NIH and the BRAIN Initiative

Brain Research through Advancing Innovative Neurotechnologies

IACC

Story Landis

April 8, 2014

National Institute of Neurological Disorders and Stroke

“The Next Great American Project”

Learning the Language of the Brain

NIH National Institute of Neurological Disorders and Stroke

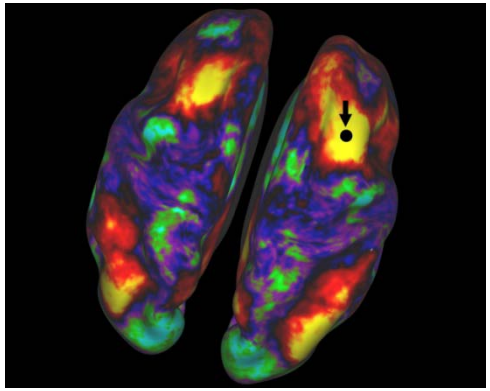
The Vision

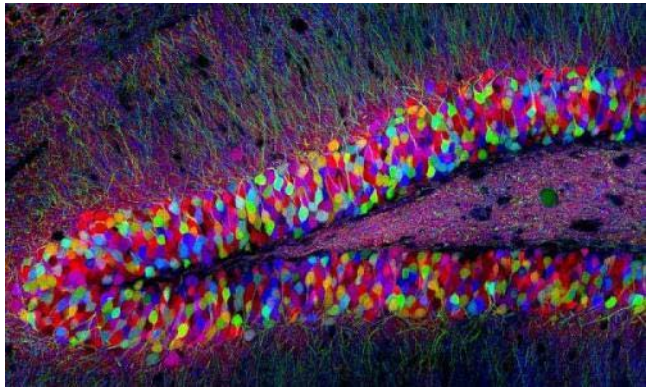
"So there is this enormous mystery waiting to be unlocked, and the BRAIN Initiative will change that by **giving scientists the tools they need to get a dynamic picture of the brain in action** and better understand how we think and how we learn and how we remember. And that knowledge could be – will be – transformative."

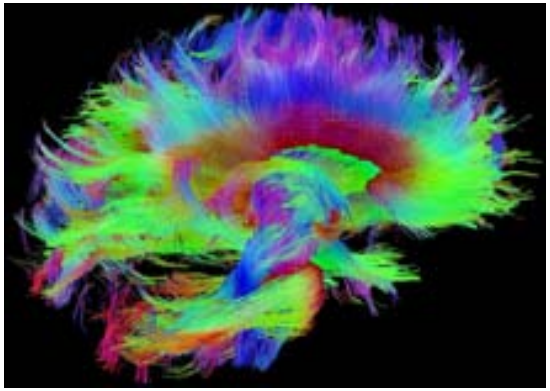
~President Obama, April 2, 2013

Brain Disorders Affect Us All

- **Neurodegenerative** disorders
  - Alzheimer's, Parkinson's, ALS, Huntington's…
  - Annual cost of dementia care in the U.S. is ~200 billion
- **Cognitive and affective** disorders
  - Schizophrenia, Bipolar Disorder, Depression, Anxiety, OCD…
- **Neurodevelopmental disorders**
  - Autism, Attention-deficit disorder, Epilepsy, Intellectual disability…
- **Injury- and insult-induced** disorders
  - PTSD, Traumatic brain injury, Stroke…

