



AMERICAN ACADEMY OF ARTS & SCIENCES

Bulletin

WWW.AMACAD.ORG

WINTER 2017
VOL. LXX, NO. 2



Induction Ceremony 2016

Class Speakers: Walter Isaacson, Jay D Keasling, Andrea Louise Campbell, Terry A. Plank, and Theaster Gates, Jr.



Educating Students Who Have Different Kinds of Minds

Temple Grandin

ALSO: Populism and the Future of American Politics – Charles Stewart III, Lawrence D. Bobo, and Jennifer L. Hochschild

Global Warming: Current Science, Future Policy – Veerabhadran Ramanathan and David G. Victor

Ethical Choices in War and Peace – Debra Satz, Scott D. Sagan, Joseph H. Felter, and Paul H. Wise

On the Professions – Denis Feeney, Ary Anthony Hoffmann, Paul Offit, and Patricia Ebrey

Upcoming Events

FEBRUARY 2017

7th

The Headliner's Club
Austin, TX

Dinner with Academy Members and discussion about The Commission on the Future of Undergraduate Education

8th

Rice University
Houston, TX

Science, Technology, and Innovation Policy in the New Administration

Featuring: **Sylvester James Gates Jr.** (University of Maryland, College Park), **Jeannette M. Wing** (Microsoft Research)

9th

University of California, San Diego Faculty Club
La Jolla, CA

The Future of Immigration Reform

Featuring UCSD faculty: **David FitzGerald**, **Tom K. Wong**, **David A. Lake**, moderator

10th

Whittemore House
St. Louis, MO

Breakfast with Academy Members

15th

House of the Academy
Cambridge, MA

in collaboration with the Catalyst Collaborative@MIT

Staged Reading and Discussion of "Paradise," a play by Laura Maria Censabella

Featuring: **Paula Hammond** (Massachusetts Institute of Technology), **Rebecca Saxe** (Massachusetts Institute of Technology), **Saba Valadkhan** (Case Western Reserve University)

20th

William Eckhardt Research Center
University of Chicago
Chicago, IL

Communicating Scientific Facts in an Age of Uncertainty

Featuring: **Arthur Lupia** (University of Michigan), **Olufunmilayo I. Olopade** (University of Chicago Medical Center), **Robert Rosner** (University of Chicago), **Robert J. Zimmer** (University of Chicago), **Jonathan F. Fanton** (American Academy)

28th

National Press Club
Washington, DC

Panel Discussion and Press Conference for final report of the Academy's Commission on Language Learning

28th

The Cosmos Club
Washington, DC

Reception, dinner, and program for Academy Members on "Investing in Language Learning for the 21st Century"

MARCH 2017

8th

House of the Academy
Cambridge, MA

2017 Distinguished Morton L. Mandel
Annual Public Lecture

Ethics and the Global War on Terror: Can Conflicts with Non-State Actors be Fought in a Just Way?

APRIL 2017

6th

House of the Academy
Cambridge, MA

Awarding of the 2016 Emerson-Thoreau Medal and the 2016 Talcott Parsons Prize

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

From the President



Jonathan F. Fanton

The remarks given by new members during our October Induction weekend remind us of the breadth and depth of talent present in the membership of the American Academy of Arts and Sciences. In this time of transition and uncertainty, both in America and around the world, the question before us is how best to employ the expertise, judgment, and values of our members, in the words of our 1780 charter, “to cultivate every art and science which may tend to advance the interest, honor, dignity, and happiness of a free, independent, and virtuous people.”

Let us consider what we have to offer. The Academy has earned a high level of trust for being independent, nonpartisan, and nonideological, committed to supporting quality research and applying evidence to policy. The Academy has more than five thousand members drawn from virtually every discipline and profession. We are forming program committees in major cities across the country and last year offered over ninety meetings for members in twenty cities. Those programs addressed a range of critical issues, including science and policy around global warming; ethical choices in war and peace; populism and the future of American politics; the creative forces in science and entertainment; threats to global cultural heritage; managing the risks of new nuclear technologies; and the role of public research universities in serving the public interest. Recommendations from Academy commissions and studies continue to inform policy; for example, three recommendations from *Restoring the Foundation*, a report from our project on New Models for U.S. Science and Technology Policy that suggests actions to secure America’s leadership in science and engineering research, are included in the recently passed American Innovation and Competitiveness Act. The Academy also has a project underway looking at how the public builds trust – or distrust – in science and the scientific process. The Public Face of Science will look at all types of media and at how science informs public policy decisions. And issues of *Daedalus* are addressing important topics such as immigration, mass incarceration, judicial independence, race and inequality, and corruption.

