

S&T Research Funding In A Rule-Changing World

Rajesh Gupta
UC San Diego

April 2, 2005

Pentagon Redirects Its Research Dollars

By [JOHN MARKOFF](#)

Our Incredible Shrinking Curiosity

By Rick Weiss

Sunday, April 10, 2005; Page B01

April 15, 2005

OP-ED COLUMNIST

Bush Disarms, Unilaterally

By [THOMAS L. FRIEDMAN](#)

Research under fire: the war on terror, academic freedom wind up as collateral damage

By Barry Bergman, Public Aff
2005

The University of California "Fiat lux" ("Let there be light") celebrates the power of knowledge. Federal officials, however, that power is a double-edged sword. They seem intent on imposing a post-9/11 credo on those who conduct university research: no free licenses.

In an age when data can be so dangerous, the Bush administration is clearly concerned with keeping classified information out of the hands of America's enemies and terrorist networks to hostile. But university officials were dimly grasped threat from

- January 27, 2005: *UC Berkeley News: Berkeleyan*, Barry Bergman, "[Research under fire: In the war on terror, academic freedom could wind up as collateral damage.](#)"
- April 2, 2005: *New York Times*, John Markoff, "[Pentagon Redirects Its Research Dollars](#)"
- April 10, 2005: *Washington Post*, Rick Weiss, "[Our Incredible Shrinking Curiosity](#)"
- April 13, 2005: *New York Times*, John M. Deutch and William H. Perry, "[Research Worth Fighting For](#)"
- April 15, 2005: *New York Times*, Tom Friedman, "[Bush Disarms, Unilaterally](#)"
- April 17, 2005: *San Jose Mercury News*, Editorial, "[Quiet change in priorities poses dire threat](#)"
- April 17, 2005: *Seattle Post-Intelligencer*, Editorial, "[Investing in Research: A lose-lose deal](#)"
- April 20, 2005: *Roll Call*, Norman J. Ornstein, "[Bad Policy Choices Are Worrisome for U.S. Economy's Future](#)"
- April 25, 2005: *Roll Call*, Morton M. Kondracke, "[Congress Must Increase Bush's Science Budget](#)" (paid subscription req'd) -- [coverage of the article](#) on CRA's [Computing Research Policy Blog](#)
- April 2005: *Communications of the ACM*, David Patterson, "[President's Letter: The State of Funding for New Initiatives in Computer Science and Engineering](#)"
- May 6, 2005: *Science*, Edward Lazowska and David Patterson, "[An Endless Frontier Postponed](#)" -- [Coverage of the article](#) on CRA's [Computing Research Policy Blog](#)
- May 6, 2005: *Los Angeles Times*, Editorial, "[The Imagination Drain](#)"
- May 11, 2005: *Business Week*, Matthew Fordhal, "[Scientists complain about Pentagon cuts](#)"
- June 2, 2005: *New York Times*, Editorial, "[Virtually Unprotected](#)"
- July 27, 2005: *Wall Street Journal*, Vint Cerf and Harris Miller, "[America Gasps for Breath in the R&D Marathon](#)" (pdf)
- August 2005: *Communications of the ACM*, Sanjeev Arora, Bernard Chazelle, "[The Thrill is Gone?](#)" (pdf)
- November 8, 2005: *CNET News.com*, Marguerite Reardon, "[Research money crunch in the U.S.](#)"
- November 10, 2005: *EDN*, Craig Barrett, "[Sputnik, races, and the state of US education](#)"

Beyond funding levels, fundamental shift in how S&T R&D is done in the US!

