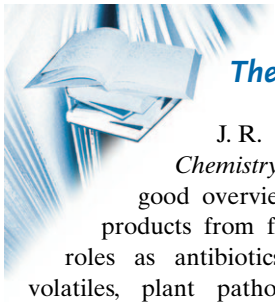


## The Chemistry of Fungi

J. R. Hanson's book *The Chemistry of Fungi* presents a good overview of important natural products from fungi, dealing with their roles as antibiotics, fungicides, pigments, volatiles, plant pathogens, and mycotoxins. Therefore, the book fills a gap, since no books devoted to fungal natural products have been published in the last few years.

Hanson begins with a historical retrospective, highlighting the changes in research on the isolation and structure elucidation of natural products, including those of fungi, that occurred during the last few decades through advances in chromatographic separation techniques and in instrumental analytical methods such as mass spectrometry and, first and foremost, NMR spectroscopy.

In the second chapter Hanson describes the methods used to establish mycelial cultures of fungi, discusses the influences of environmental conditions and the age of the cultures on the production of secondary metabolites, and describes methods for their isolation and for the elucidation of their biosynthesis, which is a topic of great practical importance, since antibiotics are isolated on a large scale from fungal cultures.

The following four chapters deal with constituents of fungi arranged according to their biogenetic origin, including amino acids, polyketides, terpenoids, and precursors of the citrate cycle. In discussing particular compounds of these classes, the author puts special emphasis on explaining the elucidation of the structures and of their biosynthesis. The chapter on fungal constituents derived from amino acids covers not only the commercially important β-lactam antibiotics, such as penicillin and cephalosporin, but also the diketopiperazines, gliotoxin, cyclopenin, cochliodinol, agaritine, and the cyclosporins that are of eminent importance in transplantation medicine because of their immunosuppressive activity. Outstanding representatives in the group of polyketides are griseofulvin, known for its ability to attack dermatophytic fungi, and the statins, highly valued for their function of depressing the cholesterol level. The chapter on fungal terpenes and terpenoids is especially detailed, including topics such as the chemistry of the trichothecenes that inhibit the sporulation of the plant-pathogenic fungus *Botrytis allii,* of the gibberellins that influence plant growth, and of ergosterol, which is important for the cell wall construction of fungi. That is followed by a short chapter dealing with fungal compounds that originate at least partly from the citrate cycle. These include tetronic acids, the nonadrides, and zaragozic acids.

The seventh chapter is devoted to fungal pigments and volatiles. Pigments play a major role in fungi, and even a chapter devoted entirely to them can only offer a short insight into their structural diversity, as exemplified by a discussion of anthraquinone pigments, pulvinic acids, metal complexes, and carotenoids.

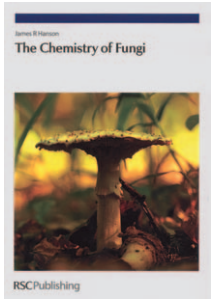
There then follows a discussion of plant diseases caused by fungi, such as the gray mold fungus (*Botrytis cinerea*) that attacks more than 200 different plant species, including many crop plants and their fruits. Dutch elm disease, in which the fungus *Ceratocystis ulmi* is distributed from tree to tree by the elm-bark beetle, is also discussed.

The penultimate chapter is devoted to the most important mycotoxins and to toxins of fruiting bodies of mushrooms. Those described include the trichothecenes, the aflatoxins, and the ergot alkaloids, as well as the amanitins and psilocybin.

The last chapter deals with the application of fungal enzymes in reactions that otherwise can be accomplished only with great difficulty, such as the stereoselective hydroxylation of the $CH_2$ group in position 11 of the steroid skeleton for the preparation of corticoids.

The book provides a rich collection of information in densely packed form, focussing on terpenoids, which the author has reviewed several times in *Natural Products Reports*. As the number of natural products derived from fungi is so enormous, the book can only present a selection of the most important compounds. Although the properties, the structural elucidation, and the biosynthesis of many compounds are discussed, the book contains little information about chemical synthesis. The table of contents gives easy access to the natural products discussed, and a very helpful glossary explains the most important terms in fungal biology. However, this generally positive impression of the book is marred by some serious mistakes: Thus, the structural formula of amanitin is incorrect and lacks information on its absolute configuration. The typical odor of mushrooms is not caused by (*S*)-1-octen-3-ol but by (*R*)-1-octen-3-ol. A severe shortcoming is the incompleteness of the collection of references in the chapter "Further Reading", which cites only few selected papers. That would be acceptable for a textbook, but this book is mainly intended for experienced natural products chemists, who are certainly interested in obtaining background information from original papers.

