Down to Earth and of Burning Interest

Biopolymers. Biology, Chemistry, Biotechnology, Applications. Vol. 1: Lignin, Humic Substances and Coal. Edited by *Alexander Steinbüchel* and *Martin Hofrichter*. Wiley-VCH, Weinheim 2001. 513 pp., hardcover € 259.00.—ISBN 3-527-30220-4

"Anyone who works on lignin or humus has only himself to blame" went a chemist's rather facetious comment many years ago. It expressed a common view about the seemingly almost impossible task of clarifying the structures of those substances, and the feeling that it was best avoided as an area of research. However, the subject of renewable materials and biopolymers nowadays enjoys an increasingly favorable status with the public, and there is growing discussion about the merits of using renewable rather than fossil materials. Against that background it has now become quite respectable and relevant to be engaged in research on the "awkward" biopolymers named in the title of this book. Thus Volume 1 of *Biopolymers* fills a significant gap in the literature, and will make it easier for young scientists to become involved in this important area of research. The substances represented in the title of the book and those additionally covered in the text (sporopollenins and melanins), are very different, but they have some common features. They consist mainly of polyphenols, and their origins are related in a broad sense. Lignin plays an important role in the formation of humus, and is also an important precursor of coal. All the substances covered, excluding sporopollenin and melanin, occur in large quantities.

The first six chapters, consisting of 208 pages altogether, are devoted to the broad subject of lignins. It is rare to find lignins treated in such a concise and clearly arranged way and so competently as here: Chapter 1, "Occurrence, Function and Biosynthesis of Lignins", by B. Monties and K. Fukushima; Chapter 2, "Synthesis of Lignin in Transgenic and Mutant Plants", by J. F. D. Dean; Chapter 3, "Methods to Reveal the Structure of Lignin", by G. Brunow; Chapter 4, "Application and Use of Lignin as Raw Material", by P. Wünning; Chapter 5, "Biodegradation of Lignin", by Hatakka; Chapter 6, "Biotechnological Applications of Lignin-Degrading Fungi (White-Rot Fungi)", by G. M. Scott and M. Akhtar. These chapters give a comprehensive overview of an area of research extending over 65 years, beginning with the introduction of chemical breakdown techniques, in a way that is fresh and not obscured by mysteries (which are still all too common in books on lignin chemistry).

In accordance with current ideas, Chapters 1 and 2 give appropriate attention to the biosynthesis of lignin precursors, research on the application of genetic engineering to synthesis, and lignification (penetration of precursors into the polysaccharide matrix of the cell wall). The literature references are mostly quite recent (the editorial cutoff date was evidently in the year 2000). In Chapter 3, G. Brunow gives a concise, clear, and very useful survey of methods for determining the structures of lignins. Brunow's work has included the discovery of two important new forms of bonding between phenylpropanoid units in lignins (namely, a labile β-1-bond and the formation of a trimeric dibenzodioxocin structure). As well as the usual routine methods based on spectroscopy and chemical breakdown, the chapter describes modern three-dimensional NMR techniques. Chapter 4 (9 pp., 5 references) is concerned with applications of lignins, but is quite inadequate, serving at best only as a brief reminder. In contrast, Chapter 5 by Annele Hatakka contains an excellent discussion of biological breakdown, with over 500 literature references. This well organized survey is extremely useful, as it would be very difficult to begin work in this area with only the primary literature as a guide. Chapter 6, on the use of white-rot fungi in biotechnological processing, is equally good. Much research effort has been invested in this topic since the early 1990s, but the initial euphoria has largely evaporated. The bibliography reflects the recent history of the topic, as most of the cited work is from the mid-1990s.

Chapter 7 on sporopollenin (by R. Wiermann, F. Ahlers, and I. Schmitz-Thom) and Chapter 8 on melanin (by J. M. Henson) can be considered as a link to the next group of major compounds. Interesting though these substances undoubtedly are, they occur only in small amounts. Sporopollenin is in fact a rather mysterious polymer. It forms the outer layer of pollen grains, and is remarkably resistant to chemical and biological attack. As a result, pollen has been able to survive in geological deposits for periods varying from thousands to millions of years. Research aimed at elucidating the structure of sporopollenin has produced an extensive literature and large compilations of data, but disappointingly this has not yet led to a structural formula (even an indication of the type of structure would have been helpful here). Chapter 8 on melanin is short but very informative. This brown substance present in fungi, bacteria, and

higher organisms is shrouded in mystery. J. M. Henson devotes special attention to the biosynthesis of dihydroxynaphthalene (DHN) and eumelanin (DOPA), and explains that one of the most important functions of melanins is protection from photochemical degradation.

