

BANBURY CENTER

# BANBURY CENTER

## EXECUTIVE DIRECTOR'S REPORT

---

Cold Spring Harbor Laboratory's Banbury Center marked another anniversary in 2018: 40 years since the first group of experts arrived at the Center for a meeting, "Assessing Chemical Mutagens: The Risk to Humans." This inaugural group set out to debate the impending health risks that could be tied to emerging and pervasive chemical technology. It is easy to find echoes of these first discussions of technology and health, as well as the conclusions that more data are needed, in the dialogues happening today.

### The Numbers

The Center was humming in 2018, with more than 50 events utilizing the estate, including traditional Banbury meetings, Meetings & Courses Program (*Workshop on Schizophrenia and Related Disorders*, *Computational Neuroscience*, *Genetics and Neurobiology of Language*, *Brain Tumors*, *Workshop on Leadership in Bioscience*, *Scientific Writing Retreat*), Watson School of Biological Sciences courses (*Microbial Pathogenesis*, *Evolution*), and laboratory retreats.

The Center welcomed 465 individuals for Banbury meetings in 2018, with 71% marking their first visit. These participants were drawn from 26 countries and 32 states in the United States. The largest portion of Banbury attendees work in academic settings (72%); however, participants from industry (10%), not-for-profit organizations (7%), U.S. and foreign governments (7%), and publishing/writing (4%) brought diverse perspectives and new cross-sector relationships. Banbury continues to strive for gender equity: 41% of participants and 36% of meeting organizers in 2018 were women.

Funding continues to be a major hurdle in convening Banbury meetings. In 2018, Banbury secured financial support from not-for-profit organizations (46%), industry (22%), and government



Technology and Education Council: Opportunities for AI and Machine Learning for the Biotech Industry



B. Amulic, B. Barnes, M. Egeblad, M. Kaplan, and A. Zychlinsky at *Diverse Functions of Neutrophils in Cancer* meeting

(4%). The CSHL Corporate Sponsor Program remained a critical resource for cutting-edge meetings and represented 29% of funding.

One of the challenges in convening confidential, invitation-only meetings is ensuring relevant discussions and outputs reach target audiences beyond meeting participants. In 2018, Banbury made progress on this front with a new website and social media accounts. With the growing number of experts using social media to share ideas and engage in discussion of science and technology, the Banbury Center waded into these platforms as a way to share outputs from meetings, as well as historical context of the program and estate. The new Banbury Twitter and Instagram accounts (@CSHLbanbury) have been a productive tool to deliver information about recent and historical meetings, share outputs, showcase the beauty of the estate, and celebrate achievements of Banbury alumni. After only a few months on Twitter, and despite limits to what we can post (because of our confidentiality policy), we tweeted 46 times, added 173 followers, gained 69 mentions, and garnered nearly 60,000 impressions.

## Meeting Themes

The year's meetings drew on two of Banbury's strengths: bridging interdisciplinary divides and hosting discussions at the frontiers of science and technology. Because of the highly diverse groups of experts, these meetings are often the only forum allowing meaningful engagement between groups. In the spring, *DNA for Digital Storage* saw synthetic biologists and computer scientists scrutinize opportunities and limitations for the use of DNA to store data. New questions emerged throughout the two days, and the group returns in 2019 to further these important discussions. Perhaps better suited for Halloween, bats were the subject of another spring meeting on *New Models for Aging Research*. The unique characteristics that allow this order to live far longer than its nonflying mammalian relatives were examined by experts spanning comparative biology, gerontology, immunology, genetics, and neuroscience; many new connections were made, which we expect will lead to new collaborations and progress in several fields. Finally, an especially diverse group of synthetic biologists, metabolic engineers, developmental biologists, and biochemists met at December's *Revolutionizing Agriculture with Synthetic Biology*, aiming to "think big" about using synthetic biology to improve crops and other plants. The year concluded with *Phase-Separated Assemblies in Cell Biology*, and lively debate between biologists and physicists over these so-called membraneless organelles.



R. Nkambule, P. Preko, H. Doyle, and A. Achrekar at *What Is Needed for a Comprehensive Community Response to HIV* meeting

In the context of neuroscience, four meetings tackled questions from basic research through training and policy. February's *The Evolving Phenomenon of Direct-to-Consumer Neuroscience* convened diverse stakeholders and experts to consider medical, ethical, and regulatory issues emerging with the availability of at-home devices and software to monitor and/or modulate brain function. The meeting's co-organizers used these discussions as the basis for a recent article in *Science*. The autumn brought issues of a more fundamental nature, including *Quantitative Approaches to Naturalistic Behaviors* in September, and *Why Does the Neocortex have Layers and Columns?* in October. The National Institute of Mental Health returned in 2018 for *Brain Camp IX*, an intensive scientific retreat for top psychiatry residents with an interest in a research career.

Cancer has always been a major target for Banbury discussions, and 2018 was not different, with four such meetings in the autumn. Three events gathered experts to discuss the ways in which cellular functions and pathways may play a role in the development or treatment of cancers: *Emerging Data on the Role of Wnt Biology in Cancer, Autophagy and Cancer*, and *Diverse Functions of Neutrophils in Cancer*. Further down the pipeline, *Towards a Cure for Advanced Stage Ovarian Carcinoma* reviewed current and prospective treatments for this disease in order to identify strategies best positioned to provide optimal outcomes for patients. Similarly working to support the best research and improving outcomes for patients, the Lustgarten Foundation returned to the Conference Room for their 2018 Scientific Meeting, providing an opportunity for the Scientific Advisory Board, as well as Foundation-supported investigators, to discuss research and strategy.

With an eye toward policy, two meetings targeted broader issues affecting the scientific community: trustworthiness and gender diversity. The former, *Signals of Trust in Science Communication*, was organized by Marcia McNutt (National Academy of Sciences), Richard Sever (CSHL Press and bioRxiv), and Kathleen Hall Jamieson (Annenberg Center). Participants debated emerging challenges to identifying whether reported research represents rigorous scientific standards, especially in the context of increasing interdisciplinarity in research, growth in the number of journals and other reporting outlets, and inconsistent peer review policies. In December, experts met at Banbury for *Increasing Gender Diversity in the Biosciences*, aiming to identify practical solutions to better recruit, promote, and support women. The meeting, led by Carol Greider (Johns Hopkins) and Jason Sheltzer (CSHL), resulted in a number of short- and long-term recommendations, including time banking, opt-out tenure clock extensions, and greater mentorship training, as well as a number of suggestions to improve policies surrounding sexual and gender harassment in academia.





A second set of policy-based meetings targeted public health: The Bill and Melinda Gates Foundation returned for May's *What Is Needed for a Comprehensive, Community Response to HIV?*, convening global leaders in HIV prevention, including organizers Rejoice Nkambule, Deputy Director at the Swaziland Ministry of Health, and Mark Dybul, former U.S. Global AIDS Coordinator. Whereas May's meeting focused on HIV prevention in Africa, September's *Non-Opioid Management of Chronic Pain* took aim at the opioid epidemic from a practical, policy approach: Reduce opioid prescriptions by improving effectiveness of a stepped care model. The meeting was co-organized by the NIH's Head of Pain Policy, Linda Porter, and the director of the Chronic Pain and Fatigue Research Center at the University of Michigan, Daniel Clauw. Among the participants were representatives from both healthcare providers and payers, including Centers for Medicare & Medicaid's Deputy Chief Medical Officer, and the Veterans Affairs National Program Director for Pain Management.

### The Team. The Team. The Team.

The real engine of the Center are the professionals who ensure organization, finance, communication, and the estate are running at a high level. In 2018 we bade farewell to Pat Iannotti, who left the Banbury office after 6 years to head for the sunnier south, and to Hakon Heimer, who stepped away from consulting on mental disorders to take up a position with the University of Copenhagen. Michelle Corbeaux celebrated her 3-year anniversary at Banbury with a promotion to Finance and Development Coordinator, and we welcomed Jasmine Breeland as Communications and Special Projects Coordinator. Basia Polakowski continues to oversee our three residence buildings, ensuring our guests are comfortable, while the Culinary Services team keeps them well fed, and the Audiovisual staff ensures technology supports rather than distracts. Jose Peña-Corvera, John Shea, and Paulo Krizanovski look after 55 acres of impeccable grounds, and the entire Facilities team quite literally keeps us running.

Rebecca Leshan  
Director

### Publications Resulting from Banbury Meetings

- Schutzer SE, Body BA, Boyle J, Branson BM, Dattwyler RJ, Fikrig E, Gerald NJ, Gomes-Solecki M, Kintrup M, Ledizet M, et al. 2018. Direct diagnostic tests for Lyme disease. *Clin Infect Dis* **68**: 1052–1057. doi:10.1093/cid/ciy614
- Wexler A, Reiner PB. 2019. Oversight of direct-to-consumer neurotechnologies. *Science* **363**: 234–235. doi:10.1126/science.aav0223

**BANBURY CENTER MEETINGS**

<i>Dates</i>	<i>Title</i>	<i>Organizer(s)</i>
February 4–6	The Evolving Phenomenon of Direct-to-Consumer Neuroscience	P. Reiner, A. Wexler
March 4–6	DNA for Digital Storage	E. Birney, Y. Erlich, N. Goldman
March 11–14	Bats: New Models for Aging Research	S. Austad, E. Teeling
April 8–11	Signals of Trust in Science Communication	K. Hall Jamieson, M. McNutt, R. Sever
April 13–15	National Institute of Mental Health: Brain Camp IX	J. Chung, J. Gordon
May 13–16	What Is Needed for a Comprehensive, Community Response to HIV?	M. Dybul, R. Nkambule
June 28	Technology and Education Council: Opportunities for AI and Machine Learning for the Biotech Industry	J. Donaldson
September 16–19	Non-Opioid Management of Chronic Pain: Developing Value-Based Models for Diagnosis and Treatment	D. Clauw, L. Porter
September 23–26	Quantitative Approaches to Naturalistic Behaviors	W. Bialek, S. Palmer, S. Sober
October 7–10	Emerging Data on the Role of Wnt Biology in Cancer	J. Clevers, C. Mirabelli, R. Nusse, D. Tuveson, B. Williams
October 14–17	Autophagy and Cancer	R. Amaravadi, J. Debnath, A. Kimmelman
October 21–23	Towards a Cure for Advanced Stage Ovarian Carcinoma	J. Boyd, S. DeFeo, D. Levine, A. Moran
October 28–31	Why Does the Neocortex have Layers and Columns?	S. Ahmad, J. Gavornik, S. Mihalas
November 11–13	The Lustgarten Foundation Scientific Meeting	K. Kaplan, D. Tuveson, R. Vizza
November 27–30	Diverse Functions of Neutrophils in Cancer	K. de Visser, M. Egeblad, P. Kubes
December 2–5	Revolutionizing Agriculture with Synthetic Biology	A. Hanson, C. Vickers, E. Wurtzel
December 9–12	Increasing Gender Diversity in the Biosciences	C. Greider, J. Sheltzer
December 16–19	Phase-Separated Assemblies in Cell Biology	A. Chakraborty, G. Seydoux, P. Sharp, R. Young

# BANBURY CENTER MEETINGS

---

## The Evolving Phenomenon of Direct-to-Consumer Neuroscience

---

February 4–6

ARRANGED BY      P. Reiner, University of British Columbia, Vancouver, Canada  
A. Wexler, University of Pennsylvania, Philadelphia

FUNDED BY        Cold Spring Harbor Laboratory Corporate Sponsor Program

A growing array of devices, products, and software are being sold directly to consumers to monitor and modulate brain function. These products—noninvasive neurostimulation, EEG recording devices, brain-fitness software, and apps that diagnose mental health disorders—are allowing the public to gain access to technologies that were once held behind the closed doors of science and medicine. As there is currently little oversight over the effectiveness of these products and the claims made by their manufacturers, this phenomenon presents a host of novel regulatory and ethical questions. This meeting convened an interdisciplinary expert group of legal scholars, philosophers, bioethicists, sociologists, regulators, and industry representatives to discuss challenges posed by the evolving phenomenon of direct-to-consumer neuroscience and to develop solutions that foster best practices in the field. The meeting's organizers used discussions at this meeting as the foundation for a 2019 policy paper in *Science*.

