



BROADWAY CLASSICS



Special Book of the Month Feature

Rodgers and Hammerstein's

# Oklahoma!





Prof. Chun C. Lin





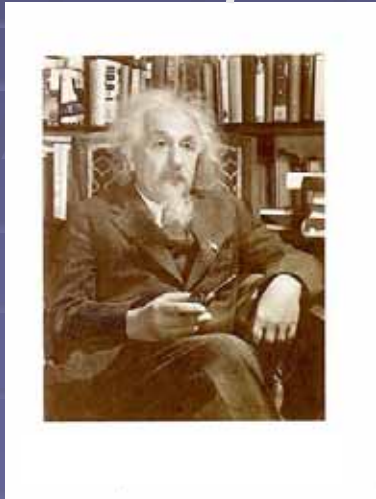
**Rice University**



**Lovett Hall**



Physics office



Lovett Hall

Rice University

# Provost's office (Lovett Hall)



Physics office



Rice University



Lovett Hall

# A career of committees !

- Rice University



- American Physical Society



- American Institute of Physics



- International physics conferences (ICPEAC)



- National Academy of Sciences – NRC



- National Science Foundation







Washington D.C.



Rice University



Lovett Hall

# The Executive Branch Of the U.S. Government

Two different jobs

with R&D agencies

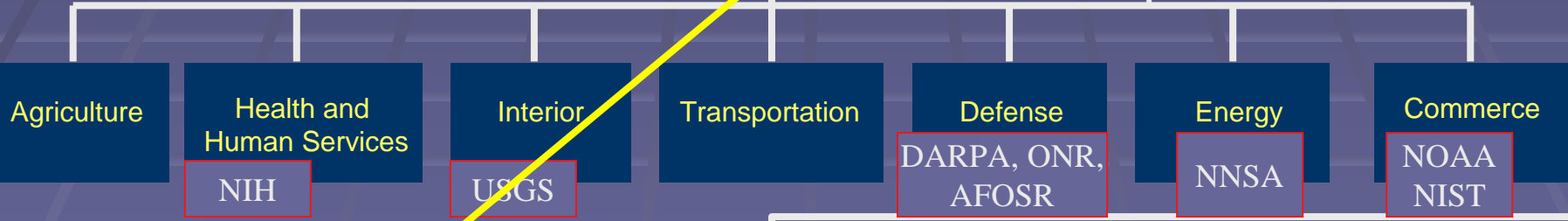


U.S. President



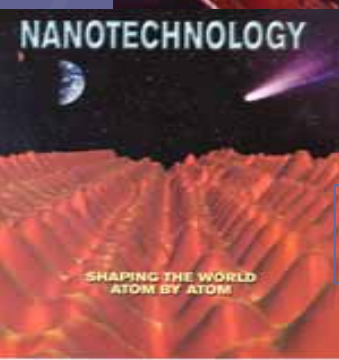
## Major Departments

Homeland Security



## Independent Agencies





**“Neal, how much do we need for nanotechnology?”**

# JAMES A. BAKER III INSTITUTE FOR PUBLIC POLICY AT RICE UNIVERSITY



## Science and Technology Policy Program

(coordinated by Dr. Kirstin Matthews)



- Energy and Environment (w/ Amy Jaffe)
- Health and Medicine (w/ TMC inst's)
- Space (w/ George Abbey)
- Nuclear Issues/ Non-Proliferation
- Education and Women in Science
- The Future of U.S. Science
- Role of Civic Scientists



# Science in the Obama Era

Department Colloquium



March 27, 2009

Neal Lane  
Rice University



## OUTLINE

- **The "Golden Age"**
- Science today - a few challenges
- The Obama Era



# World War II science and engineering

## Pre-WWII

U.S. R&D focused on  
agriculture and industry  
- with some university involvement



## WWII

mobilized U.S. industry  
and universities for the war effort



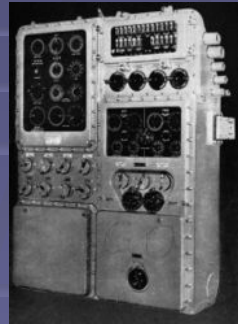
# World War II science and engineering



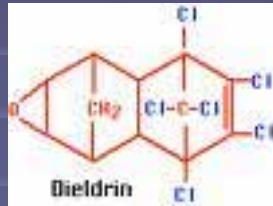
U.S. Army Radar



Proximity fuse



U.S. Navy TDC analog computer



Penicillin & Sulfa drugs



Stagg Field



Ballistic missile  
German V-2



Hiroshima  
6 August 1945 8:15 AM

Nuclear energy - "Atom Bomb"



# World War II science and engineering

## Pre-WWII

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- with some university involvement



## WWII

mobilized U.S. industry and universities for the war effort



## Post WWII -

A new partnership was established between the Federal government and universities

# Post-WWII Science

## Vannevar Bush and the Government-University Partnership



Vannevar Bush (1945)

## Vannevar Bush's "Science: The Endless Frontier"

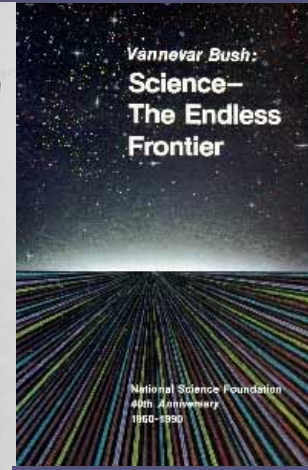
*"The Government should accept new responsibilities for promoting the flow of new scientific knowledge and the development of scientific talent in our youth. These responsibilities are the proper concern of the Government, for they vitally affect our health, our jobs and our national security."*