As the Academy approaches its 250th anniversary, it is time to return to the issues that concerned our founders: how to build a nation rooted in the belief that the government derives its “just powers from the consent of the governed.” Central to this belief was a conviction that all citizens had the right and the responsibility to be fully engaged in shaping the life of the new democracy. America has grown and prospered far beyond what the nation’s founders could have imagined. And so it is natural to ask: how can the Academy help citizens to strengthen their country by exercising the rights and embracing the responsibilities of democratic citizenship? Encouraging participation in the political process is one central goal. The fact that 42 percent of those eligible to vote in last year’s presidential election did not do so is a reminder of the importance of encouraging this most fundamental practice of citizenship in a democracy. But perhaps more important is articulating the significance of civic engagement more broadly.

The Academy is considering a new project on strengthening the practice of democratic citizenship. Certainly increasing the study of history and civics in K-12 as well as in higher education will be one objective of such a project. Understanding how people obtain accurate information about their government and develop trust in expertise will be important. A critical focus will be understanding the role of the institutions of civil society, such as churches, voluntary associations, and youth groups like the Scouts and 4-H. Academy member Thomas Ehrlich has defined civic engagement as “working to make a difference in the civic life of our communities and developing the combination of knowledge, skills, values, and motivation to make a difference. It means promoting the quality of life in a community

through both a political and non-political process.”¹ Our project seeks to better understand the forms and substance of civic engagement today, at a time when the rise of social media and other forms of on-line activity have altered the contours of community interaction.

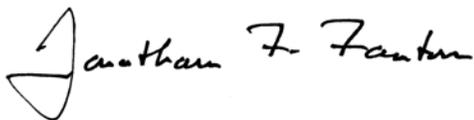
This project aspires to change the terms of an ongoing conversation about what forms of activity constitute civic engagement and how those activities help people gain the knowledge, skills, and values necessary to participate as citizens responsible for their own government. Engagement in their communities enables citizens to define problems and opportunities and then collaborate to address them. As Alexis de Tocqueville noted on his visit to the United States in the 1830s, one of the distinguishing features of the young republic was the propensity of its citizens to join together in forming associations to achieve specific community goals. He was astonished by the “immense assemblage of associations in that country,” and spent a great deal of energy analyzing why Americans – who were the most individualistic people he had ever met – were so active in forming organizations.² Tocqueville concluded of the American citizens he met that “They all, therefore, become powerless if they do not learn voluntarily to help one another.”³ This project will examine the specific ways citizens today are joining together to help one another, to improve their communities, and to develop the values – such as empathy, respect for others, and critical thinking – so essential to a healthy democracy.

Among the questions the project will ask are:

- What are the forms of civic engagement that are not included in traditional civics education? Are there behaviors that count as “civic engagement” that we might be overlooking?
- What experiences encourage people to engage in civic institutions and model the behaviors needed for civic participation?
- What mechanisms exist for connecting people across demographic and ideological boundaries? What spaces are there for people to learn how to interact with those who are different from them?
- How have the technological and media transformations of the past twenty years altered what civic engagement looks like?
- How will our needs change as the demographic makeup of the nation changes?

One objective of the project is to collect baseline data on a wide range of practices and behaviors that bolster or weaken civic engagement and to evaluate how the level of civic engagement connects to responsible democratic citizenship. The data will be collected on an ongoing basis to provide researchers and policy-makers with an evidence-based foundation for future discussions. We hope that the insights from the project will be useful to policy-makers and the public in helping Americans come together to strengthen our democracy so that it remains a positive example for societies around the world.

We welcome your comments on additional ways the Academy can fulfill its mission of advancing the common good in this time of transition.



1. Thomas Ehrlich, *Civic Responsibility and Higher Education* (Lanham, MD: Rowman and Littlefield, 2000), vi.

2. Alexis de Tocqueville, *Democracy in America*, Book II, Chapter 5.

3. Ibid.

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New Dilemmas in Ethics, Technology, and War

Though technology and warfare have greatly evolved since Michael Walzer published his seminal text *Just and Unjust Wars* over forty years ago, the debate on the ethical challenges posed by these changes has been confined mostly within the boundaries of specific disciplines; few attempts have been made to pursue a genuine interdisciplinary debate on this matter. The Academy's New Dilemmas in Ethics, Technology, and War project, chaired by Scott D. Sagan (Stanford University), aims to challenge the silo approach to the topic and to foster instead a broader and more comprehensive discussion. First convened in 2014 to explore the intricate connections between the advancement of military technology and the moral and ethical considerations of the deployment of such capabilities in war and in postwar settings, the project has produced two *Dædalus* volumes and convened workshop and outreach events, informing the ongoing debate surrounding these issues and providing useful teaching tools.

