

# An Introduction to **Fungi**

**4th Revised Edition**

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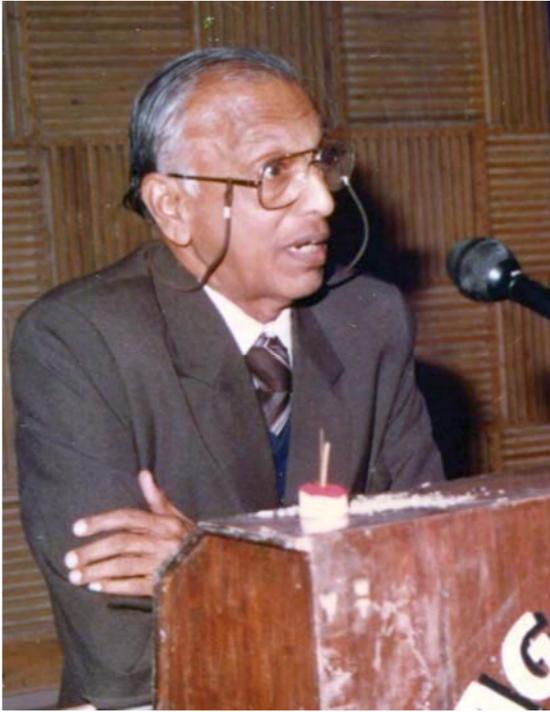
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*Dedicated with great respect  
To*



**Prof. C.V. Subramanian**

*And with prayers for his good health.*

*President*, International Mycological Association (1977-1983),  
*Member*, Executive Committee, International Union of Biological  
Sciences (1979-1982) and *Former Director*, Center for Advanced  
Study in Mycology and Plant Pathology, University of Madras.





**Prof. B.P.R. Vittal**

## **Foreword**

I am happy Dr. Dube is bringing out the 4th edition of his now monumental book *An Introduction to Fungi*, first published in 1983. There was no comprehensive book on taxonomy and biology of fungi published by an Indian author until then. The book was written in most authentic and lucid manner. The 2<sup>nd</sup> and 3<sup>rd</sup> editions of the book were published in 1990 and 2005, respectively. The book has remained indispensable for students of mycology during the last three decades. The 4<sup>th</sup> edition has rightly raised high hopes and I am confident it will fully meet the expectations. Dr. Dube's contributions to mycology will be long remembered. He doesn't need a eulogy; nevertheless I can't resist expressing my deep respect and admiration for his enthusiasm and incessantly writing on varied areas of mycology. Knowing Dr. Dube personally and most closely since our University of Madras days, more than 40 years now, I am sure the new book will be tremendously popular.

**B.P.R.Vittal**

Professor, CAS in Mycology and Plant Pathology  
University of Madras



## Preface to the Fourth Edition

I feel privileged to introduce in this (4<sup>th</sup>) edition the impact of the recent developments in mycology that have led to much better understanding of the organisms belonging to the three kingdoms of fungi and their evolution. The multigene sequence analysis by AFTOL (Arranging the Fungal Tree of Life) and “Deep hypha” projects sponsored by National Science Foundation of USA, as well as the Myconet, has revolutionized the taxonomy of fungi. For example, the phylum *Ascomycota*, which could not be classified above the rank of ‘order’ since 1983, has now (2008) 17 classes and 3 subphyla. No group has escaped such changes and this has resulted in a more natural classification of these diverse “organisms studied by mycologists”.

The publication of Ainsworth and Sussman’s 5 volumes entitled *The Fungi: an Advanced Treatise* (1966-1973) was a great event, a milestone in mycology. The first edition of *An Introduction to Fungi*, published in 1983, was largely based on information gleaned from these volumes. Ainsworth’s classification was introduced in this edition which became most popular. Later, the molecular data, especially obtained from 18S rDNA sequence analysis, gave rise to a new phylogenetic classification, which was adapted in *The Dictionary of Fungi* (8<sup>th</sup> ed, 1995). Though emotionally difficult to break away from Ainsworth’s familiar classification, the 3<sup>rd</sup> edition (2005) of this book adapted the DNA- based classification, popularly known as Hawksworth’s classification. Now, we have a much clearer picture of the fungi provided by the mega projects (AFTOL and Deep Hypha) and their genetic-relatedness as never before. This information has been the basis of the new classification (Kirk *et al.*, 2008, *Dictionary of the Fungi*), which we have followed in the 4<sup>th</sup> edition. All that is worth-knowing is included here. The chapters on the biology of fungi have been thoroughly updated.

Needless to say, I have immensely enjoyed writing, and before that, reading the vast literature now available on one ‘click’. To decipher, glean and put in order the scattered information was a challenge but it became easy due to help from friends. I profusely thank Elizabeth Frieders (University of

Wisconsin, Platteville, USA) and Anna Rosling (Univ. of Indiana, USA) for their help in solving knotty problems.