NSF established in 1950



# Post-WWII Science

## Vannevar Bush and the Government-University Partnership



Vannevar Bush (1945)

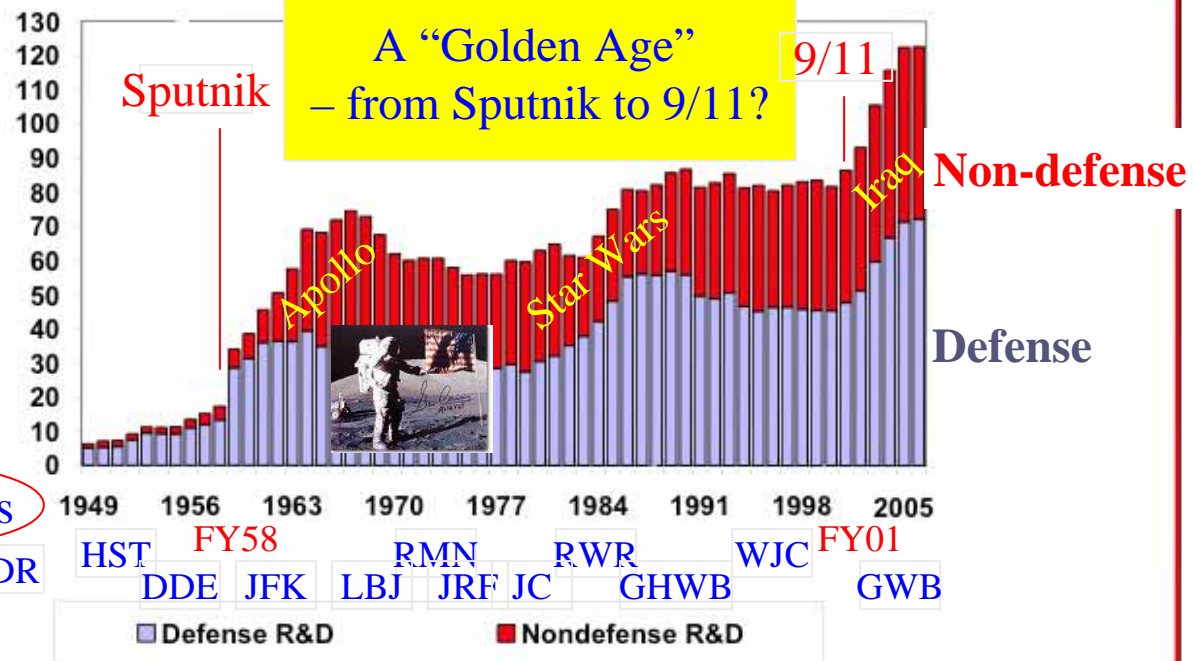
– Thus, began a new compact between “science” and the public – faculty and students do the research\* and the public pays for it (NIH, NSF, etc) with tax dollars. But there was an assumption that K-12 science and math education would provide the underpinnings.

\*understood to mean research of value to society !

# A "Golden Age" of Federal R&D Funding

## Federal Spending on Defense and Nondefense R&D

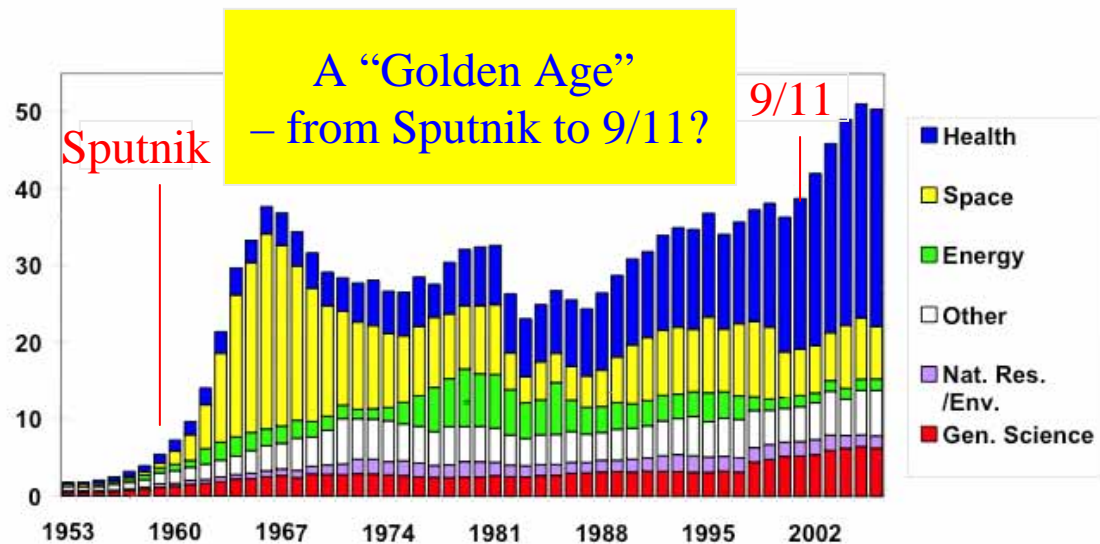
Outlays for the conduct of R&D, FY 1949-2006, billions of constant FY 2005 dollars



