

Banbury Center

COLD SPRING HARBOR LABORATORY

2009

BANBURY CENTER

EXECUTIVE DIRECTOR'S REPORT

This was a busy year for the Banbury Center, with 20 science-related meetings and 555 participants. The proportion of U.S. participants was 79.7%, a number that has remained remarkably constant over the years. The U.S. participants came from 32 states, with the usual suspects leading the way (New York, Massachusetts, and Maryland). Foreign participants came from 22 countries, the majority from the United Kingdom. There tends to be a significant gender imbalance in Banbury Center meetings, but we did rather better in 2009 with more than 30% of participants being female.

Looking back at the decade just ended, there were 212 meetings at Banbury, with 6277 participants, an average of 31 participants per meeting. (These participants represent 4839 individuals; many came more than once in the period.) Seventy-seven percent of participants came from the U.S., and the percentage of female participants was 26%. The number of meetings each year ranged from a low of 17 in 2006 to a high of 26 in 2001.

To return to 2009, the year was characterized by a larger than usual number of meetings dealing with policy or the planning of research or promotion of a research area. Perhaps the most notable of these meetings was one held in December, on *Promoting Research on Severe Mental Illness*. The themes of the meeting were that finding the genes involved in severe mental disease is the most promising line of research and that the new generation of tools for large-scale genomics provides new opportunities for research on mental illness. Led by Jim Watson, Ed Scolnick, and Herb Pardes, participants reviewed the current state of genetic and genomics research and discussed how to advance this research. Participants prepared a “call to arms” that was published in the Policy Forum of *Science* (327: 1580–1581). Fittingly, support for the meeting was provided by foundations at the forefront of research on mental illnesses, including NARSAD–The Brain & Behavior Research Fund, World Heritage Foundation–Prechter Family Fund, and the Simons Foundation.



Robertson House

Aquatic Plants: Environment, Energy, and Evolution is another example of a meeting that combined research and policy. Duckweeds are familiar to us as the green “scum” floating on the surface of still bodies of water, such as ponds. They are tiny plants, without leaves or stems, and may or may not have rootlets. Duckweeds reproduce vegetatively as well as sexually and have the fastest known doubling time of flowering plants. Their advantages as experimental organisms are that they are easy to culture, have relatively small genomes, and can be transformed. Duckweeds are already used as food and in bioremediation, but participants in this meeting believe that the full potential of duckweed has yet to be realized. As a consequence, participants critically reviewed the biological and genetic properties of duckweed and examined the ways in which these properties could be exploited, and duckweed promoted, for biomass, biofuels, metabolic engineering, and bioremediation.

Continuing with this theme of meetings promoting policy, Banbury Center hosted a meeting of the International Steering Committee for Plant Genomics, an informal group comprised of funding organizations with a special interest in promoting genomic techniques for improving crops. The Committee, which includes scientists from Australia, Canada, France, Japan, Korea, the United Kingdom, and the United States, came to Banbury to develop a first draft of “a vision paper for the future of plant biology.” Michael Gale, from the John Innes Institute in Norwich, England, was one of the participants, and we were saddened to learn of his death in July, 2009. Mike was one of the world’s leading authorities on cereal genetics, and his research career was devoted to relieving world hunger through the improvement of cereal crops.

A notable scientific meeting was *Structural Variation in the Human Genome*. Structural changes in genomes have been known for many years. Studies of chromosomes revealed major rearrangements such as translocations, inversions, and insertions. The introduction of chromosome-banding stains in the 1960s revealed much smaller, intrachromosomal insertions and deletions. There was a further increase in resolution with the use of DNA probes and microarray techniques, and it became clear that changes could be as small as a few kilobases and were far more common in the human



Conference room

genome than had been thought. Indeed, copy-number variants (CNVs) are now recognized as one of the most common forms of genetic variation in human beings. CNVs have been associated with a range of human developmental disorders, including psychiatric disorders such as schizophrenia. Participants in this meeting discussed the mechanisms by which CNVs arise, their clinical consequences, and the development of diagnostics tests.

The Human Genome Project (HGP) was one of the great scientific enterprises of the 20th century, ranking with the Manhattan and Apollo Projects. The latter have been exhaustively documented, by the Department of Energy and by NASA, and we believe that the HGP warrants the same historical attention. We have initiated a program to document the history of the HGP and related sequencing projects. The first goal of this project is to create a comprehensive database of the locations, nature, and a description of materials relating to the HGP, whether held by scientists, academic institutions, foundations, or government departments. The discussion meeting *International Catalog for the History of the Human Genome Project* was held to examine how other organizations have assembled such databases, to review the proposed project, and to suggest amendments and modifications in the light of other experience. Participants included key players in the early development of the HGP, historians of science, and archivists working on similar projects. The discussions were most helpful for planning the next steps in our project.

The Boehringer Ingelheim Foundation promotes biomedical research by providing fellowships for graduate students performing research for a Ph.D. Each year, the Foundation holds a meeting in North America for their fellows, and 2009 marked the third occasion on which the Foundation has come to Banbury. It is always a pleasure to have scientists-in-training here, especially because the Foundation generously funds a special lecture, open to CSHL scientists. We were delighted to have Beth Shapiro (Pennsylvania State University) as our speaker. Beth had just been awarded a MacArthur Fellowship and, having heard her fascinating research, it was clear to see why she had been chosen.

Meetings participants and students taking 2009 summer courses have enjoyed the fruits of the refurbishment of Robertson House, which was carried out during the winter 2008–2009. The Robertson family has continued to help us in preserving Robertson House, and in particular, I would like to thank Victoria Linnartz, the granddaughter of Charles and Marie Robertson, for all of her hard work in enhancing the beauty of the house.

When I came to the Banbury Center, Bea Toliver was already here as assistant to the Banbury director and Katya Davey was hostess in Robertson House. It was immediately clear that we needed help and so, early in 1988, Ellie Sidorenko joined us in the Banbury office. Ellie was the first and only change in the Banbury Center staff for almost 20 years, and now, in the space of just a few years, Katya, Bea, and, in 2009, Ellie retired. Banbury has been very fortunate in recruiting three people who have immediately understood the Banbury style. Basia Polakowski took on the role of hostess in Robertson House in 2005, and, in 2009, Janice Tozzo became the Banbury Center assistant and was joined by Susanne Igneri later in the year.

As always, the operations of the Banbury Center depend on many people: Janice, Susanne, and Basia have already earned the thanks of meetings participants; Mike Peluso and the grounds crew continue to keep the Banbury grounds looking beautiful; Jon Parsons is indispensable in handling our AV needs; Connie Brukin takes interesting and artistic photographs of participants; and the staff of the Laboratory's Food Services and Housekeeping cope admirably with the very full schedule of Banbury meetings.

Jan Witkowski
Executive Director

BANBURY CENTER MEETINGS

NSF Workshop: A Vision for Plant Biology

March 1–4

FUNDED BY Biotechnology and Biological Sciences Research Council (BBSRC),
Deutsche Forschungsgemeinschaft (DFG), National Science Foundation,
The Salk Institute for Biological Studies

ARRANGED BY J. Ecker, The Salk Institute for Biological Studies
A. Millar, University of Edinburgh

The International Steering Committee on Plant Genomics is an informal group made up of funding organizations with a special interest in promoting genomic techniques in improving crops. Among other goals, the Committee is intended to facilitate communications between funding agencies in this area and promoting research collaborations. A small group of scientists drawn from participating countries (including Australia, Canada, France, Japan, Korea, the United Kingdom, and the United States) came to Banbury to discuss their perspectives of current and future challenges in the plant sciences and to develop an International Model for the Future of Plant Science. A draft report was prepared by the scientists at the conclusion of the meeting and presented at widely attended community meetings for comment during 2009. The final report will be published in 2010.

Orientation: J. Ecker, The Salk Institute for Biological Studies, San Diego, California
A. Millar, University of Edinburgh, Edinburgh, United Kingdom



SESSION 1

Scientists' presentations.

SESSION 2

Summarize speaker recommendations.
Draft outline.
Finalize writing assignments.

SESSION 3

Writing groups to draft sections.

SESSION 4

Writing groups to draft sections.
Progress review.

SESSION 5

Editing and compilation of draft document by coauthors.

SESSION 6

Wrap-up and development of powerpoint presentation for Cold Spring Harbor Laboratory meeting.



M. Bevan



S.-H. Lee, E. Dennis



J. Silverthorne, R. Bastow, K. Kistner, R. McKibbin

Neurobiology of Depression: From Molecules to Mood

March 22–25

FUNDED BY AstraZeneca Pharmaceuticals, Hoffmann-LaRoche, Inc., Hope for Depression Research Foundation, Johnson & Johnson Pharmaceuticals Research, Lilly Research Laboratories, NIMH, Wyeth Pharmaceuticals

ARRANGED BY R. Hen, Columbia University
B. McEwen, The Rockefeller University
R. Duman, Yale University
H. Manji, Johnson & Johnson Pharmaceutical Research

Depression is a devastating illness that affects 15%–20% of the population, resulting in enormous personal suffering and economic loss to society. Despite intensive research, the neurobiological mechanisms underlying the etiology and treatment of major depressive disorders have not been identified. The aim of this meeting was to bring together basic and clinical investigators to provide a comprehensive and integrated assessment of the current state of knowledge of depression research. Discussions covered the genetic, molecular, and cellular determinants of mood and depression in animal models and in humans, as well as the latest information from clinical studies on the circuitry, imaging and the treatment of mood disorders.

