



WINTER 2010

# Bulletin

VOL. LXIII, NO. 2



Page 13

## Science and Technology Policy Challenges and Opportunities for the Obama Administration

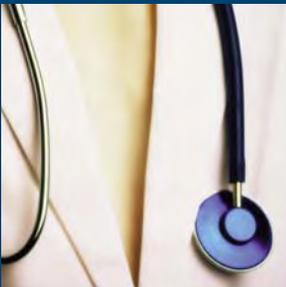
*John P. Holdren*



Page 19

## On the Future of Energy

*Richard A. Meserve, Steven E. Koonin, John W. Rowe, Paul L. Joskow, and John Doerr*



Page 53

## What Is Missing in Medical Thinking

*Jerome E. Groopman*



Page 59

## The Challenges of Mass Incarceration in America

*Larry Kramer, Bruce Western, Glenn Loury, Joan Petersilia, Nicola Lacey, and Robert Weisberg*

### INSIDE:

Academy Inducts 229th Class of Members, Page 1

Academy Workshop: Nuclear Power in the Middle East, Page 33

Global Nuclear Future Initiative Receives \$1.6 Million in Funding, Page 35

Projects and Studies Update, Page 36



# Calendar of Events

## Contents

<i>Celebrating the Arts and Sciences</i>	1
<i>Induction Ceremony</i>	3

### Induction Symposium

<i>Science and Technology Policy Challenges and Opportunities for the Obama Administration</i> John P. Holdren	13
---	----

<i>On the Future of Energy</i> Richard A. Meserve, Steven E. Koonin, John W. Rowe, Paul L. Joskow, and John Doerr	19
--	----

<i>Academy Workshop: Nuclear Power in the Middle East</i>	33
---	----

<i>Global Nuclear Future Initiative Receives \$1.6 Million in Funding</i>	35
---	----

<i>Hellman Fellowship Projects and Studies Update</i>	35
---	----

### Academy Meetings

<i>What Is Missing in Medical Thinking</i> Jerome E. Groopman	53
--	----

<i>The Challenges of Mass Incarceration in America</i> Larry Kramer, Bruce Western, Glenn Loury, Joan Petersilia, Nicola Lacey, and Robert Weisberg	59
--	----

Noteworthy	68
------------	----

Remembrance	71
-------------	----

From the Archives	72
-------------------	----



AMERICAN ACADEMY  
OF ARTS & SCIENCES

## Monday, February 8, 2010

Meeting – Chicago

*The Global Nuclear Future*  
in collaboration with the Chicago Council  
on Global Affairs

**Speakers:** Steven E. Miller, Harvard  
Kennedy School; Robert Rosner, University  
of Chicago; and Scott D. Sagan, Stanford  
University

**Location:** The Chicago Club

**Time:** 6:00 p.m.

## Wednesday, February 10, 2010

Stated Meeting – Cambridge

*The Supreme Court and Race*

**Speaker:** Michael Klarman, Harvard Law  
School

**Introduction:** Randall Kennedy, Harvard  
Law School

**Location:** House of the Academy

**Time:** 6:00 p.m.

## Monday, February 22, 2010

Concert – Cambridge

*An Evening with Thomas Zehetmair*

**Performer:** Thomas Zehetmair, violinist  
and chamber musician; Music Director,  
Northern Sinfonia

**Location:** House of the Academy

**Time:** 6:00 p.m.

## Thursday, April 15, 2010

Stated Meeting – Cambridge

*Prospects for the Economy*

**Speakers:** E. Gerald Corrigan, Goldman  
Sachs Group, Inc.; and John S. Reed,  
Citigroup, Inc.

**Introduction:** James M. Poterba, National  
Bureau of Economic Research and  
Massachusetts Institute of Technology

**Location:** House of the Academy

**Time:** 6:00 p.m.

## Wednesday, May 12, 2010

Stated Meeting – Cambridge

*Advances in Brain Science: Implications for  
Therapy*

**Speakers:** Robert Desimone, McGovern  
Institute for Brain Research, Massachusetts  
Institute of Technology; and Edward  
Scolnick, Broad Institute

**Moderator:** Emilio Bizzi, Massachusetts  
Institute of Technology

**Location:** House of the Academy

**Time:** 6:00 p.m.

---

*For information and reservations, contact the  
Events Office (phone: 617-576-5032; email:  
mevents@amacad.org).*

# Academy Inducts 229th Class of Members

## Celebrating the Arts and Sciences

On October 10, 2009, more than 500 Fellows, Foreign Honorary Members, and guests attended the Academy's 229th Induction Ceremony. The event honored the extraordinary achievements of the 230 new members – leaders in the mathematical, physical, and biological sciences; the humanities and the arts; business; public affairs; and the nonprofit sector.

The Induction Ceremony featured a reading from the letters of John and Abigail Adams by new members **James Earl Jones** (Emmy and Tony Award-winning actor and Kennedy Center Honoree) and **Emmylou Harris** (Grammy Award-winning Singer-Songwriter and Member of the Country Music Hall of Fame).

The Ceremony also included presentations by new Fellows, representing the five classes of Academy membership, who described the opportunities and challenges of their work and reflected on important issues facing our global society. **Terence Tao**, Professor of Applied Mathematics at the University of California, Los Angeles, discussed the future impact of Internet-based technologies on academia. **Elizabeth G. Nabel**, President of Brigham & Women's/Faulkner Hospitals and former Director of the National Heart, Lung, and Blood Institute, spoke about the benefits and promises of scientific and medical discovery to advance human health. **Ronald M. George**, Chief Justice of California, called for reform of the voter initiative process used in California. **Edward Villella**, Founding Artistic Director and Chief Executive Officer of the Miami City Ballet and former principal dancer for the New York City Ballet, described the transformative power of music, dance, and art. **Kent Kresa**, Chairman Emeritus of Northrop Grumman Corporation, considered



New members Emmylou Harris and James Earl Jones reading from the letters of John and Abigail Adams

the roles of robotic and human exploration activities in the country's future space program. (See pages 3 – 12 for the full text of the speakers' remarks.)

The Induction Ceremony was the centerpiece of three days of meetings and presentations that focused on the arts and the sciences. The events began on October 9 with a celebration of Academy writers. The meeting included readings by new Fellows **Jamaica Kincaid**, Josephine Olp Weeks Chair and Professor of Literature at Claremont McKenna College; **James Salter**, author of *A Sport and a Pastime*; *Light Years*; *Dusk and Other Stories*; *Burning the Days*; and *Last Night*; and **Gish Jen**, Professor and Codirector of the Creative Writing Program at Brandeis University; as well as by longtime member **Denis Donoghue**, University Professor and Henry James Professor of English and American Letters at New York University. They read prose and poetry by Elizabeth Bishop, Kenneth Koch, Mary Oliver, Robert Fitzgerald, Grace Paley, Seamus Heaney, and Anthony Hecht, many of whom are members of the Academy. The evening also featured Academy Fellow **Galway Kinnell**, former Erich Maria Remarque Professor of Creative Writing at New York University, reading from his own work, including "The Bear," "Oatmeal," and "It All Comes Back."

On October 10, leaders of Academy projects and studies briefed new members on the work of the Academy. The program included presentations on the Initiative for Science, Technology, and Engineering; The Global Nuclear Future; Reconsidering the Rules of Space; U.S. Policy Toward Russia; The Challenge of Mass Incarceration in America; The Independence of the Judiciary; Challenges to Business in the 21st Century: The Way Forward; the Initiative for Humanities and Culture; and Educating the World's Children. (See pages 36 – 52 for the full text of these presentations.)



Celebrating the Arts: An Evening with Academy Writers

Left to right: **Denis Donoghue** (New York University), **James Salter** (Bridgewater, New York), **Galway Kinnell** (New York University), **Gish Jen** (Brandeis University), and **Jamaica Kincaid** (Claremont McKenna College)

## Celebrating the Arts and Sciences

The Induction weekend concluded with a keynote address on Science Policy and a panel discussion on the Future of Energy. John P. Holdren, Director of the Office of Science and Technology Policy in the Executive Office of the President of the United States, delivered the Harvey Brooks Lecture on “Science and Technology Policy Challenges and Opportunities for the Obama Administration.” As John Holdren observed, “Economic recovery and growth and, more specifically, what science and technology can contribute in that domain” are near the top of the list of big challenges for the United States and the world. (See pages 13 – 18 for the full text of John Holdren’s presentation.)

Richard A. Meserve, President of the Carnegie Institution for Science and a member of the Academy’s Council and Trust, moderated a panel discussion on the Future of Energy. The program featured presentations by Steven E. Koonin, Under Secretary for Science at the United States Department of Energy, John W. Rowe, Chairman and Chief Executive Officer of Exelon Corporation, Paul L. Joskow, President of the Alfred P. Sloan Foundation and Elizabeth and James Killian Professor of Economics and Management at MIT (on leave), and John Doerr, Partner at Kleiner Perkins Caufield & Byers. As Paul Joskow noted, “Until we bite the bullet and educate the public about the costs as well as the long-term benefits of controlling greenhouse gas emissions, we are going to have difficulty passing the legislation that will get us on a path toward a least-cost solution to these problems.” (See pages 19 – 29 for these presentations.)



**John P. Holdren**  
(Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy, Executive Office of the President of the United States)

Commenting on the focus of this year’s Induction, Academy CEO Leslie Berlowitz remarked, “From our evening with writers to our symposium on science, energy, and the environment, the Induction weekend gave us an opportunity to celebrate the Academy’s mission and the accomplishments of its members. Their diversity reflects the range and vitality of the Academy.” ■



**Addressing Energy Challenges**  
Left to right: Richard A. Meserve (Carnegie Institution for Science), Steven E. Koonin (U.S. Department of Energy), John W. Rowe (Exelon Corporation), Paul L. Joskow (Alfred P. Sloan Foundation and MIT), and John Doerr (Kleiner Perkins Caufield & Byers)

# Induction Ceremony

## Challenges Facing a Global Society

On October 10, 2009, the American Academy of Arts and Sciences inducted its 229th class of Fellows and Foreign Honorary Members at a ceremony held in Cambridge, Massachusetts. **Terence Tao**, Professor of Applied Mathematics, University of California, Los Angeles; **Elizabeth G. Nabel**, President, Brigham & Women's/Faulkner Hospitals and former Director, National Heart, Lung, and Blood Institute; **Ronald M. George**, Chief Justice of California; **Edward Villella**, Founding Artistic Director and Chief Executive Officer, Miami City Ballet; and **Kent Kresa**, Chairman Emeritus, Northrop Grumman Corporation, addressed the audience. Their remarks appear below.



### Terence Tao

*Professor of Applied Mathematics,  
University of California, Los Angeles*

### The Future Impact of Internet-Based Technologies on Academia

#### Introduction

If I had to name the most significant technological development in recent decades, I would choose the Internet. By this, I mean not just the physical architecture of the Internet per se, which has been available to academics and government agencies since the 1960s, but the innovative technologies that flourished once the Internet matured: from tools as humble as the email mailing list to such unreasonably effective services as modern search engines or Wikipedia.

As the Internet has become more integrated into the mainstream of modern life, it has disrupted and revolutionized one sphere of

human activity after another. We read in the news about how online media are thriving as “old” media stumble; how online medical information is transforming patient-doctor relationships; how blogs, tweets, and online videos are tipping the balance in closely fought elections; and so forth.

But to most of us in academia, the temptation is to view these changes with a certain detachment: sure, established for-profit companies may well face competition (as they ought to) from lower-cost Internet-based rivals, and it is only reasonable in a democracy that politics should be influenced by popular debate, both offline and online. But we, by contrast, should be secure in our ivory towers from any Internet revolution, with our tenure, our unique expertise, and our time-tested academic traditions.

Even when new technologies do hit close to home – by threatening the profit model of the academic journal system, say, or by greatly facilitating the ability of students to cheat on their homework (and also for professors to detect such cheating!) – we can still rationalize away these developments as requiring only superficial changes to adapt to: switching from physical journals to online journals, perhaps, or placing more safeguards on our homework formats. We still perform our “core” academic activities – teaching, advising, research – much as we have for over a century: classroom by classroom, student by student, and paper by paper. We may do more of these things online now rather than offline, but the professor, not the Internet, is still at the center of things. After all, it is not as if our classes can be replaced by a Wikipedia entry, or our research by a search engine query, right? Right?

Well, yes and no. Even the most advanced online resources available today are not nearly “smart” or sophisticated enough to render our academic services obsolete; not yet, at least. Unlike many other industries, academia does not currently face any real threat from a cheap Internet-based competitor. But I believe a hybrid form of academic activity is beginning to emerge, one in which Internet-savvy academics and

*If I had to name the most significant technological development in recent decades, I would choose the Internet. By this, I mean not just the physical architecture of the Internet... but the innovative technologies that flourished once the Internet matured.*

their institutions harness the full power of online tools to initiate and organize large research collaborations and to disseminate and share their results at far more rapid and effective rates than were previously possible. In my discipline, mathematics, this type of Net-centric activity is still in its infancy, but it shows signs of potentially being substantially more efficient (and perhaps, more important, *open, cumulative, and responsive*) than traditional collaboration and dissemination, and is likely to become increasingly mainstream in the years ahead. This type of activity may not revolutionize

# Induction Ceremony

---

the way we work, the ambition of what we hope to achieve, or the academic culture we work in, but it is likely to transform them significantly.

## Teaching

Consider teaching. Year after year, day after day, and in universities across the world, we stand in lecture halls and present the foundations of our subject to classrooms consisting of hundreds or even just dozens of students at a time. This keeps us engaged with our students, hones our skills, and makes us feel useful, but is it the most efficient way to do things?

The mathematical topic Möbius transformations is taught routinely in complex analysis classes in a thousand mathematics departments across the world, to classes of perhaps thirty or fifty students in size; I have done so myself several times. On YouTube a beautiful video explaining the geometric interpretation of these transformations has been viewed *one million six hundred thousand times* so far – more people than can be reached by even ten thousand mathematics lecturers. The video can be accessed by just about anyone on the Internet through a simple Web search on the topic. (Currently it is in the top three hits on all major search engines.)<sup>1</sup>

Now, one cannot hope to replicate the entire classroom experience as a sequence of YouTube videos. The quality of interactivity, depth of material, and availability of expert attention, in particular, are much poorer. Even professional efforts that are more organized, such as the online videotaped lectures offered by institutions such as MIT, are an imperfect substitute for being physically present at lectures. But the sheer numbers of people one can reach through the Internet shows the potential of tapping this medium to teach in the future.

Hundreds of academics (including myself) use a blog to post their course notes and encourage online discussion (in all directions) between the teacher and students in the classroom, as well as visitors from around the world. I have had classes with perhaps

*The traditional classroom lecture will still play an indispensable role in the future but will do so in a rather different format than today, with its effects being vastly amplified and prolonged through its integration with the Internet.*

thirty local students but up to 100 other participants from a variety of backgrounds following (and commenting on) the blog. The quantity and level of questions asked is much higher, and the material in my notes is much improved because of this. From preparing blog materials and obtaining feedback from students and participating colleagues, I have learned more about a subject than if I had taught it in a traditional way.

Even after the physical class ends, the online class goes on. I have often had people wanting to learn a subject stumble onto year-old lecture notes on my blog through a search engine and continue the discussion afresh. Within a few years, the Internet might include valuable online content like this for nearly every commonly taught academic topic, all just one search query away for anyone with Internet access.

The technological level of online interactivity is certain to increase in the future. One can well imagine that classes will routinely (for instance) field questions by text message from students overseas who are watching the lecture in real time through video, with the discussion continuing online long after the class has ended. Not all experiments in online teaching will achieve their intended objectives, but only one clear success is needed to provide a model that can then be rapidly emulated by institutions and lecturers worldwide.

In my view, the traditional classroom lecture will still play an indispensable role in the future but will do so in a rather different format than today, with its effects being vastly amplified and prolonged through its integration with the Internet.

## Collaboration

Another major area where profound changes are happening is collaboration in research. Only four decades ago the primary mode of communication among academics in distant institutions was physical mail. This was inconveniently slow, and it discouraged collaboration with anyone who was not in the same physical location. With modern communication tools such as email, the situation today is vastly different. In mathematics, to collaborate over long distances is now completely routine, with months of online communication punctuated by only a few (but crucial) days of physical contact each year. Perhaps as a consequence, the proportion of papers in mathematics that are jointly rather than singly authored has increased tremendously. As a related phenomenon, an increasing fraction of papers are also interdisciplinary rather than specialized to a single subfield.

Software tools have recently become available to allow easier collaboration by large numbers of authors from across the world. Unlike the sciences, pure mathematics in academia has never had large laboratories in which armies of graduate students, postdocs, and senior researchers work on a single goal. The technology to make such large-scale projects possible is just now becoming available. This year, for instance, by ad hoc usage of existing tools such as blogs and wikis, the first “polymath” projects were launched. These are massively collaborative mathematical research projects, completely open for any interested mathematician to drop in, make some observations on the problem at hand, and discuss them with the other participants. The first such project solved a significant problem in combinatorics after almost six weeks of effort and almost a thousand small but nontrivial contributions from dozens of participants. This was a novel way to do mathematics, as well as a novel way to locate the collaborators with the right expertise and interest to solve the problem. The project might serve as a model to begin collaborations through online rather than physical networking.

Online collaboration confers other unexpected benefits, too. Projects retain a fully available online record of all discussions,

---

<sup>1</sup> Douglas N. Arnold and Jonathan Rogness, *Moebius Transformations Revealed*, online video (2007), [www.youtube.com/watch?v=JX3VmDgiFnY](http://www.youtube.com/watch?v=JX3VmDgiFnY).

---

including false starts, dead ends, and incremental progress, that took place while the problem was not yet solved, giving a much richer, more dynamic, and more accurate picture of how mathematical research really takes place. The cut-and-dried presentations one sees in finished products such as papers and textbooks cannot do similar justice to this process.

By taking research online, it comes to life. One participant in an online polymath project compared his anticipation to see the latest developments to the suspense one might feel while watching a TV or movie drama. Veteran researchers are familiar with these tensions, frustrations, and joys, but conveying these experiences to the graduate students entering the field used to be quite difficult. Perhaps these open Internet projects, with their “show, don’t tell” nature, may succeed in doing so in the future.

### Academic Culture

As we adopt new technology, our culture of doing things subtly changes. In mathematics, for instance, research used to be a secretive activity. One would often not discuss what one was working on before it was ready for submission to a journal and would give out preprints only to a select few colleagues before the publication process was complete (which took months or even years). With the rise of preprint servers and search engines, mathematicians nowadays customarily put a preprint online as soon as it is submission-ready (sometimes even sooner). Experience has shown that doing so greatly increases the visibility, impact, and influence of one’s work, and (perhaps counterintuitively) discourages excessively competitive behavior and even plagiarism because the time stamps given by preprint servers can help defuse arguments over precedence.

In many parts of mathematics there is now a social expectation that one’s work should be readily available online, and journals have largely abandoned attempts to enforce a monopoly on the dissemination of their authors’ work. As a result, research developments propagate at a significantly faster speed than in previous decades.

I can imagine further cultural shifts of this type. Currently, the actual problem-solving process in mathematical research is usually obscured from view until the problem has been solved and a polished, publication-quality draft is available. With the rise of open collaborative projects such as polymath, this culture may begin to change. (For instance, I circulated a draft of this talk on my blog weeks in advance, both to obtain valuable feedback and to encourage me to continue working on the text. A few years ago, I might have shown a draft to only one or two trusted friends, with perhaps a single round of revisions.)

*In the future, some of the more technical and specialized subfields of mathematics may encounter increasing societal pressure from their peers to make their work more accessible and transparent to wider audiences.*

Similarly, the advent of mathematical blogs and other semiformal outlets for discussion is reinforcing an existing trend in mathematics in which the intuition and motivation behind a mathematical topic are emphasized as much as the definitions, theorems, and proofs. In the future, some of the more technical and specialized subfields of mathematics may encounter increasing societal pressure from their peers to make their work more accessible and transparent to wider audiences.

In teaching mathematics, the current model is that of a nearly one-way street: the lecturer does almost all of the talking. Apart from a few questions from the bolder students, one receives feedback only days or weeks after the class has ended, from the assignments, evaluations, and exams the students turn in.

With improvements in technology, students might come to expect classes to be significantly more interactive, both during the “actual” class and in the online discussions

before and after. An expectation of near-instant feedback may become the norm.

Such changes will encounter resistance from some academics – consider the ongoing debate on whether to allow laptops in classrooms – and many changes will not be fully successful; we still have only a partial understanding of what makes one online experiment flourish and another fail. Nevertheless, I doubt that we will keep the status quo indefinitely in the presence of such technological and social changes.

### Conclusion

One can draw an analogy between pre-Internet academia and preindustrial manufacturing. Before the industrial revolution, manufacturing was the province of individual craftspeople or secretive guilds working painstakingly on each individual piece of work, with each master passing down his or her carefully hoarded insights and tricks to just a handful of disciples. Finding parallels to each of these phenomena in academia is not hard.

But after the Industrial Revolution, specialization and mass production became the paradigm in manufacturing – less intimate, surely, but vastly more efficient and reliable. One might bemoan the loss of creativity and individuality that each craftsman exhibited, but eventually, as the Industrial Revolution matured into the modern era, the outlets for creativity were dispersed to a wider group of people. Thanks to the division of labor, design, invention, entrepreneurship, manufacturing, marketing, training, and management could now be performed by whoever was best qualified to do each task, rather than the same individual having to handle all of them. The best practices in these areas could be adopted widely rather than being confined to their originators, and a select number of followers.

Academia has not experienced change on the scale of the Industrial Revolution since the invention of the printing press. With the advent of the Internet – the modern-day analogue of the printing press, among other things – could it be revolutionized once again? ■

---

© 2010 by Terence Tao



## Elizabeth G. Nabel

President, Brigham & Women's/Faulkner Hospitals; former Director, National Heart, Lung, and Blood Institute

### Scientific and Medical Discovery – in Service of Human Health

While we come from different backgrounds and have different research interests, for those of us in the biological sciences, we share a passion for science and a responsibility to put intellectual contributions to humanitarian use. Our nation's citizens and leaders are in the midst of a vitally important discussion on health care. This debate has provided insights into who we are as Americans and what we value. All people deserve to be healthy. Unfortunately, for many middle-class Americans good health has become increasingly unaffordable because of lost jobs, a lack of insurance, and/or insufficient income. My belief, which is shared and has been articulated by many in the audience, is that health is a basic human right, and my comments today focus on two dimensions of this discussion from the perspective of a physician-scientist.

While issues of access, quality, and affordability are complex and difficult to solve, they do not negate the underlying principle that Americans should have the ability to enjoy good health. The intensity of our na-

tional health care debate offers the scientific and medical community an important opportunity.

Many of us have worked in impoverished areas in this country and abroad. We understand the close association between poverty, a lack of decent housing and education, and poor health. How should we respond? What is our duty to our fellow citizens? A recent survey confirms that the vast majority of physicians consider it a professional obligation to address societal and health-policy issues.<sup>1</sup> Health care professionals, for the most part, are eager to serve. And so these efforts, many begun by members of this class of new Fellows, must continue: our voices must be heard as we, as scientists and physicians, advocate for health as a human right. We must continue to reach out to those in need and to those who are most vulnerable, those whose voices may be muffled to society's ears.

This past summer, I had an opportunity to witness such advocacy in rural Rwanda when I visited the Partners in Health program at the Rwinkwavu District Hospital. Rwanda is a war-torn land that is now rebuilding itself after decades of politically motivated atrocities. Here is a place where divisive acts in 1994 shredded the fabric of a country where Tutsi, Hutu, and Twa residents once peacefully coexisted. During the 1994 genocide, neighbor turned against neighbor, and the country was literally destroyed. The country's infrastructure is being rebuilt thanks to the vision and leadership of Rwanda's president, Paul Kagame. Access to quality health care in Rwanda, as in many impoverished or politically unstable regions, is far from guaranteed. But the advocacy of organizations like Partners in Health is making a difference, and hope and optimism are growing.

I visited with government and health leaders in Rwanda, and I was impressed by what is being done and by the potential for what can be done. For example, Partners in

<sup>1</sup> R. M. Antiel, F. A. Curlin, K. M. James, and J. C. Tilburt, "Physicians' Beliefs and U.S. Health Care Reform – A National Survey," *New England Journal of Medicine*, September 14, 2009 (publication ahead of print).

*We can and should use the urgency of the current health care discussion as an opportunity to focus on the role of biomedical research and medical discovery in laying the foundation for better human health.*

Health is making great progress in caring for sick Rwandans, rebuilding the medical care infrastructure, and training local people to do vital work. I acknowledge in particular the vision and on-the-ground efforts of my colleague and fellow inductee Dr. Paul Farmer, the medical anthropologist and physician who is Partners in Health's founding director. He has accomplished similar gains in Haiti.

One of the most profound and lasting ways we can serve our fellow citizens in places where poverty and political oppression vanish the right to good health is through biomedical research. The results of such research are multiplicative – extending benefit that is not possible through individual contact. Basic discoveries, translation to clinical medicine, and implementation into urban and rural communities have been the story line of medical advances for decades, sparing millions from infections, cancer, and heart disease. Much of this work is supported by taxpayer investments in biomedical research in this country through the National Institutes of Health (NIH), the National Science Foundation, and other government agencies.

President Franklin Delano Roosevelt foresaw the power that basic research could bestow on human health when on October 31, 1940, he dedicated the newly established NIH on the Bethesda campus where I am now privileged to work: "We cannot be a strong nation unless we are a healthy nation. And so we must recruit not only men and materials but also knowledge and science

---

in the service of national strength. . . . The ramparts we watch must be civilian in addition to military.”<sup>2</sup>

The NIH came to be during a time in which this country was suffering, in the wake of the Great Depression. President Roosevelt appreciated the necessity of this investment in research, and we can attest today that he was correct in his vision. I am continually inspired by the many outstanding minds that have devoted their talents to public

*As physicians and scientists, we carry deep within us a belief that health is a human right and an understanding that when our health system does not adequately serve many of our fellow Americans we must change it.*

service in the worlds of science and medicine. A perfect embodiment of this ideal is fellow Academy member, and my colleague at the NIH, Dr. Tony Fauci, with whom I work closely and often on a range of policy issues that make a mark on national and global health.

This is a special and challenging time for our biomedical community. We are in another period of economic hardship, and the NIH was fortunate to be the recipient of a multibillion-dollar investment from the American Recovery and Reinvestment Act of 2009 to create jobs and accelerate the pace of medical discovery. We can and should use the urgency of the current health care discussion as an opportunity to focus on the role of biomedical research and medical discovery in laying the foundation for better human health. This is also a time for physicians to renew their commitment to advocating for health as a human right.

---

<sup>2</sup> “History of Medicine,” in Box 6, MS C 186, Elizabeth Pritchard Papers, National Library of Medicine, Washington, D.C.

We are optimistic that knowledge from important fields of NIH-funded research will contribute significantly to our progress in achieving affordable and high-quality health care for all Americans. Research gives us the mechanism to improve health outcomes by developing and disseminating evidence-based information to patients, clinicians, and other decision-makers about which interventions are most effective for which patients under specific circumstances. Research in the areas of health economics, health systems, health disparities, and personalized medicine will also undoubtedly inform the health care discussion in unique and important ways.

As physicians and scientists, we carry deep within us a belief that health is a human right and an understanding that when our health system does not adequately serve many of our fellow Americans we must change it. Biomedical research offers hope to improve vaccines, therapeutics, devices, and health system approaches that will bring health and security to the nation. This health care discussion is not solely about our nation’s health; it is also a testament to our commitment to civility and to the protection of core human values. ■

---

© 2010 by Elizabeth G. Nabel



**Ronald M. George**

*Chief Justice of California*

### **The Perils of Direct Democracy: The California Experience**

I am honored to speak as a representative of the new class of Academy members. I would like to share some thoughts on a matter that has been of recent and continued professional concern to me but that I believe may be of general interest to members of the Academy because it fundamentally implicates how we govern ourselves. This is the increasing use of the ballot initiative process available in many states to effect constitutional and statutory changes in the law, especially in the structure and powers of government.

A not-too-subtle clue to my point of view is reflected in the caption I have chosen for these remarks: “The Perils of Direct Democracy: The California Experience.” Although two dozen states in our nation permit government by voter initiative, in no other state is the practice as extreme as in California.

By the terms of its constitution, California permits a relatively small number of petition signers – equal to at least 8 percent of the voters in the last gubernatorial election – to place before the voters a proposal to amend any aspect of our constitution. (The figure is only 5 percent for a proposed non-constitutional statutory enactment.) If approved by a simple majority of those voting

# Induction Ceremony

at the next election, the initiative measure goes into effect on the following day.

The legislature (by two-thirds vote of each house) shares with the voters the power to place proposed constitutional amendments before the electorate. California, however, is unique among all American jurisdictions in prohibiting its legislature, without express voter approval, from amending or repealing even a statutory measure enacted by the voters unless the initiative measure itself specifically confers such authority upon the legislature.

The process for amending California's Constitution thus is considerably easier than the amendment process embodied in the United States Constitution, under which an amendment may be proposed either by a vote of two-thirds of each house of Congress or by a convention called on the application of the legislatures of two-thirds of the states. An amendment can be ratified only by the legislatures of (or by conventions held in) three-quarters of the states.

The relative ease with which the California Constitution can be amended is dramatically illustrated by the frequency with which this has occurred. Only seventeen amendments to the United States Constitution (in addition to the Bill of Rights, ratified in 1791) have been adopted since that document was ratified in 1788. In contrast, more than 500 amendments to the California Constitution have been adopted since ratification of California's current constitution in 1879.

Former United States Supreme Court Justice Hugo Black was known to pride himself on carrying in his pocket a slender pamphlet containing the federal Constitution in its entirety. I could not emulate that practice with California's constitutional counterpart.

One bar leader has observed, "California's current constitution rivals India's for being the longest and most convoluted in the world. . . . [W]ith the cumulative dross of past voter initiatives incorporated, [it] is a document that assures chaos."

Initiatives have enshrined a myriad of provisions into California's constitutional charter, including a prohibition on the use of gill nets and a measure regulating the confinement of barnyard fowl in coops.

This last constitutional amendment was enacted on the same 2008 ballot that amended the state constitution to override the California Supreme Court's decision recognizing the right of same-sex couples to marry. Chickens gained valuable rights in California on the same day that gay men and lesbians lost them.

Perhaps most consequential in their impact on the ability of California state and local government to function are constitutional and statutory mandates and prohibitions – often at cross-purposes – limiting how elected officials may raise and spend revenue. California's lawmakers, and the state itself, have been placed in a fiscal straitjacket by a steep two-thirds-vote requirement – imposed at the ballot box – for raising taxes. A similar supermajoritarian re-

*Frequent amendments – coupled with the implicit threat of more in the future – have rendered our state government dysfunctional, at least in times of severe economic decline.*

quirement governs passage of the state budget. This situation is compounded by voter initiative measures that have imposed severe restrictions upon increases in the assessed value of real property that is subject to property tax, coupled with constitutional requirements of specified levels of financial support for public transportation and public schools.

These constraints upon elected officials – when combined with a lack of political will (on the part of some) to curb spending and (on the part of others) to raise taxes – often make a third alternative, borrowing, the most attractive option (at least until the bankers say "no").

Much of this constitutional and statutory structure has been brought about not by legislative fact-gathering and deliberation but by the approval of voter initiative mea-

asures, often funded by special interests. These interests are allowed under the law to pay a bounty to signature-gatherers for each signer. Frequent amendments – coupled with the implicit threat of more in the future – have rendered our state government dysfunctional, at least in times of severe economic decline.

Because of voter initiatives restricting the taxing powers that the legislature may exercise, California's tax structure is particularly dependent upon fluctuating types of revenue, giving rise to a "boom or bust" economic cycle. The consequences this year have been devastating to programs that, for example, provide food to poor children and health care for the elderly disabled. This year's fiscal crisis also has caused the Judicial Council, which I chair, to take the reluctant and unprecedented step of closing all courts in our state one day a month. That decision will enable us to offset approximately one-fourth of the more than \$400 million reduction imposed by the other two branches of government on the \$4 billion budget of our court system.

The voter initiative process places additional burdens upon the judicial branch. The court over which I preside frequently is called upon to resolve legal challenges to voter initiatives. Needless to say, we incur the displeasure of the voting public when, in the course of performing our constitutional duties as judges, we are compelled to invalidate such a measure.

On occasion, we are confronted with a pre-election lawsuit that causes us to remove an initiative proposal from the ballot because, by combining insufficiently related issues, it violates our state constitution's single-subject limitation on such measures. At other times, a voter initiative – perhaps poorly drafted and ambiguous or faced with a competing or "dueling" measure that passed at the same election – requires years of successive litigation in the courts to ferret out its intended meaning and ultimately may have to be invalidated in whole or in part.