moves to bar non-citizens foreign-born U.S. citizens participating in an ever-ex

absolutely, and
an, "[Investing in](#)
y for High-Tech

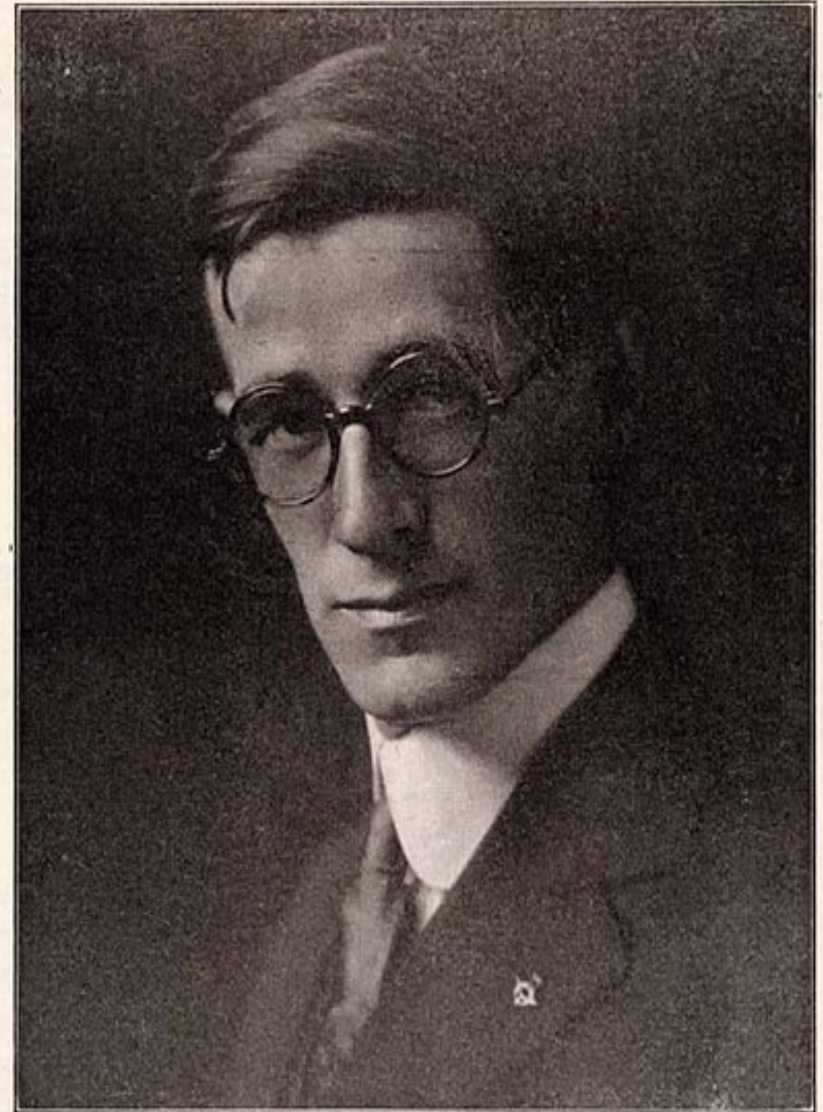
[Progress?](#) - [Blog coverage](#)

The Known World

- Federal Agencies:
 - Highly decentralized with individual subcommittees that have funding oversight over individual agencies
 - National Science Foundation
 - NIH, DOE, NASA, DoD, USDA, etc.
 - About \$68B out of which about \$5B is general R&D (6.1)
 - Singapore is \$2.4B (2004)
- States
 - Economy-driven initiatives
- ~~Industry Research Laboratories~~
- Industry and Industry-Participated Consortia
 - Competitive pressures in pre-competitive landscapes

- Co-founded American Appliance Company in 1922
 - First product was a gaseous rectifier, Raytheon, for RX power supplies
- Professor, EE @MIT 1923-32
 - Differential Analyzer
 - Claude Shannon
 - “As We May Think”: Memex, a microfilm-based mechanized memory device
- Dean of Engineering, MIT ‘32-38
- President, Carnegie Institute of Washington 1939
- Pushed for National Defense Research Committee in 1940
 - Managed to meet President Roosevelt on 12 June 1940 and convinced him to build NDRC
- Turned into Office of Scientific Research and Development (OSRD)
 - supervising work of 6000 scientists involved in the war effort...

Radio World's Hall of Fame



(Photograph by Champion Studio)

Vannevar Bush

Origins of the “Research University”

11/17/1944, President Roosevelt asked V Bush:

- (1) What can be done ... to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?
- (2) ... what can be done now to organize a program for continuing in the future the work which has been done in medicine and related sciences?
- (3) What can the Government do now and in the future to aid research activities by public and private organizations?
- (4) Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?