Despite these deficiencies, which may be easily improved in a new edition, I recommend the book as an important source of information to all natural products chemists, as well as to biochemists,




**Acid Catalysis in Modern Organic Synthesis**
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biologists, pharmaceutical chemists, and nutritional chemists dealing with fungi.

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## Handbook of Biomineralization

This is the third and most ambitious effort by Edmund Bäuerlein and his co-authors to produce a set of multi-authored books encompassing the vast area of biomineralization in a comprehensive treatment. The first book, *Biomineralization: From Biology to Biotechnology and Medical Application*, appeared in 2000. A revised and enlarged version appeared in 2004 under a similar title. Now, this new three-volume series *Handbook of Biomineralization* assembles the various aspects of the subject under the titles *Biological Aspects and Structure Formation*, *Biomimetic and Bioinspired Chemistry*, and *Medical and Clinical Aspects*. All these books now constitute an important source of information for this rapidly developing and exciting field.

The editors have made a heroic effort to cover all the areas of this vast subject: I am full of admiration for their vast amount of work and for the results that they have achieved. However, this is not really a handbook. A handbook is a compendium of information that is designed to provide comprehensive answers in a certain area. In my opinion it is impossible to achieve such a goal in biomineralization by assembling a collection of manuscripts from different authors. Take, for example, bones and teeth, the two mineralized tissues of medical/clinical importance, which are mainly addressed in the third volume. The subject of teeth is indeed covered systematically, from the formation and structure of teeth to biomechanical design, tooth diseases and treatment, tooth regeneration, and finally tissue engineering of teeth. In contrast, there is no general description of the bone tissue and its structure, of how bone is formed, and what is known about it. That is clearly a significant gap in a series of books that claims to be a handbook of biomineralization.

Biomineralization is concerned with evolution, genetics, molecular biology, cell biology, biochemistry, biomechanics, materials science, chemistry, crystallography, thermodynamics, molecular recognition, structural biology, physiology, and pathology. The *Handbook of Biomineralization* addresses all these aspects. It thus becomes possible, after observing with a bird's-eye view all the enormous amount of work reported here, to identify some of the trends that are developing in the area, especially in recent years.

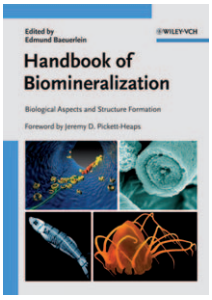
It is extremely satisfying to realize that genetic information is at last becoming available in an area where very little was known, at least in the field of invertebrates, until a very short time ago. There is no doubt in my mind that the genetic information that is emerging will contribute substantially to the advancement of research in the area. Although it is true that genetic factors govern all processes of tissue formation, it is also true that mechanisms of formation will not be fully elucidated on the basis of genetics alone. By definition, biomineralization involves the interface between minerals and biology, and a good understanding of both of these, and of their interplay, is needed.

In the compendium presented here, the highlights are, in my opinion, in the attempts to bridge the gaps between structure, function, morphology, and genetics—a very difficult enterprise indeed, especially because the interface between mineral structures and biological structures, where all the action occurs, is still poorly understood. The articles by Jogler and Schuler on magnetotactic bacteria and by Douglas and co-authors on protein cages touch on these problems and are very interesting.

In the area of carbonate mineralization, where in general much more is known about mechanisms, the gap is bridged more successfully. The chapter by Wilt and Ettensohn covers all aspects of biomineralization of the sea urchin larval skeleton, from development to cell biology, from the gene regulatory network to matrix proteins and their function, from ion and macromolecule transport to skeletal morphogenesis, and from matrix–mineral interactions to structure and mechanism of formation. Marsh takes a similar approach to the description of coccolith calcification. The chapters by Arias on "Egg Shell Growth and Matrix Macromolecules" and by Marin on "Unusually Acidic Proteins" relate the existing information on functional matrix macromolecules within a framework of structure–function relationships.

These efforts represent what is needed to obtain a comprehensive understanding of biomineralization processes. Only then can we properly understand the properties of these fantastically complex and sophisticated materials. It is fascinating to observe how, from this approach, an understanding of the biological design that results in the mechanical properties of the tissues is beginning to emerge (see, e.g., Fratzl and Gupta, Chapter 23 of Vol 1; Zaslansky and Weiner, Chapter 13 of Vol. 3).

I want to conclude with a conceptual consideration. The first article in the series, entitled "Growth and Form: What is the Aim of Biomineralization?", encapsulates the views of Bäuerlein

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