



AMERICAN ACADEMY OF ARTS & SCIENCES

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Bulletin

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Growing Pains in a Rising China

*Elizabeth J. Perry, Benjamin L. Liebman, Ching Kwan Lee,
and Barry Naughton*

Al-Qaeda and the Bomb: How Institutions Protect Against the Threat of Nuclear Terrorism

Scott D. Sagan, Thomas Hegghammer, Paul N. Stockton, Jessica Stern, and Matthew Bunn



The Universe Is Stranger Than We Thought

Martin Rees, Wendy Freedman, and Richard A. Meserve

ALSO: Public Trust in Vaccines
American and British Academies Discuss the Future of the Humanities
At Berkeley
Intellectual Diversity and *The Heart of the Matter*

Upcoming Events

OCTOBER

10th – 12th

Cambridge, MA

Induction Weekend

10th *A Celebration of the Arts and Humanities*

11th *Induction Ceremony*

12th *Closing Program, featuring Robert Ballard (Ocean Exploration Trust; Institute for Archaeological Oceanography; University of Rhode Island Graduate School of Oceanography)*

NOVEMBER

8th

Chicago, IL

in collaboration with the Chicago Humanities Festival

The Humanities and “Soft Power”

Featuring: **Karl W. Eikenberry** (Stanford University; former U.S. Ambassador to Afghanistan; retired U.S. Army Lieutenant General)

NOVEMBER

12th

House of the Academy, Cambridge

On Russia

Featuring: **Timothy Colton** (Harvard University), **George W. Breslauer** (University of California, Berkeley), and **Valerie Jane Bunce** (Cornell University)

DECEMBER

4th

New York City

The Invention of Courts

Featuring: **Judith Resnik** (Yale Law School), **Linda Greenhouse** (Yale Law School), **Jonathan Lippman** (Chief Judge of the State of New York and Chief Judge of the Court of Appeals), **Susan S. Silbey** (Massachusetts Institute of Technology), and **Jamal Greene** (Columbia Law School)

10th

House of the Academy, Cambridge

Winter Concert

Featuring members of the Boston Symphony Orchestra

For updates and additions to the calendar, visit www.amacad.org.

Special Thanks

We recently completed another successful fund-raising year with more than \$6.5 million raised. The Annual Fund surpassed \$1.6 million for the third consecutive year and exceeded its goal. Gifts from all other sources – including grants for projects – totaled more than \$4.9 million.

The generosity of an increasing number of contributors – including Members, staff, and friends; foundations, corporations, and associations; and University Affiliates – made these results possible, and we are grateful. A complete list of contributors will be sent to all Members in the fall and will also be available on the Academy’s website.

From the President

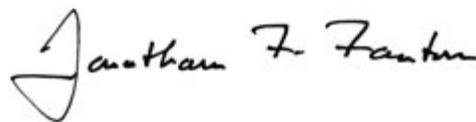
I started my work as President of the Academy on July 1 and appreciate the warm welcome from Members and staff.

I am impressed by the breadth and quality of studies underway at the Academy and by the engagement of so many Members in its work. I hope to increase the number of Members active in the Academy, and I encourage you and other Members to share your thoughts about the future of the Academy as well as your own interests. My email address is jfanton@amacad.org, and I look forward to your comments and ideas.

I commend this Summer issue of the *Bulletin* to you. It provides a rich sample of projects and publications underway at the Academy, including the follow up to *The Heart of the Matter*, a new report on Public Trust in Vaccines and another from the Global Nuclear Future project on Insider Threats, as well as an article on the recent issue of *Dædalus* on “The Invention of Courts.” In addition, the presentations on “Growing Pains in a Rising China,” “Protecting Against the Threat of Nuclear Terrorism,” and “The Universe is Stranger Than We Thought” exemplify the wide range of topics that concern the Academy and its Members. Please be sure to read Carnegie Mellon University President Subra Suresh’s closing essay about the importance of the humanities and social sciences to helping solve environmental challenges facing our world. He says, in part, “There is increasing recognition that the planet’s most severe problems cannot be treated as if they are solvable only by great engineering and scientific solutions. As *The Heart of the Matter* recognizes, the social sciences and humanities hold a key to our innovation ecosystem that will enable us to make more rapid progress in addressing major challenges.”

That speaks well to the comparative advantage the Academy has to bring together distinguished individuals from every field of human endeavor “to cultivate every art and science which may tend to advance the interest, honor, dignity, and happiness of a free, independent, and virtuous people.”

I look forward to making common cause with you in the years ahead.

A handwritten signature in black ink that reads "Jonathan F. Fanton". The signature is written in a cursive style with a large, stylized initial 'J'.

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Clockwise from top left: The Risk of Nuclear Terrorism from Insider Threats; Humanities Indicators; Barry Naughton; Scott D. Sagan; Subra Suresh; Wendy Freedman, George W. Breslauer; Elizabeth J. Perry

Academy Report Calls for More Research on Parental Decision-Making on Childhood Vaccines

The drumbeat of headlines about the latest measles, mumps, or pertussis (whooping cough) outbreaks offers evidence of a frightening reality: growing numbers of parents are either delaying or selectively administering immunizations – or choosing not to vaccinate their children at all. A new Academy report, *Public Trust in Vaccines: Defining a Research Agenda*, makes clear that reversing this trend requires dedicated research on how vaccine decisions are made and the best ways to communicate factual information to vaccine-hesitant parents.

The report is based on a September 2013 Academy workshop that convened leading researchers, practitioners, and policy-makers across a range of disciplines, from anthropology and communications to pediatric medicine and public health. The workshop was chaired by Barry Bloom, former Dean of the Harvard School of Public Health; Edgar Marcuse, Professor Emeritus of Pediatrics at the University of Washington; and Seth Mnookin, Associate Director of the Graduate Program in Sci-

ence Writing at the Massachusetts Institute of Technology and author of *The Panic Virus: The True Story Behind the Vaccine-Autism Controversy*.

The following excerpt from *Public Trust in Vaccines* delineates priorities for future research that would elucidate how health care providers can best communicate with undecided parents about the individual and community benefits of childhood vaccinations. The full report is available at www.amacad.org/vaccines.

A Proposed Research Agenda

Central Problem

Over the past two decades, a combination of fraudulent scientific studies, irresponsible reporting, and well-meaning but misinformed citizen activists has led to a steady increase in the proportion of parents who have concerns about the recommended childhood vaccine schedule. While overall vaccine uptake rates in the United States remain high, these concerns have resulted in a significant expansion in the number of parents who are delaying, and in extreme cases even refusing, vaccines for their children.

These actions have led to outbreaks of vaccine-preventable diseases: The largest domestic measles outbreak of the past 15 years occurred in 2013, and 2011 and 2013 were the two years with the highest number of domestic measles infections since the 1990s. All of the measles outbreaks in 2013 were caused by infections that originated outside of the country – and the overwhelming majority of the secondary infections occurred in deliberately unvaccinated children or infants too young to be vaccinated. The human and economic costs of these outbreaks are worthy of attention; one recent study estimated that the public sector cost of containing a *single case* of measles is more than \$10,000.¹

¹ David E. Sugarman et al., “Measles Outbreak in a Highly Vaccinated Population, San Diego, 2008: Role of the Intentionally Undervaccinated,” *Pediatrics* 125 (4) (April 1, 2010): 747–755; originally published online March 22, 2010, doi: 10.1542/peds.2009-1653.

As the scope of the problem has become more apparent, the public health and medical communities have begun to examine the best ways to communicate with anxious or wary parents. There has not, however, been a concerted effort to develop an evidenced-based toolkit to guide these discussions. The following suggested areas of research would provide the necessary data for such an effort.

Core Issues and Recommendations for Research

1. Parental Attitudes and Knowledge

- When and how are attitudes and beliefs about immunization formed?
 - How do parents learn about vaccines? Where do they encounter vaccine information, and how are they influenced by messages from expert and non-expert sources?
 - How does the perception of the benefits to the individual versus the community shape a parent’s decision to vaccinate his or her child?
 - To what extent does vaccine hesitancy result from a broader distrust in government and science?
- When are prospective parents or parents of infants most receptive to information about vaccines (e.g., during prenatal care visits, at the first well-child visit, etc.)?

Answering these questions will require longitudinal studies within individual communities to assess how and when parents arrive at vaccination decisions, how their attitudes and beliefs change over time, and what information sources (e.g., primary care physicians, Internet/television, social media, local social networks, family and friends, etc.) most strongly influence their decisions. These studies should sample prospective parents in young adulthood, expectant parents during pregnancy, parents immediately after the birth of their children, and parents when their children are scheduled to receive recommended vaccines.

2. The Medical Encounter

- How can providers best determine parents' attitudes about immunization?
- How can providers best respond to parental concerns?
- How can providers best present their science-based vaccine recommendations?
- Could a "checklist" for providers be developed to improve communications with parents?

Researchers should evaluate the effectiveness of communication strategies, including negotiation, used by all clinicians when discussing childhood vaccination with parents. A clearinghouse of vaccination-related interventions and innovations, drawing on data from state and local immunization managers and from other countries, and how these interventions affect uptake of childhood vaccinations, would facilitate such studies.

3. At-Risk Communities

- What are the most effective ways to identify geographic communities at increased risk of vaccine-preventable disease outbreaks?
- Are there common features among these communities?
- Do social networks play a different role in these communities than in communities at lower risk for vaccine-preventable disease outbreaks?
- How does peer-to-peer communication influence vaccine acceptance and uptake?
- In the case of communities or demographic groups that are apt to delay or refuse childhood vaccinations, what types of community-based interventions would have the largest effect on vaccine uptake?

A Call for Action

Childhood vaccination is a cornerstone of a healthy society – an essential bulwark against infections that, though currently in the shadows, inevitably reappear when public health defenses are down. In the United States, overall childhood vaccination coverage is still strong. But recent increases in immunization delay and refusal – and the resulting cases and outbreaks of preventable diseases – are a harbinger of danger.

Reversing this situation will require that public health leaders develop and promote evidence-based actions to increase the optimal use of vaccines. Therefore, it is critical that government agencies and private foundations support and prioritize cross-disciplinary research on immunization decision-making, as well as evaluate the effectiveness of health communication strategies. The research agenda presented here provides a foundation for enhancing both parent-provider and health agency communication. At stake is not only the physical health of the U.S. population, but also our nation's basic trust in science-based public health recommendations. A modern and well-functioning society can afford no less. ■

Reprinted from American Academy of Arts and Sciences, *Public Trust in Vaccines: Defining a Research Agenda* (Cambridge, Mass.: American Academy of Arts and Sciences, 2014).

Addressing Vaccine Hesitancy

Barry R. Bloom, Edgar Marcuse, and Seth Mnookin

Last month, the World Health Organization certified India and Southeast Asia as being polio-free, an extraordinary achievement given that the polio vaccine was declared safe and effective only 59 years ago. Vaccines are one of the safest and most cost-effective medical interventions in history. By immunizing infants, children, and teenagers, vaccines protect the entire community. Nevertheless, there is a surge of outbreaks in vaccine-preventable diseases in the United States. What research is needed to reverse this trend?

The crux of the problem is our inability to demonstrate to skeptical parents that vaccinations save lives. On the one hand, the United States has sustained impressive uptake rates for vaccinations overall. During the 2012–2013 school year, the median coverage was about 92% for vaccines against measles-mumps-rubella, diphtheria-tetanus-acellular pertussis, and varicella. Yet over the past 5 years, outbreaks of everything from measles to mumps to pertussis show that there is a growing number of communities with vaccine coverage below the levels needed to maintain herd immunity – when vaccination of a substantial portion of a population protects those who have not developed immunity. Many factors probably contribute to this decline: exposure to a report (that was later retracted) linking the measles vaccine to autism, warnings from ill-informed peers, scare tactics of antivaccine groups, and misinformation by celebrity personalities. Regardless of the source, the results are the same: debilitating infections, hospitalizations, and in tragic cases, death.

This frustrating reality illustrates that the facts do not always speak for themselves. We need only look at Western Europe to see how a few dozen cases of a vaccine-preventable disease can explode into a countrywide epidemic: In 2007, France reported 40 measles cases; in 2011, there were 15,000 cases with 6 deaths. In 2011, the United States experienced its largest number of individual measles cases (222) and outbreaks (17) since 1996. The source of nearly every outbreak was someone who was intentionally unvaccinated – often a U.S. resident traveling abroad or someone of unknown vaccine status. 2013 saw the largest single measles outbreak (58 patients) in the United States in nearly 20 years.

A recent report concluded that current public health communication about vaccines may actually increase misperceptions or reduce vaccination intention, and that attempts to increase concerns about communicable diseases or correct false claims about vaccines may be counterproductive.* Research is needed to develop evidence-based strategies that guide health care providers on how best to communicate the importance of immunization to parents who are uncertain about what to believe. Last fall, an interdisciplin-

ary group of scientists, clinicians, and social scientists convened at the American Academy of Arts and Sciences to discuss priorities in communication research that would provide specific solutions on how to move forward. The group's conclusion (the report, for which we were co-chairs, has just been released†) was that we need research that addresses how and when attitudes and beliefs about vaccines are formed, how people make decisions about immunization, how best to present information about vaccines to hesitant parents, and how to identify communities at risk of vaccine-preventable disease outbreaks. A study of the 2008 San Diego measles outbreak‡ found that the cost to the public health system of each measles infection was \$10,376, whereas the total cost to contain the outbreak was \$124,517. If the type of research proposed by the American Academy report helps to prevent even a handful of outbreaks, it will have more than paid for itself.

Strategies to combat antivaccine messages cannot be developed by educated guesswork. Evidence-based approaches that facilitate vaccination are needed if we are to prevent diseases that can easily be avoided and fulfill the potential of modern vaccine research. ■

† *Public Trust in Vaccines: Defining a Research Agenda* is available at www.amacad.org/vaccines.

‡ David E. Sugerman et al., "Measles Outbreak in a Highly Vaccinated Population, San Diego, 2008: Role of the Intentionally Undervaccinated," *Pediatrics* 125 (2010): 747.

From *Science* 344 (25 April 2014): 339. Reprinted with permission from the American Association for the Advancement of Science.

Barry R. Bloom is Harvard University Distinguished Service Professor, Department of Immunology and Infectious Diseases, and former Dean of the Harvard School of Public Health at Harvard University. He is a Fellow of the American Academy of Arts and Sciences.

Edgar Marcuse is Emeritus Professor of Pediatrics at the University of Washington.

Seth Mnookin is the Associate Director of the Graduate Program in Science Writing at the Massachusetts Institute of Technology. His most recent book is "The Panic Virus: The True Story Behind the Vaccine-Autism Controversy."

* Available at <http://pediatrics.aappublications.org/content/early/2014/02/25/peds.2013-2365>.

The Risk of Nuclear Terrorism from Insider Threats

The risk of nuclear terrorism has guided and informed the work of the Academy's **Global Nuclear Future Initiative** since its inception in 2008. The project's most recent publication, *A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes*, by Scott D. Sagan (Stanford University) and Matthew Bunn (Harvard University), highlights one particular aspect of nuclear terrorism: the problem of insider threats. In the past decade, thanks to the enormous efforts of the United States, working in cooperation with the leaders of many other governments, NGOs, think tanks, and international organizations, there has been some success in preventing non-state actors from acquiring nuclear material.

In 2004, the Bush administration garnered consensus for the adoption of United Nations Resolution 1540 on Nuclear Terrorism. The resolution, sponsored jointly by the United States and France, and approved unanimously by the UN Security Council, states that the proliferation of nuclear, chemical, and biological weapons and their means of delivery constitute a threat to international peace and security. As such, the resolution requires all states to adopt legislation to prevent the proliferation of nuclear, chemical, and biological weapons, and their means of delivery, and to establish appropriate domestic controls over related materials to prevent their illicit trafficking. Two years later, the United States, in cooperation with Russia, launched the Global Initiative to Combat Nuclear Terrorism (GICNT), a multilateral initiative to strengthen the global capacity to prevent, detect, and respond to nuclear terrorism.

The Obama administration has endorsed the nuclear security agenda launched by President Bush and has worked to expand its mission and outreach. In his historic speech in Prague in April 2009, President Obama stated, "One terrorist with one nuclear weapon could unleash massive destruction. To protect our people, we must act with a sense of purpose without delay." In the same speech, the president launched the idea of a new global initiative, the Nuclear Security Summit, to secure all vulnerable nuclear material around the world within four years. The Nuclear Security Summit has met every two years and operates on principles that are based on "Gift Basket Diplomacy," meaning only invited governments can participate in the summit and those governments are expected to bring to the summit national pledges and commitments of their respective countries to ameliorate, enhance, and improve the enforcement and implementation of their national nuclear security regime.

Three Nuclear Security Summits have been held so far, and the list of invitees has grown together with the importance and

relevance of the gift baskets that countries have been willing to commit to. The first meeting was held in Washington, D.C., in 2010 and forty-seven countries attended; the second meeting took place in Seoul, South Korea, in 2012 with fifty-three countries in attendance; and the third and most recent meeting was held in 2014 in the Netherlands with fifty-eight countries participating. The next (and perhaps final) summit is planned for 2016 in Washington, D.C.

These three Nuclear Security Summits have made significant progress toward forging global awareness on the issue of nuclear terrorism and creating international and domestic consensus to adopt costly yet necessary measures to protect countries from the threat of nuclear

terrorism. Most notably, several countries attending the summits pledged their intention to convert civilian nuclear facilities from highly enriched uranium (HEU) to non-weapons useable materials. Included among these countries are some legacy countries, such as Mexico, Kazakhstan, Ukraine, Belgium, United Kingdom, and Norway, and some nuclear newcomers, such as Vietnam, whose nuclear energy program is only in its infancy. In addition, the coun-

tries in attendance, including Indonesia, which previously opposed the nuclear security agenda because it was seen as a way to discriminate between developed and developing countries, pledged to adopt more stringent borders and export control laws and to design better transportation, accounting, consolidation, and storage practices for nuclear material.

Despite geopolitical crises such as the one unfolding in Ukraine and the increasingly tense territorial disputes in East Asia among regional and great powers, global commitment and international cooperation focused on combating and eliminating the threat of nuclear terrorism have not been weakened. This development may suggest that leaders of countries with otherwise conflicting national priorities and strategic objectives acknowledge the need

Most of the efforts to reduce the risks of nuclear terrorism focus on preventing external attacks that could create a Chernobyl-like event or would enable a terrorist to steal fissile material to make a nuclear bomb.

A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes



Matthew Bunn and Scott D. Sagan

AMERICAN ACADEMY OF ARTS & SCIENCES

and plutonium that exists at vulnerable locations. The adoption of more sophisticated monitoring devices and the deployment of better equipped and trained armed guards have become the immediate strategy implemented to address the threat of nuclear terrorism.

The recent Academy paper, *A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes*, by Bunn and Sagan, argues that one major component missing in a long-term strategy to reduce the risks of nuclear terrorism is one that addresses “the insider threat.” Sagan and Bunn demonstrate how difficult it is to address hidden dangers that come from within nuclear facilities, from insiders who might steal critical material, assist terrorist groups, or engage in sabotage attacks. The authors write that the history of nuclear materials theft supports this concern about insider threats: “all of the cases of theft of nuclear materials where the circumstances of the theft are known were perpetrated either by insiders or with the help of insiders.”

One major component missing in a long-term strategy to reduce the risks of nuclear terrorism is one that addresses “the insider threat.”

There have been a number of “best practices guides” issued by the International Atomic Energy Agency (IAEA) and the World Institute for Nuclear Security (WINS) to address insider threats. To complement these recommendations, Bunn and Sagan’s “worst practices guide” identifies a series of common mistakes that organizations have made, drawing on episodes involving intelligence agencies, the professional military, secret service bodyguards for political leaders, security measures for banking and financial institutions, and the gambling industry, among others.

Some of the specific cases that Bunn and Sagan examine include the assassination of Indian President Indira Gandhi by her two Sikh bodyguards, the organizational failures that led to the first Ford Hood shooting by U.S. Army Major Nidal Hasan, and the case of Robert Hansen, who was found responsible for fifteen counts of espionage while serving within the FBI.

The overarching message of the paper is clear: “when it comes to protecting organizations from insider threats, do not assume, always assess – and assess and test as realistically as possible.”

Among the lessons learned that are discussed in the paper, three are particularly important. First, do not assume that serious insider problems are not in your organization. According to Sagan and Bunn, “Organizational leaders should never assume that their personnel are so loyal that they will never be subject to ideologies,

to work collectively to prevent terrorist organizations from gaining access to nuclear material.

Yet much remains to be done to address this danger. Most of the efforts to reduce the risks of nuclear terrorism focus on preventing external attacks that could create a Chernobyl-like event or would enable a terrorist to steal fissile material to make a nuclear bomb. Speculation that terrorist groups may orchestrate such an assault grew exponentially after the 9/11 attacks, with the continued U.S. entanglement in Iraq and Afghanistan, and with ongoing acts of violence on targets in other parts of the globe, including Pakistan and the Middle East.

This mindset, and the perception of the nature of the threat, has resulted in a widespread response that has focused on strengthening and enhancing the physical protection of nuclear facilities and reducing the amount of highly enriched uranium

shifting allegiances or personal incentives that could lead them to become insider threats.”

Second, do not assume that background checks will solve the insider problem: these programs are effective but they are not bulletproof. Measures to complement these strategies should be put in place when these strategies fail.

