

# Preface

Why study cytochrome complexes? An answer is provided by the range of subtopics in the book, “evolution, structures, energy, and signaling,” which are described in the book title. Studies on the cytochrome family of proteins encompass a uniquely wide area of basic and applied research. Research in this field utilizes a range of theoretical and computational approaches, as well as a broad cross section of experimental techniques. Understanding obtained on the structure and function of the cytochromes and cytochrome complexes utilizes an extraordinary range of experimental approaches, including computational biology, genetics, macromolecular biochemistry, molecular biology, physics of charge transfer reactions, structure analysis using x-ray and electron diffraction, and ultrafast spectroscopy.

As reflected in the book title, the information and understanding gained in the field has an influence on a wide range of subjects, including evolution, mechanisms of membrane-based respiratory and photosynthetic energy transduction, theory of charge transfer in proteins, structure-function of large hetero-oligomeric membrane proteins, including lipid-protein interactions, and transmembrane signaling.

A special aspect of cytochromes, cytochrome complexes, as well as other proteins involved in bioenergetics and charge transfer is that they allow function to be quantitatively analyzed. Thus, in this group of proteins, it is possible to determine that a protein or protein complex is functional before committing a large amount of time to crystallization and analysis of structure. Dating back to the 1988 Nobel Prize in Chemistry, given to J. Deisenhofer, H. Michel, and R. Huber for determination of the crystal structure of the bacterial photosynthetic reaction center, the majesty of the crystal structures of hetero-

oligomeric membrane proteins obtained in the subsequent 10 years were of energy-transducing proteins. Of these, a substantial fraction involved cytochrome complexes.

*The Logic of the Collection* The book starts with an Introduction by Derek Bendall describing cytochrome notation, which is connected to the history of the field, focusing on research in England in the pre-World War II era. An *ab initio* “start with the beginning” logic then leads to a discussion of the evolution of cytochromes and hemes. Before presentation of the many individual cytochrome systems, the fundamentals of the theory of electron transfer in proteins are presented, followed by an extensive description of the molecular structures of cytochromes and cytochrome complexes from eukaryotic and prokaryotic sources, including those derived from photosynthetic reaction centers. The presentation of atomic structure information has a major role in these discussions, including the relatively new subject of “supercomplexes.” This structure information has a major niche in the broad field of membrane structure-function. Expanding the perspective beyond structure-function applied to charge transfer and energy storage, the problems of protein and macromolecule assembly, regulation, and signaling, including transmembrane signaling, which have conceptual connections to central areas of biochemistry, biophysics, and cell biology, are considered. Regarding subjects related to cutting-edge areas of biology and plant biology, the up-to-date presentation of the topics of *Regulation* and *Signaling* is noted here.

The broad extent of fundamental intellectual and research areas that are represented in this book makes it a useful resource for teaching of academic courses and presentation of seminars on fundamental and

broad aspects of biological energy transduction to advanced undergraduates and graduate students with interests in biology, biochemistry, biological engineering, chemistry, and biophysics.

As a last entry to the Introduction to this book, we note, sadly, the passing of Derek S. Bendall and Bernard L. Trumpower, whose achievements in this field are substantial and of fundamental importance. The Remembrances in this volume that are dedicated to them are of historical importance and note their many contributions to the subjects discussed herein.

**March 15, 2016**

**William A. Cramer**

Department of Biological Sciences  
Hockmeyer Building of Structural Biology  
Purdue University  
West Lafayette, IN 47917, USA  
[waclab@purdue.edu](mailto:waclab@purdue.edu)

**Toivo Kallas**

Department of Biology  
Halsey Science Center  
University of Wisconsin-Oshkosh  
Oshkosh, WI 54901, USA  
[kallas@uwosh.edu](mailto:kallas@uwosh.edu)

Cytochrome Complexes: Evolution, Structures, Energy  
Transduction, and Signaling

Cramer, W.A.; Kallas, T. (Eds.)

2016, XLV, 739 p. 178 illus., 138 illus. in color.,

Hardcover

ISBN: 978-94-017-7479-6