From the beginning, the New Dilemmas in Ethics, Technology, and War project never strove to achieve intellectual consensus among its participants, although the workshops prior to the publication of the *Dædalus* volumes allowed for a truly collaborative writing experience. By bringing together a multidisciplinary group of authors – political scientists, military practitioners, just war theorists, statesmen, philosophers, historians, ethicists, lawyers, and physicians – this project has not only gathered diverse perspectives and a wide variety of ideas, but has enabled its authors and participants to learn more about the concerns of different sectors and identify and address any gaps in their own work. In addition, the project invited outside experts to review and offer suggestions on the ongoing research, introducing multiple approaches to the study of these complex relationships.

The Fall 2016 issue of *Dædalus* on “Ethics, Technology & War” explores the questions and contradictions raised by the evolving state of twenty-first-century warfare and politics, in the context of just war theory and the international laws of war. The *Dædalus* issue addresses such diverse topics as autonomous weapons, targeted killing by drones, the use of nuclear weapons, the responsibility to protect doctrine, the role of early warning and early action, American public opinion, and the use of cyber technologies in war, among others. In “Just & Unjust Targeted Killing & Drone Warfare,” for example, Michael Walzer (Institute for Advanced Study) argues that targeted killing by drones ought to be subject to the same constraints as other forms of targeted killing in times of war. He shows that the Obama administration's secretive drone program has indeed relaxed restrictions on targeted killing, and has done so without public debate. Considering the question of whether to ban combat drones outright, he argues instead for the opening-up of the decision process to democratic scrutiny.

The Winter 2017 issue of *Dædalus* on “The Changing Rules of War” examines the evolution of just war doctrine, the laws of armed conflict, the rules of engagement, war crimes tribunals, and

other domestic and international organization procedures. The volume approaches these questions through an analysis of the rules of war in asymmetric conflicts, the prosecution of war crimes, and critiques of just war doctrine. Brigadier General Mark S. Martins (U.S. Army) and Jacob Bronsther (London School of Economics and Political Science) tackle the question of the efficacy of war crimes trials in “Stay the Hand of Justice? Evaluating Claims that War Crimes Trials Do More Harm than Good.” War crimes trial skeptics argue that such trials endanger prospects for peace by encouraging enemies to continue fighting, that they achieve only “victors' justice,” and that they are unnecessary due to the existence of more effective and less costly alternatives. But Martins and Bronsther argue, in accordance with a “moderate retributivism,” that when carried out consistently with established law and procedure, and when not dramatically outweighed by concerns that trials will exacerbate ongoing or future conflicts, prosecutions are a legitimate and sometimes necessary response to violations of the laws of war and international criminal law. Also in the volume, Paul H. Wise (Stanford University) offers a physician's perspective in “The Epidemiological Challenge to the Conduct of Just War: Confronting Indirect Civilian Casualties of War.” He points out that most civilian casualties in war are the result of “indirect effects,” of the disruption of the essentials of daily living, including food, water, shelter, and health care, and suggests that recent technological advances make such neglect increasingly unacceptable. For more information about these *Dædalus* volumes or to access the essays, please visit <http://www.amacad.org/daedalus>.

A primary goal of the project has been to reach as many policy-makers, military practitioners, academics, and students as possible, fostering conversation, debate, and, ultimately, a reexamination of the existing legal and ethical frameworks guiding prewar, war, and postwar decisions. Academy staff and project members have organized several events in the United States and abroad to reach these diverse audiences and generate a deeper examination of these issues.



Scott D. Sagan (Stanford University), **Joseph H. Felter** (Stanford University), **Paul H. Wise** (Stanford University), and **Debra Satz** (Stanford University) at the “Ethical Choices in War and Peace” Stated Meeting at Stanford University.

During an authors’ workshop and series of panel discussions hosted at West Point, for example, representatives from several organizations, including the United Nations High Commissioner for Refugees (UNHCR) and the United Nations Department of Peacekeeping Operations (UNDPKO), along with West Point’s military and civilian professors, were invited to join the authors in discussions of key ethical challenges currently facing states, international organizations, and NGOs concerned with the planning, impact, conduct, and aftermath of war. One attendee invited the Academy and project leaders to Geneva to speak with high-level leadership at UNHCR one week prior to a major five-year planning process for the organization. He expressed that, even with his years of experience in this field, the research conducted by the project’s authors offered him new perspectives that he was eager to share with his colleagues. Such new connections and opportunities have been one of the many benefits of these outreach activities.