Third, do not assume that security rules are followed. Establishing clear policies is an indispensable element for organizations to work effectively; an over-reliance on rules, however, may weaken the ability of an organization to think strategically and anticipate insider threats.

Further, not all employees may apply rules universally. Several studies, in fact, show that when employees encounter rules that “they consider senseless, they typically do not comply with them. This can contribute to a broader culture in which people follow security rules only when they find it convenient.” Managers must continue to provide incentives for employees to follow rules, but they must also implement a regular search process that identifies and eliminates redundant or obsolete rules.

The paper was distributed widely to key nuclear laboratories, military organizations, international organizations, and to more than 100 nuclear experts around the world currently involved in devising strategies and implementing policies to protect against the peril of insider threats. Several nuclear laboratories are using the paper as a training resource.

The GNF project is continuing its work in this area. Four new papers that will identify the causes and drivers of insider threats in different sectors have been commissioned. These papers will be published in an edited volume that will offer additional analysis and recommendations on how to make American and international nuclear installations safer.

The risk of nuclear terrorism is changing and growing more complex in an era of cyber-attacks and increasing competition between the United States and rising powers.

At a recent workshop held in Cambridge in May, thirty senior officials from nuclear laboratories and international and military organizations, as well as nuclear experts from academia and think tanks explored different dimensions of the insider threat problem, in contexts as different as nuclear plants, military operations, and laboratories. The participants shared challenges in facing and overcoming complacency. They discussed how the risk of nuclear terrorism is changing and growing more complex in an era of cyber-attacks and increasing competition between the United States and rising powers.

In June, leaders of the GNF Initiative traveled to Istanbul, Turkey, to participate in a capacity-building training workshop for journalists from the Middle East. Organized by the Academy, the Center for Non-Proliferation Studies, and the Stanley Foundation, the workshop trained twenty journalists from the Middle East on how to write in a more informed way about nuclear risks and threats in their region. In addition, the Academy hosted two events in cooperation with EDAM and the Global Relations Forum, two think tanks in Istanbul, at which leaders of the GNF Initiative met with policymakers, the media, and leading academics; they discussed challenges that nuclear newcomers face when establishing a nuclear energy program, including protecting their own nuclear facilities from outside and inside threats.

The Academy’s work on insider threats, and on other nuclear related issues throughout the course of its GNF Initiative, is supported by Carnegie Corporation of New York, The William and Flora Hewlett Foundation, The John D. and Catherine T. MacArthur Foundation, The Alfred P. Sloan Foundation, The Flora Family Foundation, and The Kavli Foundation. More information about the Global Nuclear Future project is available online at www.amacad.org/gnf. ■

The Academy Rolls Out Three New Research Tools

On June 19, 2014, the American Academy introduced a fully revised **Humanities Indicators** website (<http://HumanitiesIndicators.org>), a new report showing contraction across a number of funding streams for the field, and a new data forum designed to spur further dialogue about the state of the humanities.

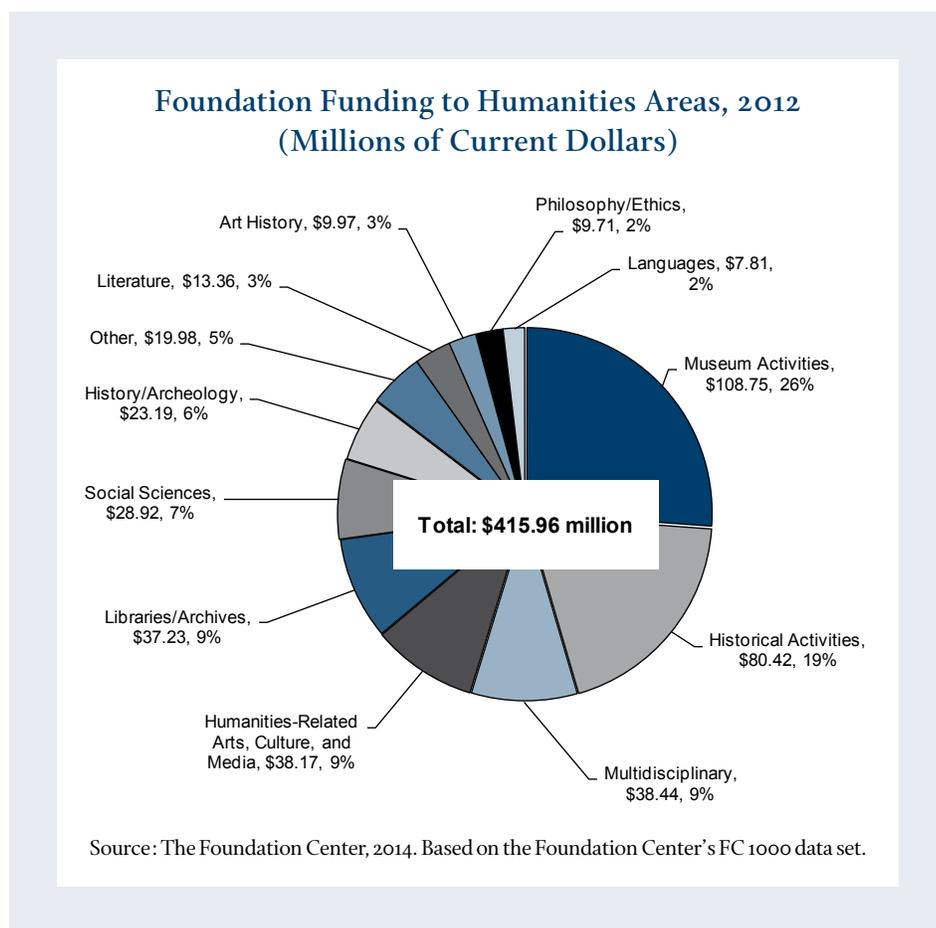
The release of these new research tools coincides with the first anniversary of the publication of *The Heart of the Matter*, the report of the Commission on the Humanities and Social Sciences, and marks the Academy's ongoing commitment to the humanities.

The Indicators website currently covers 76 topics and includes over 270 graphs detailing the state of the humanities in schools, higher education, the workforce, research and funding support, and the life of the nation. Information is updated regularly as new data become available.

The new funding report, *The State of the Humanities: Funding 2014*, demonstrates the contribution the Indicators make to our understanding of the field. The report shows that financial support to the humanities from an array of sources – federal, state, and private – is tiny in comparison to other fields and remains below pre-recession levels.

Among the findings, the report notes that federal funding for programs targeted at the humanities is 31 percent lower in 2014 than it had been in 2008. Similarly, funding from foundations to the humanities was 18 percent lower in 2012 than in 2007, according to preliminary data gathered from the Foundation Center.

The Indicators project, chaired by Norman M. Bradburn (NORC; University of Chicago), is an objective source of the best available data on the humanities, so the new funding report only describes the numbers – inviting others to assess what these trends might mean for the field. To foster such conversations about the Indicators as well as about data generated by other Academy projects, the Academy initiated The Data Forum (<https://www.amacad.org/dataforum>), in which invited



experts discuss the data and offer context, perspective, and critiques for new findings.

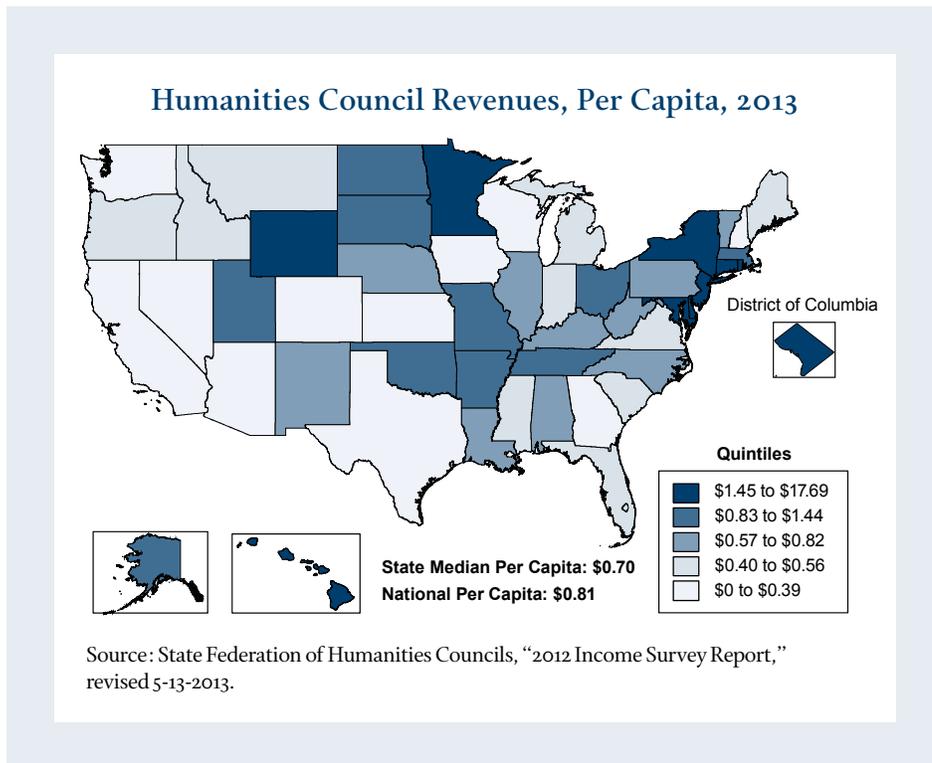
The Data Forum reinforces an ongoing effort among project leaders to make the Indicators easier to use, assuring that journalists, researchers, and the general public can quickly find answers to questions about the humanities.

Some of the changes to the Indicators website are cosmetic – such as offering a fresh and streamlined design – but most of the revisions are structural, foregrounding

statistical findings and accompanying figures rather than descriptive narratives. To aid in the use of this evidence, the site also offers PowerPoint slides and PDFs that can be easily incorporated into presentations or articles.

While the revisions simplify the presentation of evidence for a general audience, critical context about the information has been preserved in detailed notes “About the Data.”

The Indicators were first published as a prototype in 2009, after a group of Academy



members acknowledged that a long-running series of Science and Engineering Indicators from the National Science Foundation had been driving much of the conversation about the needs of the scientific community.

Like their more established counterpart in the sciences, the Humanities Indicators have provided a starting point for an array of discussions, such as last year's debates about trends in the number of college majors in the humanities.

The Humanities Report Card: 2013, which drew heavily on findings from the Indicators, has also enjoyed a wide audience. Over 10,000 copies have been distributed in print, with thousands of additional copies disseminated through the Web and social media.

Several new studies and reports are forthcoming from the Indicators project, including results from a study of humanities departments at four-year colleges and universities (available in September), findings on employment and salaries for humanities majors, and an analysis of the revenues of humanities non-profit organizations.

The Academy gratefully acknowledges the financial support of The Andrew W. Mellon Foundation, primary funder of the Humanities Indicators, as well as the National Endowment for the Humanities.

The Humanities Indicators website continues to develop and evolve. Please contact the project staff (at humanitiesindicators@amacad.org) with any questions or suggestions. ■

The American and British Academies Discuss the Future of the Humanities

On June 23 – 24, 2014, the American Academy and the British Academy held a joint conference in London that examined the state of humanities research and education in an international context. The conference concluded a year in which both academies published major reports on the humanities and social sciences: the American Academy’s *Heart of the Matter* report and the British Academy’s *Prospering Wisely* white paper.

The conference, entitled “Broadening the Debate: How the Humanities and Social Sciences can help us address global challenges,” was the first official collaboration between the two academies in a century.

Diane P. Wood – Chief Judge of the United States Court of Appeals for the Seventh Circuit, Chair of the Academy Council, and member of the Academy’s Commission on the Humanities and Social Sciences – led a U.S. delegation that included Commission members Karl W. Eikenberry, former U.S. Ambassador to Afghanistan and retired U.S. Army Lieutenant General; Hunter Rawlings, President of the Association of American Universities; and Pauline Yu, member of the Academy Council and President of the American Council of Learned Societies. The American delegation also included representatives of the National Endowment for the Humanities, the National Humanities Alliance, the American Council on Teaching Foreign Languages, and the American Councils for International Education, among others.

Participants from the British Academy included Nicholas Stern (Lord Stern of Brentford), President of the British Academy; Dame Helen Wallace of the London School of Economics and Political Science; Jonathan Bate, Provost of Worcester College, Oxford; and Nigel Vincent of the University of Manchester. In all, over two hundred Fellows of both academies attended the two-day conference.

In a preliminary statement, Don Randel, Chair of the Academy Board, said, “Independently, our academies have been working to inspire greater support for the humanities and social sciences as disciplines vital to our respective nations. This joint conference gives us an opportunity to explore these topics together and, for the first time, to speak with a unified voice about the importance of humanistic pursuits to a well-functioning society.”

The first day of the conference featured two panel discussions before an invited audience that included scholars, policy-makers, and teachers. The first panel addressed “Why a Coordinated Approach to the Humanities, Social Sciences, and Natural Sciences Matter.” Yu asserted that “the humanities and sciences are necessarily complementary” since there are “a range of human problems that cannot be defined as strictly scientific,” and she stressed the importance of a broad liberal arts education at the undergraduate level to create a pipeline of scholars prepared to address future challenges.



Hunter Rawlings (Association of American Universities), **Pauline Yu** (American Council of Learned Societies), **Robin Jackson** (British Academy), **Diane P. Wood** (United States Court of Appeals for the Seventh Circuit), **Karl W. Eikenberry** (Stanford University, former U.S. Ambassador to Afghanistan, U.S. Army Lieutenant General, ret.), and **Dame Helen Wallace** (British Academy)

During the second panel, “Promoting Opportunity through Education,” Rawlings offered an impassioned plea for new approaches to teaching, stressing the need for active student engagement that draws on the tradition of philosophical and academic dialogue founded by Plato in the 4th century BCE.

The focus of the second day of the conference was a roundtable discussion cosponsored by the British Academy and *The Guardian* as part of their ongoing collaboration on “The Case for Language

Soft power is about culture, it's about values, and it's about smart, nuanced foreign policy. . . . And I would argue that its strength lies in the arts, the humanities and the social sciences.

Learning.” Discussants, including the entire American delegation, addressed the importance of language learning in national and international policy as well as best practices in language education. Proceedings of the roundtable, moderated by *Guardian* columnist Will Hutton, were published in an online edition of the newspaper on July 7. The article, entitled “Lack of languages stifles Brits and Americans,” captures many of the themes of the two-day conference and is, in effect, the first product of collaboration between the two academies.

Transcripts of the discussion will inform a British Academy white paper that will be published in early 2015. Several language initiatives in the United States will also draw on the proceedings as inspiration for continuing efforts, including the Language Enterprise Initiative.

The conference concluded with a public event, “Global Power, Influence, and Perception in the 21st Century,” featuring Eikenberry; Sir Adam Roberts, former President of the British Academy and a Foreign Honorary Member of the American Academy; and Sir Martin Davidson, Chief Executive of the British Council. The speakers discussed the importance of the humanities and social sciences to “soft power,” the cultural and persuasive influence of nations like the United States and the United Kingdom. “Soft power is about culture, it’s about values, and it’s about smart, nuanced foreign policy,” Eikenberry said. “And I would argue that its strength lies in the arts, the humanities and the social sciences.” Bridget Kendall, diplomatic correspondent for the BBC, moderated the conversation.

Video of the events is available at www.humanitiescommission.org.

Following the conference, leaders of the British Academy and American Academy discussed future collaborations, including more frequent correspondence on issues of mutual concern, scholar exchanges, and the possibility of biannual joint conferences.

Although the two academies share a concern for the strength and vitality of intellectual life in their respective nations, contact between them has been minimal: prior to the June conference, the last recorded contact between the two academies was a publication exchange in 1914. ■

Around the Country

New York City

Chair of the Board **Don M. Randel** and President-Designate **Jonathan F. Fanton** welcomed over a hundred Fellows and guests to a reception in New York City on May 19, 2014.



Henry Arnhold (Arnhold and S. Bleichroeder Holdings, Inc.), **Angelica Zander Rudenstine** (Princeton, New Jersey; New York, New York), and **Jonathan Fanton** (American Academy)



Don M. Randel (New York, New York), **Harvey Dale** (New York University School of Law), and **Thomas Bender** (New York University)

PROJECTS AND ACTIVITIES



Daniel Rose (Rose Associates, Inc.) and **Joanna Semel Rose** (New York, New York)



Sara Lee Schupf (New York, New York), **Axel Schupf** (H. A. Schupf Co., LLC), and **Carl Pforzheimer** (Carl H. Pforzheimer and Co., LLC; CHIPCO Asset Management, LLC)



Barbara Tversky (Columbia University), **Neta Bahcall** (Princeton University), and **Walter Cahn** (Yale University)



Nannerl Keohane (Princeton University) and **Glenn Hutchins** (Silver Lake)



Peter Palese (Icahn School of Medicine at Mount Sinai) and **John Biggs** (TIAA-CREF)



Maxwell Hearn (Metropolitan Museum of Art), **Vera Michaels** (New York University), and **Robert Dijkgraaf** (Institute for Advanced Study)



Carol Mancusi-Ungaro (Harvard Art Museum; Whitney Museum of American Art) and **Neil Rudenstine** (ARTstor)



Richard Gardner (Columbia Law School) and **Carol Gluck** (Columbia University)



Jonathan Cole (Columbia University) and **Victor Navasky** (*The Nation*; Columbia University Graduate School of Journalism)



Frances Degan Horowitz (City University of New York, The Graduate Center), **Rosemary Stevens** (Cornell University, Weill Cornell Medical College), and **Harriet Zuckerman** (Andrew W. Mellon Foundation)



Gustave Hauser (Hauser Communications, Inc.), **Rita Hauser** (The Hauser Foundation), and **Debra La Morte** (New York University)



Helene Kaplan (Skadden, Arps, Slate, Meagher & Flom LLP & Affiliates) and **Joel Conarroe** (New York, New York)

Dædalus Examines “The Invention of Courts”

What challenges confront U.S. courts as democratic institutions in the twenty-first century? And what does the changing role of courts teach us about our conceptions of justice? The Summer 2014 issue of *Dædalus* explores the complex shifts occurring in U.S. courts and the implications for the citizens that rely on them. “The Invention of Courts” is guest-edited by Academy Fellows **Linda Greenhouse**, the Joseph Goldstein Lecturer in Law at Yale Law School and former Supreme Court reporter for *The New York Times*, and **Judith Resnik**, the Arthur Liman Professor of Law at Yale Law School.

Linda Greenhouse introduces the volume’s diverse essays by noting that “[t]o write about courts is to write about political theory, about lawyering, about fiscal priorities, and about social welfare, as well as about courts’ dependence on and independence from the body politic.” Many of the essays remind us that the courts do not stand on their own as static institutions; rather, they were and continue to be invented – a process informed by changing legislative, economic, political, and cultural landscapes.

In her essay, Judith Resnik traces the shifts in democratic theory and the role of social movements that pressed courts to embrace the view that all persons are equal rights holders, thereby transforming courts into democratic venues. Given the mandate to provide “open courts,” trial-level exchanges became opportunities for debates about what the shape of legal rules should be. Resnik notes, however, that in more recent decades, disputants are increasingly pressured or required to resolve disputes in private settings that do not provide the opportunity for public oversight of either processes or outcomes.

Democracy has not only changed courts; it challenges them profoundly. Resnik’s essay is one of several expressing the concern that the current system faces a host of issues, including deficits in court funding, the disappearance of trials, and the failure to translate into practice *Gideon vs. Wainwright*’s mandate of a constitutional right to adequate counsel for all indigent criminal litigants.

Among the issue’s fifteen essays, **Jonathan Lippman**, Chief Judge of the State of New York and Chief Judge of the Court of Appeals, examines the enormity of the unmet needs of New Yorkers who are unable to afford a lawyer, and introduces his and his task force’s efforts to address the crisis. **Robert Katzmann**, Chief Judge of the United States Court of Appeals for the Second Circuit, writes about the approaches he and his colleagues have explored to expand access to justice for undocumented immigrants, who often face deportation while detained and without the assistance of counsel. **Deborah R. Hensler** (Stanford Law School) discusses class actions and other ways of litigating mass harms and their implications for both individual plaintiffs and defendants. Finally, the idea of the “invention of courts” is poignantly given life in an essay by **Kate O’Regan**, who served as a Judge of the Constitutional Court of South Africa from its inception in 1994 through 2009.

