inedible, though not poisonous. Leaving these

aside, however, we are faced with the fact that there are hundreds of edible fungi and only a dozen or so which can be described as deleterious. Are we still to call all edible species mushrooms and the few poisonous ones toadstools?

The grete herball (1526) says, “Fungi ben mussheron. . . . There be two maners of them, one maner is deedly and sleeth them that eatheth of them and be called todestoles, and the other doeth not”: but all are mushrooms. In some parts of the north country we have this same use which leads to awkward phrases like: “Mushrooms as is toadstools.” Most of the earliest references to mushroom and toadstool, however, regard them as synonymous. Thus we find in John Maplet’s *A green forest* (1567), “The Mushrom or Toadstoole . . . hath two sundrie kinds, . . . for the one may be eaten: the other is not to be eaten,” and in Henry Lyte’s *A Niewe Herball* (1578), “sicke with eating of venimous Tadstooles or Mousheroms”: and about 1440, “Promptorium Parvulorum” speaks of “Muscheron, toodys hatte, *boletus*, *fungus*,” which is incidentally the second reference to mushroom given in a long series of spelling variations in the *Oxford English Dictionary*, the first being “*Mussetum*, musserouns” (14 ..): the earliest reference for toadstool (tadstoiles) is 1398.* To revert fully to this original usage would be inconvenient; one or other word should be inclusive. It would be better to use toadstool in its original sense and to restrict mushroom to those species which are usually now so-called, that is to species of the genus *Psalliota*—*Psalliota campestris*, the Field-Mushroom, *P. arvensis*, the Horse-Mushroom, and so on. Mushrooms would thus be regarded as special kinds of toadstools, and no confusion could arise about the meaning.

The word mushroom is usually thought to be derived from the French *Mousseron* (*muceron*) from *mousse*, moss, but it is not used in quite the same sense. It has been said that “mousseron is a barbarous name which has caused endless confusion.” *Tricholoma gambosum*, the St. George’s Mushroom and its varieties, is “mousseron,” “mousseron de la Saint-Georges,” or “mousseron vrai”; *Clitopilus prunulus* is “mousseron”; *Marasmius oreades*, the Fairy-Ring Champignon, is “mousseron d’automne, de Dieppe, etc.” or “faux-mousseron.” Further, the name appears to be used commercially for all fungi sold in a dried state. Strange to say, in Germany “Mousseron (Musseron)” or “echter Mousseron” is *Marasmius scorodonium*, whereas one name for *Clitopilus prunulus* is “grosser Mousseron.” It may be recalled that according to Rabelais, Dido did sell “mousserons” in hell.

The derivation of toadstool is obvious, especially when considered in conjunction with toodys hatte, paddockstool (1450), and the modern Scottish and north country paddockstool or puddockstool. John Gerard in *The Herball* (1597) says, “in English Mushrooms, Toadstooles or Paddockstooles.” Clusius states that Genus xiii of his Fungi puniciales (*Collybia maculrta*) is called Froschen stuel. Ray in *Historia* says such fungi are called Toads-stools by country people here.

A typical toadstool obviously might serve as a resting place for a sedentary batrachian, but it is peculiar that the association is mostly with toads and not with frogs; possibly the explanation is in the old belief that toads were venomous. In Brittany and neighbourhood there are local names meaning toad’s hat or toad’s bonnet; the most widespread is “tour soc” or “scabello tou soc” (escabeau de crapaud). The belief is that they are formed from the harmful substances of the earth and the venom of toads and that fungi always grow in places where toads abound, and give shelter to

them when they take the air.

There have been suggestions that the word has reference to excrement. Certainly stool might have that meaning, but the derivation of toad from the Icelandic tad (dung) is philologically unnecessary having regard to early usage. From the point of view of belief there would be nothing surprising if, originally, the word had reference to such unsavoury similes, but it seems certain that the obvious and more poetic derivation is the correct one: “The grieslie Todestoole growne there mought I se And loathed Paddocks lording on the same.”

As would be expected, we find modifications also of the Latin word fungus, though these were usually used with mushroom or toadstool as synonyms. Thus we have funge and fungo. In the “forme of cury compiled of the chef maistes cokes of kyng Richard the Secunde kyng of .nglond after the conquest; the which was accounted the best and ryallest vyand of alle esten .ynges” (1390), there is a recipe “10 Funges (mushrooms). Take funges, and pare hem clene and dyce hem; take leke, and shred hym small and do hym to seeth in gode broth; color it with safron, and do thereinne powdor fort.” W. Bullein in *The booke of simples* (1562) speaks of “rotten Moushrimpes called Fungas.”