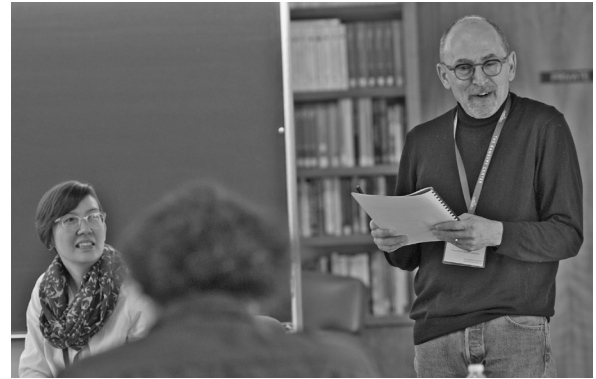
Welcoming Remarks: R. Leshan, Director, Banbury Center, Cold Spring Harbor Laboratory

Introduction and Meeting Objectives: P. Reiner, University of British Columbia, Vancouver, Canada, and  
A. Wexler, University of Pennsylvania, Philadelphia





A. Seitz, A. Wexler



K. Rommelfanger, P. Reiner

### SESSION 1: Overview of the Direct-to-Consumer Neuroscience Market

**Chairperson:** D. Dobbs, Science Journalist

A. Fernandez, SharpBrains, Washington, D.C.: What are consumers buying, and why, and how could we empower them to make better decisions in the brain/mental health space?

### SESSION 2: Institutional Pushes and Pulls

**Chairperson:** A. Wexler, University of Pennsylvania, Philadelphia

C. Peña, U.S. Food and Drug Administration, Silver Spring, Maryland: A primer on FDA oversight for neurological devices.

A. Soberats, Federal Trade Commission, Washington, D.C.: FTC advertising law, brain training cases.

### SESSION 3: Direct-to-Consumer Brain Training

**Chairperson:** P. Reiner, University of British Columbia, Vancouver, Canada

K. Rommelfanger, Emory University, Atlanta, Georgia: Internet-based brain training games, citizen scientists, and big data: Ethical issues in unprecedented virtual territories.

J. King, National Institute on Aging, NIH, Bethesda, Maryland: Integrating institutional assessment and communication of the effectiveness of cognitive training.

A. Seitz, University of California, Riverside: Experiences with carrot neurotechnology and FTC regulatory action.

### SESSION 4: Direct-to-Consumer Recording

**Chairperson:** A. Fernandez, SharpBrains, Washington, D.C.

Y. Roy, University of Montreal/NeurotechX, Quebec, Canada: Overview of direct-to-consumer EEG products: Current state and the future.

R. Thibault, McGill University, Montreal, Quebec, Canada: Assessing neurofeedback claims made by consumer EEG companies.

B. Capestany, Duke University, Durham, North Carolina: Consumer concerns with the privacy of brain analytics.

### SESSION 5: Direct-to-Consumer Electrical Stimulation

**Chairperson:** P. Zettler, Georgia State University, Atlanta

A. Wexler, University of Pennsylvania, Philadelphia: Direct-to-consumer brain stimulation: Ethical and regulatory issues.



J. King, B. Wingeier, K. Rommelfanger, C. Peña, D. Dobbs



C. O'Connor, H. Greely



B. Wingeier, Halo Neuroscience, San Francisco, California: Best practices for safe, effective, and credible consumer neurotech development.

#### SESSION 6: On the Horizon

**Chairperson:** H. Greely, Stanford University Law School, California

P. Reiner, University of British Columbia, Vancouver, Canada: Can technology be used to read our minds?

N. Farahany, Duke University, Durham, North Carolina; P. Reiner, University of British Columbia, Vancouver, Canada; and A. Wexler, University of Pennsylvania, Philadelphia: Introduction and aims for day 2.

#### SESSION 7: Perspectives from the Public

**Chairperson:** K. Rommelfanger, Emory University, Atlanta, Georgia

C. O'Connor, University College Dublin, Belfield, Ireland: Public engagement with brain optimization.

S. Lock, AARP, Washington, D.C.: Brain health.

J. Torous, Harvard University, Boston, Massachusetts: Informed decision-making around mental health apps: The American Psychiatric Association framework approach.

#### SESSION 8: Independent Third-Party Review of Products and Advertising

**Chairperson:** P. Reiner, University of British Columbia, Vancouver, Canada

B. Patten, Truth in Advertising, New York, New York: Mind games: The deceptive advertising of brain function products and audio services.

S. Schueller, Northwestern University, Chicago, Illinois: Identification and evaluation of consumer mental health apps.



N. Farahany, C. Peña, P. Reiner, R. Thibault (*back to camera*), B. Wingeier, B. Capestany (seated), K. Rommelfanger

T. Cooperman, ConsumerLabs.com, White Plains, New York: Experiences of a third-party evaluator of health and nutrition products.

#### SESSION 9: Lessons from DTC Health Products

**Chairperson:** H. Greely, Stanford University Law School, Stanford, California

P. Zettler, Georgia State University, Atlanta, Georgia: Reviewing the regulatory history of DTC Health Products.

N. Farahany, Duke University, Durham, North Carolina: Discussant.

#### SESSION 10: Summary Discussion and Wrap-Up

H. Greely, Stanford University Law School, California: Reflections and group discussion on regulation and oversight of direct-to-consumer neuroscience.

P. Reiner, University of British Columbia, Vancouver, Canada, and Anna Wexler, University of Pennsylvania, Philadelphia: Wrap-up and next steps.

# DNA for Digital Storage

---

March 4–6

**ARRANGED BY** E. Birney, European Bioinformatics Institute, Hinxton, United Kingdom  
Y. Erlich, Columbia University, New York, New York  
N. Goldman, European Bioinformatics Institute, Hinxton, United Kingdom

**FUNDED BY** Burroughs Wellcome Fund; Agilent Technologies, Inc.; Twist Bioscience Corporation;  
with additional support from Microsoft Corporation

Progress in the use of DNA encoding for data storage has surged since the initial published descriptions of the technology 5 years ago. This Banbury meeting convened experts and thought leaders in order to (1) share current knowledge on the use of DNA for information storage, (2) examine limitations and potential opportunities, and (3) identify strategies to deploy the technology for more widespread research and commercial use. Discussions at the meeting were highly productive and underscored the need for more engagement and for input from groups not represented at the meeting. Ultimately, the group determined that a second meeting in 2019 was needed to continue the momentum.

**Welcoming Remarks:** R. Leshan, Director, Banbury Center, Cold Spring Harbor Laboratory

## SESSION 1: Synthesis and Chemistry

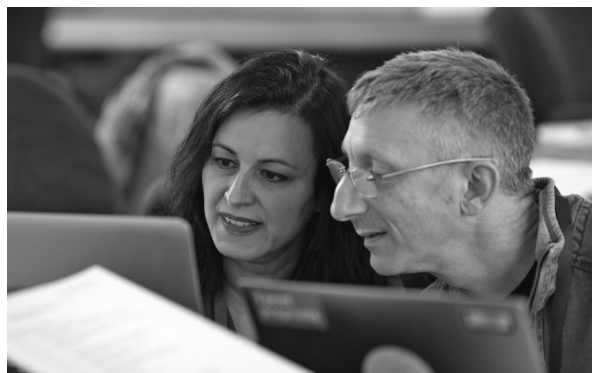
**Chairperson:** E. Birney, European Bioinformatics Institute, Hinxton, United Kingdom

B. Peck, Twist Bioscience, San Francisco, California: Addressing the skeptics, how data storage will scale DNA synthesis.

J. Sampson and L. Whitman, Agilent Technologies, Santa Clara, California: Advanced oligonucleotide library synthesis.  
J-F. Lutz, Institut Charles Sadron, Strasbourg, France: Digital polymers: Recent achievements and promises.

R. Grass, ETH Zürich, Zürich, Switzerland: The stability of DNA during storage.





O. Milenkovic, N. Goldman

O. Milenkovic, University of Illinois, Urbana: New directions in DNA-based data storage and computing.

## SESSION 2: Systems

**Chairperson:** Y. Erlich, Columbia University, New York, New York

E. Zadok, Stony Brook University, New York: History and recent trends in data storage technologies.

S. Hickling, GCHQ, Cheltenham, United Kingdom: How GCHQ is planning to use DNA for data storage.

K. Strauss, Microsoft, USA, Redmond, WA: Digital data storage in synthetic DNA.

## SESSION 3: Money

**Chairperson:** R. McKibbin, BBSRC, Swindon, United Kingdom

M. Biddle, Innovate UK, Swindon, United Kingdom: The UK approach to disruptive innovation such as DNA for digital storage.



M. Biddle, L. Whitman



R. Grass, J. Flatley, S. Kosuri, K. Strauss

B. Bramlett, Twist Bioscience, San Francisco, California: Economic Drivers for DNA Memory.

## SESSION 4: New Science

**Chairperson:** N. Goldman, European Bioinformatics Institute, Hinxton, United Kingdom

Y. Erlich, Columbia University, New York, New York and Dina Zielinski, Institut Curie, Paris, France: DNA storage: A critical evaluation.

E. Birney, European Bioinformatics Institute, Hinxton, United Kingdom: Developments in digital DNA: New uses.

S. Kosuri, University of California, Los Angeles: DNA and storage: An optimist's view.

J. Flatley, Illumina, San Diego, California: Progress in DNA sequencing.

## SESSION 5: Wrap-Up/Next Steps

**Led by:** Y. Erlich, Columbia University, New York, New York



E. Zadok, D. Rosenthal

# Bats: New Models for Aging Research

---

March 11–14

ARRANGED BY      **S. Austad**, University of Alabama at Birmingham  
                             **E. Teeling**, University College Dublin, Ireland

FUNDED BY          **The Cold Spring Harbor Laboratory Corporate Sponsor Program**

Aging, the nearly ubiquitous deterioration of physical and mental function that occurs with time, has the greatest impact on global health: People everywhere are experiencing longer life spans, but not necessarily longer “health spans.” Thus, understanding the processes that underlie healthy aging remains a critical challenge. Although researchers have made substantial progress studying aging in short-lived mammals such as mice, there is little evidence that these methods will translate to more aging-resistant species such as humans. An alternative approach is to analyze species that are even more aging-resistant than humans: bats. This Banbury meeting convened a cross-disciplinary group of experts to explore the underlying molecular basis of extended health and longevity in bats and to identify strategies for integrating the discoveries from this model species into broader aging studies.

**Welcoming Remarks:** **R. Leshan**, Director, Banbury Center, Cold Spring Harbor Laboratory  
                             **S. Austad**, University of Alabama at Birmingham: Introduction and meeting objectives; and Why bats are important for biological aging research.

## SESSION 1: Bat Biology: An Aging Context

**Chairperson:** **E. Teeling**, University College Dublin, Ireland  
**N. Simmons**, American Museum of Natural History, New York, New York: Bat diversity: What we know (and don't know).

**G. Wilkinson**, University of Maryland, College Park: Repeated evolution of longevity in bats.

**D. Dechmann**, Max Planck Institute for Ornithology, Radolfzell, Germany: The exception from the rule: Short life expectancy and unusual immune response of the Pallas free-tailed bat, *Molossus molossus*.







E. Teeling



N. Simmons, D. Dechmann

S. Puechmaile, University of Greifswald, Germany: Comparing what is ecologically comparable in interspecific ageing studies.

S. Vernes, Max Planck Institute for Psycholinguistics, Nijmegen, Netherlands: Bats as a model for ageing: What neurogenetic tools do we need?

## SESSION 2: Comparative Approaches to Aging

**Chairperson:** S. Vernes, Max Planck Institute for Psycholinguistics, Nijmegen, Netherlands

V. Gorbunova, University of Rochester, New York: Long-lived mammals as research models for healthy aging.

V. Gladyshev, Harvard Medical School, Boston, Massachusetts: Insights into lifespan control from the bat genome and comparative genomics of mammals.

R. Miller, University of Michigan, Ann Arbor: Multicladal cellular biogerontology.

W. Wright, UT Southwestern Medical Center, Dallas, Texas: The comparative biology of telomeres.

E. Teeling, University College Dublin, Ireland: Molecular basis of exceptional ageing in bats.

R. Anderson, University of Wisconsin, Madison: Nonhuman primate aging.

## SESSION 3: Mechanisms to Measure Aging and its Intervention

**Chairperson:** R. Miller, University of Michigan, Ann Arbor, Michigan

D. Gems, University College London, United Kingdom: Evolutionary and proximate mechanisms of aging: New insights from *C. elegans*.

P. Fedichev, Gero, LLC and Moscow Institute of Physics and Technology, Russian Federation: Aging as dynamic instability of underlying regulatory network: The case for negligible senescence.