Source: AAAS, based on OMB Historical Tables in *Budget of the United States Government FY 2006*. Constant dollar conversions based on GDP deflators. FY 2006 is the President's request. FEB. '05 © 2005 AAAS

# But what kind of “Golden Age” for science? - from space to medicine - leaving costly gaps.

Trends in **Nondefense R&D** by Function, FY 1953-2006  
outlays for the conduct of R&D, billions of constant FY 2005 dollars

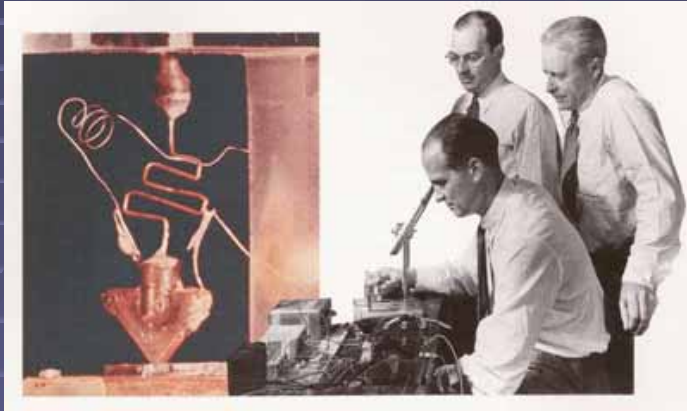


Source: AAAS, based on OMB Historical Tables in *Budget of the United States Government FY 2006*. Constant dollar conversions based on GDP deflators. FY 2006 is the President's request.

Note: Some Energy programs shifted to General Science beginning in FY 1998.  
FEB. '05 © 2005 AAAS

# From Research to Information Technology

## Early discoveries and inventions



Transistor, 1947

Federal government and Industry (Bell Labs, Texas Instruments, others)



Maser , 1953-54



Integrated Circuit, 1958

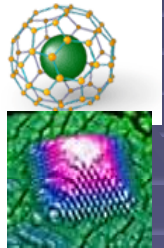
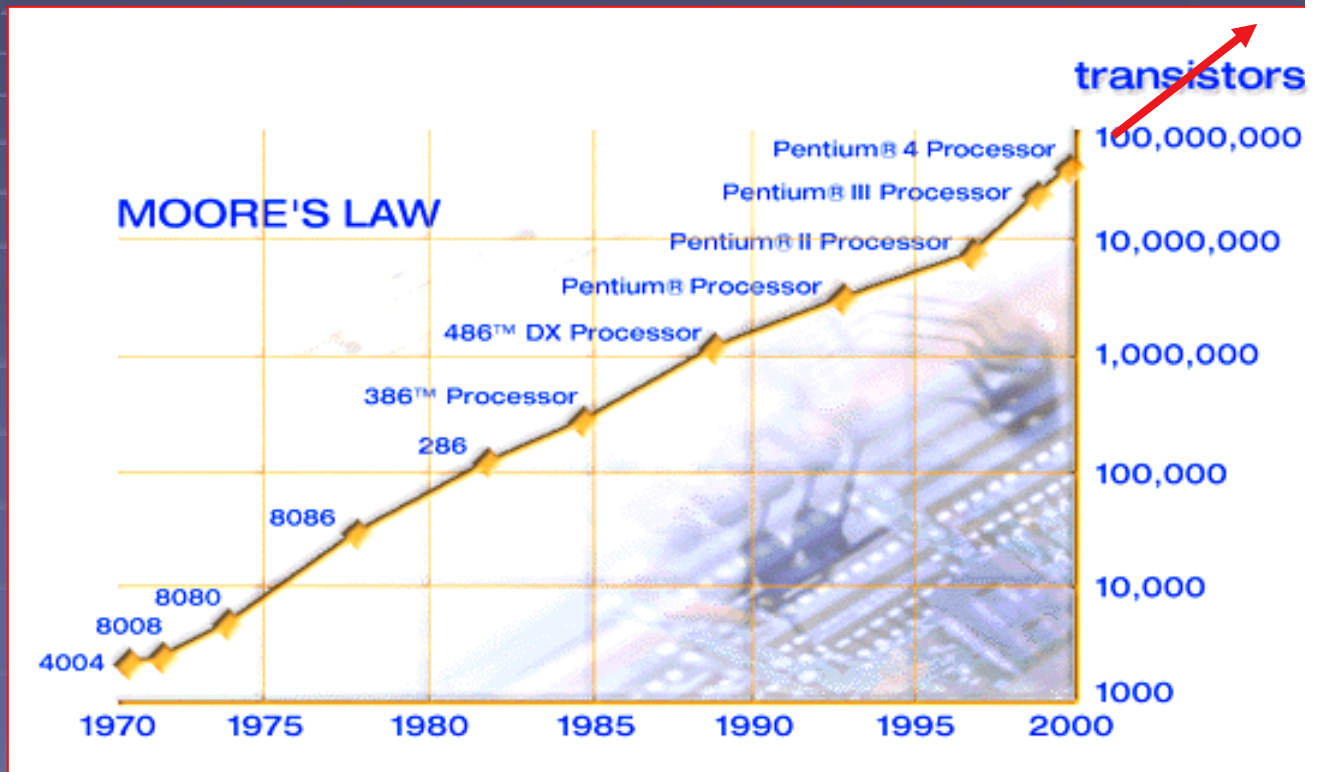


Laser, 1958-1960

# From Research to Information Technology

## The semiconductor industry and legendary “Moore’s Law”

Nanotechnology?