Though fungus in Latin meant the larger fungi generally, it also referred to fleshy excrescences on the human body and on tree trunks. It is commonly believed to be cognate with or derived from the Greek word for sponge, *sphonggos* (σφγγος), which agrees with the ideas the Romans expressed about the nature of fungi. A derivation which was apparently first suggested by J. Bauhin in *Historia Plantarum* (1650), appealed to several of the herbalists because of its supposed aptness—*funus*, funeral, and *ago*, I lead to. John Ray, in *Historia Plantarum* (1681), says whatever the etymology the idea is not unmerited.

The Greeks used the word mykes (μύκης) for mushrooms generally, presumably because of the slimy nature of some of them. It also denoted any knobbed round body shaped like a mushroom, such as the chape or cap at the end of a sword’s scabbard, and fleshy excrescences.

It is significant that both the Greeks and the Romans regarded the snuff or lamp-black of candles and lamps as being sufficiently like fungi to warrant using the same name: its occurrence was supposed to forbode rain. Similarly, they considered soft-headed doltish persons as deserving of the same appellation. Both uses are found with us; thus, Ajax in *Troilus and Cressida*—“Toadstool, learn me the proclamation.”

The usual term for the study of fungi is mycology. *Mykes* in its plural form is the ending adopted for the names of many groups of fungi without any special reference to rank; thus Eumycetes for the whole of the Fungi; Phycomycetes, Ascomycetes and Basidiomycetes, for the three main classes; Hymenomycetes, Gasteromycetes, Discomycetes, and Pyrenomycetes, for orders.

The name of the old Greek city Mycenae was derived by the ancients either from an eponymous heroine Mycene, or from the word mykes. Pausanias in his *Description of Greece*, says that Perseus, when he had received the kingdom of Proteus, founded Mycenae because there the cap of his scabbard had fallen off; he regarded this as a sign to found a city. “I have also heard that being thirsty he chanced to take up a mushroom, and that water flowing from it he drank, and being pleased gave the place

the name of Mycenae.”

CHAPTER 2

NAMES

THESE ARE SEVERAL FUNGI mentioned in Greek and Latin authors but, though some of the names are still in use, they now have a different significance. Thus, the boletus of Latin authors, Βωλίτης of Galen, is *Amanita caesarea*; pezica of Pliny, πέζις of Theophrastus, is *Lycoperdon giganteum*; agaricum of Pliny, ἀγάρικόν of Dioscorides, is *Polyporus officinalis*; ἀμάνιται of Nicander is *Psalliota campestris*, and ὑδνον of Theophrastus is a truffle.

Most writers before the time of Linnaeus endeavoured to apply these names correctly. J. J. Dillenius, however, in *Catalogus Plantarum sponte circa Gissam nascentium* (1719), a work which led to his employment by William Sherard and to his nomination in Sherard's will as the first (Sherardian) Professor of Botany at Oxford, used *Boletus* and *Peziza* (also *Amanita*) in a sense entirely different from the original. Linnaeus, who in matters of nomenclature was occasionally autocratic, adopted Dillenius's interpretation of *Boletus* and *Peziza*, and for some reason, or whim, altered the application of the names *Agaricus*, *Hydnum* and *Elvella* (*Helvella*), which last, in Cicero, is not even a fungus, but a vegetable. In *Species Plantarum* (1753), Linnaeus used these names among the ten genera that he described; the remaining five names were "modern"—and unaltered. The influence of this work was so great that the misuse of the old names was generally adopted, though not without some pointed protests, for in it the binary system of nomenclature was established; the specific names of all plants henceforth consisted of two words, a generic name and a specific epithet. This innovation is regarded by some as Linnaeus's most useful service to science.

The necessity for the convention will be best understood by glancing through the pages of a work of one of Linnaeus's immediate predecessors, for example, Ray's *Synopsis Methodica Stirpium Britannicarum* (1724, edited, anonymously, by Dillenius*). At first one has the same bewilderment as had Jacob when wrestling with the angel—"what is thy name?" The account of fungi begins with the Field-Mushroom; "I. Fungus campestris albus superne, inferne rubens *J.B.T.* 111, *P.* 2, *p.* 824, esculentus 13, sive pileolo lato and rotundo livido, *C.B.Pin.* *p.* 370. parum rubens inferne, pileo albo plano, quandoque umbilicato, *Sterb.Th.F.* *p.* 28, *Tab. I. Fig. A.* esculentus 12 *Park.Th.* *p.* 1317 *Champignon*. In pascuis sterilioribus sub finem aestatis."