Other events have included an Academy Stated Meeting on “Ethical Choices in War and Peace” (see page 68); a series of briefings with the UNDPKO in New York; a day-long series of public panel discussions on “Ethical Dilemmas in War” with King’s College London; talks at Oxford University; and a series of briefings with NATO and the NGO International Crisis Group in Brussels.

The project is continuing its efforts with meetings with think tanks in Washington, D.C., briefings with policy-makers in U.S. military leadership, and further international outreach.

In addition, the Academy is organizing a Stated Meeting in Cambridge, Massachusetts, on March 8, 2017, on “Ethics and the Global War on Terror.” The program, which will serve as the 2017 Distinguished Morton L. Mandel Annual Public Lecture, will be live-streamed online. More information about the meeting is available on the Academy’s website at www.amacad.org.

The project also hopes to participate in the blog series *Political Violence @ a Glance: Expert Analysis on Violence and Its Alternatives*, which provides analysis on violence and protest in the world’s conflict zones, as well as publish a series of op-ed essays related to the topics covered in the two *Dædalus* issues.

The Academy is grateful to Humanity United, the John D. and Catherine T. MacArthur Foundation, and the Rockefeller Foundation for supporting the New Dilemmas in Ethics, Technology, and War project. ■

Preserving Intellectual Legacies in the Digital Age

“A vivid glow NOOKed in her face, lighting up both her sorrow and her joy. . . .” Leo Tolstoy did not write this, but such writing was attributed to him when a company called Superior Formatting Publishing reformatted *War and Peace* from Amazon’s Kindle platform to Barnes & Noble’s Nook platform. The reformatting went haywire, and suddenly “NOOK” replaced the word “kindle” in copies of the literary classic transmitted to unwitting readers.

In the case of *War and Peace*, the result was slightly irritating and largely comedic. Sadly, medical scholarship, financial forecasting, and a range of public decision-making are also susceptible to such vagaries of transmission. In 2013, a team of researchers at UMass Amherst discovered that economists who were advising the EU to undertake austerity measures at the height of the recession had accidentally excluded several key data points in their Excel spreadsheet. A mistaken code in the age of self-driving cars or medical big data could easily lead to life-threatening decisions.

Learning to cope with the transitory nature of information storage and transmission will eventually become a normal feature of twenty-first-century scholarship. In the worst cases, one wrong click of a mouse button and weeks of research, years of written text, and decades (or, in the case of *War and Peace*, centuries) of preservation can be undermined, effectively making the written word as transitory as the spoken one.

A group of Academy members decided that learned societies, along with libraries, publishers, software companies, information engineers, and lawyers need to make a more coordinated effort to help scholars navigate this new terrain. This concern led to a symposium on “Preserving Intellectual Legacies in the Digital Age,” which was held at the House of the Academy on September 23, 2016, under the auspices of the Academy’s Exploratory Fund. The conference, convened by Academy members Carla Hesse (Dean of Social Sciences at the University of California, Berkeley) and Pamela Samuelson (Richard M. Sherman Distinguished Professor of Law and Information at the University of California, Berkeley) brought together librarians, legal scholars, poets, computer and cognitive scientists, publishers, sociologists, historians, and classicists.

The symposium began with a keynote presentation by Brewster Kahle (Founder of the Internet Archive), who stressed the values of equity in digital access, the reformulation of current copyright policies (particularly with regard to securing more rights for authors and distributors), and the importance of innovation.

The conference focused on five themes: the role of libraries and access to knowledge; sustainable infrastructure for knowledge creation; archiving challenges; epistemic integrity; and policies to avoid oblivion. The sessions were animated by the realization that as more and more scholarship is digitized and scholars become increasingly dependent on digital technology to preserve and archive their scholarly findings, librarians, archivists, and curators

need to partner with the worlds of technology, philanthropy, policy, and publishing to ensure that intellectual legacies survive for future generations of scholars. The participants discussed the interactions between copyright law and obsolescence, the authentication of authorship, creating financial models that allow libraries and archives to catalog and preserve digital copies of books and journals as easily as physical copies, academic mentorship for the twenty-first century, preservation of data sets and algorithms, and the integrity of a digital manuscript. The conversations also focused on the more technical problems of access, user-interface, and the mechanics of hardware and software.