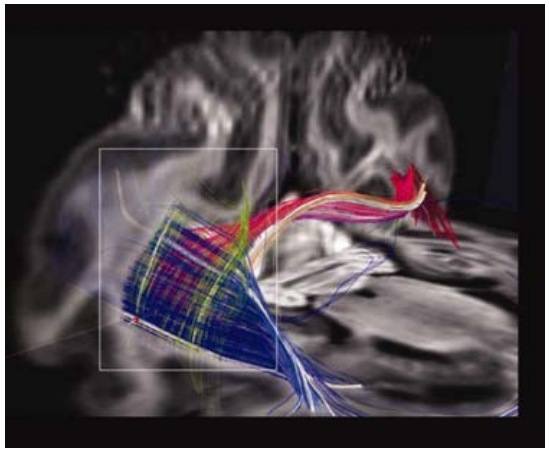






The Science Is Ready

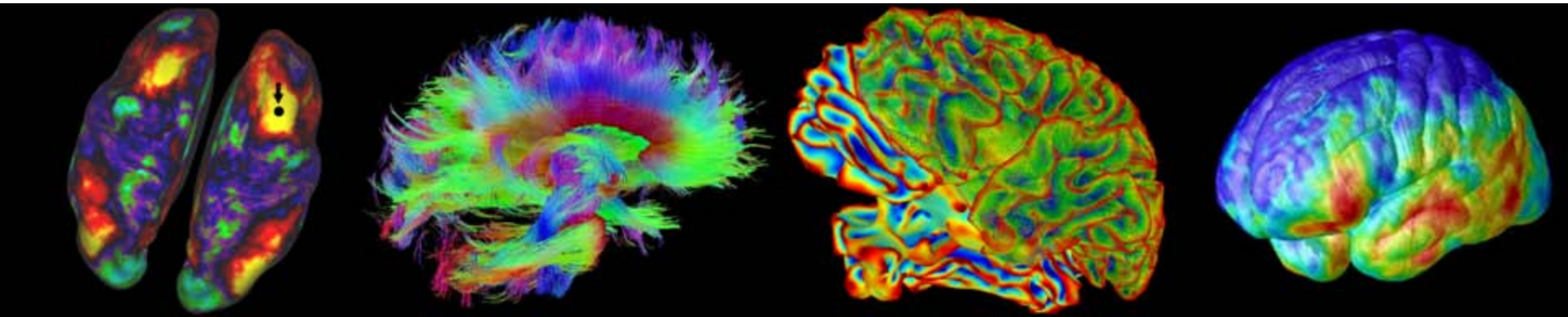
- Progress in neuroscience is yielding new insights into brain structure and function



- Progress in optics, genetics, nanotechnology, informatics, etc. is rapidly advancing the design of new tools

BRAIN Initiative: *Approach*

- Accelerate development, application of innovative technologies to construct dynamic picture of brain function that integrates neuronal and circuit activity over time and space
- Build on growing scientific foundation – neuroscience, genetics, physics, engineering, informatics, nanoscience, chemistry, mathematics, etc. – to catalyze interdisciplinary effort of unprecedented scope
- Pursue experiments in simpler model systems and in humans.



NIH BRAIN: *How will it work?*

- NIH BRAIN Working Group is developing a research plan
  - Articulate scientific goals for NIH research under BRAIN
    - Identified high-priority areas for FY14 funding in Sept ‘13
    - NIH issued 6 Requests For Applications in Dec ’13
    - Applications due by end of March, reviewed in the summer and funded in Sept. ‘14
    - A final plan that includes timetables, milestones, and costs is due June ‘14

NIH BRAIN Working Group: *Members*

Cornelia Bargmann, Rockefeller *(co-chair)*

William Newsome, Stanford *(co-chair)*

David Anderson, Caltech

Emery Brown, MIT

Karl Deisseroth, Stanford

John Donoghue, Brown

Peter MacLeish, Morehouse

Eve Marder, Brandeis

Richard Normann, Utah

Joshua Sanes, Harvard

Mark Schnitzer, Stanford

Terrence Sejnowski, Salk

David Tank, Princeton

Roger Tsien, UCSD

Kamil Ugurbil, Minnesota

EX OFFICIO MEMBERS

Kathy Hudson, NIH

Geoffrey Ling, DARPA

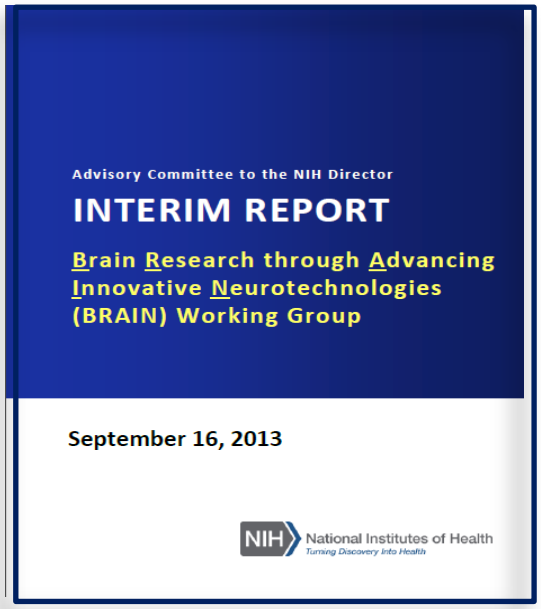
Carlos Pena, FDA

John Wingfield, NSF

EXECUTIVE SECRETARY

Lyric Jorgenson, NIH

NIH BRAIN Working Group:
High Priority Research Areas



1) Generate a census of cell types
2) Create structural maps of the brain
3) Develop new large-scale network recording capabilities
4) Develop a suite of tools for circuit manipulation
5) Link neuronal activity to behavior
6) Integrate theory, modeling, statistics, and computation with experimentation
7) Delineate mechanisms underlying human imaging technologies
8) Create mechanisms to enable collection of human data
9) Disseminate knowledge and training

NIH RFAs: *Cells, circuits, human imaging*

1. Transformative Approaches for Cell-Type Classification in the Brain *(addresses WG rec 1)*
   - Create classification strategies to generate a systematic inventory/census of cell types in the brain using existing tools and technologies

