



## Preface

## 4th Georgian Bay International Conference on Bioinorganic Chemistry



The 4th Georgian Bay International Conference on Bioinorganic Chemistry (also known as CanBIC) was held in the dockside Charles W. Stockey Centre, in Parry Sound, Ontario, Canada from 21st to 25th May, 2013. (Fig. 1) This small conference attracts a stellar array of international speakers and poster-presenters in a wide range of fields related to metals in biological roles. Nagao Kobayashi (Tohoku University, Sendai, Japan), C. Frank Shaw III (Illinois State University, Normal, Illinois, USA) and Martin Stillman (The University of Western Ontario, London, Ontario) were the international co-organizers, for the 1st, 2nd, and 3rd biennial conferences in 2007, 2009 and 2011, respectively. Eleven other colleagues joined them to serve as the CanBIC-4 International Organizing Committee. We welcomed newcomers Andrea Hartwig (Karlsruhe), Jake Pushie (Saskatchewan), Tim Storr and Charles Walsby (Simon Fraser), and Hongzhe Sun (Hong Kong), to join the original group of dedicated symposium coordinators, John Dawson (South Carolina), Ingrid Pickering and Graham George (Saskatchewan), James Kincaid (Marquette, Milwaukee), Angela Rosa (Università della Basilicata, Italy), and Stephen Ralph (Wollongong, Australia), truly an international group.

The Local Organizing Committee was: Martin Stillman – Chair; Maria Salgado – Finances; Gordon Irvine – Hall Manager; C. Frank Shaw III – Program, symposia; Tyler Pinter – Program book, scheduling; Kalen Swanick – Catering; Sharbari Lahiri – Abstract Editor; Michael Tiedemann – Transportation; Tyler Pinter & Gordon Irvine – Technical aspects; Jasjit Singh and Tom Stockman – Student participation; and David Stillman & Jessica Schulze – Georgian Bay Day.

CanBIC joins a select group of conferences focusing on the role of metals in biological systems. Metals are the key cofactors in 30% of all known proteins: for example, they are critical in muscle and synapse action and completely control respiration in all species. In short, metal-dependent biological chemistry is critical to all forms and phyla of life. The complexity of these systems and sometimes the inability to obtain single crystals has meant that studies are often very challenging. As is clear from the more than 90 talks and 34 posters at CanBIC and the results presented here, a wide range of skills – from designing *in vivo* experiments, studying the metal binding chemistry of metalloproteins, synthesizing model compounds, to using computational modeling *inter alia* – are all required; indeed, often all these skills are required to answer a single question. It is our belief that with the extraordinary

power of today's instruments, the technical aspects will no longer restrict research, and that our understanding of these complex systems is advancing rapidly. The need for specialist conferences and the availability of specialist publications to disseminate research results is of paramount importance for the overall development of this field. We are very thankful to the Editorial Board of the Journal of Inorganic Biochemistry for the privilege of publishing this special issue dedicated to papers derived from some of the invited CanBIC-4 talks.

We feel it valuable to consider some of the important aspects covered by both the conference and the papers included in this special issue. These papers reflect quite closely the overall flavor of the conference.

A major component of bioinorganic chemistry, well represented at CanBIC were studies of metal-binding proteins. Metallothionein is recognized as a major factor in the metabolism of the group 11 and 12 metals, and has been implicated in the metabolism of a number of other metals, including some or all of the metallodrugs discussed in this issue. Copper, in particular, still presents many questions when bound in proteins, and the answers require an array of sophisticated techniques to determine. For iron, though, the siderophores and heme-binding proteins control uptake in bacteria, but the oxidases control the release of the iron. Iron is, of course, paramount in heme proteins as the heme with a remarkable array of chemistries, representing part of the underlying requirements of bacterial life.