One thing is fairly certain, however. If a proposal, whatever its nature, is sufficiently funded by its backers, it most likely will obtain the requisite number of signatures

to qualify for the ballot; if it does qualify, the chances are good that the measure will pass. The converse certainly is true: poorly funded efforts, without sufficient backing to mount an expensive television campaign, are highly unlikely to succeed, whatever their merit.

This dysfunctional situation has led some to call for the convening of a convention to write a new constitution for California to replace our current 1879 charter, which in turn supplanted the original 1849 document. Yet, although a recent poll reflects that 79

*Californians may need to consider some fundamental reform of the voter initiative process. Otherwise, I am concerned we shall continue on a course of dysfunctional state government, characterized by a lack of accountability on the part of our officeholders as well as the voting public.*

percent of Californians say the state is moving in the wrong direction, only 33 percent believe that the state's constitution requires "major" changes, and approximately 60 percent are of the view that decisions made by Californians through the initiative process are better than those made by the legislature and the governor.

Add to this mix a split among scholars concerning whether a constitutional convention, if called, could be limited in the subject matter it is empowered to consider. Some argue that a convention would be open to every type of proposal from any source, including social activists and special interest groups. There also is controversy over the most appropriate procedure for selecting delegates for such a convention.

A student of government might reasonably ask: Does the voter initiative, a product of the populist movement that reached its high point in the early twentieth century in the midwestern and western states, remain a positive contribution in the form in which it now exists in twenty-first-century California? Or, despite its original objective – to curtail special interests, such as the railroads, that controlled the legislature of California and of some other states – has the voter initiative become the tool of the very types of special interests it was intended to control, and an impediment to the effective functioning of a true democratic process?

John Adams, who I believe never would have supported a voter initiative process like California's, cautioned that "democracy never lasts long . . . There is never a democracy that did not commit suicide." The nation's Founding Fathers, wary of the potential excesses of direct democracy, established a republic with a carefully crafted system of representative democracy. This system was characterized by checks and balances that conferred authority upon the officeholders of our three branches of government in a manner designed to enable them to curtail excesses engaged in by their sister branches.

Perhaps with the dangers of direct democracy in mind, Benjamin Franklin gave his much-quoted response to a question posed by a resident of Philadelphia after the adjournment of the Constitutional Convention in 1787. Asked the type of government that had been established by the delegates, Franklin responded, "It would be a republic, if you can keep it." As Justice David Souter recently observed in quoting this exchange, Franklin "understood that a republic can be lost."

At a minimum, in order to avoid such a loss, Californians may need to consider some fundamental reform of the voter initiative process. Otherwise, I am concerned we shall continue on a course of dysfunctional state government, characterized by a lack of accountability on the part of our officeholders as well as the voting public. ■

© 2010 by Ronald M. George



## Edward Villella

*Founding Artistic Director and Chief Executive Officer, Miami City Ballet*

### The Art of Life

I can divide my life into two distinct periods: life before my exposure to the arts and life after my exposure to the arts. Before the arts, I was a feisty kid with an abundance of physicality from the blue collar community of Bayside, Queens. I channeled my physicality into sandlot baseball and high school and college varsity athletics. While attending the New York State Maritime College, I added to my constant need to learn, move, and be physical a higher education in commerce and the military. However, it wasn't until George Balanchine invited me to join his company, the New York City Ballet, that I had my first serious exposure to art and a completely different kind of physicality. What I experienced and learned there utterly transformed my life. I discovered a mind-driven physicality: dance, what Balanchine called "the poetry of gesture." Once that discovery crossed my horizon and I began my sojourn as a dancer in Balanchine's singular world, my life was unalterably changed, and I never looked back.

As a dancer, I could live the Greek ideal of a balanced life of the mind and the body. And I had the rare privilege of working with two of the twentieth century's greatest cre-

# Induction Ceremony

---

ative minds: George Balanchine and Igor Stravinsky. Their collaborations produced masterworks, and when I had the opportunity to approach these works as a dancer I knew I was in the presence of their minds and an articulation of their remarkable genius. That opportunity was both exhilarating and terrifying.

When Balanchine gave me the extraordinary role of his and Stravinsky's Apollo to prepare for performance, I could not have achieved what I did without first absorbing the wealth of information and experience that he had to impart about his creation. In the time-honored custom of our field, passing knowledge and experience from body to body and mind to mind, the genius conveyed to the neophyte his insights and thoughts about the role. Imagine what it was like for me as a young artist, filled with an enormous desire to learn, to be the beneficiary of what the master had to teach me about his Apollo. He provided his points of departure, made sense of abstract gesture, and then helped me to understand it. During this transmittal of knowledge, Balanchine demonstrated one gesture that was completely revelatory, a gesture that both built the characterization and defined the character of Apollo. The characterization of a choreographic master's Greek god was ripe with images of swooping eagles, matadors, chariot drivers, soccer players, and bicycle riders. This process of teaching and learning, giving and receiving, provided me with an artful approach to prepare for my future roles.

As an athlete, I could lift. As a dancer, I had to lift, but more particularly, to partner and look after another dancer colleague. Partnering is an intimacy of physical conversation, a mutual exchange of dependence and trust. Two bodies and two minds working together as one whole.

For the past fifty years, I have devoted myself to the art form of dance, particularly classical ballet, first as a dancer, then as a teacher and artistic director. Dance has taught me so many lessons and enriched my life in more ways than I can ever describe; it gave me the ability to speak in silence, to animate movement in the most

sophisticated ways, to physicalize music, to see the honesty of art, and to know what is correct, the one possibility that is right. Dance has inspired me to seek what is ideal, what is unattainable – perfection. Dance required me to understand human behavior and develop the ability to express it theatrically and to express human relationships in the context of historical period and style and then to link this understanding back to line and form. Dance showed me

*Dance gave me the ability to speak in silence, to animate movement in the most sophisticated ways, to physicalize music, to see the honesty of art, and to know what is correct, the one possibility that is right.*

how to swim in time through designated space with gestures of integrity. Dance taught me how to respond to the music with a keen understanding of the intimacies of timing in relationship to the architecture of the score. Dance illuminated how abstraction is an idea reduced to its essence, and how the physical expression of that essential idea through qualitative entertainment can produce human pleasure. Dance revealed clarity by teaching me to recognize what is not necessary and how to be economical with gesture. Dance taught me how to portray emotion, and in the process I learned a way to be aware of and help control life's emotions. Dance gave me discipline and formal structure, but it also gave me the freedom and knowledge to move with artistic ease, removing all tensions in both body and mind. A good life lesson.

Time eventually deprives us of the pleasure of active portrayal. This inevitability, however, provides us with a different type of pleasure and an opportunity to repay an accumulated debt. I have traveled a great dis-

tance from the position in which I started – that of the neophyte receiving precious information from the master – to one filled with an enormous desire to preserve that information as authentically as possible and to pass it on to the next generations of dancers. Twenty-five years ago, this desire coupled with my desire to repay a debt to a genius and the teachers and mentors who gave me a life, a life of art, led me to create another entity, Miami City Ballet, as a vehicle to continue sharing with the world what these masters taught.

Fifty years ago, when I started my career as a dancer, it seemed clear to me, as it still does now, that to live with an understanding of music, dance, art, elegance, and nobility could be a point of departure for a life role, the art of life. ■

---

© 2010 by Edward Villella



## Kent Kresa

Chairman Emeritus, Northrop Grumman Corporation

### Space Robots Deserve More Respect

As you may have noticed from media reports, on October 9, 2009, NASA successfully carried out an important research mission on the moon using a two-component satellite named LCROSS (Lunar Crater Observing and Sensing Satellite). One part of this unmanned vehicle was designed to crash into a moon crater while the other monitored the twenty-five-mile-high debris plume created by the collision. The objective was to assess lunar soil for the possible existence of hydrated minerals, ice crystals, and hydrocarbons.

I have been thinking about LCROSS and NASA's many other impressive robotic missions in my preparations for this talk. It occurred to me that a brief consideration of what sort of value we place on robots might be a good way to engage both the arts and the sciences communities within the Academy. Doing so would also enable me to touch on a subject currently much discussed: the respective roles of robotic and human exploration activities in America's future space program.

Many with a strong humanities bias see unmanned systems as primitive and unexciting. In contrast, some in the science and engineering community view the human space programs envisioned by NASA as too costly when compared to what might be achieved with robots. Both these extreme positions contain valid arguments as well as misconceptions.

As an engineer, I'll try to present the unmanned case and leave it to others to explain manned space exploration. However, I won't try to predict or influence policy decisions. My objective today is far less ambitious. I simply want to encourage more respect for robots from their skeptics.

*Today's robots now manage networked systems that perform higher-level human functions like surveillance, decision-making, and communication and do so with far more effectiveness than human operators are capable of.*

The obstacle I face is clear if you consider how we human beings view ourselves. Most of us think Shakespeare's Hamlet was on target when he said, "What a piece of work is a man! How noble in reason, how infinite in faculty." This view of humanity has given robots a serious image problem, even from their earliest days.

I remember that my grandfather didn't want to ride in an elevator that wasn't run by a human operator. And my father would never trust an unmanned train. They had their concerns about reliability and safety, which are well resolved by now. For my own and later generations, elevators are no problem, and the only weak link in unmanned trains is the inability of human riders to remember their exit stations.

Most of us are not prepared to fly in an unmanned airplane, however, although the capability exists. This mode of transport could become commonplace for our children or grandchildren, though, as they get comfortable with that vehicle's safe performance.

Today's robots have transcended the simple heavy-lifting roles of elevators and trains and even the more complex assembly tasks of automated factories. They now manage networked systems that perform higher-level human functions like surveillance, decision-making, and communication and do so with far more effectiveness than human operators are capable of.

One thinks, for instance, of a fighter plane's fire control system that, without human assistance, rapidly collects surveillance input from the battlespace, uses GPS data to generate coordinates of enemy targets, and communicates this information by satellite to air and ground platforms best positioned to prosecute an attack. These higher-level functions will increasingly be performed by unmanned aircraft able to operate where human pilots cannot, in battlespaces that pose extraordinary risks or are situated at distances exceeding human endurance levels.

Unmanned systems are also capable of ad hoc adaptability: they can be reconfigured for alternative tasks by remote programmers. This sophisticated technology has only recently been available, and the level of adaptability is increasing as fast as Moore's Law has increased computer memory.

Over the last twenty to thirty years, unmanned systems have accomplished a sizable portion of the explorer's dream. Satellites have taken long-distance measurements. Space probes landing on or flying by all of the planets in our solar system have collected information and sent it back to analysts on Earth. The Voyager interstellar mission and others have sent unmanned systems beyond our solar system. Until recently, however, some scientists saw these efforts as more limited than what would

# Induction Ceremony

---

*For those of us who value a healthy integration of the humanities and sciences, robots are an extension of ourselves. They represent humanity's questing spirit but leverage science to reach places and see worlds that human hands will never touch.*

have been achieved had human explorers, with their superior investigative powers and flexibility, been able to go on these voyages.

Today, however, this picture is changing. Greatly increased computer power, fuzzy logic, and software advances enable engineers remotely managing a telescope like Hubble to reprogram complex observations. Similarly, robots exploring or digging samples on the surface of a planet are sophisticated enough to adapt their approaches to unexpected circumstances. The Martian rovers *Spirit* and *Opportunity* come to mind. This adaptability still falls short of human levels, but the gap is closing fast.

Other important considerations that favor robots are cost and endurance. As one would expect, the cost of human voyages is dramatically higher than for robots. A rocket carrying human beings must launch and transport far more weight because it must carry a life-support system that provides all the sustenance and protections of an Earth environment and must support a round-trip journey. Because unmanned systems have such a huge design and cost advantage, they become an increasingly serious exploration alternative, particularly as their investigative abilities move closer to those of human beings.

At present, unmanned systems represent the *only* option for deep-space exploration. Space, like the military battlespace, presents dangers and distances that human beings cannot deal with, at least not for the foreseeable future. For example, until technology evolves, human beings cannot realize NASA's hope of exploring Jupiter's Europa system because it sits in the Jovian radiation belt. Distances are a major impediment to human space travel if we assume no advance over current chemical propulsion technology. Travel to Mars now takes a year with current technology, four or five years to get to Jupiter, and thirty to reach Pluto. Given the extreme difficulty of sustaining life support for long-distance journeys, consideration of any objective beyond Mars is at present out of the question. Recruiting explorers will also become tougher when they are being asked to travel for several decades before coming home.

Robots face no such difficulties, however; they have few limits on their travel, research, and reports. In fact, a robot might even undertake the multigenerational voyage that would be required for reaching another solar system. Upon reaching its destination, it would carry out its investigation designed many years earlier and communicate the results – with some communication delay – to engineers on Earth.

Robots may not be Shakespeare's "paragon of animals," though their resume has expanded. Nor are they heroic explorers like Columbus, Magellan, or the Apollo astronauts. Still, for those of us who value a healthy integration of the humanities and sciences, robots are an extension of ourselves. They represent humanity's questing spirit but leverage science to reach places and see worlds that human hands will never touch. I encourage you to join me in respecting and honoring them for their exciting discoveries, reliable expertise, and ability to go the distance. ■

---

© 2010 by Kent Kresa

# Induction Symposium : Harvey Brooks Lecture

---

Image © MedicalRF.com/Corbis



## Science and Technology Policy Challenges and Opportunities for the Obama Administration

*John P. Holdren*

*Introduction by Neal Lane*

The Harvey Brooks Lecture was given at the 1947th Stated Meeting, held at Harvard University on October 11, 2009.



### Neal Lane

*Neal Lane is Malcolm Gillis University Professor at Rice University. He was elected a Fellow of the American Academy of Arts and Sciences in 1994 and serves as a member of the Academy's Council. He cochairs the Academy's Initiative for Science, Engineering, and Technology.*

### Introduction

Harvey Brooks, the theoretical physicist for whom this lecture is named, worked as a scientist while also advising generations of colleagues, political leaders, and policymakers. He was an original member of the advisory committee on reactor safeguards for the Atomic Energy Commission. He served on the President's Science Advisory Committee, advising Presidents Eisenhower, Kennedy, and Johnson on topics ranging from American defense and the space program to environmental policy and U.S. economic competitiveness. Harvey was generous with his time when called upon for advice. I can't remember a single incident when I called Harvey to ask a question and he had not already thought deeply about it or even written a seminal paper on the subject.

Harvey served as Dean of the Division of Engineering and Applied Sciences at Harvard University and created the program on science, technology, and public policy at the Kennedy School, a program he led for nearly two decades. As President of the American Academy from 1971 to 1976, Harvey championed landmark programs in the humanities and in social policy, and he led Academy initiatives that engaged partners around the world, including scientists from the former Soviet Union, Western Europe, and Africa. He continued to be an active advisor to the Academy until 2003. Harvey passed away in May 2004 at the age of eighty-eight.

It is now my distinct honor to introduce my good friend and successor in the role of Science and Technology Advisor to the President, John P. Holdren. Already in his first few months on the job John is bringing a vigorous new emphasis to the importance of science in executive branch decision-making. John is on leave as the Teresa and John Heinz Professor of Environmental Policy and Professor of Environmental Science and Policy in the Department of Earth and Planetary Sciences at Harvard University. John has also served as director of the program on science, technology, and public policy, the very program Harvey Brooks founded at the Kennedy School, and he has held appointments as director of the Woods Hole Research Center and cochair of the independent, bipartisan National Commission on Energy Policy. In 1995 John gave the Nobel Peace Prize acceptance lecture on behalf of the Pugwash Conferences on Science and World Affairs, the international arms control and scientific cooperation organization in which he held leadership positions for several years starting in 1982. (Members of the Academy were instrumental in the founding of Pugwash and for many years the Academy was home to the U.S. Pugwash Committee.) John has served as a key advisor to the Academy as it has expanded its science policy and energy research efforts.

During his early career John held positions at Lockheed Missiles and Space Company – his rocket scientist days – at the Lawrence Livermore National Laboratory, and at Caltech, as well as at the University of California, Berkeley. He has written extensively on climate change, energy, nuclear arms control and nonproliferation, and science and technology policy. He is a member of the National Academy of Sciences and the National Academy of Engineering, and has been a Fellow of the American Academy of Arts and Sciences since 1983. He is past president of the largest scientific society in the world, the American Association for the Advancement of Science. The list of prizes and other honors he has received is too long to note here.

John served on President Clinton's Council of Advisors on Science and Technology. He was the intellectual leader, the driving force behind many of the Council's most important reports during that period on such topics as energy, climate change, international cooperation, and nuclear nonproliferation. When John spoke, President Clinton listened. As a writer, John is a master of the sentence, and he uses his periods sparingly. When John feels that a statement, even a long, highly complicated one, needs to fit into a sentence, any attempt to talk him out of it will be fruitless. Life is simply too short. That said, John's writings have had enormous impact, so he does seem to know what he's doing. It is my great pleasure to introduce John Holdren to deliver his address on Science and Technology Policy Challenges and Opportunities for the Obama Administration and to join the Academy in honoring Harvey Brooks. ■

© 2010 by Neal Lane



**Harvey Brooks**  
1915–2004



### John P. Holdren

*John P. Holdren is Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy, Executive Office of the President of the United States. He was elected a Fellow of the American Academy of Arts and Sciences in 1983.*

#### Presentation

I am pleased to recognize the role that Harvey Brooks played in my life. He became a mentor to me in 1970, when I was the token youth on a National Academy of Sciences committee on international environmental programs. I started learning from him then and continued learning from him until his death in 2004. To reread now the long list of seminal papers in science and technology policy for which Harvey was responsible is highly instructive. In the White House I'm still learning things that I then discover Harvey already knew decades ago. In this sense I'm learning from him still.

For all of Harvey's erudition, experience, and distinction as a scientist, scholar, and America's leading practitioner and observer of science and technology policy, the man was absolutely without arrogance or affectation. He invested tremendous effort in improving the thinking and writing of his students and colleagues, who were often tempted to publish the densely reasoned commentaries he produced on their drafts and throw away the drafts themselves. Harvey cared deeply about science and technology, about policy, about teaching, and about how they might intersect to make the world a better place. I could not have had a better mentor and better preparation for the job in which I now find myself.

What challenges and opportunities does the Obama administration face in the area of science and technology policy? The biggest opportunity arises from the circumstance that we now have a President of the United States who “gets it,” a President who understands how and why science and technology are important. He understands why science is important for its own sake – for the expansion of knowledge about ourselves, our universe, and our place in it. He also understands how and why science and technology are important for addressing the great challenges that we face in the economy, in the environment, in information infrastructure, in national security, in scientific intelligence, and in so many other domains.

*We now have a President of the United States who understands how and why science and technology are important for addressing the great challenges that we face in the economy, in the environment, in information infrastructure, in national security, in scientific intelligence, and in so many other domains.*

I sometimes hear on the street or from colleagues that, “Gee, the President must have forgotten about everything except health care reform and Afghanistan because that’s all we’re reading about in the newspapers.” I reply that one of the more impressive characteristics of this President is that he is fully capable of focusing on more than one or two problems at a time. In fact, I regularly find him focusing on six or seven problems at a time, and in a twenty-minute conversation with him we will cover all of them, and I’ll discover that he’s completely up to date on every one.

He has demonstrated in many ways that science and technology are a priority for him. Science and technology were already front and center in his campaign speeches, and his inauguration speech had more mentions of science than any other inauguration speech I’m aware of. His extraordinary speech on April 27, 2009, to the annual meeting of the National Academy of Sciences marked the first time since JFK that a new President had made the trip from the White House to the National Academy to address its annual meeting. In his Cairo speech in June he made science and technology cooperation a major pillar of his strategy for rebuilding America’s relationship with the Muslim-majority countries of the world. In October, when he spoke at the awards ceremony for the National Medals of Science and the National Medals of Technology in the East Room of the White House – an occasion when one might have expected brief remarks with a few platitudes about the importance of science and technology – he offered another extraordinary speech full of specifics and depth.

The President’s commitment to science and technology has also been reflected in his appointments. An unprecedented number of members of the American Academy of Arts and Sciences, the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine serve in top positions in this administration. We have a Nobel laureate in physics leading the Department of Energy (DOE); we have a world-class marine biologist leading the National Oceanic and Atmospheric Administration (NOAA); and we have a chief technology officer and a chief information officer in the White House for the first time in history.

The priority this President places on science and technology has also been reflected in Presidential events. Given the extraordinary demands on the President’s schedule and the wide array of topics his various advisors would like him to highlight through his participation in particular events dealing with those topics, we in the Office of Science and Technology Policy have an exceptional “batting average” in the number of events we propose on science and tech-

*The United States and the world face a number of big challenges to which science and technology are germane. Near the top of the list has to be economic recovery and growth and what science and technology can contribute in that domain.*

nology themes that the President agrees to do. These have included numerous meetings with science and math prize winners, from middle-school students to Nobel laureates; conversations with space shuttle astronauts in orbit and on the ground after they’ve returned; meetings with high-tech CEOs and research university presidents to talk about innovation strategy; and meetings of all kinds on science and math – education themes, including an “astronomy night with kids” in early October in which the President, the First Lady, and their two daughters spent over an hour with 150 middle-school science students from the D.C. area, looking through telescopes set up on the White House lawn and chatting with astronomers and astronauts convened for the occasion. (Figure 1 shows the President in the Roosevelt Room in the West Wing, surrounded by young science students and a few members of Congress, as they all chat with astronauts on the International Space Station by video link.)

The priority the President places on science and technology has also been demonstrated in his budgets. Science got a huge boost in the combination of the recovery package and the final FY2009 and 2010 budgets, lifting the federal government’s investment in research to its highest level ever. Total funding for science and technology in the recovery package was about \$100 billion, which included not only R&D but also large investments in energy and transportation infrastructure and in broadband.

## Priority as reflected in Presidential events



Video link from the Roosevelt Room to the Discovery astronauts on the ISS

Figure 1

I find it helpful to think about my responsibilities as the President's science and technology advisor and the responsibilities of the Office of Science and Technology Policy in terms of Harvey Brooks's famous two-part taxonomy for science and technology policy, dividing the issues into science and technology for policy and policy for science and technology.

In the first category, my principal responsibility is to provide the President with independent advice about the scientific and technological dimensions of every issue on his plate: everything from the role of science and technology in the economy, to H1N1 flu, to the ratification of the Comprehensive Nuclear Test Ban Treaty, to energy and climate, and much more. Huge expertise in science and technology is available to the President from all across the executive branch – in DOD, DOE, NASA, NIH, NOAA, the U.S. Geological Survey (USGS), the Department of Agriculture, the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), and so on – but the function of his personal science and technology advisor is to make sure that the President is connected to this expertise when he needs it and

that he can get a judgment independent of the agenda of any particular agency if that's what he needs.

The second category into which my responsibilities fall is policy for science and technology, a good part of which consists of attention to the funding of science and technology in and through the relevant Executive Branch agencies. For example, the Director of OMB and I jointly write a letter each year to the heads of the agencies with science and technology missions, informing them of the priorities that the President would like to see reflected in their agencies' budget submissions. The OMB and OSTP staffs then work closely together with each other and the agencies to reconcile those initial budget submissions with the overall goals, priorities, and constraints with which the Administration is dealing. Also in the domain of policy for science and technology, OSTP has significant responsibilities for advancing science, technology, engineering, and mathematics (STEM) education, for coordinating science and technology initiatives that involve multiple agencies, for providing guidance on scientific-integrity issues, and more.

Given this breadth of responsibilities, the operation is surprisingly small. I have a staff of about sixty, a budget of about \$7 million a year, and four Senate-confirmed associate directors: one for science, one for technology (who is also the Chief Technology Officer for the Executive Branch), one for environment, and one for national security and international affairs. Many of our technical staff are detailees from the Executive Branch agencies that have substantial science and technology missions; we currently have detailees from NSF, NASA, NOAA, NIST, DOE, and DOD.

Our clout quite clearly comes not from the size of our staff or the size of our budget, which are tiny as the Executive Branch goes, but from our access to the President, from our statutory roles, and from the fact that everybody answers our phone calls. On the last point, it really is a wonderful thing about

*Clean energy can be the Sputnik of the Obama generation – the issue that will energize, inspire, and mobilize many of our youth to become interested in science, engineering, and math.*

having these science and technology responsibilities in the White House that everybody – not only throughout the federal government but everybody throughout the science and technology community – answers when we call saying the President needs to know more about X, what information can you provide? People not only take the call, but they deliver the goods, almost without fail and usually within about 24 hours. Our efforts to cover our broad science and technology policy responsibilities are also aided by the National Science and Technology Council (NSTC), a body that OSTP manages and that the President chairs in name but I chair in practice. It is populated by deputy and undersecretaries from S&T-rich cabinet departments and the administrators of such agencies as NSF, NASA,

*National and homeland security challenges include scientific intelligence, cybersecurity, power-grid security, and reducing the risks from nuclear and biological weapons. Science and technology have large roles to play in addressing all of these.*

NOAA, NIST, and USGS. The NSTC deals with the coordination, cooperation, and communication among all these Executive Branch entities on all issues in science and technology that are interagency in character.

Finally, OSTP and I receive a lot of help in discharging our responsibilities from the President's Council of Advisors on Science and Technology – PCAST – which I had the privilege of serving on when Neal Lane and, before him, Jack Gibbons were the science advisors to President Clinton. PCAST comprises a set of distinguished scientists, technologists, and innovators who keep their day jobs and advise the White House on S&T issues on a part-time basis, providing an additional mechanism for reaching out into the wider science and technology community. The current PCAST has three cochairs – Eric Lander, Harold Varmus, and I – and twenty-one members altogether. Sixteen of these are members of the American Academy and/or one or more of the National Academies (of science, engineering, or medicine).

The United States and the world face a number of big challenges to which science and technology are germane. Near the top of the list has to be *economic recovery and growth* and, more specifically, what science and technology can contribute in that domain – new products, new businesses, new jobs, the basis for future economic growth. Many types of technology will be involved: biotech, nanotech (and the increasingly cele-

brated intersection of the two), info tech, green tech, and other kinds of tech probably not yet invented.

*Health care* is a challenge both because it is costing too much and because it is delivering too little. The search for better outcomes at lower cost must entail not only improvement in biomedical science and technology per se but also more creative use of information technology in the health-care domain. For example, the digitization of health-care records can be the source of big savings and fewer errors.

The challenges in *energy and climate change* are also large. How do we reduce our overdependence on imported oil? How do we reduce both conventional and heat-trapping pollutants? We need no less than a transformation of the domestic and global energy system if we are to avoid a catastrophic degree of climate change. The good news here is that clean energy can be the *Sputnik* of the Obama generation – the issue that will energize, inspire, and mobilize many of our youth to become interested in science, engineering, and math. In addition to boosting the level of climate-science research, the President remains committed to finding \$150 billion over ten years for clean energy and energy efficiency. We have established ARPA-E, the energy version of the Defense Advanced Research Projects Agency, as well as new Energy Innovation Hubs and Energy Frontier Research Centers.

*Other resource and environmental challenges* include water, agriculture, toxins, and adaptation to the degree of climate change we cannot avoid. In addition to transforming the energy system, we will need to transform land-use practices. We face a huge challenge in reconciling the growing and competing demands on land and water for food, fiber, biofuels, and ecosystem services. Maintaining the ecological integrity and productivity of the oceans is similarly a huge challenge.

*National and homeland security challenges* include scientific intelligence, cybersecurity, power-grid security, and reducing the risks from nuclear and biological weapons. Science and technology have large roles to play in addressing all of these.

Of course, not just the security challenges but all of the others have international dimensions, and I and OSTP are much preoccupied with those aspects, as is the President. How can we deploy science and technology to help with poverty eradication, economic development, reduced population growth, and the combating of preventable and pandemic diseases? What are the international prerequisites for protecting the atmosphere and the oceans? What must countries do together to prevent the further proliferation of nuclear and biological weapons? International cooperation in science and technology for addressing these challenges is a domain in which Harvey Brooks made major contributions, and we continue to benefit from his insights in this domain today.

*How can we deploy science and technology to help with poverty eradication, economic development, reduced population growth, and the combating of preventable and pandemic diseases?*

Actually attaining the potential benefits of science and technology in meeting the practical challenges I have mentioned requires continuing attention to what I like to call “the cross-cutting science-and-technology foundations of success.” These include the capacities and financial health of the institutions that conduct most of our fundamental research – our great research universities and public and private laboratories; our success with STEM education, from preschool to grad school and lifelong; and the capabilities and robustness of our information, communications, transportation, and energy infrastructures.

Also important in this cross-cutting, foundational category are our capabilities in space. These relate, after all, not only to the

grand adventure of exploration and discovery in space, although to think about it in that way is always fun; they relate also to the economic functions of space activities – for example, in communications and geopositioning – as well as for intelligence, national security, and Earth observation.

Yet another cross-cutting category is the machinery of international cooperation in science and technology, which often enables us to achieve advances sooner and at lower cost than when working alone, as well as facilitating the propagation of insights and technologies through which the world as a whole can better address common challenges, such as climate change.

*I'm particularly pleased about what we've been able to accomplish on stem-cell research guidelines, open government, and streamlining the Visa Mantis procedures applicable to visiting science and technology students and researchers.*

The last of the cross-cutting underpinnings of success I will mention is a somewhat bureaucratic category I call “supporting institutional processes and guidelines” – those affecting, e.g., intellectual property, export controls, bioethics, scientific integrity, openness in government, visas, and more. These issues generally attract less public attention than the others, but getting them right is crucial. The Obama Administration has given them considerable attention and been rewarded with some important progress on many of them. I'm particularly pleased about what we've been able to accomplish on stem-cell research guidelines, open government, and streamlining the Visa Mantis procedures applicable to visiting science and technology students and researchers.

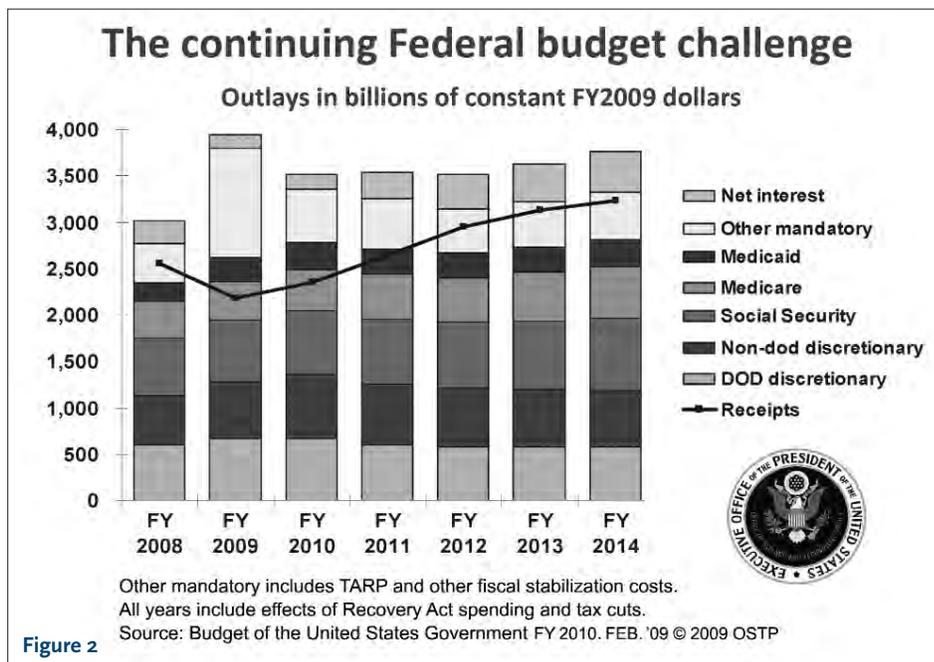


Figure 2

While we have made a good deal of progress on the science-and-technology issues on the President's agenda in the roughly nine months he has been in office, there is plenty more to do. Some of the agenda going forward is reflected in a set of explicit and very ambitious goals the President has set.

For example, he has announced a goal of raising the sum of public and private investments in research and development (R&D) in this country to more than 3 percent of gross domestic product (GDP), higher than this proportion was even at the height of the space race in the late 1960s. He has also committed us to doubling, over the space of a decade, the budgets for the National Science Foundation, the DOE Office of Science, and the laboratories of the National Institute of Standards and Technology. He has proposed to make permanent the research and experimentation tax credit, which currently must be reauthorized a year or two at a time (and is always in danger of not getting reauthorized at all). And in the supremely important domain of STEM education, the President has said we must lift the performance of American kids on science and math tests from the middle of the international pack to the top, and that we want the United States to be first in the world once more in the proportion of our young people graduating from college.

It can be no surprise that the biggest obstacle to meeting these ambitious goals is the constraint on the federal budget going forward that arises from the huge deficit this Administration inherited and the spending levels that have accompanied two wars and the recovery package that was needed to keep the worst recession of modern times from turning into another Great Depression. Figure 2 shows the budget projections the Administration presented with its FY2010 budget request to Congress. It doesn't take a Ph.D. in economics to notice that the budget for nondefense discretionary spending – the category from which all nondefense R&D spending by the federal government must come – is essentially flat in real terms out through 2014.

