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Preface

Applications of bioinorganic chemistry

Bioinorganic chemistry has progressed enormously over the past 20 years, yet the significance of its applications to human welfare and development has not been widely appreciated. It was in this context that the series of International Symposia on Applied Bioinorganic Chemistry was initiated. Wang Kui of Beijing Medical University, Beijing, China and John Webb of Murdoch University, Perth, Western Australia served as the joint Chairs of these meetings. The Symposia were set up to provide a current perspective on the science behind the established applications of bioinorganic chemistry and to stimulate developments that would lead to further applications.

The first Symposium was organized in 1989 at the Huazhong University of Science and Technology, Wuhan, China, with Xu Huibi of HUST heading up the local Committee. The second Symposium was held at Zhongshan University, Guangzhou, China with the local organization led by Ji Liangnian.

This special volume of Coordination Chemistry Reviews contains keynote lectures from the Third International Symposium on Applied Bioinorganic Chemistry (ISABC-3), held at Fremantle, Perth, Western Australia and Murdoch University in December 1994. The meeting was sponsored by the Australian Academy of Science, the Royal Australian Chemical Institute, the Commonwealth Department of Industry, Science and Technology, Australia, UNESCO, the Federation of Asian Chemical Societies and Murdoch University. Almost 100 participants attended, coming from 21 countries to present 94 papers that were roughly equally divided between oral and poster presentations. The group of participants is shown in the photograph.

The papers presented provide a contemporary overview of the considerable progress made in the applications of bioinorganic chemistry. Sadler and Berners-Price review the application of NMR spectroscopy to a wide range of metallodrugs to gain insights into their multiple biological targets. This theme continues with the paper by Wang Kui et al. on platinum drugs. Gielen presents some recent data on tin-based antitumour drugs and Sargeson reviews the potential for cage complexes in biology, including pharmaceutical and detergent uses. The complexity of the bioinorganic chemistry of wound healing processes is considered by Williams and St. Pierre et al. review studies of nanoscale iron oxides in the protein ferritin related to iron-overload diseases. Molecular studies of bacterial dioxygenases involved in bioremediation processes are presented by Bertini et al. and, finally, the development of bioelectrochemistry is reviewed by Hill.

In two round table discussions involving most of the Symposium participants, many opportunities and challenges for the applications of bioinorganic chemistry were identified. The interdisciplinary nature of these means that bioinorganic chemists will need to continue to work closely with biological, medical and industrial scientists.

Participants at the Third International Symposium on Applied Bioinorganic Chemistry, Fremantle, Perth, Australia, December 1994.

Drugs and diagnostics

Research in the area of platinum drugs, of which two are in clinical use, concerns persistent questions of drug resistance (especially in the case of ovarian cancer), toxicity, and the need for better targetting to the sites of actior. Other metal ions have been used in drug development, but much of the Periodic Table has not been touched. Traditional medicines from China and other countries can contain inorganic constituents as active components. Similarly, the inorganic fractions of natural resources, such as coral reef organisms and other tropical biota, have received almost no attention. Diagnostics, including those based on radiopharmaceuticals also offer promise, especially with a shorter lead time before use.

Environmental

Considerable opportunities exist here for bioinorganic chemistry, including aspects of metal recovery, speciation of biologically active inorganics, and bioremediation. There is a great need to avoid oversimplified analyses: thus, a proposal to precipitate excess phosphate in water bodies by the addition of iron(III) might fail to recognise that, in the anaerobic, reducing environment of lake sediments, this iron(III) can be reduced to iron(II) and bioavailability increased dramatically. Water chemistry of ecosystems, especially of their inorganic constituents, must of necessity involve bioinorganic chemistry. There are substantial opportunities for collaboration with biotechnologists here, as the power of bacteria is harnessed in environmental applications.

Agriculture and nutrition

Biotechnology is clearly critical here also. Already up to 40% of arable land in some countries is acidic and needs remediation. Rare earths are being used extensively in some agricultures in Asia, such as China and Vietnam, while research on trace metal nutrition in plants also requires the insights of bioinorganic chemistry. Problems of human nutrition persist: almost all persons over 60 years old will experience episodes of trace element deficiency. Supplementation regimes are not always straightforward: thus, for iron, food supplementation must take into account the incidence of the genetic condition known as hemochromatosis, where all iron in the diet is absorbed, leading readily to toxic iron overloading. Also the interdependence of elements needs careful consideration.

Materials science

Bioinorganic chemistry can provide inspiration for novel syntheses as well as new materials, especially those with particular desirable properties. The materials used in biology are often constructed from inorganic minerals (such as bones, shells, teeth and nanoscale particles) in association with organic polymers and enzymes. This approach, inspired by biology (and hence termed biognostic rather than biomimetic) holds much potential.

Networks for bioinorganic chemists continue to develop. In addition to the Inorganic Biochemistry Discussion Group (now based in Brussels, Belgium: Contact R.J. Ward, Unité de Biochemie, Catholique Universite de Louvain, 1348 Belgium), there is the Newsletter of the programme on Chemistry of Metals in Biological Systems of the European Science Foundation (Strasbourg) (Contact Prof. C.D. Garner, e-mail: esf-chem-metal-biol@manchester.ac.uk), the American Chemical Society's Bioinorganic WWW site maintained by S. Koch at SUNY Stony Brook, (e-mail: koch@sbchem.sunysb.edu; WWW site: http://sbchm1.sunysb.edu/koch/biic.html), a newly established Society of Bioinorganic Chemistry (Contact I. Bertini, e-mail: bertini@risc1.lrm.fi.cnr.it, or D. Garner, e-mail: dave.garner@manchester.ac.uk) and UNESCO's Asian Network for Analytical and Inorganic Chemistry (Contact J. Webb, e-mail: johnwebb@central.murdoch.edu.au).

Finally, the participants at the ISABC-3 meeting identified the pressing need for the bioinorganic community to be more forthcoming and involved in the public arena and in the wider community of scientists. Winners must be generously recognised! In this regard, it was fitting that at the Symposium H.A.O. Hill received the Royal Society of Chemistry's Robinson Medal for his work leading to the successful commercial development of the glucose sensor. We are delighted that his acceptance lecture is included in this special volume of Coordination Chemistry Reviews devoted to applications of bioinorganic chemistry.

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