Throughout the conference, the participants highlighted several challenges and cited sobering statistics. Digital humanities scholar Abby Smith Rumsey noted that nearly 80 percent of all silent films produced in the early decades of cinema have been lost entirely. Jonathan Zittrain (Professor of Law and Librarian at the Harvard Law School) commented that 75 percent of the links cited in the *Harvard Law Review* are inaccessible online because the links to those articles are no longer accurate (a phenomenon known as “link rot”).

Former Harvard University Librarian Robert Darnton pointed out that three publishing houses control 42 percent of all scholarly articles that are published each year, and can thus exercise an outsized influence over what knowledge is and is not accessible. Carla Hesse and her Berkeley colleague Molly Shaffer Van Houweling noted that the vast majority of scholarly works produced in the twentieth century are effectively invisible: these works are not commercially viable for their publishers to reprint, but they are still under copyright protection, and thus cannot be made available digitally. In addition to a failure to preserve and maintain access to older cultural materials, new bodies of content are being created without sufficient attention to how that content will be preserved. Dan Cohen (Executive Director of the Digital Public Library of America) observed that Facebook produces more data than any other company in the world, but it does little to preserve these data (at least not in a way that would make them available to future scholars). And several participants pointed out that even if the data that are being created by social media companies and others were made available, the data are organized through algorithms that are and will remain proprietary, posing additional challenges. Access to both new and old data is complicated by the need for software that will enable that access. Mahadev Satyanarayanan (Professor of Computer Science at Car-



Participants at the Academy's meeting on Preserving Intellectual Legacies in the Digital Age

negie Mellon University) remarked that there is virtually no effort made to preserve what he referred to as “software executability,” or technology that will ensure that future users of preserved software will actually have the same user experience that original users did.

The transition to digital scholarship and digital preservation also highlights the emerging challenges of up-to-date digital libraries. As Paul Courant (Harold T. Shapiro Collegiate Professor of Public Policy, Arthur F. Thurnau Professor, Professor of Economics, and Professor of Information at the University of Michigan) mentioned during the conference, physical libraries benefitted from the structural existence of what could have been a guiding invisible hand: “It is by total dumb luck, of the way that printing and publishing works technologically combined with the missions of the academy and approximately rational behavior on the part of the university administrations, who were competing in a space for quality, that no one had to do anything very special in order for the great bulk of the published academic literature to be organized in ways that made it fairly durable and easy to find.”

There is very little reason to believe that digital libraries will function in the same way. Things are not as easy to find on Google Scholar and there is not yet an intuitive way to organize such findings or even secure funding for their organization. Both the need for early investment and the scale of contemporary preservation mean that digital libraries will have to engage in a large coordinating practice if material is not to be lost.

But instead of merely highlighting challenges, participants also began to identify things that universities, libraries, publishers, authors, and learned societies can do to enable continued access to scholarship in the digital age. Many of these solutions focused on steps that can be taken to increase authors' control over the fate of the texts that they produce. Authors often transfer their copyright to publishers, who thereafter control how articles and books are

disseminated. This control can last for the entire term of the copyright (which continues for the life of the author plus seventy years), even though publishers' interests in commercial dissemination typically last only a few years. While authors' interests in reaching readers and spreading knowledge continue, the authors' ability to pursue those interests can be hampered by their lack of copyright control. Helping scholars understand their options for managing their copyrights so that they can be empowered to ensure that their rights are aligned with their interests was a process that many participants felt should be part of graduate education. (This is work that is promoted by the Authors Alliance, a group with which several of the meeting participants are involved.)

While there is reason to believe that the age of the printed scholarly book may be coming to an end, it is not clear what will replace it. Several participants stressed the need to ensure that the scholarly record does not disappear by neglect when this shift takes place. Dan Cohen proposed encouraging libraries, universities, and learned societies to devote 1 percent of their annual budgets to a collective effort at digital preservation, and to invest in technologies and user interfaces that will ensure preservation by default rather than by accident.

While increased federal funding for such a sustainable infrastructure to protect scholarship would be valuable, Don Waters (Senior Program Officer for Scholarly Communications at the Andrew W. Mellon Foundation), among others, suggested that a more realistic first step would be to coordinate “micro-preservation” at the campus level, which would connect scholars and Academy members on university campuses with their local archivists and librarians to ensure that their legacies are preserved. This type of bottom-up approach would help scholars preserve their own work and test techniques that might eventually be deployed by larger-scale efforts. ■

New Findings on the Costs, Occupations, and Incomes of Ph.D.'s

The Humanities Indicators project recently released a series of reports on the life cycle of doctoral degree recipients in every field, shedding light on the challenges involved in earning the degree, and the occupational outcomes and incomes of those with a Ph.D.