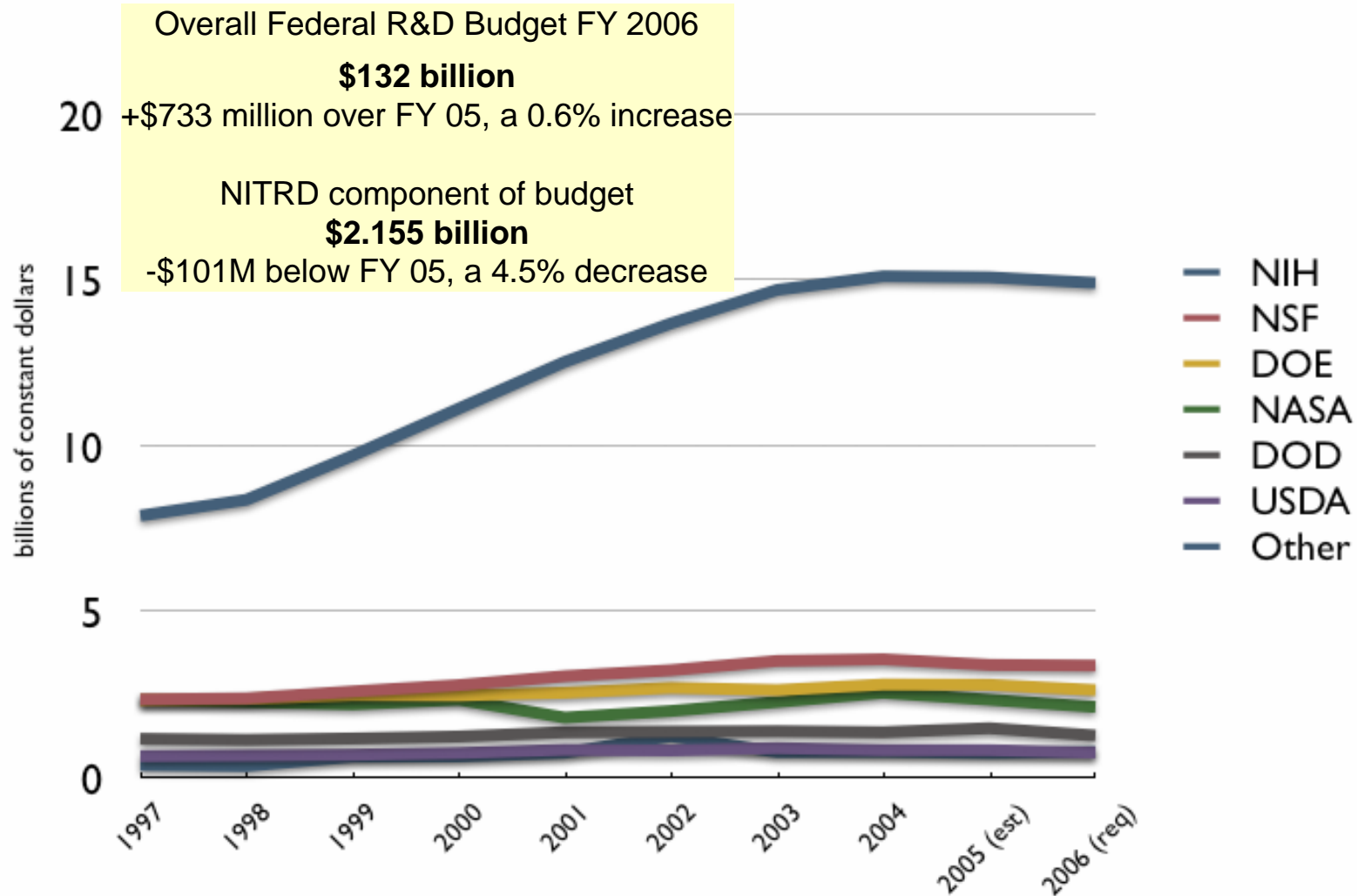
“Science: The Endless Frontier”

- submitted to President Truman 3/1945
 - Formed the basis of “University, Industry, Government” compact on research and education
 - One of the most persuasively written policy document in the nation’s history
 - “Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress.”
 - Led to the emergence of “Research University”

NSF established 1950

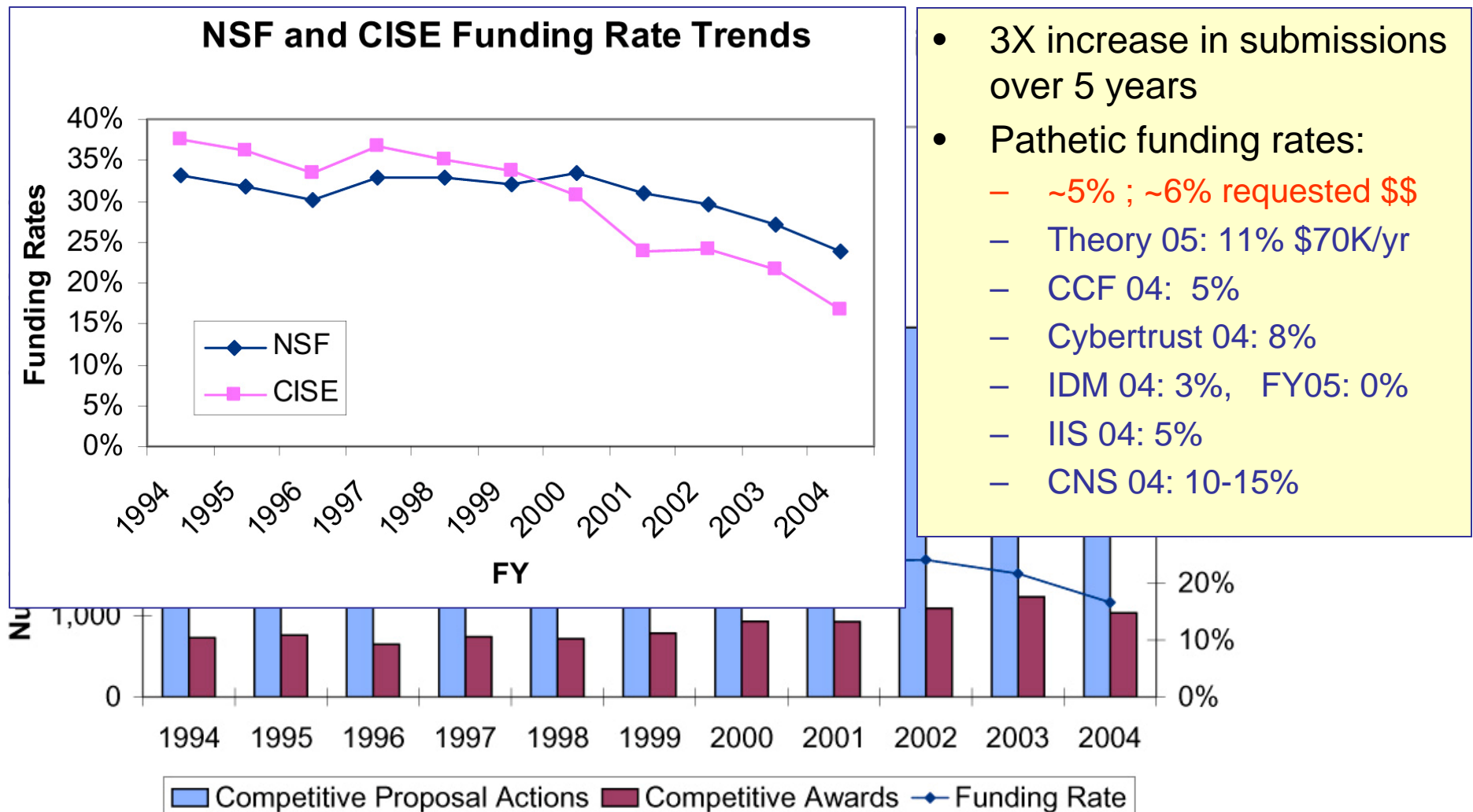
- Three policy pillars
 - Federal support of basic scientific research
 - Role of research universities
 - Federal support of education of young people in science and engineering
- “Research University”
 - “The publicly and privately supported colleges, universities, and research institutes are the centers of basic research. They are the wellsprings of knowledge and understanding.”
- Currently about \$5.65B
 - \$4.22B for research, \$841M EHR, \$174 Maj Equip
 - CISE and ENG at about \$600M each