The President has said that to succeed in this challenging environment we will need “all hands on deck.” What he means by that is the science and technology community must work together – with new levels of commitment, communication, and cooperation – across the branches and levels of government; across the public, private, academic, and NGO sectors; and across nations. That is what we will need to get the job done, and that is exactly what Harvey Brooks would have said if he were alive to comment on this situation today. ■

# Induction Symposium

Image © NASA/Goddard Space Flight Center Scientific Visualization Studio



North America and Central America at Night, 2001

## On the Future of Energy

Steven E. Koonin, John W. Rowe, Paul L. Joskow, and John Doerr

Richard A. Meserve, Moderator

This panel discussion was given at the 1947th Stated Meeting, held at Harvard University on October 11, 2009.



### Richard A. Meserve

Richard A. Meserve is President of the Carnegie Institution for Science. He was elected to the American Academy of Arts and Sciences in 1994 and serves as a member of the Academy's Council and Trust. He also serves on the advisory committee of the Academy's Global Nuclear Future Initiative. He was recently appointed to the U.S. Department of Energy's Blue Ribbon Commission on America's Nuclear Future.

The study of issues relating to energy has been an important and long-standing part of the American Academy's work. Fifty years ago the Academy's journal *Dædalus* published an issue that is widely credited with establishing an intellectual framework for the then fledgling field of nuclear studies. In fact, President Kennedy referred to that issue as the bible on arms control. Today the Academy continues that tradition with a multipronged initiative on The Global Nuclear Future. This project is generating an integrated set of policy recommendations for balancing the growing global demand for civilian nuclear power with the need to strengthen the regime for safety, security, and nonproliferation. This week the Academy published volume one of a two-volume special issue of *Dædalus* on the global nuclear future. We hope that it will be as influential and groundbreaking as its predecessor.

Today's panel will discuss the even broader topic of the global energy future. As President Obama has stated, the choices we need

*Energy is the foundation for economic and social well-being, and we must somehow satisfy the growing demand for energy around the world in the years ahead.*

to make to deal with our energy needs will play a significant role in determining future prosperity and the overall quality of life around the globe. But we face many difficult challenges in connection with energy. Energy is the foundation for economic and so-

cial well-being, and we must somehow satisfy the growing demand for energy around the world in the years ahead. The problem arises from the fact that much of the demand for energy is and will be satisfied by fossil fuels. For example, 85 percent of the energy produced in the United States is derived from fossil fuels. The harsh reality is that the use of fossil fuels, at least in the manner we use them today, is not sustainable. The growing concentration of the resulting greenhouse gases threatens the planet. We face the need to transition to an entirely new energy infrastructure.

### *Energy policy is connected not only to environmental concerns but to a cluster of difficult security challenges.*

Energy issues are also tightly connected to national and economic security. This is most obvious in the case of petroleum. We have near total reliance on petroleum to meet transportation needs around the world, but much of the world's supply comes from politically unstable areas through vulnerable supply chains. Energy policy is thus connected not only to environmental concerns but to a cluster of difficult security challenges. The problem is made even more complicated by the fact that our energy infrastructure is large and permeates every aspect of our lives. To transform that system will be a difficult and hugely expensive undertaking. Significant change will take time, require vast amounts of money, and demand sustained effort in a period in which we must confront many other challenges. And the change must occur across the entire globe if we are to make headway on the climate problem.

In short, our energy problem is both hugely important and nearly impossibly difficult. In today's panel we will hear from four distinguished Fellows of the Academy, each with special expertise and a unique vantage point to help us understand our energy future. I hope they will help us define a path to resolve the complicated set of issues that surrounds energy.

The first speaker is Steven Koonin, Under Secretary for Science in the U.S. Department of Energy (DOE). Steve is a theoretical physicist. He was the provost at Caltech and more recently was the chief scientist for BP. At DOE Steve oversees the single largest source of support for basic research in the physical sciences in the United States. He has been a member of the Academy since 1991.

Our second speaker is John Rowe, Chairman and Chief Executive Officer of the Chicago-based Exelon Corporation. Exelon is the nation's largest electric utility and the largest operator of nuclear power plants in the United States. John serves on the advisory committee of the Academy's project on The Global Nuclear Future and was inducted into the Academy yesterday.

Paul Joskow, President of the Alfred P. Sloan Foundation, will speak next. Paul has been a Fellow of the Academy since 1991. He is on leave from his position as the Elizabeth and James Killian Professor of Economics and Management at MIT, where he has served on the faculty since 1972, including eight years as the director of the MIT Center for Energy and Environmental Policy Research. Today he leads one of the nation's preeminent foundations supporting science policy, education, and workplace issues.

Our final panelist is John Doerr. John is a Partner in the Silicon Valley venture capital firm Kleiner Perkins Caufield & Byers. John has provided support for the creation and growth of numerous companies, first in information technology and more recently in green technology. He is an expert on carbon trading and has brought that expertise to his role as a member of the President's Economic Recovery Advisory Board. John was inducted into the Academy yesterday.



### **Steven E. Koonin**

*Steven E. Koonin is Under Secretary for Science in the U.S. Department of Energy. He was elected a Fellow of the American Academy of Arts and Sciences in 1991.*

**T**he United States is faced with two energy problems, largely separable. The first is associated with energy security, with providing a stable and economic flow of liquid hydrocarbons to power transport. Urgency in addressing this problem is driven by economics. We are sending roughly \$700 mil-

### *The United States is faced with two energy problems. The first is associated with energy security. The second is greenhouse gas emissions.*

lion a day offshore for oil imports. In response to this challenge the administration has set a goal of reducing oil imports or reducing oil consumption by 3.5 million barrels a day, which is roughly the amount that we import from the Middle East and Venezuela each day and is about 25 percent of what we use to run our automobiles every day.

The second challenge we face is greenhouse gas emissions. We need to reduce the threat to the climate system by reducing our emissions. This is mostly about stationary sources generating electrical power and providing heat. The urgency here is driven by the cumulative nature of the CO<sub>2</sub> concentration

in the atmosphere. It is also driven by the need to take geopolitical leadership in addressing this problem, by the great build-out of infrastructure that will happen in the next several decades in the developing world, and also by the need to rebuild the U.S. energy infrastructure, which we need to do at the same time as creating jobs. This implies a major and reasonably rapid transformation of the ways in which we produce, transmit, store, and use energy in this country.

### *The first step we need to take is to increase the efficiency standards of automobiles.*

So what do we do about this? I like to joke that governments can pretty much do anything they want as long as they don't violate the laws of physics and as long as they have the political and economic capital to pay for the changes. The question is really one of identifying the optimal path. We get to do this only once, and so we should do it right. Anyone who studies the situation realizes that we need to filter technologies according to their economics, their readiness, and their ability to impact at scale. When we apply these considerations to transport, we realize that the first step we need to take is to increase the efficiency standards of automobiles. CAFE (corporate average fuel economy) standards are set to increase from 27 miles per gallon to 35 miles per gallon, and we need to do much better than that. Fortunately, significant technical headroom remains for improving the internal combustion engine before we have to start thinking about alternative ways of powering automobiles, and we need to capitalize on that.

The effort to improve CAFE standards needs to be supplemented by a gradual electrification of the transport system, a move from ordinary automobiles to hybrids to plug-in hybrids and eventually to battery electric vehicles. The pace of that transformation and the end point will be driven by how well we do in battery technologies. Given the systems nature of energy, if we are to get to full electrification of transport we will need to worry about where that extra electricity

will come from. That is a nontrivial problem. Finally, we need to be rapidly pursuing advanced biofuels. The intersection between biology and energy holds great possibility, and we need to capitalize on that both in research and deployment.

To address the second problem, greenhouse gases, we need to start with efficiency in the end use. Appliance standards are important. So is building efficiency. Roughly half of the world's energy gets used in buildings. We have the technologies now to make buildings much more efficient. We simply need to stimulate their deployment. Also important is to set a price on greenhouse gas emissions, particularly carbon dioxide. That price needs to be predictable, it needs to be long-term, it needs to be material, it needs to be high enough to induce change, and it needs to be universal. When we set a significant carbon price in this country, we will see a shift from coal-fired power to gas, of which the United States now has significant resources, recently expanded as a result of technologies developed in the private sector to tap into shale gas and tight gas. We will also see a deployment of wind. Perhaps by 2030 roughly 20 percent of electricity generation will be from wind. To get beyond that, however, we will need to deal with issues of intermittency and transmission.

Fission has to be a significant part of the country's energy future if we are going to address greenhouse gases with reasonable economics and at scale. Finally, we need to develop, demonstrate, and deploy carbon capture and storage. Fifty percent of the country's electricity now comes from coal. We can't instantly rebuild all of those plants, so we need to figure out a way to capture the carbon from existing plants, and newly built plants need to have carbon capture and storage built in. Lest you think that the country has abandoned coal, you should know that about 15 gigawatts of coal capacity are in the permitting or construction process, and many more plants have been announced. We also need to improve the electrical grid in order to integrate intermittent renewables, efficiently match supply and demand, and ensure robustness of the grid against catastrophic failure.

Those of us who aspire to transform the energy system are both informed and somewhat sobered by the history of the U.S. energy supply (see Figure 1). At the time of the Civil War most of the country's energy came from wood. As the Industrial Revolution set in, coal became important. The mobility revolution of the early- to mid-twentieth century made oil important. Gas occupies an increasingly important wedge of the country's energy profile in the middle of the century, and nuclear forms a smaller wedge in the last three or four decades, followed by a tiny wedge for renewables beyond hydropower (namely, wind and solar). The good news is that energy technologies do change. They change in response to technology, economics, and politics.

### *We have the technologies now to make buildings much more efficient. We simply need to stimulate their deployment.*

The bad news is that they change slowly, on a decade scale at least. Compared with the evolution of energy technology, IT technologies change far more rapidly. Consider that in less than one decade personal music and video technology went from CDs and tapes to predominantly MP3s and flash memory (see Figure 2).

So energy is different from other spheres in which we have seen great technical evolution. Clearly, we cannot continue with business as usual and make the kinds of transformations we expect in the energy system. We need to find the right path to accelerate development and deployment. We need to put all the players together – including academia, the national labs, and the private sector – much more intimately than we have before. Doing so poses many challenges, however. For example, the universities shy away from significant commercial involvement. Ownership of intellectual property is often a source of tension. Businesses must seek differential advantage if they are to be successful, but government cannot grant such advantages. The scale of capital required for meaningful energy demonstra-

## Energy technologies change slowly

US energy supply since 1850

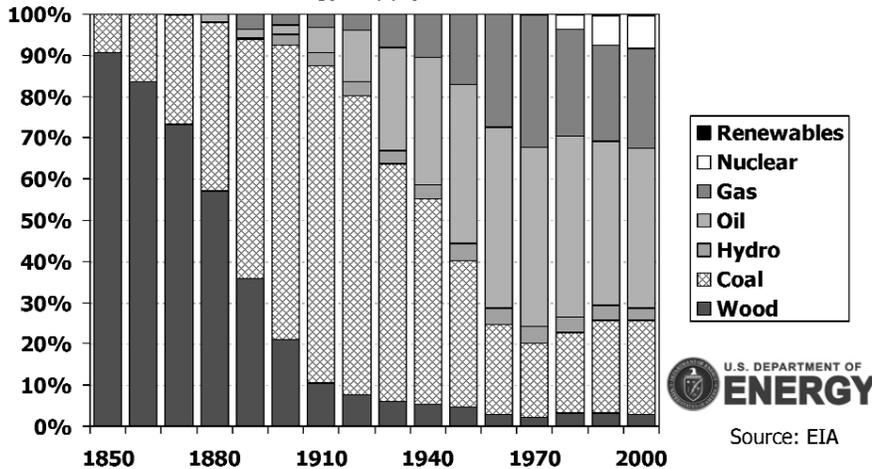


Figure 1

## IT technologies change rapidly

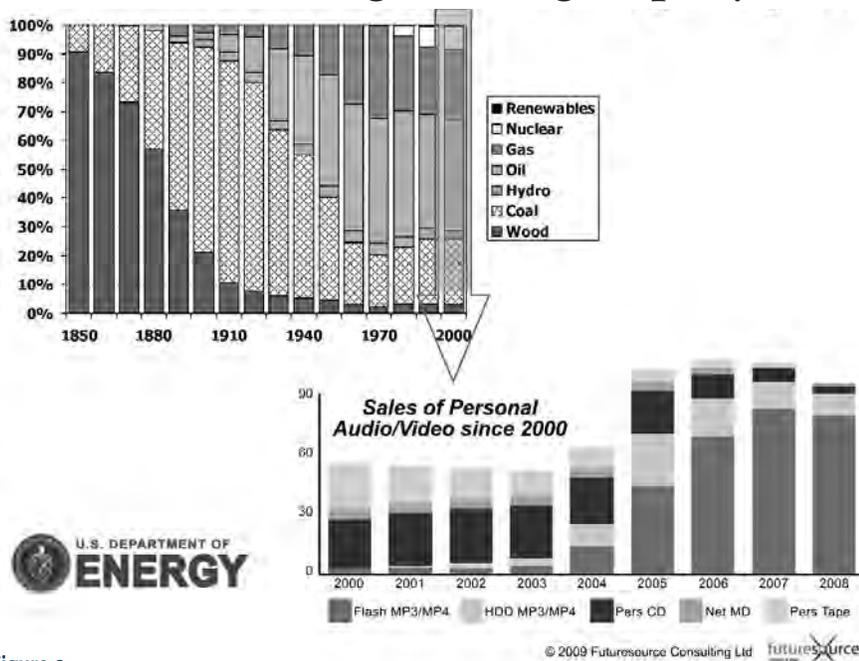


Figure 2

funding are going into innovation in diverse areas, including vehicle technologies, manufacturing, carbon capture and storage, renewables, and modernization of the electric grid. We are making tangible progress in energy innovation.

Technical innovation alone is not going to lead to the jobs that are the other dimension we need to be addressing. Many energy technologies developed in the United States in past decades, including photovoltaics, automobile efficiency, batteries, electricity transmission, power electronics,

*Fission has to be a significant part of the country's energy future if we are going to address greenhouse gases with reasonable economics and at scale.*

and nuclear, are now dominated by other countries. To capture all of the jobs that will stem from energy innovation, we have to reverse the U.S. decline in manufacturing and again make this country a favored venue for production. Since 2000, about six million jobs have been lost in the manufacturing sector, a 30 percent decrease. If we are going to reverse that trend, many nontechnical issues need to be addressed, such as labor costs, health care costs, and regulatory and tax regimes. If we do not address those issues, the United States will not realize the full benefits of whatever technical innovation we can achieve in the next many years.

tion projects makes it difficult for any one player to move along the learning curve.

All of the players we need to get together have conceptions of their roles that are hard to change but indeed have to change if energy innovation is to proceed at the pace we need it to. We in the Department of Energy are pursuing a variety of programs to stimulate energy innovation. Among these are

the Energy Frontier Research Centers that are focused on basic science and technology; the Advanced Research Projects Agency-Energy (ARPA-E), which will nimbly fund high risk, high payoff concepts; and the energy innovation Hubs that would bring together diverse players across multiyear, directed research programs from basic research to demonstration. Significant amounts of stimulus and base program



### John W. Rowe

*John W. Rowe is Chairman and Chief Executive Officer of Exelon Corporation. He was elected a Fellow of the American Academy of Arts and Sciences in 2009 and serves on the advisory committee of the Academy's Global Nuclear Future Initiative. He was recently appointed to the U.S. Department of Energy's Blue Ribbon Commission on America's Nuclear Future.*

What do we really know about energy in the future, and what do we not know? I suppose the most important single thing we know is that the amount of energy around will be about the same as it has always been. The laws of conservation of energy and the doxology we used to sing in the Methodist church where I grew up are about the same. We know that certain policy parameters are pretty well determined. It is important that we become less dependent for our energy needs in the United States on certain portions of the world, and in parallel it is important that our remaining dependence be organized in ways that are safer than they are today.

We know that it is important that we address the climate challenge but also and increasingly that we plan to cope with our failures in addressing it. We know that the economics of energy remain vital to all of our other social and economic objectives. We also know quite a bit about the sources of energy that give us opportunities to meet these policy objectives. We know the opportunities for greater efficiency are vast. We know that natural gas will dominate the economic supply of low-carbon energy for at least a decade, perhaps several. We know that just over the horizon of a century or so

the direct uses of solar energy must become a better, even larger portion of our energy supply.

We actually know quite a lot.

But we also don't know a vast number of important things. We don't know what will go along with all of that natural gas and that ultimate solar hope or expectation. We don't know what bridges will follow the natural gas bridge to a lower carbon future. These are things about which we have opinions, and the opinions vary greatly. What we do know is that in the past when we have picked choices within these areas we have often been wrong. My company runs the nation's largest fleet of nuclear reactors, and I can say with an almost straight face that I have never met a nuclear plant I didn't like. I grew up on a farm in Wisconsin and had to tend the windmill; so I've almost never met a windmill I did like either. But I wouldn't submit that that's much of a guide for energy policy.

*It is important that we become less dependent for our energy needs in the United States on certain portions of the world, and that our remaining dependence be organized in ways that are safer than they are today.*

We know that new nuclear plants today are a difficult economic bet because foreseeable prices for natural gas will trump nuclear again and again and again. We know that wind needs a sibling, nuclear or coal or natural gas, to back it up. We know we have often been wrong. Resources for the Future conducted a poll about a year-and-a-half ago, slightly before the recession traumatized American opinions on nearly everything. In that poll the majority of Americans appeared to believe that the climate challenge was real and that the United States should do something about it. However, the majority of Americans don't like to think

*Natural gas will dominate the economic supply of low-carbon energy for at least a decade, perhaps several.*

of a carbon tax, because they know that costs them money, and they don't really like the idea of cap-and-trade, because they rightly think that will cost them money. But they were quite fond of renewable portfolio standards, because they assume these will cost only me money.

We at Exelon have done a great deal of work on the climate issue. We have something we call Exelon 2020, a plan to reduce, offset, or otherwise neutralize our entire carbon footprint by 2020 (details are available on our corporate website). We actually can do it, largely because of our seventeen nuclear reactors. And we can do it without building a new nuclear plant. Instead we will do it with a mix of energy efficiency, natural gas, wind, and offsets and by upgrading our existing nuclear fleet. In developing Exelon 2020, we looked at the relative cost of all sorts of measures in terms of dollars per ton of avoided carbon dioxide. Not surprisingly, we found that some forms of conservation are nearly free. What we don't know is why people aren't doing them anyway.

We were able to cut energy consumption in our home office by 50 percent, more or less economically, but we know we can't do that in most of our buildings. We know that natural gas trumps most other choices for a long time. We just don't know how long. We know that upgrades in our nuclear plants are relatively cheap. For the first time this year in our analyses wind became cheaper than new nuclear – not because the new nuclear became more expensive but because the gas we assume backs up the wind became so much cheaper. But the real issue is that wind now costs \$50 – \$90 per ton of offset CO<sub>2</sub>, depending on where the wind is. New nuclear is somewhere around \$70 a ton, coal with carbon sequestration is in the hundreds for a new plant, and solar is even higher. This makes a big difference.

California is relying heavily on renewable portfolio standards. I have heard estimates of \$150 – \$180 per ton as the price of these standards. In electricity terms that amounts to an increase of \$0.15 – \$0.18 per kilowatt-hour. California can't afford it, and no other state would contemplate affording it.

Congress is grappling with the American Clean Energy and Security Act of 2009 (commonly known as Waxman-Markey), a bill that will probably cost \$15 – \$20 per ton; yet it passed in the House by only seven votes after John Holdren, Rahm Emanuel, and the President of the United States himself applied all the muscle they could put behind it. But we simply must have cap-and-trade or a carbon tax. We simply must put the costs of CO<sub>2</sub> and other greenhouse gases into the marketplace precisely because none of us is smart enough to build that bridge between our natural gas- and coal- and nuclear-driven present and our solar-driven hope. Not a one of us can get it right. To those who argue that “we have one chance and we must get it right,” I respond with deep respect that I hope they are wrong, because we are unlikely to get it right. We have a number of self-correcting chances, and we must build a framework of policy and markets that allows us to adapt, that forces us to adapt, that demands that we innovate, that rewards the innovation, and that makes possible structures we can't fully see today.

This is why Exelon has been working on cap-and-trade systems for most of the past decade. This is why I spend too much of my time in Washington on my knees lobbying. This is why we pulled out of the U.S. Chamber of Commerce, a relatively trivial act that got more attention than anything constructive we have done. We simply must build a system that allows us to react on a rational basis, that incents us to deal with the climate issue in the lowest-cost way, and that recognizes the great imperfections in our knowledge of the gaps between today's economic and political realities and the enduring musts of physics and geology.



### Paul L. Joskow

*Paul L. Joskow is President of the Alfred P. Sloan Foundation and Elizabeth and James Killian Professor of Economics and Management at the Massachusetts Institute of Technology (on leave). He was elected a Fellow of the American Academy of Arts and Sciences in 1991.*

Many of our energy policies were formed during the first and second oil shocks of the 1970s. But a lot has changed since then, and our energy policies need to change, too. The energy intensity of the U.S. economy has declined dramatically since 1970, and economic performance, whether measured by gross domestic product (GDP) growth or productivity growth or inflation, is much less susceptible to oil price shocks than was the case during the oil price shocks of the 1970s. The utilization of energy per real dollar of GDP had declined by over 50 percent through 2007 and is likely to continue to decline in the future even if no new policies are adopted.

Many factors have led to this significant increase in the energy efficiency of the U.S. economy. The structure of the U.S. economy has changed dramatically, and technological changes in the production and use of energy have played an important role. Regulatory initiatives aimed at increasing end-use energy efficiency have also played a role, as have higher energy prices. The relationship between GDP growth and growth in energy use has also changed. The elasticity of energy consumption with respect to GDP (that is, how much energy use increases if GDP growth increases 10 percent) has declined significantly in the past fifty years. In the 1960s it was 0.9 (meaning that if the

GDP grew 10 percent, energy use grew 9 percent). During the 1970s elasticity declined to 0.45. During the 1980s when energy prices were really high, it declined to 0.25. During the 1990s when energy prices fell, it climbed back to 0.4, but between 2000 and 2007 it fell to 0.15. That means a 10 percent increase in GDP growth now leads to only a 1.5 percent increase in energy use.

So the relationship between changes in economic activity measured in a number of different ways and changes in energy use, while still important, has declined significantly in the last thirty-five years. Energy still plays an important role in the economy, but that role has declined and will continue to decline in the future. Numerous studies by economists have tried to relate various measures of economic performance to energy price shocks subsequent to the two oil

*Global oil demand will continue to rise over the next twenty-five years, a rise that is primarily attributable to growth in developing countries.*

price shocks of the 1970s, and the measured impacts have repeatedly been shown to be relatively small. This has implications for energy security policies and our views about the economic significance of imports of oil from other countries.

If you have been in the energy business for a while, you know that predicting the future is a prescription for going broke. But the best estimates that I rely on suggest that with the energy policies currently on the books – including the new energy policies introduced in the last few years – U.S. energy consumption will increase slowly over the next twenty years, perhaps by 0.5 percent per year (using the Obama administration's forecast for economic growth). U.S. petroleum consumption probably peaked in 2006. Indeed, petroleum consumption in the aggregate for the member countries of the Organisation for Economic Co-oper-

ation and Development probably peaked in 2006. My expectations for little growth in annual U.S. petroleum consumption for the next couple of decades can be explained by mandated improvements in the energy efficiency of passenger cars and light and heavy trucks, which will gradually increase the energy efficiency of the stock of vehicles on the road, the growth in the use of biofuels, and the stabilization in miles driven per passenger vehicle. U.S. petroleum imports from countries outside of North America have almost certainly peaked as well under best-case oil price assumptions. U.S. CO<sub>2</sub> emissions will be roughly flat over the next twenty-five years absent new greenhouse gas emissions mitigation policies. That is the good news.

*Much of the thinking about energy security has not adapted to changes in the relationships between energy use (and energy imports) and the performance of the U.S. economy and those of other oil-importing countries.*

The bad news is that the situation is different in many of the other developed countries, which import much more of their energy, and in most of the developing countries. *Global* oil demand will continue to rise over the next twenty-five years, a rise that is primarily attributable to growth in developing countries. Oil prices are likely to continue to rise, possibly doubling over the next twenty years in real terms, although technological developments in extraction from existing fields and in the identification and extraction of oil from deep water deposits may reduce that price trend. Global oil exports will become increasingly concentrated from countries in unstable areas of the world, the Persian Gulf and Africa in particular, as production in other producing regions such as Mexico, the North Sea, Latin America, or at least net exports from these areas, decline as well. This suggests

that while the impact of oil price shocks on the U.S. economy may have declined significantly, the *probability* that supply disruptions and price shocks will occur may have increased significantly. Finally, flat CO<sub>2</sub> emissions are not nearly good enough for the United States if widely accepted global targets for containing the rise in average global temperatures are to be met. To meet these goals and the balance between the distributional and political issues that arise in negotiations between developed and developing countries, we are looking for reductions of 80 percent by 2050 for the United States and countries like Canada, Australia, Japan, and the EU, something nowhere close to being flat.

Much of the thinking about energy security was also formed during the 1970s and has not adapted to changes in the relationships between energy use (and energy imports) and the performance of the U.S. economy and those of other oil-importing countries. Every president since Richard Nixon has articulated some form of a U.S. “energy independence” goal. “Energy independence” should be read as something like “ending oil imports” or “ending oil imports from unstable areas of the world.” The goal has never been achieved, and it never will be, and it is not really a good idea from an economic or an environmental perspective to try to make it happen. Conceptualizing energy security issues with a metaphor built around “U.S. dependence on imported oil” that is produced in insecure areas of the world – read the Persian Gulf – is misleading. Yet this metaphor continues to play a big role in U.S. energy policy. The United States itself actually imports relatively little oil from the Persian Gulf. The United States is the largest producer as well as the largest consumer of energy in the world, but our largest trading partner, accounting for 60 percent of the oil we import, is Canada. Mexico is also a big oil trading partner. And Canada accounts for essentially all of the natural gas we import. Persian Gulf countries account for only about 3.5 percent of U.S. energy consumption and 10 percent of U.S. oil consumption. Our allies in Europe and Asia import much more of their energy from that region of the world than does the United States.

*Energy security issues are global issues . . . other countries need to and must bear more of the burden of securing oil supplies in the future than they have in the past.*

But these facts are irrelevant. They reflect 1970s thinking. The oil market is one big integrated international pool where prices are typically quite well arbitrated across delivery locations. The trading patterns that we see reflect differences in transportation costs. It is not a shock that we import oil from Canada, Mexico, Venezuela, and from western Africa and that Japan and China and countries in Europe import oil from Russia, North Africa, and the Middle East. These are the trading patterns that minimize transportation costs. The effects of an oil supply disruption, whether it is from a disaster in some country or from cartel behavior, adversely impact *all* oil-importing countries regardless of where each specific barrel of oil they import happens to come from because *global* oil prices will rise in response to an oil supply disruption wherever it happens to occur. All oil-importing countries are affected by reduced supplies and higher prices, though the *effects* on economic activity will vary from one country to the next depending on the importance of imported oil in their economies. The picture of the United States being targeted by one or more oil-producing countries and having to absorb the entire supply hit reflects a deep misunderstanding about how oil markets work today and, one hopes, will continue to work in the future.

This suggests that energy security issues are global issues. A global problem requires global solutions, and other countries need to and must bear more of the burden of securing oil supplies in the future than they have in the past.

The recent presidential campaign featured debates about the desirability of promoting renewable technologies like windmills and/or “domestic” nuclear power (most urani-

um used in the U.S. nuclear power industry in now imported by the way). These technologies produce electricity. However, the United States consumes essentially no oil to produce electricity. That wasn't true in the 1970s, when nearly 20 percent of the electricity was produced with oil. This suggests that promoting wind, nuclear, and other technologies that produce electricity provides no direct energy security benefits because they would displace coal and natural gas produced in North America. They don't directly displace imports of foreign oil. The primary short-run argument for promoting renewable energy and nuclear power is to reduce carbon dioxide emissions – not to promote energy security goals. In the longer run the role of these technologies in the energy security story must work through the transportation sector, where 70 percent of the oil is consumed in the United States. The future of transportation will have to include electric vehicles, including hybrids, the expansion of environmentally acceptable biofuels, increases in vehicle energy efficiency, and perhaps even increased use of compressed natural gas if natural gas prices stay low and if we want to reduce oil imports.

Technological change has had important effects on energy production and use and must continue to do so if we are even to come close to achieving greenhouse gas reduction goals consistent with our economic performance goals. The revolution going on in the natural gas supply business in the United States, a revolution that is likely to spread to Europe and Asia, is a good example of how technological innovation is making large, new domestic (and Canadian) supplies of natural gas, the least carbon-intensive fossil fuel, available at relatively low prices. A combination of technological developments in horizontal drilling and hydraulic fracturing is making gas trapped in deep shale deposits, gas that we always knew was there but thought was too costly to extract, available at relatively low prices. Developments like these promote all of our economic and environmental goals. They make energy less expensive, they keep energy prices low, they use domestic and Canadian resources, they promote economic growth, they are partially the result of a

more competitive natural gas sector, they reflect the benefits of decentralized technological innovations developed and deployed by the private sector, and they reduce environmental damage from energy use.

Many commentators argue that we need the equivalent of the Apollo program to develop new energy technologies that meet economic and environmental goals. I think that the Apollo program, which calls to mind government spending on selected large-scale technological innovation programs focused on specific technologies chosen by the federal government, is the wrong metaphor for technological change that will promote the widely accepted economic, energy security, and environmental

*Technological change has had important effects on energy production and use and must continue to do so if we are even to come close to achieving greenhouse gas reduction goals consistent with our economic performance goals.*

goals that I have discussed. There is enormous uncertainty about future energy demand, the attributes of future energy supply technologies, prices, the rate and direction of technological change, and other attributes of the energy system and its role in the economy. Getting locked into what appears to be “the solution” to mitigate CO<sub>2</sub> emissions or reduce imports of foreign oil would be a big mistake. Creating an incentive structure that aligns policy goals with the incentives of consumers, producers, equipment suppliers, and those who finance them is critical for good policy outcomes. The most important incentive-compatible policy to put in place is the implementation of appropriate prices on greenhouse gas emissions. The prices placed on greenhouse gas emissions will end up being much higher than what is anticipated by the American Clean Energy and Security Act of 2009 (Wax-

man-Markey) that is currently moving through Congress if its ambitious 2050 GHG emissions reduction goals are to be met. We want those charges to flow through naturally into energy prices and to allow producers of energy and consumers of energy to respond in ways that make them better off when they face these prices. Whether the mechanism used to place appropriate prices on greenhouse gas emissions is emissions taxes or a cap-and-trade really doesn't matter much in the grander scheme of things, though it is a lively focus of debate among some economists. In my view, for those of us interested in policies that place appropriate prices on greenhouse gas emissions, the debate among economists about whether it should be a tax or a cap-and-trade system or some hybrid mechanism is not very important (it is like arguing about how many angels are on the head of a pin), and the apparent disagreements among economists is being used by some interest groups as a rationale for opposing any policies that place prices on greenhouse gas emissions. What matters is getting a price on greenhouse gas emissions to stimulate the decentralized incentives that on the demand, supply, and innovation side will lead to the identification of a portfolio of competing technological options to reduce our reliance on fossil fuels and to reduce the emission of greenhouse gases into the atmosphere.

The government's record on picking winners in energy technology is pretty bad. Coal gasification: not too good. The Clinch River Breeder Reactor Project: not too good. Nuclear waste storage: \$20 billion down the drain. And the government played almost no role in the identification or deployment of the two technologies that have been most fundamental in spurring development of North American natural gas resources. If we are going to bet on the future, let's not have the Apollo program on our mind. Instead, let's focus on getting the incentives right. That means making it much more costly to emit greenhouse gases and to allow the decentralized entrepreneurial spirit and the decentralized interest of consumers in saving money to motivate efforts to find the best, the most innovative, and the most economical solutions to these problems.



**John Doerr**

*John Doerr is a Partner at Kleiner Perkins Caufield & Byers. He was elected a Fellow of the American Academy of Arts and Sciences in 2009.*

We have heard many times that America confronts three interrelated crises: an economic crisis, a climate crisis, and an energy security crisis. My message is that we face a fourth, a competitiveness crisis. At stake is our worldwide standing in the next great global industry: green technology. Fifty years ago America won the space race with the Soviet Union. Today we are in an “Earth race” for the future of the planet and an energy race for the future of America’s standing in the world.

I was inducted into the Academy yesterday. When I received word of this honor, I was quite sure they had made a mistake because I am not a distinguished thinker or a scientist or an artist or performer. In fact, I am an engineer and a partner at the venture capital firm Kleiner Perkins Caufield & Byers. We work for the country’s great colleges and universities. We get funds from their endowments, and we invest those monies in the risky plans of unproven entrepreneurs who would never qualify for a bank loan. We are not financial engineers. Some would say we are investing in sub-sub-prime opportunities. But it turns out these entrepreneurs end up building real businesses with lots of jobs – in the case of my partnership since the mid-1970s, over 500 companies and 400,000 U.S. jobs. The companies include the likes of Genentech, which pioneered an entirely new industry, and Google, which changed the way we search. So my perspective is that of the entrepreneur and the innovator.