Introductory Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

Welcoming Remarks,
Overview of the Agenda/

Schedule, and Objectives: R. Hen, Columbia University, College of Physicians & Surgeons, New York, New York

SESSION 1: Treatments and Models

Chairperson: R. Duman, Yale University School of Medicine, New Haven, Connecticut

H. Koenigsberg, Mount Sinai School of Medicine, New York:
Does a psychosocial perspective have something to offer
neurobiological research in depression and vice versa?

D. Charney, Mount Sinai School of Medicine, New York:
Therapeutic effects of ketamine in treatment-resistant
depression.



H. Manji, Johnson & Johnson Pharmaceutical Research & Development, Titusville, New Jersey: Targeting synaptic and cellular plasticity cascades to develop improved therapeutics.
C. Nemeroff, Emory University School of Medicine, Atlanta,

Georgia: Early life trauma in major depression: A distinct endophenotype.
B. McEwen, The Rockefeller University, New York: Depression, adaptive plasticity, and resilience: Insights from animal models.

SESSION 2: Imaging/Circuitry

Chairperson: H. Manji, Johnson & Johnson Pharmaceutical Research & Development, Titusville, New Jersey

Y. Sheline, Washington University School of Medicine, St. Louis, Missouri: Resting state connectivity studies in major depression.
S. Maier, University of Colorado, Boulder, Colorado: Role of the medial prefrontal cortex in resilience and vulnerability.
M. George, Medical University of South Carolina, Charleston: Noninvasively modulating prefrontal cortical-subcortical networks to treat depression: The current evidence for TMS

and future directions.
H. Mayberg, Emory University School of Medicine, Atlanta, Georgia: Deep brain stimulation for treatment-resistant depression.
K. Disseroth, Stanford University, Stanford, California: Development and application of optical technologies for probing depression.

SESSION 3: Genes and Development

Chairperson: R. Hen, Columbia University, College of Physicians & Surgeons, New York

K. Kendler, Virginia Commonwealth University, Richmond: The genetic epidemiology of major depression.
J. Gingrich, Columbia University, New York: Role of developmental serotonin signaling in adult affective function.
K. Ressler, Emory University, Atlanta, Georgia: BDNF in prefrontal cortex, amygdala, and hippocampus required for extinction of aversive memories.
M. Meaney, McGill University, Montreal, Canada: Epigenetic mechanisms for the environmental programming of gene expression.
E. Nestler, Mount Sinai School of Medicine, New York: Epigenetic mechanisms of depression.



B. McEwen, R. Hen

SESSION 4: Stress and Sex

Chairperson: H. Akil, University of Michigan, Ann Arbor

R. Duman, Yale University School of Medicine, New Haven, Connecticut: Neurotrophic factors in the pathophysiology and treatment of depression.
N. Sousa, University of Minho, Braga, Portugal: Role of neurogenesis in depression.
W. Carlezon, Harvard Medical School–McLean Hospital, Belmont, Massachusetts: Stress, behavior, and hippocampal neurogenesis.

A. Miller, Emory University School of Medicine, Atlanta, Georgia: Inflammation and its discontents: Role of cytokines in the pathophysiology of depression.
P. Schmidt, National Institutes of Health/NIMH, Bethesda, Maryland: Reproductive endocrinology and mood disorders in women.
T. Schors, Rutgers University, Piscataway, New Jersey: Why are females so smart and yet so susceptible to stress?

SESSION 5: New Directions

Chairperson: B. McEwen, The Rockefeller University, New York

A. Lewy, Oregon Health Sciences University, Portland: Circadian misalignment component of sleep and mood disorders.
R. Hen, Columbia University, College of Physicians & Surgeons, New York: Mechanisms underlying the response to antidepressants: Responders versus nonresponders.
H. Akil, University of Michigan, Ann Arbor: Novel molecular

targets in mood disorders.
Z. Nahas, Medical University of South Carolina, Charleston: Oxytocin for depression.
M. Solms, University of Cape Town, Rondebosch, South Africa: Depression and separation distress.
L. Brady and R. Nakamura, National Institutes of Health/NIMH, Bethesda, Maryland: NIH initiatives.

New Developments in Fragile X Syndrome: From Basic Mechanisms to Therapeutics

April 5–8

FUNDED BY NIHM grant to the University of Illinois

ARRANGED BY **K. Huber**, University of Texas Southwestern Medical Center
 F. Gasparini, Novartis Pharma AG
 W.T. Greenough, University of Illinois
 E. Berry-Kravis, Rush University Medical Center
 K. Clapp, FRAXA Research Foundation

There has been much progress in the past years in several areas of research on Fragile X, but there is still much to be learned. This meeting focused on the basic mechanisms of FMRP function, the consequences of its loss on synaptic and circuit function, and therapies for treatment. Some questions that were examined included: How does FMRP regulate translation and processing of its associated mRNAs? How is neuronal circuit function altered in Fragile X Syndrome and can this explain the behavioral symptoms of the disease?

Introductory Remarks: **J.A. Witkowski**, Banbury Center

Opening Comments: **K. Clapp**, FRAXA Research Foundation, Newburyport, Massachusetts

SESSION 1: Molecular Functions of FMRP and Related Proteins

Chairperson: **D. Nelson**, Baylor College of Medicine, Houston, Texas

H. Moine, Institute de Genetique, Illkirch, France: FMRP in mRNA metabolism: From RISC to dendritic mRNA control.

C. Bagni, K.U. Leuven University, Belgium: Developmental changes of the FMRP-BC1 interaction alter the regulation of synaptic translation.



S. Vasudevan, Yale University, New Haven, Connecticut:
Translational regulation by microRNPs.

J. Darnell, The Rockefeller University, New York:
Identification of neuronal RNA ligands of FMRP by cross-linking-IP analysis.

J. Richter, University of Massachusetts Medical School, Worcester: RNA processing and synaptic plasticity.

P. Lombroso, Yale University School of Medicine, New Haven, Connecticut: Taking STEP's to improve cognition: Role of STEP in Fragile X syndrome.

SESSION 2: Synaptic Mechanisms of FMRP Function and Alterations in Fragile X Syndrome

Chairperson: W.T. Greenough, University of Illinois, Urbana

G. Bassell, Emory University, Atlanta, Georgia: FMRP and miRNA-mediated translation regulation at synapses.

P. Vanderklish, Scripps Research Institute, La Jolla, California:
Kinase and phosphatase regulatory protein abnormalities in the Fmr1 KO.

K. Huber, University of Texas Southwestern Medical Center, Dallas: FMRP regulation of mGluR-dependent long-term depression.

S. Zukin, Albert Einstein College of Medicine, Bronx, New York: Dysregulation of mTOR signaling in a mouse model of Fragile X.

I. Weiler, University of Illinois, Urbana Champaign: A novel

presynaptic defect in FXS.

T. Price, University of Arizona, Tucson: Axonal plasticity, FMRP, and pain.

M. Zhuo, University of Toronto, Ontario, Canada: Regulation of FMRP in prefrontal cortex.

M. Bear, Massachusetts Institute of Technology, Cambridge: Hypersensitivity to, not hyperactivity of, mGluR5 in Fragile X.

S. Chattarji, Tata Institute of Fundamental Research, Bangalore, India: Characterization and reversal of synaptic defects in the amygdala in a mouse model of Fragile X syndrome.

B. Oostra, Erasmus University, Rotterdam, The Netherlands: Effects of mGluR antagonists on neurons.

SESSION 3: Circuit Function and Development in Fragile X Syndrome

Chairperson: K. Huber, University of Texas Southwestern Medical Center, Dallas

K. Broadie, Vanderbilt University & Medical School, Nashville, Tennessee: *Drosophila* model of Fragile X: Brain circuit function.

D. Nelson, Baylor College of Medicine, Houston, Texas:
Developmental requirements of FMRP.

P. Kind, University of Edinburgh, United Kingdom: Role of FMRP in early postnatal development of the cerebral cortex.

J. Gibson, University of Texas Southwestern Medical Center, Dallas: Alterations in neocortical connectivity and circuit

function in the Fmr1 KO mouse.

M. Avoli, McGill University, Montreal, Canada: Tonic inhibition and Fragile X syndrome.

R. Wong, SUNY-Downstate Health Science Center, Brooklyn, New York: Plasticity mechanisms for mGluR-mediated epileptiform activity in Fragile X mice.

L. Kaczmarek, Yale University School of Medicine, New Haven, Connecticut: FMRP and sodium-activated potassium channels.

SESSION 4: Therapeutics in Animal Models of Fragile X Syndrome and Patients

Chairperson: M. Tranfaglia, FRAXA Research Institute, Newburyport, Massachusetts

F. Bolduc, University of Alberta, Edmonton, Canada: Fragile X flies and memory: Therapeutic approaches.

W. Spooren, F. Hoffmann-LaRoche Ltd., Basel, Switzerland:
Translational aspects of Fragile X.

F. Gasparini, Novartis Pharma AG, Basel, Switzerland:
mGluR5 antagonists as antihyperalgesic in models for inflammatory pain.

R. Hagerman, University of California Davis Health System, Sacramento: Minocycline treatment in Fragile X syndrome.

E. Berry-Kravis, Rush University Medical Center, Chicago, Illinois: Pilot measures of inhibition and executive function for clinical trials in FXS.

S. Jacquemont, University Hospital, Lausanne, Switzerland:
Phase-2 clinical trials of a specific mGluR5 antagonist in Fragile X syndrome.

C.B. Smith, National Institutes of Health/NIMH, Bethesda, Maryland: Fragile X permutation: Morphological, behavioral, and neurochemical effects in a mouse model.