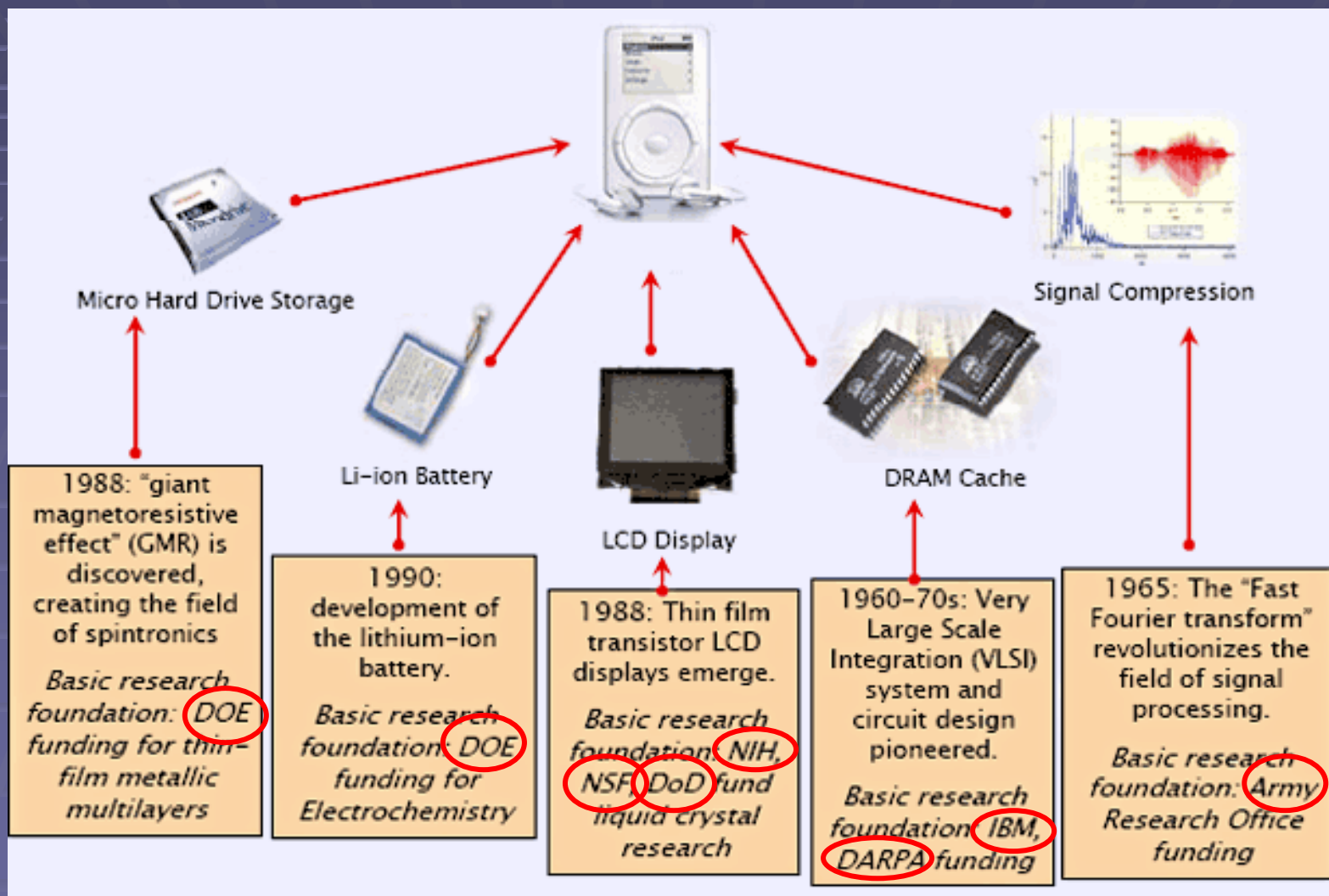


Gordon Moore

Source: Intel's Silicon Showcase,  
<http://www.intel.com/research/silicon/mooreslaw.htm>

# From Research to Information Technology

## The "iPod"





## OUTLINE

- The "Golden Age"
- **Science today - a few challenges**
- The Obama Era



# Challenges to the Nation

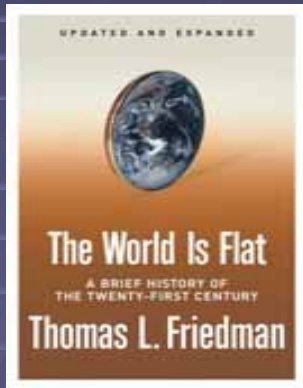
(A Few Examples Among Many)

- **Health** – affordable healthcare, personal safety
- **Economy** – workforce – innovation & competitiveness
- **Energy** – secure supply of carbon-free energy & fuels
- **Environment** – clean air & water – climate change “M&A”
- **Security** – terrorism, nuclear proliferation
- **Education** – poor incentives for teachers and students
- **Physical Infrastructure** – roads, bridges, rail & air systems
- **National Image** – in need of repair
- **Science and Technology** – essential to progress



# Challenges to the Nation

## Tom Friedman's Flat World

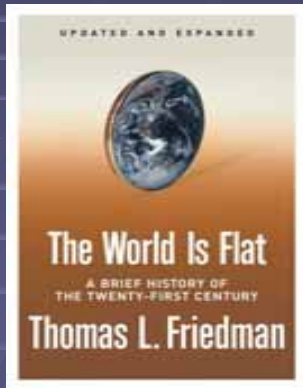


Ten forces are leveling the playing field for commerce – most have to do with technology and innovation.