While the importance of porphyrins in biological systems is well known, perhaps it is not so well known that the functional properties are controlled, often dramatically so, by slight structural changes, such as modification of the periphery, degree of deformation, axial ligands, acidity and basicity of the ligand, and of course, the central metal. Synthetic porphyrins exploit this wonderfully controllable chemistry. For example, phthalocyanines, which are conventionally named as tetrabenzotetraazaporphyrins, were synthesized as byproducts of other reactions about a century ago and now more than 50,000 t per year are produced in the world, making it one of the most promising compounds for the 21st century. Variants of these porphyrins have been used as pigments and dyes for nearly 80 years, and have also been used as catalysts for the removal of sulfur from crude oil, and recently as charge-generation materials in xerography, in optical

read/write disks, as photodynamic reagents for cancer therapy, in deodorants, germicides and anti-bacterial reagents, and as growth promoting and retarding reagents in plants. Together these properties provide an exciting area to study and discuss at CanBIC, and to report in this issue.

We now turn to smaller molecules, specifically metallopharmaceuticals, which provide an almost infinite and relatively untapped source of potential new therapeutic agents. Modern methods of ligand design allow targeting to specific enzymes, receptors, transport mechanisms and cell types. Archaic, mid-20th century fears of metal toxicity have been disproven with the 80 year history of chrysotherapy for rheumatoid arthritis, the successful evolution of three generations of platinum anti-tumor agents, lithium therapy for bipolar disorder and the spectacular effectiveness of silver anti-bacterial agents. The renaissance of metallodrugs parallels our ever deeper appreciation of the subtle effects of metalloproteins, in which the coordination environments chosen by mother nature (the best inorganic chemist ever) modify many elements to serve a wide variety of structural and functional roles essential to all life forms. These uses – natural and man-made – require an understanding of the pharmacology and toxicology of essential, therapeutic and toxic metal ions and complexes.

Prof. Ed Solomon (Stanford, USA) gave the Plenary Lecture: "Geometric and electronic structure contributions to Cu/O<sub>2</sub> reactivity". 88 invited speakers contributed to the following nine symposia that ran over three very long days: "Advances in porphyrin chemistry" (chair: Nagao Kobayashi); "Pharmaceutical bioinorganic chemistry" (co-chairs: Tim Storr & Charles Walsby); "Metallothioneins" (chair: Frank Shaw) "Theoretical aspects of bioinorganic chemistry" (chair: Angela Rosa); "Applications of Raman spectroscopy to heme

proteins" (chair: James Kincaid); "Biological aspects of toxic of metals" (chair: Andrea Hartwig); "Heme proteins and analogues" (chair: John Dawson); "Instrumental probes of metal coordination binding sites" (chair: Stephen Ralph) and "Synchrotron spectroscopies in bioinorganic chemistry" (chairs: Graham George, Ingrid Pickering, and Jake Pushie). In addition, 34 posters were on display throughout the conference with a dedicated session on the 2nd night. The presenters included undergraduate and graduate students, and post-doctoral fellows whose posters and perspectives greatly enriched the conference.

The 140 participants came from over 15 countries as far-afeld as Australia, China, Hong Kong, and Japan, as well as most countries in Europe, and of course, across Canada and the USA (Fig. 1). One of the attractions of CanBIC is the remarkable environment – the scenery and rugged vistas of Georgian Bay, Fig. 2.

The International organizing Committee came from many countries and are the backbone of CanBIC. We, the organizers than them for their dedication to CanBIC, Fig. 3 (photo is unfortunately missing Frank Shaw, Angela Rosa, Andrea Hartwig, James Kincaid, and Stephen Ralph). The complete list of 2013 symposia speakers and poster presenters are listed on the CanBIC website, [www.canbic.ca](http://www.canbic.ca) (go to "2013 conference" and select "Programs & Abstracts"). The Georgian Bay venue facilitated scientific discussions that began with the first participants arriving on the "CanBIC Bus" from Toronto Airport and continued daily from 7:30 am and, long after the last bus back to the hotels at 10 pm (Fig. 3).

The Charles W. Stockey Centre for the Performing Arts, was designed for the world-renowned *Festival of the Sound*, which presents chamber and classical music from mid-July to mid-August each year. The Centre advertises itself as a venue "where nature, culture, sports and entertainment meet". To this list we must now add "science", because of the



Fig. 1. The participants in CanBIC-4 came from Asia, Europe, Australia, the USA and Canada.

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