F. Sierra, National Institute on Aging, NIH, Bethesda, Maryland: Phylogenetic efforts at NIA.

S. Horvath, University of California, Los Angeles Epigenetic clock for mammals.

D. Promislow, University of Washington, Seattle: Systems biology approaches in aging research.

## SESSION 4: Flight, Immunity, Hibernation and Longevity

**Chairperson:** C. Wright, Journalist

L. Dávalos, Stony Brook University, New York: Metabolism, immunity, and the emergent unified theory of survival and disease.



R. Miller, S. Austad



S. Horvath, P. Fedichev

- V. Deep Dixit, Yale University, New Haven, Connecticut: Immune to aging.
- K. Belov, The University of Sydney, Australia: Immunity and aging in marsupials.
- K. Storey, Carleton University, Ottawa, Canada: Hibernation and aging.
- E. Teeling, University College Dublin, Ireland: The bat immune system and its potential role in ageing.

#### SESSION 5: Breakout Groups

**Chairperson: S. Austad**, University of Alabama at Birmingham This interactive session used insights from meeting presentations to consider questions around the future of bats and aging research.

S. Austad, University of Alabama at Birmingham, Alabama: Overview of breakout group aims, and dividing into groups.



V. Gorbunova, S. Horvath

#### SESSION 6: Meeting Wrap-Up and Next Steps

**Chairpersons: E. Teeling**, University College Dublin, Ireland, and **S. Austad**, University of Alabama at Birmingham

# Signals of Trust in Science Communication

---

April 8–11

ARRANGED BY      **K. Hall Jamieson**, University of Pennsylvania, Philadelphia  
                         **M. McNutt**, National Academy of Sciences, Washington, D.C.  
                         **R. Sever**, Cold Spring Harbor Laboratory Press

FUNDED BY        **The Alfred P. Sloan Foundation**

Although overall confidence in science remains relatively high, a number of factors are making it harder for scientists themselves to determine whether a source of scientific knowledge is trustworthy, a specific finding robust, and a scientific consensus confirmed. The expanding use of preprints in biomedical sciences in particular has the potential to confuse readers about the extent to which work has been vetted and/or is generally accepted by a field. At this Banbury Center meeting, leading scientists joined science communicators and information technology experts to explore how the scientific community can identify and institutionalize signals of trustworthiness on which the audiences can rely in assessing scientific information.

**Welcoming Remarks:** **R. Leshan**, Director, Banbury Center, Cold Spring Harbor Laboratory

**Introduction and Meeting Objectives:** **M. McNutt**, National Academy of Sciences, Washington, D.C.,  
   **J. Greenberg**, Alfred P. Sloan Foundation, New York, New York

## SESSION 1: Social Context and Trust

**Chairpersons:** **K. Hall Jamieson**, University of Pennsylvania, Philadelphia, and **K. Prewitt**, Columbia University, New York, New York

**M. Woolley**, ResearchAmerica!, Arlington, Virginia: Signals of trust from the American public in the age of Twitter.  
**B. Spellman**, University of Virginia School of Law, Charlottesville: Starting early by educating the consumers of scientific information.





C. Zimmer, B. Spellman



R. Schekman, C. Bargmann

- G. Gray, University of Victoria, British Columbia, Canada: The social organization of trustworthiness in research.  
 A. Russell, Defense Advanced Research Projects Agency, Arlington, Virginia: Striking while the irony is hot: Lessons from trusting research for doing research on trust.  
 K. Prewitt, Columbia University, New York, New York: The sticky problem of self-inflicted wounds.

## SESSION 2: Science in Practice

- Chairperson:** M. McNutt, National Academy of Sciences, Washington, D.C.  
 C. Bargmann, Chan Zuckerberg Initiative, Palo Alto, California: Aligning incentives in science.  
 K. Mitchell, Trinity College Dublin, Ireland: Differentiating signal from noise in the scientific literature.  
 R. Schekman, University of California at Berkeley: Challenge of reproducibility in biomedical science.  
 F. Lynch, Mayo Clinic, Rochester, Minnesota: Research storytelling at Mayo Clinic.  
 N. Thompson, Massachusetts Institute of Technology, Cambridge: Science is shaped by Wikipedia: Evidence from a randomized control trial.



K. Jamieson, M. McNutt

## SESSION 3: Academic Publication—Peer Review

- Chairpersons:** R. Sever, Cold Spring Harbor Laboratory Press, and A. Casadevall, Johns Hopkins School of Medicine, Baltimore, Maryland  
 R. Anderson, University of Utah, Salt Lake City: Peer review, What is it good for?: What peer review can do, what it can't, and why it seems (and may actually be) irreducible.  
 T. Bloom, The BMJ, London, United Kingdom: Peer review and trust: What is the role of journals in ensuring the trustworthiness of reported findings?  
 E. Phimister, *New England Journal of Medicine*, Boston, Massachusetts: How editorial requirements improve trust in communication.  
 J. Berg, Science Journals, Washington, D.C.: The role of publishers in communicating science to the scientific community and the public.  
 A. Casadevall, Johns Hopkins School of Medicine, Baltimore, Maryland: Creating a more robust rigorous research enterprise.  
 B. Nosek, Center for Open Science, Charlottesville, Virginia: Open science.  
 V. Kiermer, Public Library of Science, San Francisco, California: Screening content at scale before peer review—Respective roles of technology, publishers and community.



A. Acharya, V. Kiermer, J. Sheehan, R. Sever, J. Greenberg





J. Dickerson, E. Phimister



U. Manber, A. Acharya

#### SESSION 4: Technology for Discovery and Assessment

**Chairperson:** U. Manber, University of California, San Francisco

J. Sheehan, U.S. National Library of Medicine, NIH, Bethesda, Maryland: Trusted health information: A tale of two systems.

U. Manber, University of California, San Francisco: The future of science is not what it used to be.

A. Acharya, Google, Inc., Mountain View, California: Leveraging aggregation to compute trustworthiness.

G. Bilder, Crossref, Oxford, United Kingdom: What color is your paratext?

J. Dickerson, Consumer Reports, Yonkers, New York: Consumer Reports: Smarter choices for a better world.

S. Hawke, World Wide Web Consortium, Waltham, Massachusetts: Toward cooperative verification: Standardizing credibility indicators on the web.

#### SESSION 5: Communicating with the Public

**Chairperson:** K. Hall Jamieson, University of Pennsylvania, Philadelphia

C. Zimmer, *The New York Times*, New York: How science journalists look for signals of good science.

S. Borenstein, The Associated Press, Washington, D.C.: We CAN handle the truth! Truth-telling tests and how science writers sort facts, fraud and fluff.

R. Harris, National Public Radio, Washington, D.C.: The role of science journalists in addressing the “reproducibility crisis.”

L. Lindenfeld, Stony Brook University, New York: Linking research with practice to advance science communication.

#### SESSION 6: Wrap-Up and Next Steps

**Facilitator:** K. Hall Jamieson, University of Pennsylvania, Philadelphia

# National Institute of Mental Health: Brain Camp XI

---

April 13–15

ARRANGED BY      **J. Chung**, National Institute of Mental Health, Bethesda, Maryland  
                             **J. Gordon**, National Institute of Mental Health, Bethesda, Maryland

FUNDED BY          **National Institute of Mental Health, NIH**

Cold Spring Harbor Laboratory is renowned worldwide for its educational programs, from high school to the highest professional levels. One of the Banbury Center's contributions is to host the NIMH-sponsored "Brain Camp." The goal of the Brain Camp is to identify areas of neuroscience research with relevance to psychiatrists and to open discussions of these areas with a small group of outstanding psychiatry residents and research fellows. Some of the most distinguished and thoughtful neuroscientists in the country came as guest speakers to the meeting.

## SESSION 1

**B. Cuthbert**, National Institute of Mental Health, Bethesda, Maryland: Welcome and Introductions.

**H. Blair Simpson**, Columbia University College of Physicians, New York, New York, and **S. Ahmari**, University of Pittsburgh Medical Center, Pennsylvania: ORAP: The next generation.

**D. Ross**, Yale School of Medicine, New Haven, Connecticut, and **K. Dzirasa**, Duke University, Durham, North Carolina: Brain camp ten years later.

## SESSION 2

**J. Javitch**, Columbia University College of Physicians, New York, New York: Novel approaches to targeting G protein-coupled receptors.

**S. Ahmari**, University of Pittsburgh Medical Center, Pennsylvania: Using translational strategies to identify the neural substrates of OCD-like behaviors and treatment response.



- K. Dzirasa, Duke University, Durham, North Carolina: Mapping emotions: Discovering structure in mesoscale electrical brain recordings.
- M. Paulus, Laureate Institute for Brain Research, Tulsa, Oklahoma: The challenge of connecting units of analyses: Toward a multilevel description of psychiatric disorders.

### SESSION 3

- D. Hafeman, University of Pittsburgh, Pennsylvania: Steps toward prevention: Probing the bipolar prodrome in at-risk youth.
- S. Vinogradov, University of Minnesota, Minneapolis: Neuroscience-informed cognitive training for neural system impairment in psychiatric illness.

# What Is Needed for a Comprehensive, Community Response to HIV?

---

May 13–16

ARRANGED BY      **M. Dybul**, Georgetown University, Washington, D.C.  
                             **R. Nkambule**, Kingdom of Swaziland Ministry of Health, Swaziland

FUNDED BY      **The Bill and Melinda Gates Foundation**

The HIV pandemic has created a long-term challenge for public health in low-income, severely affected countries and communities. In these countries, the lack of well-resourced and functioning health systems means that accelerating the declines in HIV infections will be a critical challenge requiring innovative thinking around community delivery and use of health promotion and healthcare. This Banbury meeting brought together experts in community responses to HIV, organizing frontline healthcare workers, designing and managing health systems, and political and management thinking in order to develop an agenda to promote sustainable, community adoption of effective HIV prevention, testing, and treatment.

**Welcoming Remarks:** **R. Leshan**, Director, Banbury Center, Cold Spring Harbor Laboratory

**SESSION 1:** Introductions and Framework for the Meeting

**Introduction and Meeting Objectives:** **R. Nkambule**, Ministry of Health, Swaziland, and **M. Dybul**, Georgetown University, Washington, D.C.

**G. Garnett**, Bill and Melinda Gates Foundation, Seattle, Washington: Gates Foundation strategy and perspectives on community-based service delivery for HIV.

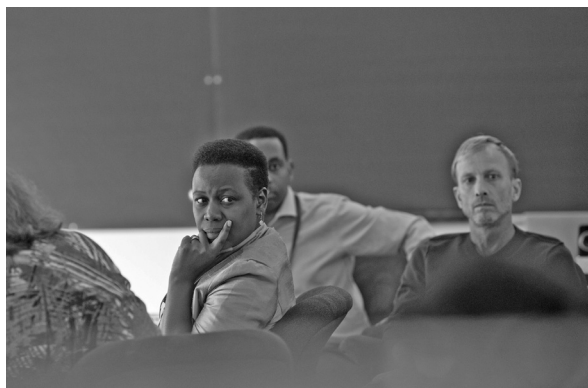
**SESSION 2:** Core Meeting Themes: What Are Key Elements of Community-Based Care, and Multidisciplinary Perspectives for Person-Centered Care from Across a Health System

**Chairperson:** **M. Dybul**, Georgetown University, Washington, D.C.

**C. Kinoti**, National AIDS Control Council of Kenya, Nairobi: Engaging communities and county governments in Kenya in promoting a coordinated HIV response.







C. Kinoti, M. Osman, M. Dybul



C. Kinoti, A. Hardon, S. Fadiga-Branchi

S. Arbeiter, World Relief, Baltimore, Maryland: The impact of the faith community in addressing HIV.

S. Baptiste, International Treatment Preparedness, Gaborone, Botswana: What it really takes to work with and support communities.

C. Chikanda, Pulse Health, Midrand, South Africa: HIV epidemic control in South Africa—Is the private sector the missing link?

K. Sikkema, Duke University, Durham, North Carolina: Addressing mental health in HIV prevention and treatment.

L.-G. Bekker, Desmond Tutu HIV Centre, Cape Town, South Africa: Addressing reproductive health and beyond: Clinical interventions to engage adolescents and young people.

G. Mackie, University of California, San Diego, California: Learning from programs that organize change of moral, social, and legal norms.

A. Hardon, Amsterdam Institute Social Science, Amsterdam, Netherlands: New social forms in HIV prevention and care.

### SESSION 3: Experiences in Community-Based Prevention for HIV

**Chairperson:** R. Nkambule, Ministry of Health, Swaziland

D. Birx, U.S. Department of State, Washington, D.C.: PEP-FAR perspectives on prevention opportunities and challenges.

P. Bhattacharjee, University of Manitoba, Nairobi, Kenya: Scaling up a violence prevention and response program for key populations.