How far behind are we in this energy race? Did you know that the United States is home to only two of the top ten solar photovoltaic producers worldwide, only one of the top ten wind providers worldwide, and only one of the top ten advanced battery makers worldwide? Only four of the top thirty companies worldwide in these green technologies are headquartered in the United States. Yet we use a lot of these products, and we use a lot of energy. At this point in the race for the next great global industry, we are not winning. That fact should worry all of us a lot. If we lose our advantage in technologies that were invented and pioneered here, it will cost us dearly.

*Only four of the top thirty companies worldwide in green technologies are headquartered in the United States.*

So who is on track to win this race? China. China’s commitment to green technologies is staggering. China is on track to deploy 120 gigawatts of wind by 2020. That is more than four times the cumulative U.S. wind deployment over the past thirty years. It is the equivalent of 250 coal-fired power plants. China is investing in energy stimulus on a scale that is six times the U.S. investment from our stimulus package. And China is deploying high-speed rail at a pace and scale that are almost hard to imagine.

Can we possibly catch up? I think we can, but only through the power of good old homegrown American entrepreneurs and innovations and the right policies and the power of private capital markets. More money flows through private markets in a day than through all the governments of the world in a year. Never underestimate the power of entrepreneurs. They do more than anyone thinks possible with less than anyone thinks possible.

All the work that these entrepreneurs are doing will fail unless we get one thing really right. I have recently spent time in Wash-

*We need to get the rules and regulations for our utilities right to drive efficiency, to drive renewable portfolio investments, and to get a national unified smart grid.*

ington, D.C., to advocate for comprehensive forward-looking energy and climate-change legislation. This legislation must have four key components. First, it must put a price on carbon. By putting a price on carbon we will unleash the investment of worldwide capital markets. We need that capital. The market needs a long-term price signal. We need the equivalent of what the Netscape initial public offering was for the world’s Internet entrepreneurs. Putting a price on carbon will rally entrepreneurs, innovators, investors, policy-makers, and business leaders to get about this important business.

Second, we need to get the rules and regulations for our utilities right to drive efficiency, to drive renewable portfolio investments, and to get a national unified smart grid. Third, we need efficiency standards. America should have the most fuel-efficient cars and the most energy-efficient buildings in the world. The only way to get there is through standards and incentives. Fourth, we must get serious about funding R&D&D (the second D is deployment) at scale. Energy is a \$1 trillion component of our economy; yet, in 2008 the federal investment in energy research was about \$1.8 billion. This is shameful.

We know these kinds of policies can work. We know innovation can work. It is already working in other countries around the world. Denmark has a smaller population than Missouri, Tennessee, or Michigan. In 1970 they put in place policies to encourage a low-carbon, independent energy future. These policies led to the start of their wind industry, which today supplies a third of all windmills in the world. In 2008, Denmark’s technology exports were \$10 billion, and their unemployment rate was under 3 percent.

Fifteen years ago Web browsers did not exist. The very idea of Internet point and click that we now take for granted hadn't been invented. We had no Internet at our fingertips, no e-commerce, no search engines. Today these things have transformed our lives. Now, imagine a world in which Microsoft was a German company; Apple was Japanese; Google, eBay, and Yahoo were all Chinese-headquartered companies; and only Amazon was American. That is the path today with respect to our nation's prosperity and worldwide leadership if we don't address the looming clean energy competitiveness crisis. Today's Internet was created in about fifteen years and is a \$1 trillion economy that 1.2 billion people around the world access. Energy is a \$6 trillion economy with 4 billion users of electricity around the world, and usage is doubling every twenty years or so. It is the "mother" of all markets, the largest economic opportunity of the twenty-first century. For the United States to lead in this future we need the right policies, we need the right incentives, and we need the right kind of innovation. Our competitors around the world have woken up. We need to do the same with forward-looking comprehensive climate and energy legislation, or we will be buying our future from them.

## Discussion

### Richard Meserve:

Steve, Paul Joskow pointed out that the government does not have a good track record when it tries to select winning technologies, and John Doerr questioned whether we have the right policies in place to move forward appropriately in the area of energy technology. How is the Department of Energy confronting these issues?

### Steven Koonin:

First, as the representative of the government, I'll just note that about eight months ago the government changed, so I'm not sure I have to defend what the government did over the last decade or so!

I find myself much in agreement with Paul Joskow and John Rowe, and I'm disappointed if I gave a different impression. I certainly didn't mean to imply that the government is good at or should be picking winners and losers. A level playing field, a universal price on carbon, and low-carbon portfolio standards are probably the best way to go about tackling the greenhouse gas problem. That said, the slightly different points of view held by an economist and a technologist are worth highlighting.

Paul argues that if we just set a price on carbon the market will take care of everything else. Perhaps. As a technologist I have some appreciation for the state of play of various technologies and the potential for their evolution and deployment. I think we can make reasonable projections, at least on a ten- or twenty-year time scale, of what is going to happen, particularly given the long time scales for energy. Roughly six years is needed to put a major power plant or refinery into the ground from the time you say go, whereas you can probably deploy a software build in six days. So the time scales are very different.

### Paul Joskow:

Putting an appropriate price on CO<sub>2</sub> emissions and emissions of other greenhouse gases is not the only policy we need, but it is the most important policy. We will need supplementary policies, too, but the guiding principle, if the focus is on greenhouse gas mitigation, is to find the most economical options for reducing greenhouse gases. We will have to make some guesses as to what those options will be. But by putting a price on CO<sub>2</sub> emissions we will inevitably lead both consumers and producers, as well as companies that finance innovation, to look for the most profitable and least costly solutions.

We ought to be focusing on the low-cost options first, moving our way up the curve, doing more R&D on some of the higher-cost options to bring their costs down, and providing flexibility for new ideas from both the demand and supply sides to enter the market and make contributions to miti-

*Putting an appropriate price on CO<sub>2</sub> emissions and emissions of other greenhouse gases is not the only policy we need, but it is the most important policy.*

gation rather than trying to constrain them by deciding what is and what isn't in a renewable energy portfolio standard. If nuclear power is as carbon free as wind energy, then why shouldn't it be part of the renewable energy portfolio standard? Why shouldn't it get the same treatment as other renewables? I know the answer is politics, but from an economic perspective it makes no sense.

### John Doerr:

I do think there is good reason to treat nuclear separate from other renewables. Enormous capital is required to build these plants, and much legislative underbrush needs to be cleared so we can streamline their siting. To have nuclear competing against all the other renewables for those incentives could sop up all the incentives we have to offer.

### John Rowe:

Ideally we would have a legal structure that provides a framework of property rights and trading rules that make an efficient marketplace respond to a set of social needs. The challenge in energy is that the patchwork of legal interventions in the marketplace really doesn't constitute a framework. The effect is more like a group of rifle shots going off throughout the market. One major correction to this would be a cap-and-trade or carbon tax or other carbon-pricing measure.

Nuclear is challenging because it doesn't take three or four years to make a nuclear plant; it takes eight. They come in about \$6 billion clumps. They're all pigs in the python.

*Devising a market structure to deal with the interplay between different kinds of renewable technologies and nuclear is difficult because the more you do of one in the short run the less economical the other is in the longer run.*

Devising a market structure to deal with the interplay between different kinds of renewable technologies and nuclear is difficult because the more you do of one in the short run the less economical the other is in the longer run. And in the case of nuclear, anything you get correct now won't come into play for a decade. Unfortunately, we are not good yet at finding a way to use policies to frame a market that is informative and has healthy feedback mechanisms instead of a relatively self-destructive feedback mechanism.

**John Doerr:**

We have just gone through what I hope is the worst economic crisis of our lives and what is perhaps the second worst in our nation's history. The energy choices we are going to make will be made in light of our Great Recession, which means that preference will be given to generating a lot of jobs really fast. Some observers have argued that a jobless recovery and another year of high unemployment would pose the gravest threat to the nation's and administration's agenda. Why not, as some really smart people have observed, put the million-and-a-half out-of-work construction workers to work retrofitting America's homes, which emit twice as much greenhouse gas as the entire light-vehicle transportation fleet? The energy savings would be abundant,

and we would create a new American industry, an offshoot of the home-building industry. Over the course of a decade or two we should assess and, as needed, retrofit 100 million American homes. In fact, we probably can't get to our climate goals if we don't do this.

**Paul Joskow:**

The American public has not been adequately prepared for the sudden onslaught of carbon legislation. The level of discussion, even among well-educated people in the United States, over the last five years has been quite different than in Europe and Japan, where these issues are still being discussed. This is creating a challenge for politicians. To meet the goal of 80 percent reduction by 2050, energy prices will have

*Until we bite the bullet and educate the public about the costs as well as the long-term benefits of controlling greenhouse gas emissions, we are going to have difficulty passing the legislation that will get us on a path toward a least-cost solution to these problems.*

to go up, and nobody wants to tell the truth about that. Waxman-Markey and some of the other bills are designed to hide the ball or to delay the rise in energy prices. This is unfortunate because it will lead to much more inefficient programs. Energy prices need to rise for two reasons. First, we want to give consumers incentives to adopt energy-efficient technologies. Second, the technologies for reducing greenhouse gas emissions are going to cost some money, and

eventually someone has to pay. The government can't pay for all of it forever. Until we bite the bullet and educate the public about the costs as well as the long-term benefits of controlling greenhouse gas emissions, we are going to have difficulty passing the legislation that will get us on a path toward a least-cost solution to these problems. ■

---

© 2010 by Richard A. Meserve, Steven E. Koonin, John W. Rowe, Paul L. Joskow, and John Doerr, respectively

# 2009 Induction



1. Alan Thomas (University of Chicago Press), Alice Kaplan '09 (Yale University), and Robert von Hallberg '09 (University of Chicago)

2. John Seely Brown '09 (University of Southern California) and William Gerberding '09 (University of Washington)

3. James Truman '09 (Howard Hughes Medical Institute) and Scott Edwards '09 (Harvard University)

4. David Agard '09 (University of California, San Francisco) and Karen Strier '09 (University of Wisconsin-Madison)

5. Maria Klawe '09 (Harvey Mudd College) and Michael Sipser '09 (MIT)

6. Academy Councilor David Sabatini '80 (New York University School of Medicine) and Lelio Orci '09 (University of Geneva Medical School)



7. J. Harvie Wilkinson III '09 (United States Court of Appeals, Fourth Circuit), Academy Councilor Linda Greenhouse '94 (Yale Law School), and Academy Librarian Robert C. Post '93 (Yale Law School)
8. Dan Slobin '09 (University of California, Berkeley) and James Wertsch '09 (Washington University in St. Louis)
9. Mahlon DeLong '09 (Emory University) and Steven Louie '09 (University of California, Berkeley)
10. Emmylou Harris '09 (Nashville, Tennessee) and Academy Trust Member Warren Hellman '05 (Hellman & Friedman)
11. Naomi Halas '09 (Rice University) and Donald Worster '09 (University of Kansas)
12. John Doerr '09 (Kleiner Perkins Caufield & Byers) and Academy Trust Member Kenneth Wallach '07 (Central National-Gottesman)

# 2009 Induction



13



14



15



16



17



18

13. Danielle Allen '09 (Institute for Advanced Study) signing the Book of Members
14. Academy Trust Member Tom Leighton '03 (Akamai Technologies; Massachusetts Institute of Technology) and Maria Klawe '09 (Harvey Mudd College)
15. Academy Trust Member John Cogan, Jr. '05 (Pioneer Investment Management USA, Inc.) and Scott D. Sagan '08 (Stanford University)
16. Andrew Meltzoff '09 (University of Washington), William Gerberding '09 (University of Washington), and Nancy Kanwisher '09 (Massachusetts Institute of Technology)
17. Academy President Emilio Bizzi '80 (Massachusetts Institute of Technology) and Academy Librarian Robert C. Post '93 (Yale Law School)
18. Robert Birgeneau '87 (University of California, Berkeley) and Academy Councilor Robert A. Albery '68 (Massachusetts Institute of Technology)

# Academy Workshop

## Nuclear Power in the Middle East

From December 13 to 15, 2009, government officials and policy experts from sixteen countries gathered in Abu Dhabi – capital of the United Arab Emirates (UAE) – to discuss the political, technical, and nonproliferation considerations related to the global and regional expansion of nuclear power. The Academy organized the three-day meeting on *Nuclear Power in the Middle East* as part of its initiative on the Global Nuclear Future. The project, led by Steven E. Miller (Harvard University) and Scott D. Sagan (Stanford University), is working to identify, refine, and promote measures that will limit the safety, security, and proliferation risks associated with the anticipated global expansion of nuclear power.

More than a dozen nations in the Middle East have expressed interest in nuclear power, and the plans for the UAE are among the most advanced in the region. Importantly, however, the UAE has voluntarily undertaken not to pursue proliferation-sensitive technologies (uranium enrichment and reprocessing for plutonium) that could provide a pathway to nuclear weapons. Instead, the country is choosing to rely on the international market for these services.

The participants in the Abu Dhabi meeting brought a diverse range of expertise and experience in nuclear program development, regulation, and nonproliferation and disarmament efforts to the discussions. The meeting included ambassadors and other senior officials from the United Nations Office of Disarmament Affairs, the International Atomic Energy Agency (IAEA), the League of Arab States, and the Arab Atomic Energy Agency, as well as high-ranking representatives from various national governments and think tanks. The attendees came from Algeria, Brazil, China, Egypt, Finland, Iran,



Academy CEO Leslie Berlowitz, High Representative for Disarmament Affairs Sergio Duarte (United Nations), and UAE Permanent Representative to the IAEA Hamad Al Kaabi

Italy, Malaysia, Norway, the Philippines, Sweden, Switzerland, Tunisia, Turkey, the UAE, and the United States.

U.S. Ambassador to the UAE Richard Olson, in his opening remarks, discussed the bilateral nuclear cooperation pact between the UAE and the United States. The agreement “establishes a firm foundation for mutually beneficial cooperation in civil nuclear energy,” Olson said. “It incorporates the UAE’s commitment to renounce any intention to develop domestic enrichment and reprocessing capabilities in favor of long-term commitments to obtain nuclear fuel from reliable and responsible international suppliers. . . . More broadly, [the agreement] is a tangible expression of the United States’ desire to cooperate with states in the Middle East and around the world that want to develop nuclear power peacefully and in a manner consistent with the highest nonproliferation, safety, and security standards.”

Ambassador Hamad Al Kaabi, the UAE Permanent Representative to the IAEA, noting that energy demand in the UAE is projected to triple between 2007 and 2020, remarked that his government is aspiring to satisfy the country’s long-term energy needs with nuclear power. “Nuclear power is a viable option for us,” he said. “Our government has adopted policy principles such as transparency, cooperation with the IAEA, and high standards of safety that we are using to develop the infrastructure for a domestic nuclear industry.”

Over the course of the meeting, the participants discussed a number of complex issues, including how best to manage the spread of nuclear power and the emerging nuclear order, as well as how to



Project Coleader Scott D. Sagan (Stanford University), Ambassador to the UAE Richard Olson (U.S. Department of State), and Project Coleader Steven E. Miller (Harvard University)

## Academy Workshop

strengthen the nuclear nonproliferation regime. They also considered the priorities for the May 2010 Review Conference for the Nuclear Nonproliferation Treaty (NPT) – the international agreement that serves as a cornerstone of the regime.

Many of the conference participants expressed their support for the Academy's project on the Global Nuclear Future and their pleasure in having had an opportunity to meet and discuss issues of common interest with such a diverse group of colleagues, many of whom were meeting each other for the first time.

The Academy is planning a follow-up meeting in New York during the NPT Review Conference and another international meeting in Southeast Asia in late 2010. Prospects for strengthening the non-proliferation regime depend largely on the willingness of the non-nuclear-weapons states (including the nuclear power aspirants among them) to support and implement reform efforts. To gauge the prospects for improving the nuclear nonproliferation regime and to assess its adequacy for the future, it is essential to understand the preferences and interests of the nuclear have-nots and to appreciate their concerns and the solutions that are acceptable to them. The Academy will convene experts and policy-makers from non-nuclear-weapons states in Southeast Asia, including countries pursuing nuclear energy programs, to consider the regional implications of nuclear power programs and to incorporate their views into a new strategy for strengthening the nonproliferation regime. The Initiative will advance this work by engaging with ASEAN (Association of Southeast Asian Nations) and utilizing the relationships built with influential experts and officials in



**Saideh Lotfian (University of Tehran, Iran) and Mustafa Kibaroglu (Bilkent University, Turkey)**

those countries, including Noramly Bin Muslim (Chairman, Malaysian Atomic Energy Licensing Board) and Jayantha Dhanapala (President, Pugwash Conferences on Science and World Affairs). The Academy hopes to promote a dialogue between the nuclear haves and have-nots and craft solutions that are local and region-specific.

More information about the Global Nuclear Future Initiative is available on the Academy's website at <http://www.amacad.org/projects/globalNuclear.aspx>. ■



**Conference participants (left to right): Minister Counsellor Mostefa Zeghlache (Embassy of Algeria to the UAE); Director of Disarmament Affairs Khaled Shamaa (Ministry of Foreign Affairs of Egypt), Director of Multilateral Relations Wael Al-Assad (League of Arab States), Professor of Political Science Saideh Lotfian (University of Tehran), Secretary General Paolo Cotta-Ramusino (Pugwash Conferences on Science and World Affairs), High Representative for Disarmament Affairs Sergio Duarte (United Nations), Senior Research Fellow Sverre Lodgaard (Norwegian Institute for International Affairs), and Chairman Rolf Ekéus (Stockholm International Peace Research Institute)**

# Academy Funding

## Global Nuclear Future Project Receives \$1.6 Million in Funding

Three of the nation's leading private foundations have awarded grants totaling more than \$1.6 million to the American Academy in support of its initiative on the Global Nuclear Future.

Grants from Carnegie Corporation of New York, the William and Flora Hewlett Foundation, and the Alfred P. Sloan Foundation will advance the Academy's efforts to convene experts from the research, engineering, industry, academic, and policy communities to find and promote ways of minimizing the potential security risks posed by the expansion of nuclear energy.

"We are grateful to Carnegie Corporation of New York, the William and Flora Hewlett Foundation, and the Alfred P. Sloan Foundation for partnering with the Academy to address one of the great challenges of our time," said Chief Executive Officer Leslie Berlowitz. "With more than five decades of experience working on nuclear arms control and energy security issues, and relying on a broad consortium of institutions and individuals, the American Academy is in a special position to contribute valuable ideas and policy advice in this area."

While the world will rely on many sources to meet growing energy demand and to address concerns about climate change, nuclear power is the only energy source that both avoids carbon emissions and is technologically mature enough for large-scale deployment in a relatively short time frame, according to the project's Codirectors Steven E. Miller (Harvard University) and Scott D. Sagan (Stanford University).

The initiative is working to develop pragmatic recommendations for global nuclear growth that reduce the probability that a terrorist group could steal or acquire nuclear material from a nuclear facility; diminish the likelihood that new nuclear states will retain and reprocess spent fuel materials, which could facilitate their development of nuclear weapons; limit the number of states with uranium enrichment facilities; increase the focus of the nuclear industry on nonproliferation and security concerns; and strengthen the international Nonproliferation Treaty regime.

By bringing together constituencies in the United States and abroad that historically have not communicated with each other – from government policy-makers to the heads of nongovernmental organizations, from nuclear engineers to industry leaders, from social scientists to nonproliferation experts – the Academy's project seeks to contribute to a new global architecture for the nuclear future, accounting for new players, varying interests, and changing realities.

The Global Nuclear Future Initiative is led by Fellows Steven E. Miller and Scott D. Sagan, with research coordinator Thomas Isaacs (Stanford University and Lawrence Livermore National Laboratory) and senior advisor and Fellow Robert Rosner (University of Chicago). Academy Fellows John W. Rowe (Exelon Corporation), Richard A. Meserve (Carnegie Institution for Science), and Albert Carnesale (University of California, Los Angeles) are among the expert members of the project's advisory committee.

For more about the Academy's Initiative on the Global Nuclear Future, see <http://www.amacad.org/projects/globalNuclear1.aspx>. ■

## Hellman Fellowship in Science and Technology Policy



Hellman Fellow Kimberly Durniak, Warren Hellman, Chris Hellman, and Hellman Fellows Dorit Zuk and John Randell

The Hellman Fellowship in Science and Technology Policy, established by the Hellman Family Foundation in 2007, encourages scholarship in science policy. Hellman Fellows work with senior scientists and policy experts on critical national and international policy issues related to science, engineering, and technology.

On October 10, 2009, Hellman Fellows Dorit Zuk, Kimberly Durniak, and John Randell met with Warren and Chris Hellman. They described their experiences as Hellman Fellows and the impact of the fellowship on their careers.

"The Hellman Fellowship has given me an opportunity to work on a broad range of research projects," said Durniak. "It has been especially gratifying to work on studies that are dealing with science funding and energy policy because of their impact on America's competitiveness in a global society."

The Academy is grateful to the Hellman Family Foundation and to Warren Hellman for establishing the Hellman Fellowship in Science and Technology Policy. ■

# Projects and Studies Update

---

At a morning briefing for new members, held on October 10, 2009, leaders of Academy projects and studies presented updates on their work.

## Initiative for Science, Engineering, and Technology



### Neal Lane

Neal Lane is Malcolm Gillis University Professor at Rice University. He was elected to the American Academy of Arts and Sciences in 1994 and serves as a member of the Academy's Council.

The Academy's Initiative for Science, Engineering, and Technology includes several current and emerging projects, such as Alternative Models for the Federal Funding of Science, whose *ARISE: Advancing Research In Science and Engineering* study was released in 2008. *ARISE*, like many Academy efforts, is concerned with understanding and offering solutions for current problems in higher education. Another example is the Science in the Liberal Arts Curriculum project directed by Jerrold Meinwald of Cornell University and John Hildebrand of the University of Arizona. They are investigating questions such as: What do we think university students really ought to learn about science? What science content should be taught in the liberal arts curriculum? What are the existing goals for this curriculum? Are they appropriate? Are they being met? Provosts, deans, and academic leaders from across the country have been invited to contribute to this project, which will result in a collection of case studies that should help us better understand what's going on, how effective it is, and what we might do better in the future. The outcomes and conclusions of the study will soon be shared with the larger community.

A third project, Scientists' Understanding of the Public, aims to consider the obverse of something we often talk about: the public's understanding of science. If researchers are to do their work and have it properly impact society, scientists, engineers, and technical professionals must understand those impacts and how people think about and respond to new developments in science, engineering, and technology. This project will present a series of case studies contributed by a cross-disciplinary and cross-sectoral community of scientists, journalists, policy-makers, and others.

*As the Academy pursues efforts like the Initiative for Science, Engineering, and Technology, two core strengths allow us to explore topics in ways that few other organizations can: the Academy is fully independent and interdisciplinary, and Academy Fellows represent all disciplines and professions.*

A fourth project, Securing the Internet as Public Space, is, like the Initiative for Science, Engineering, and Technology, part of the Academy's larger program on Science, Technology, and Global Security. The Internet as Public Space project seeks to explore options for the future of the Internet. As choices are made about the evolution of this extraordinary global commons, how will commercial and governmental interests in controlling the rules of its use be balanced with the needs and rights of individual users around the world? The Internet project is led by David Clark of MIT

and involves computer scientists, lawyers, technology and policy specialists, and scholars from academia, business, and government.

As the Academy pursues efforts like the Initiative for Science, Engineering, and Technology, two core strengths allow us to explore topics in ways that few other organizations can. Unlike many organizations, the Academy is fully independent and interdisciplinary. Academy Fellows represent all disciplines and professions, encompassing both the academy and the business sector and stretching from the sciences to the humanities to the arts, including the performing and visual arts. By bringing together representatives from these different constituencies, we can add value to whatever discussion is important at the time. And we can explore niches that might be overlooked elsewhere. ■

---

© 2010 by Neal Lane

## Initiative for Science, Engineering, and Technology



### Randy Schekman

*Randy Schekman is Professor of Molecular and Cell Biology at the University of California, Berkeley, and an Investigator at the Howard Hughes Medical Institute. He was elected a Fellow of the American Academy of Arts and Sciences in 2000 and serves as a member of the Academy's Council.*

Many of us who started our careers in the life sciences back in the 1960s and 1970s routinely received funding grants while we were in our late twenties and early thirties. But now the training of young investigators takes so long and the struggle to get funding has become so difficult that many are almost into middle age before they receive their first independent grant. The average age of a new National Institutes of Health (NIH) grantee is now forty-three. This is an alarming trend.

The Academy's Committee on Alternative Models for the Federal Funding of Science, chaired by Tom Cech, a Nobel laureate and former head of Howard Hughes Medical Institute, was formed to analyze current science-funding policies. But rather than focus on the issue of increasing the pot of money available for funding, we focused on the funding mechanisms the granting agencies use to evaluate funds for early-career scientists and for scientists who engage in high-risk, high-reward research. (As the study developed, however, and the Obama administration took over, funding, especially for biomedical science, grew substantially.) We interviewed many agency heads and many successful young investigators.

We asked how the agencies were dealing with the issue of innovation and research for beginning career investigators. Some agencies, such as the NIH, have been experimental in their approach to funding. Under the leadership of Elias Zerhouni, the NIH introduced a number of new funding tracks, some of which were successful, others not. We applaud their new Pioneer Award Program, which awards grants to risk takers in biomedical and behavioral

*The Office of Management and Budget has written into the relevant federal regulations the very language we encouraged for promoting beginning investigators and high-risk research.*

research. Unfortunately, the NIH did not allocate enough money to the program, and out of the first round of applications only 1 percent were successful and there were no women in that group. In a demonstration of their willingness to experiment, the NIH revised the program, and it has gone forward quite successfully. Other agencies have been less experimental, and we have encouraged them to look at the NIH as a model for how they might change their grant-making policies.

Over the period of a year, the committee met many times in Washington, D.C., and San Francisco and came up with a small number of specific proposals. They are all described in the *ARISE* report, which is available online (<http://www.amacad.org/AriseFolder/default.aspx>). We looked at, for instance, the problem of federal program officers' reduced engagement with the academic community. When I began my career at Berkeley many years ago, the program officers hired by the NIH to manage grants and to field questions from investigators were treated as members of the scientific community. They would attend meetings and get to know young, up-and-

coming investigators. Increasingly, budget cuts have limited program officers' ability to travel and so they know fewer young investigators. We feel that a simple and relatively inexpensive solution to this problem would be for federal agencies to review their program officers' travel funding and to encourage them to become more visible in the academic community.

We also encourage universities to consider more carefully how promotions are evaluated, to try to get away from counting publications and instead to consider the impact of work. We also recommend that universities not rely on growth in the NIH budget to expand the faculty base without a matching investment of funds in the research enterprise. During the doubling of the NIH budget, for instance, many universities decided to capitalize on the increase in funds by constructing new buildings but did not provide new faculty with the resources necessary to sustain their programs. Thus, construction consumed a disproportionate amount of many universities' share of NIH money.

The committee's work will be valuable only to the extent that it has impact. I am pleased with the kind of impact the *ARISE* report has had. The report generated wide media coverage, including a number of op-ed pieces in newspapers. Tom Cech made a presentation about it at the National Press Club, and in the year since it was issued Congress has embraced its lessons. The Obama administration has also been highly supportive. The Office of Management and Budget has written into the relevant federal regulations the very language we encouraged for promoting beginning investigators and high-risk research. And we are particularly pleased that committee member Steve Chu was selected as Obama's Secretary of Energy. In his new position, Steve has been able to introduce the Department of Energy to the concepts developed by the study group.

The relatively small amount of work we have done thus far has had a disproportionate impact, and we are encouraged to go forward. Neal Lane and several others of us are engaged in the next phase of the project,

what we call *ARISE II*, which will focus even more on the responsibilities of the university. For example, we wish to encourage universities to reconsider how they allocate salary supports and fund building projects and not to rely exclusively on federal funds. This will be a challenge. We will try to engage university presidents, who I am sure will have a different point of view. But I think *ARISE II* can have a significant impact. I encourage each newly elected member to this august body to think seriously how he or she can contribute to this effort and to ones similar to it. Your efforts will add meaning to the honor of membership in the Academy. ■

© 2010 by Randy Schekman

## The Global Nuclear Future



### Scott D. Sagan

*Scott D. Sagan is Caroline S.G. Munro Professor of Political Science and Codirector of the Center for International Security and Cooperation at Stanford University. He was elected a Fellow of the American Academy of Arts and Sciences in 2008.*

Concerns about climate change, the volatility of oil prices, and the security of energy supplies have all combined to create what some individuals have called a renaissance of interest in nuclear power around the world. The Academy's project on The Global Nuclear Future has a single goal: to reduce the risk that the spread of nuclear power will create security dangers, such as increased nuclear weapons proliferation or nuclear terrorism.

Although the term *renaissance* and the phrase "spread of nuclear power" are often used, we should differentiate between the expansion of the use of nuclear power in states that have nuclear power today and the potential spread of nuclear power to new countries. Some thirty countries have nuclear power plants today, and some of these are considering adding more. Another fifty states are interested in developing nuclear power programs and have asked the International Atomic Energy Agency (IAEA) for assistance in conducting the studies needed to initiate such a program in their own country (see Figure 1). Even more interesting than the sheer number of new aspiring nuclear states is their geographic distribution: more than half are from the developing states in the Middle East, Africa, and Latin America. If we contrast the characteristics of aspiring nuclear power states with those of existing nuclear power states, we see that with respect to governance, the control of corruption, political stability (as measured by the probability of a government falling because of domestic political violence), and regulatory quality (as measured by the World Bank), the aspiring states all have significantly weaker records in those categories that would influence their ability to manage nuclear power in a safe and secure manner (see Figure 2). We have al-



Figure 1

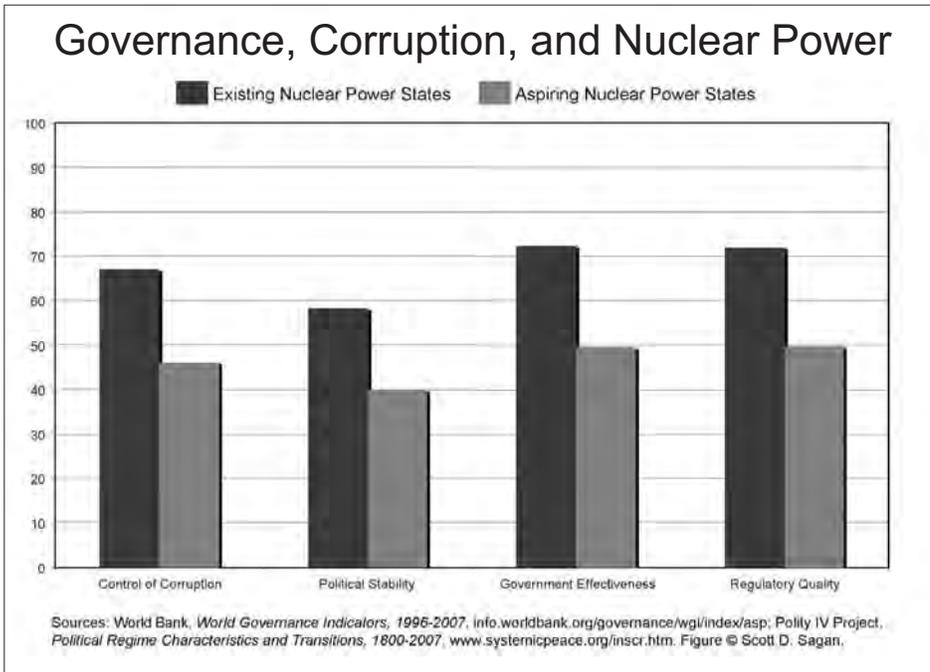


Figure 2

### Nuclear Power and Terrorism

Incidents of terrorism in past five years, current nuclear power states		Incidents of terrorism in past five years, current and aspiring nuclear power states	
India	4,462	India	4,462
Pakistan	3,697	Pakistan	3,697
Russia	1,302	Thailand	1,301
Spain	313	Israel	2,778
France	277	Russia	1,302
United Kingdom	220	Philippines	1,061
Iran	56	Sri Lanka	700
China	31	Turkey	403
Mexico	29	Algeria	328
Ukraine	25	Spain	313

Source: Worldwide Incidents Tracking System, National Counterterrorism Center (NCTC).

Figure 3

ready seen the dangers posed by the A. Q. Khan network in Pakistan and the problems corruption can cause in countries that have nuclear power or nuclear weapons. Issues such as these will become even more of a challenge if more countries acquire nuclear power.