Trends in Basic Research, by Agency FY 1997 - 2006

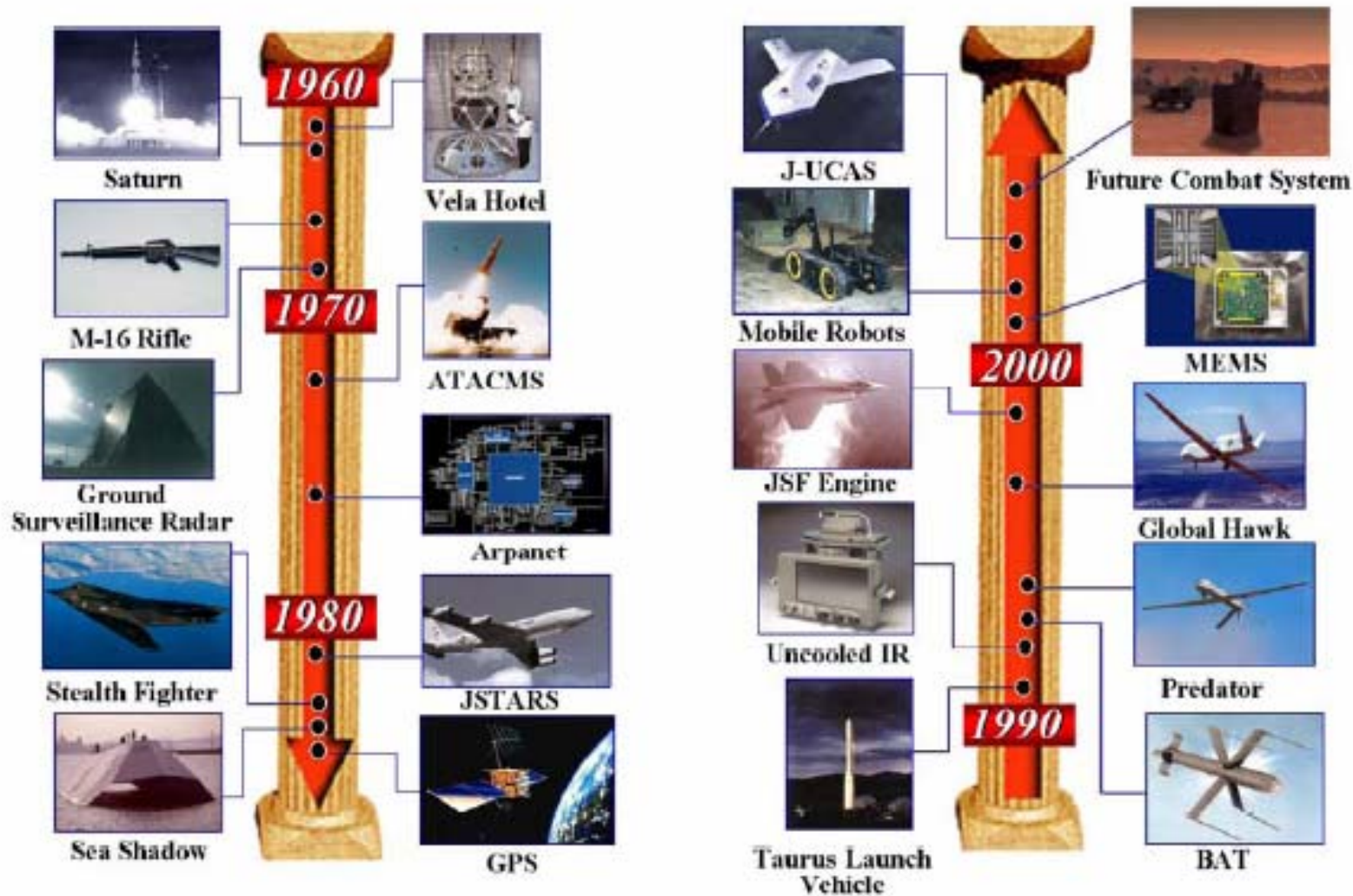


Source: AAAS Reports I through XXX, based on OMB and agency R&D budget data.
Includes conduct of R&D and R&D facilities.
Constant dollar conversions based on OMB's GDP deflators from the FY 2006 budget.

CISE@NSF provides 86% of Federal Obligations for Basic CS Research



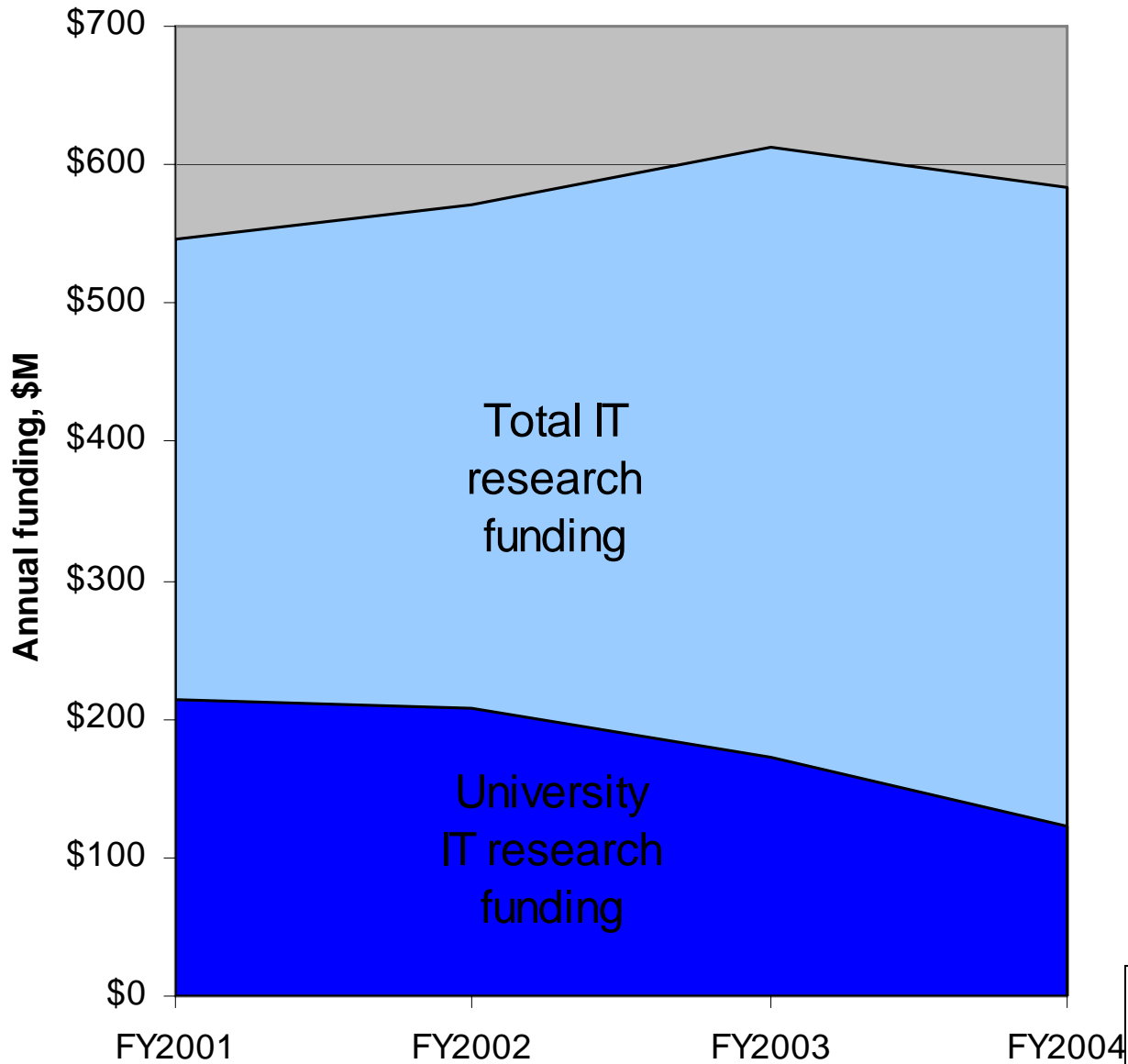
DARPA: Mission Oriented



DARPA

- FY 2005: \$2.97B
 - \$1.3B is basic research, \$1.6B is applied research
 - Materials and Electronics is about \$0.5B
- FY 2006: \$3.08B => \$2.8B
 - \$1.4B basic, \$1.5B applied
 - All computing related money to Cognitive Computing (\$200M)
 - Latest: \$55M cut from \$114M
 - Electronics at \$241M
 - Network centric warfare is a growth component.