# Challenges to the Nation

## Tom Friedman's Flat World



Ten forces are leveling the playing field for commerce – most have to do with technology and innovation.

And Three “Dirty Little Secrets” about the U.S.

- Secret #1 The Numbers Gap
- Secret #2 The Ambition Gap
- Secret #3 The Education Gap



# Challenges to Science

## Neal's Flat World

Pre-Obama Forces have been "leveling the playing field" between scientific knowledge and opinion.

- **Money** for science - too little & out of balance
- **People** in science - too few & not representative
- **Understanding** of science - too little
- **Ideology** - too much
- **Politics** - too intrusive
- **Public confidence** in science – how fragile is it ?

# Challenges to Science Policy

(A Few Pre-Obama Examples Among Many)

- **Health** – cuts to NIH budget, restricted stem cell research
- **Energy** – inadequate R&D on new energy technologies
- **Environment** – science ignored, no policy on GHG emissions
- **Security** – proliferation of nuclear weapons
- **Education** – poor science/math teaching, attack on evolution
- **Workforce** – lack technical skills – SE careers not glitzy
- **Integrity of Science** – manipulations, misbehavior, ignorance
- **Space** – NASA in crisis: shuttle; space station; science
- **Research** – cuts on many fronts, and out of balance
- **Interagency cooperation** – chronic and systemic problem
- **International Cooperation** – U.S. an unreliable partner ?

# Challenges to Science Policy

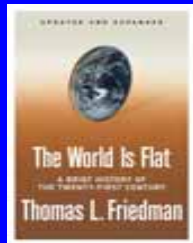
(A Few Pre-Obama Examples Among Many)

- **Health** – cuts to NIH budget, restricted stem cell research
- **Energy** – inadequate R&D on new energy technologies
- **Environment** – science-based decisions
- **Security** – proliferation
- **Education** – poor
- **Workforce** – lack of
- **Integrity of Science** – ignorance
- **Space** – NASA in crisis: shuttle; space station; science
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- **International Cooperation** – U.S. an unreliable partner ?

Several policy issues were the focus of a highly influential study and report of the National Academies, called “Rising Above the Gathering Storm”

# The National Academies spoke out about a “Gathering Storm” for the U.S.

“Flat World” mapped onto U.S. Science and Technology  
– Congress asked the National Academies for advice



**Norm Augustine** (Panel Chair)

“Rising Above the Gathering Storm”  
National Academies NRC Report 2006

**Norm Augustine**

“Is America Falling Off the Flat Earth?”  
National Academies Press 2007



# The National Academies spoke out about a “Gathering Storm” for the U.S.

“Flat World” mapped onto U.S. Science and Technology  
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Congress was ready to increase research budgets by large amounts – when a fight between Congress and President Bush over bottom line numbers wiped out the increases for science in FY2008 !

Norm Augustine (Panel Chair)

“Rising Above the Gathering Storm”  
National Academies NRC Report 2006

Norm Augustine

“Is America Falling Off the Flat Earth?”  
National Academies Press 2007

# FY08 Science Budgets



Slide -Rosina Bierbaum

## OUTLINE

- The "Golden Age"
- Science today - a few challenges
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# “America has new leadership”