Print and Kindle copies of the new issue can be ordered at: <https://www.amacad.org/publications/daedalus>. ■

Summer 2014 *Dædalus* “The Invention of Courts”

Linda Greenhouse (Yale Law School), *Introduction: The Invention of Courts*

Judith Resnik (Yale Law School), *Reinventing Courts as Democratic Institutions*

Jonathan Lippman (New York Court of Appeals), *State Courts: Enabling Access*

Robert A. Katzmann (United States Court of Appeals for the Second Circuit), *When Legal Representation is Deficient: The Challenge of Immigration Cases for the Courts*

Carol Steiker (Harvard Law School), *Gideon’s Problematic Promises*

Jonathan Simon (University of California, Berkeley), *Uncommon Law: America’s Excessive Criminal Law & Our Common-Law Origins*

Deborah R. Hensler (Stanford Law School), *Justice for the Masses? Aggregate Litigation & Its Alternatives*

Gillian K. Hadfield (University of Southern California), *Innovating to Improve Access: Changing the Way Courts Regulate Legal Markets*

Michael J. Graetz (Columbia Law School; Yale Law School), *Trusting the Courts: Redressing the State Court Funding Crisis*

Frederick Schauer (University of Virginia), *Our Informationally Disabled Courts*

Marc Galanter (University of Wisconsin, Madison) and **Angela M. Frozena** (non-practicing attorney), *A Grin without a Cat: The Continuing Decline and Displacement of Trials in American Courts*

Stephen C. Yeazell (University of California, Los Angeles School of Law), *Courting Ignorance: Why We Know So Little About Our Most Important Courts*

Susan S. Silbey (Massachusetts Institute of Technology), *The Courts in American Public Culture*

Jamal Greene (Columbia Law School), *(Anti)Canonizing Courts*

Kate O’Regan (formerly, Constitutional Court of South Africa), *Justice & Memory: South Africa’s Constitutional Court*

Growing Pains in a Rising China

On April 17, 2014, Elizabeth J. Perry (Henry Rosovsky Professor of Government at Harvard University and Director of the Harvard-Yenching Institute), Barry Naughton (Sokwanlok Chair of Chinese International Affairs and Professor of Chinese Economy at the University of California, San Diego), Ching Kwan Lee (Professor of Sociology at the University of California, Los Angeles), and Benjamin L. Liebman (Robert L. Lieff Professor of Law and Director of the Center for Chinese Legal Studies at Columbia Law School) participated in a conversation on the challenges that face China after thirty-five years of reform efforts. The program, which served as the Academy's 2007th Stated Meeting, included a welcome from Don M. Randel (Chair of the Board of the American Academy). The following is an edited transcript of the presentations.



Elizabeth J. Perry

*Elizabeth J. Perry is Henry Rosovsky Professor of Government at Harvard University and Director of the Harvard-Yenching Institute. She was elected a Fellow of the American Academy in 2002 and is the guest editor of the recent *Dædalus* issue on “Growing Pains in a Rising China.”*

The title of the Spring 2014 issue of *Dædalus* – “Growing Pains in a Rising China” – was chosen to underscore the tremendous challenges and contradictions that China currently faces on so many fronts, while at the same time suggesting that these tensions may perhaps be better

The affluence of the new urban middle and upper classes, which are flush with the proceeds from lucrative real estate deals, is offset by the indigence of millions of rural dwellers, as well as the millions of migrants who labor in the midst of urban affluence.

understood as growing pains of a body politic that is still in the process of changing and maturing, rather than as the death pangs of a communist dinosaur destined to imminent extinction.

The issue's contributors – an interdisciplinary group of social scientists, including political scientists, economists, sociologists, anthropologists, and historians – explore the challenges that face China after thirty-five years of reform efforts. The collection of essays attempts to take stock of China's challenges on a wide range of issues, including demography, health care, welfare, labor, the effects of the Internet, contemporary religious diversity, higher education, local governance, globalization, and environmental pollution, as well as the economy, legal reform, and social protest.

Evaluating China's performance on any of these fronts is not an easy task. The head-spinning pace of change in China threatens to render any of our academic assessments quickly obsolete. Further, the People's Republic of China's (PRC) post-Mao

record of achievement is decidedly uneven. It is uneven across geographic regions, across social strata, and across the different policy sectors that we have examined.

The major cities of China boast gleaming infrastructure and urban amenities that equal, or in some cases surpass those to be found in the advanced industrial world, but much of the rural interior remains mired in grinding poverty. The contrast between these two very different Chinas is the theme of many of the fifteen essays in the issue of *Dædalus*. The affluence of the new urban middle and upper classes, which are flush with the proceeds from lucrative real estate deals, is offset by the indigence of millions of rural dwellers, as well as the millions of migrants who labor in the midst of urban affluence. And although the Chinese state can take a good deal of credit, at least through the 1990s, for spearheading a series of bold economic measures that have replenished central coffers and have enriched many citizens, post-Mao achievements in the realm of social welfare, not to

mention political and legal reform, have to date been a good deal less impressive.

Despite its many very serious problems, however, the post-Mao Chinese state has survived, and indeed, by many measures, thrived. Moreover, the historical origins of the PRC suggest that its future may not be well predicted by the fates of the former Soviet Union and East European communist regimes. The PRC, like the four other remaining communist regimes, ascended to power via an extended rural revolution that endowed the state and its ruling Communist Party with strong nationalist credentials. This stands in contrast to the Communist Party of the Soviet Union, which gained control through a relatively short and quite narrowly based urban revolution; and the difference from Eastern Europe, where communist regimes were generally imposed by Soviet military might at the end of the Second World War, is even sharper.

The contributors to this issue of *Dædalus* were invited to explore ways in which the Chinese state is addressing actual policy concerns, from protest to public health. Although these problems may be especially pronounced and politically sensitive in China – in light of China’s exceptional size and its rapid economic growth under a basically unreformed Leninist political system – these are also problems that are common to virtually all countries. The issue’s authors were encouraged to assess the Chinese state’s record in comparative context, highlighting what is unique or unusual, for better or worse, in the PRC’s efforts to resolve these universal dilemmas.

Thinking comparatively about global dilemmas is of more than academic interest. We live today in a fragile and yet highly interdependent world that is troubled by a range of transnational challenges, from pandemics and climate change to finan-

We would be foolhardy to disregard or discount China’s efforts to resolve its serious problems simply because we predict that its political system is someday destined to disappear.

Unlike most of the formerly communist world, the PRC and its fellow surviving communist states attained power in the course of prolonged and pervasive peasant mobilization. That rich revolutionary history bequeathed valuable practical experience in social organization and control, while bestowing important political advantages that so far have withstood the test of time. This is certainly not to imply that these regimes are destined to last forever – far from it – but whatever the lifespan of the PRC turns out to be, its remarkable rise and resilience to date suggest that we should take quite seriously its efforts to resolve its current challenges.

cial meltdowns and terrorism. Institutions of governance as different as the Chinese Communist Politburo and the U.S. Congress find themselves severely tested, both ideologically and operationally, in trying to address these issues. We would be foolhardy to disregard or discount China’s efforts to resolve its serious problems simply because we predict that its political system is someday destined to disappear.



Barry Naughton

Barry Naughton is the Sokwanlok Chair of Chinese International Affairs and Professor of Chinese Economy at the University of California, San Diego. His essay, "China's Economy: Complacency, Crisis & the Challenge of Reform," appears in the recent issue of Dædalus on "Growing Pains in a Rising China."

I want to begin the discussion about what is unique or distinctive about China by first exploring what is not unique or distinctive. One thing we see very clearly, and which colors our understanding of China's economy, is that China is just now finishing a period of miraculous growth that essentially echoes what other successful East Asian economies have done over the last forty or fifty years. In its basic contours, China's economic miracle is a reproduction of those of other forerunner economies.

That is not to diminish the Chinese achievement, but simply to put it into context. When we compare the Chinese economic miracle period to that of other forerunner economies, what we discover is that not only is China bigger – with fun-

damental geographic and demographic challenges that some of the other forerunners did not face – but in terms of the outcome, China has also grown faster than any other economy in the history of the world. So, although the overall contours are similar, there are characteristics of the Chinese achievement that we still need to explain.

A characteristic of China's economic miracle that is both distinctive to China and critical to the world going forward is that China has mobilized a larger share of its total economic output for investment than any other economy in recorded history.

Unfortunately, we cannot identify the exact source of China's superb economic performance. Is it China's huge and impressive domestic market? Is it the sudden impact of new technologies like cell phones? Is it a statistical illusion, created by an understatement of gross domestic product in the late 1970s? All these explanations are possible, but overshadowing each is a characteristic of China's economic miracle that is both distinctive to China and critical to the world going forward: China has mobilized a larger share of its total economic output for investment than any other economy in recorded history.

For the last five years, China has spent about 48 percent of its gross domestic product on new fixed capital; that is three times the rate that the United States spends. So even though China is the second-largest economy in the world, substantially smaller than the United States, its investment economy is already as large as, and even slightly larger than, that of the United States. That means China has an extraordinary ability not only to build fundamental physical infrastructure, such as housing, roads, and factories, but also to develop advanced proj-

ects, such as its high-speed rail network. The reductionist answer is that this high state investment has driven China's rapid economic growth.

When we look at China from a somewhat broader and more institutional framework, we can see a ten-year period in which the Chinese administration of

General Secretary Hu Jintao and Premier Wen Jiabao was able to use the success of the economic development program and the mobilization of economic resources to further the consolidation and the stabilization of their system. In other words, the China that we have grown accustomed to over the last ten years is a China that increasingly has resources to build what it wants to build, to invest in the stabilization of party-state institutions, to solve some of its most critical social problems, and, in general, to consolidate the basis of Communist Party rule.

The great paradox of this period has been that just as the outside world has fully absorbed China's tremendous economic success, the trajectory within China has changed course. The kinds of policies that we think of as being foundational for the creation of China's success have become less prominent in state policy over the last ten years. Speaking as an economist, I am speaking primarily of disruptive, market-oriented economic reforms – the kinds of reform that were so distinctive during the administration of Premier Zhu Rongji in the 1990s and early 2000s.

As we have moved deeper into the twenty-first century, we have found that although China's successes are impressive, its commitment to economic reform – especially market-oriented economic reform that fosters an open-entry, open-access, level playing field and competitive approach to economic decision-making – has become less meaningful. There has even been some regression. And as a result of this slowdown in reform-oriented economic policy-making, there has been an increasing sense of hesitation, perhaps even a kind of credibility crisis, among the people of China. And to a certain extent, this has affected analysts of China who look at China from the outside. That is, we certainly think of China as being successful, but when we ask whether it has the political will and the institutional foundation to continue the reform process – not even in the sense of political reforms such as democratization or the separation of

reform, but rather that the administration has seemed to show a willingness to fundamentally disrupt the kind of economic and political stability bargain that had seemed to be so firmly ensconced by the late years of the Hu–Wen administration. The new administration of General Secretary Xi Jinping has in the last six or seven months introduced an economic reform program that is bold, that is extremely broad, and that challenges the achievements of the previous administration, announcing clearly: “We need to do more.”

But what I find especially interesting is that beyond setting the outlines of a reform program that may or may not make sense from a pure economic institutional basis, Xi Jinping has also shown a willingness to stir things up: to attack corruption, make life difficult for political leaders, and open up a number of issues that seemed to have been relatively settled during the last sev-

role of government in the economy. So far, China's government has not shown many signs of moving toward this gentler role. As we watch this intersection of slowing growth, changing policy, and renewed reform, the great question for economists is what will happen first and what kinds of external events will drive this unpredictable complex of policies, reactions, and economic changes.

Beyond setting the outlines of a reform program that may or may not make sense from a pure economic institutional basis, Xi Jinping has also shown a willingness to stir things up: to attack corruption, make life difficult for political leaders, and open up a number of issues that seemed to have been relatively settled during the last several years.

powers, but only in the very restricted sense of economic reforms – we find increasing doubt and hesitation about the ability and willingness of the Chinese Communist party-state to do so.

That doubt spread steadily through the most recent administration of Hu Jintao and Wen Jiabao. In some ways, the big surprise in the last few years has been not just that a new administration has come in and talked about the need to reinstate economic

eral years. We know that the growth rate has to fall, and we know that it is already falling. What we do not know is whether policy-makers can adapt a model that was very successful during the miracle growth period into a different kind of model suited for a new kind of economy.

In predecessor economies, the adaptation of the new model has always been difficult, but it has also always ultimately led to what we might think of as a lighter-touch



Ching Kwan Lee

Ching Kwan Lee is Professor of Sociology at the University of California, Los Angeles. Her essay, "State & Social Protest," appears in the recent issue of Dædalus on "Growing Pains in a Rising China."

Every year, China has to deal with more than one hundred thousand incidents of mass disturbance or protests. But how do they do it? How do they maintain stability in the face of so many protests erupting around the country every day?

I would like to be clear from the start that the kind of protest I am talking about mostly involves violations of labor rights, land rights, and property rights, as well as, more recently, issues relating to pollution and health problems. The protestors are not political dissidents, and most of them do not use violence. Nor are these protestors part of the ethnic or religious uprisings that are sometimes reported on in the international media. Within China, the vast majority of protests have to do with socioeconomic grievances. So, how does the Chinese government handle these kinds of protests?

What is distinctive about the Chinese response to protest is that it combines the use of a market logic of governance with a mass line logic of governance. What we have found through our research in major cities in China, especially since the Beijing Olympics in 2008, is that the government tries to buy stability: literally, to purchase it by bargaining with protestors and paying them with cash or other kinds of material benefits or services. And that explains why the *Financial Times* reports that today, China's budget for domestic security exceeds that for external security. And the reason for this kind of expansion in the expenditure for domestic security is that officials actually spend money to pacify protestors, who may bargain on the spot, and sometimes in the courtroom, over the price of their appeasement.

What is distinctive about the Chinese response to protest is that it combines the use of a market logic of governance with a mass line logic of governance. . . . The government tries to buy stability by bargaining with protestors and paying them with cash or other kinds of material benefits or services.

Officials' use of the market is one way of pacifying protestors. But if you dish out cash every time a protest rises to the surface, you only reinforce the unwanted behavior, and the protestors will return, bargaining for increasingly more. Thus, if you seek sustained harmony, you cannot just give cash to protestors and send them on their way home; a supplementary approach is needed. And through my ethnographic research looking into these processes, I was astonished to see how buying stability actually involves personal and time-consuming "mass work."

I found that cadre officials combine this market logic with a mass line logic: they do a tremendous amount of work building relationships with the "masses" (these protestors). It is an extremely labor-intensive, personal kind of government-subject interaction, with grassroots officials actually engaging in long, protracted discussions with the protestors. They do so to come to know them, to learn their personalities, and to use that knowledge to manipulate their emotions. Through this intimate relationship, officials hope to transform protestors' consciousness and redefine what rights they actually believe they have. And this effort goes beyond the laws as they appear in the law book: officials explain to protestors that beyond the letter of the law, there are practical rights you can enjoy if you play by the rules. Officials form friendships with pro-

testors, sometimes bribing them or recruiting them as future informants; but officials also intimidate their targets, using force or the threat of force to gain compliance.

This process of transforming individuals by relating to them as people is an old Maoist method of "doing mass work," as officials call it. And it is this combination of mass line and market logic that makes buying stability a very effective means of pacifying protest and maintaining social order. Moreover, we found that through this bargaining process, Chinese people experience Chinese authoritarianism as a system

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that actually allows for room to maneuver. It is an authoritarian system, but the lived experience of the regime by ordinary Chinese people is not necessarily one of coercion. There is some room to play in what is a non-zero sum game, and there are rewards for those who play well.

And through this process, grassroots officials also gain something: they gain the claims or the excuse to increase their departmental budget. Officials prefer to maintain a certain level of instability because only when there are protests can they go upstairs and request a bigger budget or justify a promotion. In this way, officials advance their careers with the assistance of protestors. Through the bargaining process, we observed the frontline of the authoritarian state machinery, where both parties enter into a mutually beneficial alliance that ultimately sustains this continuous low-level instability.

This unique Chinese approach is supported by two distinct capacities of the Chinese state. The first is a fiscal capacity: the strong budgetary position of the state that enables purchasing stability with cash. The second capacity is what sociologist Michael Mann has called “infrastructural capacity”: the state’s ability to reach out to every Chinese city, neighborhood, and village to do this kind of labor-intensive mass line work.

Looking ahead, the mass line and the market are likely to remain salient methods of maintaining stability, though perhaps in new ways. The Third Plenum Resolution suggests that social governance will rely

more on society, NGOs, communities, and public opinion. For example, the party-state may combine market and mass line logic by purchasing services from NGOs. The party-state may throw a lifeline to struggling NGOs, allowing them to prosper and proliferate, by purchasing services provided by the NGOs. And as contractors of the party-state, NGOs’ agendas are thereby shaped by the government’s interests and rulings on what is permissible. In this way, the party-state can co-opt branches of society through market mechanisms.



Benjamin L. Liebman

Benjamin L. Liebman is the Robert L. Lieff Professor of Law and Director of the Center for Chinese Legal Studies at Columbia Law School. His essay, "Legal Reform: China's Law-Stability Paradox," appears in the recent issue of Dædalus on "Growing Pains in a Rising China."

The Chinese party-state devoted enormous resources to constructing a legal system during the first two decades of reform, with many impressive successes. Nevertheless, it has been reluctant to allow the legal system to play a primary role in resolving tensions in Chinese society, or indeed, even in many cases involving routine disputes. The party-state's reluctance to rely on the legal system it built to resolve the most pressing social and economic issues facing China today is what I refer to as China's law-stability paradox.

This paradox has continued to be manifest over the past year as China's new leadership has initiated important legal reforms at the same time that it has ramped up the use of extralegal mechanisms to quell dissent and prevent unrest. China's new adminis-

China's new administration, like its predecessors, continues to be ambiguous with regard to whether law should serve a primary role in governing a society undergoing rapid change.

tration, like its predecessors, continues to be ambiguous with regard to whether law should serve a primary role in governing a society undergoing rapid change.

I will sketch four brief points about the current state of legal reform in China that I hope will provide a basis for discussion.

First, despite much discussion in the Western media claiming that China is no longer committed to legal reform, significant reform is possible within the Chinese legal system, albeit in piecemeal and inconsistent fashion, and sometimes with unintended consequences. We have seen this in the past couple of years, in the abolition of the reeducation through labor detention system – which previously allowed the police to detain people for up to three years with no legal procedures – and in important reforms to the criminal procedure law.

But the implementation of reforms remains inconsistent and uneven. For example, the criminal procedure law has new provisions that make it much easier for criminal defense lawyers to get access to their clients. Surprisingly, these actually seem to have been implemented quite well so far. At the local level lawyers are getting access to their clients. But new provisions requiring that witnesses actually show up in court are not being implemented. And although the reeducation through labor system has been abolished, local officials in some areas of China are proving themselves remarkably innovative in their ability to construct new forms of arbitrary detention.

We also see the potential for further reform in discussions about how judges are appointed and how courts are funded, and

in proposals to create specialized or regional courts. The Supreme People's Court has also announced a major push to improve transparency, although the goals of this seem aimed as much at improving oversight of judges as at strengthening access to information for individuals.

The past few years have also shown that when it comes to determining which legal reforms do and do not get passed or implemented, personal and institutional politics can often be as important as central Communist Party policy. It is not surprising, for example, that the Supreme People's Court has emerged in recent months as a major proponent of reform. Of course, the courts stand to gain status through any potential reforms. It is likewise not surprising that the police and the procuratorates (which serve both prosecutorial and general oversight roles in the Chinese system) are far less excited about reforms that might well reduce their influence.

Second, legal reforms are neither designed nor likely to transform the Chinese political system, although there are many in China who would like to see this happen. Legal reforms are also not generally focused on advancing individual rights, although at times Chinese legal reforms do have this effect. Legal reforms are back in favor right now precisely because they serve the party-state's interest in asserting control, curbing abuses, addressing specific problems in Chinese society, and perhaps in advancing economic reform – which were also the goals of legal reform throughout the eighties and nineties. The Chinese party-state continues to embrace law as a tool for advancing par-

ticular policy goals. Law may help make government function more effectively, but it is not fundamentally designed to constrain the party-state itself.

One trend we have seen in the past year or two is a much clearer delineation of the limits of reform coming from the center, manifest in the ongoing crackdown on activist lawyers and tightening control over legal academics. Such moves, although deplorable and in most cases illegal under Chinese law, are not necessarily in tension with renewed commitment to legal reform. That is, I don't think it is right to read the ongoing crackdown on legal activists in China as a sign that China is not serious about legal reform. China's new leadership appears to be sending a message that reform is possible, but that clear lines need to be drawn between what is and is not permissible.

Third, many of the problems that continue to plague the legal system reflect broader problems in the Chinese political system, including corruption, political interference, and weak formal institutions. Some of the problems also have deep historical roots, most notably the tendency of officials to focus on results and responsiveness at the expense of legal procedures and rules. The Chinese party-state continues to base its legitimacy in significant part on responsiveness, not adherence to law or procedures.

Yet some problems are also the product of reform. We see this most notably in the growing importance of wealth as a determinant of outcomes in civil and criminal cases, and what appears to be a growing sense that the legal system serves the interests of the economically powerful. Of course, this is not a criticism that is unique to the Chinese legal system.

Lack of trust in the legal system reflects lack of trust in Chinese society, and in formal institutions more generally. But there is a distinct strand of distrust in the legal

system today that results from this growing sense of inequality. This is at least partially distinct from frustration or distrust resulting from political non-accountability, although political and economic elites are closely intertwined in China.

Fourth and finally, what is the capacity of the legal system to address the tensions and challenges I have outlined? The joke making the rounds in Beijing last week was that the Chinese Communist Party is finished if it does not reform, but it is also finished if it does reform, since it would destroy itself in the process. This may be overstated, but such comments do give a sense of the challenge. Of course, the legal system is in some

The Chinese party-state continues to embrace law as a tool for advancing particular policy goals.

ways only a minor player in the larger questions playing out regarding reform and the capacity to adapt. For all the recent focus on reforms in the courts, for example, it is important to remember that the president of China's Supreme People's Court has never ranked among the top fifty officials in China. This is unlikely to change any time soon. So formally, in the constitution, in practice, and also in the party structure, the legal system plays a secondary role.

The most significant developments now taking place in the Chinese legal system are not those that appear to make the Chinese legal system look more like our own – reforms such as the creation of regional courts or specialized intellectual property or environmental courts, as well as making individual judges, not their court superiors or court leaders, responsible for the decisions they issue. Likewise, the most important reforms are not those coming from the Supreme People's Court in Beijing. Rather, they are reforms working from the inside,

not following Western models. For example, in Henan Province in recent years the courts have enthusiastically sought to use populism and popular support both to make the legal system more accessible to ordinary people and as a base for resisting external pressure on the courts. The use of populism as a political tool is not new, but the use of populism as a strategy for increasing the authority and perhaps the autonomy of legal institutions is a new development.