W. Spooren

Searching for Principles Underlying Memory in Biological Systems

April 12–15

FUNDED BY The Swartz Foundation

ARRANGED BY W.A. Suzuki, New York University
 S. Fusi, Columbia University

This workshop brought together experimentalists and theoreticians studying both medial temporal lobe functions and prefrontal functions, as well as their interactions. Participants included experimentalists working on questions of synaptic plasticity and systems-level behavioral neurophysiology, as well as human neuropsychologists. The goal was to encourage interaction and discussion between theoreticians and experimentalists working at all of these different levels of analysis.

Introductory Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory
Introduction: Why this meeting? W.A. Suzuki, New York University, New York
 S. Fusi, Columbia University, New York

SESSION 1: Functional Organization of the Medial Temporal Lobe: Views From Across Different Experimental Systems

Chairperson: L. Davachi, New York University, New York

H. Eichenbaum, Boston University, Boston, Massachusetts:
How does the hippocampus integrate “what” and “where” information?

J.T. Wixted, University of California, San Diego, La Jolla: Interpreting memory-related activity in the medial temporal lobe.

Y. Dudai, Weizmann Institute of Science, Rehovot, Israel:

Predicting not to predict too much: How the cellular machinery of memory anticipates the uncertain future.

W.A. Suzuki, New York University, New York: Task-dependent patterns of medial temporal lobe activity.

P. Dayan, University College London, United Kingdom: Episodic control: Singular recall and optimal actions.



SESSION 2: Functional Organization of the Medial Temporal Lobe: Views from Across Different Experimental Systems

Chairperson: H. Eichenbaum, Boston University, Boston, Massachusetts

D.L. Shachter, Harvard University, Cambridge, Massachusetts: Episodic simulation of future events and the medial temporal lobe.

D. Shohamy, Columbia University, New York: Striatal and hippocampal contributions to different forms of learning.

L. Davachi, New York University, New York: Memory signals

in the human medial temporal lobe.

G. Buzsaki, Rutgers, The State University of New Jersey, Newark: Cell assembly sequences in the service of memory.

C. Stark, University of California, Irvine: Pattern separation in the human hippocampus.

SESSION 3: Hippocampal Functions: Theoretical and Experimental Views

Chairperson: G. Buzsaki, Rutgers, The State University of New Jersey, Newark

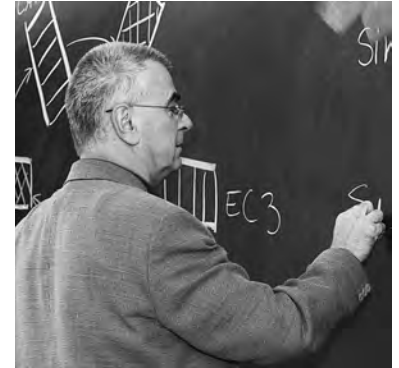
N. Burgess, University College London, United Kingdom: Neural mechanisms of spatial memory.

L. Colgin, Kavli Institute for Systems Neuroscience, Trondheim, Norway: High and low frequencies of γ oscillations serve as discrete communication channels in the hippocampus.

J.J. Knierim, Johns Hopkins University, Baltimore, Maryland: Medial and lateral entorhinal inputs to the hippocampus.

M.A. Wilson, Massachusetts Institute of Technology, Cambridge: Memory reactivation in the hippocampus.

S. Fusi, Columbia University, New York: Memories on multiple timescales: The importance of heterogeneity and memory transfer.



G. Buzsaki

SESSION 4: Working Memory

Chairperson: S. Grant, Wellcome Trust Sanger Institute, Hinxton, United Kingdom

E.K. Miller, Massachusetts Institute of Technology, Cambridge: Brain rhythms and short-term memory.

X.J. Wang, Yale University School of Medicine, New Haven, Connecticut: Slow reverberation mechanism of working memory.

S. Ganguli, University of California, San Francisco: Short-term sequence memory in neuronal networks.

A. Treves, SISSA-Cognitive Neuroscience, Trieste, Italy: Creative latching dynamics in simplified cortical networks.

M.V. Tosodyks, Weizmann Institute of Science, Rehovot, Israel: Synaptic theory of working memory.



N. Burgess, C. Stark

SESSION 5: Synaptic Plasticity: Theory and Experiments

Chairperson: W.A. Suzuki, New York University, New York

L.F. Abbott, Columbia University, New York: Chemical kinetics and memory.

S. Grant, Wellcome Trust Sanger Institute, Hinxton, United Kingdom: Synapse complexity.

A. Maffei, SUNY, Stony Brook, New York: Plasticity of inhibition in visual cortex.

S. Wang, Princeton University, Princeton, New Jersey: Elements of synaptic learning rules.

M.A. Hauser, University College London, United Kingdom: How do the properties of dendrites influence synaptic plasticity and memory storage?



Y. Dudai

Molecular Biology of Sirtuins

April 26–29

FUNDED BY Cold Spring Harbor Laboratory Corporate Sponsor Program

ARRANGED BY L.P. Guarente, Massachusetts Institute of Technology
D.A. Sinclair, Harvard Medical School

In the 1990s, the Sir2 protein was identified as a key regulator of lifespan in budding yeast. Since then, it has become increasingly clear that the Sir2 family proteins are highly conserved enzymes that mediate many of the health benefits of calorie restriction. Sirtuins are becoming increasingly appreciated for their potential in treating diverse diseases, from neurodegeneration to Type II diabetes. The modulation of sirtuins by metabolites such as NAD⁺ and nicotinamide, by environmental changes such as DNA damage, diet and exercise, and most recently by small drug-like molecules, has further increased interest in sirtuins. Participants in this meeting discussed new directions for research on sirtuins and identified how sirtuins can be used for improving human health.

Introductory Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

SESSION 1: Metabolism 1

Chairperson: D.A. Sinclair, Harvard Medical School, Boston, Massachusetts

D. Accili, Columbia University, New York: Metabolic actions of Sirt1.

J. Auwerx, Ecole Polytechnique Federal de Lausanne, Switzerland: A cofactor network to control metabolism.

N. Barzilai, Albert Einstein College of Medicine, Bronx, New

York: Central effects of Sirt1 on peripheral glucose homeostasis.

R. de Cabo, National Institutes of Health/NIA, Baltimore, Maryland: Health and longevity consequences of activating SIRT1.



M.Y. Donath, University Hospital Zurich, Switzerland: SIRT1 in type-1 diabetes and autoimmune/autoinflammatory diseases.
S.-I. Imai, Washington University School of Medicine, St.

Louis, Missouri: Systemic regulation of metabolism and aging by SIRT1 and Nampt-mediated NAD biosynthesis.
C. Deng, National Institutes of Health/NIDDK, Bethesda, Maryland: Sirt6 in glucose and fat metabolism.

SESSION 2: Neuro-Cancer

Chairperson: D. Accili, Columbia University, New York

A. Brunet, Stanford University, Stanford, California: Sirt1 and FoxO3 in adult neural stem cells.
R. Coppari, University of Texas Southwestern Medical Center, Dallas: Brain SIRT1: A novel target to treat diet-induced metabolic dysfunctions?
L.P. Guarante, Massachusetts Institute of Technology, Cambridge: Sirtuins and disease.

L.-H. Tsai, Massachusetts Institute of Technology, Cambridge: Role of SIRT1 in neuroprotections and cognition.
E.N. Chini, Mayo Clinic, Rochester, Minnesota: Role of the NADase CD38 and the nuclear protein DBC1 as regulators of SIRT1 and metabolism.
Z. Lou, Mayo Clinic, Rochester, Minnesota: A c-Myc/SIRT 1 feedback loop regulates cell growth and transformation.

SESSION 3: Metabolism 2

Chairperson: A. Brunet, Stanford University, Stanford, California

S.-J. Lin, University of California, Davis: Sirtuins, NAD metabolism, and calorie restriction: Insight from *S. cerevisiae*.
M.W. McBurney, Ottawa Health Research Institute, Ontario, Canada: Roles of FMRP in neuronal architecture development and synaptogenesis.
T. Nystrom, CMB Gothenborg University, Gothenborg, Sweden: Global genetic interaction network of Sir2

and damage segregation.
V. Sartorelli, National Institutes of Health/NIAMS, IRP, Bethesda, Maryland: Roles of SIRT1 in skeletal muscle.
K. Irani, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania: Nitroso-redox regulation of SIRT1.
P. Sassone-Corsi, University of California, Irvine: SIRT and circadian clock.

SESSION 4: Metabolism 3 and Drugs

Chairperson: S.-J. Lin, University of California, Davis

D.A. Sinclair, Harvard Medical School, Boston, Massachusetts: Genes and small molecules that modulate sirtuins.
Y. Suh, Albert Einstein College of Medicine, Bronx, New York: Genetic variation in sirtuins and disease.
L. Bordone, Novartis Institute for Biomedical Research, Cambridge, Massachusetts: Therapeutic opportunities for sirtuins.
G.P. Vlasuk and C. Westphal, Sirtris, Cambridge, Massachusetts: New therapeutic opportunities for pharmacological modulators of sirtuin activity.

SESSION 5: SIRT2-7

Chairperson: L.P. Guarante, Massachusetts Institute of Technology, Cambridge

M. Haigis, Harvard Medical School, Boston, Massachusetts: Understanding the impact of sirtuins on mitochondrial metabolism.
A.A. Sauve, Weill Cornell Medical College, New York: Enzymology and chemical reactivity of SIRT5 and SIRT6.
Q. Tong, Baylor College of Medicine, Houston, Texas: Functions of SIRT2 and SIRT3.