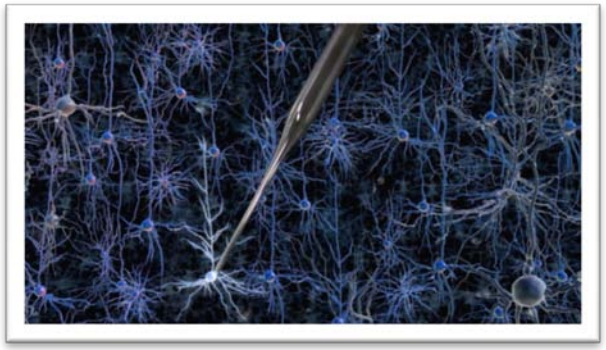
3. New Technologies and Novel Approaches for Large-Scale Recording and Modulation in the Nervous System *(addresses WG rec 3, 4, & 5)*
   - Focuses on the development and proof-of-concept testing of new technologies for large scale recording and manipulation of neural activity

6. Planning for Next Generation Human Imaging *(addresses WG rec 7)*
   - Aims to create teams of scientists to plan for a new generation of non-invasive imaging techniques that will be used to understand human brain function

Plans from Other Agencies: DARPA

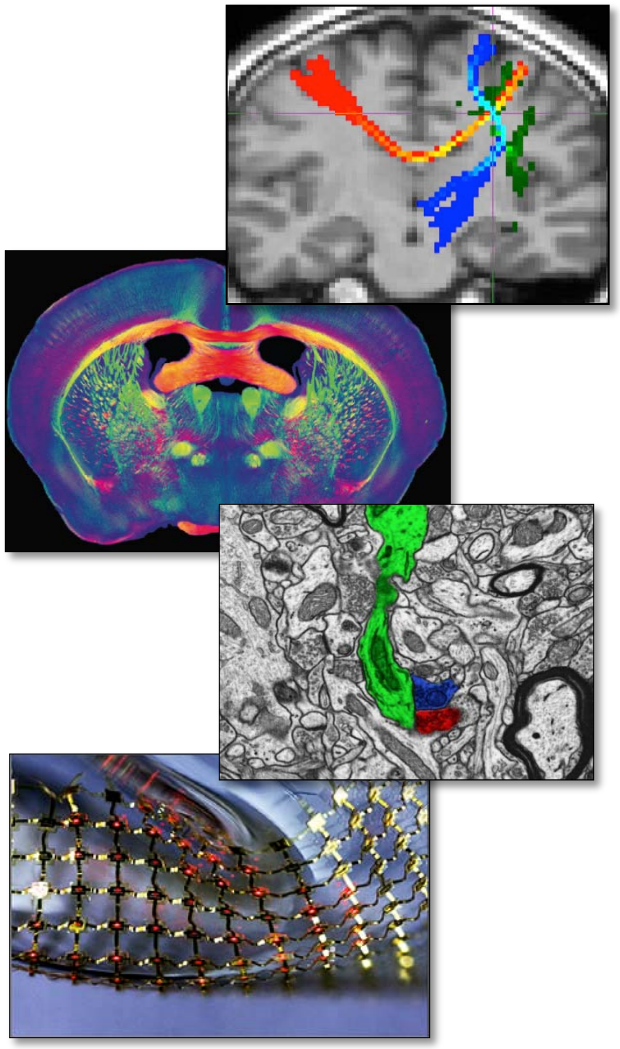
- System-Based Neurotechnology for Emerging Therapies (SUBNETS)
  - Create closed-loop medical devices able to measure and modulate networks of neurons in cases of intractable psychiatric illness and alleviate severe symptoms of diseases
- Restoring Active Memory (RAM)
  - Deliver a wireless device that repairs brain damage and restores memory loss
- Prosthetic Hand Proprioception and Touch Interfaces (HAPTIX)
  - Develop human-ready implantable electronic microsystems that enable amputees to intuitively control and gain sensory functions with prosthetic limbs

Plans from Other Agencies: NSF



- Meetings, organized by different Directorates, similar in scope to NIH-sponsored meetings
- Examples NSF investments in The BRAIN Initiative include:
  - $25 million Science and Technology Center on "Brains, Minds and Machines"
  - Research Coordination Networks (RCNs) to organize the scientific community and increase collaboration

BRAIN Initiative: High Impact/High Quality Science



The BRAIN Initiative℠ must accelerate other areas of neuroscience research

- NIH spends ~$5.5B/year on neuroscience research. BRAIN will be $40M (<1%) in 2014. It must focus, yet have broad impact
- Emphasis: tools to enhance **many** areas of brain research and methods for deeper understanding of **all** brain disorders

Technology is not an end in itself

- Focus is on **acquiring fundamental insight** about nervous system function in health and disease. What tools and infrastructure are needed?

Pose the problems, don't dictate the solutions

- Allow the most compelling ideas to flourish – it is early and new approaches are still emerging. Encourage collaboration.

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Public Interest in BRAIN is Growing