We can't predict which of the countries that currently aspire to nuclear power will actually be able to acquire the necessary technol-

ogy, but financial constraints will almost certainly reduce the number over time. Nevertheless, some countries have already begun – and others will soon begin – negotiations for contracts to start nuclear power facilities.

I originally thought we would find that countries aspiring to nuclear power have higher rates of terrorism than do existing nuclear power countries. However, when

we averaged the U.S. National Counterterrorism Center numbers, we found this not to be the case – but only because the high number of terrorist incidents in India and Pakistan over the last five years skewed the data so strongly (see Figure 3). Still, if all of the aspirants join the “nuclear power club,” they will be six of the “top ten ter-

*We must work hard to develop new strategies to reduce the risk of nuclear proliferation and nuclear terrorism, for the global renaissance of nuclear power will otherwise produce severe challenges to international security.*

rorist risk states.” This result highlights a real problem with the potential spread of nuclear power into more countries: the security concerns raised by having nuclear power in countries with high rates of terrorism. In short, we must work hard to develop new strategies to reduce the risk of nuclear proliferation and nuclear terrorism, for the global renaissance of nuclear power will otherwise produce severe challenges to international security. ■

© 2010 by Scott D. Sagan

### The Global Nuclear Future



#### Steven E. Miller

Steven E. Miller is Director of the International Security Program at the Belfer Center for Science and International Affairs at the Harvard Kennedy School. He was elected a Fellow of the American Academy of Arts and Sciences in 2006.

The Global Nuclear Future project is one of a number of projects that are under the rubric of the Committee on International Security Studies, one of the Academy's standing research groups. This committee has at least a fifty-year history of addressing various security issues, particularly but not exclusively focused on things nuclear.

We are heading into a new nuclear world; it will be different from the one in which we have been living. More nuclear technology will be spread across more places, raising worrisome possibilities that nuclear technology will end up in places that may be hostile, unstable, or unreliable in their management of the technology. The linkage between nuclear power technology and nuclear weapons is inherent and thus inescapable, which raises concerns about nuclear terrorism and nuclear proliferation.

Those of us participating in The Global Nuclear Future project are trying to answer the question "Where do we want to be in twenty to twenty-five years?" What attributes are desirable in a nuclear order in which many more states have access to nuclear power? How can we get there, and what do we need to be doing now in order to make sure that when we arrive we have in place the rules, institutions, arrangements, and norms that will make it possible for us to harvest the benefits of nuclear power with-

out being subjected to the various adverse consequences?

Our goals fall under four headings. First, we would like nuclear power in the future to be safe. Second, we would like it to be secure. Nuclear materials and facilities should be well protected against abuse, misuse, and theft. Third, we would like fuel-cycle arrangements – that is, the provision of nuclear fuel to nuclear power plants – to be limited as much as possible to purely civilian applications and to inhibit the spread of the technologies required to produce nuclear material for weapons purposes. Fourth, we would like the institutional, legal, and normative arrangements associated with the nonproliferation regime to be augmented and adapted in such a way that

*We are heading into a new nuclear world; it will be different from the one in which we have been living. More nuclear technology will be spread across more places, raising worrisome possibilities that nuclear technology will end up in places that may be hostile, unstable, or unreliable in their management of the technology.*

they are adequate to the challenges that we'll face in the future. Many people question whether these arrangements are adequate today. The crises with Iran and North Korea suggest that present arrangements may well be inadequate for the more demanding tasks of the future. Cutting across all four goals is the proposition that the desirable nuclear order, the world in which we want to live, is not going to arise automatically and spontaneously. We have to think about the design characteristics we want, and we have to work to achieve them.

So what are we doing to promote these goals? We have held a series of workshops (and have more to come). We have briefed the White House. We have established ties with the IAEA. We have forged links with the nuclear power industry. We are working with both the World Institute of Nuclear Security and the World Association of Nuclear Operators. We have links to the Office of Multilateral Affairs of the Arab League, trying to help them help their members coordinate their nuclear activities as they go about constructing their own nuclear futures. We have drawn in an international group of collaborators. Finally, Scott Sagan and I organized two special issues of *Dædalus* (Fall 2009 and Winter 2010) that highlight the international character of the problem by presenting the perspectives of a diverse, distinguished, and international group of colleagues. Through these efforts we hope to make at least a small contribution by putting this issue on the agenda, promoting ideas for reducing the risks involved in the spread of nuclear power, and contributing to an outcome that in twenty to twenty-five years we won't regret. ■

© 2010 by Steven E. Miller

---

## The Global Nuclear Future



### Robert Rosner

Robert Rosner is William E. Wrather Distinguished Service Professor in Physics and Astronomy & Astrophysics at the University of Chicago. He was elected a Fellow of the American Academy of Arts and Sciences in 2001.

Among the countries that currently aspire to nuclear power are several that do not possess the human and technological infrastructure needed to operate nuclear power plants in a safe and secure fashion. Many are simply interested in turnkey operations. They would like to purchase a nuclear plant together with everything needed to operate the plant, including the equivalent of a U.S. Nuclear Regulatory Commission (NRC), over a long period of time. During the time when the plant is being operated for them, they would, one hopes, have sufficient wherewithal to train their own population to operate the plant in a safe and secure fashion.

Might the American nuclear power industry, which traditionally has had a national focus, be interested in engaging in these kinds of contracts? In particular, would they be willing to share their widely recognized capabilities in safely and securely operating nuclear plants? Earlier in 2009 the Academy convened a group of folks from the nuclear power industry – operators and builders, both U.S. and foreign – to discuss these questions. The group agreed that substantial thought should be given to how the U.S. nuclear industry might become more internationally involved.

But the issue is not simply whether American companies should get involved in this

process. Nuclear power industries exist in other countries where the linkage between safety and security is well understood; for example, in Japan and the European nuclear countries. Operators in these countries have expressed an interest in working with states that aspire to nuclear power. We hope in the coming months to expand our discussions to include these non-U.S. operators. In order to do so, however, we will need to figure out how to get all parties in the room to discuss the issues candidly and without fear that they are giving away negotiating tactics or revealing trade secrets that competitors could use to gain advantage.

*A number of national labs and universities, American companies both small and large, and U.S. entrepreneurs are thinking deeply about the nuclear future and considering some innovative concepts.*

The ongoing nuclear renaissance is an international phenomenon. But is it an American phenomenon? Many would argue no. However, a number of national labs and universities, American companies both small and large, and U.S. entrepreneurs are thinking deeply about the nuclear future and considering some innovative concepts. The current difficulties in getting NRC licensing approval for new types of nuclear fuel and plant designs mean that developing and bringing these new ideas to market is a long process. So it is no surprise that these folks are looking outside the United States to build and innovate, which raises problems of intellectual property rights, as well as export controls on the kinds of things that are necessary to build a plant. The question is how do we address these problems? One approach would focus on the way the NRC operates, that is, to rethink the licensing process and how one might shorten the time the NRC devotes to the licensing process – not by short-cutting

the process, but by applying modern computer simulation and experimental methodologies to this problem area. Another (complementary) approach might be to modify the rules that govern the export of technologies of the sort needed to build and operate nuclear power plants – after all, many of the vendors of nuclear energy technologies are already highly international in character. ■

---

© 2010 by Robert Rosner

### Reconsidering the Rules of Space



#### John D. Steinbruner

*John D. Steinbruner is Professor of Public Policy at the School of Public Policy and Director of the Center for International and Security Studies at the University of Maryland. He was elected a Fellow of the American Academy of Arts and Sciences in 1992.*

The eight monographs, or occasional papers, released as part of the Academy's Reconsidering the Rules of Space project are intended to stimulate broader public discussion of a range of domestic and international issues raised by the use and exploration of outer space. We recognize that on this subject, as on many others, the U.S. political system is having difficulty balancing the broad array of interests and is having particular difficulty balancing two fundamental principles of space activity: equitable accommodation and antagonistic confrontation. For those who are interested in the dynamics of human belief, this is one of the more interesting sagas, and I encourage all interested parties to think about it. The published occasional papers are designed to provide the basis for doing so.

The papers review some basic facts: Space activity began in the context of Cold War confrontation, and to this day most of the basic activities, rocket technology in particular, are funded through defense budgets. Despite the antagonistic beginning, the physical characteristics of the space environment imposed themselves from the start, and the competing United States and Soviet Union were forced to recognize that one cannot behave in space as antagonisti-

cally as one can in the skies or in the seas or on the ground. In fact, the principal feature that was required to legally and politically enable space activity to occur was that sovereign countries not attempt to extend jurisdiction to orbit. That principle was established by an informal conversation between Nikita Khrushchev and Charles de Gaulle during the Paris Summit of 1960. The occasion was a dispute over U.S. violation of Soviet air rights: the United States had been flying U-2 spy planes over the Soviet Union, a fact the Soviets proved when they shot down one of the planes on May 1, 1960, two weeks before the summit. The Soviet Union insisted on defending its airspace but conceded that it could not extend that defense to space. This critical principle was later formally established in the Outer Space Treaty of 1967. The Treaty allows observation, navigation, and communications

*The increasingly significant commercial development of space will require a comparable rule against interference. In the very long term, colonization of entities outside our own little planet will be accomplished only if the human species can work as a whole.*

in space for fundamental military purposes; in other words, it allows all of the operations that are critical to the functioning of modern military establishments under the supposition that those activities will be peaceful as defined in the UN Charter. The Treaty bans weapons of mass destruction but does not mention any specific prohibition on interference. This hole in the regime has long been a problem.

It is physically possible to interfere with assets in space, and doing so has not specifically been declared to be illegal. During the Cold War, although the two antagonists ex-

plored ways of disrupting satellite operations and developed rudimentary capabilities for attacking space assets, neither of them established fully dedicated anti-satellite missions. In 1979, in response to the Soviet invasion of Afghanistan, the United States suspended formal negotiations on expanding the rules of space to ban interference. The negotiations have never been reconvened despite worldwide efforts nearly every year to do so. When the matter comes up in the United Nations General Assembly, the United States, Israel, and the Marshall Islands usually find themselves alone in refusing to issue a mandate to initiate negotiations.

Some in the United States believe that we might want to engage in ballistic missile defense activities in space that would not be consistent with the constraints envisioned by the proposed rules of space. A series of U.S. military planning documents has even asserted the intention to dominate space for national advantage and deny similar capability to everyone else. These attitudes have only stimulated the rest of the world to be even more vigorous about introducing equitable negotiations.

We expect that over the long term, the principle of noninterference will have to be recognized as the fundamental U.S. interest because we operate the most expensive, most sophisticated, and most vulnerable space assets.

The increasingly significant commercial development of space will require a comparable rule against interference. In the very long term, colonization of entities outside our own little planet will be accomplished only if the human species can work as a whole. For the present moment, however, the issue at stake is balancing the principles of equitable accommodation, which are fundamental to the legal regime of space, although not completely articulated, against the impulse for national advantage – a continuing saga that we urge all Academy members to contemplate. ■

© 2010 by John D. Steinbruner

## U.S. Policy Toward Russia



### Robert H. Legvold

Robert H. Legvold is Marshall Shulman Professor of Political Science Emeritus at Columbia University. He was elected a Fellow of the American Academy of Arts and Sciences in 2005.

The Academy project on rethinking U.S. Policy Toward Russia began in April 2008 under a dual inspiration. The first inspiration was the belief that the U.S.-Russia relationship was far more important and the U.S. stake in that relationship far greater than many people appreciated (and not simply because of nuclear weapons and oil and gas). The second inspiration was a recognition that the relationship, illogically, was in serious disrepair and getting worse. This view was held not only by government officials, members of the public policy world, and university academics but by Carnegie Corporation of New York, a foundation that has put a lot of money into Russian studies and work in Russia. Carnegie Corporation took the initiative both in pushing the Academy to do the project and in funding it.

The Academy is a uniquely appropriate place for the project to be situated: first, because of the national standing of the institution and its independence; second, because of its human resources; and, third, because of its political neutrality. The project is unusual in a number of respects. We began with not one but four working groups, and the project operated under a steering committee of both practitioners and scholars. Also unusual is the multiplicity of products the project has and continues to create. Our purpose was never to move toward an ultimate book or report but to have an ongoing influence from the months before

the 2008 national elections through the unfolding of policy in the new administration and to direct the discussion toward a variety of objectives.

Project activities started with an early strategic assessment of the challenges facing the United States in dealing with Russia, including prospects for improving relations and directions the United States might take. The assessment was then shared with the policy community, a select group of professionals, and the Russians. We also produced a series of memoranda for the administration and the policy community on matters such as the need for a strategic dialogue with Russia, including lessons from past attempts in this direction; the need for a major presidential address on improving U.S.-Russian

### *How might we successfully conduct a positive agenda toward Russia . . . while at the same time have an independent, supportive, strong policy toward Ukraine, Georgia, and Russia's other neighbors?*

relations (a speech President Obama eventually gave in Moscow in July 2009); and, as the administration goes forward with its Russia policy, the need to address a critical conceptual and strategic problem facing the United States: namely, how we might successfully conduct an ambitious, engaged, positive agenda toward Russia, thus achieving the Obama administration's goal of putting the U.S.-Russia relationship on a different footing, while at the same time having an independent, supportive, strong policy toward Ukraine, Georgia, and Russia's other neighbors, particularly in those cases where the relationship between the neighbor and Russia is not strong or healthy or positive.

We held a major conference on March 27, 2009, at the Library of Congress. This day-long meeting on designing U.S. policy toward Russia was co-sponsored by the Aspen Institute, the Brookings Institution, the

Council on Foreign Relations, the Carnegie Endowment, the Woodrow Wilson Center, and the Library of Congress. As this large number of institutions suggests, many other organizations and individuals have also been working on issues related to U.S. policy toward Russia. Our project will recognize some of the best ideas to come from these groups and individuals with a report that surveys the many reports and essays on U.S. policy toward Russia that have appeared in the last six to twelve months.

Information about all of the project's activities is presented on a special page on the Academy's website (<http://www.amacad.org/russiapolicy.aspx>).

Many Academy projects seek to reach multiple audiences. U.S. Policy Toward Russia is perhaps unusual in the extent to which we have actively addressed them, however. For example, I recently spent three days presenting and discussing with senior figures in the White House, Vice President's office, State Department, and Pentagon the study group's memorandum on how to reconcile a U.S.-Russia policy with a U.S. policy toward Russia's neighbors. I and other members of the project's steering committee have been holding similar discussions with administration leaders, as well as the leadership of the Senate Foreign Relations Committee and the House Foreign Affairs Committee, since well before the elections in November 2008. We have also reached out to the engaged public by hosting sessions in Chicago, Los Angeles, San Francisco, Houston, Seattle, and Atlanta for world affairs councils and others interested in U.S.-Russia relations.

On January 29, 2010, we will hold a meeting at the Academy titled "The Policy World Meets Academia: Designing U.S. Policy Toward Russia." We will look at how the work being done in university social science and political science departments can be made more accessible and relevant to the policy community.

Those of us on the steering committee of the U.S. Policy Toward Russia project hope that the project will serve a larger need as well as the Academy has served the project. ■

© 2010 by Robert H. Legvold

### The Challenge of Mass Incarceration in America



#### Bruce Western

Bruce Western is Professor of Sociology and Director of the Program on Inequality and Social Policy at Harvard University. He was elected a Fellow of the American Academy of Arts and Sciences in 2007.

The Academy's work on The Challenge of Mass Incarceration in America involves researchers with backgrounds in criminology, economics, policy analysis, demography, law, sociology, and political science and practitioners, including two heads of correctional agencies, prisoner reentry specialists, and policy reform advocates. We have two main goals. One is to contribute to the public conversation about crime and criminal justice in America. To that end, and with the great support of the Academy, we are in the process of preparing a special issue of *Dædalus* that will summarize a lot of recent research on the problems of crime and criminal justice in America. The second goal is to engage policy-makers and the policy process in a more pluralistic debate by providing a forum for studying and discussing policy alternatives at a time when the public discussion of criminal justice has drifted in a highly punitive direction.

On an average day in the United States, 686 out of every 100,000 residents, or about 0.7 percent of the population, are incarcerated (based on 2001 figures; see Figure 1). For most of the Western European countries, the incarceration rate is about 100 per 100,000,



Figure 1

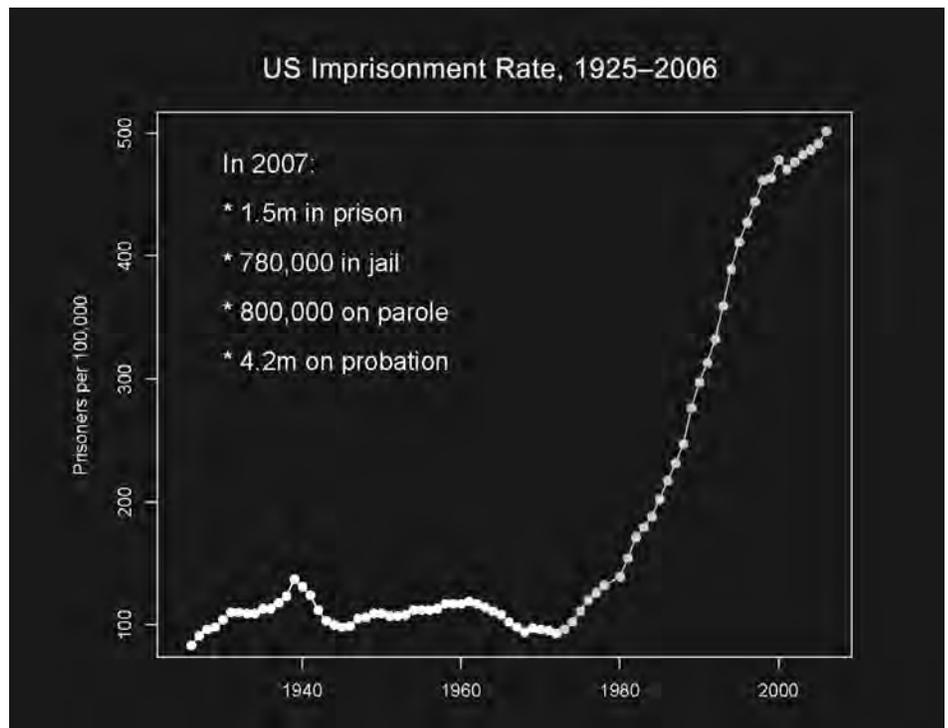


Figure 2

or about 0.1 percent of the population. The incarceration rate in the United States is nearly an order of magnitude larger than that in Western Europe. And the gap between the United States and Europe is even larger today, in 2009, than when these figures were collected in early 2000.

For most of the twentieth century, from 1925 to the early 1970s, the scale of the American penal system was roughly constant at about 100 state and federal prisoners per 100,000 population – the level we see in Europe today. In the mid-1970s, the system began to grow, and the rate of imprisonment has moved steadily upward for the last thirty years (see Figure 2). By 2007, 1.5 million people were in American prisons, another 780,000 were in local jails, and another

*The risk today that a thirty-to thirty-four-year-old African American man who has dropped out of high school will go to prison at some point in his life is almost 70 percent.*

800,000 were under some sort of community supervision on parole. Finally, 4.2 million people were on probation. Thus, in the United States today more than 7 million people are under some kind of criminal justice supervision, a historically novel situation for our country. We are the world leader in criminal justice supervision.

As striking as these figures are, however, I tend to think they are not what is most important about the criminal justice system in the United States at the moment. Instead, the system’s most significant feature is its distribution across the population. The risk today that a thirty- to thirty-four-year-old African American man who has dropped out of high school will go to prison at some point in his life is almost 70 percent (see

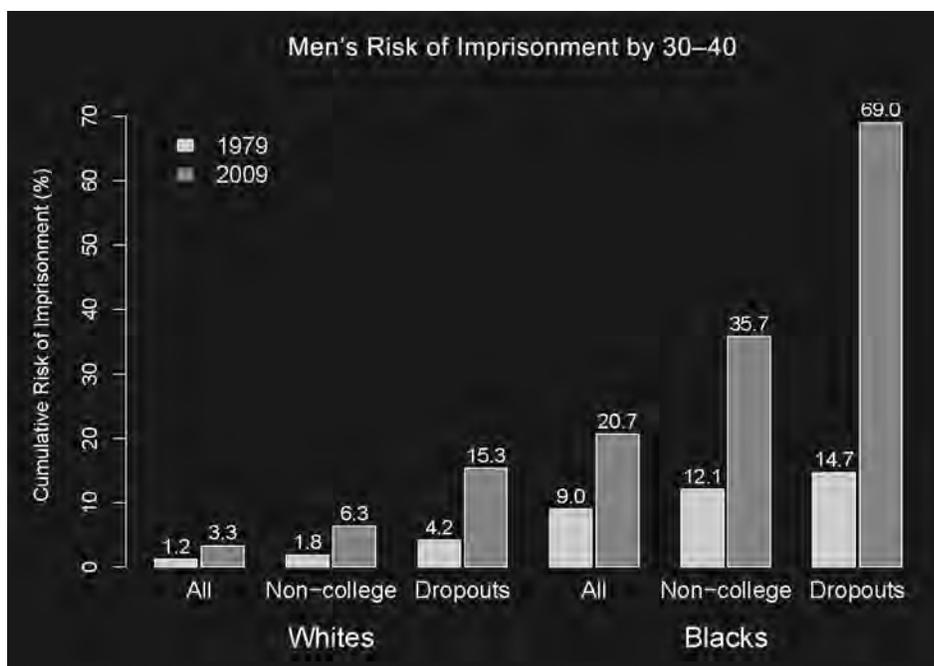


Figure 3

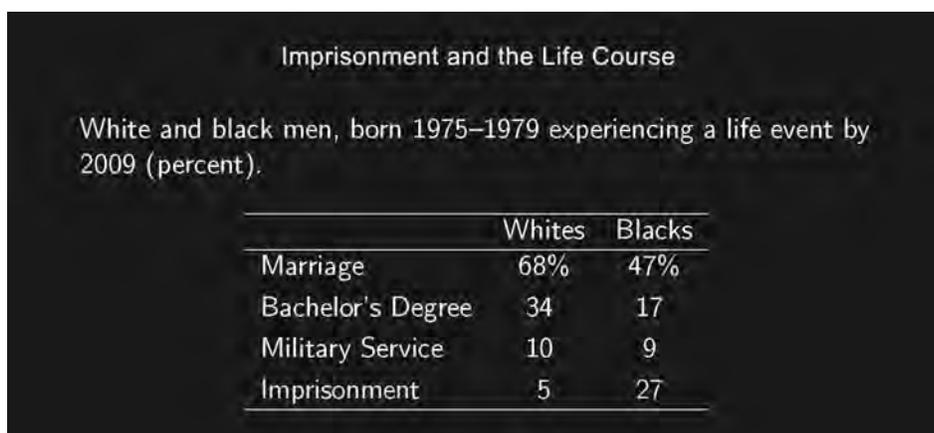


Figure 4

Figure 3). The risk in 1979 was about 15 percent. Incarceration has become a normal life event for many low-education African American men and is a more common life event than graduating college or serving in the military for all black men born between 1975 and 1979 (see Figure 4). This is a situation with which we have to come to grips in the policy debate. The arrival of the Obama administration has created a sense of political and policy opportunity, and, indeed, a variety of reform discussions are taking

place both within Congress and the administration. Those of us involved in the Academy’s incarceration work are hopeful of engaging the major parties in these discussions and of expanding the public understanding of the issue of mass incarceration. ■

© 2010 by Bruce Western

### The Challenge of Mass Incarceration in America



#### Glenn Loury

Glenn Loury is Merton P. Stoltz Professor of the Social Sciences and Professor of Economics at Brown University. He was elected a Fellow of the American Academy of Arts and Sciences in 2000.

The proper role for the social scientist in discussions of policy is not self-evident, because the most challenging policy problems are not merely technical. To rightly decide how we govern ourselves, we have to confront questions of ethics and values. Moreover, policy talk is not merely instrumental; it's also expressive and constitutive. By constitutive, I mean a public discourse that asks and answers the question, what manner of people are we Americans? Policy talk promotes or retards the framing of key moral judgment by the citizenry and sets an agenda for action. Among the most prominent moral challenges of our time is the fact that incarceration on a massive scale has become the central component of social policy in the United States. The prison system in America has grown into a leviathan unmatched in human history. An unprecedented expansion and transformation of penal institutions has occurred since 1970.

These developments ought to trouble deeply anyone who professes to love liberty. Here we are, after all, with great armies on the march under a figurative banner that reads freedom, and yet the United States is home to the largest custodial infrastructure for the mass depredation of liberty to be found on the planet. What is more, the demographic composition of prisoners in the

United States is highly skewed. Blacks and Hispanics form about one-quarter of the population in the country and about two-thirds of the people behind bars on any given day. The element of race is crucial here. It's true that slavery ended a long time ago, but it's also true that the ideology of racial subordination that accompanied the institution of African slavery cast a long shadow. These distant events and ideas are not unrelated to the current situation, either as a matter of historical causation, what with the structure of our cities, for instance, and their massive racial ghettos being implicated in the production of deviancy among the people living therein; or as a matter of ethical evaluation, what with the decency of our institutions being dependent on the extent to which they comport with the national

*Among the most prominent moral challenges of our time is the fact that incarceration on a massive scale has become the central component of social policy in the United States. The prison system in America has grown into a leviathan unmatched in human history.*

narrative of purpose that involves acknowledging and acting to limit and to reverse the consequences of our history. Indeed, I see the rise of mass imprisonment as opening a new front in the historic struggle for racial justice, and I make no apology about linking the notions of race and social justice. One provocative claim is that the racial disparity in our punishment policy reflects both explicit and tacit racism. That is, the emergence of this punishment infrastructure has garnered public support sometimes because of and at other times despite its disproportionately adverse impact on blacks. In any case, the management of social dys-

function via imprisonment has become a principal instrument through which racial hierarchy is reproduced in our society. What does this state of affairs say about our purportedly open and democratic society? What manner of people does our incarceration policy reveal us to be?

The core of the problem is that the socially marginal are not seen as belonging to the same general public body as the rest of us. It becomes possible, therefore, to do just about anything with them. Our political community acts as though some of us are different from the rest because of culture, bad values, self-destructive behavior, malfeasance, criminality, and lack of responsibility. The implication is that these others deserve their fate. However, this posture is inconsistent with the attainment of a just distribution of benefits and burdens in society. The racial disparity of punishment in America should not be seen as an accidental accretion of neutral state action applied to a racially divergent social flow. Properly viewed, it is seen as a residual effect of our history of enslavement, disenfranchisement, segregation, and discrimination and is, therefore, an abhorrent expression of who we Americans have become as a people at the dawn of the twenty-first century.

I realize that I have just stated an opinion and that however defensible I believe it to be, it is still an opinion. As social scientists who would address ourselves to policy, we cannot avoid drawing conclusions such as this, or the opposite, and then arguing forcefully for that position. Let me cut to the chase: My view is that a pure ethic of personal responsibility is an inadequate foundation for distributing the negative good that punishment has become in contemporary American society. I have set myself in this project the task of shifting the public discussion of this problem toward a great acknowledgment of social responsibility even for the wrongful acts freely chosen by individual persons. In pursuing this aim, I'm not so much making a root causes argument – he did the crime but only because he had no choice – as I'm arguing that the society at large is implicated in such choices because we have acquiesced in structural arrangements working to the

benefit of some and to the detriment of others and which shape the consciousness of offenders and their sense of identity in such a way that the choices they make, which we may condemn, are nevertheless compelling to them. This task I've set is a problem of moral philosophy, and I'm a social scientist. Thus, I approach this philosophical problem by emphasizing models of social inequality in which closed and bounded social structures such as the racially homogenous urban ghettos that we find in our cities create contexts where pathological and dysfunctional cultural reforms emerge and yet are not intrinsic to the people caught in these structures, nor are they independent of the behavior of those of us who stand outside. ■

© 2010 by Glenn Loury

## The Independence of the Judiciary



### Robert C. Post

*Robert C. Post is Dean and Sol and Lillian Goldman Professor of Law at Yale Law School. He was elected a Fellow of the American Academy of Arts and Sciences in 1993 and serves as Librarian of the Academy.*

The Independence of the Judiciary project of the Academy began about fifteen years ago, when the Supreme Court of the United States decided for the first time since the 1930s that the national government lacked power to enact certain forms of legislation. It is one thing for the Court to announce that national legislation violates rights, say First Amendment rights; it is quite another to conclude that the national government does not have power to pass legislation adequate to address national needs.

In response to decisions of this kind, the Academy brought together Supreme Court Justices, the majority of whom, by the way, are members of the Academy; members of the congressional judiciary committees; and scholars who were political scientists, legal academics, historians, and so on. We convened a series of off-the-record meetings to discuss and, we hoped, somewhat to defuse the potential crisis between Congress and the Court. In taking these steps, the Academy exemplified its distinctive role as a disinterested broker who can summon expertise from a variety of sources to affect the development of public policy.

In the early twenty-first century, the Academy's project developed into one that focused on the independence of the judiciary, in

particular on the autonomy of state court judges. Eighty-five percent of all state court judges in this country have to face election, either a competitive election or a retention election, and much evidence suggests that these elections are becoming increasingly expensive and increasingly politicized. They feature fund-raising, political advertisements, large expenditures, and so forth. At one of the meetings we convened to discuss this issue, Bert Brandenburg, the executive director of an organization called Justice at Stake, calculated that since 1999 state supreme court justices have raised in excess of \$150 million for their election campaigns. Often this money comes from the very people who appear before them in court. In its last term the U.S. Supreme Court decided a case out of West Virginia that addressed precisely this issue. A. T. Massey Coal Co. was found liable for \$50 million by a jury for fraudulent misrepresentation,

*The idea that judicial independence must include freedom to err is a complicated one, and it suggests the difficulty in explicating what judicial independence might mean. Getting that question right is at the core of the Academy's initiative on the judiciary.*

concealment, and tortious interference with existing contractual relations. The company subsequently donated about \$3 million to a candidate who was running for a position on the Supreme Court of Appeals of West Virginia. The candidate was elected and miraculously proved to be the third vote in a three to two decision that reversed and set aside the jury's verdict. The case then went to the Supreme Court, which by a vote of five to four held the reversal to be a violation of due process (*Caperton v. A. T. Massey Coal, Co.*, 129 S. Ct. 2252 [2009]).

It is striking that the vote was five to four; yet the conflict of interest is obvious. Such conflicts are bound to multiply as judicial elections become increasingly politicized. Consider that 95 percent of all legal proceedings in the United States occur in the state courts.

The funding of judicial elections is an issue of huge significance and one that helps to generate growing mistrust of state courts. A national organization called Jail for Judges takes the position that if a state court judge gets a decision wrong, the injured party should be able to sue for personal damages, and if the judge gets a decision very wrong, he or she should be indicted and sent to jail. The proposals of Jail for Judges actually got on the ballot in South Dakota; these proposals were defeated, but similar efforts are proliferating throughout the states.

Many years ago I was in China lecturing on the rule of law and on the necessity of an independent judiciary. I asked an appellate court judge about how he regarded a trial court judge who had issued a mistaken judgment. He responded that judicial errors are wrongful conduct that deserves punishment. Nothing could more deeply compromise judicial independence, as the Jail for Judges initiative demonstrates. Yet the idea that judicial independence must include freedom to err is a complicated one, and it suggests the difficulty in explicating what judicial independence might mean. Getting that question right is at the core of the Academy's initiative on the judiciary.

At one meeting that we convened on this subject, former Supreme Court Justice Sandra Day O'Connor observed that "The breadth and intensity of rage currently being leveled at the judiciary may be unmatched in American history." Our project is about that rage: its sources and its amelioration. We have convened scholars, public officials, and state and federal court judges in an effort to discuss the problem and imagine solutions. Some of the results of these studies are published in the Fall

2008 issue of *Dædalus*. The issue contains papers prepared by former Supreme Court Justice Sandra Day O'Connor, Supreme Court Justice Stephen Breyer, Senator Charles Schumer, Chief Justice of the Massachusetts Supreme Judicial Court Margaret Marshall, Yale Law Professor Judith Resnik, and two jurists we are proud to induct as Fellows of the Academy today, J. Harvie Wilkinson III of the United States Court of Appeals for the Fourth Circuit and Ronald George, Chief Justice of California. ■

---

© 2010 by Robert C. Post

## Initiative for Humanities and Culture



### Patricia Meyer Spacks

*Patricia Meyer Spacks is Edgar F. Shannon Professor of English Emerita at the University of Virginia. She was elected a Fellow of the American Academy of Arts and Sciences in 1994 and served as the Academy's President from 2001 to 2006. She is Chair of the Visiting Scholars Program at the Academy.*

Supporting the humanities has long been a central activity in the Academy. The urgency of this activity is becoming increasingly clear, and one thing making it clear is the Humanities Indicators project. Eight or nine years ago, a group of leaders in the academic humanities agreed about the importance of collecting data as an essential foundation for cogent discussion of the humanities. We needed something, we decided, like the biennial *Science and Engineering Indicators* that provide statistics on everything from the number of majors in scientific fields to the salaries paid to academics who profess these fields. Moreover, we needed to amass information on a continuing basis. This would cost a staggering amount of money, which the Academy didn't have.