### SESSION 4: Experiences in Community-Based Care and Treatment for HIV

**Chairperson:** C. Holmes, Georgetown University, Washington, D.C.

R. Barnabas, University of Washington, Seattle, Washington: Community-based HIV testing, ART initiation, monitoring, and retention in HIV care.

I. Sikazwe, Centre for Infectious Disease Research in Zambia, Lukasa, Zambia: Differentiated HIV service delivery in Zambia.

### SESSION 5: Scaling Up Comprehensive Community-Based HIV Prevention, Care and Treatment for HIV

**Chairperson:** R. Nkambule, Ministry of Health, Swaziland



C. Holmes, P. Preko



R. Nkambule, S. Hamm Rush



S. Mukasa Monico, S. Baptiste



D. Birx

W. El-Sadr, ICAP at Columbia University, New York, New York: Paper presentation: Moving toward scaling up of differentiated service delivery models.

### Panelist Responses

P. Preko, ICAP at Columbia University, New York, New York  
S. Mukasa Monico, UNAIDS, Juba, South Sudan

**SESSION 6:** Achieving Sustainability in Community Engagement for HIV Prevention, Care, and Treatment for Greater Impact

**Chairperson:** S. Arbeiter, World Relief

H. Doyle, The Global Fund, Vernier, Switzerland: Innovations from the Global Fund.

S. Fadiga-Branchi, Ambassade de France en Côte d'Ivoire, Abidjan, Côte d'Ivoire: Empowering communities in the HIV response, what it means in our national, regional, global health architecture?

D. Rech, The Aurum Institute, Bedfordview, South Africa: Using digital tools for greater performance and impact in community programs.

M. Osman, Elton John AIDS Foundation, London, United Kingdom: Donor perspectives.

**SESSION 7:** Outstanding Topics and Breakout Groups

**Chairperson:** M. Dybul, Georgetown University and Rejoice Nkambule, Ministry of Health, Swaziland

**SESSION 8:** Meeting Wrap-Up, Next Steps

**Chairpersons:** M. Dybul, Georgetown University, Washington, D.C., and R. Nkambule, Ministry of Health, Swaziland



G. Garnett, H. Doyle

# Technology and Education Council: Opportunities for AI and Machine Learning for the Biotech Industry

---

June 28

ARRANGED BY J. Donaldson, Cold Spring Harbor Laboratory

FUNDED BY The Banbury Center, Cold Spring Harbor Laboratory's Meetings and Courses Program, and Cold Spring Harbor Laboratory's Technology and Education Council

This one-day meeting brought together members of Cold Spring Harbor Laboratory's Technology and Education Council with experts and thought leaders for high-level, interdisciplinary engagement around the future of artificial intelligence, machine learning, and high-volume data for the biosciences. In addition to discussions of opportunities to better inform uptake and implementation strategies for these technologies, the meeting stimulated new cross-sector and cross-disciplinary relationships and insights.

**Welcoming Remarks and Introduction:** B. Stillman, Cold Spring Harbor Laboratory

## SESSION 1

**Chairperson:** J. Crawford, Northwell Health, Lake Success, New York

K. Hudson, People-Centered Research Foundation, Washington, D.C.: How to do patient-centered research.

S. Khader, Northwell Health, New Hyde Park, New York: Therapeutic trajectories, repositioning candidates and companion diagnostics from electronic health records.

O. Elemento, Weill Cornell Medicine, New York, New York: An integrative AI framework that enables target identification, indication discovery, and drug safety predictions.

## SESSION 2

**Chairperson:** P.J. Amini, Monsanto, St. Louis, Missouri

J. Wiens, University of Michigan, Ann Arbor: Increasing the utility of ML in clinical care: Leveraging big data and domain expertise.

J. Dutkowski, Data4Cure, San Diego, California: Combining systems biology and machine learning to continuously grow biomedical knowledge.

A. Heifets, Atomwise, San Francisco, California: Are we evaluating performance or just overfitting? How to assess the performance of Ligand-based algorithms on virtual screening benchmarks.

A. Vaughan, MapNeuro, Inc., Cold Spring Harbor, New York: ML for connectomics, and what to do with it.

M. Akerman, Envisagenics, New York, New York: Drug target discovery with splicing AI.

G. Yancopoulos, Regeneron Pharmaceuticals, Tarrytown, New York: General discussion and closing remarks.





# Non-Opioid Management of Chronic Pain: Developing Value-Based Models for Diagnosis and Treatment

---

September 16–19

ARRANGED BY      **D. Clauw**, University of Michigan, Ann Arbor  
                             **L. Porter**, National Institute of Neurological Disorders and Stroke, Bethesda, Maryland

FUNDED BY        **The MAYDAY Fund**

The United States is in the midst of an opioid epidemic that is partly driven by the overprescribing of opioids for both acute and chronic pain. One of the challenges around removing opioids from the management of chronic pain patients is that nonopioid treatments, especially nonpharmacological therapies, are often not reimbursed by third-party payers and/or are difficult to deliver in the short office visits that are now the norm in primary care and other settings. Recent advances in our understanding of chronic pain provide an opportunity to introduce innovative care models that could increase the quality of care while reducing costs. This Banbury Center meeting convenes relevant stakeholders, thought leaders, and constituents to develop value-based models for diagnosis and treatment of chronic pain.

**Welcoming Remarks:** **R. Leshan**, Director, Banbury Center, Cold Spring Harbor Laboratory

**Introduction and Meeting Objectives:** **D. Clauw**, University of Michigan, Ann Arbor, and  
**L. Porter**, National Institute of Neurological Disorders and Stroke,  
Bethesda, Maryland







D. Clauw, T. Postma



M. Cheattle (*back to camera*), L. Porter

### SESSION 1: Systems/Care Models I—Primary Care

- Chairperson:** D. Clauw, University of Michigan, Ann Arbor
- B. McCarberg, University of California, San Diego, Poway, California: Chronic pain management in primary care.
- K. Gebke, Indiana University School of Medicine, Indianapolis: Physician workflow and efficiency.
- L. DeBar, Kaiser Permanente Washington Health, Seattle, Washington: Activating patients and promoting lifestyle approaches to pain management in frontline clinical care: Lessons from embedded research in integrated health plans and community health clinics.
- K. Kroenke, Indiana University, Indianapolis: Telecare, stepped care, and collaborative care for chronic pain.

### SESSION 2: Systems/Care Models II—Integrating into Specialty Care

- Chairperson:** L. Porter, NINDS, Bethesda, Maryland
- H. Slater, Curtin University, Perth, Australia: Shifting the balance from low value to high value pain care: The role of models of care in driving system-wide reform.
- F. Sandbrink, Veterans Affairs Medical Center, Washington, D.C.: Pain management and the opioid safety initiative in the Veterans Health Administration.



R. Coakley, L. DeBar

- S. Stanos, Swedish Health Services, Seattle, Washington: Pain rehabilitation and interdisciplinary care: Our time has come.
- A. Doorenbos, University of Washington, Seattle: Determinants of optimal dose and sequence of functional restoration and integrative therapies in service members with neuromusculoskeletal injury.

### SESSION 3: Systems/Care Models III—Patient Perspective

- Chairperson:** L. Porter, NINDS, Bethesda, Maryland
- C. Veasley, Chronic Pain Research Alliance, Brookfield, Wisconsin: The need to incorporate evidence and patient-centeredness into pain care models.

### SESSION 4: Managing Pain Without Opioids

- Chairperson:** D. Clauw, University of Michigan, Ann Arbor
- M.-A. Fitzcharles, McGill University, Montreal, Quebec, Canada: Can a multidisciplinary chronic pain program provide effective care without opioids?
- J. D'Olimpio, Northwell Health, Lake Success, New York: Challenges in the nonopioid management of neuropathic pain.



A. Doorenbos, F. Sandbrink, M.-A. Fitzcharles

M. Cheatle, University of Pennsylvania, Philadelphia: Managing pain while opioid sparing: Treating common pain comorbidities.

C. Buckenmaier, Uniformed Services University, Rockville, Maryland: Nonpharmacological approaches for pain.

#### SESSION 5: Psychological Interventions

**Chairperson:** L. Porter, NINDS, Bethesda, Maryland

J. Haythornthwaite, Johns Hopkins University, Baltimore, Maryland: Addressing psychosocial factors as a critical component of managing chronic pain.

C. Rini, Hackensack University Medical Center, Hackensack, New Jersey: Automated, web-based pain coping skill training: Potential to expand access to an evidence-based, non-pharmacologic pain treatment.

#### SESSION 6: Payers Perspective

**Chairperson:** D. Clauw, University of Michigan, Ann Arbor

S. Ling, Centers for Medicare & Medicaid Services, Baltimore, Maryland: Program and policy opportunities to build on the evidence: CMS perspective.

T. Postma, Centers for Medicare & Medicaid Services, Woodlawn, Maryland: Chronic pain management and CMS value-based models.

D. Knecht, Aetna, New York, New York: Aetna's data-driven approach to combating the opioid epidemic.

#### SESSION 7: Pain in Special Populations

**Chairperson:** L. Porter, NINDS, Bethesda, Maryland

R. Coakley, Boston Children's Hospital, Massachusetts: Psychological interventions for the treatment of chronic pediatric pain: Translating and scaling current science into widespread, accessible practice.

C. Chambers, Centre for Pediatric Pain Research, Halifax, Canada: Pediatric pain: Innovative care models that can or are being used.



C. Buckenmaier, M. Cheatle

C. Reid, Weill Cornell Medicine, New York, New York: Behavioral approaches to pain management in older adults: How helpful are they?

#### SESSION 8: Potential Future Directions Driven by New Research

**Chairperson:** L. DeBar, Kaiser Permanente Washington Health, Seattle

E. Bair, University of North Carolina, Chapel Hill, North Carolina: Using systems biology approaches to identify clusters of individuals with similar underlying mechanisms of chronic pain.

D. Clauw, University of Michigan, Ann Arbor: Innovative research approaches to chronic pain that can help improve care and reduce costs.

L. Porter, National Institute of Neurological Disorders and Stroke, Bethesda, Maryland: The NIH pain research portfolio.

#### SESSION 9: Closing and Outputs

**Chairpersons:** L. Porter, NINDS, Bethesda, Maryland, and D. Clauw, University of Michigan, Ann Arbor

# Quantitative Approaches to Naturalistic Behaviors

---

September 23–26

ARRANGED BY      **B. Bialek**, Graduate Center at CUNY, New York, New York  
                         **S. Palmer**, University of Chicago, Illinois  
                         **S. Sober**, Emory University, Atlanta, Georgia

FUNDED BY          **The Swartz Foundation**

The first thing that fascinates us about life is the macroscopic behavior of organisms. Recent years have seen an explosion of interest in quantitative approaches to study these real-world behaviors, taming their complexity through more powerful measurements and analyses. This Banbury workshop explored progress in this field, with examples drawn from many different systems ranging from worms to humans.

**Welcoming Remarks:** **R. Leshan**, Director, Banbury Center, Cold Spring Harbor Laboratory

**Introduction and Meeting Objectives:** **B. Bialek**, Graduate Center at CUNY, New York, New York;  
**S. Palmer**, University of Chicago, Illinois; and  
**S. Sober**, Emory University, Atlanta, Georgia

## SESSION 1: Quantifying Behavior—Single Organisms

**Chairperson:** **L. Osborne**, Duke University, Durham, North Carolina

**G. Berman**, Emory University, Atlanta, Georgia: Measuring the hidden dynamics of animal behavior.

**S. Reiter**, Max Planck Institute for Brain Research, Frankfurt, Germany: Decomposing the control of skin patterning in cuttlefish.

**S. Datta**, Harvard Medical School, Boston, Massachusetts: Inferring internal from external state using motion sequencing.







E. Mackevicius, W. Bialek, G. Stephens



A. Kennedy, S. Datta

M. Mathis, Harvard University, Cambridge, Massachusetts: Markerless tracking of user-defined features with deep learning.

L. Osborne, Duke University, Durham, North Carolina: Sensation through the lens of behavior.

G. Stephens, VU Amsterdam and OIST, Amsterdam, Netherlands: Capturing the continuous complexity of behavior.

## SESSION 2: Interacting Systems—Quantifying and Modeling Social Behavior

**Chairperson: B. Bialek**, Graduate Center at CUNY, New York, New York

A. Cavagna, Institute for Complex Systems, Rome, Italy: The relevance of scaling laws in natural groups.

P. Gonzalez-Bellido, University of Minnesota, St. Paul: How several predatory aerial insect groups intercept small, fast-moving targets, and why understanding reasons for the species-specific behavioral strategies matters.