Whether such reforms can succeed and spread throughout China may go a long way toward telling us whether legal institutions and the legal system as a whole will continue to play secondary roles in governing

Chinese society – or will come to assume more important roles, from the perspective both of the party-state and of ordinary people. Such reforms may also provide a window into broader trends in governance in China: in particular, whether populism can be harnessed not only as a mechanism for sustaining regime legitimacy, but also for pushing forward with new, and many would say much needed, reforms. ■

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To view or listen to the presentations, visit <https://www.amacad.org/growingpains>.

At Berkeley, a new documentary by Frederick Wiseman

On March 12, 2014, the Academy hosted a program at its 2006th Stated Meeting about “At Berkeley,” a new documentary by Frederick Wiseman. The program included screened selections from the film, followed by a panel discussion with Frederick Wiseman (filmmaker), Robert J. Birgeneau (Chancellor Emeritus and Silverman Professor of Physics, Materials Science, and Engineering and Public Policy at the University of California, Berkeley), George W. Breslauer (Executive Vice Chancellor and Provost, Emeritus at the University of California, Berkeley), and Mark S. Schlissel (Provost of Brown University and President-Elect of the University of Michigan). Lawrence S. Bacow (President Emeritus of Tufts University and President-in-Residence in the Higher Education Program at the Harvard Graduate School of Education) moderated the discussion.



Lawrence S. Bacow

Lawrence S. Bacow is President Emeritus of Tufts University. He is currently serving as President-in-Residence in the Higher Education Program at the Harvard Graduate School of Education. He was elected a Fellow of the American Academy of Arts and Sciences in 2003.



Frederick Wiseman

Frederick Wiseman is an independent filmmaker. He was elected a Fellow of the American Academy of Arts and Sciences in 1991.

I have the privilege of moderating the discussion this evening with Frederick Wiseman, our filmmaker, and with three individuals who were at Berkeley during the filming: Robert Birgeneau, George Breslauer, and Mark Schlissel. I will start the discussion with a question for Fred: Why did you decide to focus on higher education?

I had been doing a series on education, and I wanted to focus on public universities. UC Berkeley is a great public university, and much to my surprise, I received permission to do the film there.

Lawrence Bacow

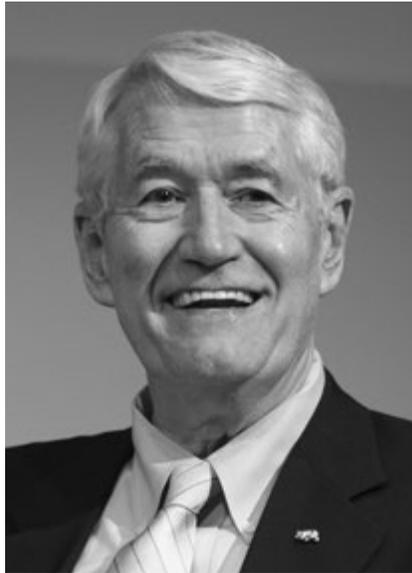
Did you go to Bob Birgeneau, who was then Chancellor of the university, or did you go to somebody else?

Frederick Wiseman

I went to Bob; you always go to the top.

Lawrence Bacow

Bob, I am curious who you had to talk to before you were willing to commit to this project, and what you thought the risks were in letting someone come in and shoot 250 hours of film on your campus. How did you get other people to agree to participate?



Robert J. Birgeneau

Robert J. Birgeneau is Chancellor Emeritus and Silverman Professor of Physics, Materials Science, and Engineering and Public Policy of the University of California, Berkeley. He was elected a Fellow of the American Academy of Arts and Sciences in 1987.

Frederick first contacted Candace Slater, the English professor who is speaking in the very first vignette that we saw earlier. Candace had been head of our Townsend Humanities Center when Fred visited Berkeley for a week in the mid-1990s.

She sent me an email saying that Fred Wiseman was interested in making a film about Berkeley. Anyone who has lived in Massachusetts for any length of time, as I have, knows of Fred because of his film *Titicut Follies*, which helped transform mental health care in the state of Massachusetts.

Berkeley is a place where we like to believe that we live on the edge, so if Berkeley's not willing to consider this kind of project, then probably no other institution in the country would. I thought that at the minimum it was a very interesting idea. I initially discussed

Fred's proposal with George Breslauer, provost of the university, who was a little more skeptical than I was. (I will let George talk about that later.)

Subsequently, I called the people in our journalism and film departments, asking them what they thought. Fred is such a hero to people in film studies and filmmaking, so their response was incredibly positive. They convinced us to meet with Fred in person to explore the possibility further.

We invited Fred to campus to begin having a conversation. One of the first observations that he made was that Harvard, MIT, and Berkeley appear in more than a hundred Hollywood films, including *Love Story* (Harvard), *Basic Instinct* and *The Graduate* (Berkeley), and *Good Will Hunting* (MIT). This gives you a taste of how universities are typically portrayed in movies. Fred said that by contrast he wanted to make a film showing how universities, which are very complex institutions, actually run. I thought that this was a fascinating idea.

Obviously, there were some risks, but we decided that these were risks worth taking. In addition, Fred was very persuasive; among other things, he convinced us that he was sincere.

Lawrence Bacow

My guess, George, is that you and Bob could get together and decide this was a good idea, but maybe not everyone else on campus would follow your lead. What was the process like in persuading faculty members and students to allow Fred into their classrooms?



George W. Breslauer

George W. Breslauer is Professor of the Graduate School; Professor of Political Science, Emeritus; and Executive Vice Chancellor and Provost, Emeritus at the University of California, Berkeley. He was elected a Fellow of the American Academy of Arts and Sciences in 2014.

It is true that we made the decision jointly and did not really ask anybody else. We did not do a market survey to figure out whether people would lock their doors if Fred's cameras were approaching. We did not ask the Academic Senate or seek any other such approval.

Lawrence Bacow

Did you get anyone to sign a release?

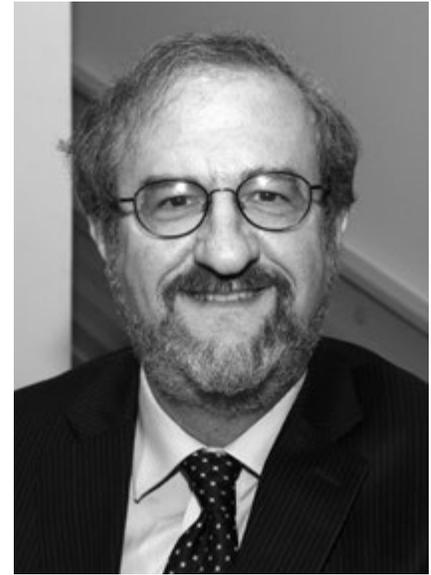
George Breslauer

No. We did not get major blowback, but sometimes Fred was closed out, or he would get frustrated that enough doors were not being opened. He would then come to me and say, "I can't do this film unless you get some doors opened." I would make a phone call or send an email to a professor in that particular unit that I thought would be especially responsive to my pleading for openness. Much to my delight, they agreed most of the time.

There were some areas where he simply was not allowed, and we were in fact persuaded that he should not be allowed: for example, when leaders in our development office were discussing donors and strategies for approaching donors.

Lawrence Bacow

Mark, you were a faculty member and a dean at Berkeley when all of this was going on. I am interested in your perspective.



Mark Schlissel

Mark Schlissel is Provost of Brown University and President-Elect of the University of Michigan.

We were presented with the opportunity to project an image of Berkeley, and that is something the faculty and the leadership were extremely proud to be part of. We did not have as much fear as you might imagine we would have.

George and Bob, when they set this up, had Fred agree that if we asked him to stop and leave, he would stop and leave. So the hardest part was just getting used to somebody with a camera and a sound boom 12 inches from your face as you were in discussion. Once you forgot he was there, we just went about our business.

Lawrence Bacow

Did you get asked to leave very often, Fred?

Frederick Wiseman

No.

Lawrence Bacow

Were there times in which you thought it was hard to tell the story that you wanted to tell?

Frederick Wiseman

I did not really know the story I wanted to tell. I discovered the story in the editing. While I was at Berkeley, all I tried to do was stimulate sequences that I thought would be interesting. I used only one-sixtieth of the total material I collected. In the kind of filmmaking I do, there is no script, no story, no thesis in advance.

Lawrence Bacow

Was there a time for any of the three of you when you were nervous about what was being recorded in real time?

Robert Birgeneau

Just to add a couple of details to what Fred said in terms of the agreement – we actually did not have a signed contract when he first started to film. That turned out to be a good thing because in one of the early meetings involving the university's chief leadership team, I said something quite inappropriate. I could see my associate chancellor turn purple because it was now captured on film.

So for the sake of Berkeley's interests and well-being, I went and talked to our lawyer, and after a bit of back and forth, Fred ultimately agreed that people like myself would

have a forty-eight-hour window in which to insist that a particular segment be removed.

Fred was, of course, correctly reluctant to agree to that, because he thought he might lose the juiciest parts.

The only person who ended up exercising that right was me, and I did so five times. And five out of five times, it was about politicians in Sacramento.

Lawrence Bacow

Fred, in making this film, what do you think is the most powerful insight you had about either Berkeley or higher education in general?

What I think I learned, and what I hope the film shows, is the devotion on the part of a lot of people in the administration to maintaining the standards and integrity of the university.

Frederick Wiseman

I did not really know much about Berkeley before I started. What I think I learned, and what I hope the film shows, is the devotion on the part of a lot of people in the administration to maintaining the standards and integrity of the university.

Lawrence Bacow

One of the things the film does quite remarkably is to convey the complexity and texture of an institution of this greatness. Everybody who went to college thinks they can run one. This film helps counter that feeling by showing that a lot goes into the decision-making.

Was there any time, George, that the routine decision-making that goes on in a provost's office was in any way altered or influenced by the presence of the camera?

George Breslauer

That is a question that is always asked, and entirely legitimately so, because you would assume that people would be self-conscious about being filmed. In the sequences in which I happened to be involved, I was struck by how quickly we simply went on with our work and saw the camera and sound mic almost like a fly on the wall. At the time of filming, Berkeley was going through some difficulties. We did not have the luxury of wasting meetings playing to the camera or saying things that we would not have otherwise said.

Robert Birgeneau

Another way you may have asked the question is, are there things we wish were in the movie that are not? Fred would say no, but for me the answer is yes. One of the major issues that we had to deal with locally and at the state and national levels was the challenges faced by our undocumented students. In California, we have a very large number of these students. You may not know that Berkeley was the first university in the United States to offer comprehensive financial aid to undocumented students, something we are very proud of. Fred got to film the beginnings of that. We had an undergraduate student organization called RISE, Rising Immigrant Students for Education, which was a cover for our undocumented students. RISE had about forty students, the vast majority of whom were

One of the things that attracted us to Fred’s offer to make this film was his feeling that no one had ever looked at how higher education institutions are governed. Others have looked at what happens at universities, whether in the teaching realm or the social realm, but not at how they are governed.

Chicano. The president of RISE came to talk to me about how we could make progress on the political front for undocumented students in this country. Fred found this meeting on my schedule, and we agreed that he could film it. But during that autumn, it happened that one of the Republican candidates for governor of California promised to send the immigration police onto the California university and college campuses to grab all the undocumented students and deport them. And so not surprisingly, I was uncomfortable about having this undocumented student filmed by Fred. When we had the meeting, the student actually wanted to be filmed because he wanted his story heard, so Fred agreed to film him from the back.

This was perhaps the most extraordinary half hour of my entire service as Chancellor at Berkeley, because this young man talked in detail about his life as an undocumented person. His mother worked in a sweatshop in Los Angeles. The student described all the challenges that he had faced and continued to encounter, any one of which might well totally defeat an ordinary student. That meeting was so important to me personally, that I immediately became politically active on behalf of our DREAMers. We got bills providing financial aid to undocumented students passed in the state senate. I met with the governor on this issue four times, and he ultimately signed the bills into law. California thereby became the first state in the union to enact legislation allowing pub-

lic universities to provide full financial aid to undocumented students. So it was a phenomenal success, Fred captured it, and yet it is not in the documentary. So I asked Fred, “How could you not include this? It is the single most important thing that happened in the entire 250 hours of filming.” And he replied correctly – which shows that I am an academic, not a filmmaker – that since he shot from the back what he captured may have been “important politically, but it makes for bad film.”

Lawrence Bacow

Berkeley does not have its own board of regents, but rather there is a California system-wide board of regents. What do you think the conversation would be like if you had to persuade a board that this was a project worth undertaking?

Robert Birgeneau

Berkeley is almost ungoverned from above; there is no equivalent of the Harvard Corporation or the MIT Corporation. There are the Regents, but they are well separated from the individual campuses. There was no one to ask for permission, because there was virtually no one immediately in charge.

George Breslauer

We mentioned earlier that the internal workings of the development office were not part of the film. Neither was the office of the president, which is the presidency over the entire California system. The regents were also not part of the film. So the broader governance structure that constrains the choices that we make at the campus level was not visible in the film. One of the things that attracted us to Fred’s offer to make this film was his feeling that no one had ever looked at how higher education institutions are governed. Others have looked at what happens at universities, whether in the teaching realm or the social realm, but not at how they are governed. What was unique about this film was its ability to peer into the chancellor- and provost-level discussions of what to do, given the perceived options. But it did not go into the deliberations of those people or governing bodies that constrained our options.

Question and Answer Session

Question

What years were covered in the film?

Frederick Wiseman

The film was shot between August and November 2010.

Robert Birgeneau

That was an important period. When I started as chancellor of Berkeley in 2004, the state provided about 30 percent of our budget. There was a commitment from Governor Schwarzenegger that this amount would go up progressively, year by year. By 2010, we had suffered two consecutive years of precipitous cuts, with state funding very

quickly dropping from 30 percent to 16 percent. We lost the salaries of close to half of our staff in a two-year period. And so the film captured the whole university trying to deal with a level of disinvestment that was literally unprecedented in the history of the University of California.

Comment from the Audience

For those of us who were watching what was going on in California from a distance, it was quite extraordinary. Other institutions were trying to take advantage of all the furloughs in the California system by raiding your faculty right and left. The leadership of Berkeley at that time did an extraordinary

Question

What has been the reaction to the film, particularly outside of the university and perhaps in the political arena? Has it led to more awareness of what universities face?

Robert Birgeneau

People who have seen this film have been very appreciative of just how rich and complex these institutions are. However, that does not mean that anyone has come down from Sacramento to say, "I am sorry that we did this horrible thing to you." On the other hand, as we went through the worst parts of the state disinvestment, our donors, alumni, and friends

One of the aspects of the film that I like best is the classroom scenes, in which really great scholars are teaching undergraduates. . . . The film is an advertisement for the exciting work that goes on at great research universities in general, public or private.

job. Fred, I am glad that you let the rest of us observe some of the important decisions in real time. We all owe you guys a debt of gratitude for preserving one of the jewels in the crown of American public higher education.

Robert Birgeneau

At the time I asked George, "Why aren't we losing faculty? Why haven't the East Coast private universities been more successful in disassembling our university while the state disinvests?" I think the faculty stayed because of one another: the density of quality scholars and the shared commitment to research and teaching as well as our public purpose. It is hard to imagine a better place to be a scholar.

finally became aware that our financial model was now not that different from that of MIT, Yale, or Harvard, and that they needed to step up in the same way that the alumni of these and many other private universities routinely do. Our alumni offered support in a way that was really marvelous during a terrible period of state disinvestment.

George Breslauer

We have been monitoring the reviews of the film, including those from closer to home in the Bay Area. What is striking is how a large majority of the reviews from outside the Bay Area are highly appreciative of the film, either because of Fred Wiseman's craftsmanship or because of the university

displayed, or sometimes both. In the Bay Area reviews, there is a lot of negativity and snark. Newspapers in the Bay Area have a tendency to haze the administrators and valorize the protestors. By contrast, the protestors featured in the film come across as rather vapid, and the administrators come across as struggling to deal with difficult choices. That was not music to the ears of the local newspaper editorial boards.

Question

Quiet scholarship is an essential part of a university, but I imagine that must be hard to portray cinematically. Did you try?

Frederick Wiseman

I did not try to do that. I was not sure that I knew how to capture "quiet scholarship."

Robert Birgeneau

There is one exception: a wonderful segment where Saul Perlmutter is conducting a research seminar. This was one year before Saul received the Nobel Prize for the very work that he was discussing in that seminar. At the end of the segment featuring that seminar, at least at the New York Film Festival, the entire audience burst out in laughter – not because Saul was so funny, which he can be, but because the subject matter was so incomprehensible to a general audience.

One of the aspects of the film that I like best is the classroom scenes, in which really great scholars are teaching undergraduates. Fred captured a lot of this, and the film manages to make you think, "Boy, would I like to be an undergraduate again and be in that class!" In this respect, the film is an advertisement for the exciting work that goes on at great research universities in general, public or private.

Lawrence Bacow

It is also a great advertisement for what happens when we actually bring real faculty together with real students in a residential setting in real time. We hear a lot about how these great residential institutions are going to become dinosaurs, because we will be able to provide all this education digitally. One of the things the film does brilliantly is to illustrate the magic that happens in an actual classroom.

Question

Is the film meant to portray what Berkeley is about, or is it a film about what higher education is capable of within the broader public education landscape?

George Breslauer

I think of this film as if you are looking at a hundred impressionist paintings on recurring themes. The paintings are lined up side by side, and you have two-and-a-half minutes on average in front of each one. The themes would recur over the course of the film’s four hours, and you gain an impression in the process. The pastoral scenes could be any other university. The classroom scenes could be any other great university. The extracurricular student activities could be any other great university, whether it is music-related activities or ROTC or throwing a Frisbee on the lawn. What is unique to Berkeley, I think, is the deliberation among the administrators with regard to handling the crisis in which we found ourselves.

Mark Schlissel

Having been at a number of different institutions, I can report that all our institutions are dealing with the same problems. Yet it seems as if they bubble up first at Berkeley,

We hear a lot about how these great residential institutions are going to become dinosaurs, because we will be able to provide all this education digitally. One of the things the film does brilliantly is to illustrate the magic that happens in an actual classroom.

and get first addressed there, too. Consider undocumented students, as Bob mentioned earlier. Universities across the country are devising ways to deal with this issue at a political, social, and financial level. Other aspects that have to do with budget crises or calling in consultants or looking at how we do the back office part of running a university. Berkeley is big enough, ambitious enough, and complex enough that it is somewhat of a canary in a coal mine for the higher education sector as a whole.

Question

Is there a record of what the reaction to the film has been in places outside the United States?

Robert Birgeneau

Just last week I received an email from President François Hollande’s press attaché extolling the virtues of the movie, and of Berkeley, and saying that she was going to make sure that her daughter got her university education at Berkeley. But this film is not just about Berkeley; it is about how the American research university is a unique institution. Even though we copied the form from the Germans, we now do universities a lot better than any other country in the world except, perhaps, Great Britain.

Lawrence Bacow

Can you explain how you financed the film?

Frederick Wiseman

There are only eight or ten places in the world where I can go for money. I usually get about 15 percent of my budget from PBS, with other contributions from a combination of sources such as the Ford Foundation, the National Endowment for the Arts, the Independent Television Service (ITVS), the BBC, or French television. (I made a couple of films in France, so I have been eligible for French subsidies.) Sometimes I have money from private foundations.

Lawrence Bacow

I just have to observe that many of those in Congress who have been hostile to higher education have also been hostile to some of the sources that have been funding your films.

Question

Did you document the relationship between the academic side of Berkeley and its athletic prowess?

Frederick Wiseman

We did about ninety seconds of football and maybe sixty-five seconds of women’s field hockey.

Question

How do you explain these rather strange relationships we have between major universities and public entertainment, particularly in terms of athletics?

Mark Schlissel

It is a real challenge getting the balance right. The sports entertainment business brings great notoriety to our universities. Many of our peers claim that application numbers go up when the home team has a good season. We must not, though, lose sight of the fact that we are academic institutions, and sports are auxiliary, an extracurricular activity. You have to keep that separation in mind while recognizing the community-building aspects of intercollegiate sports.

Robert Birgeneau

Just one factoid: an important role that men's football and men's basketball play is that they generate a lot of income, and that income supports our Olympic sports. In the London summer Olympics, Berkeley athletes, including both current students and graduates, won the same number of gold medals as did France and Germany. And four of the Pac-12 schools – Berkeley, UCLA, Stanford, and USC – account for nearly one half of the gold medals that the United States has won historically in the summer Olympics.

One of the things I had to do in the middle of the funding challenges, because the faculty demanded it and we really had no choice, was to announce at a press conference (which Fred filmed, but thank God did not put in the film) that Berkeley would no longer have varsity rugby, men's baseball, women's lacrosse, or men's and women's gymnastics. If you ever want to receive vit-

The sports entertainment business brings great notoriety to our universities. . . . We must not, though, lose sight of the fact that we are academic institutions, and sports are auxiliary, an extracurricular activity.

riolic email, hateful beyond belief, just try cutting major sports like baseball and rugby.