We subsequently discovered that a lot of data already existed. Government agencies, educational organizations, and learned societies all gather statistics, but the information they provide has been nearly useless for getting the big picture. That's because different organizations employ different definitions, different modes of gathering data, different ways of calculating, and different classifications. The first step to using these data was to make them compatible, a task more modest than that of collecting

data but a large one nonetheless. Norman Bradburn, a distinguished social psychologist currently based at the National Opinion Research Council, assumed responsibility for organizing and presenting the Indicators under five large categories: primary and secondary education; undergraduate and graduate education (including data on the jobs pipeline, or the road to gainful employment, which proved particularly depressing); humanities research and funding; the humanities workforce (meaning the workforce outside academia); and the humanities in American life (meaning life outside the academy).

*Statistics show that in 2003 and 2004, 26.5 percent of students taking history in public high schools were taught by someone who not only lacked certification in the subject but had not even majored in it in college.*

A preliminary version of the Indicators became available to the public in January 2009 and can be found online at [www.HumanitiesIndicators.org](http://www.HumanitiesIndicators.org). Although in some respects the Indicators revealed what many already knew, in other ways the results were unexpectedly alarming. For example, in 1967 the average verbal score on the SAT exceeded the math score by almost 30 points. By 2007, after dropping more than 40 points since 1967, the mean verbal score was 13 points lower than the math score. In other words, students on average now know slightly more about math than they did 40 years ago, but they have much less capacity to control language, a fundamental skill necessary to almost all occupations. The students' elders have similar difficulties. In the mid-1990s, 22 percent of adults in the United States were highly prose literate, meaning they had the knowledge and skills necessary to understand and use information from text. By 2003, the proportion had dropped to 12.8 percent, the largest decline experienced by any nation participating in

the relevant survey. Meanwhile, the number of those with weak literacy skills, meaning they could read but couldn't make sense of what they were reading, grew by 7.5 percent.

High school teachers aren't doing too well either. The shortage of qualified teachers of science and math is well known, but the problem is actually worse in some areas of the humanities. Statistics show that in 2003 and 2004, 26.5 percent of students taking history in public high schools were taught by someone who not only lacked certification in the subject but had not even majored in it in college. This proportion was considerably higher than for any other subject. Despite all the publicity about underprepared science and math teachers, the corresponding rates for math and for the natural sciences were 12.1 percent and 5.2 percent, respectively.

Knowing such facts is a necessary first step in doing something about them. An updated version of the Indicators is currently in progress, and we hope that some federal agency will assume the expensive task of preserving and enlarging the data in coming years.

A more cheerful perspective on the humanities emerges in the Winter 2009 issue of *Dædalus* entitled "Reflecting on the Humanities." This collection of essays provides a kind of sequel to the volume published under the auspices of the Mellon Foundation in 1997, *What's Happened to the Humanities?* Contributors to the *Dædalus* volume include the head of a major foundation, a nonacademic philanthropist who has generously supported the humanities, a university president, a former college president, several distinguished academics, a provost, and the director of a humanities center. They write about matters ranging from the digital humanities to recent trends in funding. Several of them make deductive use of information from the Indicators. They consider the humanities and social change, the future of the so-called public humanities, and the role of the humanities in liberal arts colleges, as well as disciplinary questions. They both assert and demonstrate the vitality of the humanities. I hope you will have a look. ■

© 2010 by Patricia Meyer Spacks

## Educating the World's Children



### David E. Bloom

*David E. Bloom is Chair of the Department of Global Health and Population and Clarence James Gamble Professor of Economics and Demography at the Harvard School of Public Health. He was elected a Fellow of the American Academy of Arts and Sciences in 2005.*

U BASE is a long-standing Academy effort in the global education arena. The acronym stands for Universal Basic and Secondary Education. The project is an ambitious undertaking focused on identifying the rationale, consequences, and means for getting every child in the world age five to sixteen a quality education.

The jumping-off point for the project is the observation that basic and secondary education are in a perilous state in much of the developing world. This is hardly a novel observation. For example, in 1990, delegates from 155 countries met in Jomtien, Thailand, and pledged to achieve universal primary education by the year 2000. They were motivated by the fact that nearly a billion adults were illiterate and that 100 million children of primary school age were not enrolled in primary school. They were also motivated by the severe gender gap in primary school enrollment in many countries.

In the decade following that meeting, respectable educational advances were made, but it was absolutely clear by the year 2000 that the goal of universal primary education was nowhere close to being achieved. So the international community took a page out of an academic playbook and graciously grant-

## Projects and Studies Update

ed itself a no-cost extension. That extension took the form of the Millennium Development Goals, in which world leaders pledged to achieve universal primary education by 2015. We're now in striking distance of the 2015 deadline, and we see a picture that appears simultaneously good, bad, and ugly.

The good news is that the world has made significant progress over the past decade. Primary school enrollments have continued to increase throughout the world, and gender disparities, particularly in primary enrollment, have decreased substantially.

*The UBASE project is an ambitious undertaking focused on identifying the rationale, consequences, and means for getting every child in the world age five to sixteen a quality education.*

The bad news is that large numbers of children are still not enrolled in school, and we are not on a promising trajectory for meeting the 2015 goal. Even if enrollment rates continue to grow at the pace they did between 1999 and 2008, an estimated 49 million primary school-age children will not be enrolled in school in 2015. That represents 7 percent of the world's primary school-age children. And there is further bad news: The shortfall with respect to secondary education remains especially striking, despite growing recognition of the economic, social, and political importance of secondary school. We project that 191 million, or more than one-quarter of the world's children of secondary school-age, will not be enrolled in secondary school in 2015. What's more, these figures do not address the issue of quality. That's because enrollment does not necessarily mean attendance, attendance does not necessarily mean receiving an education, and receiving an education does not necessarily mean receiving a good education. Some 75 percent of the world's children live in countries where the quality of education lags behind

– most often far behind – the average of industrial countries, as measured by standardized test scores. Although that standard may not be universally appropriate, the fact that educational quality is often quite poor is uncontested.

Finally, we have the ugly news, which is what we see when we juxtapose the good and the bad. I am referring here to disparities in both educational access and educational quality between the wealthy industrial countries at one extreme and low-income countries at the other. I am also referring to disparities within countries, especially those between girls and boys, rural and urban areas, and racial and ethnic groups. Disparity also shows up in things like expenditures per pupil, teacher qualifications, teacher absenteeism, infrastructure, and curriculum quality.

The UBASE project was initiated by the Academy in 2001 and has aimed to understand the current lay of the land in global education and to think constructively about what it would take to bring about significant improvements. I have been working on this project with Academy Fellow Joel Cohen, who has a base at both Rockefeller University and Columbia University. Over the years, Joel and I have benefited from the unflagging encouragement and support of Leslie Berlowitz, and we have had outstanding assistance from various Academy staff. The project has received financial support from the Academy, the William and Flora Hewlett Foundation, and a number of generous individuals. From the start, our focus has been not on advocacy but on taking careful and critical stock of what we already know and what we still need to know and blending these with as much fresh and out-of-the-box thinking as possible.

We got started by dividing our task into reasonably manageable components, and we recruited experts to lead research efforts in a number of areas. We surrounded these experts with working groups that included people from a wide range of geographic, institutional, and professional backgrounds who could review and comment on the work.

The project's components have included the nature and information content of education data; the history of efforts to achieve

*What are the contours of the global education problem? Why does it matter? And what do we do about it?*

universal education; the likely consequences of achieving UBASE; the meaning and measurement of educational quality; the politics of achieving UBASE; and the costs of achieving UBASE. With respect to cost, estimates made by Paul Glewwe, Meng Zhao, and Melissa Binder suggest an upper limit of an additional \$70 billion per year for all children to receive a decent primary and secondary education. At one level, this seems like a rather modest sum: It is less than one-ninth of the U.S. government's annual military budget, and it is less than one-fourth of the foreign aid goal of 0.7 percent of the \$43 trillion of gross national income of the developed countries. On the other hand, it's a formidable amount because foreign aid is substantially below the 0.7 percent target, especially in the United States.

The Academy has been an ideal home for this project. It has enhanced our capacity to convene outstanding working groups – with representation from across disciplines, professions, and countries; it has provided neutral territory for discussion and an integrity and independence that add to the gravity of what we produce; and it makes for a great meeting venue.

Our work to date has come to fruition partly in the form of two books. The first of these is *Educating All Children: A Global Agenda*, which I coedited with Joel Cohen and Martin Malin and which was published by MIT Press in 2006. The book lays out the justification for UBASE: the moral, ethical, and humanitarian justification, the international law justification, the social justification, the political justification, and the economic justification. The book argues that UBASE is, in general terms, not impossibly out of reach. The second book is *International Perspectives on the Goals of Universal Basic and Secondary Education*, edited by Joel Cohen and Martin Malin. Due to be published this year by Routledge, this book consists of a series of essays that explore the goals of

---

education, in particular the economic goals, the political and civic goals, and the personal goals.

We are now endeavoring to synthesize for education leaders, policy-makers, business leaders, and the attentive public the main messages that have emerged from the project thus far. We have assembled an international blue-ribbon advisory committee that is preparing a white paper tentatively titled “Educate,” containing a highly accessible summary of our conclusions to date. A key objective is to promote deeper engagement of U.S. policy-makers in the idea of UBASE. This short report will address bottom-line questions such as “What? So what? And now what?” – that is, what are the contours of the global education problem? Why does it matter? And what do we do about it?

After “Educate” is published, we plan to develop this project further by starting work on a blueprint for achieving universal basic and secondary education. To do this, we will delve into the challenge of implementation, which we see as a matter of design, leadership, management, coordination, and funding. In the process, we will seek to identify successful schooling models from around the world and to pay special attention to what about them is idiosyncratic and what is portable from one setting to another. We hope to rely on many of our new Academy Fellows for help with this next phase of UBASE. ■

---

© 2010 by David E. Bloom

## Challenges to Business in the Twenty-First Century: The Way Forward



### Gerald Rosenfeld

*Gerald Rosenfeld is Deputy Chairman of Rothschild North America. He was elected a Fellow of the American Academy of Arts and Sciences in 2004 and serves as a member of the Academy Trust.*

I am the anecdotal piece of evidence that gets translated into data at the American Academy, proof that you don't have to be a tenured professor at a university to contribute to and be part of a study. I say to my colleagues from the world of business and

*The current crisis has given us an opportunity to think about ways we might extend our earlier study of the relationship of business to society.*

commerce that the Academy offers many interesting studies and projects on which to work. One of the words in the Academy's founding documents is *commerce*, and we spend a lot of time thinking in particular about the relationship of business to the rest of society, to the other professions, and so forth.

The project on Challenges to Business in the Twenty-First Century started in the aftermath of the so-called corporate scandals of the early part of this decade: Enron et al. A group of Academy Fellows, business

practitioners, and academics came together to try to understand how those in the gatekeeper professions – lawyers, financial advisors, investment bankers, regulators, auditors, corporate directors – contributed to the scandals. We held a series of panels and dialogues and commissioned a number of essays, which we published in a 2005 volume bearing the aspirational title *Restoring Trust in American Business*. I'm not sure how well we've done in meeting that goal.

The book received a lot of publicity at the time it was published, and a number of schools adopted chapters from it as part of their curriculum, particularly in courses on professional responsibility. I initiated a professional responsibility course at NYU five years ago that is taught to law students and business students simultaneously and allows both groups to satisfy their school's respective professional responsibility requirements and to engage in dialogue with another part of the professional training branch. I begin the course by saying that lawyers have a book that tells them how to behave, the Model Rules of Professional Conduct, and businesspeople have “Gee, I hope I don't get arrested tomorrow.” Somewhere between the Model Rules of Professional Conduct and “Gee, I hope I don't get arrested tomorrow” is a commonality of behaviors that we explore in the class using, among other sources, information from *Restoring Trust in American Business*.

For the past year or two we have been working to extend the work that culminated in the 2005 volume. Fortunately for us, a crisis comes along regularly. We get about one fifty-year storm every three or four years these days. The most recent example is known variously as the Financial Crisis, the Great Recession, and so on. Whatever capitalized term you want to apply to it, the current crisis has given us an opportunity to think about ways we might extend our earlier study of the relationship of business to society. Rakesh Khurana, Jay Lorsch, and I are working on this, and the Academy will convene a symposium on the topic in late November 2009 in collaboration with the Pollack Center for Law & Business at New York University. ■

---

© 2010 by Gerald Rosenfeld

### Challenges to Business in the Twenty-First Century: The Way Forward



#### Rakesh Khurana

Rakesh Khurana is Marvin Bower Professor of Leadership Development at Harvard Business School.

Over the past year, the United States has engaged in a continual multibillion-dollar payout, a taxpayer-financed bailout of the financial industry, ranging from banks to insurance companies. The U.S. government is now also the controlling shareholder of the largest industrial concern in the world, General Motors, and many economists are predicting that we will see record levels of postwar unemployment.

Trust in business as an institution is now the lowest in any of the recorded surveys. In fact, business leaders are now seen as less trustworthy than Washington politicians, which is quite an accomplishment. Our economic unraveling has unmasked numerous contradictions and challenges confronting global capitalism. We hope to discuss three of these at our upcoming symposium. First, economic activity and the political process were once largely conducted within the same geographical area and therefore could balance each other. Production took place predominantly within national boundaries, and capital flows were limited and controlled through international agreements so that the politics of nation-states could still determine the priorities of

the economy and to some degree govern its performance. Today the economic crisis reveals the role of public authorities directly involved in correcting errors and malfunctions in the so-called free market/global market economy. The importance of national governments working together across the globe to prevent future crises highlights the fact that we need to think about new forms of global governance that can more effectively manage the global economy.

In the course of the discussions we have held to date, the notion of how we get back to the status ex ante was frequently raised. However, what ultimately has emerged is a realization that we can't return to the status ex ante. We have to recognize that globalization and the direction of global capitalism have created enormous inequalities that have contributed to increased social instability. World Bank data now reveal that for over two decades, as the world's wealth grew in absolute terms, inequalities increased and are now at levels that have not been measured since the 1920s. One need only look around our own country to see that even prior to the economic crisis millions of our fellow citizens were experiencing dramatic declines in their standard of living and future economic prospects.

*Trust in business as an institution is now the lowest in any of the recorded surveys. In fact, business leaders are now seen as less trustworthy than Washington politicians.*

A second issue we will be discussing at our upcoming symposium is CEO compensation. In 2007, the CEO of the median Standard and Poor's 500 company made approximately \$7.6 million. To put this in perspective: in 1960, the ratio of average CEO pay to the salary of the president of the United States was about 2 to 1. Today the ratio is about 20 to 1. If average pay for factory

workers had risen as fast as CEO pay, it would be about \$120,000 this year instead of \$24,000. If the minimum wage had risen as fast, it would be about \$24.30 per hour rather than \$7.25. In 1980, the ratio of CEO pay to the average worker's pay was about 42 to 1. By 1999, it had gone to 475 to 1, and it peaked in 2000 at about 530 to 1, settling at about 300 to 1 last year. These ratios are for the United States. In the United Kingdom the ratio is about 25 to 1; in France, 16 to 1; in Germany, 11 to 1; and in Japan, 10 to 1. So the United States leads the world not only in incarceration rates but in executive compensation. That some of these things are linked is increasingly being recognized.

A third area we hope to examine at our symposium falls within the realm of technology and the economy, particularly the business media. To imagine the current economy without the pervasive presence of the continuous information cycle is almost impossible. Given the media's fundamental importance in both reflecting and engineering changes in perception, we have to reflect carefully on its influence, especially in regard to how economic imperatives can clash with our ethical imperatives for serving a well-informed citizenry. Just because social communication can increase the possibilities of interconnections and dissemination of ideas, it does not follow that communication necessarily promotes freedom, fair economic development, or rational and reasoned discourse.

Our symposium will take place in a unique historical moment. We have an opportunity to reflect more deeply on the meaning of the economy and its goals. We hope to begin a conversation that will expand and contribute to a larger discourse and will take a more farsighted view of the model of global capitalism than the one that has brought us to our present condition. ■

---

© 2010 by Rakesh Khurana

# Academy Meetings



Image © Randy Faris/Corbis

## What Is Missing in Medical Thinking

Jerome E. Groopman

This presentation was given at the 1943rd Stated Meeting, held at the House of the Academy on May 13, 2009.



### Jerome E. Groopman

Jerome E. Groopman is Dina and Raphael Recanati Chair of Medicine at Harvard Medical School; Chief of Experimental Medicine at Beth Israel Deaconess Medical Center; and Staff Writer at “The New Yorker.” He has been a Fellow of the American Academy since 2008.

### Presentation

About three years ago I was the attending physician in general internal medicine at the Beth Israel Deaconess Medical Center. I would round with Harvard medical students and the interns and residents, seeing all types of patients, not just those with the illnesses that I specialized in (blood diseases, cancer, and AIDS). I would see people with pneumonia, diabetes, and some whose problems were not clear but who were ill enough to be in the hospital. After a few weeks, I found myself unsettled. Here were all of these bright, motivated, and usually affable young men and women – Harvard medical students and Harvard house staff – but somehow they were not thinking deeply or broadly about the patients under our care. At first I held myself back. I thought, uh-oh, I’m gray and bald-

ing, and I’m starting to think that when I was a house officer thirty-three years ago the training was really rigorous, and we did it right; but this new generation. . . .

*The mistakes that lead to delayed or never-made diagnoses are thinking mistakes.*

I stopped myself because I realized that to teach these young doctors to think better I had to know how I thought as a physician. And I realized that despite all my training at prestigious institutions no one had ever really taught me to think; and at times (many times) I did not think deeply or broadly. The question was why.

So I spoke with various colleagues, men and women whom I knew in medicine and respected for their clinical acumen. I asked them, “How do you think?”

They said, “What are you talking about? I think.”

I said, “No, *how* do you think?”

“I don’t know how I think, I just think.”

So I said, okay, this is a problem. If I am going to be a more effective teacher – frankly, if I am going to improve my own abilities as a physician – I need to know how doctors think. I need to know why we as physicians get it right and what accounts for the times when we get it wrong, particularly when we misdiagnose.

*If I am going to be a more effective teacher – if I am going to improve my own abilities as a physician – I need to know how doctors think.*

About ten years ago the Institute of Medicine came out with a report about medical mistakes called *To Err Is Human*.<sup>1</sup> Unfortunately, the report includes almost nothing about diagnosis and thinking. Instead, this important document focuses on systems and procedures and looks at the hospital essentially as a large factory, trying to pinpoint where on the assembly line workers screw up.

Most of the report is concerned with safety issues. It details shocking levels of sloppiness – for example, poor hand washing, which obviously can lead to the spread of infections – and the familiar headline-grabbing errors: the neurosurgeon who operated on the wrong side of the brain; an orthopedist amputating the wrong limb. These kinds of medical mistakes are jarring and

great fodder for critics, and they shouldn’t happen. Fortunately, they are rare – really rare – and systems have been instituted to help prevent them.

Recently I injured my arm and required surgery. When I went to have my arm put back together, I was given a bracelet, and I had to say my name three times. At first I was worried they thought I was demented.

“You are sure you’re Jerome Groopman?”

“Yes, I am sure I’m Jerome Groopman.”

Then they marked my hand to indicate which arm was to be fixed.

This and the other steps are all important in preventing systems errors. Unfortunately, systems errors of the type focused on by the Institute of Medicine don’t explain why 15 – 20 percent of all patients are misdiagnosed. The mistakes that lead to delayed or never-made diagnoses are thinking mistakes.

Incidentally, getting to the data on misdiagnosis is not easy. The data are hidden and take a while to find. Researchers have performed chart reviews, autopsy studies, and run simulations where “actor-patients” are asked to visit established physicians and mimic an illness and a history. About 80 – 85 percent of the time, doctors get it right. If you are a baseball player and you are batting .800 or .850, that’s unimaginable, right? Or if you manage your university’s endowment and made the right stock picks 80 – 85 percent of the time, you would be a genius, right? But in medicine a 15 – 20 percent rate of delayed or never-made diagnoses is simply too high.

So, how does a doctor think? We work under tremendous time pressure, and we work under conditions of uncertainty with limited data at hand. We are also doing what Donald Schön at MIT has called “thought-in-action.”<sup>2</sup> We are thinking while we are

*Physicians anchor all the time. They take the first bit of data the patient gives them about what’s wrong, and they run with it. The time pressures of modern medicine only exacerbate the problem.*

doing, so we’re not like an economist who sits quietly in his cozy office looking at a data set and analyzing everything from beginning to end in a linear, systematic way. Our minds work like magnets. We pull in information and cues from every direction. From the moment someone walks in and says hello, our eyes are performing a physical exam. From the patient’s first response to our initial question (What brought you here today? What’s wrong?), we are getting data and integrating them. The data increase as we do a physical exam and look at the patient’s labs, X-ray studies, and so on.

Amos Tversky and Daniel Kahneman were pioneers in cognitive science when they were at Hebrew University in Israel, where they studied thinking under conditions of uncertainty and time pressure. Tversky died an untimely death as a young man. Kahneman won the Nobel Prize in economics and is currently at Princeton. Together they defined using experimental paradigms for certain biases that many people argue are wired into the human brain. I believe their work explains much of the genesis of misdiagnosis.

Tversky and Kahneman performed a series of experiments to identify the shortcuts and mistakes that people make. For example, they showed one group of students – not math majors – a series of numbers that were to be multiplied. One times two times three times four, all the way to eight. They quickly showed the numbers on a screen and then told the group to estimate the product of multiplying all the numbers.

The group put down on their papers something like 500.

---

<sup>1</sup>Institute of Medicine, *To Err Is Human: Building a Safer Health System*, ed. Linda T. Kohn, Janet M. Corrigan, and Molla S. Donaldson (Washington, D.C.: National Academy Press, 1999).

<sup>2</sup>Donald A. Schön, “From Technical Rationality to Reflection-in-Action,” in *Professional Judgment: A Reader in Clinical Decision Making*, ed. Jack Dowie and Arthur Elstein (Cambridge, U.K.: Cambridge University Press, 1988). Schön’s essay was originally published in Schön, *The Reflective Practitioner* (New York: Basic Books, 1983).

A second group with a similar composition – bright students but no math majors – was shown the same series of numbers in reverse: eight times seven times six times five, down to one.

The second group put down something like 2,200 as their estimate.

Both estimates are wrong, but the difference between them is nearly fivefold. Tversky and Kahneman defined what's called "anchoring" based on this type of experiment. Anchoring turns out to be more powerful, and more insidious, than this simple experiment with students would suggest. Our judgments – say, of whether a series of numbers multiplies to the hundreds of thousands or to the millions – are biased by the initial data we encounter, whether it is eight times seven times six, which is 336, or one times two times three, which is six.

*I believe the time has come to incorporate cognitive science into the education of medical students and physicians. We need to know how we think and why we often, too often, think incorrectly.*

When he was at MIT, Dan Ariely, realizing that he was dealing with math majors who would immediately know the formula for multiplying a series, invited a group of MIT undergraduates to play a game about auctioning automobiles. He told them to put, for identification purposes, the last two digits of their Social Security Number in the right-hand corner of their paper and then to forget about it. Everyone jotted down the last two digits of his or her Social Security Number – some had low digits (09 or 18), some had digits in the mid-range (45, 58), and some had high digits (88, 92). Ariely then showed three automobiles: a Chevette, which is a tin can; a Camry, which is a mid-level car; and a fancy, high-end Lexus. Ariely asked the students to imagine the cars were being sold at auction and to determine what they would be willing to bid for them.

He found that students with low final digits in their Social Security Number tended to put in lowball bids on every one of the cars. People with digits in the middle put in middle-range bids. And people with high digits overbid. Obviously, the last two digits of a Social Security Number have nothing to do with the price of a Chevette, Camry, or Lexus. But in Ariely's experiment, the mind anchors on those numbers. Even though the students are told to put the numbers to the side and even though rationally they know the numbers are irrelevant, they become biased.

Physicians anchor all the time. They take the first bit of data the patient gives them about what's wrong, and they run with it. The time pressures of modern medicine only exacerbate the problem. Many misdiagnoses are due to anchoring.

A second common mistake is the availability heuristic, also defined by Tversky and Kahneman, although mainly with regard to economics. Imagine that you go to a wedding with your spouse or significant other. You are sitting at the table with your Uncle Moe, who didn't go to college and is a schlub. Moe says, "I bought Google when it was \$83. I made so much money. I knew Google was a great company. I could tell they would do this, they would do that. And now it's trading at \$350."

On the drive home your significant other says, "I told you to buy Google, and you didn't listen. I told you, 'It's Google!' All these years you've been telling me Moe is a schlub and he doesn't know anything. He made a fortune. And look at us."

So, a month later someone says, "There's this new Internet company; it's unbelievable." You have Google on the brain, not to mention Uncle Moe. So when you analyze what this company does, what its prospects are, you superimpose the drama and success of Google on your decisions.

Dramatic or prevalent problems or cases are easily retrieved from memory. What is most available from the past becomes superimposed on the present. So, doctors who have seen a dramatic or unusual case are more prone to see the same dramatic or

*I strongly believe in the autonomy of the patient. It is the patient, the sick person, who either enjoys the benefits or suffers the consequences of decisions made about treatment.*

unusual problem elsewhere. Doctors in the middle of a flu epidemic will conclude that every patient they see has flu, even if those people don't have flu.

The last important error is related to attribution bias. We all have stereotypes in our mind. We see someone who's not shaved, has a stubbly beard, clothes don't look good, maybe there's a whiff of alcohol. Immediately we conclude he's a chronic alcoholic. In my book *How Doctors Think*,<sup>3</sup> I describe a woman I call Ellen Barnett, who saw five doctors while in the middle of menopause. She told them she was feeling explosions in her body.

Now, when it's 4:30 in the afternoon and you've seen fourteen patients, and some high-strung perimenopausal woman comes in and says, "I'm feeling explosions in my body, I have explosions in my body," you say, "It's menopause," right? You think, "Another high-strung woman with hot flashes." You attribute her problem to the stereotype, often pejorative, that you have in your mind.

After seeing five really good physicians, all of whom patted Ellen Barnett on the head and told her she was just having problems with menopause, she saw a sixth doctor, an endocrinologist. She said to the doctor, "You know, I am a little cuckoo, and I am having a really tough time with menopause, but I'm telling you I am feeling explosions in my body." This doctor did not make an attribution error. She didn't say, "Ugh. One more menopausal woman driving me crazy." She said, "Let's be counterfactual. Let's say

<sup>3</sup>Jerome Groopman, *How Doctors Think* (New York: Houghton Mifflin, 2007).

it's not menopause. What else could it be?" She thought and she listened. The sixth doctor discovered that Ellen Barnett had a pheochromocytoma, a tumor that produces adrenaline and can cause sky-high blood pressure, precipitating a stroke or heart attack – in short, a tumor that can be fatal. The doctor who didn't make the attribution error, who avoided the misdiagnosis, saved Ellen Barnett's life.

Medicine has been very effective at incorporating important scientific disciplines that were initially not part of its fabric; for example, molecular biology. In the 1970s when I was training, other people on campus were working on bacteria. But they didn't talk to doctors, and doctors didn't talk to them. Now DNA analysis is mainstream. So are high-performance computers, bioinformatics, and MRI scans. Medicine has incorporated all of this technology, some of it good, some of it with downsides. I believe the time has come to incorporate cognitive science into the education of medical students and physicians. We need to know how we think and why we often, too often, think incorrectly.

While on rounds I also noticed that the interns, residents, and medical students all would immediately glom onto the computer, use it to arrive at a diagnosis, and find the so-called guidelines for the diagnosis. These guidelines are basically algorithms or decision trees that have been put together by expert committees based on "best evidence" or "best practices." Some guidelines are designed to help prevent shameful levels of contamination; for example, guidelines on hand washing or how to place a central line. Others are meant to keep doctors from making avoidable errors – leaving surgical instruments in someone's abdomen or prescribing medications that interact in a toxic way. Still others deal with aspects of acute care; for example, giving an aspirin after a myocardial infarction.

The problem is that guidelines are now moving beyond where I believe their reach is best set. They are recommendations, but they are becoming rules. And they have real scientific and cultural limitations. The main scientific limitation is that all evidence

is imperfect. In the last few years the lay public has repeatedly seen medical dogma overturned:

- Estrogen replacement therapy for postmenopausal women. This was gospel for 40 years because the medical profession thought it prevented heart disease and dementia. Recent results from a much better designed, randomized controlled study indicate that this isn't the case.
- Glucose control for diabetes. For years the dogma in certain circles was that you had to tightly control blood sugar. In the last six months, however, important studies have been published, mainly in *The New England Journal of Medicine*, showing that you kill more people than you help by so tightly regulating blood sugar. So that might not be such a smart idea.
- Low-fat diets. Ten, twelve years ago, all the emphasis was on low-fat diets. And what resulted? An epidemic of obesity as lay people and doctors alike thought that carbohydrates were a good substitute.

### *My cognitive burden as a physician is to figure out how the various guidelines do or do not correspond to the individual sitting in front of me.*

So we are often not as smart as we think. The other problem with converting recommendations – or reference points (guidelines are important reference points) – into rules has to do with the very process by which guidelines are developed. Experts often don't agree. But guidelines come out of consensus. I have been on these committees. Sometimes the committee will include a forceful, dominating personality who says, "Tight blood sugar regulation is essential; we know this." And therefore the guideline is written that way. What is happening in Massachusetts, and may soon happen across the country, is that physicians who deviate from the guideline are being dinged.

The problem is twofold. First, I strongly believe in the autonomy of the patient. It is the patient, the sick person, who either enjoys the benefits or suffers the consequences of decisions made about treatment. Therefore, the patient's preferences, goals, and values need ultimately to prevail. That doesn't mean a patient should be able to come into the hospital and say, "I want you to have dirty hands in the OR." Or, "You don't have to mark my right hand. Just do whatever you want." But what if someone doesn't want to take a statin drug for borderline cholesterol – in effect, doesn't want to follow the guidelines many elite medical groups have developed for these drugs? A lot of people say, "I don't want to take it. I don't want to have muscle aches or risk getting them. I don't want to take another pill." One would hope that the interests of the physician would align with those of the patient, but if the physician is under financial pressure to follow the guidelines, his or her interests and those of the patient might no longer be in alignment.

The second part of the problem is conflict of interest, an issue recently heralded by the Institute of Medicine.<sup>4</sup> The fact is that many of the people who write guidelines have financial interests in the areas covered by those guidelines. I don't believe that they are consciously prostituting themselves. I really don't. Some people truly do believe deeply in some things, and the pharmaceutical and medical device companies find those people, those opinion leaders who strongly believe, and they support them, make sure that they fund the guideline committees on which those people serve. A devastating recent article in *The Journal of the American Medical Association* showed how the diabetes guidelines were formulated with inadequate transparency and the support of a pharmaceutical company. No voices of dissent were included.

So, we are at a watershed moment in terms of health care. We need to have universal coverage, and we need to contain costs, but

---

<sup>4</sup> Institute of Medicine, *Conflict of Interest in Medical Research, Education, and Practice*, ed. Bernard Lo and Marilyn J. Field (Washington, D.C.: National Academy Press, 2009).

we also have to be extremely attentive to making sure that as these imperatives are met we don't set up a system where we stop thinking about the individual. My cognitive burden as a physician is to figure out how the various guidelines do or do not correspond to the individual sitting in front of me. The studies on which guidelines are based consist of statistical averages of cherry-picked and relatively homogeneous populations that may or may not correspond to the patient in my office who also has kidney disease or heart disease in addition to his lymphoma. The skill is to understand how the individual does or does not correspond to the published data and then to find out from the individual what his or her goals and values and preferences are. While thinking about the disease, the physician should also be thinking about the individual.

**Question:** I would like you to speak more about differential diagnosis. Back when I was in medical school, the teaching we received was quite good on differential diagnosis, how to go about it, the process, and so on. But over my career I've certainly seen people do exactly as you say. They fixate on one issue, and they don't bother to proceed with a differential diagnosis. They aren't ruling things out. They're just putting them aside. Can you discuss what you think are some of the influences besides time pressure that cause physicians not to follow what (I assume) is still being taught? What pressures have you encountered as you've studied this problem?

**Groopman:** In addition to time pressure, which is a major factor, we need to consider the benefits and downsides of the electronic medical record. My wife, Pam Hartzband, and I have written about this in *The New England Journal of Medicine*.<sup>5</sup> We are seeing a terrible abandonment of narrative. The average physician now interrupts a patient within eighteen seconds. Talk about anchoring! When you ask, "What's wrong with you?" but then interrupt so quickly, you don't hear the story. And the story is critical for two reasons: one, the most im-

<sup>5</sup>Pamela Hartzband and Jerome E. Groopman, "Off the record – Avoiding the pitfalls of going electronic," [Perspective] *The New England Journal of Medicine* (358) (2008): 1656 – 1658.