N. Mhatre, University of Toronto, Ontario, Canada: Tree crickets optimize the acoustics of baffles to exaggerate their mate-attraction signal.

G. Theraulaz, Université Paul Sabatier, Toulouse, France: Collective information processing in human phase separation.

A. Kennedy, California Institute of Technology, Pasadena: Quantifying social interactions in pairs of freely behaving mice.

## SESSION 3A: The Neural Control of Behavior—Part 1

**Chairperson: M. Carey**, Champalimaud Center, Lisbon, Portugal

M. Carey, Champalimaud Center, Lisbon, Portugal: Cerebellar contributions to coordinated locomotion in mice.

R. Shadmehr, Johns Hopkins University, Baltimore, Maryland: Population coding in the cerebellum.

A. Churchland, Cold Spring Harbor Laboratory: A new view of decision-making neural activity from quantifying spontaneous movements.

## SESSION 3B: The Neural Control of Behavior—Part 2

**Chairperson: S. Sober**, Emory University, Atlanta, Georgia



G. Theraulaz, G. Berman



S. Sober, S. Palmer, S. Reiter



- M. Kaschube, Frankfurt Institute for Advanced Studies, Frankfurt, Germany: Sepia skin pattern control and development at chromatophore resolution.
- E. Mackevicius, Columbia University, New York, New York: Unsupervised discovery of temporal sequences in high-dimensional datasets, with applications to neuroscience.
- S. Sober, Emory University, Atlanta, Georgia: Spike timing codes for motor control and sensorimotor learning.

**SESSION 4: Modeling at the Interface of Sensation and Action**

**Chairperson:** I. Nemenman, Emory University, Atlanta, Georgia

- A. Fairhall, University of Washington, Seattle: Sensory drivers of search behavior in mosquitoes.
- C. Huang, University of Pittsburgh, Pennsylvania: Propagation and modulation of information in visual pathway.

- I. Nemenman, Emory University, Atlanta, Georgia: Automated, predictive, and interpretable inference of *C. elegans* behavioral dynamics.

- G. Tavoni, University of Pennsylvania, Philadelphia: Efficient strategies for predictive inference in dynamic environments.

**SESSION 5: Challenges and Opportunities in the Physics of Behavior**

**Chairperson:** S. Palmer, University of Chicago, Illinois

**SESSION 6: Wrap-Up and Next Steps**

**Chairpersons:** B. Bialek, Graduate Center at CUNY, New York, New York; S. Palmer, University of Chicago, Illinois; and Sam Sober, Emory University, Atlanta, Georgia

# Emerging Data on the Role of Wnt Biology in Cancer

---

October 7–10

ARRANGED BY      H. Clevers, Hubrecht Institute, Utrecht, Netherlands  
C. Mirabelli, Leap Therapeutics, Cambridge, Massachusetts  
R. Nusse, Stanford University, California  
D. Tuveson, Cold Spring Harbor Laboratory  
B. Williams, Van Andel Research Institute, Grand Rapids, Michigan

FUNDED BY          Leap Therapeutics

Aberrations and mutations in Wnt-driven signaling pathways appear to play roles in a variety of human cancers. Far less clear are the specific molecular targets within canonical and noncanonical Wnt signaling pathways that drive cancer cell biology and the immune response to cancer. This Banbury Center meeting brought together experts in Wnt-related biology, immunology, pharmacology, and translational cancer medicine in order to assess the current state of the science, identify emerging themes, and prioritize potential therapeutic strategies.

Welcoming Remarks: R. Leshan, Director, Banbury Center, Cold Spring Harbor Laboratory

Introduction and Meeting Objectives: R. Nusse, Stanford University, California, and  
B. Williams, Van Andel Research Institute, Grand Rapids, Michigan

## SESSION 1: Therapeutic Targeting in Oncology

Chairperson: L. Lum, Pfizer, San Diego, California

L. Lum, Pfizer, San Diego, California: Small molecule disruption of Wnt acylation in disease.

D. Virshup, Duke NUS Medical School, Singapore, Asia: Wnt signaling pathways in cancer revealed by PORCN inhibition.  
M. Resh, Memorial Sloan Kettering Cancer Center, New York, New York: Biochemistry of Wnt acylation by porcupine: Insights into the mechanism of MBOAT acyltransferases.





M. Waterman, D. Virshup, R. Hannoush



R. Nusse, H. Varmus, X. He (back to camera)

## SESSION 2: Regenerative Medicine Applications

**Chairperson: B. Williams**, Van Andel Research Institute, Grand Rapids, Michigan

L. Boulter, University of Edinburgh, Edinburgh, United Kingdom: Modulating noncanonical Wnt signaling in liver repair.

Y. Yang, Harvard School of Dental Medicine, Boston, Massachusetts: Mechanism of Wnt/planar cell polarity signaling in vertebrate embryonic morphogenesis.

B. Williams, Van Andel Research Institute, Grand Rapids, Michigan: Wnt signaling in the skeleton.

## SESSION 3: Genetic Screens

**Chairperson: S. Angers**, University of Toronto, Ontario, Canada

S. Angers, University of Toronto, Ontario, Canada: Charting Wnt signaling networks in normal and cancer cells using CRISPR functional genomic screens.

R. Rohatgi, Stanford University School of Medicine, Stanford, California: Genetic analysis of WNT signaling using haploid human cells.

Y. Ahmed, Dartmouth Medical School, Hanover, New Hampshire: The guts of Wnt signaling in *Drosophila*.

## SESSION 4: Targeting DKK1

**Chairperson: C. Mirabelli**, Leap Therapeutics, Cambridge, Massachusetts

R. Faccio, Washington University in St. Louis, Missouri: Immune suppressive effects of Dkk1 during tumor progression.

A. Bothwell, Yale University School of Medicine, New Haven, Connecticut: Complex immunoregulation by Dickkopf proteins.

D. Wise, New York University Langone Medical Center, New York: Circulating Dickkopf-1 (DKK1) is a marker of

aggressive metastatic castration-resistant prostate adenocarcinoma with low PSA expression.

W. Newman, Leap Therapeutics, Cambridge, Massachusetts: Overview of preclinical data regarding the therapeutic targeting of DKK1 in cancer and ongoing translational medicine activities.

C. Sirard, Leap Therapeutics, Cambridge, Massachusetts: Clinical data with DKN-01.

M. Kagey, Leap Therapeutics, Cambridge, Massachusetts: Translational biomarkers for targeting DKK1 in oncology.

## SESSION 5: Membrane Receptors and Signalosome Assembly

**Chairperson: C. Janda**, Princess Maxima Center for Pediatric Oncology, Utrecht, Netherlands

C. Niehrs, German Cancer Research Center (DKFZ), Heidelberg, Germany: Wnt signaling at the membrane.

E. Lee, Vanderbilt University, Nashville, Tennessee: Regulation of Wnt receptor activity.

C. Janda, Princess Maxima Center for Pediatric Oncology, Utrecht, Netherlands: Surrogate Wnt antagonists that phenocopy canonical Wnt ligands.

## SESSION 6: Membrane Receptors: R-Spondin, Rnf43/Znrf3, and Frizzleds

**Chairperson: M. Maurice**, University Medical Center Utrecht, Netherlands

M. Maurice, University Medical Center Utrecht, Netherlands: Mechanisms of driver mutations in Wnt pathway tumor suppressors.

B. Reversade, A\*STAR Institute of Medical Biology, Immunos, Singapore: R(e)SPONDIN' to WNT with or without LGR4/5/6.

F. Cong, Novartis Institute for Biomedical Research, Cambridge, Massachusetts: Regulation of the  $\beta$ -catenin destruction complex in colorectal cancer.



C. Janda, L. Lum



D. Tuveson, B. Williams

A. Gurney, OncoMed Pharmaceuticals, Redwood City, California: Therapeutic agents targeting the Wnt pathway.

S. Spranger, Koch Institute for Integrative Cancer Research, Cambridge, Massachusetts: Impact of tumor cell-intrinsic signaling on adaptive and innate immune responses.

#### SESSION 7: Wnt Signaling and Stem Cells

**Chairperson:** X. He, Boston Children's Hospital, Massachusetts

X. He, Boston Children's Hospital, Massachusetts: Wnt signaling in stem cells and cancer.

M. Waterman, University of California, Irvine: Modeling connections between WNT, stem cells, and the microenvironment in colorectal cancer.

R. Hannoush, Genentech, South San Francisco, California: Pharmacological targeting of Wnt-mediated stem cell function.

#### SESSION 9: Wrap-Up: Conclusions and Next Steps

**Chairpersons:** R. Nusse, Stanford University, California, and B. Williams, Van Andel Research Institute, Grand Rapids, Michigan

R. Nusse, Stanford University, Stanford, California: Closing plenary.

#### SESSION 8: Emerging Applications for Wnt Signaling in Cancer

**Chairperson:** H. Varmus, Weill Cornell Medicine, New York, New York, and David Tuveson, Cold Spring Harbor Laboratory

T. Tammela, Memorial Sloan Kettering Cancer Center, New York, New York: Wnt-producing niches in stem cell compartments and carcinomas.

J. Massagué, Memorial Sloan Kettering Cancer Center, New York, New York: Regenerative origin of L1CAM<sup>+</sup>/LGR5<sup>+</sup> metastatic stem cells.



B. Reversade, M. Maurice, T. Tammela, S. Spranger



# Autophagy and Cancer

---

October 14–17

ARRANGED BY     R. Amaravadi, University of Pennsylvania, Philadelphia  
J. Debnath, University of California, San Francisco  
A. Kimmelman, New York University, New York

FUNDED BY        Vescor Therapeutics; Deciphera Pharmaceuticals; Janssen Research and Development;  
and Sprint Bioscience, with additional funding from Genentech and the Cold Spring  
Harbor Laboratory Corporate Sponsor Program

In March 2016, the first Banbury Center meeting on Autophagy and Cancer convened academic and industry leaders and resulted in a review article in *Genes & Development*. Since that time, numerous advances have emerged, including new understanding of autophagy's role in cytokine and metabolite secretion, cancer cell metabolism, metastases, and stem cells. However, controversy remains about the fundamental role of autophagy as a tumor suppressor or tumor promoter in cancer, as well as its role in tumor immunity. The goal of this meeting was to explore the mechanisms by which autophagy modulates cancer and to identify strategies to therapeutically target the autophagy pathway in order to best move the field forward.

Welcoming Remarks: R. Leshan, Director, Banbury Center, Cold Spring Harbor Laboratory

Introduction and Meeting Objectives: R. Amaravadi, University of Pennsylvania, Philadelphia;  
J. Debnath, University of California, San Francisco; and  
A. Kimmelman, New York University, New York





S. Tooze, A. Simon



R. Perera, J. Debnath

### SESSION 1: Signaling Targets in the Autophagy Pathway

**Chairperson:** J. Debnath, University of California, San Francisco

S. Tooze, Francis Crick Institute, London, United Kingdom: Novel targets modulating autophagy in pancreatic cancer.

R. Zoncu, University of California, Berkeley: Regulation of lysosomal mTORC1 signaling by intracellular cholesterol transport.

J. Martinsson, Sprint Bioscience AB, Huddinge, Sweden: Vps34 inhibitors as immunomodulating agents.

R. Shaw, The Salk Institute for Biological Studies, La Jolla, California: AMPK and ULK1 control of metabolism and cancer.

D. Flynn, Deciphera Pharmaceuticals, Inc., Lawrence, Kansas: Probing the multiple mechanisms of ULK1/2 kinases in cancer cell autophagy, metabolism and survival.

C. Severin, Celgene, San Diego, California: Single cell sequencing analysis of autophagy pathway cross talk in pancreatic cancer.

### SESSION 2: Selective Autophagy and Cancer

**Chairperson:** A. Kimmelman, NYU Langone Medical Center, New York, New York

A. Simonsen, University of Oslo, Norway: Lipid-binding proteins in selective autophagy.

W. Harper, Harvard Medical School, Boston, Massachusetts: Understanding selective autophagy.

J. Moscat, Sanford-Burnham Prebys Medical Discovery Institute, La Jolla, California: Autophagy adaptors in cancer metabolism and inflammation.

A. Thorburn, University of Colorado, Aurora [Presentation on behalf of Jean Mulcahy Levy, University of Colorado, Aurora, Colorado]: Autophagy inhibition for the pediatric brain tumor population. Autophagy, cell death and cancer treatment.

