Preface

Modern research in biomineralization was first summarized in 1989 in the basic work "On Biomineralization" by two of the pioneers in the field, M. A. Lowenstam and S. Weiner. Parallel to this more biological review, its inorganic counterpart was published the same year "On Biomineralization: chemical and biochemical perspectives" by three pioneers of the chemical approach, S. Mann, J. Webb and R. P. R. William. These perspectives were highlighted in 2001 in "Biomineralization: Principles and Concepts in Bioinorganic Materials Chemistry" by its guiding chemical initiator Stephen Mann. It is obvious by these comprehensive volumes that biomineralization was dominated for about 20 years by excellent and extended structural and physiological research.

At the end of this period I had began to study magnetite crystal formation in bacteria. Parallel to progress in bacterial genetics the conviction was and is still growing on me that mechanisms in biomineralization will be predominantly elucidated by methods of molecular biology. The term "mechanism in biomineralization" is permanently discussed between chemists and biologists, whether the molecular process or the coupled process of transport, directed saturation and interaction of several organic compounds may be designated a mechanism.

A "Workshop on Biomineralization and Nanofabrication", organized by Richard B. Frankel in May 1996, inspired me to edit a multi-author volume on "Biomineralization. From Biology to Biotechnology and Medical Application" in November 2000. The aim of this edition was to compare structure formation of inorganic materials in those organisms that were expected to be analyzed most likely in the near future by genetics and molecular biology. At this time, prokaryotic and eukaryotic unicellular organisms, the magnetotactic bacteria and the mineralizing algae, coccolithophores and diatoms, were the prime candidates for these very biological approaches in biomineralization.

Almost complete genome sequences of 15 bacteria, including those of two magnetotactic bacteria, have been made available to the public domain surprisingly fast by the Joint Genome Institute (IGE) of the U.S. Department of Energy. These two genome sequences allowed studying magnetite nanocrystal formation at the genomic level. The human genome project was accomplished just before this work. In addition sequencing of the genome of the zebra fish, an important model organism for the human being, began in 2001 (and should be finished in 2005). Because of extended mutant analyses, I intended to introduce studies on mineral formation of this simple organism in this new edition, and at the beginning of this year I fortunately succeeded in finding two such reports.

This progress by modern biological methods was paralleled by extraordinary developments in modern physical methods, the highlight of which is cryo-electron tomography, elaborated by W. Baumeister. Research in biomineralization not only comes together with material science from the very edges of its biological and physical parts, but also directly in the recent, epoch-making publication by M. O. Stone and co workers on "Peptide Templates for Nanoparticle Synthesis derived from Polymerase Chain Reaction-Driven Phage Display".

I am very grateful to Professor Dieter Oesterhelt for the opportunity to stay as a guest in his department, an opportunity which remarkably facilitates my task as editor and author.

I thank very much to Professor Peter Behrens, the Organizer of the DFG-Priority Program "Principles of Biomineralization", for inviting me to several workshops of this very interdisciplinary project.

The various information encouraged me to select new topics for this new edition, among these are models of human biomineralization and modern physical methods.

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