Apart from the name *Champignon*† and the last sentence giving the place and season, there is no description beyond what is contained in the names bestowed by four previous authors, J. Bauhin, C. Bauhin, Sterbeeck and Parkinson, and presumably the first of these synonyms was favoured by adoption. There is, however, no regular procedure; for some species we find the phrase name written separately, followed by a

description; with many of the newly added species, moreover, there is no attempt at anything beyond a description, though this may contain seventy words or more.

How did such clumsy names arise? Greek authors who wrote about plants were writing for the general public and used the names of everyday speech; indeed, occasionally, more than one name was given to the same plant obviously drawn from different localities, where, incidentally, many of the names are still in use. I had this impressed on me early in 1919 when sitting on the slope of the so-called Clytemnestra's tomb at Mycenae in company with Capt. T. S. Hele (later master of Emmanuel College, Cambridge). An old shepherd came along and with obvious enthusiasm pointed to the different places of interest within sight. I was puzzled by a plant which was forming abundant spirals on the ground, but was not in flower. More as an acknowledgment of his friendliness than with a hope of acquiring knowledge, I drew his attention to the plant, which he at once called "heliotropion." It was *Heliotropium supinum*, and an unkempt, illiterate shepherd knew it by the same name that Theophrastus had used in *Enquiry into Plants* about 300 B.C. In this, the earliest known botanical work and one which served as a text for several centuries, we find plant names of different kinds. About five hundred plants are mentioned, the majority cultivated, and all from a restricted area. Many of the names are single words (nouns) referring to the only species then known (e.g. *Asparagus*). Sometimes, however, plants recognised as not being closely related had some character in common which led to a name which described this similarity. Often this resemblance was in the roots which were well known, for the root-gatherers* of antiquity provided the materials for medicines. Thus for Theophrastus, Sweet Flag was compared to a reed *κάλαμος* and was called the sweet-smelling reed *κάλαμος ο εἴωστος* just as we have Ivy and Ground Ivy, Nettle and Dead Nettle.

The same system of naming was followed for species; the commonest species was given the generic name, and other species were distinguished by adding an adjective such as "broad-leaved," or, as is frequent in Greek, the adjective was joined on to the noun to make a compound word *κυνόρροισι*, dog rose. All plant names in Theophrastus, whether of genus, species or variety, are either a noun, or a noun qualified by an adjective. When, later, the Romans began to take an interest in plants, they based their ideas on Greek lore. They used Latin words of common speech for the species known to them; for others they borrowed names from Greek writers, Theophrastus particularly. Consequently almost all their plant names are of the same kind as those of the Greeks, namely a noun, or a noun and an adjective, the latter, in Latin, always written as two words no matter what the Greek form was.

Latin became the acknowledged medium for natural history works at the time of the Revival of Learning, and in the Herbals we find that the classical names used, being mainly unitary or binary, have a much more modern appearance than those of the first half of the eighteenth century. Though generic names were rarely descriptive, the qualifying adjective was invariably so. So long as comparatively few species of a genus were known it was simple to give names sufficiently distinctive to recognise them. As knowledge increased so simple a nomenclature was sure to break down. It did so almost at once with fungi because of the impossibility of finding a distinctive character definable in a word. Pliny distinguished different truffles as *Tuber colore*

nigro, *Tuber colore intus candido* and *Tuber colore rufo*, which clearly indicate the method that led to his using *Boleti veneni*, *diluto rubore*, *rancido aspectu*, *livido intus colore*, *rimosa stria*, *pallido per ambitum labro* for *Amanita muscaria*, and *Boleti sicci*, *nitri similes*, *veluti guttas in vertice albas ex tunica sua* for *Amanita pantherina*, whereas, as we have seen, *Amanita caesarea* was simply *boletus*. Similarly, in the period following the Herbalists, when the spread of knowledge and the opening up of new lands had greatly increased the numbers of known plants, the distinguishing phrase replaced the descriptive adjective. Some authors showed considerable ingenuity in keeping these phrases within reasonable bounds, for all were free to use whatever name they chose. Linnaeus originally set himself a limit of twelve words for the formation of a specific name; others left nothing out and the name was in fact a detailed description of the plant. The result was that the study of natural history—for animal names were similar in kind—was hampered and confused; it was becoming as difficult to find a way through the tangle as it would be to travel hopefully if all places had such descriptive names as Llanfairpwllgwyngyllgogerychwyrndrobwllllandysiliogogoch.*

Linnaeus eventually realised that a name and a description need have nothing in common. A generic name and a specific epithet are sufficient to denote an organism; the description gives its distinctive characters. The epithet may be erroneous or even ridiculous, but this signifies nothing so long as we have a convenient name to use and know precisely to what it refers.