I remember (always!) with gratitude my teacher late Prof. KS Bilgrami, who in 1963 initiated me into research, and later, in 1976 made me an author in *A Text Book of Modern Plant Pathology*. One shock! My senior colleague at University of Madras, Prof. R N. Swamy passed away. He was a source of inspiration to me for over 40 years and his demise has been a great personal loss to me. Life Goes on!

I hope students would be benefited by this book and there in lays my happiness. You are welcome to discuss any mycological problem through my e mail [hcdharish@yahoo.co.in](mailto:hcdharish@yahoo.co.in). Thank you.

**H C Dube**

July 2012

## Preface to the First Edition

Books, ever since Newton's *Principia* (which indeed reads like a textbook) and Darwin's *Origin of Species*, have had a respectable place in scientific literature. Their role and esteem have, however, been eroded in recent years with greater emphasis on journal articles. Even at the undergraduate level, students are provided with list of references to articles in journals with the argument that in rapidly advancing scientific fields good and up-to-date textbooks simply do not exist. This, to quote *Nature*\* "Is a thin excuse for many teachers' laziness. The remedy is in their own hands, or pens." Journals and review articles, notwithstanding their own merit, lack the historical perspective and the judicious evaluation of scientific publications. Also, they are less accessible and unportable. There is an urgent need for more books. Working scientists must withdraw for a time from the bench or "competition for space in the ordinary journals, and discharge their professional responsibility."

I have felt lonely on occasions. The pains of authorship became endurable only by remembering the fate of students in India, who have neither journals nor books available to them. I am offering them *An Introduction to Fungi* with great satisfaction. Without being unnecessarily humble, I feel happy that I am giving something which was long due.

I hope students will enjoy studying fungi which, since the beginning of man's quest for knowledge, have commanded great attention and have given rise to several additional disciplines like biochemistry and plant pathology. The enzymes, with which biochemistry started, were first studied in the yeasts (etymologically the word 'enzyme' means *in yeasts*). Plant Pathology, to use Horsfall's phrase, was spawned in the backyard of mycology. Tatum and Beadle ushered in the biochemical genetics, which later developed in much wider realm of molecular biology, with *Neurospora*.

Mycology started with the study of mushrooms (mykes = mushrooms) which were highly delicious as food. Soon, some of them proved to be poisonous and got the name 'toadestuhl' (death chair), which later became

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\* "Who will write more books"? – 5 November 1981, pp. 17

`toadstool'. This necessitated the identification of edible mushrooms from poisonous toadstools. The speculations about their origin from a liquid accompanying thunder and storm or from the venom of snakes, may look odd today, but they did contribute by drawing attention to their study. The use of some fungi as source of hallucinations, which in no time could lift the soul and enable the patron to enjoy the sight and music of a different and bizarre world, has now been harnessed in the preparation of drugs for curing schizophrenia, and for `taking a trip'. More sobering and important contributions of fungi are in the realm of biodegradation, elucidation of complex life processes, their increasing role in contaminating the already threatened habitat by their toxins, and their prospects in biotechnology and industry, in which they have contributed more than any other group of organisms. Besides, the study of their own biology - the unending variability, their association in dual organisms, the novel alterantive of sex, the role of sex hormones in their reproduction, are all areas of interesting and challenging studies. Their study is never tiring; rather it is refreshing! Hope you will enjoy.

I remember with gratitude my teachers of mycology. Dr. G.C. Srivastava, Dr. P.C. Misra, Dr. R. Sahai, and Prof. K.S. Bhargava, are unforgettable. Prof. C.V. Subramanian, during my two years of stay at Madras, made an everlasting impression on me. Prof. Bilgrami's contributions are beyond repayment. But the students have not to be unduly careful to repay as their relation transcends acknowledgements. I am thankful to my students whom I taught for 12 years at Udaipur University. They, in their own way, also taught me mycology. Thanks to them. Most pleasant was my experience with my research colleagues, S.K. Doshi, D. Daniel, Ashok Shrivastava, T. Silas Paul and K. Prabhakaran, who always came forward to help me and never grudged the help. I thank them for the "Yes." Then, nothing can be done in a non-congenial atmosphere. The Biosciences Department of Sardar Patel University is an ideal place for research and serious work, and I congratulate my colleagues for achieving this.

Thanks are due to Prof Lichtwardt of University of Kansas, Lawrence, USA, Prof. U.K. Sinha of Patna University and the Academic Press, New York, for allowing me to use some of the figures. A word of thanks is most certainly due to my wife (better-half, to be more appropriate) who always cooperated and also typed the manuscript, not once but three times. Thanks to my children who never allowed peace to prevail in the house and made me immune to noise. Thank you all.

**H C DUBE**

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