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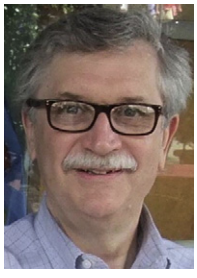
Preface

Metals in bioenergetics and biomimetics systems

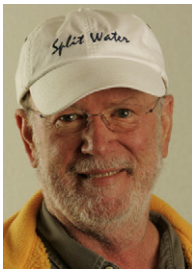
Enzymes involved in bioenergetic processes must obey a set of principles common to catalysis in general. Yet, compared with human-designed devices, they carry out a wide variety of reactions with unequaled catalytic efficiencies and proficiencies. Identifying those principles and applying them to the design of biomimetic constructs have the potential to transform energy use efficiency in technology as practiced today. Metals are often involved as cofactors in enzymes. Understanding how they contribute to catalysis is essential for designing bio-biomimetic devices that are soon expected to reach, and in some cases exceed, the catalytic activity of enzymes. Indeed, the benchmarks for catalysts employed in human technology are different from those that mark success under nature's selection pressure.

Even though these basic statements are likely to be commonly agreed upon, expertise in biological catalysis and expertise in biomimetic approaches are rarely brought together in an all-embracing opus. We feel that the time is right for a special volume that highlights the basic principles behind these two approaches. We also feel that such a volume would foster a fruitful dialog between the two overlapping scientific fields. Additionally, because the nascent field of synthetic biology offers the opportunity to design and produce catalysts that address benchmarks relevant to our technology, the principles that arise from the intersection of biological and bio-inspired catalysis will be important to those scientists as well. Surpassing constraints imposed by natural selection pressures using the techniques of synthetic biology could bring a new era to catalyst design — to paraphrase Feynman, "There is plenty of room in biology."

The aim of this volume was not only to identify the mechanistic principles and rules that govern a particular enzyme or a device but also to identify the roadblocks and the challenges that remain to be overcome. We have thus encouraged the authors to go beyond a mere review of the current knowledge and provide provocative and stimulating ideas or hypotheses. We hope that the readers will share our appreciation that this goal has been achieved.



John H. Golbeck is Professor of Biochemistry, Biophysics, and Chemistry at The Pennsylvania State University. John earned his B.S. in Chemistry from Valparaiso University in 1971 and his Ph.D. in Biological Chemistry from Indiana University in 1976. After working for 8 years as an industrial scientist at Martin Marietta Laboratories, he resumed his academic career first at Portland State University, then in the University of Nebraska, and most recently at The Pennsylvania State University. Dr. Golbeck's research interests focus on the assembly, structure, function, and modification of Type I photosynthetic reaction centers. His immediate research interests involve the protein and environmental factors that confer thermodynamic properties such as redox potentials to organic and inorganic cofactors and the structural composition of Type I reaction centers from anaerobic photosynthetic bacteria, particularly heliobacteria. His long-term goal lies in engineering biohybrid photosynthetic constructs that directly produce hydrogen or reduce CO_2. Dr. Golbeck is a member of the American Biophysical Society and currently serves as Treasurer for the International Society of Photosynthesis Research.



Thomas A. Moore is a Regents' Professor in the Department of Chemistry and Biochemistry at Arizona State University where he is the Director of the Center for Bioenergy and Photosynthesis, Distinguished Sustainability Scientist, GIOS, and a team leader in the DOE Energy Frontiers Research Center, "Center for Bio-Inspired Solar Fuel Production" at ASU. Professor Moore worked under the direction of Professor Pill-Soon Song for the Ph.D. degree from Texas Tech University. He served as President of the American Society for Photobiology in 2004 and received the Senior Research Award from the Society in 2001. Over the period 2005–2007, Professor Moore was awarded a Chaire Internationale de Recherche Blaise Pascal, Région d'Ile de France. He has been awarded a visiting professorship at Vrije Universiteit, Amsterdam, for 2011 and 2012. He has served on several Department of Energy Basic Research Needs Workshops including the DOE Basic Energy Sciences Grand Challenges Committee which produced "*Directing Matter and Energy*: *Five Challenges for Science and the Imagination*," outlining research priorities for the foreseeable future. Professor Moore and his long-time colleagues, Professors Ana Moore and Devens Gust, collaborate on research in artificial photosynthesis which is aimed at providing a deeper understanding of the fundamental principles involved in solar-to-fuel energy conversion and thereby the knowledge base necessary for sustainable energy conversion for human use. Their work addresses the design, synthesis and assembly of bio-inspired constructs for solar energy conversion and the design principles for artificial systems to be realized through the techniques of synthetic biology.

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Fabrice Rappaport is a Research director at the CNRS. He graduated in Biophysics from the Pierre et Marie Curie University and from the Ecole Normale Superieure in Paris. He joined Jerome Lavergne's group in Pierre Joliot's lab and obtained his PhD, in 1994, for his work on the release of proton associated with the turnover of the water splitting enzyme in Photosystem II. He then moved to Imperial College, London, to work, as a postdoctoral fellow, with David Klug and James Barber. In 1997, he was appointed by the CNRS and moved back to Paris and the Institut de Biologie Physcio-Chimique held, at this time, by Pierre Joliot and now by Francis-Andre Wollman. There, his research aims at understanding the function of the main complexes of the photosynthetic chain with an emphasis on the thermodynamics and kinetics aspects. He recently expanded his studies to mitochondria and the respiratory chain. He stood as board member of the French Society for Photosynthesis.

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