Like the Greeks, we have few popular fungus names. A popular name is a sure sign that a species is recognised by country people, and, indeed, it is usual to find more than one such name for the few fungi so endowed. Occasionally in these pages English names are given, but most of them are not folk-names, having been coined in an effort to popularise the study of fungi. Many writers of books which aim at a wide appeal, think it wise to criticise the use of Latin names for organisms, as if this were pedantic, even if not cryptic. Doubtless, as a knowledge of the larger fungi becomes more popular, names will be invented by or for those who prefer homely appellations, but myriads of microscopic species are unlikely to have bestowed upon them anything additional to their baptismal names. It is really only at the outset that Latin names appear forbidding: amateur gardeners soon talk of *Antirrhinum* and *Delphinium* instead of Snapdragon and Larkspur; *Chrysanthemum*, *Rhododendron*, and suchlike, occasion no comment. Genuine English names should be treasured; made-up book-names, which are often merely translations of the Latin names, should be regarded as makeshift stepping stones and discarded so soon as they have served their purpose.

When writing the name of a plant it is customary to add the name of the author who first described it, either in full or in an abbreviated form. This “authority” is really a shortened reference, but it also indicates which species is meant when the same name has been used in different senses by two or more authors. The name of the Chanterelle is written *Cantharellus cibarius* Fr. meaning that F. M. Fries, the illustrious Swedish mycologist, gave this name to the fungus, which he also described in a manner which permits of certain identification. To be more precise the name should be written *Cantharellus cibarius* Fr. Syst. Myc. I 318 (1821), for Fries wrote much from 1815 till 1874, and, moreover, gave several descriptions of this fungus. He was not the first to describe it; he was the first to call it *Cantharellus cibarius*.

Frequently two authorities are given, the first within brackets, for example, *Amanitopsis strangulata* (Fr.) Roze. This indicates that the specific epithet was bestowed on the fungus by Fries but that he had placed it in another genus—here it was *Agaricus*—and that E. Roze transferred it to *Amanitopsis*, which, incidentally, was a new genus proposed by him. Thus in *Cantharellus cibarius*, Fries is the authority for the specific name, in *Amanitopsis strangulata*, only for the specific epithet. No matter for what reason a transference is made, the fact that it has occurred is shown by such a “double citation.” For example *Agaricus echinatus* Roth, because of its puzzling characters* has been placed in different genera; it is *Agaricus (Psalliota) echinatus* (Roth) Fr., *Agaricus (Chamaeota) echinatus* (Roth) Cooke, *Agaricus (Inocybe) echinatus* (Roth) Cooke, *Agaricus (Pholiota) echinatus* (Roth) Pat., *Pratella echinata* (Roth) Gill., *Lepiota echinata* (Roth) Quél., *Cystoderma echinatum* (Roth) Sing., *Naucoria echinata* (Roth) Schroet. and *Melanophyllum echinatum* (Roth) Sing.; the check to the identity is the specific epithet and the authority for it.

Some mycologists favour genera with narrow circumscription, others are more catholic. This brief account is merely to explain the significance of what often puzzles the uninitiated. The subject of nomenclature is full of difficulties, not excluding psychological ones. International Rules of Botanical Nomenclature have been drawn up with the object of straightening out some of the tangles, but as they are retroactive it is not always easy to apply them both logically and reasonably; it is possible to legislate for ourselves, and perhaps for our successors, but our predecessors cannot be influenced. The names in this book are without “authorities,” for, except where comment is made, they are used in the sense accepted in British mycological writings.

CHAPTER 3

HISTORY

IN ADDITION to the outstanding fact that fungi, though very occasionally green, do not possess chlorophyll, is the equally significant one that like mosses, ferns, liverworts and other cryptogams, they reproduce by spores and not by seeds. The spores of fungi are very small and those of only three or four species are sufficiently large to be within the range of unaided vision. Those of toadstools average about 10 μ in length, a μ (micron or mu) being $1/1000$ of a millimetre, i.e. $1/25400$ of an inch. Though the smallest seeds, those of orchids, are much larger than any fungus spore, the essential difference between a seed and a spore is not in size but in structure. That of a seed is highly organised with, typically, an embryo and surrounding tissues: that of a spore is extremely simple, for there is no tissue and no embryo, merely, as a rule, an outer cell-wall enclosing protoplasm with a little oil or other reserve food-material, though sometimes the spore is divided by cross-walls and, less frequently, also by vertical ones.