J. Debnath, University of California, San Francisco: NBR1, selective autophagy, and breast cancer metastasis.

### SESSION 3: Insights on Autophagy and Cancer from Model Systems

**Chairperson:** A. Thorburn, University of Colorado, Aurora

T.E. Rusten, Oslo University Hospital, Norway: Autophagy and cancer—What flies tell us.

K. Ryan, Cancer Research UK Beatson Institute, Glasgow, United Kingdom: The connection between autophagy and pathways of tumor suppression.



B. Janji, J. Martinsson, W. Harper, A. Simon



R. Zoncu, A. Kimmelman

J. Guo, Rutgers Cancer Institute of New Jersey, New Brunswick: The role of autophagy in regulating lipid metabolism to support lung tumor growth.

J.-L. Guan, University of Cincinnati, Ohio: Regulation of different subtypes of breast cancer by autophagy genes.

A. Kimmelman, NYU Langone Medical Center, New York, New York: Autophagy and pancreatic cancer.

#### **SESSION 4:** Autophagy in Metabolism, Immunity and Inflammation

**Chairperson:** R. Amaravadi, University of Pennsylvania, Philadelphia

E. White, Rutgers University, New Brunswick, New Jersey: Autophagy-dependent metabolic and immune mechanisms to regulate cancer.

B. Janji, Luxembourg Institute of Health, Germany: Impact of targeting autophagy on the immune landscape of melanoma.

K. Simon, University of Oxford, United Kingdom: Autophagy in differentiating hematopoietic cells.

R. Perera, University of California, San Francisco: Lysosome mediated remodeling of the cellular proteome in pancreatic cancer.

D. Green, St. Jude Children's Research Hospital, Memphis, Tennessee: LC3-associated phagocytosis.

#### **SESSION 5:** Therapeutic Targeting of Autophagy in Cancer

**Chairperson:** A. Viale, MD Anderson Cancer Center, Houston, Texas

R. Amaravadi, University of Pennsylvania, Philadelphia: Targeting PPT1 in cancer.



A. Viale, T.E. Rusten

R. Amaravadi [on behalf of Peter O'Dwyer], University of Pennsylvania, Philadelphia: HCQ in colon/pancreatic cancer.

N. Bahary, McGowan Institute for Regenerative Medicine, Pittsburgh, Pennsylvania: Neoadjuvant chemotherapy combined with autophagy inhibition in pancreatic adenocarcinoma.

A. Viale, MD Anderson Cancer Center, Houston, Texas: Metabolic targeting of chemoresistance impacts clonal complexity in pancreatic tumors.

#### **SESSION 6:** General Discussion, Meeting Conclusions and Next Steps

R. Amaravadi, University of Pennsylvania, Philadelphia; A. Kimmelman, New York University, New York; and J. Debnath, University of California, San Francisco

# Towards a Cure for Advanced Stage Ovarian Carcinoma

---

October 21–23

ARRANGED BY J. Boyd, Florida International University, Miami, Florida  
S. DeFeo, Ovarian Cancer Research Alliance, New York, New York  
D. Levine, New York University, New York  
A. Moran, Ovarian Cancer Research Alliance, New York, New York

FUNDED BY Ovarian Cancer Research Alliance, with additional funding provided by ImmunoGen and Clovis Oncology

The large majority of epithelial ovarian carcinoma patients are diagnosed at an advanced stage (II–IV), and the great majority of these patients eventually succumb to their disease. However, clinical experience and epidemiologic evidence clearly indicate that a small fraction of these patients experience long-term survival (>12 years) and may effectively be considered as cured of disease. This Banbury Center meeting brought together a multidisciplinary group of thought leaders in the fields of ovarian cancer biology, genetics, epidemiology, surgery, and therapy in order to discuss existing data and to develop strategies that may provide optimal outcomes for the greatest proportion of ovarian cancer patients. In addition, strategies for exporting such a model(s) outside the context of major academic cancer centers were explored.

**Welcoming Remarks:** R. Leshan, Director, Banbury Center, Cold Spring Harbor Laboratory

## SESSION 1: Overview/Intro

**Chairperson:** D. Levine, New York University, New York

**Introduction and Meeting Objectives:** J. Boyd, Florida International University, Miami; D. Levine, New York University,

New York; and A. Moran, Ovarian Cancer Research Alliance, New York, New York

S. Narod, University of Toronto, Ontario, Canada: Strategy to avoid death.







C. Brown, A. Odunsi



D. Levine, S. Shah

M. Pike, Memorial Sloan Kettering Cancer Center, New York, New York: Risk factors related to long-term survivorship.  
S. Shah, Memorial Sloan Kettering Cancer Center, New York, New York: Evolutionary dynamics of primary disease.

## SESSION 2: Surgery

**Chairperson: J. Boyd**, Florida International University, Miami

D. Chi, Memorial Sloan Kettering Cancer Center, New York, New York: What are the limits of aggressive cytoreduction?

A. Fagotti, Catholic University of the Sacred Heart, Rome, Italy: Patient selection for primary cytoreduction—Biology and clinical?

C. Fotopoulou, Imperial College London, United Kingdom: Can you be cured after interval cytoreduction (complete path response).

C. Brown, Memorial Sloan Kettering Cancer Center, New York, New York: Optimal ovarian cancer care in under-resourced populations.

## SESSION 3: Adjuvant Therapy

**Chairperson: S. Shah**, Memorial Sloan Kettering Cancer Center, New York, New York

G. Mills, Oregon Health and Science University, Portland, Oregon: Systems biology perspectives for curing initial disease.

D. Armstrong, Johns Hopkins University, Baltimore, Maryland: Route of administration of cytotoxics.

A. Oza, Princess Margaret Hospital, Toronto, Ontario, Canada: Better initial treatments with targeted agents.

## SESSION 4: Immunotherapy and Needs Assessment

**Chairperson: D. Levine**, New York University, New York

A. Odunsi, Roswell Park Cancer Institute, Buffalo, New York: Immunotherapy to cure in the primary setting.

A. Ellis, Ovarian Cancer Survivor and Research Advocate, White Plains, New York: Balancing hope versus reality in early survivorship?

## SESSION 5: Meeting Summary and Next Steps

**Chairpersons: J. Boyd**, Florida International University, Miami, and **D. Levine**, New York University, New York



E. Baugh, S. Leighton



J. Boyd, S. Narod

# Why Does the Neocortex have Layers and Columns?

---

October 28–31

ARRANGED BY      S. Ahmad, Numenta, Redwood City, California  
                         J. Gavornik, Boston University, Massachusetts  
                         S. Mihalas, Allen Institute for Brain Science, Seattle, Washington

FUNDED BY          Numenta and Cold Spring Harbor Laboratory

The neocortex is complex. Fortunately, most of this complex circuitry is remarkably preserved in all regions, suggesting that a canonical circuit consisting of columns and layers underlies much of what the neocortex does. Recent advances in recording technologies now enable detailed recording of activity in the microcircuitry of cortical columns, and new mapping technologies are rapidly increasing our knowledge of anatomical connections. However, despite these advances, the function of the laminar and columnar circuitry remains unclear and controversial. This Banbury Center meeting brought together experts from experimental, computational, and theoretical neurosciences to present their latest findings related to the anatomy, physiology, and function of cortical circuits. The goal was to develop a theoretical framework for understanding the function of stereotypical cortical circuits.

Welcoming Remarks: R. Leshan, Director, Banbury Center, Cold Spring Harbor Laboratory

Introduction and Meeting Objectives: S. Ahmad, Numenta, Redwood City, California;  
                         J. Gavornik, Boston University, Massachusetts; and  
                         S. Mihalas, Allen Institute for Brain Science, Seattle, Washington





### SESSION 1: General Frameworks

**Chairperson:** S. Ahmad, Numenta, Redwood City, California

J. Hawkins, Numenta, Redwood City, California: Does the neocortex model objects in the same way that the entorhinal cortex models spaces?

M. Berry, Princeton University, New Jersey: Canonical computations in the neocortical microcircuit.

R. Rao, University of Washington, Seattle: Bayesian models of the neocortex: From predictive coding to POMDPs.

S. Mihalas, Allen Institute for Brain Science, Seattle, Washington: Hierarchical models with canonical local circuits.

### SESSION 2: Anatomy/Thalamus I

**Chairperson:** S. Mihalas, Allen Institute for Brain Science, Seattle, Washington

K. Rockland, Boston University School of Medicine, Massachusetts: What if they're not stereotyped?

S. Aton, University of Michigan, Ann Arbor: State-dependent thalamocortical dynamics and visual system plasticity.

A. Zador, Cold Spring Harbor Laboratory: Statistics organization of long-range cortical projections.



M. Usrey, University of California, Davis: Cortical columns and layers facilitate feedforward and feedback network interactions between thalamus and cortex.

### SESSION 3: Anatomy/Thalamus II

**Chairperson:** A. Pasupathy, University of Washington, Seattle

R. Bruno, Columbia University, New York, New York: The many input layers of the neocortex.

S. Brown, Johns Hopkins University, Baltimore, Maryland: Cortical layers and columns: Lessons from layer 6.

M. Sherman, University of Chicago, Illinois: Transthalamic corticocortical pathways.

M. Halassa, Massachusetts Institute of Technology, Cambridge, Massachusetts: Thalamic computations in cognitive control and flexibility.

### SESSION 4: Sensory Systems

**Chairperson:** M. Geffen, University of Pennsylvania, Philadelphia

T. Engel, Cold Spring Harbor Laboratory: Cortical state and correlated variability across layers and columns.



R. Rao, A. Angelucci



A. Pasupathy, K. Nielsen

- A. Pasupathy, University of Washington, Seattle: Cortical processing of occlusions: Role of feedback and inhibition.
- A. Angelucci, University of Utah, Salt Lake City: Organization and function of feedback connections in early visual processing.
- K. Nielsen, Johns Hopkins University, Baltimore, Maryland: Fine-scale organization of monkey visual cortex.
- A. Hires, University of Southern California, Los Angeles: Circuit and behavioral mechanisms of feature learning in somatosensory cortex.

#### SESSION 5: Sequences, Prediction, and Cognition

**Chairperson:** A. Angelucci, University of Utah, Salt Lake City

- M. Geffen, University of Pennsylvania, Philadelphia: Neural circuits for dynamic auditory processing.
- J. Gavornik, Boston University, Massachusetts: Transient and durable temporal predictions in visual cortical circuits.
- D. Schneider, New York University, New York: Learning, recalling, and ignoring self-generated sounds.
- C. Constantinople, New York University, New York: Cortical computations during economic choice.

#### SESSION 6: Hippocampus/Navigation/Sensorimotor

**Chairperson:** J. Gavornik, Boston University, Massachusetts

- M. Hasselmo, Boston University, Massachusetts: Coding in cortical circuits.



K. Rockland, G. Keller

- C. Niell, University of Oregon, Eugene: Neural circuits for vision in action.
- G. Shepherd, Northwestern University, Chicago, Illinois: Cortical circuit organization from a motor systems perspective.
- S. Ahmad, Numenta, Redwood City, California: Interlaminar and intercolumnar models of sensorimotor prediction.
- G. Keller, Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland: Internal models of the environment in the mouse cortex.

#### SESSION 7: Meeting Wrap-Up and Next Steps

- S. Ahmad, Numenta, Redwood City, California; J. Gavornik, Boston University, Massachusetts; and S. Mihalas, Allen Institute for Brain Science, Seattle, Washington: Key conclusions and potential outputs.



# The Lustgarten Foundation Scientific Advisory Board Meeting

---

November 11–13

ARRANGED BY      **K. Kaplan**, Lustgarten Foundation, Woodbury, New York  
                         **D. Tuveson**, Cold Spring Harbor Laboratory  
                         **R. Vizza**, Lustgarten Foundation, Woodbury, New York

FUNDED BY          **The Lustgarten Foundation**

Banbury was pleased to welcome back the Lustgarten Foundation for their 2018 Scientific Meeting, which provided an opportunity for the Scientific Advisory Board, as well as Foundation-supported investigators, to discuss research and strategy, evaluate performance, provide feedback for improvement, strengthen collaboration, and identify new ideas to bolster progress in the field.