A. Brunet, S.-I. Imai, P. Sassone-Corsi

The First NIMH-sponsored Brain Camp

April 29–May 2

FUNDED BY **National Institute of Mental Health**

ARRANGED BY **M. Akil, National Institute of Mental Health**
 T.R. Insel, National Institute of Mental Health

There is a need to link psychiatry training to neuroscience. Although psychiatric disorders such as schizophrenia and depression are regarded as brain disorders, current training programs in psychiatry include very little of the findings of modern neuroscience. This NIMH-sponsored “brain camp” was a first attempt to see whether this situation can be rectified by providing psychiatry residents with an intense exposure to the world of cognitive neuroscience. To this end, more than 20 psychiatry residents and 17 speakers participated in in-depth discussions of a variety of topics.

Introduction and Charge: **T.R. Insel, National Institute of Mental Health, Bethesda, Maryland**

SESSION 1: Genetics

F. McMahon, National Institute of Mental Health, Bethesda, Maryland

M.W. State, Yale University School of Medicine, New Haven, Connecticut



SESSION 2: Social Neuroscience: The social brain

R. Adolphs, California Institute of Technology, Pasadena
T.R. Insel, National Institute of Mental Health, Bethesda,
Maryland

SESSION 3: Developmental Neurobiology/Schizophrenia

S.A. Anderson, Weill Medical College of Cornell University,
New York
D.A. Lewis, University of Pittsburgh Medical Center,
Pittsburgh, Pennsylvania

Discussion with the organizers: Teaching neuroscience in
medical school and during psychiatry training; what's
missing?

**SESSION 4: The Neurobiology of Affect, Emotion, and
Affective Disorders**

M. Davis, Emory University, Atlanta, Georgia
H. Akil, University of Michigan, Ann Arbor
K. J. Ressler, Emory University, Atlanta, Georgia

SESSION 5: Cognitive Neuroscience

C. Carter, University of California Davis, Sacramento
J.D. Cohen, Princeton University, Princeton, New Jersey
D. Barch, Washington University, St. Louis, Missouri

Special Presentation: Molecular and Cellular Tools for
Studying and Perturbing Brain Circuits
K. Deisseroth, Stanford University, Stanford

SESSION 6: Cognitive Neuroscience II

J. Wallis, University of California, Berkeley
M. Frank, Brown University, Providence, Rhode Island

**SESSION 7: Effects of Pre- and Postnatal
Experiences on Adult Stress Response and
Disease Vulnerability**

E.J. Nestler, Mount Sinai School of Medicine,
New York
F. Champagne, Columbia University, New York



S. Wang



R. Caceda



D. Ross



T. Insel, A. Yusim



J. Coughlin, M. Nakic

International Catalog for the History of the Human Genome Project

June 16–17

FUNDED BY The Wellcome Trust

ARRANGED BY L. Pollock, Library and Archives, Cold Spring Harbor Laboratory
 J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

The Human Genome Project (HGP) was one of the great scientific enterprises of the 20th century, and we have initiated a program to document the history of the HGP and related sequencing projects. The first goal of this project is to create a comprehensive database of the locations, nature, and description of materials relating to the HGP, whether held by scientists, academic institutions, foundations, or government departments. This discussion meeting was held to examine how other organizations have assembled such databases, to review the proposed project, and to suggest amendments and modifications in the light of other experience.

Welcome: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

Introductory Remarks: L. Pollock, Library and Archives, Cold Spring Harbor Laboratory

SESSION 1: Case Studies

J. Anderson, Niels Bohr Library and Archives, American Institute of Physics, College Park, Maryland: Center for History of Physics at the American Institute of Physics.
P. Theerman, NLM History of Medicine, Bethesda, Maryland: National Library of Medicine's Profiles in Science.

J. Van Oudenaren, World Digital Library, Library of Congress, Washington, D.C.: World Digital Library.
R. Moore, Data Intensive Cyber Environments, Renaissance Computing Institute, Chapel Hill, North Carolina: Managing and integrating diverse data sets.



M. Olson, J.D. Watson

SESSION 2: About the Project

M. Pollock, Library and Archives, Cold Spring Harbor Laboratory: Immediate and future goals.

SESSION 3: Planning the Next Steps: What Should We Consider?

Types and Sources of Materials

What period should be covered?

What should be collected?

Where is it?

How Much is There?

Organization—How to do it?

Project plan

Phases

Collaborations

Funding: How Can We Fund the Project?

Where from?

What about long-term support?

What working groups would be useful?

Group I: Technical issues relating to managing and integrating data.

Group II: Identifying collections and owners of relevant materials.

Group III: Finance.

SESSION 4: Summary and Conclusions

Personal Remarks: J.D. Watson, Cold Spring Harbor Laboratory



E. Carlson



A. Patrinos, C. DeLisi



J. Weissenbach

Arbuscular Mycorrhizal Symbioses and Their Impact on Plant Nutrition

September 8–11

FUNDED BY Cold Spring Harbor Laboratory Corporate Sponsor Program

ARRANGED BY M. Harrison, Cornell University
U. Paszkowski, Université de Lausanne

The arbuscular mycorrhizal (AM) symbiosis is a widespread plant–fungal interaction that occurs between roots of terrestrial plants and Glomeromycotan fungi. This association has received considerable scientific attention because of (1) the nutritional benefit it confers on the plant by improving access to otherwise limiting sources of nutrients, (2) its widespread occurrence among extant plants and significance in terrestrial ecosystems, and (3) its ancestral role in the evolution of symbiosis signaling pathways. This discussion meeting focused on AM symbioses and their impact on plant nutrition and brought together key researchers from the AM symbiosis, plant mineral nutrition, and root architecture fields.

Introductory and Welcoming Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory
M. Harrison, Boyce Thompson Institute, Cornell University, Ithaca, New York
U. Paszkowski, Université de Lausanne, Lausanne, Switzerland

SESSION 1: Signaling and Development of Arbuscular Mycorrhizal Symbiosis
Chairperson: M. Parniske, University of Munich, Munich, Germany

P. Young, University of York, United Kingdom: The glomus genome: What we have learnt so far?

G. Becard, University of Toulouse, France: Early signaling in the AM symbiosis from the lab to the field.

M. Parniske, University of Munich, Germany: Signal

transduction in symbiosis.

G. Oldroyd, John Innes Center, BBSRC, United Kingdom: Early signaling events during the establishment of the mycorrhizal association.



SESSION 2: Phosphorus and Nitrogen Sensing and Signaling

Chairperson: S. Abel, University of California, Davis

- M. Udvardi, Samuel Roberts Noble Foundation, Ardmore, Oklahoma: HERMES: A Medicago gene required for both AM and nitrogen-fixing/rhizobial symbioses.
S. Abel, University of California, Davis: Phosphate sensing in root development.

- J. Paz-Ares, Centro Nacional de Biotechnología, Madrid, Spain: Phosphate starvation signaling in *Arabidopsis*.
B. Forde, Lancaster University, United Kingdom: Nitrogen signaling and the modulation of root architecture.

SESSION 3: Root Architecture and Mineral Nutrient Acquisition

Chairperson: D. Schachtman, Donald Danforth Plant Science Center, St. Louis, Missouri

- E. Nielsen, University of Michigan, Ann Arbor: Polarized membrane trafficking during root hair growth.
C. Hardtke, Université de Lausanne, Lausanne, Switzerland:

- Natural genetic variation.
J. Lynch, Pennsylvania State University, University Park: Root architecture and AMs.

SESSION 4: Mineral Nutrient Acquisition in AM Symbiosis

Chairperson: M. Harrison, Boyce Thompson Institute, Cornell University, Ithaca, New York

- I. Jakobsen, Technical University of Denmark, Roskilde, Denmark: Functional analysis of Pi uptake pathways by means of VIGS.
D. Schachtman, Donald Danforth Plant Science Center, St. Louis, Missouri: Response of mycorrhizal and nonmycorrhizal tomato roots to nutrient enriched soil patches.
E. Neumann, Institute of Vegetable and Ornamental Crops, Grossbeeren, Germany: Exploitation of different soil

- nitrogen resources by the extraradial mycelium of arbuscular mycorrhizal fungi.
Y. Shachar-Hill, Michigan State University, East Lansing: Movement and metabolism of carbon, nitrogen, and sulfur in the AM symbiosis.
D. Reinhardt, University of Fribourg, Fribourg, Switzerland: Regulation of AM symbiosis by nutrients.
M. Harrison, Boyce Thompson Institute, Cornell University, Ithaca, New York: Phosphate transport in AM symbiosis.

SESSION 5: Functional Diversity in AM Symbiosis

Chairperson: U. Paszkowski, Université de Lausanne, Lausanne, Switzerland

- J. Bever, Indiana University, Bloomington: Preferential allocation of plant photosynthate and the maintenance of the AM mutualism.
D. Janos, University of Miami, Coral Gables, Florida: Evolution of dependence upon, responsiveness to, and effectiveness of AM.
S. Kaeppler, University of Wisconsin, Madison: Variation among maize lines for mycorrhizal responsiveness under P stress.
U. Paszkowski, Université de Lausanne, Lausanne, Switzerland: Molecular genetics of the AM symbiosis in cereals.