DARPA Support for IT Research



*~125M for
FY05*

*43%
reduction in
5 years.*

DARPA response to
SASC, 4/2005

State Participation

- Goes long back: 19th century
 - land grant universities that focused on agriculture and technology
- Feds took dramatic lead during WWII
- IT boom enabled states to get back into the action
 - Even as feds withdrew to 0.9% of GDP from 1.5% in 1965

The Consortia

- “A loose long-term alliance between competitors in a given industry”
 - Modestly budgeted than company alliances
 - Often non-profit (or marginally so)
- Enabled by the National Cooperative Research Act 1984
 - Quite a bit of international dynamics: Japanese TRA, EU
 - But variations in tax-payer support (Japan: 53%, US: 17%)
- Some ‘successful’ models
 - Well-defined pre-competitive technology developments (SEMATECH)
 - Centers that form consortia for solving well-defined technical problems (IMEC)
 - Endowed Institutes and University Centers
 - (Cal Institutes for Science and Innovation: CITRIS, CallIT2, CNSI, QBIC; Albany NanoTech; Texas Tech Initiative)

Year	1985	1986	1987	1988	1989	1990	1991	1992
#consortia registered	50	17	27	33	34	45	59	59

SEMATECH

- 1986: US share of semi market was project to reach 20% by 1993
 - DSB and SIA contributed to the overall noise against the Japanese
- 14 companies accounting for 80% of US semi industry banded together
 - Strange bedfellows bounded by a common threat
 - Goal: “To provide the US Semi industry the capability of achieving world-leadership manufacturing position by the mid 1990s.”
 - \$100M/year from US, 1% of sales (\$1M-\$15M)
 - \$200M/year operating budget
- By 1993, US Semi overtook Japan
 - by 1996: US: 44%, Japan: 36%
 - Execution, Central research facility key to its success.

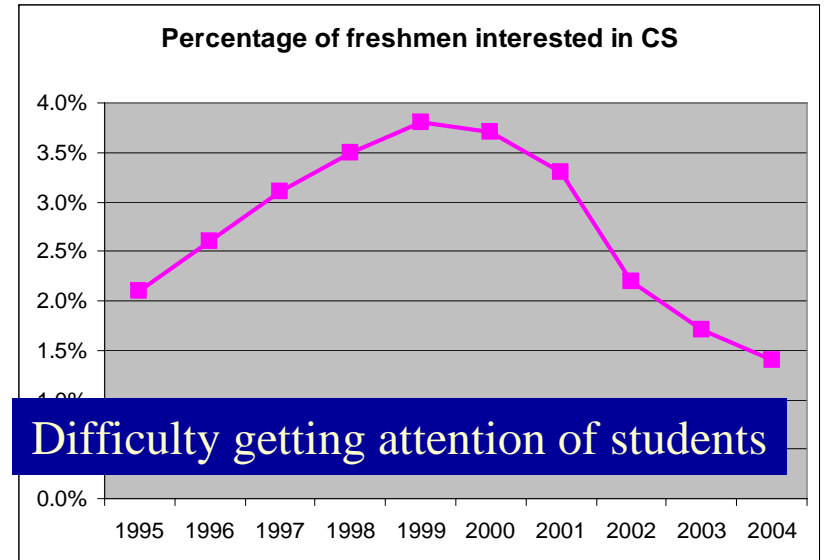
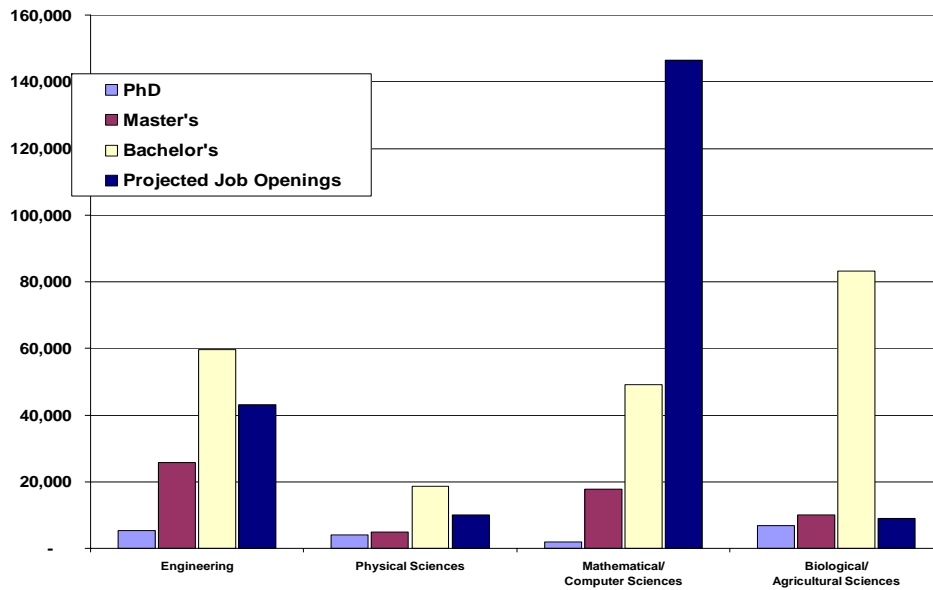