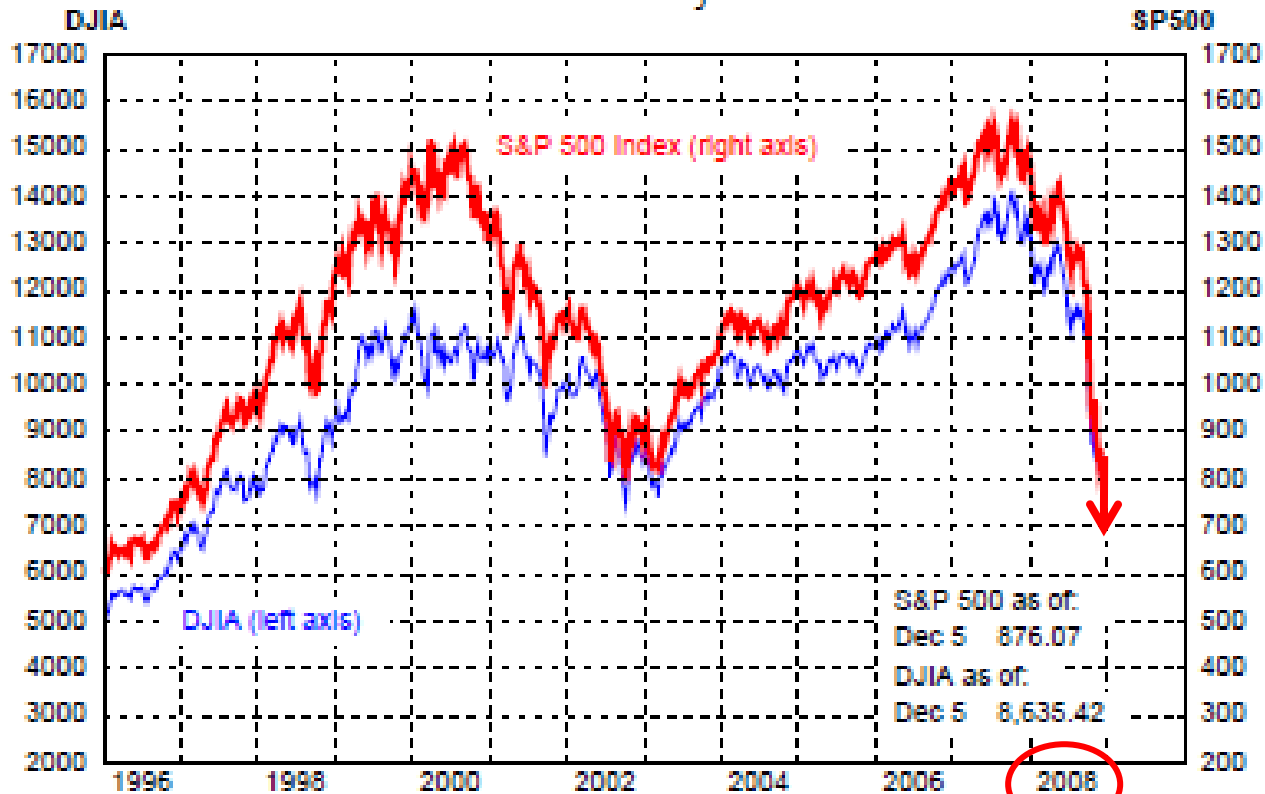


President Obama has made it clear that science is vital to America's future and he will give it strong support.

# Also cometh the recession - panic !

(Nation needs stimulus spending!)

DOW JONES INDUSTRIAL AVERAGE AND S&P 500 INDICES  
Weekly



Source: Federal Reserve Board

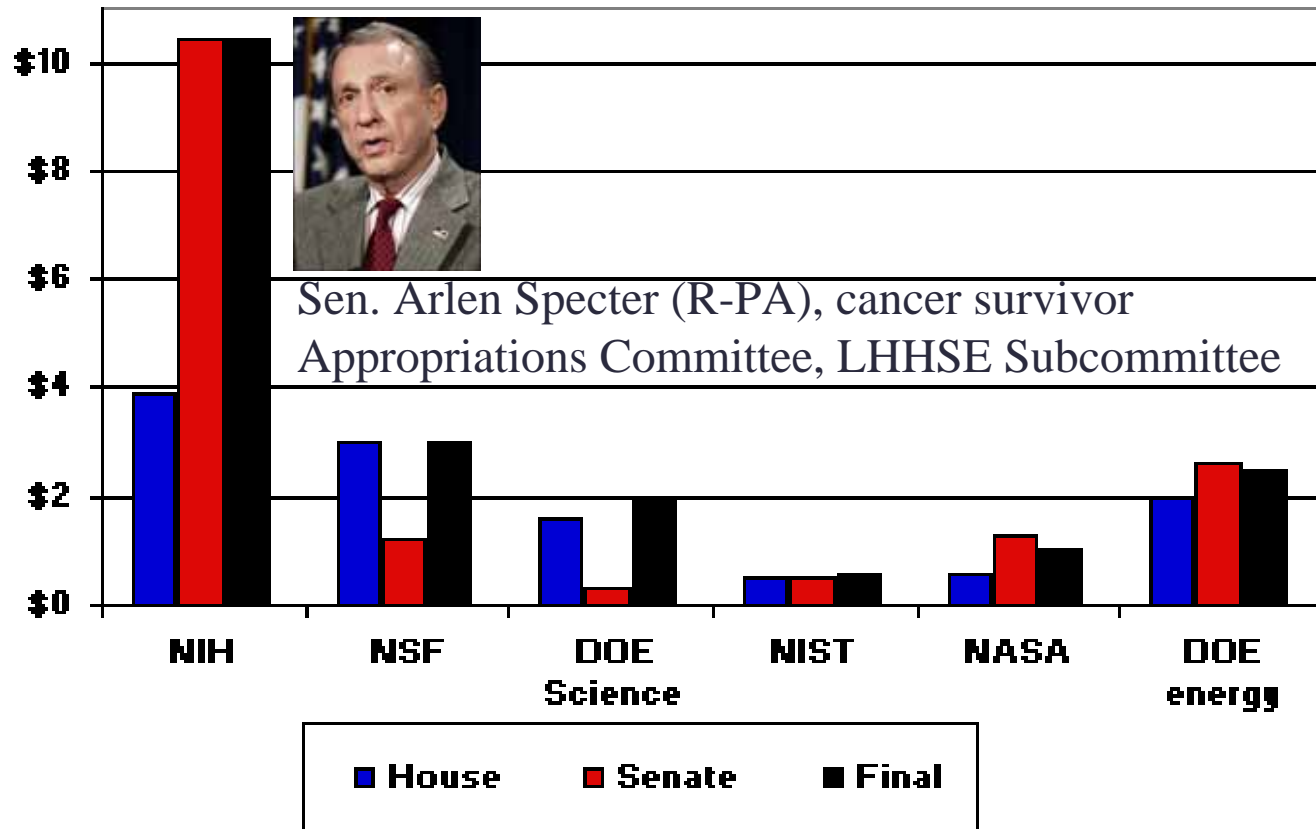
# FY09 Science Budgets



What a difference a year makes...