U. Paszkowski

From Infection to Neurometabolism: A Nexus for CFS

September 13–16

FUNDED BY National Institutes of Health and the CFIDS Association of America

ARRANGED BY S. Vernon, CFIDS Association of America
 E. Hanna, NIH, Office of Research on Women's Health

Chronic fatigue and widespread pain are common physical symptoms and unfortunately are the most likely to remain unexplained. Chief among illnesses characterized by medically unexplained chronic fatigue and pain is chronic fatigue syndrome (CFS), afflicting at least 4 million American adults. Despite more than 20 years of CFS research and more than 5000 peer-reviewed biomedical publications detailing infection, genetic polymorphisms, and brain metabolism in CFS, there is still no evidence-based diagnosis and treatment. The objective of this workshop was to lay the foundation for an expanded CFS research network that will work toward evidence-based objective diagnosis and treatment of CFS.

Introductory and Welcoming Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

SESSION 1: Gathering and Integration of Information to Identify Biomarkers for CFS Diagnosis and Treatment

Chairpersons: S. Vernon, CFIDS Association of America, Charlotte, North Carolina, and
 E. Hanna, NIH, Office of Research on Women's Health, Bethesda, Maryland

K. McCleary, CFIDS Association of America, Charlotte, North Carolina: Supporting CFS research through advocacy.

E. Hanna, NIH, Office of Research on Women's Health, Bethesda, Maryland: Establishing and supporting a CFS research network.

L. Bateman, The Fatigue Consultation Clinic, Salt Lake City, Utah: The minimal clinical information required in a research network.

L. Jason, DePaul University, Chicago, Illinois: Importance of defining CFS for research studies.

S. Vernon, CFIDS Association of America, Charlotte, North Carolina: The minimal laboratory information required in a research network.

B. Mishra, New York University, New York: Computational possibilities of a research network.

S. Srivastava, National Cancer Institute, Bethesda, Maryland:



Establishing an evidence-based biomarker research network.
K. Helmer, Massachusetts General Hospital, Charleston:

Creating a research network using BIRN resources.

SESSION 2: Infectious and Immunologic Biomarkers of CFS

Chairpersons: S. Vernon, CFIDS Association of America, Charlotte, North Carolina, and
E. Hanna, NIH, Office of Research on Women's Health, Bethesda, Maryland

M. Hornig, Columbia University, New York: Chronic viruses as biomarkers.

B. Katz, Children's Memorial Hospital, Chicago, Illinois: EBV: Cause, trigger, or sustain CFS.

B. Huber, Tufts University School of Medicine, Boston, Massachusetts: Endogenous retroviruses: Cause, trigger, or sustain CFS.

R. Engler, Walter Reed Army Medical Center, Washington,

D.C.: Vaccines and CFS.

T. Theoharides, Tufts University School of Medicine, Boston, Massachusetts: Mast cells and CFS.

K. Light, University of Utah Health Sciences Center, Salt Lake City: Peripheral blood biomarkers in CFS.

M. Fletcher, University of Miami School of Medicine, Miami, Florida: Neuroimmune biomarkers in CFS.

Evidence evaluation and summary sessions of infection and immunity presentations

S. Raj, A. Vincent, N. Klimas, T. Komaroff, L. Royster, C. Bausch, S. Vernon, E. Hanna, K. McCleary, S. Yale, E. Aslakson, B. Evengard

SESSION 3: ANS and CNS Biomarkers of CFS

Chairpersons: S. Vernon, CFIDS Association of America, Charlotte, North Carolina, and
E. Hanna, NIH, Office of Research on Women's Health, Bethesda, Maryland

P. Rowe, Johns Hopkins University, Baltimore, Maryland: Orthostatic stability and instability.

I. Biaggioni, Vanderbilt University, Nashville, Tennessee: Biomarkers of blood pressure regulation.

M. Medow, New York Medical College, Valhalla: Cerebral blood flow and autoregulation.

J. Stewart, New York Medical College, Hawthorne: Blood flow

biomarkers in CFS.

D. Shungu, Weill Medical College of Cornell University, New York: Brain metabolic correlates of CFS.

D. Cook, University of Wisconsin, Madison: Brain function as indicated by fMRI in CFS.

B. Natelson, Beth Israel Medical Center, New York: Neurologic biomarkers in CFS.

SESSION 4: Future Directions

Chairpersons: K. McCleary, CFIDS Association of America, Charlotte, North Carolina, and
L. Royster, DePaul University, Chicago, Illinois

A. Kogelnik, Open Medicine Institute, Mount View, California: Electronic medical record and genetics as biomarkers of CFS.

J. Baraniuk, Georgetown University, Washington, D.C.: Proteomic biomarkers of CFS.

G. Broderick, University of Alberta, Edmonton, Canada:

Genomic identification of dysfunctional cell subsets as biomarkers.

S. Shukla, Marshfield Clinic Research Foundation, Marshfield, Wisconsin: Metagenomic approach to investigate microbiological markers.

Workgroup meets to evaluate evidence and summarize sessions of ANS, CNS, and omic presentations

S. Raj, A. Vincent, N. Klimas, T. Komaroff, L. Royster, C. Bausch, S. Vernon, E. Hanna, K. McCleary, S. Yale, E. Aslakson, B. Evengard

SESSION 5: Evaluation and Summary Reports

Chairpersons: S. Vernon, CFIDS Association of America, Charlotte, North Carolina, and
E. Hanna, NIH, Office of Research on Women's Health, Bethesda, Maryland

Y. Setty, Microsoft Research Cambridge, Cambridge, United Kingdom: Can a research network help realistic modeling of CFS?

A. Komaroff, Harvard Medical School, Boston, Massachusetts: Infectious agents as CFS biomarkers.

N. Klimas, University of Miami, Miami, Florida: Immunologic and omic biomarkers of CFS.

S. Raj, Vanderbilt University, Nashville, Tennessee: ANS and

CNS biomarkers of CFS.

Research Network Next Steps:

E. Hanna, NIH, Office of Research on Women's Health, Bethesda, Maryland

S. Vernon, CFIDS Association of America, Charlotte, North Carolina

Epigenetic Inheritance, Gene Regulation, and Plant Development

September 20–23

FUNDED BY The Cold Spring Harbor–Pioneer Collaborative Research Program

ARRANGED BY R. Martienssen, Cold Spring Harbor Laboratory
 S. Tingey, DuPont Experimental Station

This meeting fulfilled two functions. The first was that it provided an opportunity for participants in the Cold Spring Harbor Laboratory–DuPont–Pioneer collaboration to meet one another and to exchange data, information, and ideas, and to review progress. Second, epigenetics is of special interest in plant science, and one day of the meeting was devoted to a minisymposium on the topic with invited speakers drawn from outside the collaboration.

Introductory and Welcoming Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

SESSION 1: Epigenetics and Functional Genomics

Chairperson: J.A. Rafalski, DuPont Experimental Station, Delaware

R. Martienssen (R. Schwab), Cold Spring Harbor Laboratory:
Efficiency of artificial miRNA.

M. Aukerman, DuPont Experimental Station, Wilmington,
Delaware: miRNAs for translational silencing.

B. Meeley, Pioneer Hi-Bred International, Johnston, Iowa:
Activation tagging in maize and other updates.

M. Tanurdzic, Cold Spring Harbor Laboratory: Epigenetic

variation.

W. McCombie, Cold Spring Harbor Laboratory: Next-
generation sequencing.

J. Hicks and J. Kendall, Cold Spring Harbor Laboratory:
Hybrid capture bisulfite sequencing.

M. Regulski, Cold Spring Harbor Laboratory: Hybrid capture
of maize DNA/discussion.



SESSION 2: Gene Expression and Development

Chairperson: D. Jackson, Cold Spring Harbor Laboratory

- J. Tisdall, DuPont Experimental Station, Wilmington, Delaware: Whole transcriptome work.
 A. Eveland, Cold Spring Harbor Laboratory: Analysis of solexa transcriptome data.
 V. Llaca, Pioneer Hi-Bred International, Johnston, Iowa and S. DesChamps, Dupont Experimental Station, Wilmington, Delaware: SBS technology.
 P. Bommert, Cold Spring Harbor Laboratory: Positional

- cloning of fasciated ear genes.
 M. Guo, Pioneer Hi-Bred International, Johnston, Iowa: Regulation of organ size in maize.
 D. Jackson, Cold Spring Harbor Laboratory: Fluorescent reporter lines in maize.
 M. Dotto, Cold Spring Harbor Laboratory: Leaf patterning by laxmidrib and tasiRNA pathways.

SESSION 3: Genomes and Epigenomes in Plant Development

Chairperson: R. Martienssen, Cold Spring Harbor Laboratory

- D. Ware, Cold Spring Harbor Laboratory: Sequencing the maize genome.
 A. Rafalski, DuPont Experimental Station, Wilmington, Delaware: Genome technologies.
 N. Springer, University of Minnesota, St. Paul: Links between genomic structure variation and epigenetic variation in maize.

- M. Timmermans, Cold Spring Harbor Laboratory: Mutations in the maize tasiRNA pathway affect multiple developmental processes.
 Z. Lippman, Cold Spring Harbor Laboratory: Inflorescence architecture, flowering, and heterosis.
 V. Chandler, Gordon and Betty Moore Foundation, Palo Alto, California: Paramutation.

SESSION 4: Epigenetic Inheritance

Chairperson: M. Auckerman, DuPont Experimental Station, Delaware

- V. Colot, CNRS-École Normale Supérieure, Paris, France: The other side of genetics: Epigenetics across generations.
 J. Paszkowski, University of Geneva, Geneva, Switzerland: Role of methylation in transgenerational inheritance.
 E. Richards, Cornell University, Ithaca, New York: Epigenetic variation or resistance gene variation/instability.

