



5th Georgian Bay International Conference on Bioinorganic Chemistry



The 5th 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 19th – 23rd May, 2015. 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, Illinois, USA), John Dawson (South Carolina, USA) and Martin Stillman (The University of Western Ontario, Canada) were the international co-organizers.

Nine other colleagues joined them to serve as the CanBIC-5 International Organizing Committee: Zhifeng Ding (University of Western Ontario, Canada), Andrea Hartwig (Karlsruhe Institute for Technology, Karlsruhe, Germany), Tim Storr (Simon Fraser, Vancouver, Canada), Charles Walsby (Simon Fraser, Vancouver, Canada), James Kincaid (Marquette, Milwaukee, USA), David Petering (Wisconsin-Milwaukee, USA), Angela Rosa (Universita della Basilicata, Italy), Sam de Visser (University of Manchester, Manchester, UK) and Stephen Ralph (University of Wollongong, New South Wales, Australia). The organizers span the globe and make CanBIC a truly international meeting by bringing together the top researchers in their respective specialties worldwide to this small town in northern Ontario to enjoy the rugged environment of the magnificent granite Canadian Shield, the remarkable Stockey Centre, world-class musical interludes, and wonderful science.

The Local Organizing Committee was: Martin Stillman - Chair; Daisy Wong - Finances; Gordon Irvine - Hall Manager & Transportation; C. Frank Shaw III - Programme - Symposia; Tyler Pinter - Programme Book - Symposium Scheduling; Zhifeng Ding - Student Symposium; Amy Tapley & Michelle Li - Catering; Sharbari Lahiri - Abstract Editor; Dan Vacarello - Technical aspects; Matthew Turnbull - Volunteer Student Participation; David Stillman & Jessica Schultze - Georgian Bay Day.

CanBIC joins a select group of conferences focusing on the role of metals in biological systems. Indeed, the organizers feel that CanBIC has become a fixture in the “BIC” conference series, the bioinorganic conference group, joining the International Conference (ICBIC), EuroBIC, AsBIC and recently V Latin American Meeting on Biological Inorganic Chemistry (V LABIC), and as well the numerous flavors of Gordon Conferences that are available throughout the year. The 5th CanBIC Conference in 2015, follows the 1st, 2nd, 3rd and 4th biennial conferences held in 2007, 2009, 2011 and 2013, respectively, all in the lovely small, lake-side town of Parry Sound, Ontario.

Metals are the key cofactors in more than 30% of known proteins: for example, they are critical in muscle and synapse action and completely control respiration in all species. Metal-dependent biological chemistry is critical to all forms and phyla of life. The complexity of these systems, and often an inability to obtain single crystals, has meant that structural and mechanistic studies are often very challenging. As is clear from the

more than 95 talks and 40 posters at CanBIC-5 and the results presented here as full papers, 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 each one of these skills is required to answer a single question. The need for specialist bioinorganic chemistry conferences and the availability of specialist publications to disseminate the research results is of paramount importance for the overall development and expansion 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 a selection of the invited CanBIC-5 talks.

A major component of bioinorganic chemistry, well represented at CanBIC, are 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, 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 its 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 reaction about a century ago and now more than 50,000 tons a year are produced in the world, and in particular in Japan, making it one of the most promising compounds for the 21st century. Variants of these porphyrins have been used as pigments and dyestuffs for nearly 80 years since the first reports in 1927, significantly including the Scottish Dyes Ltd. company, 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 discs, as photodynamic reagents for cancer therapy, in deodorants, germicides and antibacterial 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.

Turning now 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



Fig. 1.

and cell types. Mid-20th Century fears of metal toxicity from allmetal-based therapeutic agents 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.

Finally, theoretical methods are needed to underpin and interpret the biological properties and point the way to develop synthetic analogs.

As is the custom in CanBICs, there was one key lecture, the Plenary Lecture. Prof. Harry Gray (California Institute of Technology, USA) gave the Plenary Lecture: "The currents of Life: Electron flow through proteins". Previous Plenary Lectures were given by:

David Dolphin (UBC) "Models and mimics of the cytochromes P450 - an historical perspective", Peter Sadler (Warwick) "Coordination chemistry for the design of new medicines", Yoshiaki Kobuke (Kyoto)

"Mimics of bacterial photosynthesis by use of complementary coordination", and for CanBIC-4 in 2013 Ed Solomon (Stanford) "Geometric and electronic structure contributions to Cu/O₂ reactivity".

Fig. 1. Harry Gray (Caltech) gave the Plenary Lecture.

Over 95 invited speakers contributed to the following symposia that ran over three very long days: "Advances in porphyrin chemistry" (chair: Nagao Kobayashi); "Pharmaceutical bioinorganic chemistry" (co-chairs: Tim Storr & Charles Walsby); "Essential biological metals" (co-chairs: David Petering & C. Frank Shaw); "Theoretical aspects of bioinorganic chemistry" (co-chairs: Angela Rosa and Sam de Visser); "Applications of resonance 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); "Bioinorganic environmental chemistry" (chair: C. Frank Shaw), and a special "Studentsymposium" (chair: Zhifeng Ding). In addition, 42 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 160 participants came from over 15 countries as far-afiel as Australia, China, Hong Kong, and Japan, as well as most countries in Europe, and of course, across Canada and the US.

Fig. 2. Harry Gray, with John Dawson and Nagao Kobayashi.

Fig. 3. The participants in CanBIC-5 came from Asia, Europe, Australia, the USA and Canada.

Fig. 4. The wonderful environment of Georgian Bay.

Fig. 5. (From top, left to right) Katie Stillman, Miao Miao Yu, Megan Tam, Katie Stillman & Miao Miao Yu, Katie Stillman and Miao Miao Yu and Megan Tam. Music at CanBIC.

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 excellent environment for both formal lectures, and for informal scientific discussions in the foyer and on the patio. For CanBIC-5, we continued with "Music at CanBIC", two short evening recitals open to the public, taking advantage of the world-class acoustics of the main hall in the Centre. We were delighted that Ms. Katie Stillman (violin), Ms. Megan Tam (viola), and Ms. Miao Miao Yu (piano) were able to perform again at CanBIC - they started with a formal program of selections for violin, viola, and piano, followed on the second evening by a lighter 1920's soiree program.

We sincerely thank the management and staff of the Charles W. Stockey Centre for the Performing Arts and Bobby Orr Hall of Fame,



Fig. 2.

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