I had seen this coming a year in advance because the intercollegiate athletics budget was spiraling out of control, so that we were not going to be able to continue to support our athletics program in the way that we traditionally had. And so I sent an email to our major donors to athletics, saying that their sports were in danger and they needed to step up. They didn't, and so we announced that we were being forced to cut the sports. Then the alumni athletic supporters all came to me and asked what they could do. Baseball, which had been raising about \$300,000 a year to support the team, magically raised \$10 million in six weeks immediately after we announced the prospective demise of the team as a varsity sport. The same thing happened in rugby. It was an extraordinary phenomenon.

One of the people who gave \$1 million to baseball also gave \$5 million to support academic programs in Public Policy. So, had we not saved the baseball team, we might well not have received the \$5 million for Public Policy. At a PAC-12 university like Berkeley academic and athletic philanthropy are much more tightly connected than you could ever imagine.

George Breslauer

We have very few donors who give only to athletics. When you look at the list of major donors to athletics, for the most part they also make large donations to the academic side. ■

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To view or listen to the presentations, visit <https://www.amacad.org/atberkeley>.

Al-Qaeda and the Bomb: How Institutions Protect Against the Threat of Nuclear Terrorism

On May 15, 2014, at the Academy's 2008th Stated Meeting, five experts discussed how institutions protect against the threat of nuclear terrorism. **Scott D. Sagan** (Cochair of the Academy's Global Nuclear Future Initiative; Caroline S.G. Munro Professor of Political Science, the Mimi and Peter Haas University Fellow in Undergraduate Education, and Senior Fellow at the Center for International Security and Cooperation and the Freeman Spogli Institute at Stanford University) moderated a panel discussion with **Thomas Hegghammer** (Director of Terrorism Research at the Norwegian Defence Research Establishment), **Paul N. Stockton** (Managing Director of Sonecon, LLC, and former Assistant Secretary of Defense for Homeland Defense and Americas' Security Affairs at the U.S. Department of Defense), **Jessica Stern** (Fellow at the FXB Center for Health and Human Rights and Lecturer in Government at Harvard University), and **Matthew Bunn** (Professor of Practice at Harvard Kennedy School). The following is an edited transcript of the discussion.



Scott D. Sagan

Scott D. Sagan is the Caroline S.G. Munro Professor of Political Science, the Mimi and Peter Haas University Fellow in Undergraduate Education, and Senior Fellow at the Center for International Security and Cooperation and the Freeman Spogli Institute for International Studies at Stanford University. He was elected a Fellow of the American Academy of Arts and Sciences in 2008 and serves as Cochair of the Academy's Global Nuclear Future Initiative.

The 9/11 attacks were a wake-up call, not only to the general danger of global terrorism, but also to the specific danger of nuclear terrorism.

The 9/11 attacks were a wake-up call, not only to the general danger of global terrorism, but also to the specific danger of nuclear terrorism. Osama Bin Laden had earlier said that he felt that it was the duty of all Muslims to try to get a nuclear weapon. Khalid Sheikh Mohammed admitted that the 9/11 attackers had considered, in their planning before September 11, 2001, the option of attacking a U.S. nuclear reactor to try to create a Chernobyl-type event. Both those threats were taken far more seriously after 9/11. In the years since the 2001 attacks, the United States and its allies and friends have significantly degraded the capability of Al-Qaeda, by attacking, killing, and capturing the leadership and by damaging the organizational structure. The United States has also significantly tightened security around nuclear materials, although more can be done in this arena.

In the Academy's Global Nuclear Future project, we recognized that one of the most insidious dangers is that of an insider threat. In these scenarios, an individual of malicious intent, or somebody that has been coerced, could do something inside a

nuclear facility to sabotage it, create a vulnerability, or make a terrorist attack possible. Unless we address the insider threat, efforts to reduce the outsider terrorist danger will be inadequate.

In order to address these problems, we have gathered together a remarkably diverse and experienced group of people, including senior military commanders, psychiatrists, biologists, nuclear specialists from the Department of Energy, and political scientists and historians. Our guiding principle is that we should not only learn from our past mistakes, but also practice what I call "vicarious learning." We should learn not only from our own past mistakes but also from those of others in order to minimize future insider threats.



Thomas Hegghammer

Thomas Hegghammer is Director of Terrorism Research at the Norwegian Defence Research Establishment and author of “Jihad in Saudi Arabia.”

How interested have terrorists been in the past in attacking nuclear installations through insiders? The motivation for this question is, of course, that we know how damaging the insider tactic can be. But there has been little research into how serious terrorists are about carrying such operations out. My colleague Andreas Daehli and I set out to examine what terrorists have written about this in their literature, as well as any nuclear insider recruitment that has actually been attempted or carried out. We discovered that, in fact, based on the evidence that we have, they have not been very interested in infiltrating nuclear facilities so far. We discovered no elaborate texts about the nuclear insider tactic in the vast jihadi literature or the far-right literature. There are references to insider tactics, but there

We propose that terrorists may see insider recruitment as so difficult and so unlikely to succeed that they do not even try; they opt for other methods instead.

are no detailed manuals of the kind that exist for many other tactics.

As far as plots and attempts are concerned, we found only one confirmed serious nuclear insider attack involving terrorists, occurring in South Africa in 1982 at a plant under construction and with lax security. Of course, we cannot be sure that there haven't been other attempts, and we are uncertain about some of the data. But we think that at worst, there have only been a handful of other such incidents – and this is out of over 100,000 instances of terrorist activity over several decades.

There have been several attempts to attack nuclear facilities, but not with insider tactics. Terrorists have used other methods, typically armed assault or attempted bombings. We see these same methods discussed in the texts as well, but again, comparatively little about using insiders. This is very interesting, because much of the literature so far seems to take for granted that terrorists will want to use insiders to get into nuclear installations, because it seems the most logical thing to do.

This finding begs for an explanation. My coauthor and I do not know the answer, but we propose that terrorists may see insider recruitment as so difficult and so unlikely to succeed that they do not even try; they opt for other methods instead. Why is insider recruitment so difficult? One of the key factors is surveillance. Active terrorist groups expect to be under close surveillance, which makes it very difficult for them to insert an existing operative into a nuclear facility or to recruit someone already on the inside. It is easier, of course, if someone on the inside reaches out to the group and makes him- or herself available.

But presumably, this happens so rarely that the terrorist planners cannot count on it as a reliably available option.

Despite the apparently low use of insider tactics, the insider threat is real and growing. One of the primary concerns we have is the enormous increase in the amount of online radical propaganda over the last decade. In our view, this increases the likelihood that employees at nuclear facilities may radicalize after they are hired, and either act alone or reach out to a group.

In light of this, we offer three policy recommendations. The first is to develop good monitoring systems to identify radicalizing insiders early. The second is for governments to develop a strategy to undermine trust between terrorists on the outside and radicalizing employees on the inside, so that when an insider contacts a terrorist organization, that terrorist organization is reluctant to cooperate with him or her. Sting operations and information-gathering operations are just two possible methods of undermining that trust.

A third recommendation is for governments to release more data on insider crimes. The data on this phenomenon that we and other academics have had to work with are very patchy, and we believe that releasing more information would produce more robust research and better advice against this very important threat.



Paul N. Stockton

Paul N. Stockton is Managing Director of Sonecon, LLC. Before joining Sonecon, he served as Assistant Secretary of Defense for Homeland Defense and Americas' Security Affairs. In September 2013, Secretary of Defense Chuck Hagel appointed him to co-chair the Independent Review of the Washington Navy Yard Shootings.

I recently had the honor of being appointed to co-chair the Independent Review of the Washington Navy Yard Shootings, which were the result of an insider threat of a different sort than we have been focusing on tonight. But in the course of the committee's work, we identified some larger gaps in security that apply to all types of insider threats.

One particular vulnerability lies in our flawed security clearance system. I believe there are three problems with the system: first, too many people have security clearances, including personnel who don't need them; second, too many of those who have security clearances have dangerously broad access to classified material; and third, too much information is inappropriately classified. Together, these issues create significant

Too many people have security clearances, including plenty who don't need them; those who have security clearances have far too broad access to classified material; and too much information is classified.

gaps in security that leave us more open to insider threats than we ought to be.

In the aftermath of 9/11, the number of people in the Department of Defense and the federal government who have secret and top-secret security clearances ballooned. By some measures, over three million DOD personnel now have these clearances. Many personnel have no need for them. Those joining the U.S. military automatically are adjudicated to receive secret clearances shortly after they sign up, whether their jobs require it or not. Under law, the Department of Defense and other departments are supposed to make sure that those who get security clearances have a demonstrated need-to-know the classified information to which they will have access. However, the Department has effectively dropped that as a guideline since 9/11. The new norm is that everybody gets security clearances, and people who never should have had clearances become trusted insiders – including Aaron Alexis, the Washington Navy Yard shooter.

The U.S. government also needs to ensure that once appropriate people are granted security clearances, they are vetted more carefully when they are serving the Department, and are evaluated on a continuous basis. At a time when budgets in the Defense Department are going down, the only way to afford the creation of such a continuous evaluation system is to reduce the size of the cleared population. We can do this by making sure that only those who genuinely need security clearances will receive them.

Second, too many of those granted security clearances have overly broad access to classified information. The broad access that personnel have today stems in part from lessons learned from 9/11. The primary lesson of 9/11 was that we failed to connect the dots. People in the intelligence community, in the FBI, and elsewhere were not able to share information well enough to understand the nature of the threat. However, I believe we have over-learned this lesson. Today, personnel can share classified information across a broad array of domains. Relatively low-level employees, such as system administrators, can use this broad access to information to damage U.S. security. Individuals such as Edward Snowden and Chelsea Manning exploited this situation to do immense harm. We need to reevaluate who needs access to what.

Finally, *too much* information is inappropriately classified. If everything is classified, but security clearances are commonplace, how are we to protect the genuine secrets that really are our crown jewels? If everything is secret nothing is. Let's focus on protecting information that is truly vital to national security. If information is not genuinely in need of being classified, I would suggest it should be out in the open to help inform public debate.



Jessica Stern

Jessica Stern is a Fellow at the FXB Center for Health and Human Rights, a Lecturer in Government at Harvard University, and a member of the Hoover Institution Task Force on National Security and Law.

I am going to talk about another insider actor, this one at a government bioweapons research lab. A week after September 11, 2001, letters containing anthrax spores were delivered to the offices of NBC News, the *New York Post*, and the *National Enquirer*. Over the next month, contaminated letters were sent to then-Senate Majority Leader Tom Daschle and Senator Patrick Leahy, among others. By the end of the year, anthrax-contaminated letters had infected at least 22 people, five of whom died. To allow for a complete sweep of its offices, the House stopped operations for five days. The Hart Building was closed for several months while it was fumigated and cleaned. Operations at the Supreme Court were disrupted. In retrospect, considering these attacks outside of the shadow of 9/11, they had an impressive impact.

The letters, which were dated September 11, 2001, contained the words, “Death to America. Death to Israel. And Allah is Great.” So, given the text of the letters and the timing, officials initially assumed that the letters were part of a second-wave assault by Al-Qaeda or Iraq, or possibly the two working together. This theory was bolstered

We need to take the clearance process much more seriously than we do now. We shouldn't hire private firms that have a financial incentive to rush clearances through, which is current practice.

by the fact that Iraq had admitted to an enormous biological weapons program, informing the United Nations that it had 8,500 liters of anthrax. The CIA had warned that Saddam could deliver biological or chemical agents clandestinely using special forces, civilian government agents, or foreign tourists in an attempt to take out as many of his enemies as he could. Iraq had also repeatedly threatened to smuggle anthrax and other weapons of mass destruction into Britain, in one case threatening to put anthrax in duty-free bottles of alcohol, cosmetics, cigarette lighters, and perfume sprays.

Immediately after 9/11, when our government was considering invading Iraq, many of my colleagues here in Cambridge were skeptical. They thought the Bush administration was just making up evidence of Iraq's possession of weapons of mass destruction out of whole cloth. But the truth is that Iraq had admitted to possessing an enormous biological weapons program in the 1990s. Moreover, there was confusion about the presence of silica and the erroneous identification of bentonite (an additive known to be used by Iraq in its anthrax). So, it was reasonable to assume that Iraq was involved in the anthrax attack.

Nonetheless, that assumption was wrong. The strain used in the attacks was the Ames strain, isolated from a sick cow in Texas, and reportedly distributed to only five labs in the United States, Canada, and the United Kingdom. One of those locations was USAMRIID, which is the Department of Defense's own biological laboratory in

Frederick, Maryland. The identification of the strain led authorities to focus on government scientists – in other words, insiders – as the likeliest perpetrators.

The government initially focused on a physician named Steven Hatfill, who had worked at USAMRIID. Hatfill was eventually exonerated. Years after the attack, another potential insider was identified, and that was Bruce Ivins. I will briefly tell you what we know about him.

Dr. Ivins, who worked at USAMRIID, was a complex man who claimed to have two sides to his personality. His public face was a pillar of the community. He was involved in developing anthrax vaccines and was responsible for preparing anthrax to test them. In fact, he was a member of the team that investigated the attacks. He received an Outstanding Civilian Employee award from the Department of Defense in 2003. He was active in the Catholic Church; he played keyboard at masses and other functions. He wrote poems and sent them to his colleagues. He was seen as a very kind man, if a bit eccentric.

But there was another side of Dr. Ivins that was largely unknown, even though this hidden side should have been investigated, and should have prevented him from getting

a security clearance or working with biological agents. What did government authorities not know that they should have known? First, Dr. Ivins was mentally ill. There were discrepancies in his security-clearance forms that were not followed up on. Had anyone spoken with his clinicians, authorities would have known that Dr. Ivins had been involved in criminal activities and had a history of serious mental illness. Indeed, one of his clinicians described him as the scariest patient she had ever treated. He drank to excess. He was on a cocktail of medications (including antipsychotics), some of which were prescribed to him fraudulently. When he asked a girl out on a date in college and she declined, he became obsessed with her sorority – a serious obsession that lasted the rest of his life. The obsession led him to stalk members of the sorority and to break into sorority buildings. His first therapist said that when she heard about the anthrax attack, she immediately thought of him.

I will read you one of the poems that he wrote to one of his colleagues.

*I'm a little dream self
Short and stout
I'm the other half of Bruce
When he lets me out.
When I get all steamed up
I don't pout.
I push Bruce aside
Then I'm free to run about.
Bruce and this other guy
Sitting by some trees
Exchanging personalities
It's like having two-in-one
Actually, it's rather fun.*

The colleague to whom Ivins sent this poem did not inform the authorities. All the information about his psychotherapy, the psychotropic medications he was on, and his discussion about his criminal activities were available if people had bothered

to investigate discrepancies in his security clearance applications.

Another interesting feature of this case is that Ivins deliberately deflected the investigation away from himself. He hinted that Iraq might have acquired the Ames strain. He hinted that Al-Qaeda might have been involved. He mislabeled samples so that it looked like the anthrax used in the attack was actually from another facility. He refused to turn over the samples until somebody actually came right into the lab and took them from him.

Ivins's case shows that red flags can be ignored to an astonishing degree. People do not want to rat out their colleagues. It is not enough to have good procedures on the books: regulations must be followed. For example, Ivins working at night in the "hot suites" just before the anthrax mailings should have been noticed, but wasn't. Another lesson is that we need to take the clearance process much more seriously than we do now. We shouldn't hire private firms that have a financial incentive to rush clearances through, which is current practice.

But what was his motivation? Briefly, he had a financial incentive. He was working on anthrax vaccines, and if people were really frightened of anthrax, his vaccine might have more interest from buyers. He wanted to bring attention to inadequate preparation for a biological attack, it seems.

I agree with Paul Stockton that the security-clearance process is broken. I know from personal experience that the people who do the field work for security clearances are inadequately trained for the job. They don't do their homework. The clearance process is still too focused on Cold-War-era threats. In the case of Snowden and Ivins, it seems to me that narcissism might be a risk factor. I think that narcissism and other psychological factors should be more closely examined.



Matthew Bunn

Matthew Bunn is Professor of Practice at the Harvard Kennedy School and Co-Principal Investigator of Harvard's Managing the Atom Project. He is the author of more than twenty books and major technical reports, including "Securing the Bomb" series.

About two decades ago at a nuclear fuel fabrication facility about an hour outside of Moscow, a man named Leonid Smirnov began stealing weapons-grade highly enriched uranium. He was having severe financial problems; the Russian ruble was collapsing and his salary was not keeping up. He was part of the accounting system for the facility, so he knew that as long as output was within 3 percent or so of input, the missing uranium would be written off as normal losses to waste. So he stole little bits at a time over several months. He ultimately stole over a kilogram and a half of weapons-grade highly enriched uranium. And, lest you think that there is not much threat of insiders, this is only one of about twenty confirmed cases of seizure of stolen highly enriched uranium or plutonium that

are in the public record. However, none of them were clearly connected to terrorists, as Thomas Hegghammer has pointed out. The majority of cases we have found so far are of opportunistic insiders who steal the material and then go looking for someone to sell it to.

Governments ought to put together analyses of the real incidents that have taken place, and then they ought to share them and make them more broadly available.

But we do not know the circumstances of many of these thefts. It is a disturbing fact that only a few were ever noticed before the material was later seized, which strongly suggests that there are more thefts that were, in fact, never noticed. But all the thefts whose circumstances we do know were done by insiders or with the help of insiders, and all the others look like they were likely done by insiders. That is why we are focusing so intently on this issue.

As Scott Sagan mentioned, he and I offered "worst practices" – lessons from disasters – because disasters often offer more vivid and memorable lessons than somebody just telling you a useful thing to do. We quote Bismarck on the subject of learning from other people: only a fool learns from his mistakes; a wise man learns from the mistakes of others. But I have another favorite quote, this one from the American humorist Will Rogers. To paraphrase: "Some men are able to learn from other people's mistakes, but most people have to pee on the electric fence for themselves." So we are hoping to help people learn from other people's mistakes without suffering the consequences themselves. We have ten lessons; we might call them the Bunn and Sagan Ten Commandments, or

as a Unitarian might say, "The Ten Suggestions." I will discuss three of these.

First, we found that there are a lot of cognitive and organizational biases that undermine most organizations' focus on the significance of the insider threat, leading organizations to fail to accurately address

it. The first of these biases, I think, is overconfidence. Just as people say, "not in my backyard," so there is also "not in my organization." People really believe: "All the people in my organization are trustworthy. I know them. They would never be an insider problem." The example we use is the tragic assassination of Indian Prime Minister Indira Gandhi. After the Golden Temple violence, her security manager recommended to her that she remove the Sikhs from her security detail, at least temporarily, and she said, "No, for political reasons, I need to be seen as the Prime Minister of all the people, including the Sikhs, and I trust these particular people." And the man who first pulled the trigger, the man who gunned her down, was a Sikh who was her most trusted guard. You have to avoid believing that it will never happen in your organization.

Second, do not assume that background checks or ongoing monitoring are going to catch every threat. Often, you don't see the red flags when they are there. Sometimes the red flags simply are not there. Sometimes the insiders genuinely are trustworthy, but are coerced. We use the example of a bank in Northern Ireland, which had a perfectly sensible security system that required two senior officers of the bank to turn their keys

The fundamental lesson underlying all of our advice is: Don't assume. Evaluate. Assess. Test. Collect real data to the extent that you can.

in order to open the vault. A gang kidnapped the families of two of the senior officers of the bank, the officers turned their keys, and the gang went off with millions of pounds.

Finally, don't assume that there will only be one insider, that there will not be a conspiracy. If you look at thefts from heavily guarded facilities (not nuclear facilities, but just as an analogy), what you find is that overwhelmingly, they are the result of conspiracies. It is not just one individual who overcomes the security system, it is a conspiracy of people. They happen all the time, but they are very difficult to guard against. It is very tricky to design your security system to cope with the possibility that two or three of the people you are relying on for the security might be the very people attempting to bypass it. And so administrators tend to discount the possibility and brush it away.

The fundamental lesson underlying all of our advice is, "Don't assume." We urge people: "Don't assume. Evaluate. Assess. Test. Collect real data to the extent that you can." So one of our recommendations parallels one of Thomas's, which is that governments ought to put together analyses of the real incidents that have taken place, and then they ought to share them and make them more broadly available. Stories are very effective teaching tools. ■

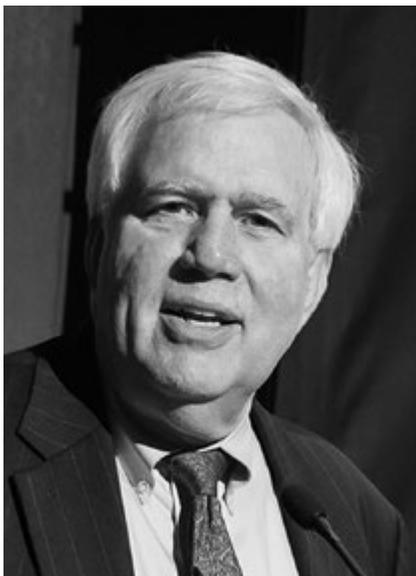
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The Universe Is Stranger Than We Thought

At a meeting sponsored by the American Academy, the Royal Society, and the Carnegie Institution for Science, **Wendy Freedman** (Crawford H. Greenewalt Chair and Director of Carnegie Observatories at the Carnegie Institution for Science) and **Martin Rees** (Fellow of Trinity College; Emeritus Professor of Cosmology and Astrophysics at the University of Cambridge; Astronomer Royal; and Visiting Professor at Imperial College London and at Leicester University) discussed what we know and do not know about the universe. **Richard A. Meserve** (President of the Carnegie Institution for Science) moderated the discussion. The meeting took place on April 29, 2014, at the Carnegie Institution for Science. An edited version of the presentations follows.