# FY09 “Stimulus Funding”

2009 Supplemental Recovery Funding for R&D  
(House, Senate, and Final bills)  
(budget authority in billions of dollars)



Source: AAAS analysis of R&D in House, Senate,  
and Final stimulus appropriations bills (HR 1).  
FEB. '09 © 2009 AAAS



# R&D in the Economic Recovery Bill

## FY09 Increases over FY08

*(dollars in millions)*

<u>Programs</u>	<u>FY08</u>	<u>FY09 Add-on</u>	<u>Add-on (%)</u>
DOE	4036	1600	+40%
(science)	1238	2500	+102%
NSF	6055	3000	+50%
NASA	17179	1000	+6%
NIH	29607	10400	+35%



**R&D in  
FY08  
(dollars in millions)**

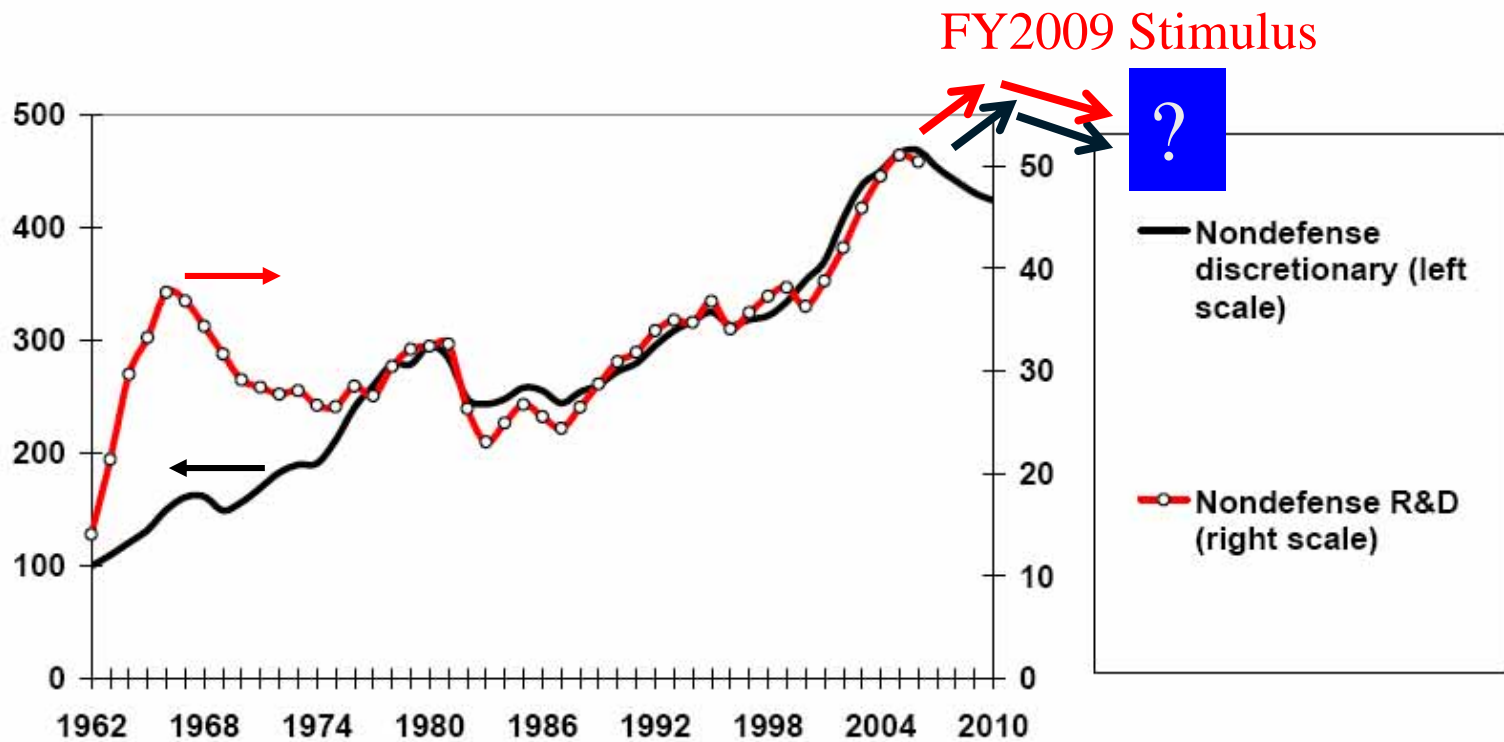
But this stimulus add-on  
is one-time money, so what  
about future years?  
Stay tuned !

<u>Programs</u>	<u>FY08</u>	<u>FY09 Add-on</u>	<u>Add-on (%)</u>
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# Future budgets up, then down?