Humic substances are some of the most widely distributed organic natural products in soil and aquatic media, and they are covered in appropriate detail in Chapters 9–13 (135 pp. altogether). In Chapter 9, "Soil Humic Substances", N. Senesi and E. Loffredo describe the lignin–protein, sugar–amine, and polyphenol theories that have been proposed to explain the formation of these substances in soil. The structural formulas presented give a good impression of the very complex nature of humus in soil (although the authors could well have omitted the explanations about determining the molecular masses of the macromolecules involved). This chapter and Chapter 10 ("Aquatic Humic Substances", by F. Frimmel) will be very useful for biologists, botanists, agricultural scientists, environmental chemists, and others who need an introduction to this area. These are followed by excellent chapters concerned with methods: Chapter 11, "Methods to Reveal the Structure of Humic Substances", by A. Amlés; Chapter 12, "Biodegradation of Humic Substances", by M. Kästner and M. Hofrichter; Chapter 13, "Medical Aspects and Application of Humic Substances", by K. Klöcking and B. Helbig. If you have ever wanted to know about the functions of a mud-bath or a Fango pack, you should read Chapter 13. This remarkable book ends with three short but very informative chapters about coal: Chapter 14, "Microbial Degradation and Modification of Coal", by M. Hofrichter and R. M. Fakoussa; Chapter 15, "Desulfurization of Coal", by B. Bogenschneider, F. G. Jung, and J. Klein; Chapter 16, "Biotechnological Conversion of Coals into Upgraded Products", by M. Meyrahn and A. Steinbüchel. These chapters too provide what their titles promise. They are well illustrated, and the literature references are up-to-date.

Of the widely different classes of substances described in this book, some (lignins, humic substances) present great difficulties with regard to research and applications, whereas others (coal) are almost fully worked out as research topics. Although many authors have contributed to the book, the arrangement of the subject matter and the style of presentation has been kept fairly consistent. The contents fulfill the promise of the series subtitle "Biology, Chemistry, Biotechnology, Applications", as each of these aspects is given appropriate attention. One of the features deserving special praise is the glossary of abbreviations provided at the beginning of each chapter. The text has evidently been carefully checked. The volume will be mainly of value to scientists and students whose interests cover the broad field of biopolymers, but specialists too will benefit from the clear presentation of their particular area of expertise.

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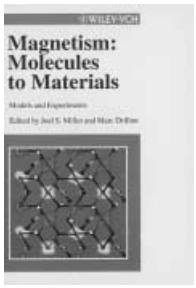
Magnetism: Molecules to Materials. Edited by *Joel S. Miller* and *Marc Drillon.* Wiley-VCH, Weinheim 2001.
Volume I: Models and Experiments, 437 pp., hardcover, € 139.00.—ISBN 3-527-29772-2
Volume II: Molecule-Based Materials, 489 pp., hardcover, € 159.00.—ISBN 3-527-30301-4
Volume III: Nanosized Magnetic Materials, 288 pp., hardcover, € 139.00.—ISBN 3-527-30302-2

This new book series picks up magnetism as a theme which accompanied the entire scientific development of our civilization and had a lasting impression. This extends from the discovery of magnetic iron by the ancient Greeks to its scientific historical significance as a subject of the first experimental scientific monograph—which dates back to Pièrre de Maricourt, better known as the crusader Petrus Peregrinus, written in a field camp outside of Lucera, Italy in the year 1269—upto its roles in the framework of our modern technology and information societies. Therefore, it is not surprising that this subject was intensively investigated, which has led to a comprehensive understanding of corresponding physical properties. In the last few years new discoveries have shown that magnetism—despite its already advancing age—still constitutes a very energetic research area. I therefore agree with the publishers when they write: "In the past few years our understanding of magnetic materials, thought to be mature, has enjoyed a renaissance as it has been expanded by contributions from many diverse areas of science and engineering."



The strong interdisciplinary orientation of magnetism as a modern research area is reflected in the selection of articles in the current first three volumes of this series which contain a very broad spectrum of research areas in chemistry, physics, and materials science. At the same time the concise subtitle "Molecules to Materials" not only reflects the extensive program of this series, but also describes the modern concept in chemistry en route to new magnetic materials.

The first volume, with the title: "Models and Experiments", contains in total 12 articles which describe recent developments in the physical characterization of magnetic materials as well as concepts and their practical realization. This includes reviews of one-dimensional magnetism and Spin–Peierls materials as well as a description of the so-called "Haldane Quantum Spin Chains", the special case of a one-dimensional Heisenberg antiferromagnet. An increased availability of relevant radiation sources (X-ray Circular Dichroism (XMCD), Muon-Spin Rotation (MSR), Neutron Scattering) particularly came in useful as physical methods for the investigation of magnetic materials. However, a chapter in the first volume is also dedicated to classical NMR spectroscopy as a modern method for investigating spin densities. The first volume is rounded off with three chapters on topical aspects from the areas of photomagnetic properties, colossal magneto resistance, and mixed-valent systems.

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