Richard A. Meserve

Richard A. Meserve is President of the Carnegie Institution for Science. He was elected a Fellow of the American Academy of Arts and Sciences in 1994, and serves on the Academy's Council and Trust. He is also a member of the advisory committee to the Academy's Global Nuclear Future Initiative and to the Academy's Science and Technology policy study group.

One of the defining characteristics of science is the reality that the more you know, the more you realize you don't know. And there is perhaps no field today in which that is more evident than in astronomy. Over the last two decades, we have learned

that we fundamentally do not understand the stuff that comprises 95 percent of the universe: dark energy and dark matter. In one sense, in this time of scientific achievement, our ignorance is a little embarrassing. But in another sense, this is a time of enormous excitement. There are deep mysteries to be solved, presenting a great challenge to the researchers of our time.

Over the last two decades, we have learned that we fundamentally do not understand the stuff that comprises 95 percent of the universe: dark energy and dark matter.

We first learned about dark energy about fifteen years ago. Cosmologists had long expected that the force of gravity produced by the matter in the universe would cause the universe's expansion to slow down, and perhaps eventually to reverse course. But contrary to everyone's expectations, observations of Type Ia supernovae by the High-Z Supernova Search Team in 1998 and by the Supernova Cosmology Project one year later suggested that the expansion of the universe is actually accelerating. Thus, we were presented with a great mystery: why is the universe's expansion accelerating, and what could possibly be fueling it? To answer these questions, cosmologists rethought the known contents of the universe, determining that about 70 percent of its matter/energy

inventory is embodied in dark energy, a substance we have not yet begun to understand.

But even before the discovery of evidence for dark energy, we had already found evidence of dark matter. In fact, Vera Rubin, a Carnegie astronomer, was responsible for the verification of the existence of dark matter. Rubin helped prove dark matter's existence through her measurements of its

influence on the movement of stars within galaxies. The trajectories she observed simply did not fit Newton's laws of gravity; there had to be matter that we cannot observe. Once we accommodate it, we find that dark matter constitutes about 25 percent of the matter/energy inventory of the universe.

So, the stars and galaxies and the conventional matter we observe all around us really only compose 5 percent of what constitutes our universe. Our research has revealed to us deep mysteries about the remaining 95 percent, inspiring the title of tonight's discussion, "The Universe Is Stranger Than We Thought."



Wendy Freedman

Wendy Freedman is Crawford H. Greenewalt Chair and Director of Carnegie Observatories at the Carnegie Institution for Science. She was elected a Fellow of the American Academy of Arts and Sciences in 2000.

A century ago, we astronomers understood the universe to be both dominated by stars and unchanging with time. We observed the diurnal motions of stars, but they were, to us, fixed; the universe was neither expanding nor contracting. A century later, we have learned that ours is a dynamic universe: it is evolving, it is changing with time, it is filled not only with stars but with galaxies composed of stars and exotic objects like black holes, and it is overwhelmingly filled with dark energy and with matter that bears little resemblance to the matter that we know about. These findings were part of a century of far-reaching cosmological discovery. Today, I will concentrate on three discoveries in particular: the discovery of the expanding universe, the discovery of evidence supporting the presence of dark matter in the universe, and the

The universe is being stretched apart and the galaxies are participating in this overall expansion of the universe.

discovery of the acceleration of the expansion of the universe.

I will begin with the discovery of the universe's expansion, for which we are indebted to Edwin Hubble, after whom the Hubble Space Telescope is named. The history of Hubble's discovery – and of cosmology in the twentieth century generally – is inextricably intertwined with the history of the Carnegie Institution of Science itself. Andrew Carnegie had a vision: if you hired exceptional scientists, and if you gave them resources, a laboratory, and the apparatus to do science, then interesting discoveries would follow. Likewise, George Ellery Hale, the first director of the observatories of the Carnegie Institution, had a vision of his own: if you built large telescopes with reflecting mirrors, then you would make discoveries in astronomy. Hale was fond of saying, "Make no little plans. They have no magic to stir men's blood," a quotation from the American architect Daniel Burnham. And Hale certainly made no little plans, arriving in Pasadena in 1903, where he identified Mount Wilson as a site for his observatory of large reflecting telescopes.

At Mount Wilson, Hale first built a solar telescope (he was a solar astronomer and, in fact, was the astronomer who discovered that there were magnetic fields on the Sun) and then began construction of a 60-inch mirror telescope. This 60-inch telescope is what then Carnegie astronomer Harlow Shapley used to discover that our Sun is not the center of the universe, where it had been presumed to reside ever since Copernicus had in 1543 shown that the Earth was not the center of the universe. Shapley showed that the Sun is actually located about two-thirds of the way out in a disk, a plane, of what we

now know as our Milky Way galaxy. That was an extraordinary early discovery to come out of the first telescopes at Hale's observatory. But it was the 100-inch Mount Wilson telescope, whose construction began before the 60-inch telescope was even complete, that enabled Hubble to make his discoveries about the expanding universe.

Edwin Hubble used the 100-inch telescope to study a class of objects known as "nebulae." In the early twentieth century, nebula was the classification given to any number of diffuse objects, including interstellar clouds of dust and gas that we now know act as stellar nurseries, star clusters and galaxies beyond the Milky Way. Figure 1 features a photograph of Hubble examining a glass photographic plate, as well as an image of the nearby Andromeda nebula shown on a plate Hubble took. Glass photographic plates were the detectors in use when the 100-inch Mount Wilson telescope became operational. The black fuzzy mass centered on the glass plate is what Hubble identified as a nebula. These objects had been catalogued by astronomers for a couple hundred years. The question was, were these nebulae objects swirling around regions of gas and dust, collecting under gravity to form new stars in the Milky Way? Or were they perhaps galaxies like the Milky Way, at far greater distances? In the box in the upper right corner of the photographic plate in Figure 1, which is a negative image, you can see where Hubble marked "VAR!" "VAR" stands for variable, and the new variable Hubble had found was a class of star called a Cepheid: a star whose luminosity and pulsation period allow astronomers to measure distances to extragalactic objects.

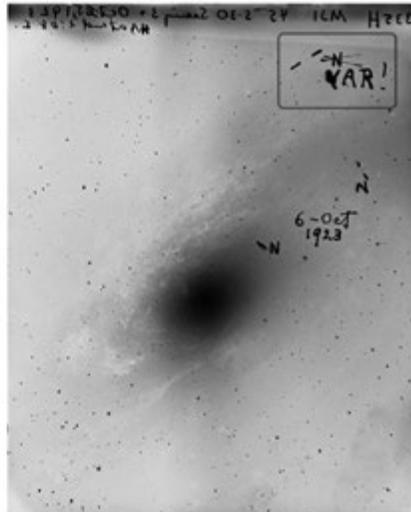


Figure 1.
Left: Astronomer Edwin Hubble examining plate, c. 1952
Right: Hubble's discovery plate of a Cepheid in Andromeda

Using Cepheids, Hubble was able to show that Andromeda was well beyond the confines of our own galaxy – we now know it is about two million light years away from us. Hubble went on to make these measurements for many different galaxies and, as illustrated by Figure 2, he was able to show that when he plotted the velocity (km/s; erroneously labeled just “km” on Hubble’s graph) of the galaxy on one axis and the distance (millions of parsecs or Megaparsecs, where 1 parsec = 3.26 light years) on the other, there was a correlation between how fast the galaxy was moving and the distances he measured. That is, the farther away the galaxy is, the faster it is moving away from us.

These were two spectacular discoveries: 1) what followed is that we now know that there are about one hundred billion such galaxies in our observable universe in addition to our own, and that within galaxies like our Milky Way, there are about

one hundred billion stars; and 2) that the universe is expanding and that the galaxies are participating in this overall expansion of the universe.

The current best hypothesis is that dark matter is a relic from the early universe that interacts with ordinary matter only through gravity.

We think Hubble did not actually believe that the universe was expanding, despite the evidence his empirical results provided. It was the integration of Einstein’s General Theory of Relativity that described, based on Hubble’s observational results about the linear relationship between velocity and distance, that the universe must have had a beginning. If the universe is expanding now, there must have been a time when it was compressed, hot, and dense. Einstein’s

theory and Hubble’s observations led to our picture of a universe developed from the Big Bang: a furiously hot and dense explosion about 14 billion years ago. This extrapolation of Hubble’s observations has since been confirmed by more exact measurements of the Cepheid variables recently taken with the Hubble Space Telescope and its sister satellite, the Spitzer Space Telescope (which operates in the medium infrared, very long wavelengths) – which have charted out the distance scale of the universe based on many galaxies. Further, using the Hubble Space Telescope, we have estimated the age of the universe to be about 13.7 billion years, a number that has been corroborated by numerous independent findings.

The second discovery I want to talk about is the existence of dark matter in the universe. That story begins with the observations of Fritz Zwicky at Caltech in the 1930s, and the observations by Carnegie astronomer Horace Babcock, who in 1939 made the first measurements of the velocity of stars in the Andromeda galaxy (the same galaxy in which Hubble discovered Cepheids). Zwicky found that the velocities of galaxies in the nearby Coma cluster

were so high that the galaxies could not have been bound to the cluster; they should have escaped long ago. Babcock learned that the velocity of stars and gas in the Andromeda galaxy increases and then stays constant as you move away from the center of the galaxy toward the outer regions. The expectation was that in the same manner that we observe the orbital velocities of planets in our solar system reduce proportionally to the distance from the Sun, the velocities of

stars and gases in galaxies should fall off in the outer regions. For decades, these data were largely ignored because they were not expected and simply could not be explained. Then in the 1970s, Vera Rubin, of Carnegie's Department of Terrestrial Magnetism in Washington, D.C., made her own observations. Once again, the velocities of outer stars and gases in every galaxy that Rubin and her collaborator Kent Ford measured either increased or remained flat. Other astronomers measured the velocities of hydrogen clouds within galaxies. None of these velocities decreased with distance as they did in the solar system.

Rubin's findings signaled that there was additional matter in the outer regions of these galaxies whose gravitational influence bound these high-velocity stars to the structure. Without additional matter, there simply would not be enough mass to prevent the stars, moving at such great speeds, from escaping the galaxy. There were alternative

explanations, but the evidence for what would become known as dark matter kept increasing. The measurements of velocities of other galaxies in clusters confirmed Fritz Zwicky's measurements in the Coma cluster. Additionally, with new advancements

We do not know the nature of the dark energy that is causing the acceleration of the expansion, but it makes up most of the composition of the universe.

in X-ray astronomy, astronomers were able to discover gas as hot as 100 million degrees Celsius residing in these galaxy clusters. But without additional mass to bind this gas to the cluster, it should have, at those temperatures, evaporated. Finally, Einstein's General Relativity predicted that space would bend in the vicinity of a massive object, and light would bend around it. This phenomenon, known as gravitational lensing, reveals

to us the strength of the gravitational influence of the object that is changing the light's course. But the arcs we observe suggest that there is far more mass acting upon the light than is accounted for by the luminous matter in galaxies alone.

Ultimately, only about 4 percent of the total composition of mass and energy in the universe is ordinary visible matter. The vast majority of the matter in the universe is dark. We cannot see it and it does not emit visible light or any kind of electromagnetic radiation. So what could this dark matter be? Could it be rocks, planets, remnants of old stars that no longer shine? Could it be gas, massive compact objects, space dust, or black holes? In the 1980s, many groups embarked on searches for dark matter in such forms that we already understood, and all failed. The only option left standing was an undiscovered particle, one formed soon after the Big Bang.

The current best hypothesis is that dark matter is a relic from the early universe that interacts with ordinary matter only through gravity. That is, dark matter does not interact via electromagnetic or other known forces. Researchers are currently looking for dark matter in underground laboratories, shielded by lead from other noise sources, using detectors made of elements like germanium and silicon to look for this very faint signal from what could be these weakly interacting massive particles. The Fermi gamma-ray satellite, as well as the Large Hadron Collider – a particle accelerator between France and Switzerland that accelerates particles to very high velocities and smashes them – are also looking for evidence of dark matter candi-

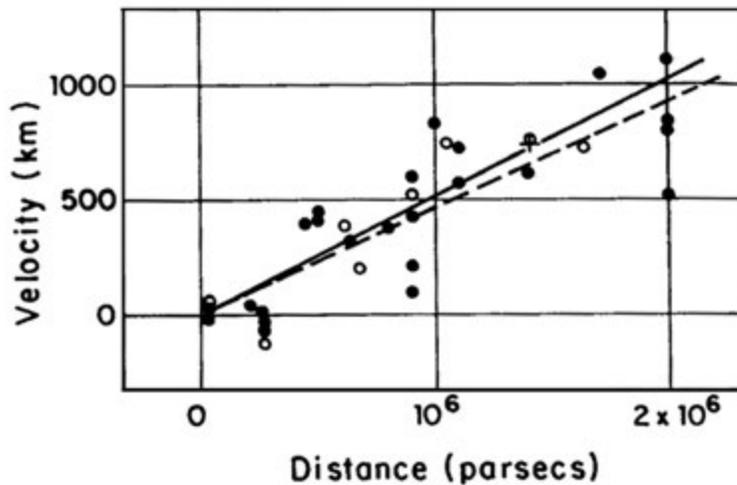


Figure 2. Hubble Diagram (1929)

dates. Physicists and astronomers hope that these elusive particles will be discovered in the next decade – a Nobel Prize for this discovery awaits.

The third discovery I would like to discuss is the acceleration of the expansion of the universe, a discovery made in 1998 and 1999 by two independent groups studying Type Ia supernovae. Type Ia supernovae are thought to occur in a binary star system in which one of the stars is a white dwarf (a

centimeter). It appears that there is energy in the vacuum of space, and although the density is so slight, the sheer volume of space establishes the energy's dominance in our universe. Although astronomers have now measured the effects of dark energy and dark matter in several independent ways, we do not yet understand the fundamental nature of what is causing the universe to be stretched apart; nor do we know at this time what composes 95 percent of the universe.

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star that has completed its normal life cycle and has ceased nuclear fusion). If the white dwarf accretes enough mass from its companion star and exceeds a certain mass, that white dwarf explodes in so bright a display that you can actually see it over most of the observable universe. Another possibility is that the explosion occurs when two white dwarf stars merge. Whatever the mechanism, the supernovae themselves can be as bright as an entire galaxy. Using these supernovae, we have found that as we look back further in time (farther in space), the expansion rate has increased over time – the expansion of the universe is accelerating.

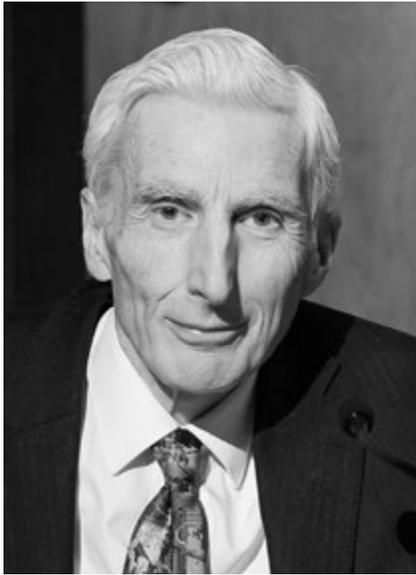
The reason for this acceleration is not well understood at this time. We do not know the nature of the dark energy that is causing the acceleration of the expansion, but it makes up most of the composition of the universe. To give you some sense of what we think we know about dark energy, the density of dark energy is tiny – about 10^{-30} grams per cubic centimeter (for a relative comparison, the density of water is about 1 gram per cubic

To conclude, I quickly want to say a few words about what is on the horizon, because this is a very exciting time in astronomy. The successor to the Hubble Space Telescope, the James Webb Space Telescope – which features a mirror 6.5 meters (250 inches) in diameter – is due to be launched in 2018. Unlike the Hubble, which orbits the Earth about 350 miles above our heads (for comparison, the Earth-Moon distance is about 250,000 miles), the James Webb Space Telescope will reside about one million miles from the Earth, and will let us study some of the earliest moments in the universe, including the so-called Dark Ages about 400,000 years after the Big Bang, about which we know virtually nothing.

Back on the ground, I have had the pleasure of leading an international consortium planning the Giant Magellan Telescope (GMT), now poised to enter its construction phase. The GMT is a joint effort by the Carnegie Institution, the Smithsonian Institution, Harvard University, the Universities of Arizona, Chicago, Texas at Austin, and

Texas A&M, as well as Australia and South Korea. The GMT is a 25-meter (1000-inch) telescope that will use seven mirrors, each over 27 feet in diameter, to capture images ten times the resolution of the Hubble Space Telescope. These mirrors are being manufactured underneath the football stadium at the University of Arizona – not what the football stadium was designed to do, but it really is a good use of the empty space in the facility! We will ship these mirrors and assemble this telescope at Carnegie's Las Campanas Observatory in the Andes Mountains in Chile, home to our current 6.5-meter Magellan Telescopes. We hope to begin taking data with the GMT in 2021.

In summary, our universe has revealed itself to be quite extraordinary. It is stranger than we think, it is vast, it is expanding and that expansion is accelerating, it is filled with exotic objects and new kinds of matter and energy. And I would venture that it is very unlikely to be through surprising us.



Martin Rees

Martin Rees is a Fellow of Trinity College and Emeritus Professor of Cosmology and Astrophysics at the University of Cambridge. He holds the title of Astronomer Royal and is a Visiting Professor at Imperial College London and at Leicester University. He was elected a Foreign Honorary Member of the American Academy of Arts and Sciences in 1975.

Charles Darwin's *On the Origin of Species* closes with these famous words: "Whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."

But the young Earth – Darwin's "simple beginning" – was in fact already very complicated, chemically and geologically. Astronomers aim to probe back farther than this beginning; to set our Earth in its vast cosmic context and address basic questions like: How did planets such as ours form? How did stars originate? Where did the atoms that make up planets and stars come from? Over the past few decades there has

We have made huge progress in delineating a process of cosmic emergence, which we can trace back to a mysterious, hot, and dense beginning 13.8 billion years ago.

been a crescendo of progress and discovery, owed primarily to advancing instrumentation: more powerful telescopes, computers, and space technology.

Unmanned probes to other planets have beamed back pictures of varied and distinctive worlds: Venus, rendered torrid and uninhabitable by the greenhouse effect that has poisoned its atmosphere; and Mars, with its intricate geology, now being explored by the Curiosity rover. Farther afield, we have fascinating close-ups of Jupiter's moons: icy Europa and sulphurous Io. The European probe Huygens has landed on Saturn's giant moon Titan, revealing flowing rivers of liquid ethane at -170 degrees Celsius.

Astronomers aim not only to understand the solar system in which we live, but to trace back farther in our history – to understand how stars and planets form, and from where their constituent atoms came. We have made huge progress in delineating a process of cosmic emergence, which we can trace back to a mysterious, hot, and dense beginning 13.8 billion years ago.

But let's start our cosmic exploration closer to home. And this leads to one of the great unknowns, which certainly would have fascinated Darwin: what creatures might be out there in space already?

Prospects for life look bleak in our solar system – even on Mars or under the ice of Saturn's moon Enceladus. But prospects brighten if we widen our horizons to other stars – far beyond the reach of any probe we can now envisage. Indeed, a hot current topic in astronomy is the realization that many other stars – perhaps even most of

them – are orbited by retinues of planets, like the Sun is.

These planets are not detected directly but inferred by precise measurement of their parent star. One technique is very simple. From our vantage point, a star dims slightly when a planet is "in transit" in front of it. An Earth-like planet transiting a Sun-like star causes a fractional dimming, recurring once per orbit, of one part in ten thousand.

NASA's Kepler spacecraft spent three years monitoring the brightness of over one hundred and fifty thousand stars, at least twice every hour, with this precision. It has determined the orbits of more than two thousand planets, and allowed us to infer their sizes from the depth of the dip during transit. We are especially interested in possible "twins" of our Earth: planets the same size as ours, on orbits with temperatures such that water neither boils nor stays frozen. The best such candidate so far is one of five planets orbiting a star half the mass of the Sun (and much fainter). The outermost planet has 1.2 times the Earth's radius, and it orbits at a distance from the parent star such that liquid water might just exist. There may be better candidates still to be retrieved from the Kepler data. Moreover, Kepler has only looked at a thousandth of the area of the sky; so we would expect, after scanning it all, to find a candidate planet that is ten times closer and one hundred times less faint than this one.

The real goal, of course, is to see Earth-like planets directly – not just their shadows. But that is hard. To realize just how hard, suppose an alien astronomer with a

powerful telescope was viewing the Earth from thirty light years away – the distance of a nearby star. Our planet would seem to be, in Carl Sagan’s phrase, a “pale blue dot,” very close to a star (our Sun) that outshines it: like a firefly next to a searchlight. But if the aliens could detect this dot, there is a lot they could infer. The shade of blue would be slightly different, depending on whether the Pacific Ocean or the Eurasian land mass

planets orbiting double-star systems, a relationship that produces two “suns” in the planet’s sky. But the existence of these planets was not surprising given what we have learned about how stars form via the contraction of clouds of dusty gas. If a protostellar cloud has any angular momentum, it will spin faster as it contracts and spin off a dusty disc around the protostar, in which gas condenses and dust agglomerates into

amorphous fireball. It might seem to violate a hallowed physical principle – the second law of thermodynamics – which describes an inexorable tendency for patterns and structure to decay or disperse. The answer to this seeming paradox lies in the force of gravity. Gravitating structures have a negative specific heat. As they lose energy, they get hotter. If the nuclear reactions that generate its power were switched off, the Sun would gradually contract, but in the process its center would get hotter: higher pressure would be needed to balance gravity as the Sun shrunk.