- R. Martienssen, Cold Spring Harbor Laboratory: Reprogramming of transposons in pollen.
 J.P. Vielle-Calzada, National Laboratory of Genomics for Biodiversity, Carretera Irapuato-Leon, Mexico: Control of gamete formation by a small RNA pathway in *Arabidopsis*.

SESSION 5: The Maize Genome and General Discussion

Chairperson: S. Tingey, Dupont Experimental Station, Delaware

- D. Ware Laboratory, Cold Spring Harbor Laboratory
 J. Stein: Genome fractionation/evolutionary analysis.
 J.-M. Chia: Diversity/HapMap.
 C. Liang: Gene building and incorporation of RNA-Seq data.



J. Paszkowski, J. Rafalski



D. Ware, M. Timmermans

Psychiatric Genetics: Current Progress and Future Directions

September 23–24

FUNDED BY The Stanley Research Foundation

ARRANGED BY J.D. Watson, Cold Spring Harbor Laboratory
 S.C. Gary, Cold Spring Harbor Laboratory
 E. Scolnick, Broad Institute, Massachusetts Institute of Technology

Ted and Veda Stanley and the Stanley Medical Research Institute are most generous supporters of research on schizophrenia and bipolar disorder. Among their initiatives are the Stanley Center for Psychiatric Research at the Broad Institute, and the Stanley Institute for Cognitive Genomics at Cold Spring Harbor Laboratory (CSHL). Both groups are using the latest genome technologies to search for genetic alterations that contribute to schizophrenia and bipolar disorder. This meeting brought Stanley-funded investigators from the Broad Institute and CSHL together, with the goals of providing an update on the research and reviewing topics that may be the basis for future projects and collaborations.

Welcoming Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

Introductory Remarks: J.D. Watson, Cold Spring Harbor Laboratory

SESSION 1: Genetics Update

Chairperson: T. Schulze, National Institutes of Health/NIMH, Bethesda, Maryland

J. Sebat, Cold Spring Harbor Laboratory

W.R. McCombie, Cold Spring Harbor Laboratory

P. Sklar, Broad Institute, MIT, Harvard University,

Boston, Massachusetts

N. Craddock, Cardiff University School of Medicine,

Cardiff, United Kingdom



Coffee break

SESSION 2: Genetics: Next Steps

Chairperson: P. Sklar, Broad Institute, MIT, Harvard University, Boston, Massachusetts

E. Leibenluft, National Institutes of Health/NIMH, Bethesda,
Maryland

T. Schulze, National Institutes of Health/NIMH, Bethesda,
Maryland

SESSION 3: Neuroscience

Chairperson: L. Tsai, Massachusetts Institute of Technology, Cambridge

K. Singh, Broad Institute, Boston, Massachusetts

P. Osten, Cold Spring Harbor Laboratory

A. Sawa, Johns Hopkins School of Medicine, Baltimore,
Maryland

B. Li, Cold Spring Harbor Laboratory

T. Petryshen, Broad Institute, MIT, Boston, Massachusetts

SESSION 4: iPS

Chairperson: A. Malhotra, The Zucker Hillside Hospital, Glen Oaks, New York

H. Song, Johns Hopkins University School of Medicine,
Baltimore, Maryland

J. Madison, Broad Institute, MIT, Boston, Massachusetts

K. Brennand, The Salk Institute, La Jolla, California

SESSION 5: Drug Discovery

Chairperson: M. Moyer, Broad Institute, Cambridge, Massachusetts

S. Haggarty, Broad Institute, Harvard University, Boston,
Massachusetts

J. Pan, Broad Institute, MIT, Boston, Massachusetts

SESSION 6: Stanley Medical Research Institute

Chairperson: B. Yolken, Johns Hopkins University, Baltimore, Maryland

S. Kim, Stanley Medical Research Institute

L. Brando, Stanley Medical Research Institute

S. Sabuncian, Stanley Medical Research Institute

SESSION 7: Future Directions

Chairperson: E. Scolnick, Broad Institute, MIT, Cambridge, Massachusetts

Meeting Summary and Discussion on Future Directions

SESSION 8: Special Session

Introduction: J.D. Watson, Cold Spring Harbor Laboratory

N. Craddock, Cardiff University School of Medicine, Cardiff,
United Kingdom

E. Scolnick, Broad Institute, MIT, Cambridge, Massachusetts,
and J.D. Watson, Cold Spring Harbor Laboratory

R. Perlis, Broad Institute, Massachusetts General Hospital,
Boston

Science: Get It Across!

October 1-8

FUNDED BY **Boehringer Ingelheim Fonds Foundation for Basic Research in Medicine**

ARRANGED BY **C. Walther, Bohringer Ingelheim Fonds**
 S. Schedler, Bohringer Ingelheim Fonds

The Bohringer Ingelheim Fonds Foundation returned to the Banbury Center for their biannual fellows meeting in North America. In addition to providing training for their fellows, the Foundation very generously supported a special lecture by a visiting young scientist, given in Grace Auditorium and open to all CSHL scientists. This year's lecture, "Measuring evolution through space and time" was given by Beth Shapiro, Shaffer Assistant Professor from the Department of Biology at Pennsylvania State University.

Opening Remarks: **C. Walther, Bohringer Ingelheim Fonds, Heidesheim, Germany**

Speakers

W. Wells, Global Alliance for TB Drug Development, New York: Writing techniques and how to structure papers.

W. Tansey, Cold Spring Harbor Laboratory: Presentation of graphic information and how to prepare and deliver a scientific talk.

W. Tansey, Cold Spring Harbor Laboratory: Powerpoint presentations and review of videotaped presentations. Writing assignments. Review and critique of videotaped presentations.

H. Ploegh, Whitehead Institute, Cambridge, Massachusetts: What makes success in science?

C. Walther, Bohringer Ingelheim Fonds, Heidesheim, Germany: All about Bohringer Ingelheim Fonds.

B. Shapiro, Pennsylvania State University, University Park: Measuring evolution through space and time at Grace Auditorium.

M. Hansen and M. Corral, Nature Publishing Group, New York: Graphic assignments and presentations.



Aquatic Plants: Environment, Energy, and Evolution

October 18–21

FUNDED BY The Gordon and Betty Moore Foundation

ARRANGED BY R. Martienssen, Cold Spring Harbor Laboratory
 J. Shanklin, Brookhaven National Laboratories
 T. Michael, Rutgers University

The aquatic plant duckweed (*Lemna* spp.) has been proposed as an aquatic plant “model” system. They are easy to culture and some species have relatively compact genomes. They propagate vegetatively as well as sexually, have the fastest known doubling time of flowering plants, and are amenable for transient transformation. The Joint Genome Institute recently embarked on sequencing the *Spirodela polyrhiza* genome. Participants in this workshop critically reviewed the biological and genetic properties of duckweed, which may lead to its use in many fields, including plant biology, aquatic biology, biomass, biofuels, metabolic engineering, and bioremediation.

Introductory and Welcoming Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory
Introductory Remarks: R. Martienssen, Cold Spring Harbor Laboratory

SESSION 1: Genetics and Genomics

Chairperson: R. Martienssen, Cold Spring Harbor Laboratory

I. Sussex, Yale University, New Haven, Connecticut, and E. Landolt, ETH, Zurich, Switzerland: Comments to the morphological systematic and to the genotypic variability of *Lemnaceae* (read by M. Eberius, LemnaTec GmbH, Würselen, Germany).
M. Edelman, Weizmann Institute of Science, Rehovot, Israel:

Lemnaceae: Model plants for in vivo studies.
R. McCombie, Cold Spring Harbor Laboratory: Sequencing *Lemna* and other plant genomes using next-generation sequencing.
T. Michael, Rutgers University, Piscataway, New Jersey: The Duckweed Genome Project.



SESSION 2: Biofuels, Bioremediation, and Other Opportunities

Chairperson: J. Shanklin, Brookhaven National Laboratory, Upton, New York

- A. Stomp, North Carolina State University, Raleigh: The Lemnaceae: Tantalizing opportunities and significant challenges.
- R. Kerstetter, Rutgers University, Piscataway, New Jersey: The remarkable potential of duckweed as a biofuel feed stock.
- C. Xu, Brookhaven National Laboratory, Upton, New York:

Regulatory mechanisms controlling biosyntheses and storage in plants and microalgae.

- K. Appenroth, University of Jena, Jena, Germany: The affair between duckweeds and heavy metals.
- J. Cheng, North Carolina State University, Raleigh: Growing duckweed for nutrient recovery from wastewater.

SESSION 3: Evolution, Ecology, and Education

Chairperson: J. Messing, Rutgers University, Piscataway, New Jersey

- C. De Pamphilis, Pennsylvania State University, University Park: Tribe analyses, ancestral genes, and ancient polyploidy.
- D. Les, University of Connecticut, Storrs: Phylogenetics and genome evaluation in duckweeds and other aquatic plants.
- V. de Miranda, Universidade de Mogi das Cruzes: Aspects of biology, ecology, and evolution of Utricularia (Lentibulariaceae).

- B. Greenburg, University of Waterloo, Waterloo, Canada: Use of *Lemna* in environmental toxicology: An ideal system to study mechanisms of phytotoxicology.
- T. Oyama, Kyoto University, Kyoto, Japan: Genetic manipulation of *Lemna* in the study of circadian rhythm.
- D. Micklos, Dolan DNA Learning Center, Cold Spring Harbor Laboratory: Discussion.