## R&D and Discretionary Outlays (Nondefense), 1962-2010

in billions of constant FY 2005 dollars

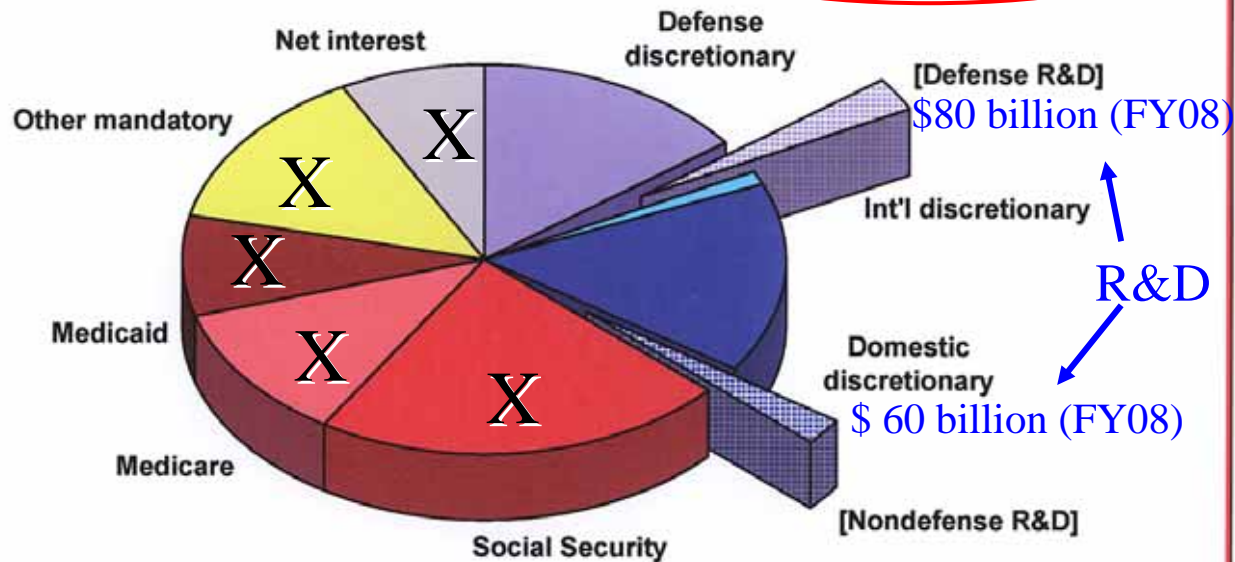


# Research is a small part of Federal spending - and it is likely to get squeezed !



## Total Federal Spending (except Iraq)

**\$ 2.9 trillion in FY08**



X = non-discretionary

**Research** — **\$ 58 billion (FY08)**

Note: Projected Unified deficit is \$307 billion.  
Source: AAAS, based on *Budget of the United States Government FY 2004*.  
FEB. '03 © 2003 AAAS





# Challenges to Science

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# Challenges to Science Policy

(Likely responses from the Obama Administration)

- **Health** – NIH budget up, less restricted stem cell research
- **Energy** – Large increases in R&D on new energy technologies
- **Environment** – expect science-based environmental policies
- **Security** – expect reductions in nuclear weapons
- **Education** – expect revision of Pres. Bush's "NCLB Act"
- **Workforce** – expect financial help for education/training
- **Integrity of Science** – expect evidence-based policy making
- **Space** – expect more emphasis on science, robotic missions
- **Research** – expect growth in physical and life sciences
- **Interagency cooperation** – expect ostp to address
- **International Cooperation** – expect openness to partnership

# “America has new leadership”



President Obama has made it clear that science is vital to America's future and he will give it strong support.

But he cannot do it alone. He will need the help of many 'civic scientists'.

# What is a 'civic scientist' ?

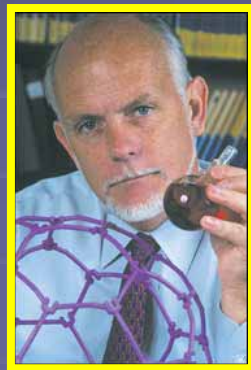
-Former Congressman George Brown (D-CA)  
had some advice for us.

“to become more involved with  
the political process and the  
needs of the broader society  
— in other words, be more  
effective citizens.”



# One Civic Scientist, the late Rick Smalley, spoke out on Humanity's Top Ten Problems for Next 50 Years

1. ENERGY (carbon-free)
2. WATER
3. FOOD
4. ENVIRONMENT
5. POVERTY
6. TERRORISM & WAR
7. DISEASE
8. EDUCATION
9. DEMOCRACY
10. POPULATION



Rice's Rick Smalley  
(1943-2005)



The world will need revolutionary new technologies - nanotechnology?



# A few examples -among many- of civic scientists!



Sally Ride  
UCSD

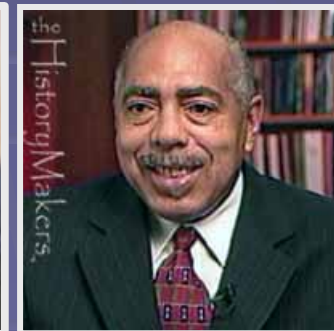
Neil de Grasse Tyson  
Hayden Planetarium

Mary Good  
Commerce

Rita Colwell  
NSF

Leon Lederman  
Fermilab

Richard Tapia  
Rice, NSB



Rush Holt  
D-NJ

Vern Ehlers  
R-Mich

Bill Foster  
D-III

Shirley Jackson  
RPI, NRC

Bassam Shkhashiri  
"science is fun"

Bruce Alberts  
NAS, 'Science'

Walter Massey  
NSF, Morehouse.

Arden Bement  
NSF

# Civic Scientists in Obama's Administration



Jane Lubchenco

Jane Lubchenco,  
Administrator, NOAA



John Holdren, Pres.  
Science Advisor (OSTP)



Steve Chu, Secretary,  
Department of Energy

# "The Future of U.S. Science?"



Why are my grandkids smiling ?

# Thank You !

