lized chiral catalysts. The main part of the book addresses individual areas, such as immobilized enzymes, various aspects of enantioselective hydrogenation, catalytic heterogeneous dihydroxylation and epoxidation, C–C bond formation, and diastereoselective catalysis.

The first chapter, written by industrial chemists, outlines the challenges in the field for both industry and academia. It summarizes and comments on many recent developments, although some topics, such as separation techniques for soluble supports, combinatorial approaches, and catalytically active molecularly imprinted polymers (MIPs) are only mentioned briefly. For the academic reader the current industrial requirements in terms of TOFs ($>500\ h^{-1}$) and TONs (>1000) may appear overwhelming, but are important benchmarks for new immobilized chiral catalysts. In Table 3 the authors compare some typical existing and some potentially useful immobilized catalysts. In the case of catalytic hydrogenation of C=C bonds, the table indicates that various rhodium diphosphines supported on a soluble non-crosslinked polymer show TOFs ten times higher than those of comparable heterogeneous systems supported on crosslinked polymers. At the same time, however, the authors question the use of soluble polymeric supports because of the lack of suitable separation techniques. The modern advanced membrane filtration technique is described as complicated and expensive. This is outdated! The field of membrane technology for catalysis in general is advancing rapidly, and commercially available systems can be afforded even by the academic user. There are even some large-scale industrial processes that rely on membrane filtration as a separation technique. For example, BASF uses this technique to separate a polymer-stabilized rhodium catalyst from impurities in a continuous hydroformylation process (Patent DE 19801437).

In the following chapters, different approaches to immobilization and phase separation of chiral catalysts are reviewed. The section on catalyst immobilization on inorganic supports contains a very useful and comprehensive table of all inorganic supports that have been used in enantioselective catalysis up to now. I really appreciated the amount of useful information summarized in this table, but unfortunately there are few tables of this kind in the book. At the same time the authors raise some important issues concerning catalyst recycling: for example, there are still groups who apparently do not re-use the supported catalyst. They also warn against some unsuitable approaches to immobilization, thus possibly saving time and effort for other groups working in this area in the future. The following chapter shows that crosslinked (insoluble) and non-crosslinked (soluble) organic polymers can also be used as catalyst recovery vehicles. It also demonstrates that the use of polymer-supported enantioselective catalysts is a rapidly growing field.

A chapter on immobilization of enzymes may seem surprising at first glance, but this area has really advanced fundamentally in the last decade. The emphasis is on technologies applicable to industry rather than on the latest developments in pure research. Cost reduction through genetic engineering and efficient recycling of the enzymes makes this technique feasible for the industrial production of fine chemicals. Also, a broad range of immobilized enzymes are now commercially available for academic laboratories, and this chapter will help in understanding the different kinds of carrier systems, separation techniques, and the operational stability of immobilized enzymes.

Apart from the shortcomings mentioned above, no major mistakes were noticed. Redundancy between the chapters has mainly been avoided. Only the topics of catalytic dihydroxylation and epoxidation are covered twice, in Chapters 3 and 10. In some parts of the book the artwork looks slightly antiquated, but the message is always clear.

The critical description and evaluation of immobilized chiral catalyts in this book will be of great help for chemists in industry and academia, and it should be available in every chemical library. It is also recommended to interested scientists working in the area of stereoselective catalysis.

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Biomineralization. From Biology to Biotechnology and Medical Application. Edited by *Edmund Baeuerlein*. Wiley-VCH, Weinheim 2000. xxii + 294 pp., hardcover DM 268.00 (ca. € 137).—ISBN 3-527-29987-4

Biomineralization is the process whereby living organisms produce inorganic solids (minerals) which they use. The extent to which such processes determine our environment is often not recognized: calcium phosphate keeps our bodies upright (through bones) and provides us with “tools” for dealing with our food (teeth); biologically generated calcium carbonate forms mountain ranges (made of calcareous algae and mollusc shells) and plays a role in our “balance” (in the form of minute crystals in the organ of the inner ear that controls balance). More than sixty different inorganic solids are known to occur in biological systems. A particularly fascinating aspect of biominerals is their esthetic appeal, as seen in the delicate structures of algal skeletons (e.g., of radiolaria, coccoliths, foraminifera, and diatoms), elaborate snail shells, and nacreous mother-of-pearl in mollusc shells, none of which have up to now been replicated by chemical synthesis.