SESSION 4: Physiology and Biochemistry

Chairperson: T. Michael, Rutgers University, Piscataway, New Jersey

- S. Tresch, BASF Agricultural Center, Limburgerhof, Germany: *Lemna paucicostata*: A plant test organism in herbicide mode of action research.
- E. Lam, Rutgers University, New Brunswick, New Jersey: Engineering of duckweed: Plastid transformation.
- O. Babourina, University of Western Australia, Perth: Ion transport in aquatic plants.

- J. Schwender, Brookhaven National Laboratory, Upton, New York: Duckweeds and metabolic studies using stable isotope tracers.
- J. Slovin, U.S. Department of Agriculture, Beltsville, Maryland: Lemnaceae as ideal organisms for metabolic pathway research.
- J. Cohen, University of Minnesota, St. Paul: Discussion.

SESSION 5: Aquatic Plants and Other Model Systems

Chairperson: T. Michael, Rutgers University, Piscataway, New Jersey

- V. Citovsky, SUNY, Stony Brook, New York: Discussion.
- T. Mockler, Oregon State University, Corvallis: Application of next-generation sequencing to transcriptome annotation.
- M. Eberius, LemnaTec GmbH, Würselen, Germany: High-throughput screening for phenotype and growth to identify and characterize genotype phenotype relation of duckweed.
- R. Martienssen, Cold Spring Harbor Laboratory: Developmental challenges and genetic solutions in biofuel crop design.

SESSION 6: Strategies for Future Developments

Discussion moderated by

- R. Martienssen, Cold Spring Harbor Laboratory
- J. Shanklin, Brookhaven National Laboratories, Upton, New York
- T. Michael, Rutgers University, Piscataway, New Jersey



A. Stomp

Feedback Networks in the Intersection of Metabolism and Receptor Tyrosine Kinase Signaling

November 8–10

FUNDED BY OSI Pharmaceuticals, Inc.

ARRANGED BY J. Haley, OSI Pharmaceuticals

In recent years, it has become clear that proliferative and survival signaling pathways can be made redundant by compensatory signaling through alternative pathways. Many of receptor tyrosine kinase networks are subject to dynamic feedback controls through other pathways that impact the efficacy of single-agent targeted therapies. Similarly, many of the pathways specifically targeted by recent cancer therapeutics are intersected by metabolic control networks that can dynamically alter pathway inhibition and efficacy. This discussion meeting reviewed what is known of signaling networks affecting feedback control of energy utilization, receptor tyrosine kinase signaling, and their intersection nodes and the modeling and imaging of networks and nodes. The goal was to develop a better understanding of how combinations of targeted antitumor agents can overcome the compensatory and feedback control that limits their use as single therapies.

Welcome and Introductory Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory
Background to Meeting: J. Haley, OSI Pharmaceuticals, Farmingdale, New York



SESSION 1: Metabolism-PI3K-Tor

Chairperson: J. Haley, OSI Pharmaceuticals, Farmingdale, New York

- C. Thompson, University of Pennsylvania, Philadelphia:
Metabolic intermediates amplify phosphotyrosine signaling.
M. Simon, University of Pennsylvania, Philadelphia: Oxygen
availability and tumor cell metabolism.
L. Cantley, Harvard Medical Center, Boston, Massachusetts:
PI3 kinase and cancer metabolism.
D. Sabatini, Whitehead Institute, Massachusetts Institute of
Technology, Cambridge: mTOR and the control of cell
growth.

- P. Dennis, National Cancer Institute, Bethesda, Maryland:
Tissue-specific modulation of cancer signaling by metformin
in a model of chemoprevention.
W. Weiss, University of California, San Francisco: Akt and
autophagy cooperate to promote therapeutic resistance in
glioma.
N. Rosen, Memorial Sloan-Kettering Cancer Center, New
York: Octogene-induced feedback: Implications for therapy.

SESSION 2: Regulation of RTK Signaling Systems

Chairperson: C. Thompson, University of Pennsylvania, Philadelphia

- Y. Yarden, Weizmann Institute of Science, Rehovot, Israel: The
ErbB/Her network.
N. Hynes, Friedrich Miescher Institute, Basel, Switzerland:

- Targeting RTKs in breast cancer: ErbB, Ret, and FGFRs.
P. Carmeliet, Katholieke Universiteit, Leuven, Belgium:
Angiogenic strategies by targeting RTK or metabolism.

SESSION 3: Metabolic Controls in the Ras-Raf-Erk and Jnk/p38 Pathways

Chairperson: C. Thompson, University of Pennsylvania, Philadelphia

- R. Marais, Institute of Cancer Research, London, England:
BRAF therapeutic opportunities.
S. Benkovic, Pennsylvania State University, University Park:
De novo purine biosyntheses: The “purinosome.”

- R. Davis, University of Massachusetts Medical School/HHMI,
Worcester: Stress-activated MAP kinase regulation of insulin
signaling.

SESSION 4: Network Control of and by Protein Phosphatases

Chairperson: L. Cantley, Harvard Medical Center, Boston, Massachusetts

- J. den Hertog, Hubrecht Institute, Utrecht, The Netherlands:
Protein tyrosine phosphatases in development and disease.
S. Keyse, University of Dundee, Dundee, Scotland: Regulation
of MAPK signaling by protein phosphatases.
T. Tiganis, Monash University, Victoria, Australia: Reactive
oxygen species, protein tyrosine phosphatases, and type 2
diabetes.
N. Tonks, Cold Spring Harbor Laboratory: Redox regulation
of PTP1B: Novel avenues for therapeutic intervention in
diabetes and obesity.

**SESSION 5: Global Approaches to Interrogating Networks and
Systems**

Chairperson: N. Tonks, Cold Spring Harbor Laboratory

- M. Comb, Cell Signaling Technology, Beverly, Massachusetts:
A new view on Akt signaling downstream from RTKs.
K. Janes, University of Virginia, Charlottesville: Identifying
feedback networks in single cells.
W. Hahn, Harvard Medical Center, Boston, Massachusetts:
Genetic approaches to dissect feedback and signaling in
cancer.



R. Davis

Structural Variation in the Human Genome

November 15–18

FUNDED BY Cold Spring Harbor Laboratory Corporate Sponsor Program

ARRANGED BY J. Lupski, Baylor College of Medicine
E. Eichler, University of Washington

Chromosomal rearrangements were the first genome-scale variations to be discovered in human beings. They were detected by light microscopy of chromosomes stained with simple dyes and later at higher resolution when Giemsa banding was introduced. Fifty years later, extraordinary resolution is being provided by genomic microarrays and sequencing, and new classes of genomic variations are being revealed. Copy-number variants (CNVs) are, perhaps, the most important of these. Ranging in size from kilobases to megabases, CNVs have been associated with a number of human developmental disorders. However, much remains to be done before CNVs can be used routinely as diagnostic markers. The goals of this meeting were to review the occurrence and generation of CNVs in the human genome, discuss approaches for their discovery, examine their relationship with disease, discuss their use for genetic diagnoses, and explore how to develop cost-effective tests.

Introductory and Welcoming Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory
Introductory Remarks: E. Eichler, University of Washington, Seattle
J. Lupski, Baylor College of Medicine, Houston, Texas



SESSION 1: CNVs: The Clinical Perspective

Chairperson: J. Lupski, Baylor College of Medicine, Houston, Texas

- B. Bejjani, Signature Genomics Laboratories, Spokane, Washington: Managing CNVs in the diagnostic laboratory.
P. Stankiewicz, Baylor College of Medicine, Houston, Texas: Design of clinical arrays.

- H. Firth, Addenbrooke's Hospital, Cambridge, England: Decipher/deciphering developmental disorders.
D. Ledbetter, Emory University School of Medicine, Atlanta, Georgia: CNV atlas of human development.

SESSION 2: Mechanism and Evolution

Chairperson: M. Snyder, Stanford University School of Medicine, Stanford, California

- J. Lupski, Baylor College of Medicine, Houston, Texas: Genomic disorders: Mechanisms upstream and downstream from CNV.
E. Hollox, University of Leicester, Leicester, England: Evolution and variation of β -defensin copy number.

- J. Sikela, University of Colorado, Aurora: Linking genome instability, evolutionary adaptation, and disease.
P. Hastings, Baylor College of Medicine, Houston, Texas: Mechanisms of structural change.

SESSION 3: Next-generation Detection and Interpretation

Chairperson: E. Eichler, University of Washington, Seattle

- M. Gerstein, Yale University, New Haven, Connecticut: Detection and analysis of structural variants in personal genome sequencing data.
J. Korbel, EMBL Heidelberg, Heidelberg, Germany: Next-generation analysis of structural variation in humans with a breakpoint library.
H. Peckham, Life Technologies, Beverly, Massachusetts: CNV detection with short-read sequencing.
M. Snyder, Stanford University School of Medicine, Stanford,

- California: Variation and transcription factor binding in humans.
E. Klopocki, Charité Universitätsmedizin Berlin, Berlin, Germany: CNVs of conserved noncoding sequence elements: A novel mechanism in the pathogenesis of congenital malformations.
X. Zhang, Chinese Academy of Medical Sciences, Beijing, China: Variable phenotypes associated with CNVs of the same chromosomal regions.

SESSION 4: Neuropsychiatric Traits and CNV

Chairperson: H. Mefford, University of Washington, Seattle

- S. Scherer, The Hospital for Sick Children, Toronto, Canada: CNV in autism spectrum and related neurodevelopmental disorders: Genome to outcome.
E. Eichler, University of Washington, Seattle: Genome structural variation and disease.

- A. Beaudet, Baylor College of Medicine, Houston, Texas: Genotype/phenotype correlations for CHRNA7 to antisocial behaviors.
J. Sebat, Cold Spring Harbor Laboratory: Looking for rare variants of large effect in schizophrenia and bipolar disorder.