**R. Evans**, Salk Institute for Biological Studies  
**D. Fearon**, Cold Spring Harbor Laboratory  
**E. Fishman**, Johns Hopkins Medicine  
**F. Froeling**, Cold Spring Harbor Laboratory  
**C. Fuchs**, Yale School of Medicine  
**L. Gruskiewicz**, Lustgarten Foundation  
**T. Hunter**, Salk Institute for Biological Studies  
**T. Jacks**, Massachusetts Institute of Technology  
**E. Jaffee**, Johns Hopkins School of Medicine  
**K. Kaplan**, The Lustgarten Foundation for Pancreatic Cancer Research  
**D. Kelsen**, Memorial Sloan Kettering Cancer Center  
**R. Mayer**, Harvard University

**D. Pellman**, Dana-Farber Cancer Institute  
**B. Stillman**, Cold Spring Harbor Laboratory  
**E. Stoeber**, Lustgarten Foundation  
**H. Tiriac**, Cold Spring Harbor Laboratory  
**D. Tuveson**, Cold Spring Harbor Laboratory  
**F. Valsecchi**, Lustgarten Foundation  
**R. Vizza**, The Lustgarten Foundation for Pancreatic Cancer Research  
**B. Vogelstein**, Howard Hughes Medical Institute and Johns Hopkins University  
**B. Wolpin**, Harvard University Medical School  
**A. Yuille**, Johns Hopkins University

# Diverse Functions of Neutrophils in Cancer

---

November 27–30

ARRANGED BY      K. de Visser, The Netherlands Cancer Institute, Amsterdam  
M. Egeblad, Cold Spring Harbor Laboratory  
P. Kubes, University of Calgary, Alberta, Canada

FUNDED BY          Northwell Health–Cold Spring Harbor Laboratory Affiliation

Neutrophils are the most abundant leukocytes in blood, indispensable for combating microbial infections and facilitating wound healing. Recent studies have highlighted the diverse functions of neutrophils in cancer; however, it is still not clear when neutrophils are beneficial or detrimental to the host in the context of cancer. The goal of this Banbury meeting was to bring together cancer biologists with scientists and clinicians studying other aspects of neutrophils in order to facilitate discussions of recent findings on the functions of neutrophils, the classifications of neutrophils, and their potential as clinical biomarkers and therapeutic targets. A better understanding of the role of neutrophils is likely to provide opportunities for targeting of the antimetastatic effects of neutrophils, for immunomodulation acting via neutrophils, and, ultimately, for improving the treatment of cancer patients.

Welcoming Remarks: R. Leshan, Director, The Banbury Center, Cold Spring Harbor Laboratory

Introduction and Meeting Objectives: K. de Visser, The Netherlands Cancer Institute, Amsterdam;  
M. Egeblad, Cold Spring Harbor Laboratory; and  
P. Kubes, University of Calgary, Alberta, Canada





M. Egeblad, P. Kubes



P. Frenette, T. van den Berg

### SESSION 1: Phenotyping Neutrophil Diversity and Targeting Neutrophils

**Chairperson:** P. Kubes, University of Calgary, Alberta, Canada

H. Goodridge, Cedars-Sinai Medical Center, Los Angeles, California: Myeloid cell heterogeneity, origins, and functional programming.

A. Hidalgo, Fundación CNIC, Madrid, Spain: Neutrophil diversity in homeostasis.

I. Udalova, University of Oxford, United Kingdom: Genomic control of neutrophil responses.

Z. Fridlender, Hadassah Medical Center, Jerusalem, Israel: Circulating neutrophils in human cancer—A functional and phenotypic (CyTOF) characterization.

E. Meylan, École Polytechnique Fédérale de Lausanne, Switzerland: Depletion strategies and targeting neutrophil metabolism in lung cancer.

### SESSION 2: Sepsis, Stress, Infections, and Autoimmunity

**Chairperson:** B. Sherry, Feinstein Institute for Medical Research, Manhasset, New York

P. Kubes, University of Calgary, Alberta, Canada: Studying the neutrophil in health, injury, and repair.

P. Frenette, Albert Einstein College of Medicine, Bronx, New York: Influence of stress on neutrophil function.

P. Wang, Feinstein Institute for Medical Research, Manhasset, New York: CIRP Induces neutrophil reverse transendothelial migration.

M. Aziz, Feinstein Institute for Medical Research, Manhasset, New York: Neutrophils in sepsis: Role of cold-inducible RNA-binding protein.

M. Kaplan, National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, Bethesda, Maryland: Neutrophil subsets and their role in systemic autoimmunity and organ damage.



K. de Visser, M. Pittet, Z. Fridlender



Z. Fridlender, A. Huttenlocher



P. Wang, M. Aziz



Z. Werb

B. Barnes, Feinstein Institute for Medical Research, Manhasset, New York: IRF5 genetic risk, spontaneous NETosis and autoimmunity.

### SESSION 3: NETs and Imaging

**Chairperson:** P. Frenette, Albert Einstein College of Medicine, Bronx, New York

- A. Zychlinsky, Max Planck Institute for Infection Biology, Berlin, Germany: NETs—The second function of chromatin.
- B. Amulic, University of Bristol, United Kingdom: NETs in propagation of vascular inflammation.
- D. Wagner, Boston's Children's Hospital, Boston, Massachusetts: NETs in cancer.
- M. Egeblad, Cold Spring Harbor Laboratory: Functions of neutrophil extracellular traps in metastasis.
- A. Huttenlocher, University of Wisconsin, Madison: Live imaging of neutrophils in the tumor microenvironment.

### SESSION 4: Roles of Neutrophils in Metastasis and Lung Cancer

**Chairperson:** M. Egeblad, Cold Spring Harbor Laboratory



M. Kaplan, B. Sherry, B. Barnes

V. Mittal, Weill Cornell Medicine, New York, New York: Mechanisms of neutrophil-mediated metastasis.

M. Pittet, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts: Neutrophils and lung cancer.

I. Malanchi, The Francis Crick Institute, London, United Kingdom: Cancer: The evil companion corrupting good behavior.

K. de Visser, The Netherlands Cancer Institute, Amsterdam: The genetic makeup of breast cancer dictates systemic neutrophilic inflammation.

D. Quail, McGill University, Montréal, Quebec, Canada: Obesity-associated inflammation and cancer metastasis.

### SESSION 5: Antitumor and Proimmune Functions of Neutrophils

**Chairperson:** K. de Visser, The Netherlands Cancer Institute, Amsterdam

T. van den Berg, Sanquin Research and VU Medical Center, Amsterdam, Netherlands: Neutrophils kill antibody-opsonized cancer cells by trogoptosis.

T. Merghoub, Memorial Sloan Kettering Cancer Center, New York, New York: Contribution of innate immunity in T cell immunomodulatory antibody-based therapies.

E. Eruslanov, University of Pennsylvania, Philadelphia: Tumor-associated neutrophils with antigen-presenting cell features in human lung cancer.

Z. Granot, The Hebrew University of Jerusalem, Israel: Microenvironmental cues determine tumor cell susceptibility to neutrophil cytotoxicity.

Z. Werb, University of California, San Francisco: Regulation of neutrophils that are prometastasis or antimetastasis.

### SESSION 6: Meeting Conclusions, Wrap-Up, and Next Steps

**Chairpersons:** M. Egeblad, Cold Spring Harbor Laboratory; K. de Visser, The Netherlands Cancer Institute, Amsterdam; and P. Kubes, University of Calgary, Alberta, Canada



# Revolutionizing Agriculture with Synthetic Biology

---

December 2–5

ARRANGED BY     A. Hanson, University of Florida, Gainesville  
C. Vickers, CSIRO and The University of Queensland, Brisbane, Australia  
E. Wurtzel, Lehman College, CUNY, Bronx, New York

FUNDED BY        Cold Spring Harbor Laboratory Corporate Sponsor Program

Synthetic biology has the transformative potential to reconfigure metabolic pathways and other biological systems. Yet, thinking in the nascent plant synthetic biology sector tends still to be dominated by a “tinkering” mind-set and focuses on traditional mainline targets such as photosynthesis and producing plant pharmaceuticals in *Escherichia coli* or yeast. This Banbury meeting challenged an international group of experts to “think big” about using synthetic biology to install entirely new metabolic pathways and genetic circuitry in crops and other plants and to radically improve the efficiency of existing pathways and processes. The cross-sector discussions also touched on the necessity for continued advances in foundational knowledge, tools, and training as well as the real-world issues of government regulation and managing the public perception of plant synthetic biology.

Welcoming Remarks: R. Leshan, Director, Banbury Center, Cold Spring Harbor Laboratory

Introduction and Meeting Objectives: E. Wurtzel, Lehman College, The City University of New York, Bronx;  
A. Hanson, University of Florida, Gainesville;  
C. Vickers, CSIRO and The University of Queensland, Brisbane, Australia





R. Gershenzon, C. Vickers



J. Shanklin, J. Medford, J. Nemhauser, J. Matos

### SESSION 1: Primary Metabolism

**Chairperson:** C. Vickers, CSIRO and The University of Queensland, Brisbane, Australia

T. Erb, Max Planck Institute for Terrestrial Microbiology, Marburg, Germany: Fixing carbon fixation: Developing alternative solutions to the Calvin Benson Bassham cycle with synthetic biology.

S. Long, University of Illinois, Urbana: From math to field—Proof of concept in engineering photosynthesis for higher crop yield.

H. Millar, University of Western Australia, Crawley, Australia: Defining molecular targets for manipulation to improve efficiency of energy use processes to alter growth rate.

A. Hanson, University of Florida, Gainesville: “Maintenance respiration” as a next-gen target to improve crop productivity.

C. Vickers, CSIRO Synthetic Biology Future Science Platform, Brisbane, Australia: Carbon flux regulation for isoprenoid production.

E. Wurtzel, Lehman College, The City University of New York, Bronx: The complexity of engineering carotenoid biosynthesis.

T. Muranaka, Osaka University, Japan: Redesign of terpenoid biosynthetic pathway in plant by genome editing toward human health.

J. Shanklin, Brookhaven National Laboratory, Upton, New York: Controlling the diversity and yield of plant lipids.

B. Sattely, Stanford University, California: Discovery and engineering plant natural product biosynthesis.

### SESSION 2: Specialized Metabolism

**Chairperson:** J. Gershenzon, Max Planck Institute for Chemical Ecology, Jena, Germany

### SESSION 3: Eco-Interactions

**Chairperson:** A. Osbourn, John Innes Centre, Norwich, United Kingdom

P. Nikel, The Novo Nordisk Foundation Center for Biosustainability, Kongens Lyngby, Denmark: Engineering soil bacteria as biotechnological platforms.



J. Gershenzon, A. Hanson



D. Bhaya, P. Hines, E. Wurtzel



J. Nemhauser, N. Patron



A. Osbourn, H. Bouwmeester, N. Patron

G. Barbier, JoynBio, Boston, Massachusetts: Engineered microbes for agricultural use.

H. Bouwmeester, University of Amsterdam, Netherlands: Metabolic engineering to optimize the crop rhizosphere.

J. Gershenzon, Max Planck Institute for Chemical Ecology, Jena, Germany: Increasing the protective value of plant defense compounds: Plant-mediated deterrence of insect pest detoxification pathways.

#### SESSION 4: Radical Redesign

**Chairperson:** A. Hanson, University of Florida, Gainesville

B. Lindberg Møller, University of Copenhagen, Frederiksberg, Denmark: Bioengineering of structurally complex diterpenoids in yeast and photosynthetic cells.

J. Nemhauser, University of Washington, Seattle: Plant logic: Discovering and re-engineering design rules governing plant form.

J. Haseloff, University of Cambridge, United Kingdom: *Marchantia* as a simple prototype for bioengineering.

J. Medford, Colorado State University, Fort Collins: Plant synthetic biology: Following the path of electronics to produce genetic circuits with predictive functions and enabling synthetic biological desalination.

N. Patron, The Earlham Institute, Norfolk, United Kingdom: Toward predictable engineering of complex traits.

A. Kinney, Corteva Agriscience, Johnston, Iowa: Engineering oil seed composition.

#### SESSION 5: Parts-Prospecting and Tools

**Chairperson:** E. Wurtzel, Lehman College, The City University of New York, Bronx

A. Osbourn, John Innes Centre, Norwich, United Kingdom; Harnessing plant metabolism: From biosynthetic gene clusters to genomics and back.

M. Cooper, The University of Queensland, Brisbane, Australia: Genomic prediction and gene networks.

D. Orzáez, Universitat Politècnica de València, Spain: A toolbox of modular elements for orthogonal control of gene expression in plants.

R. Bock, Max Planck Institute of Molecular Plant Physiology, Potsdam, Germany: Taming plastids for synthetic biology.

N. Boyle, Colorado School of Mines, Golden: Next-generation metabolic models.

L. Nielsen, Novo Nordisk Foundation Center for Biosustainability, Kongens Lyngby, Denmark: A multitissue genome-scale metabolic modeling framework to guide plant metabolic engineering.