A seed, when it germinates, first puts forth the young root of the embryo or germ, and later the stem apex with or without the seed leaves (cotyledons). The fungal spore, as it does not contain an embryonic fungus, does not germinate in a similar way; indeed, strictly speaking, as it has no "germ" it does not germinate, though it is customary and convenient so to speak of the first stage of development. This, in all the larger fungi, consists in the protrusion of a part of the spore wall as a tube, the germ-tube, which gradually lengthens until it becomes thread-like, and then with continuous growth, branching, and anastomosis, spreads in all directions. The thread-like portion is called a *hypha*, the more advanced stage a *mycelium*. There is no hard and fast distinction between the two, and usually hyphae and mycelium are spoken of as though synonymous. The flesh of mushrooms, toadstools and other fungi with similarly definite shapes, is formed by the massing together of these hyphae. It is "tissue" in a descriptive rather than a strictly anatomical sense.

Though spores are produced in enormous numbers, and deposits containing millions of them can often be seen on leaves and stumps as well as on parts of a fungus itself, it was long before their significance was realised. To the Greeks and Romans the origin of fungi was a mystery. They had no conception of spores and therefore marvelled at the absence of seeds, and though mycelial threads must have been noticed, their import was not grasped. But there were occasional surmises about the mystery. A common belief was that fungi, truffles especially, were produced by thunder, a belief still held in the Philippines. Theophrastus, however, speaks of this as a peculiar belief, as also the fact that some thought that truffles were produced from seed, because those that grew on the shore of the Mityleneans appeared only after floods which brought down the seed from Tiarae, where truffles abound.

Pliny, over three centuries later, says about truffles:

“Among the most wonderful of all things is the fact that anything can spring up and live without a root...Now whether this imperfection of the earth—for it cannot be said to be anything else—grows, or whether it has at once assumed its full globular size, whether it lives or not, are matters which I think cannot be easily understood. In their being liable to become rotten, these things resemble wood.”

“The origin of boletus [*Amanita caesarea*] is from mud and the acrid juices of moist earth, or frequently from those of acorn-bearing trees; at first it appears as a kind of tenacious foam, then as a membranous body: afterwards the young boletus appears.”

Nicander, about 185 B.C., refers to a fungus as “the evil ferment of the earth”; and, generally, “the central heat of the globe forms them by rarefying the mud of the earth.”

It seemed so unlikely that fungi could be produced in any normal manner that Petronius commenting on the extravagancies of the gourmand Trimalchio, joked about his having sent to India for seeds of boletus.

The writers of Herbals stuck rather closely to classical authority in most things, and not least in the explanations given about the origin of these “earthie excrescences” or “bastard plants.”

It is fascinating to follow the threads of ideas about the nature of fungi from their earliest mention until they were woven as the warp and weft of definite pattern. This took longer to attain than with most other organisms, for as fungi did not appear to fit into the notions conceived at different periods about the “Order of Nature,” their characters were sometimes regarded philosophically rather than interpreted factually. The problem was whether fungi were manifestations of some phenomenon, or were entities, and how they were produced, and reproduced.

The earlier herbalists were occupied for the main part in elucidating *De Materia Medica* of Dioscorides. Their interpretations were not simply literary exercises but commentaries with reference to the floras of their own countries, which became more and more valuable as it was gradually realised that many of the plants were different, and illustrations were made from living specimens. William Turner in *A new Herball* (1551–1568), the first important English botanical work, realised the difficulties, and in his forthright manner—a manner which at that period proved perilous for a prelate—wrote that he had:

“taught the truthe of certeyne plantes....And because I would not be lyke unto a cryer yt cryeth a loste horse in the marketh, & telleth all the markes and tokens that he hath, & yet never sawe the horse, nether coulde knowe the horse if he sawe him: I wente into Italye and into diverse partes of Germany, to knowe and se the herbes my selfe.”

Mixed with ideas about the nature of fungi which are derived directly from writers of antiquity, we find modifications due to personal observations and independent judgment. Thus Caesalpinus in *De Plantis* (1583), wrote that: