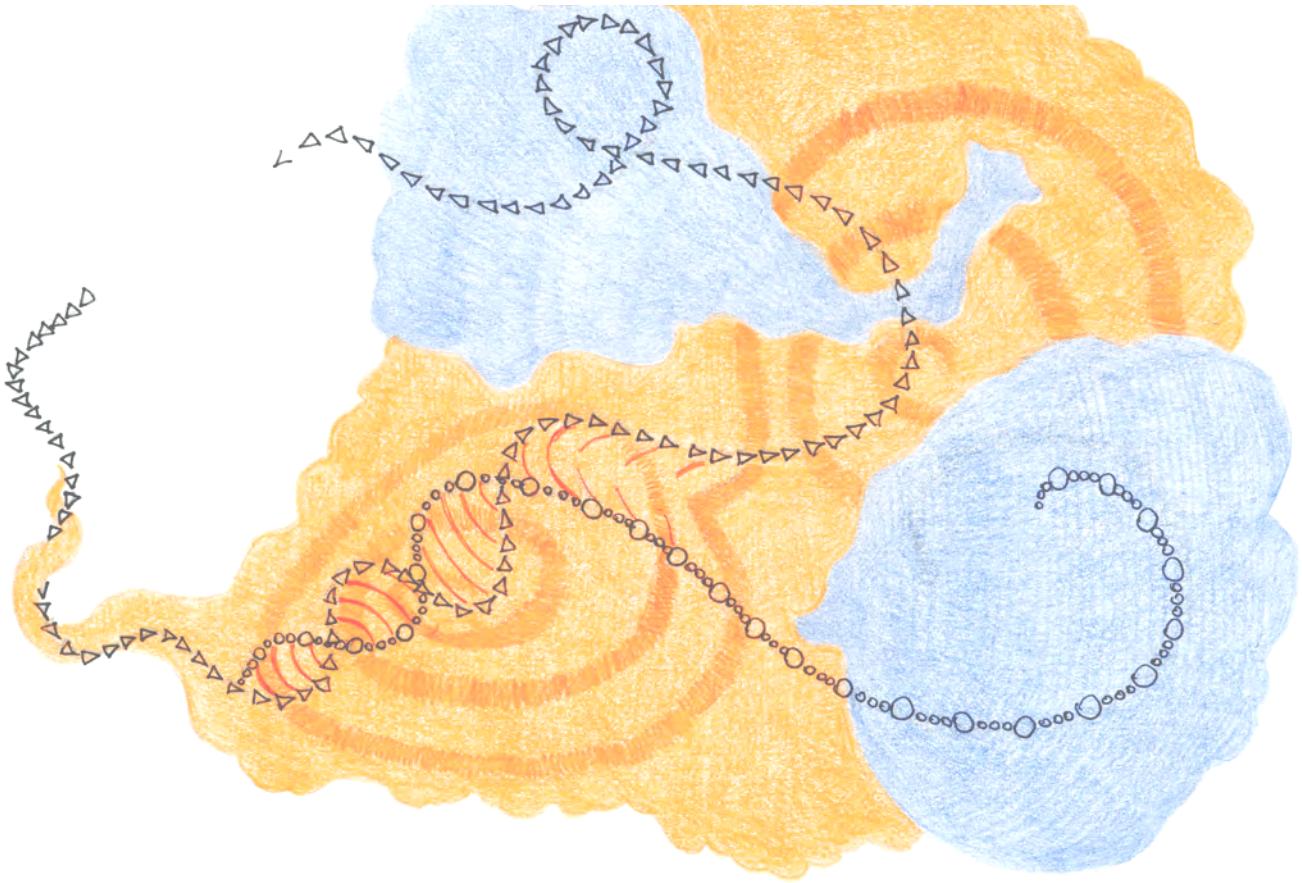
24th Annual Gibbs Conference on Biothermodynamics

September 25-28, 2010



Organizers

Elisar Barbar and Vince LiCata

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Table of contents

Cover figure: Abstract depiction of the allosteric enzyme RecBC helicase (RecB-orange; RecC-blue) during unwinding and translocation along DNA. (Illustration by Lydia O'Neal, courtesy of Tim Lohman)

The Gibbs Conference on Biothermodynamics

History and past meetings

Fall, 1986	1st discussion of the discipline, Thermodynamics in Biological Systems. Vail, CO. Gary Ackers, Wayne Bolen, Ernesto Freire, Stan Gill, Jim Lee
Feb, 1987	2nd discussion of the discipline, Thermodynamics in Biological Systems. New Orleans, LA. Gary Ackers, Norma Allewell, Wayne Bolen, Ken Breslauer, Ken Dill, Ernesto Freire, Stan Gill, Jim Lee
1987	Organizers: Jim Lee and Wayne Bolen, Keynote: Ken Dill
1988	Gary Ackers and Michael Johnson
1989	Organizers: Susan G. Frasier and Michael Johnson
1990	Organizers: Michael Johnson and Marty Straume
1991	Organizers: Gary Ackers and Tim Lohman. Keynote: Ernesto Freire
1992	Organizers: Jim Lee and Tomasz Heyduk. Keynotes: Serge Timasheff and John Schellman
1993	Organizers: Maurice Eftink and Glen Ramsay. Keynotes: Peter von Hippel and Julian Sturtevant
1994	Organizers: Enrico Di Cera and Madeline Shea. Keynotes: Gary Ackers and Kathleen S. Matthews
1995	Organizers: Kenneth P. Murphy and Michael D. Brenowitz. Keynotes: Victor Bloomfield and Mario Amzel
1996	Organizers: Jonathan B. Chaires and Michael L. Doyle. Keynotes: J. Michael Schurr and Allen Minton
1997	Organizers: Dorothy Beckett and Jack Correia. Keynote: Adrian Parsegian
1998	Organizer: Andy Robertson. Keynote: David Draper
1999	Organizers: Bertrand Garcia-Moreno and John Shriver. Keynotes: Wayne Bolen and Gary Ackers
2000	Organizers: George Turner and Kim Sharp. Keynote: Steve White
2001	Organizers: Margaret A. Daugherty and Luis A. Marky. Keynote: George Rose
2002	Organizers: Michael Mossing and George Makhatadze. Keynote: Rodney Biltonen
2003	Organizers: Vince Hilser and Dick Sheardy. Keynote: Jim Lee
2004	Organizers: Doug Barrick and Kathleen Hall. Keynote: Nacho Tinoco
2005	Organizers: Trevor Creamer and Clay Clark. Keynote: Carl Frieden
2006	Organizers: Karen Fleming and Rohit Pappu. Keynotes: Madeline A. Shea and Timothy Lohman
2007	Organizers: Brian M. Baker and Michael T. Henzl. Keynote: Jamie Williamson
2008	Organizers: Jannette Carey and David Bain. Keynotes: Dorothy Beckett and Ken Dill
2009	Organizers: Nathan Baker and Liskin Swint-Kruse. Keynote: Linda Jen-Jacobson, The Gary K. Ackers Lecture in Biothermodynamics: Michael Brenowitz
2010	Organizers: Elisar Barbar and Vince LiCata. Keynote: C. Nick Pace, The Gary K. Ackers Lecture in Biothermodynamics: Timothy Lohman

Incorporation and further reading

In 2002, the Gibbs Conference on Biothermodynamics incorporated as a mechanism of preserving the philosophy and spirit of the meeting. For a published 10-year history, see: Ackers GK, Bolen DW. The Gibbs Conference on Biothermodynamics: origins and evolution. *Biophys Chem*, **64** (1-3), 3-5,1997. doi:10.1016/S0301-4622(96)02246-6

Officers

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Past Presidents

2001-2002	Gary Ackers
2002-2003	Jack Correia
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2004-2005	Madeline Shea
2005-2006	Dorothy Beckett
2006-2007	Jonathan Chaires
2007-2008	Tim Lohman
2008-2009	Luis Marky

Gary K. Ackers Lecture in Biological Thermodynamics

2010 Lecturer – Timothy Lohman, Washington University in St Louis

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This lecture honors the scientific contributions of Gary K. Ackers to the field of Biological Thermodynamics. Gary is a Professor Emeritus of the Washington University School of Medicine, and Fellow of the Biophysical Society.

Gary has demonstrated a lifelong commitment to the growth and development of an intellectual community of scholars devoted to furthering the field of biothermodynamics. Gary has been an active member of the Biophysical Society throughout his career and has served as President of the Society, as well as Organizer of the annual meeting. While on the faculty of the University of Virginia, he was a leader in the graduate biophysics training program. When on the faculty in the Department of Biology at the Johns Hopkins University, he conceived and organized the *Institute for Biophysical Studies of Macromolecular Assemblies*, a university-wide training program in molecular biophysics that has continued for decades. While at Johns Hopkins, he also played a leading role in the establishment of the Gibbs Conference on Biothermodynamics, an annual meeting organized to promote innovative development of biophysical principles applied to current problems in biology and to train the next generation of molecular biophysicists to tackle hard problems rigorously. After moving to St. Louis to chair the Department of Biochemistry and Molecular Biophysics at Washington University, he spearheaded a new graduate program in biophysics and hired many faculty who have joined the community of regular contributors to the Gibbs Conference.

Gary was a pioneer in the development of methods and application of principles of equilibrium thermodynamics to the study of linkage in complex macromolecular assemblies. Studies from his laboratory on the energetics of self-association and ligand binding in human hemoglobin proved unequivocally that the classic and elegant MWC model of intersubunit allostery was insufficient to explain cooperative oxygen binding: the position, as well as the number, of ligands matters. His contributions in this area greatly enhanced our understanding of the relationship between structure, energy and function in hemoglobin, and in multimeric allosteric systems in general. By probing ever more deeply into the molecular mechanism of cooperativity, he demonstrated a beautiful, useful, and general strategy for dissecting functional energetics in macromolecular assemblies.

His quantitative study of the interactions between proteins and nucleic acids in the bacteriophage lambda system included the development of quantitative DNase footprinting methods for measuring free energies of repressor-operator interactions. The footprinting assay remains an effective tool for measuring the extremely tight binding constants that are often encountered in site-specific interactions between proteins and nucleic acids. Those studies paved the way for similar methods to study protein-nucleic acid interactions in more complex systems, including time-resolved studies of the kinetics of RNA folding. Based on his experimental studies of phage lambda, his group developed statistical thermodynamic models to simulate the lysogenic-to-lytic growth switch: the series of macromolecular events that determine the fate of bacteriophage lambda during infection of E. Coli. This work demonstrated how a complex biological function could be predicted quantitatively, strictly from the kinetics of transcription and translation, and the Gibbs free energy of interactions between the key macromolecular components in the genetic switch.

During Gary's early career, he developed methods to measure association constants in self-associating systems based on analytical gel permeation chromatography. Those methods have since become standard tools in the field. His group was also responsible for modifications of the cryo-gel electrophoresis methods, moving from applying them to hemoglobin to protein-DNA interactions. These contributions focused on developing the capacity to quantify intermediate states that are only transiently populated during the course of a biochemical process. His more than 200 articles and chapters changed our view of the molecular mechanisms that govern complex biochemical reactions.

Meeting schedule

Saturday, September 25

4:00 – 10:00 pm Check-in at Little Grassy Lodge
7:00 –10:00 pm Reception in Indian Room. Light refreshments/drinks
9:30 – 11:00 pm Science Film Fest (a program of short, independent science films), Little Grassy Lodge

Sunday, September 26

8:30 am Welcome: Bertrand Garcia-Moreno, Gibbs Society President
8:35 am Administrivia: Elisar Barbar and Vince LiCata

Macromolecular Interactions

Moderator: Brian Doctrow, Garcia-Moreno lab, Johns Hopkins University
8:40 Introduction to The Gary K. Ackers Lecture in Biothermodynamics: Dorothy Beckett, University of Maryland, College Park

8:50 – 9:50 The Gary K. Ackers Lecture in Biothermodynamics: **Mechanisms of DNA Binding, Translocation and Unwinding by *E. coli* RecBCD and RecBC Helicases**
Timothy M. Lohman, Washington University School of Medicine

9:50 – 10:10 **The Origin for Distinct Ligand Specificity in Homologous PDZ Domains from the Tiam-family of Nucleotide Exchange Factors**
Tyson R. Shepherd, Fuentes lab, University of Iowa

10:10 – 10:30 Break

10:30 – 10:50 **Light Chain-dependent Self-association of Dynein Intermediate Chain**
Afua Nyarko, Barbar lab, Oregon State University

10:50 – 11:30 **Structural and Functional Studies of the *E. coli* ClpA Molecular Motor**
Aaron L. Lucius, University of Alabama at Birmingham

11:30 – 12:10 **Structure-thermodynamic Correlations as a Tool for Understanding Biomolecular Interactions and an Aid to Drug Design.**
John E. Ladbury, MD Anderson Cancer Center

12:10 Group photo and lunch

Outreach Workshop I

Moderator: Elisar Barbar, Oregon State University
2:00 – 2:50 Biophysics, Biothermodynamics, and Undergraduate Education

Univ. of Iowa FUTURE in Biomedicine Program Fostering Undergraduate Talent - Uniting Research and Education
Madeline A. Shea, University of Iowa

Bringing Inquiry-Based Projects into the Biochemistry Lab and the Development of an Online Community Resource to Aid Their Development and Transferability
James R. Horn, Northern Illinois University

Physical Biochemistry Laboratory: A Template for a Capstone Course using Biothermodynamics
Jacob W. Gauer, Hinderliter lab, University of Minnesota Duluth

Modeling and Computational Biophysics

Moderator: Stephanie Geiser, Lee lab, Southern Illinois University

3:00 – 3:40 **Towards understanding the design principles underlying the recognition of NEF by the Hsp70 ATPase Domain: Intrinsic Dynamics and Sequence Evolution**
Ivet Bahar, University of Pittsburgh

3:40 – 4:00 **Molecular Dynamics and Enzyme Kinetics of Catalytic Activity in a Carboxylesterase**
Xiaozhen Yu, Wadkins lab, University of Mississippi

4:00 – 4:20 **Developing Solutes (Urea, KGlutamate, Glycine Betaine, TFE) as Quantitative Probes of Protein and DNA Processes**
Emily J. Guinn, Record lab, University of Wisconsin

4:20 – 4:40 Break

4:40 – 5:20 **Theory of Free Energy and Entropy in Noncovalent Binding**
Huan-Xiang Zhou, Florida State University

5:20 – 6:00 *Flash talks*
The ATPase Cycle of the RNA Helicase Protein NS3 from Hepatitis C Virus
Michael Bradley De La Cruz lab, Yale University
Partitioning of the 3'-Primer Terminus of pt-DNA Between the Polymerization and Proofreading Sites of Klenow Polymerase
Hiromi S. Brown,Vince J. LiCata lab, Louisiana State University
Probing Conformational Dynamics of Polyubiquitin Chains
Carlos A. Castañeda, Fushman lab, University of Maryland, College Park
Endogenous Inhibitors of Calcineurin
Tori B. Dunlap,Creamer lab University of Kentucky
Coupling of Endonuclease and Translocase Functions in Type I Restriction-modification Enzymes
Morteza Khabiri, Carey and Ettrich lab. Princeton University and Czech Academy of Sciences
Single Molecule Analysis of Yeast Rrp44 Exonuclease Reveals a Spring-loaded Mechanism of RNA Unwinding
Gwangrog Lee, Ha lab,University of Illinois at Urbana-Champaign

6:00 Dinner

8:00 Poster Session I: Presenters with last name starting from A to I

Monday, September 27

9:00 am Administrivia: Elisar Barbar and Vince LiCata

Folding and Disorder

Moderator: Daniel Lyons, Correia lab, University of Mississippi Medical Center

9:02 – 9:10 Keynote Introduction: Doug Barrick, Johns Hopkins University

9:10 – 10:10 Gibbs Conference Keynote Address: **Urea Denatured State Ensembles Contain Extensive Secondary Structure that is Increased in Hydrophobic Proteins**
Nick Pace, Texas A&M University.

10:10 – 10:30 **Osmolyte Impact on Water Structure: a Mechanism Controlling Peptide Folding**
Regina Politi, Harries lab, The Hebrew University

10:30 – 10:50 Break

10:50 – 11:10 **Unfolding Thermodynamics of DNA Hairpins Containing Internal Loops**
Iztok Prislan, Marky lab, University of Nebraska Medical Center

11:10 – 11:30 **The Molecular and Functional Origins of Picomolar Binding Affinity of an Intrinsically Disordered Protein Domain**
Igor Drobnak, Lah lab, University of Ljubljana, Slovenia

11:30 – 12:10 **α-Synuclein: Probing the Conformations of a Polymorphic Membrane-binding Protein**
Elizabeth Rhoades, Yale University

12:10 Lunch and business meeting

Monday PM Outreach Workshop II

Moderator: Vince LiCata, Louisiana State University

2:00 – 2:50 Biophysics, Biothermodynamics, and Public Outreach

Bringing Science to the Layperson
Liskin Swint-Kruse, The University of Kansas Medical Center

Outreach Through Summer Research Programs for Local High School Students
Gabriela C. Pérez-Alvarado, Southern Illinois University

Short, Dynamic Video Profiles of Scientists Designed for General Audiences
Vince J. LiCata, Louisiana State University

Structure and Thermodynamics

Moderator: Nicola Pozzi, DiCera lab, Doisy Research Center, SLU

3:00 – 3:40 **Side-Chain Dynamics in PDZ Domain Structure and Function**
Andrew L. Lee, University of North Carolina at Chapel Hill

3:40 – 4:00 **Structural and Thermodynamic Insights into Pitx2 Homeodomain - DNA Interactions**
Thomas Doerdelmann, Rance lab, University of Cincinnati

4:00 – 4:20 **The Biophysics of Permissive Mutations in the Evolution of an Allosteric Protein**

Michael J. Harms, Thornton lab, University of Oregon

4:20 – 4:40 Break

4:40 – 5:20 **Nanometer Propagation of Millisecond Motions in V-type Allostery**
Patrick Loria, Yale University

5:20 – 6:00 *Flash talks*
An Allosteric Network of Interactions in Caspase-3 Provides a Novel Strategy for Inhibitor Design
Sarah H. MacKenzie, Clark lab, North Carolina State University
Thermodynamic Dissection of Human Estrogen Receptor α Assembly at a Complex Promoter Sequence
Amie D. Moody, David Bain lab, University of Colorado, Denver, Anschutz Medical Campus
Probing the Energetic Basis for T-cell Recognition
Kurt H. Piepenbrink, Baker lab, University of Notre Dame
Differences in D2O and H2O Changes Ligand Saturating Conditions
Charulata B. Prasannan, Fenton lab, The University of Kansas Medical Center
Drosophila SNF Protein and its RNA Binding Preferences
Sandra G. Williams, Hall lab, Washington University, St Louis
Linkage Equilibrium Analysis of SecA Dimerization
Andy J. Wowor, Cole lab, University of Connecticut

6:00 Dinner

8:00 Poster Session II; Presenters with last name starting with J to Z

Tuesday September 28

9:00 – 9:05 am Administrivia: Elisar Barbar and Vince LiCata

Membrane Proteins

Moderator: Sharrol Bachas, Wade lab, Johns Hopkins University School of Medicine

9:05 – 9:45 **A Dynamic Model of Activation of Membrane-Bound Phospholipase Cbeta2 by Gbeta-gamma Subunits**
Suzanne Scarlata, Stony Brook University

9:45 – 10:05 **Characterization of the VirG/IcsA Autotransporter from Yersinia pestis**
Richard N. Besingi, Clark lab, University of Notre Dame

10:05 – 10:25 Break

10:25 – 11:05 **Making the Membrane Disappear: Orthogonal High-throughput Screens to Engineer Pore-forming and Cell Penetrating Peptides**
William C. Wimley, Tulane University

11:05 – 11:25 **The Association-dissociation Behavior of the Apolipoprotein E proteins: Kinetic and Equilibrium Studies**
Kanchan Garai, Frieden lab, Washington University School of Medicine

11:25 – 11:45 **A Reporter Platform for the Detection of Local Structural Change in AcrB**
Yinan Wei, University of Kentucky

11:45 am Closing Remarks, Box lunch and departure