#### SESSION 6: Implementing SynBio

**Chairperson:** P. Hines, *Science*

D. Bhaya, National Science Foundation, Alexandria, Virginia: Plant synthetic biology: An NSF perspective.

S. Evans, Dow Agrosiences, Indianapolis, Indiana: Of plants and plants.

P. Rabinowicz, U.S. Department of Energy, Washington, D.C.: How BER supports synthetic biology: Research programs, user facilities, and enabling technologies.

#### SESSION 7: Wrap-Up

**Chairperson:** E. Wurtzel, Lehman College, The City University of New York, Bronx



# Increasing Gender Diversity in the Biosciences

---

December 9–12

ARRANGED BY C. Greider, Johns Hopkins University, Baltimore, Maryland  
J. Sheltzer, Cold Spring Harbor Laboratory

FUNDED BY Cold Spring Harbor Laboratory

The underrepresentation of women in bioscience careers is a fundamental problem because it represents a significant loss of talent and diversity. This meeting convened experts to identify practical institutional and extra-institutional approaches that can promote and support the advancement of women in science—connecting leaders from diverse fields to share lessons learned and to inspire innovative new ideas to achieve gender equity in biomedical research. The ultimate goal was to generate a list of general and adaptable “best practices” that institutions and communities can implement to stimulate and support the advancement of women in science.

Welcoming Remarks: R. Leshan, Director, Banbury Center, Cold Spring Harbor

Introduction and Meeting Objectives: C. Greider, Johns Hopkins University, Baltimore, Maryland, and  
J. Sheltzer, Cold Spring Harbor Laboratory

SESSION 1: Overview—Sexism and Academia

Chairperson: C. Greider, Johns Hopkins University, Baltimore, Maryland

J. Steitz, Yale University and Howard Hughes Medical Institute, New Haven, Connecticut: Reflections on (nearly) 50 years in academia.







C. Greider, L. Joshua-Tor



D. Ruebain, W. Copeland

S. Tilghman, Princeton University, New Jersey: Why leadership matters.

N. Hopkins, Massachusetts Institute of Technology, Cambridge: The leaky biology-to-biotech pipeline: Should universities step in?

## SESSION 2: Implicit Biases and the Leaky Pipeline

**Chairperson:** D. Ruebain, Consultant, Equality, Diversity, and Inclusion in Higher Ed and Research Sectors, London, United Kingdom

J. Sheltzer, Cold Spring Harbor Laboratory: "Hidden" pipelines in biomedical research.

V. Valian, Hunter College, New York, New York: Remedying the (still too) slow advancement of women.

N. Dasgupta, University of Massachusetts at Amherst: Reducing bias and increasing diversity in STEM: What works and what doesn't.

L. Villa-Komaroff, Intersections SBD, Boston, Massachusetts: Why thinking fast makes changing slow: How cognitive processes impede gender equity.

## SESSION 3: Academic Culture

**Chairperson:** J. Raymond, Stanford University, California

C. Greider, Johns Hopkins University, Baltimore, Maryland: Finally seeing the bubble: My experience as department chair.

L. Joshua-Tor, Cold Spring Harbor Laboratory: Let's get practical.

G. McDowell, Future of Research Organization, Abington, Massachusetts: Empowering the next generation of researchers to overcome adversity, bias, and sexual harassment.

J. Polka, ASAPbio, Cambridge, Massachusetts: Addressing gender bias in an evolving scientific publishing ecosystem.

## SESSION 4: Government, Industry, and Funders

**Chairperson:** L. Villa-Komaroff, Intersections SBD, Boston, Massachusetts

H. Valentine, National Institutes of Health, Bethesda, Maryland: NIH's scientific approach to eliminating the gender leadership gap in biomedicine.



C. Greider, J. Sheltzer



J. Steitz, E. O'Shea



H. Valantine, N. Dasgupta



B. Stillman, N. Hopkins

- A. Gammie, National Institute of General Medical Sciences, Bethesda, Maryland: Diversifying the biomedical research workforce.
- E. O'Shea, Howard Hughes Medical Institute, Chevy Chase, Maryland: HHMI efforts to increase gender diversity in science.
- W. Copeland, Celgene Corporation, Seattle, Washington: A corporate framework to quantify diversity and inclusion: Integrating metrics and business practice.

#### SESSION 5: Sexual Harassment and Legal Remedies

- Chairperson:** L. Joshua-Tor, Cold Spring Harbor Laboratory
- M. Wadman, *Science*, Washington, D.C.: What I've learned while covering sexual harassment in science as a reporter.
- B. McLaughlin, Vanderbilt University, Nashville, Tennessee: Disobedient ones.
- A. Olivarius, McAllister Olivarius, Maidenhead, United Kingdom: War stories from a sexual harassment lawyer.
- N. Chi Cantalupo, Barry University, Orlando, Florida: Taking a civil rights approach to gender-based violence in education.
- C. Greider, Johns Hopkins University, Baltimore, Maryland [on behalf of Vicki Lundblad, Salk Institute of Biological Sciences, La Jolla, California]: Women scientists need to tell their stories.

#### SESSION 6: Organizational Approaches and Mentorship

- Chairperson:** N. Chi Cantalupo, Barry University, Orlando, Florida
- J. Raymond, Stanford University, California: Diversity increases equity in peer review.

- D. Ruebain, Consultant, EDI in Higher Education and Research Sectors, London, United Kingdom: The use of systemic change programmes to address chronic, long-standing underrepresentation and disadvantage.
- J. Metcalf, Colorado State University, Fort Collins: 500 Women Scientists: A grassroots organization with a mission to serve society by making science open, inclusive, and accessible.
- J. Wong, Boston University, Massachusetts: BU ARROWS: Creating organizational commitment and structured programs in academia to advance academic leaders in STEM.

#### SESSION 7: General Discussion, Meeting Conclusions, Outlining Next Steps

- C. Greider, Johns Hopkins University, Baltimore, Maryland, and J. Sheltzer, Cold Spring Harbor Laboratory



J. Metcalf, J. Wong, G. McDowell, B. McLaughlin

# Phase-Separated Assemblies in Cell Biology

---

December 16–19

ARRANGED BY     **Arup K. Chakraborty**, Massachusetts Institute of Technology, Cambridge  
                         **G. Seydoux**, Johns Hopkins University, Baltimore, Maryland  
                         **P. Sharp**, Koch Institute for Integrative Cancer Research, Cambridge, Massachusetts  
                         **R. Young**, Whitehead Institute for Biomedical Research, Cambridge, Massachusetts

FUNDED BY        **Cold Spring Harbor Laboratory Corporate Sponsor Program**

An abundance of research has described intracellular condensation of proteins into liquids or hydrogels, and these studies have included work at the intersection of multiple fields, including molecular biology, chemistry, and physics. This Banbury meeting brought together an interdisciplinary group of experts to review functions and types of phase-separated assemblies in biology, develop a common conceptual framework and nomenclature, identify molecular code characteristics underlying assemblies, consider pathologies caused by aberrant phase-separated assemblies, and examine manipulation of phase-separated assemblies as a novel treatment target.

**Welcoming Remarks:** **R. Leshan**, Director, Banbury Center, Cold Spring Harbor Laboratory

**Introduction and Meeting Objectives:** **A. Chakraborty**, Massachusetts Institute of Technology, Cambridge;  
   **G. Seydoux**, Johns Hopkins University, Baltimore, Maryland;  
   **R. Young**, Whitehead Institute for Biomedical Research, Cambridge,  
   Massachusetts







D. Lowe, J. Forman-Kay, G. Seydoux



P. Sharp, B. Stillman

### SESSION 1: Physical Principles

**Chairperson:** R. Pappu, Washington University in St. Louis, Missouri

C. Brangwynne, Princeton University, New Jersey: Mechanics of phase separation.

A. Chakraborty, Massachusetts Institute of Technology, Cambridge: The role of phase separation in regulating transcription.

C. Fan Lee, Imperial College London, United Kingdom: Physics of passive and active emulsions.

C. Keating, Pennsylvania State University, University Park: Experimental model systems for compartmentalization based on phase separation.

T. Nott, University of Oxford, United Kingdom: Emergent properties of liquid-like membraneless organelles.

E. Siggia, Rockefeller University, New York, New York: Physical chemical properties of membrane bound organelles.

T. Mittag, St. Jude Children's Research Hospital, Memphis, Tennessee: How does the molecular grammar of low-complexity domains translate into phase transitions?

J. Forman-Kay, Hospital for Sick Children, Toronto, Ontario, Canada: Biophysical insights into neuronal granules and activity-dependent translation.

T. Hyman, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany: A molecular grammar for phase separation of FUS family proteins.

R. Pappu, Washington University in St. Louis, Missouri: Connecting sequence to phase behavior using physical principles.

R. Tycko, National Institutes of Health, Bethesda, Maryland: Molecular structure of low-complexity protein assemblies: Information from magnetic resonance.

S. McKnight, University of Texas Southwestern Medical Center, Dallas, Texas: How do low-complexity domains achieve biological specificity?

### SESSION 2: Molecular Determinants

**Chairperson:** R. Parker, University of Colorado and Howard Hughes Medical Institute, Boulder, Colorado

### SESSION 3: Imaging Dynamics

**Chairperson:** C. Fan Lee, Imperial College London, United Kingdom

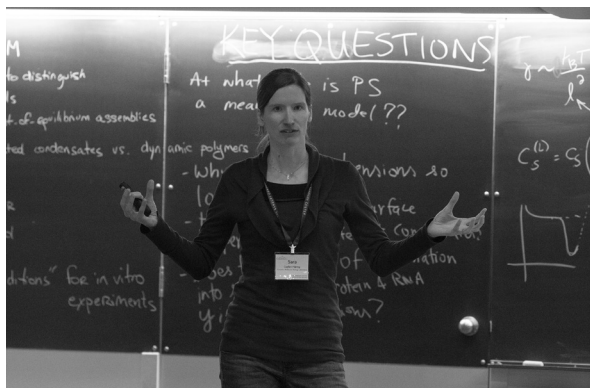


C. Brangwynne, R. Pappu



R. Young





S. Cuylen-Häring



B. Tu, R. Tycko, S. McKnight, C. Keating

- X. Darzacq, University of California, Berkeley: Imaging technologies provide new perspectives into phase separation.
- I. Cissé, Massachusetts Institute of Technology, Cambridge: Superresolution imaging of transcription in live mammalian cells.
- M. Botchan, University of California, Berkeley: *Drosophila* replication initiation factors that assemble on DNA through Cdk/cyclin regulated phase separation.
- R. Parker, University of Colorado and Howard Hughes Medical Institute, Boulder, Colorado: Rnp granules.
- R. Lehmann, New York University School of Medicine, New York: Nuclear and cytoplasmic germ granules in *Drosophila*: Connecting structure with function.
- G. Seydoux, Johns Hopkins University, Baltimore, Maryland: RNA granule assembly in vivo and in vitro.

#### SESSION 4: Function

**Chairperson:** R. Lehmann, New York University School of Medicine, New York

- R. Young, Whitehead Institute for Biomedical Research, Cambridge, Massachusetts: Transcriptional condensates.
- G. Narlikar, University of California, San Francisco: Biophysical basis for phase separation processes in heterochromatin.
- S. Cuylen-Häring, European Molecular Biology Laboratory, Heidelberg, Germany; Ki-67: From surfactant function to phase separation.
- C. Mayr, Memorial Sloan Kettering Cancer Center, New York, New York: The interplay between the TIS granule and the ER creates a new subcellular compartment.
- P. De Camilli, Yale University, New Haven, Connecticut: Phase separation as an organizing principle at neuronal synapses.
- S. Petry, Princeton University, New Jersey: Phase separation enhances branching microtubule nucleation.

#### SESSION 5: Ensemble Properties

**Chairperson:** J. Forman-Kay, Hospital for Sick Children, Toronto, Ontario, Canada

- B. Tu, University of Texas Southwestern Medical Center, Dallas, Texas: A metabolically regulated low-complexity domain.
- P. Taylor, St. Jude Children's Research Hospital, Memphis, Tennessee: Dynamic RNA-protein assemblies and neurological disease.
- D. Lowe, Novartis Institutes for BioMedical Research, Cambridge, Massachusetts: An industrial drug discovery perspective on intracellular phase condensates.

#### SESSION 6: Meeting Wrap-Up

**Chairpersons:** P. Sharp, Koch Institute for Integrative Cancer Research, Cambridge, Massachusetts, and B. Stillman, Cold Spring Harbor Laboratory



M. Botchan, G. Narlikar