*While thinking about the disease, the physician should also be thinking about the individual.*

portant information often doesn't come at the beginning; two, ultimately you need to know who this person is in order to develop a shared strategy about what to do and how to treat. After my recent accident I experienced this problem firsthand. My physicians didn't look at me. They were absolutely glued to the computer screen. They didn't use open-ended questioning when speaking with me. All of their questions were close-ended because they needed to check off boxes to show on the electronic record that they had met the quality metrics. Otherwise they get dinged. I was shocked to see that the RAND organization has set forth 439 "quality" indicators that a doctor must measure up to.<sup>6</sup> Some of these are overwhelming. Others are process measures of unclear utility, unproven with respect to changing disease outcomes. You would be checking boxes for twenty hours a day! When doctors stop thinking in an open, expansive way, they stop thinking about differential diagnoses. The errors, the shortcuts, the heuristics, the biases that Tversky and Kahneman defined are then amplified because the doctor's focus is on checking off the boxes and fragmenting the patient to fit the structure of the electronic record.

**Question:** You emphasized the importance of teaching students how to think about taking care of patients. Your thesis was that we don't pay enough attention to that anymore. I agree with you. I would suggest, however, that you omitted the most important reason for this phenomenon: our health care system has been turned into an industry. Medicine is no longer a social service rendered by professionals in a personal relationship with patients; it's a business. Doctors are being forced to be cost-

<sup>6</sup>Elizabeth A. McGlynn, Steven M. Asch, John Adams, Joan Keeseey, Jennifer Hicks, Alison DeCristofaro, and Eve A. Kerr, "The quality of health care delivered to adults in the United States," *The New England Journal of Medicine* (348) (2003): 2635 – 2645.

effective and to use their time efficiently to generate more income. That can't be done without changing the health care system. I have been a physician for sixty-three years, and I can clearly remember how it was when I started out in medicine and the kind of medicine I taught to students in the 1950s, 1960s, and 1970s. Students and house officers were required to spend time with patients; it was open-ended. For economic reasons, that practice is no longer available. Do you think that we physicians ought to be speaking more loudly and more clearly about the need to reform the health care system so that it doesn't continue to become simply a business that generates maximum income for investors, owners, private insurers, and so on?

*When doctors stop thinking in an open, expansive way, they stop thinking about differential diagnoses.*

**Groopman:** Yes, I strongly agree with that; it's another issue that my wife and I have written about in *The New England Journal*.<sup>7</sup> Today doctors are subject to what's called "relative value units." Every physician has to account in dollars for his or her time. The social fabric of medicine is being changed as people are increasingly conditioned to think of time as money all the time. Therefore, they take the shortest distance between two points when making a "diagnosis" or recommending a treatment. The compassionate dimension of medicine is telescoped to a point where it is disappearing.

Cognitive psychologists have conducted studies in which they place people in rooms and ask them to "decode" sentences.<sup>8</sup> In one room the person decodes neutral sentences. In the other room the person decodes sentences that include financial terms, words

<sup>7</sup>Pamela Hartzband and Jerome E. Groopman, "Money and the changing culture of medicine," [Perspective] *The New England Journal of Medicine* (360) (2009): 101 – 103.

<sup>8</sup>Kathleen D. Vohs, Nicole L. Mead, and Miranda R. Goode, "The psychological consequences of money," *Science* 314 (2006): 1154 – 1156.

about money. A confederate of the researchers enters each room and drops a bunch of pencils on the floor. Compared to the person who is decoding sentences that include monetary terms, the person who is decoding neutral sentences will pick up twice as many pencils. The same result occurs when someone enters the room and says, "Will you help me with these instructions? I don't understand the problem." Compared to the person who is being subliminally prompted about money, the person who is decoding neutral sentences will spend two to three times as much time trying to help.

A famous line in the Talmud begins, "Ayn kemach, Ayn Torah." Without bread there is no learning. Doctors need resources to do science and to educate patients. But the present-day focus on money in medicine is so intense that an entire dimension of medicine is being negated as a result.

**Question:** What benefit might be conveyed by truly intelligent computers that know all about differential diagnosis, including the uncertainties in differential diagnosis?

**Groopman:** This actually has been tested. Computers are a definitely useful resource. If I want to check a symptom or get a differential diagnosis or a span of possibilities, computers are very efficient. However, the field-testing of reasonably sophisticated computing with large medical databases has been a failure. Most of the data are negative, and the reason is, to use the jargon of some of my computer friends, "garbage in garbage out." If you don't have the skill set to extract from the patient's narrative what is really going on, if you take the symptom based on anchoring or availability or attribution, the computer is not going to step in and say, "Listen, guy, you interrupted at eighteen seconds. Give me something intelligent here, not the first bit of data the patient gave you – 'I have a headache' – because that data, the headache, is irrelevant." In a situation like this, the supposedly "intelligent" computer is inert: it spits out a differential diagnosis and decision tree based on the headache datum, and you send the person to the neurologist and the MRI and so on. You have misdiagnosed or delayed

*Studies of physician-patient interactions have found that if the doctor doesn't prompt the patient in an open-ended way, the doctor won't get good information.*

diagnosis by relying on the computer. But the problem is not the computer. The problem is the human being who relied on it.

**Question:** You have suggested that the medical profession should consult cognitive scientists such as Emilio Bizzi. Is that not naive, given that cognitive science, like computer science, is such a young discipline?

**Groopman:** We can learn or be trained in what's called metacognition: thinking about our thinking. It sounds simple, but people don't do it. Not only doctors but people in every sphere of work should constantly be asking themselves a series of straightforward counterfactual questions. The first is, "What else could it be?" Instead of just dismissing Ellen Barnett as a kooky, perimenopausal woman, ask what other diagnoses might explain her symptoms. The second question is, "Could two things be going on at once?" In medical school we are taught Occam's razor over and over again: look for a single unifying explanation. The problem is that people sometimes have two problems going on at once. This is a huge issue for radiology. Researchers have done some wonderful studies where they track the eyes of the radiologist looking at an image. As soon as radiologists find an abnormality, they stop looking. Even if their retina passes over a second abnormality, they don't assimilate it. This is termed "satisfaction of search." The third question is, "What in this set of data goes against my hypothesis?" This question protects you against confirmation bias, stops you from cherry-picking the data that confirm your assumption and discounting the data that are contradictory. These three simple metacognitive questions should be widely taught and practiced.

**Question:** Why can't the box-checking exercises be used as a way of countering the heuristics that lead doctors to misdiagnose or delay diagnosis? For example, the three metacognitive questions could be on the checklist. "Did you ask whether it could be something else?" That is a box the doctor could check off.

**Groopman:** The problem is that you then have an infinite set of questions to find the answer to "What else could it be?" A checklist can't encompass the universe of questions that would need to be asked if you don't have the skill set to engage in an open-ended narrative. When *How Doctors Think* came out, I received an email about one of the patients from someone who works in computers and databases. He said, "I ran her symptoms through the computer, and I got forty-three different diseases I could posit." But he can't evaluate those forty-three possibilities in the way that a well-trained physician can.

Maybe we can do checklists better. I am not against having information in a more structured way. But the way checklists are now implemented is limiting rather than expanding. We need to return to engaging the patient in a narrative. When you engage people with checklists, they often won't tell you things accurately until you are done with the checklist. You need to talk to find out what's wrong. In fact, studies of physician-patient interactions have found that if the doctor doesn't prompt the patient in an open-ended way, the doctor won't get good information. That's just how people are. We want to tell our story, and if we're not given that opportunity the doctor is put at a disadvantage. ■

---

© 2010 by Jerome E. Groopman

# Academy Meetings



Image © Moodboard/Corbis

## The Challenges of Mass Incarceration in America

*Bruce Western, Glenn Loury, Joan Petersilia, Nicola Lacey, and Robert Weisberg*

*Welcome by Larry Kramer*

This panel discussion was given at the 1944th Stated Meeting, held in collaboration with Stanford Law School on September 17, 2009, at the Law School.



### Larry Kramer

*Larry Kramer is Richard E. Lang Professor of Law and Dean of Stanford Law School. He has been a Fellow of the American Academy of Arts and Sciences since 2006.*

#### Welcome

It is my pleasure to welcome you to the 1944th Stated Meeting of the Academy, which will address the challenges of mass incarceration.

Before I was dean of Stanford Law School, I wrote about constitutional history, with an emphasis on the founding era and early American republic. The United States is still a very young country. We don't have many institutions with really impressive historical pedigrees – at least not when compared with, say, Europe's finest universities, many of which are considerably older than the United States. One of the thrills of being elected to the American Academy was becoming part of an organization whose

charter members included John and Sam Adams and whose earliest inductees were the likes of Benjamin Franklin, George Washington, Alexander Hamilton, and Thomas Jefferson.

But historical pedigree alone is not what makes the Academy such an interesting and important organization. What makes the Academy special is the mission that motivated its original creation and the way it has continually supported that mission for two centuries. The mission is laid out in the Academy's Charter: "to promote and encourage . . . [and] in fine, to cultivate every art and science which may tend to advance the interest, honour, dignity, and

happiness of a free, independent, and virtuous people.” The countless ways in which the Academy has advanced this mission range from simply standing as evidence of the importance of research, science, and art, to promoting work in nearly every field and discipline, to helping disseminate knowledge and understanding, to engaging in efforts to preserve the values and practices needed for knowledge and the creation of knowledge so these can remain free from the forces that would demean or distort understanding for political or other ends.

### *Few topics generate more interest or are more important than those surrounding the enforcement of crime and the handling of criminals.*

Meetings like this are a wonderful example of the role the Academy plays in helping to inform the public. Few topics generate more interest or are more important than those surrounding the enforcement of crime and the handling of criminals. This has almost always been true, moreover: matters of criminal law and punishment generated as much interest and debate when our nation was founded as they do today. These debates matter because the way in which a society handles those who violate its rules provides an important benchmark and test of that society’s morality. How we deal with crime and punishment goes far toward defining who we are and what kind of people we want to be.

There is a tendency today to throw up one’s hands and assume that studying the criminal justice system is a waste of time, that public debate about crime is pointless because the political system is simply a ratchet when it comes to these issues: we only ever increase punishment, we only ever make sentences harsher, we only ever treat the convicted worse, and we only ever think less about support and rehabilitation.

And if one looks at the record of just the past 30 or 40 years, one might think that’s true. Public debate, or at least political debate, about crime has been rather one-

sided and unidirectional. But even I’m old enough to remember the time before that “Dirty Harry” moment in the late 1960s, when the discussion and its policy outcomes were less reflexive. That the debate was once other than it is today shows that it can be different again. I think we may well be at one of those times where we have a window of opportunity and the reflexive assumptions of the past are softened enough to make us open to change.

I don’t mean by this to suggest that any particular change is right or wrong. I mean merely to say that the time seems right to have a real discussion and debate, because we may have arrived at one of those moments when new policy or better policy can actually be made. We will of course still encounter disagreement about what a better policy might be, but now is a time for study, for learning what we can do. At times like these the scholarly community matters more than ever, because we in the Academy have an important role to play in making sure that the moment isn’t wasted. This entails more than just doing research and writing papers; it means talking to and working with practitioners in the criminal justice community, talking to and working with government and with law enforcement officials, helping to build consensus and craft new policies for everything from police investigations to trial rights to sentencing to prison reform, reentry policy, voting rights, juvenile justice, and on and on.

The Academy is a place where people from all sides and with all views can come together to engage in such a conversation; it’s a place where no one will shout, “You lie!” – and where even if such an outburst did occur, it would be followed by debate and discussion to show why it’s so or not so. We offer a sanctuary from overt politics and a forum for debate that if not exactly disinterested is at least open-minded. We should be worrying today about the increasing tendency of people on all sides to limit themselves to hearing only from others with whom they already agree and to dismiss those with whom they disagree as ill-motivated. As scholars we are obliged to rise above this. And *that* is something the American Academy of Arts and Sciences has always stood for and promoted.



### **Bruce Western**

*Bruce Western is Professor of Sociology and Director of the Multidisciplinary Program in Inequality and Social Policy at Harvard University. He has been a Fellow of the American Academy of Arts and Sciences since 2007.*

When I think about criminal justice in the United States, I often picture a prison scene of intense overcrowding. And perhaps because I am from Cambridge, Massachusetts, the dominant image I have of race at this moment is the somewhat more genteel, even bucolic, scene of President Obama’s so-called beer summit.

### *Nothing distinguishes the life experience of blacks and whites in America like contact with the criminal justice system.*

I think the beer summit has actually done the public conversation about race and criminal justice a great disservice by distracting us from the real issues. As Glenn Loury argued in a recent op-ed piece in *The New York Times*, the reaction to the arrest of Henry Louis Gates Jr. by a white Cambridge, Massachusetts, police officer has largely served to trivialize the quite profound challenges to social justice in America.<sup>1</sup>

<sup>1</sup> Glenn C. Loury, “Obama, Gates and the American Black Man,” *The New York Times*, July 25, 2009, [www.nytimes.com/2009/07/26/opinion/26loury.html](http://www.nytimes.com/2009/07/26/opinion/26loury.html).

One of the challenges of the Academy's work on incarceration will be to recalibrate the debate and try to inject some hard facts into the discussion.

To understand the recent trends in incarceration in the United States, we might begin by looking at the comparative incarceration rates in Western Europe (see Figure 1). The incarceration rate is a measure of the scale of the criminal justice system; it records the fraction of the population that is incarcerated. In the early 2000s in Western Europe the incarceration rate was about 100 per 100,000, or 0.1 percent of the population. The U.S. incarceration rate at the time was about an order of magnitude larger, 700 per 100,000. From a comparative point of view, the U.S. incarceration rate is incredibly unusual. The American penal system is also unusual in historical terms (see Figure 2). From 1925 to the early 1970s the imprisonment rate was roughly constant at about 100 per 100,000, about the same level we see in Western Europe today.

In the early 1970s the system began to grow, and it has grown every year for the last 36 or 37 years. But the imprisonment rate doesn't capture the entire population under criminal justice supervision. While we have 1.5 million people in prison in the United States, another 780,000 are in local jails, 800,000 are on parole, and 4.2 million are on probation. More than 7 million people are under some sort of criminal justice supervision in this country, a situation that is historically novel. These very high levels of supervision have emerged only in the last decade or so. Striking as these figures are, they do not capture the most important thing about incarceration in the United States: the inequality of its distribution.

By 2008, 750 people were in prison or jail for every 100,000 in population. That is 0.75 percent of the overall population behind bars. For every 100,000 young white men with low levels of schooling who have dropped out of high school, 11,000 are incarcerated. The overall incarceration rate for young African American men today is also 11,000 per 100,000. But the rate for young African American men who have dropped out of high school is 37,000 per 100,000. Thirty-seven percent of all African

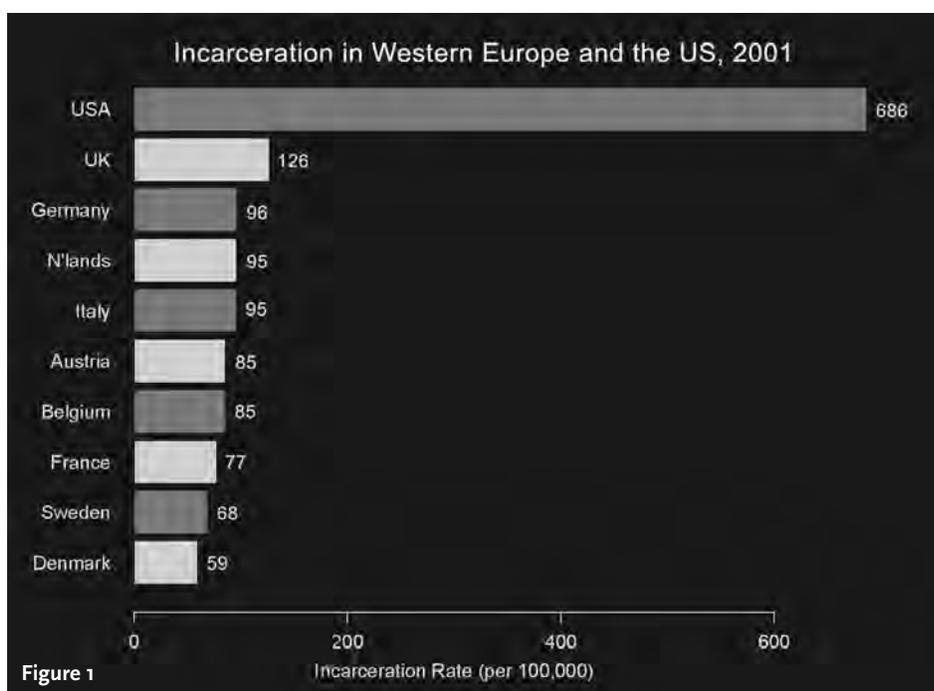


Figure 1

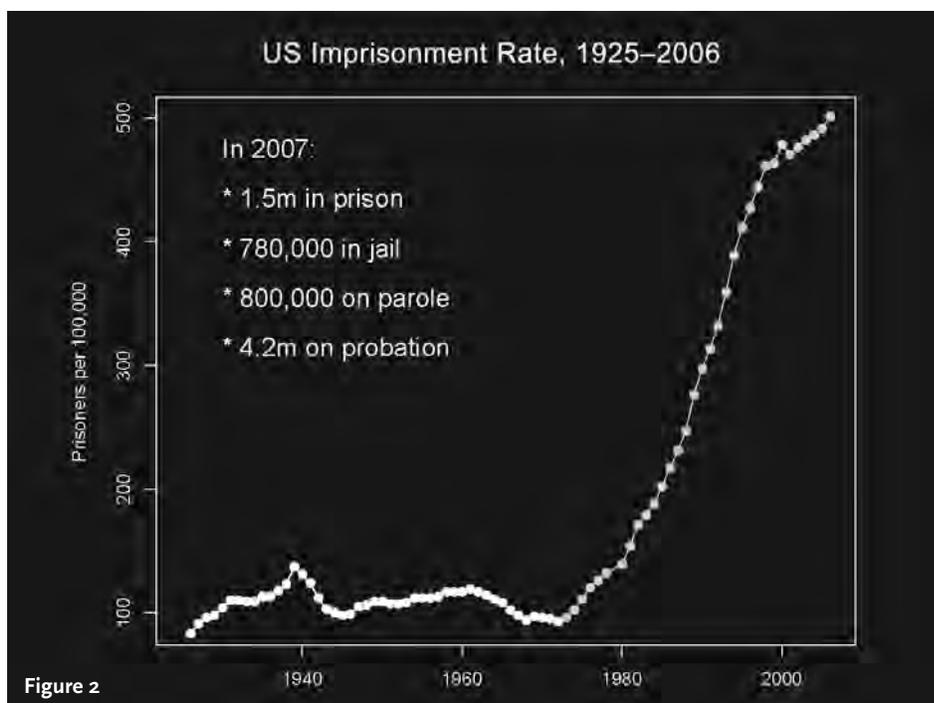


Figure 2

American men under the age of 35 who have dropped out of high school are behind bars, under lock and key, in prison or jail. Their incarceration rate is 50 times the national average.

This is just a snapshot at a point in time. We might also ask, what is the likelihood you've ever been to prison at some point in your life? We might be interested in this

question because we think incarceration confers an enduring life status that affects a whole array of life chances even after you have been released. So we want to know the size of the group that is exposed to this risk of diminished life chances. Among African American men who never went to college, one in eight will go to prison at some point in their lives if they were born in the late

1940s, just after World War II. If they were born in the late 1970s and thus grew up in the period of the prison boom, their lifetime risk of serving time in a state or federal facility for a felony conviction is 70 percent if they dropped out of high school (see Figure 3). For the recent birth cohorts of African American men with low education, serving time in prison is utterly normal.

In fact, if we compare the risk of imprisonment to other events that we think characterize the pathway through adulthood (marriage, completing college, and serving in the military), imprisonment for African American men today is much more com-

mon than completing college with a four-year degree or serving in the military (see Figure 4). The opposite is true for whites, who are more likely to marry, complete college, or serve in the military than go to prison. Whites are also more likely than African Americans to experience these life events. The lone life event that African Americans will experience more commonly than whites is incarceration, and the racial disparity for this one event (i.e., the gap between the percentage of whites who will experience it and the percentage of African Americans who will) is larger than for any of the others.

Nothing distinguishes the life experience of blacks and whites in America like contact with the criminal justice system. We could look at any number of other social indicators – the wage gap, infant mortality rates, gaps in unemployment – and not find one in which the racial disparity is greater. This tells us something profound about the state of American race relations. As we consider the issues associated with mass incarceration in the United States, we must consider how our extraordinary present-day rates of incarceration are a significant source of social inequality in America.

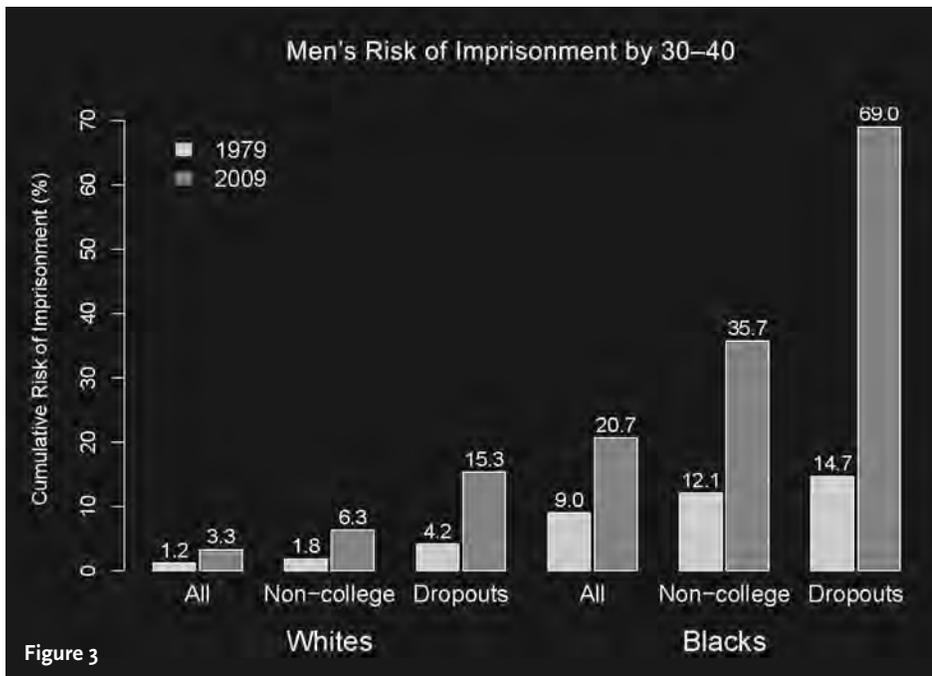


Figure 3

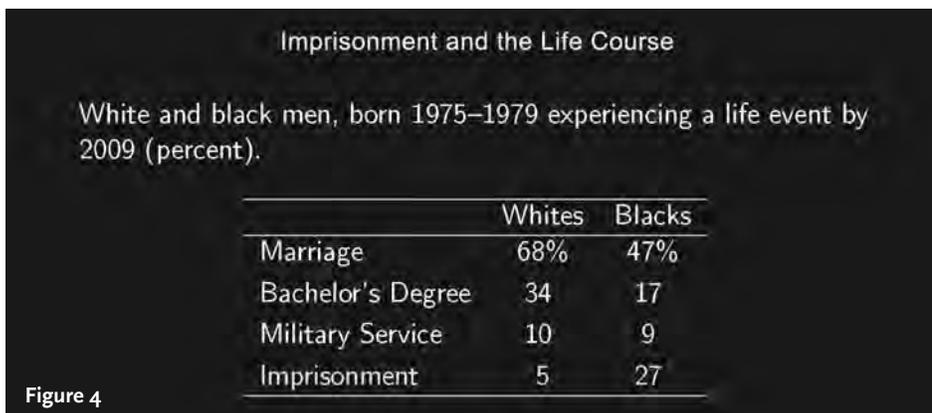


Figure 4



## Glenn Loury

Glenn Loury is Merton P. Stoltz Professor of the Social Sciences and Professor of Economics at Brown University. He has been a Fellow of the American Academy of Arts and Sciences since 2000.

We are a nation of jailers. We have 2.25 million people under lock and key on a given day and another 5 million under supervision. This level of incarceration would be one thing if it were a random draw on the population or if we somehow had a meter of the evilness of the soul and had used it to lock up the people who were the most evil among us. But in fact the incidence of this practice is highly selective by class and by race. This is justice, but of a strange kind. And the legitimacy and the morality of our practice are in question. We have armies marching around the world under a figurative banner that reads Freedom, and yet we are home to institutions unmatched in human history in their scope and scale for the custodial supervision and detention of persons.

We might argue that we are simply meting out to individuals their just desserts. The rules have been clearly stated, they violated the rules, and it is the obligation of institutions of criminal justice to deliver penalties for the violation of rules. I see that as a very, very thin reed on which to rest this structure that we have built. I don't think we can get past the legitimacy question on a one-off argument that each and every one of America's 2.25 million prisoners did this or that and we are meting out to them what they earned.

I think we are doing social policy here. I think we are managing deep social problems in our society, failures of other institutions, of education, the economy, and so forth, and failures of human development. I think we are reaping what we have sown in the way in which we have partitioned ourselves, whether it's the physical space of our cities or the relational space of how we are connected to one another. People are isolated, they are deprived, they are disadvantaged, they don't have the opportunity to realize their full human potential. We have fifteen- and sixteen-year-olds walking around in some of our cities with pistols. Sometimes they use them. And we treat them as if this were entirely their problem, not acknowledging that we, collectively through our institutions and our social organization, might have any responsibility for their wrongdoing.

*If my words betray some emotion and a sense of outrage, they do so because our American practice of incarceration is a societal practice, the workings out of our democratic institutions.*

Clearly, I am not giving a social scientist's lecture. I haven't presented any data or made any kind of scientific claim. I am making statements that might be regarded as my opinion. When I was in graduate school I was taught that as an economist my job was to work out the implications of the assumptions we make about human behavior and the ways that markets work. The question of evaluating those outcomes was somebody else's job. That story worked for me for a few decades, but it doesn't work anymore. Since being invited to deliver one of Stanford's Tanner Lectures on human values a few years ago, I have pursued a new tack, one less concerned with technical economics than with moral philosophy. My subject then as now, America's system of mass incarceration, is one I will not let go.

If my words betray some emotion and a sense of outrage, they do so because our American practice of incarceration is a societal practice, the workings out of our democratic institutions. The American system of justice and incarceration acts on our behalf, in our name, with our endorsement, seeking our votes. And its practice is scandalous. Placed in an international comparative context, we are off the charts. Viewed against the backdrop of our own history, when we look at the inner-city communities where a lot of this activity is taking place, when we think about these populations and how they have come to be where they are, when we think about all of the practices, the generations leading up to where we are now that have helped to make the situation the way it is, I find it scandalous that we would manage the consequences of this history through coercion, force, stigmatization, isolation, and confinement.

The pain in the lives of the people who are the subjects of our institutions of mass incarceration is unimaginable. Yes, there are victims. However, the political calculus that simply asserts we have victims, we have perpetrators, and we are going to vindicate the victims and punish the perpetrators is a superficial moral calculus.

We are scholars – dispassionate, objective, clearheaded. But we are also citizens and human beings. And most of us have megaphones held up to our mouths. We can influence the public debate; we can frame the discussion. If we have the courage to step out and call wrong what we see as wrong and if we try to bring our intellectual resources to bear on these problems, we can make a difference.



### Joan Petersilia

*Joan Petersilia is Adelbert H. Sweet Professor of Law at Stanford Law School and Codirector of the Stanford Criminal Justice Center.*

Something missing from our public discussion of the profound and troubling issue of mass incarceration in the United States is any consideration of what happens when all these prisoners come home. We spent the last decade thinking about who should go to prison. We passed three strikes laws,

*Something missing from our public discussion of the profound and troubling issue of mass incarceration in the United States is any consideration of what happens when all these prisoners come home.*

mandatory drug laws, and on and on and on, but we gave little thought to what would happen after the people at whom these laws were aimed completed their sentences. If you quadruple the prison population, as we have done since 1960, you quadruple the number of people coming home. The public is very much unaware of this reality. They somehow think that people sent to prison will be there for a very, very long time. In fact, the average prison term is two years, and probation and parole violators do much less time.

Forty-five percent of everybody sitting in a prison cell today will be released within the year. Almost half of our current prisoners will soon be returning home. Most of those people are uneducated, illiterate, and unemployable. Increasingly they will lack the kinds of supports we think would help in their reintegration. When prisoners are released in California they are given \$200. In most other states they are given less. Most former prisoners return to inner-city communities. The data show that fewer and fewer areas are willing to accept prisoners who are released, so we are concentrating them in a smaller and smaller number of neighborhoods. Those neighborhoods often lack jobs and housing and are the least able to deal with the particular needs of former prisoners.

It turns out that getting out of prison is a lot easier than staying out of prison: 70 percent of everybody released from prison will be back in custody within three years. We also know that about three-quarters of all prisoners enter prison with a substance abuse problem and about one in five is diagnosed mentally ill. They, too, are coming out. The average newly released prisoner has a sixth-grade education, is about twenty-nine years of age, has nine prior arrests, and has served two prior jail terms. The churning just goes on and on.

For the last several years my work has focused on the moment of release. That moment represents a great opportunity. After all, we have invested on average \$100,000 on each person we release (adding court and corrections costs). We spend \$65 billion a year on corrections in the United States. For more than a decade the growth in spending on corrections at the state level has been exceeded only by the growth in Medicaid costs. The costs are tremendous, and states can no longer afford them. They are closing prisons and instituting early-release programs. But at a time of widespread budget crisis, these measures are a catch-22. When we release prisoners, they are pretty much on their own. They now have the stigma of being an ex-con, and they are about to require community services that are being reduced or cut thanks to the current fiscal crisis. They are going to stand behind very, very long lines of nonconvicts who need the same

*When we start thinking about mass incarceration and prisoner reentry, we must also think about sentencing, about how we want prisoners to use their time when they are in prison, and about release decisions.*

health care and job retraining services. This is the aspect of mass incarceration that the public does not understand. Those of us who have advocated for less incarceration should now be worried about what communities will offer prisoners when they are released.

When we start thinking about mass incarceration and prisoner reentry, we must also think about sentencing, about how we want prisoners to use their time when they are in prison, and about release decisions. Who should be getting out and under what kinds of conditions? Who should be going back when they violate the law, and who should be sentenced to community-based alternatives? What is the role of government in retraining people whom we have placed in prison? Do we have any role? How much are we willing to spend on it? And what are the public safety consequences if we say we are not willing to spend very much?

A recent study shows that about 20 percent of all arrests are of parolees, and that is with our current support system. When prisoners are released and we start pulling back services, they end up in our local jails, which are less expensive but also less able than prisons to handle long-term sentences.

The Academy's concern with mass incarceration struggles with a set of incredibly complicated issues. My hope is that someday, maybe in our lifetime, the need for such a focus will not be quite as urgent because more offenders who leave prison will be going home to stay.



## Nicola Lacey

Nicola Lacey is Professor of Criminal Law and Legal Theory at the London School of Economics.

My interest in comparative criminal justice began nearly twenty years ago when I was a guest at Stanford borrowing the office of an absent faculty member, James Whitman, who later became famous for a marvelous book on the historical and comparative origins of America's harsh justice system. Despite this history, I feel I am the outsider in this conversation because I'm not an expert on the American prison system in the way my colleagues on this panel are. What I am able to offer are three brief points from the perspective of somebody who is a comparativist and an interested and concerned observer.

First, I agree with Joan Petersilia that the U.S. public is broadly aware of the fact of mass imprisonment and to some extent the costs and scale of it. My impression, however, is that the extent to which this system is exceptional in international comparative terms – the United States is an outlier to a quite extraordinary extent – is less widely debated and thus less well known. Not long ago I was at a lecture that Bruce Western gave at a top American university before a highly educated audience. When he put up a simple chart graphically showing the scale of American imprisonment in relation to that of countries at similar levels of economic and social development, the level of real surprise shown by this highly educated audience was astounding.

The imprisonment rate in the United States is almost six times higher than that in Canada, five times higher than in the United Kingdom, about eight times higher than in Germany, and about ten times higher than in most of the Nordic countries. The phrase "American exceptionalism" is perhaps overused and often underanalyzed, but its use is more than justified when discussing America's unprecedented experiment in mass internal exile.

*The imprisonment rate in the United States is almost six times higher than that in Canada, five times higher than in the United Kingdom, about eight times higher than in Germany, and about ten times higher than in most of the Nordic countries.*

The sheer numbers of the incarcerated are not the only relevant issue, though. Equally deserving of attention and exploration are the qualitative aspects of imprisonment in this country – the quality of prison regimes and rehabilitation programs, for example – as well as the long-term treatment of prisoners who have completed their sentences.