The book reviewed here has a wide-embracing title, raising high expectations for a comprehensive treatment of the subject. Regrettably, that promise is not entirely fulfilled. About half of the book is devoted to iron oxide minerals, with the rest divided approximately equally between siliceous deposits and calcium carbonate. Calcium phosphates are not covered, and as these minerals are of particular interest for medical applications of biomineralization (e.g., for repairing bones or teeth), the last part of the subtitle, “Medical Application”, is hardly justified. The fact that the book only deals with unicellular organisms, and thus does not cover mineralization in higher life-forms, is only mentioned on the back cover.

Is that limitation a cause for criticism? I think not—it would probably be impossible to treat the whole subject fully, including all known biominerals, within 300 pages. This book is not a work of reference, but a collection of articles based on papers presented at a conference that took place in California in 1996. However, notwithstanding the date of the conference, it is pleasing to find that the literature coverage extends beyond 1996. The references include even some very recent publications, so that the book reflects the current state of knowledge.

The book contains 17 chapters dealing with various aspects of biomineralization. A short introduction to the subject is followed by Chapters 2–9, which are mainly concerned with iron oxide particles in magnetotactic bacteria. These organisms, which are widely distributed in aquatic environments, generate chains consisting of single crystals with a typical diameter of about 100 nm ("magnetosomes"), which serve for orientation in the earth's magnetic field. It is thought that the purpose is to control the depth of the bacteria in the water, so that they can remain in the zone with the most favorable oxygen concentration. Crystallographic, microbiological, and genetic aspects of the formation of iron minerals in magnetotactic bacteria are discussed in detail from various points of view. The possibility of using magnetosomes as transfer media for gene therapy is also discussed (thus partially justifying the subtitle "Medical Application").

As the individual chapters do not build upon each others' contents to any great extent, there is some repetition. For example, the first 140 pages contain many electron microscope images of aligned bacterial magnetosomes. Chapter 10, "A Grand Unified Theory of Biomineralization", summarizes the available research results on iron minerals and reaches some rather speculative conclusions. The evidence is claimed to show that terrestrial organisms have been using magnetosomes for 2 billion years. It is further speculated that some 4-billion-year-old inclusions found in a Mars meteorite are also of biological origin. Interestingly, crystals of the kind described above are also found in some higher organisms, for example in the tissues of salmon and of the human brain. Perhaps iron oxide has played a more important role in evolution than is generally assumed.

Chapters 11–14 are concerned with siliceous algae, especially diatoms. The main emphasis is on the transport and deposition of siliceous minerals by biological systems. Chapters 15–17 deal with calcium carbonate, including model systems for mother-of-pearl in molluscs and mineralization in calcareous algae (coccolithophores).

The study of biomineralization occupies a position between mineralogy (including crystallography and solid state chemistry) and biology (including genetics and biomedicine). The focus of this book lies more on the biological side than the inorganic side. Nevertheless, the authors have made an effort to present the subject in a way that is easier to understand, so that it is accessible to readers other than biochemists. The chapters are clearly arranged, well illustrated (even with some color figures), and written in a good style. The book has been produced to a high standard, something that one cannot always take for granted, even in very expensive books. Readers seeking information about the three biominerals treated in the book (Fe_3O_4, $SiO_2 \cdot H_2O$, $CaCO_3$) will find that the book provides a good way into the subject. It is essential for anyone who is concerned with iron oxide biominerals in particular.

One last comment: as E. Baeuerlein mentions in his preface, any book on this subject must be able to bear comparison with the classic work *On Biomineralization* (Lowenstam and Weiner, 1989). The authors have succeeded well in achieving that, in the treatments of iron oxide and siliceous minerals. I recommend the book to all researchers interested in biomineralization.

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