Courtesy: Bill Joyner, SRC

A Rule-Changing World: Shifting priorities of a nation at war

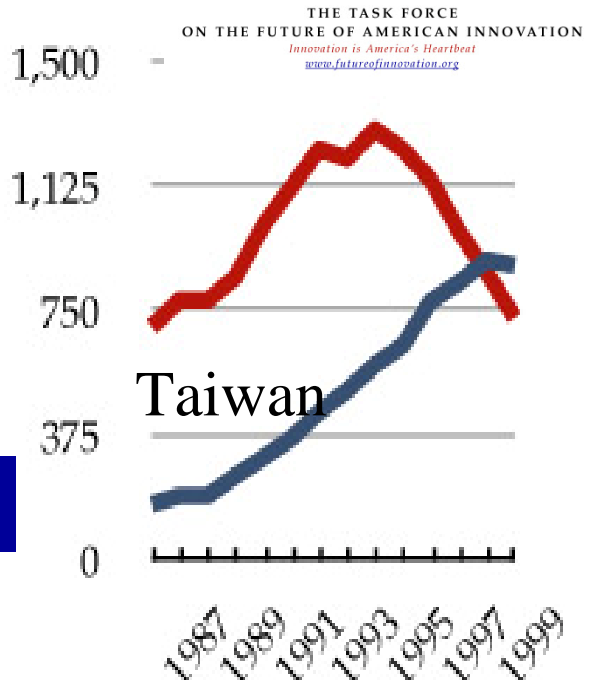
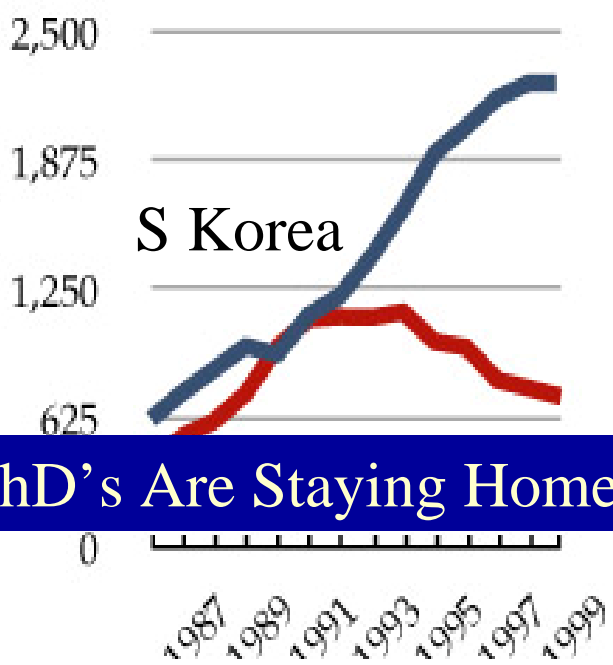
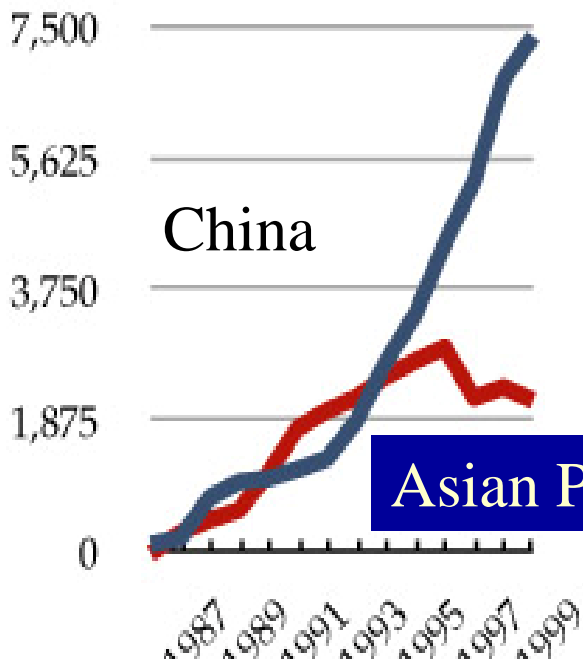
- Goals of technology policy are changing
 - Pre 9/11:
 - We need technology advantage for a superior military
 - Collateral commercial developments are a good thing
 - Post 9/11:
 - We *have* technology advantage. We need deployment.
 - A deepening paranoia of the foreigners among our midst
- Partly driven by “neocon” dislike for centrally organized anything
 - A (minority) thought that never really bought the endless frontier.
 - Cf: @Cato & Hoover;
 - Donald Kennedy on “Riding through the Endless Frontier –Right past the students”
- Partly by a palpable political sense that science is getting in the way of policy (and ethics)
 - Not really laughable concerns. Cf: Bill Joy