SESSION 5: CNV and Common Complex Traits

Chairperson: A. Beaudet, Baylor College of Medicine, Houston, Texas

- H. Mefford, University of Washington, Seattle: CNVs in epilepsy: Expanding the phenotypic spectrum of genomic disorders.
T. Aitman, Imperial College, London, England:

- CNV and autoimmunity.
S. McCarroll, Harvard Medical School, Boston, Massachusetts: Genome structural polymorphism in common diseases.

SESSION 6: Interpretation of Phenotypic Consequences of CNV

Chairperson: A. Beaudet, Baylor College of Medicine, Houston, Texas

- L. Pérez Jurado, University of Washington, Seattle: The hidden variation: Common CNVs/PSVs in autism spectrum disorders.
B. de Vries, University Medical Center Nijmegen, Nijmegen, The Netherlands: Interpretation of CNVs in a clinical

- setting; benign versus pathogenic.
N. Spinner, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania: Genomic alterations and phenotype: Determining pathogenicity is NOT SO SIMPLE.

Concluding Remarks: J. Lupski, Baylor College of Medicine, Houston, Texas
E. Eichler, University of Washington

Promoting Research on Severe Mental Illness

December 3–5

FUNDED BY NARSAD, The Brain & Behavior Research Fund, World Heritage Foundation–Prechter Family Fund, Simons Foundation

ARRANGED BY J.D. Watson, Cold Spring Harbor Laboratory
 E. Scolnick, Broad Institute
 H. Pardes, New York Presbyterian Hospital
 H. Heimer, Schizophrenia Research Forum
 A. Moran, NARSAD
 J. Witkowski, Banbury Center, Cold Spring Harbor Laboratory

Mental disorders place a terrible burden on society, and there is an urgent need to encourage Congress to promote research on these disorders. A major effort to find the genes involved in mental disorders began in the 1980s, but the then available tools were not suitable for the analysis of disorders caused by many mutations. Continuing technical developments, many arising from the Human Genome Project, have revitalized genetic analysis of complex disorders, and these new techniques are being applied to mental disorders. Participants in this meeting included eminent scientists and psychiatrists, as well as individuals familiar with promoting research, in this case, genomics-based research, an approach offering the best path to treatments or prevention of mental disorders.

Welcome and Introductory Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory
Welcome and Introductory Remarks: C. Lieber and S. Lieber, NARSAD, Great Neck, New York
The Need for Research: J.D. Watson, Cold Spring Harbor Laboratory



SESSION 1: Genetics and Genomics

Chairperson: E. Kandel, Columbia University, New York

K. Kendler, Virginia Commonwealth University, Richmond:
Challenges in genetics research in mental illness.

E. Scolnick and P. Sklar, Broad Institute, Cambridge,
Massachusetts: Genomic approaches to mental illness.

W. McCombie, Cold Spring Harbor Laboratory: Fourth-
generation DNA sequencing and human genetic disorders.

D. Goldstein, Duke University, North Carolina: Rare and
common genetic variants contributing to risk of
schizophrenia.

M. Daly, Harvard University, Cambridge, Massachusetts:
General discussion.

SESSION 2: Promoting Genomic Research in Mental Illness

Chairperson: T. Insel, National Institutes of Health/NIMH, Bethesda, Maryland

Views of Genetic and Genomic Research

T. Lehner, National Institute for Mental Health

E. Green, National Human Genome Research Institute, Bethesda,
Maryland

A. Malhotra, The Zucker Hillside Hospital, Glen Oaks, New York

C. Gilliam, University of Chicago, Chicago, Illinois

F. Henn, Brookhaven National Laboratory, New York

R. DePaulo, Johns Hopkins University School of Medicine, Baltimore,
Maryland

H. Akil, University of Michigan, Ann Arbor

W. Bunney, University of California, Irvine

Input from Groups Engaged in Promoting Research

NARSAD: H. Pardes, New York Presbyterian Hospital, New York

Pechter Fund: W. Prechter, Heinz C. Prechter Bipolar Research Fund,
Ann Arbor, Michigan

Simons Foundation: G. Fischbach, Simons Foundation, New York

General Discussion and Points Arising

SESSION 3: What to Do?

Chairperson: H. Pardes, New York Presbyterian Hospital, New York

M. Woolley, Research!America, Alexandria, Virginia: Promoting
research.

Is Washington D.C. Receptive to This Message?

G. Weiblinger, National Institutes of Health/NIMH, Bethesda, Maryland:
Determining the NIH Annual Budget.

How to Do It?

M.-C. King, University of Washington, Seattle: Scientists joining the
advocacy for mental health research.

B. Metheny, South Dartmouth, Massachusetts: Delegation model.

J. Greden, University of Michigan, Ann Arbor: National networks of
depression centers.

B. Gill, The Charles A. Dana Foundation, New York: Dana Alliance for
Brain Research.

**What Do We Need? Summation and Action Points: Open
Discussion**

Moderator: H. Pardes, New York Presbyterian Hospital, New York



A. Moran, B. Shobe



E. Green, J.D. Watson

Coinfections in Lyme Disease

December 14–15

FUNDED BY Time for Lyme, Inc.

ARRANGED BY S. Schutzer, UMDNJ–New Jersey Medical School

Since the 1990s, the Banbury Center has been the venue for a series of very influential meetings on Lyme disease. A benefit of such meetings has been collaborations into research on coinfections carried by the same tick vector that transmits Lyme disease. This meeting reviewed what is known of coinfections in Lyme disease and provided an opportunity for planning a Lyme disease meeting at Banbury in 2010.

Introductory and Welcoming Remarks: J.A. Witkowski, Banbury Center, Cold Spring Harbor Laboratory
Introductory Remarks: S. Schutzer, UMDNJ–New Jersey Medical School, Newark

SESSION 1

Chairperson: S. Schutzer, UMDNJ–New Jersey Medical School, Newark

D. Fish, Yale University, New Haven, Connecticut: Ticks and the environment.

M. Eshoo, IBIS Biosciences, Inc., Carlsbad, California: Summary of polymicrobial detection studies in tick-borne diseases.

SESSION 2

Chairperson: P. Fox, Animal Medical Center, New York

A. Hohenhaus, Animal Medical Center, New York: The dog as a sentinel of tick-borne diseases.

S. Schutzer, UMDNJ–New Jersey Medical School, Newark: Continued and future studies and discussion.



BANBURY CENTER GRANTS

<i>Grantor</i>	<i>Program</i>	<i>Duration of Grant</i>	<i>2009 Funding</i>
FEDERAL SUPPORT			
NIH–National Institute of Mental Health	The 1st Annual NIMH-Sponsored Brain Camp	2009	\$ 37,177
NIH–National Institute on Drug Abuse	Neurobiology of Depression: From Molecules to Mood	2009	5,580
NIH–National Institute of Neurological Disorders and Stroke	From Infection to Neurometabolism: A Nexus for CFS	2009	35,000
NIH–National Institute of Mental Health (through a grant to University of Illinois)	New Developments in Fragile X Syndrome: From Basic Mechanisms to Therapeutics	2009	51,273
National Science Foundation	NSF Workshop: A Vision for Plant Biology	2009	915
NONFEDERAL SUPPORT			
<i>Meeting Support</i>			
AstraZeneca Pharmaceuticals	Neurobiology of Depression: From Molecules to Mood	2009	7,000
Biotechnology and Biological Sciences Research Council (BBSRC)	NSF Workshop: A Vision for Plant Biology	2009	2,745
Boehringer Ingelheim Fonds	Science: Get it Across!	2009	67,991
CFIDS Association of America	From Infection to Neurometabolism: A Nexus for CFS	2009	15,753
Cold Spring Harbor–Pioneer Collaborative Research Program	Epigenetic Inheritance, Gene Regulation, and Plant Development	2009	47,049
Deutsche Forschungsgemeinschaft (DFG)	NSF Workshop: A Vision for Plant Biology	2009	915
The Gordon and Betty Moore Foundation	Aquatic Plants: Environment, Energy, and Evolution	2009	50,000
Hoffmann-LaRoche, Inc.	Neurobiology of Depression: From Molecules to Mood	2009	10,000
Hope for Depression Research Foundation	Neurobiology of Depression: From Molecules to Mood	2009	4,593
Johnson & Johnson	Neurobiology of Depression: From Molecules to Mood	2009	10,000
Lilly Research Laboratories	Neurobiology of Depression: From Molecules to Mood	2009	6,600
NARSAD, The Brain and Behavior Research Fund	Promoting Research on Severe Mental Illness	2009	15,000
OSI Pharmaceuticals, Inc.	Feedback Networks in the Intersection of Metabolism and Receptor Tyrosine Kinase Signaling	2009	32,132
The Salk Institute	NSF Workshop: A Vision for Plant Biology	2009	8,235
Simons Foundation	Promoting Research on Severe Mental Illness	2009	5,000
The Stanley Research Foundation	Psychiatric Genetics: Current Progress and Future Directions	2009	17,823
The Swartz Foundation	Searching for Principles Underlying Memory in Biological Systems	2009	44,355
Time for Lyme, Inc.	Coinfections in Lyme Disease	2009	5,070
University of Arizona	iPlant Collaborative	2009	23,078
The Wellcome Trust	International Catalog for the History of the Human Genome Project	2009	12,369
World Heritage Foundation– Prechter Family Fund	Promoting Research on Severe Mental Illness	2009	5,000
Wyeth Pharmaceuticals	Neurobiology of Depression: From Molecules to Mood	2009	5,000