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In the expanding universe, gravity enhances, density contrasts. Any patch of the universe that starts off slightly denser than average would decelerate more because it feels extra gravity; its expansion lags farther and farther behind, until it eventually stops expanding and separates out. Computer simulations of part of a “virtual universe” clearly show incipient structures unfolding and evolving. Within the resulting galaxy-scale clumps, gravity enhances the contrasts still further: gas is pulled in and compressed into stars. Simulations of this kind, displayed as movies, portray how galaxies emerged sixteen powers of ten times faster than it actually happened! Each galaxy is an arena within which stars, planets, and perhaps life can emerge.

was facing them (of course, also depending on the global pattern of cloud cover). So the alien astronomers could infer the length of our “day,” the length of our seasons, the gross topography, and the climate. By analyzing the faint light, they could infer that the Earth had a biosphere. In the 2020s, telescopes like the Giant Magellan Telescope and its European counterpart, the Extremely Large Telescope (with a mirror 39 meters across), will be drawing such inferences about planets the size of our Earth that orbit other Sun-like stars.

rocks and planets. We believe this to be a generic process in all protostars.

Could there be life on these planets? Here we are still in the realm of speculation. Even if simple life is common, it is a separate question whether it is likely to evolve into anything we might recognize as intelligent or complex – whether Darwin’s writ runs through the wider cosmos. Perhaps the cosmos teems with life; on the other hand, our Earth could be unique among the billions of planets that surely exist.

Flashback to Newton, who famously explained why planets move in ellipses, but did not understand why they were orbiting on roughly the same plane: the ecliptic. Newton believed it was providence, but we now understand it as a natural outcome of formation from a dusty proto-stellar disc. We have pushed back the causal chain farther than Newton could. Indeed, as Wendy Freedman has adumbrated, we have pushed it right back to the cosmos’s hot, dense beginning. We can trace cosmic history back to one second after the Big Bang, when the temperature was 1 MeV and helium and deuterium formed via nuclear fusion. Indeed we can probably be confident back to a nanosecond after the Big Bang, when each particle had about 50 GeV of energy – as much as can be achieved in the Large Hadron Collider accelerator in Geneva.

What has surprised people about these planetary systems is their great variety: Jupiter-mass planets very near their stars; planets on extremely eccentric orbits; and

Our complex cosmos today manifests a huge range of temperature and density – from blazingly hot stars to the dark night sky. People sometimes worry about how this intricate complexity emerged from an

And there is one important point: the initial irregularities fed into the computer models are not arbitrary; they are inferred from the observed fluctuations in the temperature of the cosmic microwave background. The amplitude is only one part in one hundred thousand, but computing forward, the fluctuations are amplified by gravity into the conspicuous structures – galaxies, galaxy clusters – in the present universe. This vindicates the claim that structure emerges by clustering of the gravitationally dominant dark matter during cosmic expansion.

As I said, we can trace cosmic history back to a nanosecond after the Big Bang, when the entire visible universe was squeezed to the size of our solar system. But questions like “where did the fluctuations come from?” and “why did the early universe contain the actual mix we observe of protons, photons, and dark matter?” take us back to an even younger universe, where matter was hugely more compressed still.

The physics at that era are of course still conjectural. But an astonishingly bold theory called “inflation” suggests that the fluctuations could have been generated by microscopic quantum fluctuations that are stretched by the subsequent expansion right up to the scales of galaxies, and beyond. The generic idea of inflation has achieved success in predicting two features of the fluctuations: that they are Gaussian, and that their amplitude depends on scale in a distinctive way. As well as generating the density fluctuations that evolve into galaxies, quantum effects could generate a second kind of fluctuation: gravitational waves that generate transverse motions, without changing the density.

Recent claims to have detected the latter would, if confirmed, offer further support for “inflation”; their strength is an important discriminant among different models.

Now for another basic question: How much space is there altogether? How large is physical reality? We can only see a finite volume, a finite number of galaxies. That is essentially because there is a horizon, a shell around us delineating the distance light could have travelled since the Big Bang. But that shell has no more physical significance than the circle that delineates your horizon if you are in the middle of the ocean. There is no perceptible gradient across the visible universe, which suggests that, if finite and bounded, it stretches thousands of times farther. But that is just a minimum. If it stretched far enough, then all combinatorial possibilities would be repeated. Far beyond

the horizon, we could all have avatars. Even conservative astronomers are confident that the volume of space-time within range of our telescopes – what astronomers have traditionally called “the universe” – is only a tiny fraction of the aftermath of our Big Bang.

But that is not all. Plausible models for 10^{16} GeV physics lead to so-called eternal inflation. “Our” Big Bang could be just one island of space-time in a vast cosmic archipelago. This is speculative physics – it is perplexing today, just as the shape of the Solar System was to Newton and the “Big Bang” was until fifty years ago. But it is physics, not metaphysics; we can hope to push the casual chain back farther still.

So a challenge for twenty-first-century physics is to address two fundamental questions. First, are there many big bangs rather than just one? Second, if there are many, are they all governed by the same physics or

We now realize that even within our own galaxy there are billions of stars, each with planetary systems.

not? Many string theorists do not think so. They think there could be a huge number of different vacuum states – arenas for different microphysics. If they are right, what we call “laws of nature” may in this grander perspective be local bylaws governing our cosmic patch. Many patches could be still-born or sterile: the laws prevailing in them might not allow any kind of complexity. We therefore would not expect to find ourselves in a typical universe; rather, we would be a typical member of the subset where an observer could evolve. This is sometimes called anthropic selection.

Such conjectures motivate us to explore what range of parameters would allow complexity to emerge. Those who are allergic to multiverses can regard this just as an

exercise in counterfactual history (rather as historians speculate on what might have happened to America if the British had fought more competently in 1776, and biologists conjecture how our biosphere might have evolved if the dinosaurs had not been wiped out).

Anthropic arguments are irrelevant if the constants are unique. Otherwise, they are the best explanation we will ever have. It is reminiscent of planetary science four hundred years ago, even before Newton. At that time, Kepler thought that the Earth was unique, its orbit related to the other planets by beautiful mathematical ratios. We now realize that even within our own galaxy there are billions of stars, each with planetary systems. Earth’s orbit is special only insofar as it is in the range of radii and eccentricities compatible with life. Maybe we are due for an analogous conceptual shift

on a far grander scale. Our Big Bang may not be unique any more than planetary systems are. Its parameters may be “environmental accidents,” like the details of the Earth’s orbit. The hope for neat explanations in cosmology may be as vain as Kepler’s numerical quest.

Mention of a multiverse often triggers the response that unobservable domains are not part of science. I want to contest this by way of aversion therapy, the psychological process of increased exposure whereby you are, for example, at first presented with a spider a long way away, but end up at ease even with tarantulas crawling over you. I mentioned that there are galaxies beyond our horizon: in a decelerating universe, their existence is untroublesome, since as the

This century may be a defining moment, for good or for ill. It is the first century when complex entities – technologically empowered humans – have mapped the cosmos and have begun to understand how they emerged. But it is also the first century where one species – ours – holds the Earth’s future in its hands, and could jeopardize life’s immense potential here and far beyond.

universe’s expansion slows, they will eventually be observable. However, as Wendy Freedman explained, we realize now that these galaxies are accelerating away from us, which means that they will never in principle be observable. But does that make them any less “real”? They are the aftermath of “our” Big Bang. But since they will never be observable, why is their reality more acceptable than that of galaxies in the aftermaths of other big bangs (if there are other big bangs, which we, of course, do not know)? We will only take other big bangs seriously if they are a prediction of a unified theory that gains credibility by being “battle tested” in other ways.

If there is a multiverse, it will take our Copernican demotion one stage further: our Big Bang may be one among billions. It may disappoint some physicists if some of the key numbers they are trying to explain turn out to be mere environmental contingencies. But in compensation, we would realize space and time were richly textured, but on a scale so vast that astronomers are not directly aware of it – not any more than a plankton whose “universe” was a spoonful of water would be aware of the world’s topography and biosphere.

The bedrock nature of space and time and the unification of cosmos and quantum are surely among science’s great “open frontiers.” But calling this the quest for a “theory of everything” is hubristic and misleading. It is irrelevant to 99 percent of scientists. Problems in biology and in environmental and human sciences remain

unsolved because it is hard to elucidate the complexities of Darwin’s “forms most wonderful,” not because we do not understand subatomic physics well enough.

Now let’s focus back on the Earth. I have lived my life among astronomers, and I can assure you that their awareness of vast expanses of space and time does not make them more serene in everyday life. But there is one special perspective that astronomers can offer: an awareness of a vast future. The stupendous time spans of the evolutionary past are now part of common culture. But most people still somehow think that humans are the culmination of the evolutionary tree. That hardly seems credible to astronomers.

Our Sun formed 4.5 billion years ago and has 6 billion more years before its fuel runs out. It will then flare up, engulfing the inner planets. The expanding universe will continue – perhaps forever – destined to become ever colder, ever emptier. Any creatures witnessing the Sun’s demise 6 billion years hence won’t be human – they will be as different from us as we are from a bug. Posthuman evolution – here on Earth and far beyond – could be as prolonged as the Darwinian evolution that has led to us, and could be even more wonderful. And, of course, the evolution is even faster now: machines may take over.

However, even in this concertinaed timeline – extending billions of years into the future, as well as into the past – this century may be a defining moment, for good or for ill. It is the first century when complex entities –

technologically empowered humans – have mapped the cosmos and have begun to understand how they emerged. But it is also the first century where one species – ours – holds the Earth’s future in its hands, and could jeopardize life’s immense potential here and far beyond.

This pale blue dot in the cosmos is a special place. It may be a unique place. And we are its stewards at a crucial era. That is a message for us all, whether we are interested in astronomy or not. ■

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Intellectual Diversity and *The Heart of the Matter*

Reflections by Subra Suresh

Subra Suresh is President of Carnegie Mellon University. He was elected a Fellow of the American Academy of Arts and Sciences in 2004.

The Heart of the Matter, the 2013 report prepared by the American Academy's Commission on the Humanities and Social Sciences, offered many sound and inspiring ideas for guaranteeing the vitality of the humanities and social sciences in the twenty-first-century United States. The report underscored how essential these disciplines are for literacy, citizenship, and quality of life in our nation. Echoing a core message of the report, I believe that the humanities and social sciences are essential if we are to solve the urgent social and environmental challenges now facing our world.

In 2000, the National Academy of Engineering listed the greatest engineering achievements of the twentieth century, highlighting such revolutions as electrification, petroleum engineering, nuclear power, air travel, and the Internet. Then in 2004, it listed the fourteen "grand challenges" facing humanity in the twenty-first century, including making solar power economical, developing carbon sequestration methods, coping with infectious diseases, and securing infrastructure and privacy in cyberspace. I am struck by how many of the twenty-first century's challenges could be viewed as direct, but unintended, consequences of the twentieth century's achievements: the progress in petroleum engineering requires us to deal with the serious issues of global change that require carbon sequestration and solar power; the Internet brought many benefits, but also opened the door for cyberterrorism; jet travel enables us to connect with one another in an increasingly globalized world, but also allows viruses to spread rapidly around the planet, posing a serious public health threat to humans and other species.

What can we learn from the unintended consequences of the last century's greatest engineering achievements while we confront the engineering grand challenges of the twenty-first century? In creating, deploying, and scaling technologies, we did not anticipate and sufficiently allow for the human factor and the human condition as much as we should have. We failed to anticipate what human beings would do with new capabilities, how they would deliberately or accidentally adapt their capacities in destructive ways.

Consider one example of the human factor's influence: the National Science Foundation, which I directed from 2010 to 2013, funded many projects to better track severe storms and weather events such as tornadoes and hurricanes. Scientists have made immense progress over the past several decades in predicting the size, strength, and timing of these major storms, enabling gov-



ernments and media to provide much earlier warnings to people living in the storms' paths. Yet despite such advances, every year dozens of Americans and hundreds of others around the world die in tornadoes and hurricanes; people miss the warnings, or are confused about what to do, or they simply refuse to follow instructions to avoid danger. Machines alone cannot save these lives. The human factor diminishes the weight of even the most powerful technological achievement; we have seen this over and over again.

Researchers are recognizing and adapting to this understanding. At Carnegie Mellon's College of Engineering, for example, there is a department of Engineering and Public Policy that integrates a wide range of disciplines into solving what seem like purely technical issues. At our School of Computer Science, there is a stand-alone "Human-Computer Interaction" department that focuses on problems at the intersection of computing and human behavior, including learning technologies. Increasingly, research funders are designing programs for intellectually diverse teams: they have seen the impressive results achieved when engineers and scientists work with those who study behavioral sciences, health care, decision-making, economics, design, architecture, and visual arts. Tapping into the collective wisdom of literature, history, and art is another means of gaining insight about human capacities and desires.

There is increasing recognition that the planet's most severe problems cannot be treated as if they are solvable only by great engineering and scientific solutions. As *The Heart of the Matter* recognizes, the social sciences and humanities hold a key to our innovation ecosystem that will enable us to make more rapid progress in addressing major challenges.

We need culturally diverse teams, too, and – especially important in information technology – teams with diversity of age. In my experience in research, diverse teams work faster and have improved outcomes because they can correct one another's biases and hidden assumptions in a way that more homogeneous teams never will.

There is increasing recognition that the planet's most severe problems cannot be treated as if they are solvable only by great engineering and scientific solutions. As *The Heart of the Matter* recognizes, the social sciences and humanities hold a key to our innovation ecosystem that will enable us to make more rapid progress in addressing major challenges.

It is likely that the next decades will introduce a cascade of powerful new technologies to our nation; now is the time to continue and expand support for those humanistic disciplines that will allow us to understand the incentives and responses that will shape the ways in which human beings will use and abuse these new capacities in intended and unintended ways. In this way we can also better anticipate how new technologies will affect the environmental quality – air, water, land, and biodiversity – of our planet, as well as how they will shape nations, communities, families, and individuals.

Support for such deep intellectual diversity is truly at the heart of the matter for any educational and research activity today. ■

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Select Prizes and Awards

Bruce Alberts (University of California, San Francisco) was awarded a 2014 Centennial Medal from Harvard University Graduate School of Arts and Sciences.

Victor Ambros (University of Massachusetts Medical School) received the 2014 Gruber Genetics Prize. He shares the prize with **Gary Ruvkun** (Massachusetts General Hospital; Harvard Medical School) and **David Baulcombe** (University of Cambridge).

Mark Aronoff (Stony Brook University, State University of New York) received a 2014 John Simon Guggenheim Fellowship.

Jacqueline K. Barton (California Institute of Technology) received the 2015 Priestley Medal from the American Chemical Society.

Bonnie Bassler (Princeton University) received a Phi Beta Kappa Award for Excellence in Undergraduate Teaching.

Kamaljit Bawa (Ashoka Trust; University of Massachusetts) received a Doctor of Science honorary degree from the University of Alberta.

Anthony Bebbington (Clark University) received a 2014 John Simon Guggenheim Fellowship.

Timothy Berners-Lee (World Wide Web Consortium; Massachusetts Institute of Technology) received a Doctor of Engineering and Technology honorary degree from Yale University.

Michael Blackwood (Michael Blackwood Productions) received a 2014 Arts and Letters Award in Architecture from the American Academy of Arts and Letters.

Michael Bloomberg (Bloomberg LP) received a Doctor of Laws honorary degree from Harvard University. He was also awarded an inaugural Genesis Prize.

Rodney Brooks (Massachusetts Institute of Technology; Rethink Robotics, Inc.) is the recipient of the 2014 Engelberger Award for Leadership.

Emery N. Brown (Massachusetts Institute of Technology; Massachusetts General Hospital; Harvard Medical School) was elected a member of the National Academy of Sciences.

John Seely Brown (University of Southern California; Deloitte Center for Edge Innovation) received a Doctor of Science honorary degree from Bates College.

Stephen L. Buchwald (Massachusetts Institute of Technology) is the recipient of the 2014 Linus Pauling Medal Award from the American Chemical Society.

Hal Caswell (Woods Hole Oceanographic Institution) received the 2014 Mindel C. Sheps Award from the Population Association of America.

Shu Chien (University of California, San Diego) received the 2014 Roger Revelle Medal, given by the University of California, San Diego.

Sallie Chisholm (Massachusetts Institute of Technology) was named the 2014 recipient of the James R. Killian Jr. Faculty Achievement Award, given by MIT.

Keith Christiansen (Metropolitan Museum of Art) was awarded a 2014 Centennial Medal from Harvard University Graduate School of Arts and Sciences.

Scott Cowen (Tulane University) received the TIAA-CREF Theodore M. Hesburgh Award for Leadership Excellence in Higher Education.

Thomas Crow (New York University) received a 2014 John Simon Guggenheim Fellowship.

Daniel Diermeier (Northwestern University) received a 2014 John Simon Guggenheim Fellowship.

Rita Dove (University of Virginia) received a Doctor of Letters honorary degree from Yale University.

William A. Eaton (National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health) received a Distinguished Graduate Award from the University of Pennsylvania School of Medicine.

Wendy Freedman (Carnegie Institution for Science) received a Doctor of Science honorary degree from the University of Chicago.

Susan Gal (University of Chicago) received a Faculty Award for Excellence in Graduate Teaching and Mentoring from the University of Chicago.

Gary Glatzmaier (University of California, Santa Cruz) was awarded the 2014 John Adam Fleming Medal from the American Geophysical Union.

Jeffrey I. Gordon (Washington University in St. Louis) is the recipient of the 2014 Passano Foundation Award. He also received a Doctor of Science honorary degree from the University of Chicago.

Robert J. Gordon (Northwestern University) has been named a Distinguished Fellow of the American Economic Association.

Peter Gourevitch (University of California, San Diego) received the 2014 Roger Revelle Medal, given by the University of California, San Diego.

Adolf Grünbaum (University of Pittsburgh) received the Great Federal Merit Cross from the German government. He was also awarded an Honorary Doctorate of Philosophy from the University of Cologne.

Alan H. Guth (Massachusetts Institute of Technology) was awarded a 2014 Kavli Prize in Astrophysics. He shares the prize with **Andrei D. Linde** (Stanford University) and **Alexei A. Starobinsky** (Landau Institute for Theoretical Physics, Russian Academy of Sciences).

Ray A. Hammond (Bethel African Methodist Episcopal Church) received a Doctor of Humane Letters honorary degree from the University of Notre Dame.

Herbie Hancock (Los Angeles, California) received the Lifetime Achievement in Jazz Award from the Jazz Journalists Association.

Larry Hedges (Northwestern University) received the AERA Presidential Citation for Research Excellence from the American Education Research Association.

Michael J. Hopkins (Harvard University) is the recipient of the 2014 Frederic Esser Nemmers Prize in Mathematics.

Anthony Ives (University of Wisconsin-Madison) received a Kellett Mid-Career Award from the University of Wisconsin-Madison.

Thomas Jessell (Columbia University) received the 2014 Gruber Neuroscience Prize.

Daniel Kahneman (Princeton University) received a Doctor of Social Science honorary degree from Yale University.

Andrew H. Knoll (Harvard University) received a Doctor of Science honorary degree from the University of Chicago.

Jon A. Krosnick (Stanford University) received the 2014 AAPOR Award from the American Association of Public Opinion Research.

Thorne Lay (University of California, Santa Cruz) was awarded the 2014 Inge Lehmann Medal from the American Geophysical Union.

Jill Lepore (Harvard University; *The New Yorker*) received a 2014 John Simon Guggenheim Fellowship.

Jonathan Levin (Stanford University) received a 2014 John Simon Guggenheim Fellowship.

Andrei D. Linde (Stanford University) was awarded a 2014 Kavli Prize in Astrophysics. He shares the prize with **Alan H. Guth** (Massachusetts Institute of Technology) and **Alexei A. Starobinsky** (Landau Institute for Theoretical Physics, Russian Academy of Sciences).

George Lusztig (Massachusetts Institute of Technology) was awarded the 2014 Shaw Prize in Mathematical Sciences.

Penelope Maddy (University of California, Irvine) has been named Phi Beta Kappa Romanell Professor.

Grigoriy Margulis (Yale University) received a Doctor of Science honorary degree from the University of Chicago.

Tobin Marks (Northwestern University) is the 2014 recipient of the Sir Geoffrey Wilkinson Award from the Royal Society of Chemistry.

Carolyn “Biddy” Martin (Amherst College) received a Doctor of Laws honorary degree from the University of North Carolina at Chapel Hill.

Leo Marx (Massachusetts Institute of Technology) was awarded a 2014 Centennial Medal from Harvard University Graduate School of Arts and Sciences.

Susan K. McConnell (Stanford University) has been named a Howard Hughes Medical Institute Professor.

Jerrold Meinwald (Cornell University) was awarded the 2014 Nakanishi Prize by the Chemical Society of Japan.

H. Jay Melosh (Purdue University) is the 2014 recipient of the Herbert Newby McCoy Award, given by Purdue University.

Elliot M. Meyerowitz (California Institute of Technology) received a Doctor of Science honorary degree from Yale University.

Brenda Milner (McGill University) was awarded a 2014 Kavli Prize in Neuroscience. She shares the prize with John O’Keefe (University College London) and **Marcus E. Raichle** (Washington University in St. Louis).