Annual Degrees and Job Openings in Broad S&E Fields



Difficulty getting attention of students

John Sargent, Senior Policy Analyst, U.S. Department of Commerce, presented to the Computing Research Association, 2/2004



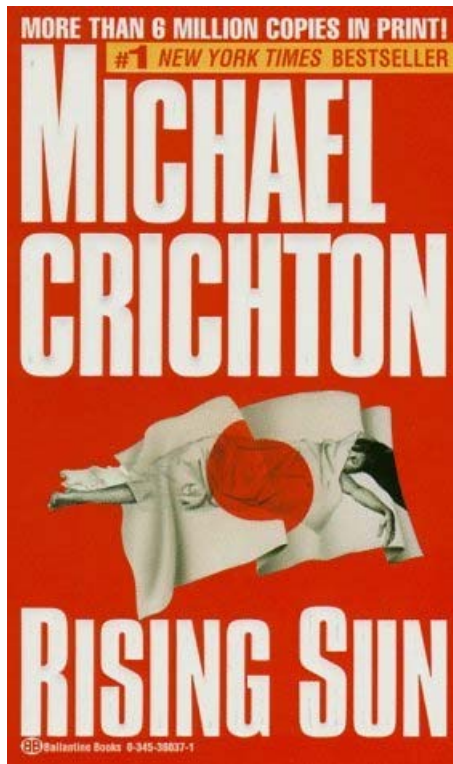
Asian PhD's Are Staying Home

THE TASK FORCE ON THE FUTURE OF AMERICAN INNOVATION
Innovation is America's Heartbeat
www.futureofinnovation.org

Closing Thoughts

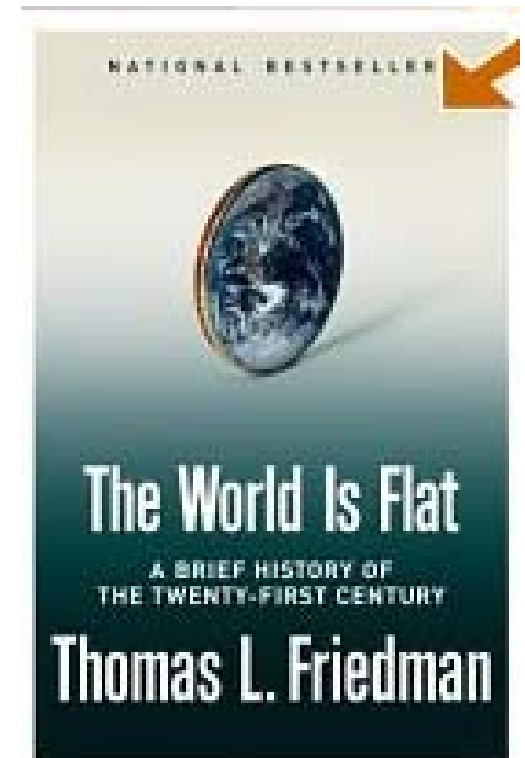
- What is the role of “unsolicited” research?
 - Agencies routinely engage in divining future
 - Picking up technology winners by committee or worse
 - Plenty of humbling experiences in predicting technology winners: General Magic, Telecosm, MCC, FGCP
- Shrinking co-investments are altering the R&D ecosystem
 - While small in magnitude, federal R&D leadership is the catalyst for the much larger R&D engine to keep going
 - Example: CISE/NMS \$3-5M; SRC at \$40M
 - versus \$900M (WW) ITRS related spending
- What are the good models to effectively advocate S&T policy?

FUD?



1984

2005





Effect of S&T R&D on Our Lives?

“ Calit2 represents a new mechanism to address large-scale societal issues by bringing together multidisciplinary teams of the best minds. ” *Larry Smarr, Director, Calit2*

Star sickness

Celebrities speaking out about their afflictions can raise awareness and money.

By Mark Ebner and Lisa Derrick

Nov. 29, 1999 | Celebrity is a fleeting thing, fragile and impermanent. And health, like elusive fame, can vanish in an instant, leaving the subject weakened and bereft. Stardom and illness have united in banquet halls and the halls of Congress to raise money for and awareness of everything from Alzheimer's to osteoporosis. Disease-stricken celebrities have put a familiar face on infirmities that otherwise hovered below the high-profile funding radar.

Until recently, for instance, Parkinson's disease was just a shaky blip in the National Institutes of Health's budget, despite the more than 1 million victims of the neurological illness. In 1998, the NIH research funding for Parkinson's was \$41 million (or \$41 per person afflicted), ...



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