The second point that I would like to make is that the American criminal justice system has not always been so. The United States has a worthy and respectable history in penal reform. But an extraordinary mismatch has emerged between the present facts of imprisonment and America's distinguished history of penal reform and the conception of itself as a land committed to freedom and dignity. As recently as the early 1970s the U.S. imprisonment rate was one-and-a-half times that in the United Kingdom. Today the U.S. rate is five times the U.K. rate, despite the fact that the United Kingdom's imprisonment rate has doubled over the same period.

Finally, a note of caution about the implications of these comparative facts and the much more detailed comparative research that has been produced. One of the temptations of comparative research is to think that we can simply study countries that have managed to keep their imprisonment rate stable during an era in which they, too, have suffered the shocks of social, economic, and political change that appear to have been involved in producing the steep increase in America's mass imprisonment. To simply go to Sweden or Denmark or Germany and see how they do it and then export their institutions back to the United States is a tempting idea; indeed, it's one of the reasons we're interested in comparative research. But, of course, it doesn't work like that for the simple reason that the criminal justice system is not an autonomous social institution, but rather operates in a complex cultural, political, and institutional environment. What's more, those features of this environment interact with one another so that each criminal process is part of an interlocking institutional social system. We can and should try to improve the situation through changes of the kind that Joan Petersilia has already alluded to, but we have to think about the broader picture as well. We have to think about welfare states, for example, something that has featured in Bruce Western's work. We have to think about how social inequality is produced and how it became so extreme in the United States. We even have to think about less obvious things such as the way in which the American electoral system works and the extent to which elections are directly relevant to the delivery of criminal justice.

I don't wish to cast a damper on the idea that we should be seriously and immediately concerned with policy development, nor do I think that comparative research is irrelevant to that. Comparative research helps us to understand how these extraordinary differences have been produced and in doing so to understand a lot more about how the criminal process interacts with other political, economic, and social institutions. Only if we begin to understand these things better will we be in a good position to think sensibly about those broader policy questions that must also be on our mind.



### Robert Weisberg

*Robert Weisberg is Edwin E. Huddleson, Jr. Professor of Law at Stanford Law School and Director of the Stanford Criminal Justice Center.*

If the United States is the great international anomaly when it comes to mass incarceration, then California is to the United States as the United States is to the world. The Golden State is exceptional within the United States but in complicated ways. For example, in terms of the ratio of prisoners to population, California is about average; its incarceration rate is nothing to be proud of, but it's not anomalous. (Traditionally, the states with the highest imprisonment rates have been in the Deep South, and by and large they still are.) So in what sense is California exceptional?

First, it has the worst overcrowding problem, the causes of which are extremely interesting and have nothing to do with a lack of space or a lack of resources (in a broad sense). Instead the dysfunctionality of the state's political economy during good and bad economic times has produced an incredible mismatch of needs and resources. Second, and related to the first point, California has an incredibly weird political system. (Comparativists interested in the political anthropology of alien cultures would do well to come to California.) The state has received a lot of attention because of the strange constitutional restrictions that inhibit the possibility of holding sensible revenue discussions. In the context of the imprisonment problem, California's bizarre nature becomes an interesting academic subject in a way that also makes it an important practical policy subject. California

doesn't know what to do with political and economic accountability. One illustration of this is the debate, really a sub-debate of California's recent general prison debate, about whether the state should have a sentencing commission.

Many states have sentencing commissions. Most are at worst uncontroversial and at best extremely successful public agencies. They are extremely heterogeneous but do have one common denominator: They help the real branches of government, the executive and the legislature and the judiciary to some extent, think about criminal justice policy in the same rational, cost-benefit terms government is prone to do with policies in other regulatory areas. Legislatures and other branches of government can choose to cede as much of their authority to sentencing commissions as they wish or to hold back authority or reverse decisions in any way they want. The commissions work pretty well in most states.

*Conventional discussions within the world of criminal jurisprudence often turn on the question of what is the real purpose of punishment. Is it incapacitation, retribution, deterrence, or something else?*

The most infamous sentencing commission in the United States in modern history is actually the federal sentencing commission, which has had its share of problems but is nonetheless associated with harsh, rigidly applied punishments and a humongous increase in the federal prison population. Despite the successes of sentencing commissions elsewhere in the country, in California if you propose one you're told, "Oh, so you want the legislature to hand over the prison keys to . . ." The object of the proposition varies to some extent. Sometimes it's socialists, sometimes it's sentimentalists, sometimes it's lily-livered San Franciscans. And sometimes it's "those people who

do numbers, and you know what they are always going to tell you: release people."

That outcome has simply not been the experience with other states' sentencing commissions. They've been successful because they've proven to be moderate and rational. But there's something about the political dysfunctionality of California whereby it seems only logical that the legislature, which has proved unbelievably unaccountable in every relevant way, would say, "We won't give up our accountability to this unaccountable body; we just won't take that risk even though, frankly, we could create a commission in any way we wanted."

The irony here is that because of its dysfunctionality California's regular branches of government have already ceded authority over the prison system – only not to a sentencing commission but to this other body called the United States District Court for the Northern District of California. So what we have is a war, a ballet, an unhappy neurotic marriage (choose your own metaphor!). This is a fascinating political science and legal problem about how we deflect and go about rearranging accountability in our system.

Conventional discussions within the world of criminal jurisprudence often turn on the question of what is the real purpose of punishment. Is it incapacitation, retribution, deterrence, or something else? Unfortunately, these debates usually occur at such an abstract level that even when, for example, they involve criticizing the retribution argument for failing to take account of the real world, they leave out that very issue (i.e., the real world) in the prosecution of their argument. We academics need to do a better job of accounting for "shock effect" facts, those data points that the public finds most salient but that we tend to give no more importance to than any of the other data points we might consider in our analyses. When these facts are brought into the academic discussion, the results can be illuminating. Take, for instance, a book called *Marked* by Princeton sociologist Devah Pager.<sup>1</sup> *Marked* is based on an inter-

<sup>1</sup>Devah Pager, *Marked* (Chicago: University of Chicago Press, 2007).

esting sociological simulation experiment in which people were randomly assigned a fictitious criminal record and then asked to try to get a job. Despite controlling for the fact that many ex-convicts have educational, career, and/or personal deficits prior to serving time in prison, the study still found that a criminal record is the most significant obstacle to gaining or regaining employment.

Pager's work is related to that of Bruce Western, who coined the term *aggregate earnings penalty* to describe the metastatic effect imprisonment has on a person's economic, social, and personal life course. Our abstractions suggest that we should be able to control the effects of the penalties we inflict on people. The research being

conducted by academics like Pager and Western, however, shows that the penalties we inflict on people have ever-widening, self-generating, self-reinforcing effects. In the abstract, a term like *stigma* plays an important role in philosophical discussions of how deterrence should work. In the real world, Pager's research shows, there's certainly a stigma, but it goes well beyond any simple philosophical notion. We need to redefine terms such as this so that in our academic debates we achieve some measure of accordance with the real world.

Finally, a word on rehabilitation. We all know that certain things do work if they're tried: drug rehabilitation programs, employment counseling, and so on. Bruce Western writes about reentry programs,

whose development he lauds and encourages. But he points out they are not exactly rehabilitation programs in the traditional sense. Rather, they are rehabilitation programs for the era of mass incarceration. In effect, we've redefined rehabilitation. No longer is it intended to make you better than you were before you went to prison. Now rehabilitation is an important thing we do to mitigate the bad effects prison has on you. ■

---

© 2010 by Larry Kramer, Bruce Western, Glenn Loury, Joan Petersilia, Nicola Lacey, and Robert Weisberg, respectively



Loren Buddress, Chief Probation Officer, San Mateo County

# Noteworthy

As of press time, several Fellows of the Academy, listed below, have been invited to serve in senior roles in President Barack Obama's administration. They are in addition to the Fellows listed in the Winter, Spring, and Summer 2009 issues of the *Bulletin*.

**Amy Gutmann** (University of Pennsylvania): Chair of the Presidential Commission for the Study of Bioethical Issues

**Marcia McNutt** (Monterey Bay Aquarium Research Institute): Director of the United States Geological Survey

**Cass R. Sunstein** (University of Chicago): Head of the Office of Information and Regulatory Affairs, White House Office of Management and Budget

**James W. Wagner** (Emory University): Vice Chair of the Presidential Commission for the Study of Bioethical Issues

**Fellows serving on the President's Committee on the Arts and the Humanities:**

**Mary Schmidt Campbell**, Vice Chairwoman (New York University)

**Teresa Heinz** (Heinz Family Philanthropies)

**Yo-Yo Ma** (Cambridge, Massachusetts)

**Thom Mayne** (Morphosis Architects)

**Fellows serving on the Department of Energy's Blue Ribbon Commission on America's Nuclear Future**

**Albert Carnesale** (University of California, Los Angeles)

**Richard A. Meserve** (Carnegie Institution for Science)

**John W. Rowe** (Exelon Corporation)

## Select Prizes and Awards

### Nobel Prizes, 2009

#### *Physiology or Medicine*

**Elizabeth H. Blackburn** (University of California, San Francisco)

**Carl W. Greider** (Johns Hopkins University)

**Jack W. Szostak** (Harvard Medical School; Massachusetts General Hospital)

#### *Chemistry*

**Thomas A. Steitz** (Yale University)

**Ada E. Yonath** (Weizmann Institute of Science)

#### *Economics*

**Elinor Ostrom** (Indiana University; Arizona State University)

### National Medal of Science, 2008

**Berni Alder** (Lawrence Livermore National Laboratory)

**Francis Collins** (National Institutes of Health)

**Elaine Fuchs** (Rockefeller University)

**Rudolf Kalman** (Eidgenössische Technische Hochschule Zürich)

**Michael Posner** (University of Oregon)

**JoAnne Stubbe** (Massachusetts Institute of Technology)

**J. Craig Venter** (J. Craig Venter Institute)

### National Medal of Technology and Innovation, 2008

**Charles M. Geschke** (Adobe Systems, Inc.)

**John E. Warnock** (Adobe Systems, Inc.)

## Other Awards

**Utpal Banerjee** (University of California, Los Angeles) was awarded the Elizabeth W. Jones Award for Excellence in Education by the Genetics Society of America.

**Barry R. Bloom** (Harvard School of Public Health) is the recipient of the 2009 Prix Galien USA Pro Bono Humanum Award.

**Winslow Briggs** (Carnegie Institution for Science) was awarded the International Prize for Biology from the Japan Society for the Promotion of Science.

**Ching-Wu Paul Chu** (University of Houston) is the recipient of a K.T. Li Chair Professor Award given by the National Cheng Kung University.

**Thomas Cline** (University of California, Berkeley) was awarded the Edward Novitski Prize from the Genetics Society of America.

**John E. Dowling** (Harvard University) was awarded the Glenn A. Fry Medal in Physiological Optics.

**Esther Duflo** (Massachusetts Institute of Technology) was named a 2009 MacArthur Fellow.

**Richard A. Easterlin** (University of Southern California) was awarded the 2009 IZA Prize in Labor Economics by the Institute for the Study of Labor.

**Richard Eisenberg** (University of Rochester) was named a Fellow of the American Chemical Society.

**Henry Louis Gates, Jr.** (Harvard University) is the recipient of the 2009 Sarah Josepha Hale Award.

**Barbara Goldsmith** (Barbara Goldsmith Productions) received the Knight's Cross of the Order of Merit of the Republic of Poland.

**Robert H. Grubbs** (California Institute of Technology) was awarded the AIC Gold Medal by the Chemical Heritage Foundation.

**Edward E. Harlow, Jr.** (Harvard Medical School) was awarded the American Cancer Society's Medal of Honor for Basic Research.

**David Haussler** (University of California, Santa Cruz) is the corecipient of the 2009 Curt Stern Award, given by the American Society of Human Genetics.

**Siegfried S. Hecker** (Stanford University) is the corecipient of the 2009 Enrico Fermi Award given by the U.S. government.

**Jeremy Jackson** (University of California, San Diego) has been awarded the Paleontological Society Medal.

**Gershon Kekst** (Kekst and Company) is the recipient of the Louis B. Marshall Award of the Jewish Theological Seminary.

**Linda K. Kerber** (University of Iowa) was inducted into the Iowa Women's Hall of Fame.

**Jon M. Kleinberg** (Cornell University) is the recipient of the 2009 Katayanagi Emerging Leadership Prize.

**Donald E. Knuth** (Stanford University) is the recipient of the 2009 Katayanagi Prize for Research Excellence.

**Michael S. Levine** (University of California, Berkeley) is among the recipients of the Wilbur Lucius Cross Medal, given by Yale University.

**Wen-hsiung Li** (University of Chicago) was awarded the 2009 Mendel Medal by the Genetics Society.

**Barbara J. Meyer** (University of California, Berkeley) was awarded the Genetics Society of America Medal.

**Brenda Milner** (McGill University) was awarded the 2009 Balzan Prize for Cognitive Neurosciences.

**Walter Munk** (University of California, San Diego) was awarded the 2010 Crafoord Prize in Geosciences by the Royal Swedish Academy of Sciences.

**Roger Myerson** (University of Chicago) is the recipient of the Jean-Jacques Laffont Prize from the Institute of Industrial Economy and the city of Toulouse, France.

**Elizabeth G. Nabel** (Brigham & Women's/Faulkner Hospitals) was awarded a 2009 Katz Prize in Cardiovascular Research.

**Julie E. Packard** (Monterey Bay Aquarium) was named a 2009 California Coastal Hero.

**H. Vincent Poor** (Princeton University) was elected a Fellow of the Royal Academy of Engineering of the United Kingdom.

**Geoffrey K. Pullum** (University of Edinburgh) has been elected a Fellow of the British Academy.

**Frank Richter** (University of Chicago) was awarded the 2009 Harry H. Hess Medal.

**Donald B. Rubin** (Harvard University) was elected a Corresponding Fellow of the British Academy.

**Phillip A. Sharp** (Massachusetts Institute of Technology) was named winner of the American Society for Biochemistry and Molecular Biology 2010 Herbert Tabor/*Journal of Biological Chemistry* Lectureship.

**Neil Shubin's** (University of Chicago) *Your Inner Fish* won the prize for best book in the National Academies' 2009 Communications Awards, which recognize excellence in reporting and communicating science, engineering, and medicine to the general public.

**Clifford H. Taubes** (Harvard University) was awarded the 2009 Shaw Prize in Mathematical Sciences. He shares the prize with Simon K. Donaldson (Imperial College, London).

**Andrew J. Viterbi** (Viterbi Group, LLC) is the recipient of the 2010 IEEE Medal of Honor.

**Alan Walker** (Pennsylvania State University) and **Pat Shipman** (Pennsylvania State University) are the recipients of the 2009 W.W. Howells Book Award for *The Ape in the Tree, A Natural and Intellectual History of Proconsul*.

**Gerhard L. Weinberg** (University of North Carolina at Chapel Hill) is the recipient of the 2009 Pritzker Military Library Literature Award for Lifetime Achievement in Military Writing.

**Gerald Westheimer** (University of California, Berkeley) was appointed member of the Order of Australia as part of the 2009 Queen's Birthday Honors.

**George Whitesides** (Harvard University) was awarded the 2010 Othmer Gold Medal of the Chemical Heritage Foundation.

**Sheila Widnall** (Massachusetts Institute of Technology) is the recipient of the Arthur M. Bueche Award from the National Academy of Engineering.

**William J. Willis** (Columbia University) is among the recipients of the Wilbur Lucius Cross Medal, given by Yale University.

**Edward O. Wilson** (Harvard University) has been named Commander, First Class of the Royal Order of the Polar Star, by King Carl XVI Gustaf of Sweden.

## New Appointments

### Fellows Appointed to the Board of Directors of the Broad Institute

**Dennis Ausiello** (Harvard Medical School and Massachusetts General Hospital)

**David Baltimore** (California Institute of Technology)

**Eli Broad** (Broad Foundation)

**Drew Gilpin Faust** (Harvard University)

**Jeffrey S. Flier** (Harvard Medical School)

**Susan Hockfield** (Massachusetts Institute of Technology)

**Eric S. Lander** (Broad Institute)

**Arthur D. Levinson** (Genentech, Inc.)

**Phillip A. Sharp** (Massachusetts Institute of Technology)

**Patty Stonesifer** (Smithsonian Institution and Bill & Melinda Gates Foundation)

**Diana Chapman Walsh** (Wellesley College)

## Other New Appointments

**Paul Alivisatos** (University of California, Berkeley) has been named Director of the Lawrence Berkeley National Laboratory.

**Utpal Banerjee** (University of California, Los Angeles) was elected as a Director to the Board of the Genetics Society of America.

**William R. Brody** (Salk Institute for Biological Studies) has been appointed to the governing board of the California Institute of Regenerative Medicine.

**David Clary** (Magdalen College, University of Oxford) has been appointed as Chief Scientific Advisor to the Foreign and Commonwealth Office.

**France A. Córdova** (Purdue University) has been named to the Smithsonian Institution's Board of Regents.

**Haile T. Debas** (University of California, San Francisco) was appointed to the Aga Khan University Board of Trustees.

**Nicholas M. Donofrio** (IBM) was appointed Senior Fellow at the Ewing Marion Kauffman Foundation. He was also named to the Board of Directors of TopCoder, Inc.

**Frances D. Fergusson** (Vassar College) was elected to the Board of Directors of Pfizer, Inc.

**Howard Gardner** (Harvard University) has been appointed to the Amherst College Board of Trustees.

**Corey S. Goodman** (University of California, San Francisco) has been appointed as an Outside Director to the Board of Mirna Therapeutics, Inc.

**Edward E. Harlow, Jr.** (Harvard Medical School) has been appointed as Chief Scientific Officer of Constellation Pharmaceuticals, Inc.

**Edward Lazear** (Stanford University) has been appointed Senior Advisor to Cornerstone Research.

**Thomas Magnanti** (Massachusetts Institute of Technology) was appointed founding President of the Singapore University of Technology and Design.

**W. James McNerney, Jr.** (Boeing Company) was elected to the Board of Directors of IBM.

**Elizabeth G. Nabel** (National Institutes of Health) was named President of Brigham & Women's/Faulkner Hospitals.

**Norman Nie** (Stanford University) was named Chief Executive Officer of REvolution Computing.

**Emiko Ohnuki-Tierney** (University of Wisconsin-Madison) was named the Kluge Distinguished Chair of Modern Culture at the John W. Kluge Center at the Library of Congress.

**Gordon Orians** (University of Washington) was elected Chair of the Washington state Board of Trustees of the Nature Conservancy.

**Thomas J. Silhavy** (Princeton University) was elected as a Director to the Board of the Genetics Society of America.

**Paul W. Sternberg** (California Institute of Technology) was elected as Vice President to the Genetics Society of America Board.

**Arthur Weiss** (University of California, San Francisco) was appointed to the Scientific Advisory Board of Lycera Corp.

## Select Publications

### Poetry

**Charles Bernstein** (University of Pennsylvania). *All the Whiskey in Heaven: Selected Poems*. Farrar, Straus and Giroux, March 2010

### Fiction

**Aharon Appelfeld** (Ben-Gurion University of the Negev, Israel). *Blooms of Darkness*. Schocken, March 2010

**J. M. Coetzee** (University of Adelaide, Australia). *Summertime*. Viking, January 2010

**Rebecca Goldstein** (Harvard University). *36 Arguments for the Existence of God: A Work of Fiction*. Random House, January 2010

**Maureen Howard** (Columbia University). *The Rags of Time*. Viking, October 2009

**Lore Segal** (New York, New York). *Lucinella*. Melville House, October 2009

### Nonfiction

**Joyce Appleby** (University of California, Los Angeles). *The Relentless Revolution: A History of Capitalism*. W.W. Norton, January 2010

**Bernard Bailyn** (Harvard University) and Patricia L. Denault (Harvard University), eds. *Soundings in Atlantic History: Latent Structures and Intellectual Currents, 1500–1830*. Harvard University Press, June 2009

**Ira Berlin** (University of Maryland). *The Making of African America: The Four Great Migrations*. Viking, January 2010

**Rebecca M. Blank** (Brookings Institution) and Michael S. Barr (University of Michigan Law School). *Insufficient Funds: Savings, Assets, Credit, and Banking among Low-Income Households*. Russell Sage Foundation Publications, April 2009

**Derek Bok** (Harvard Kennedy School). *The Politics of Happiness: What Government Can Learn from the New Research on Well-Being*. Princeton University Press, March 2010

**Alan Brinkley** (Columbia University). *Franklin Delano Roosevelt*. Oxford University Press, December 2009

**Peter A. Brooke** (Advent International Corporation) with Daniel Penrice (Cambridge, Massachusetts). *A Vision for Venture Capital: Realizing the Promise of Global Venture Capital & Private Equity*. New Ventures Press, December 2009

**Christopher R. Browning** (University of North Carolina at Chapel Hill). *Remembering Survival: Inside a Nazi Slave-Labor Camp*. W.W. Norton, January 2010

**Noam Chomsky** (Massachusetts Institute of Technology). *Hopes and Prospects*. Haymarket Books, March 2010

**Keith Christiansen** (Metropolitan Museum of Art). *The Genius of Andrea Mantegna*. Yale University Press, March 2010

**Jonathan R. Cole** (Columbia University). *The Great American University: Its Rise to Preeminence, Its Indispensable National Role, and Why It Must Be Protected*. PublicAffairs, January 2010

**Karen S. Cook** (Stanford University), Chris Snijders (Eindhoven University of Technology), Vincent Buskens (Utrecht University), and Coye Cheshire (University of California, Berkeley), eds. *eTrust: Forming Relationships in the Online World*. Russell Sage Foundation Publications, November 2009

**Bruce Cumings** (University of Chicago). *Dominion from Sea to Sea: Pacific Ascendancy and American Power*. Yale University Press, November 2009

**Sheldon Danziger** (University of Michigan) and Maria Cancian (University of Wisconsin-Madison), eds. *Changing Poverty, Changing Policies*. Russell Sage Foundation Publications, September 2009

**Robert Darnton** (Harvard University). *The Case for Books: Past, Present, and Future*. PublicAffairs, October 2009

**Jared Diamond** (University of California, Los Angeles) and James A. Robinson (Harvard University), eds. *Natural Experiments of History*. Harvard University Press, January 2010

**David Ekbladh** (Tufts University; Academy Visiting Scholar, 2007–2008). *The Great American Mission: Modernization and the Construction of an American World Order*. Princeton University Press, December 2009

**David L. Featherman** (University of Michigan), Martin Hall (University of Salford, Greater Manchester), and Marvin Krislov (Oberlin College), eds. *The Next Twenty-Five Years: Affirmative Action in Higher Education in the United States and South Africa*. University of Michigan Press, December 2009

**Robert J. Fogelin** (Dartmouth College). *Taking Wittgenstein at His Word: A Textual Study*. Princeton University Press, December 2009

**Carol Gluck** (Columbia University) and Anna Tsing (University of California, Santa Cruz), eds. *Words in Motion: Toward a Global Lexicon*. Duke University Press, November 2009

**Anthony Grafton** (Princeton University), **Glenn W. Most** (Scuola Normale Superiore di Pisa and University of Chicago) and **Salvatore Settis** (Scuola Normale Superiore di Pisa), eds. *The Classical Tradition*. Harvard University Press, January 2010

**Christopher P. Jones** (Harvard University). *New Heroes in Antiquity: From Achilles to Antinoos*. Harvard University Press, January 2010

**Frank Kermode** (University of Cambridge). *Concerning E. M. Forster*. Farrar, Straus and Giroux, December 2009

**David S. Landes** (Harvard University), **Joel Mokyr** (Northwestern University), and **William J. Baumol** (New York University), eds. *The Invention of Enterprise: Entrepreneurship from Ancient Mesopotamia to Modern Times*. Princeton University Press, February 2010

**Steven D. Levitt** (University of Chicago) and Stephen J. Dubner (*The New York Times*). *Superfreakonomics: Global Cooling, Patriotic Prostitutes and Why Suicide Bombers Should Buy Life Insurance*. William Morrow, November 2009

**Charles Muscatine** (University of California, Berkeley). *Fixing College Education: A New Curriculum for the Twenty-First Century*. University of Virginia Press, September 2009

**Martha C. Nussbaum** (University of Chicago Law School). *From Disgust to Humanity: Sexual Orientation and Constitutional Law*. Oxford University Press, February 2010

**Francis Oakley** (Williams College). *Empty Bottles of Gentilism: Kingship and the Divine in Late Antiquity and the Early Middle Ages (to 1050)*. Yale University Press, March 2010

**Nell Irvin Painter** (Princeton University). *The History of White People*. W.W. Norton, March 2010

**Michael Pasquier** (Louisiana State University; Academy Visiting Scholar, 2008–2009). *Fathers on the Frontier: French Missionaries and the Roman Catholic Priesthood in the United States, 1789–1870*. Oxford University Press, January 2010

**Henry Petroski** (Duke University). *The Essential Engineer: Why Science Alone Will Not Solve Our Global Problems*. Knopf, January 2010

**Robert Pozen** (MFS Investment Management). *Too Big to Save? How to Fix the U.S. Financial System*. Wiley, November 2009

**Christopher Ricks** (Boston University). *True Friendship: Geoffrey Hill, Anthony Hecht, and Robert Lowell under the Sign of Eliot and Pound*. Yale University Press, March 2010

**Michael J. Sandel** (Harvard University). *Justice: What's the Right Thing to Do?* Farrar, Straus and Giroux, September 2009

**Seymour Slive** (Harvard University). *Rembrandt Drawings*. Getty Publications, October 2009

**Neil J. Smelser** (Berkeley, California). *The Odyssey Experience: Physical, Social, Psychological, and Spiritual Journeys*. University of California Press, March 2009

**Barbara Herrnstein Smith** (Duke University and Brown University). *Natural Reflections: Human Cognition at the Nexus of Science and Religion*. Yale University Press, January 2010

**Werner Sollors** (Harvard University) and Greil Marcus (Berkeley, California), eds. *A New Literary History of America*. Belknap Press of Harvard University Press, September 2009

**Steven Weinberg** (University of Texas at Austin). *Lake Views: The World and the Universe*. Harvard University Press, January 2010

**Meg Whitman** (Atherton, California) with Joan O'C. Hamilton (San Francisco, California). *The Power of Many: Values for Success in Business and in Life*. Crown, January 2010

**Theodore Ziolkowski** (Princeton University). *Heidelberger Romantik: Mythos und Symbol*. Universitätsverlag Winter, July 2009; *Scandal on Stage: European Theater as Moral Trial*. Cambridge University Press, October 2009

**Harriet Zuckerman** (Andrew W. Mellon Foundation), Ronald G. Ehrenberg (Cornell University), Jeffrey A. Groen (Bureau of Labor Statistics), and Sharon M. Brucker (Princeton University). *Educating Scholars: Doctoral Education in the Humanities*. Princeton University Press, October 2009

*We invite all Fellows and Foreign Honorary Members to send notices about their recent and forthcoming publications, scientific findings, exhibitions and performances, and honors and prizes to [bulletin@amacad.org](mailto:bulletin@amacad.org). ■*

## Remembrance

*It is with sadness that the Academy notes the passing of the following members.\**

**Louis Auchincloss** – January 26, 2010; elected to the Academy in 1997

**Geoffrey Burbidge** – January 26, 2010; elected to the Academy in 1971

**Albert Victor Crewe** – November 18, 2009; elected to the Academy in 1972

**Robben Wright Fleming** – January 11, 2010; elected to the Academy in 1978

**Lincoln Gordon** – December 19, 2009; elected to the Academy in 1959

**John L. Harper** – March 22, 2009; elected to the Academy in 1992

**Dell Hathaway Hymes** – November 13, 2009; elected to the Academy in 1974

**Howard Wesley Johnson** – December 12, 2009; elected to the Academy in 1966

**Stanley Kelley, Jr.** – January 17, 2010; elected to the Academy in 1993

**Edwin Gerhard Krebs** – December 21, 2009; elected to the Academy in 1971

**Andrew Evan Lange** – January 22, 2010; elected to the Academy in 2005

**Edward H. Linde** – January 10, 2010; elected to the Academy in 2009

**Peter Hugh Jefferd Lloyd-Jones** – October 5, 2009; elected to the Academy in 1978

**Domenico Maffei** – July 4, 2009; elected to the Academy in 1984

**Emanuel Margoliash** – April 10, 2008; elected to the Academy in 1970

**John Robert Meyer** – October 20, 2009; elected to the Academy in 1968

**Marshall W. Nirenberg** – January 15, 2010; elected to the Academy in 1965

**Kenneth Clifton Noland** – January 5, 2010; elected to the Academy in 1991

**Paul Anthony Samuelson** – December 13, 2009; elected to the Academy in 1942

**Ihor Ševčenko** – December 26, 2009; elected to the Academy in 1974

**Philip Siekevitz** – December 5, 2009; elected to the Academy in 1978

**Stephen Edelston Toulmin** – December 4, 2009; elected to the Academy in 1989

**Eugene Earl van Tamelen** – December 12, 2009; elected to the Academy in 1972

**Nikolay Nikolayevich Vorontsov** – March 3, 2000; elected to the Academy in 1994

**Robert Edward Ward** – December 14, 2009; elected to the Academy in 1975

**Yosef Hayim Yerushalmi** – December 8, 2009; elected to the Academy in 1986

\* Notice received from November 13, 2009, to January 31, 2010

# From the Archives



The Academy's 28 Newbury Street House in 1909 before expansion into adjoining lot and construction of a new House (photo: A. L. Rotch)



The Academy's rebuilt House (photographed ca. 1940) and the same building today (photograph below)



On January 10, 1906, the Academy held its first meeting in its new headquarters at 28 Newbury Street, in Boston's Back Bay. Former Academy President Alexander Agassiz's generous bequest in 1910 enabled the Academy to purchase the adjoining property and erect an entirely new building on the enlarged site. The Academy held meetings in this new building until 1955. The property now houses a Banana Republic store, though the Academy's name and that of President Agassiz remain prominent over the front door.

## Notices to the Fellows

- **Appraisal Ballot Deadline: March 5, 2010**

The final Appraisal Ballot for the 2010 membership election was sent to all Fellows on February 12, 2010. The deadline for returning ballots is March 5, 2010. Election results will be announced in April.

- **The Annual Fund**

The Academy's 2009 – 2010 Annual Fund is nearing its closing date of March 31. With the help of members and friends, Development Committee Cochairs Louis Cabot and Robert Alberty hope to surpass the \$1.5 million mark once again. The Annual Fund helps to support Academy projects and studies, publications and outreach, website, meetings, and other activities for Fellows. Every gift counts toward reaching our ambitious goal. The Annual Fund challenge will match all new and increased gifts.

If you have already made a gift to the Annual Fund, thank you. If not, we urge you to participate by March 31. For assistance in making a gift to the Academy, please contact the Development Office: (email: [dev@amacad.org](mailto:dev@amacad.org); telephone: 617-576-5057).

## AMERICAN ACADEMY OF ARTS & SCIENCES

Norton's Woods, 136 Irving Street, Cambridge, MA 02138  
telephone 617-576-5000, facsimile 617-576-5050,  
email [aaas@amacad.org](mailto:aaas@amacad.org), website [www.amacad.org](http://www.amacad.org)

---

### ACADEMY OFFICERS

Louis W. Cabot, *Chairman of the Board Pro Tem*

Leslie Berlowitz, *Chief Executive Officer and William T. Golden Chair*

John S. Reed, *Treasurer*

Jerrold Meinwald, *Secretary*

Steven Marcus, *Editor*

Neal Lane, *Cochair of the Council Pro Tem*

Gerald Early, *Cochair of the Council Pro Tem*

---

### PUBLICATIONS ADVISORY BOARD

Jerome Kagan, *Chair*; Jesse H. Choper, Denis Donoghue,  
Linda Greenhouse, Steven Marcus, Jerrold Meinwald, Emilio Bizzi

---

### EDITORIAL STAFF

Phyllis S. Bendell, *Director of Publications*

Micah J. Buis, *Associate Editor*

Scott Eaton Wilder, *Design & Layout*

Initial design by Joe Moore of Moore + Associates

---

*Bulletin* Winter 2010  
Issued as Volume LXIII, Number 2  
© 2010 by the American Academy of Arts & Sciences

*The Bulletin of the American Academy of Arts & Sciences* (ISSN 0002-712X) is published quarterly by the American Academy of Arts & Sciences. Periodicals rate postage paid at Boston, MA, and at additional mailing offices. Postmaster: Send address changes to *Bulletin*, American Academy of Arts & Sciences, 136 Irving Street, Cambridge, MA 02138.

The views expressed in the *Bulletin* are those held by each contributor and are not necessarily those of the Officers and Fellows of the American Academy of Arts & Sciences.

---

### PHOTO CREDITS

Steve Rosenthal	inside front cover
Martha Stewart	pages 1-3, 6-7, 9, 11, 13-14, 19-20, 23-24, 27, 30-32, 35-38, 40-44, 46-49, 51-53
Abbas Ali Shirazi	pages 33-34
Joe Neto	pages 59-60, 63-67