Jeffrey S. Moore (University of Illinois at Urbana-Champaign) has been named a Howard Hughes Medical Institute Professor.

Richard G. M. Morris (University of Edinburgh) was awarded the 2013 Fondation Ipsen Prize for Neuronal Plasticity; was elected to the European Molecular Biology Organization; and received the Royal Medal of the Royal Society of Edinburgh.

Andrew Murray (Harvard University) has been named a Howard Hughes Medical Institute Professor.

Barbara Partee (University of Massachusetts) received a Doctor of Humane Letters honorary degree from the University of Chicago.

John B. Pendry (Imperial College London) was awarded a 2014 Kavli Prize in Nanoscience. He shares the prize with Thomas W. Ebbesen (Université de Strasbourg, France) and Stefan W. Hell (Max Planck Institute for Biophysical Chemistry, Germany).

Marjorie Perloff (Stanford University) is the 2014 recipient of Washington University’s International Humanities Medal.

Monika Piazzesi (Stanford University) received a 2014 John Simon Guggenheim Fellowship.

Joseph Polchinski (University of California, Santa Barbara) was named the 59th Annual Faculty Research Lecturer at the University of California, Santa Barbara.

Joseph W. Polisi (The Juilliard School) received a Doctor of Music honorary degree from Yale University.

Emily Rauh Pulitzer (The Pulitzer Foundation for the Arts) received a 2014 Harvard Medal from the Harvard Alumni Association.

Marcus E. Raichle (Washington University in St. Louis) was awarded a 2014 Kavli Prize in Neuroscience. He shares the prize with **Brenda Milner** (McGill University) and John O’Keefe (University College London).

Peter Raven (Missouri Botanical Garden; Washington University in St. Louis) received a Doctor of Science honorary degree from Harvard University.

Alfred G. Redfield (Brandeis University) is the recipient of the 2015 Pittsburgh Spectroscopy Award, given by the Spectroscopy Society of Pittsburgh.

Giacomo Rizzolatti (Università degli Studi di Parma, Italy) was awarded the 2014 Grete Lundbeck European Brain Research Prize. He shares the prize with Stanislas Dehaene (Collège de France, Paris) and Trevor Robbins (University of Cambridge).

Richard Rosenberg (Bank of America) received a 2014 UCSF Medal for Advancing Health Worldwide.

Philip Roth (New York, New York) received a Yaddo Artist Medal.

Gary Ruvkun (Massachusetts General Hospital; Harvard Medical School) received the 2014 Gruber Genetics Prize. He shares the prize with **Victor Ambros** (University of Massachusetts Medical School) and David Baulcombe (University of Cambridge).

Haun Saussy (University of Chicago) received a 2014 John Simon Guggenheim Fellowship.

Anne Firor Scott (Duke University) received a Doctor of Humane Letters honorary degree from the University of North Carolina at Chapel Hill.

David N. Seidman (Northwestern University) was elected a Fellow of the American Association for the Advancement of Science; was awarded a 2014 AIME-TMS Honorary Membership; and is the 2015 ASM International Edward DeMille Campbell Memorial Lecturer.

Richard B. Silverman (Northwestern University) received the Northwestern University Trustee Medal for Faculty Innovation and Entrepreneurship.

Charles Simic (University of New Hampshire) received the 2014 Zbigniew Herbert International Literary Award.

Paul Simon (New York, New York) received a 2014 NYU Steinhart Vision Award.

Seymour Slive (Harvard University) received a Doctor of Arts honorary degree from Harvard University.

David L. Spector (Cold Spring Harbor Laboratory) was elected to the European Molecular Biology Organization.

Ralph Stanley (Coeburn, Virginia) received a Doctor of Music honorary degree from Yale University.

Donald F. Steiner (University of Chicago) is the recipient of a 2014 University of Chicago Alumni Medal.

Susan Stewart (Princeton University) received the Howard T. Behrman Award for Distinguished Achievement in the Humanities, given by Princeton University.

Bruce Stillman (Cold Spring Harbor Laboratory) is the recipient of the American Society for Biochemistry and Molecular Biology’s Herbert Tabor Research Award.

Galen Stucky (University of California, Santa Barbara) received the 2014 Prince of Asturias Award for Technical and Scientific Research.

David F. Swensen (Yale University) received a Doctor of Humane Letters honorary degree from Yale University.

Terence Tao (University of California, Los Angeles) was awarded a Breakthrough Prize in Mathematics.

Richard Taylor (Institute for Advanced Study) was awarded a Breakthrough Prize in Mathematics.

Eugene Ulrich (University of Notre Dame) was awarded a NEH Fellowship.

Alexander Varshavsky (California Institute of Technology) is the recipient of the 2014 Albany Medical Center Prize in Medicine and Biomedical Research.

David Walt (Tufts University) received the Esselen Award for Chemistry in Public Interest from the Northeastern Section of the American Chemical Society.

Peter Walter (University of California, San Francisco) was awarded the 2014 Shaw Prize in Life Science and Medicine. He shares the prize with Kazutoshi Mori (Kyoto University, Japan).

Hayden V. White (University of California, San Cruz) received a Doctor of Humane Letters honorary degree from Wesleyan University.

Fred Wudl (University of California, Santa Barbara) received the 2014 Spiers Memorial Award, given by the Royal Society of Chemistry.

Richard Zeckhauser (Harvard University) has been named a Distinguished Fellow of the American Economic Association.

Ahmed H. Zewail (California Institute of Technology) received a Doctor of Science honorary degree from Yale University.

New Appointments

Danielle Allen (Institute for Advanced Study) has been elected Chair of the Pulitzer Prize Board.

Susan Athey (Stanford University) was named to the Board of Directors of Ripple Labs.

Dean Baquet (*The New York Times*) was named Executive Editor of *The New York Times*.

Rodney Brooks (Massachusetts Institute of Technology; Rethink Robotics, Inc.) has been appointed to the Visiting Committee on Advanced Technology of the National Institute of Standards and Technology.

Lord Browne of Madingley (Royal Academy of Engineering) has been reappointed Chairman of the Tate Gallery's Board of Trustees.

Edward G. Carmines (Indiana University) has been appointed President of the Midwest Political Science Association.

Thomas D. Cook (Northwestern University) was appointed to Mathematica Policy Research as a Senior Fellow.

France Córdova (National Science Foundation) was confirmed as Director of the National Science Foundation.

Pierre Corvol (Collège de France) was appointed Chairman of the Scientific Advisory Board of Quantum Genomics.

Daniel Diermeier (Northwestern University) has been appointed Dean of the Harris School of Public Policy Studies at the University of Chicago.

Persis Drell (Stanford University) has been named Dean of the Stanford University School of Engineering.

Stanley Fischer (U.S. Federal Reserve System) has been confirmed by the U.S. Senate to serve as Vice Chairman at the Federal Reserve.

Joseph S. Francisco (Purdue University) has been named Dean of the College of Arts and Sciences at the University of Nebraska-Lincoln.

Alice Gast (Lehigh University) has been named President of Imperial College London.

Laura Greene (University of Illinois) has been elected to the presidential line of the American Physical Society and will serve successive one-year terms as vice president, president-elect, president, and past president.

Bryan Grenfell (Princeton University) has been appointed to the Board of Governors of the Wellcome Trust.

Mark Groudine (Fred Hutchinson Cancer Research Center) has been named Interim President and Director of the Fred Hutchinson Cancer Research Center.

Robert M. Groves (Georgetown University) has been named to the National Science Board of the National Science Foundation.

Frances Hellman (University of California, Berkeley) has been appointed Dean of the Division of Mathematical and Physical Sciences in the College of Letters and Science at the University of California, Berkeley.

James Jackson (University of Michigan) has been named to the National Science Board of the National Science Foundation.

William Chester Jordan (Princeton University) has been elected President of the Medieval Academy of America.

Margaret Levi (Center for Advanced Study in Behavioral Sciences, Stanford University) has been appointed to the Board of Trustees of the Institute for Advanced Study.

Jane Lubchenco (Oregon State University) has been elected to Harvard University's Board of Overseers.

John Maunsell (University of Chicago) has been appointed inaugural Director of the Grossman Institute for Neuroscience, Quantitative Biology, and Human Behavior at the University of Chicago.

Sabeeha Merchant (University of California, Los Angeles) has been appointed Director of the UCLA-Department of Energy (UCLA-DOE) Institute.

Cherry Murray (Harvard University) was named to the Board of Directors of Newport Corporation.

Maurice Obstfeld (University of California, Berkeley) has been named to the White House Council of Economic Advisors.

Jerrold Olefsky (University of California, San Diego) has been appointed to the Scientific Advisory Board of AntriaBio, Inc.

Eric Olson (University of Texas Southwestern Medical Center) has been named Director of the Hamon Center for Regenerative Science and Medicine.

Edward Penhoet (Alta Partners) has been appointed to the Board of Directors of aTyr Pharma.

Peter Rossky (University of Texas at Austin) has been named Dean of Rice University's Wiess School of Natural Sciences.

Ruth Simmons (Brown University) was elected to the Board of Trustees of Rice University.

Michael Sipser (Massachusetts Institute of Technology) has been named Dean of the School of Science at the Massachusetts Institute of Technology.

Rogers Smith (University of Pennsylvania) has been appointed Associate Dean for the Social Sciences at the University of Pennsylvania.

Twyla Tharp (Twyla Tharp Dance Company) has been appointed to the Board of Trustees of Barnard College.

Elizabeth Thompson (University of Washington) has been elected President-Elect of the International Biometric Society.

Shirley Tilghman (Princeton University) has been appointed to the Board of Trustees of the Institute for Advanced Study.

J. Craig Venter (J. Craig Venter Institute) has been appointed to the Board of Directors of MYOS Corporation.

Clifford M. Will (University of Florida) has been appointed to a second term as Editor-in-Chief of the journal *Classical and Quantum Gravity*.

Select Publications

Fiction

James Carroll (Boston, Massachusetts). *Warburg in Rome: A Novel*. Houghton Mifflin Harcourt, July 2014

Jane Smiley (New York, New York). *Some Luck*. Knopf, October 2014

Paul Theroux (East Sandwich, Massachusetts). *Mr. Bones: Twenty Stories*. Houghton Mifflin Harcourt, September 2014

Nonfiction

Robert B. Brandom (University of Pittsburgh). *From Empiricism to Expressivism*. Harvard University Press, December 2014

Ken Burns (Florentine Films) and **Geoffrey C. Ward** (New York, New York). *The Roosevelts: An Intimate History*. Knopf, September 2014

David Card (University of California, Berkeley) and **Steven Raphael** (University of California, Berkeley), eds. *Immigration, Poverty, and Socioeconomic Inequality*. Russell Sage Foundation, July 2013

Hillary Rodham Clinton (Bill, Hillary & Chelsea Clinton Foundation). *Hard Choices*. Simon & Schuster, June 2014

Scott Cowen (Tulane University). *The Inevitable City: The Resurgence of New Orleans and the Future of Urban America*. Palgrave Macmillan, June 2014

Thomas Crow (New York University). *The Long March of Pop: Art, Music, and Design, 1930–1995*. Yale University Press, October 2014

Robert Darnton (Harvard University). *Censors at Work: How States Shaped Literature*. W.W. Norton, September 2014

Jenny Davidson (Columbia University; Visiting Scholar, 2005–2006). *Reading Style: A Life in Sentences*. Columbia University Press, June 2014

Ruth DeFries (Columbia University). *The Big Ratchet: How Humanity Thrives in the Face of Natural Crisis*. Basic Books, September 2014

Richard S. Dunn (University of Pennsylvania). *A Tale of Two Plantations: Slave Life and Labor in Jamaica and Virginia*. Harvard University Press, November 2014

Barry Eichengreen (University of California, Berkeley), Wonhyuk Lim (Korean Development Institute), Yung Chul Park (Korea University), and Dwight H. Perkins (Harvard University). *The Korean Economy: From a Miraculous Past to a Sustainable Future*. Harvard University Press, December 2014

Renée C. Fox (University of Pennsylvania). *Doctors Without Borders: Humanitarian Quests, Impossible Dreams of Médecins Sans Frontières*. Johns Hopkins University Press, April 2014

Henry Louis Gates, Jr. (Harvard University) and David Bindman (University College London), eds. *The Image of the Black in Western Art: The Twentieth Century: The Rise of Black Artists*. Harvard University Press, October 2014

Owen Gingerich (Harvard University). *God's Planet*. Harvard University Press, October 2014

Peter R. Grant (Princeton University) and **B. Rosemary Grant** (Princeton University). *40 Years of Evolution: Darwin's Finches on Daphne Major Island*. Princeton University Press, April 2014

Ellen T. Harris (Massachusetts Institute of Technology). *George Frideric Handel: A Life with Friends*. W.W. Norton, September 2014

Frances Kamm (Harvard University). *Bioethical Prescriptions: To Create, End, Choose, and Improve Lives*. Oxford University Press, November 2013

George Kateb (Princeton University). *Lincoln's Political Thought*. Harvard University Press, December 2014

Philip Kitcher (Columbia University). *Life After Faith: The Case for Secular Humanism*. Yale University Press, October 2014

A. A. Long (University of California, Berkeley). *Greek Models of Mind and Self*. Harvard University Press, November 2014

Jerome McGann (University of Virginia). *The Poet Edgar Allan Poe: Alien Angel*. Harvard University Press, October 2014

Bernard McGinn (University of Chicago Divinity School). *Thomas Aquinas's Summa Theologiae: A Biography*. Princeton University Press, June 2014

James M. McPherson (Princeton University). *Embattled Rebel: Jefferson Davis as Commander in Chief*. Penguin Press, October 2014

Jessye Norman (New York, New York). *Stand Up Straight and Sing!* Houghton Mifflin Harcourt, May 2014

Orlando Patterson (Harvard University), ed. *The Cultural Matrix: Understanding Black Youth*. Harvard University Press, January 2015

Carl Phillips (Washington University in St. Louis). *The Art of Daring: Risk, Restlessness, Imagination*. Graywolf Press, August 2014

Steven Pinker (Harvard University). *The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century*. Viking, September 2014

Sheldon Pollock (Columbia University), Benjamin A. Elman (Princeton University), and Ku-ming Kevin Chang (Academia Sinica), eds. *World Philology*. Harvard University Press, December 2014

Richard Rose (University of Strathclyde, Glasgow). *Learning about Politics in Time and Space: A Memoir*. ECPR Press, January 2014

Frederick Schauer (University of Virginia). *The Force of Law*. Harvard University Press, January 2015

Ian Shapiro (Yale University) and Jane E. Calvert (University of Kentucky), eds. *Selected Writings of Thomas Paine*. Yale University Press, September 2014

Theodore E. Stebbins Jr. (Harvard University) and Melissa Renn (Harvard University). *American Paintings at Harvard: Volume 1: Paintings, Watercolors, and Pastels by Artists Born before 1826*. Harvard Art Museums/Yale University Press, December 2014

Steve J. Stern (University of Wisconsin-Madison) and Scott Straus (University of Wisconsin-Madison), eds. *The Human Rights Paradox: Universality and its Discontents*. University of Wisconsin Press, April 2014

Elizabeth Warren (U.S. Senate). *A Fighting Chance*. Metropolitan Books, April 2014

Clifford M. Will (University of Florida) and Eric Poisson (University of Guelph). *Gravity: Newtonian, Post-Newtonian, Relativistic*. Cambridge University Press, May 2014

Edward O. Wilson (Harvard University). *The Meaning of Human Existence*. W.W. Norton/Liveright, October 2014

Allen W. Wood (Indiana University) and Dieter Schönecker (Universität Siegen). *Immanuel Kant's Groundwork for the Metaphysics of Morals*. Harvard University Press, December 2014

Robert Wuthnow (Princeton University). *Rough Country: How Texas Became America's Most Powerful Bible-Belt State*. Princeton University Press, August 2014

Jan M. Ziolkowski (Harvard University), ed. *Dante and the Greeks*. Harvard University Press, December 2014

Exhibitions

Jeff Koons (New York, New York). *Jeff Koons: A Retrospective* at the Whitney Museum of American Art, June 27–October 19, 2014

Bill Viola (Bill Viola Studio). Exhibit at the Grand Palais in Paris, March 5–July 21, 2014.

Films

Ken Burns (Florentine Films). *The Roosevelts: An Intimate History*. PBS, September 2014

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. ■

Remembrance

*It is with sadness that the Academy notes the passing of the following Members.**

Anatole Abragam – June 8, 2011; elected in 1974
Morris Albert Adelman – May 8, 2014; elected in 1956
Francis Alfred Allen – April 6, 2007; elected in 1975
David Malet Armstrong – May 13, 2014; elected in 2008
Gary Stanley Becker – May 3, 2014; elected in 1972
James MacGregor Burns – July 15, 2014; elected in 2003
Arland Frederick Christ-Janer – November 9, 2008; elected in 1968
Dorrit Cohn – March 10, 2012; elected in 2000
Bryce Low Crawford, Jr. – September 16, 2011; elected in 1977
Gerald Maurice Edelman – May 17, 2014; elected in 1968
Robert F. Erburu – May 11, 2014; elected in 1991
Richard N. Frye – March 27, 2014; elected in 1958
Robert Grosvenor Gardner – June 21, 2014; elected in 1964
Peter Thomas Geach – December 21, 2013; elected in 1986
Creighton Eddy Gilbert – April 6, 2011; elected in 1964
Melvin Jacob Glimcher – May 12, 2014; elected in 1962
Nadine Gordimer – July 13, 2014; elected in 1980
Robert McQueen Grant – June 10, 2014; elected in 1981
Jerome Gross – January 27, 2014; elected in 1966
Allen Richard Grossman – June 27, 2014; elected in 1993
Evelyn Byrd Harrison – November 3, 2012; elected in 1973
George Harry Heilmeier – April 21, 2014; elected in 1995
James Higginbotham – April 25, 2014; elected in 2011
Nagayo Homma – September 15, 2012; elected in 1996
Michael Kasha – June 13, 2013; elected in 1963
Malcolm Daniel Lane – April 10, 2014; elected in 1982

Robert Lewis Letsinger – May 25, 2014; elected in 1988
William Lloyd MacDonald – March 6, 2010; elected in 1995
Thomas Francis Malone – July 6, 2013; elected in 1979
Juan Marichal – August 8, 2010; elected in 1965
Peter Robert Marler – July 5, 2014; elected in 1970
Peter Matthiessen – April 5, 2014; elected in 1991
Grigori Mints – May 29, 2014; elected in 2010
John L. Moll – July 19, 2011; elected in 1992
Irwin Oppenheim – June 3, 2014; elected in 1970
David Francis Pears – July 1, 2009; elected in 1996
Jean Joseph Francois Perrot – December 26, 2012; elected in 1967
Ashoka Jahnavi Prasad, Jr. – January 30, 2001; elected in 1972
Arnold Seymour Relman – June 17, 2014; elected in 1965
Lloyd George Richards – June 29, 2006; elected in 1986
Paul Gillan Risser – July 10, 2014; elected in 1994
John Max Rosenfield – December 16, 2013; elected in 1971
Israel Scheffler – February 16, 2014; elected in 1971
Jarvis Edwin Seegmiller – May 31, 2006; elected in 1982
Seymour Slive – June 14, 2014; elected in 1964
Eugene Nikolaievich Sokolov – May 14, 2008; elected in 1976
Albert Alan Townsend – August 31, 2010; elected in 1975
Richard Henry Ullman – March 11, 2014; elected in 1974
Hans-Ulrich Wehler – July 7, 2014; elected in 2006
Arthur Strong Wightman – January 13, 2013; elected in 1966
Bruno Zumino – June 22, 2014; elected in 1984

**Notice received from March 27, 2014, to July 15, 2014*

Ways of Giving to the American Academy of Arts & Sciences

Gifts and grants from members, other individuals, foundations, corporations, businesses, and a group of fifty-nine University Affiliates support the Academy's work. Contributions may be made in a variety of ways.

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Donor-Advised Funds

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Bequests

Bequests from Fellows and their spouses helped to create and build the Academy's endowment. Today, bequests continue this tradition and provide support for new initiatives, projects, and studies. Provision for including the Academy in an estate plan may be made in a new will, in a codicil to an existing will, or through trusts.

Other Planned Gifts and Naming Opportunities

Please contact the Development Office for additional information about planned gifts and naming opportunities, including life-income gifts and gifts of appreciated property.

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AMERICAN ACADEMY
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Norton's Woods, 136 Irving Street, Cambridge, MA 02138
telephone 617-576-5000, facsimile 617-576-5050,
email aaas@amacad.org, website www.amacad.org

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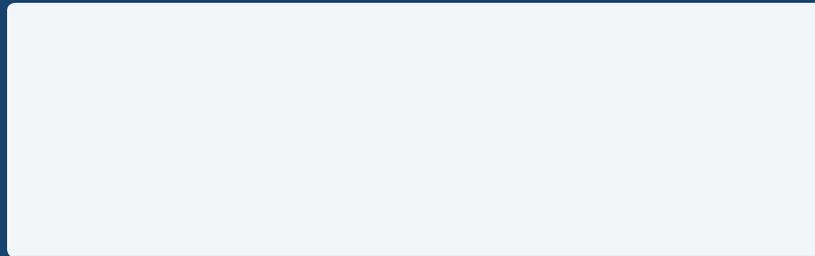
Cambridge, MA 02138-1996 USA

telephone 617-576-5000

facsimile 617-576-5050

email aaas@amacad.org

website www.amacad.org



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