The Costs of a Ph.D.

In a new analysis of the costs of earning a Ph.D., the Indicators report that debt accumulated during graduate study among recent degree recipients has been rising faster than inflation.¹ From 2002 to 2014, for example, the median level of graduate education debt of doctoral degree recipients increased 39 percent, from \$11,252 to \$15,591 in inflation-adjusted dollars (Figure 1).

Debt levels rose most sharply for doctoral degree recipients in education (an increase of 130 percent) and in the humanities (an increase of 56 percent), as well as in the behavioral and social sciences (an increase of 51 percent). As of 2014, median debt levels for students in all three fields were well above the median for all fields combined – ranging from \$22,405 among humanities Ph.D.'s to \$28,412 for doctoral degree recipients in education.

In a separate analysis, the Indicators report that these same three fields also have the largest shares of graduates that relied primarily on their own resources to pay for their studies: 48 percent of the 2014 Ph.D.'s in education, 25 percent of the graduates in the behavioral and social sciences, and 20 percent among new degree recipients in the humanities.²

Ph.D.'s in the humanities were also notable for having the highest reliance on teaching assistantships: 41 percent reported that teaching assistantships were their primary source of support. In comparison, among doctoral degree recipients in the life and physical sciences, less than 28 percent reported a strong reliance on teaching

1. See <http://humanitiesindicators.org/content/indicatorDoc.aspx?i=11125>. Data drawn from federal Survey of Earned Doctorates.

2. See <http://humanitiesindicators.org/content/indicatorDoc.aspx?i=50>. Data drawn from federal Survey of Earned Doctorates.

assistantships, but more than 33 percent in each field reported research assistantships as their primary source of support.

Another important cost for those pursuing a Ph.D. is time spent earning the degree. The Indicators highlight variation among the fields: the median number of years humanities doctoral degree recipients spend in their programs is one year longer than Ph.D.'s in the science fields.³ In a new analysis, the Indicators find that the median age of doctoral degree recipients in the humanities has consistently been three-years older than the median for all fields com-

3. See <http://humanitiesindicators.org/content/indicatorDoc.aspx?i=49>. Data drawn from federal Survey of Earned Doctorates.

Average Level of Graduate Education Debt Accumulated by Doctorate Recipients, Selected Academic Fields, 2002 – 2014 (Adjusted for Inflation)

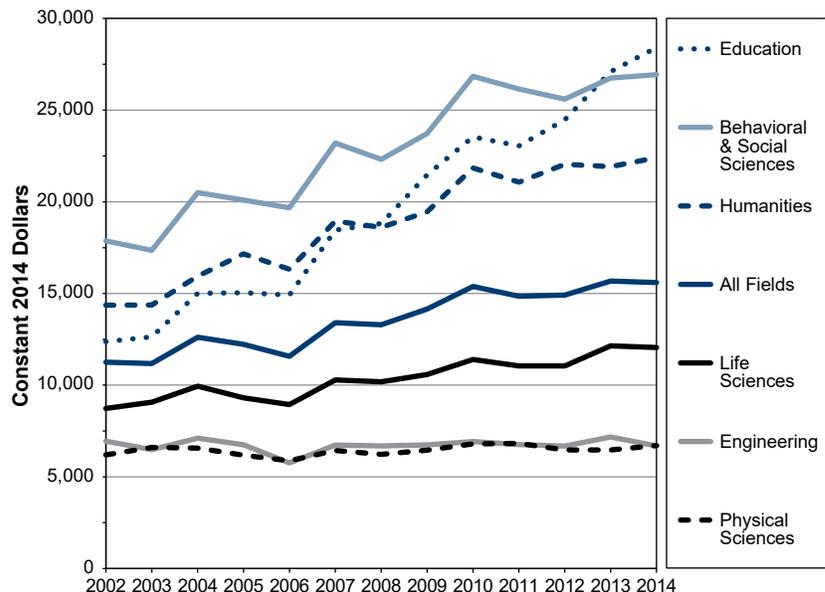


Figure 1

Source and details at <http://humanitiesindicators.org>.

Occupations of Employed Ph.D.'s, in the Humanities and STEM Fields, 2013

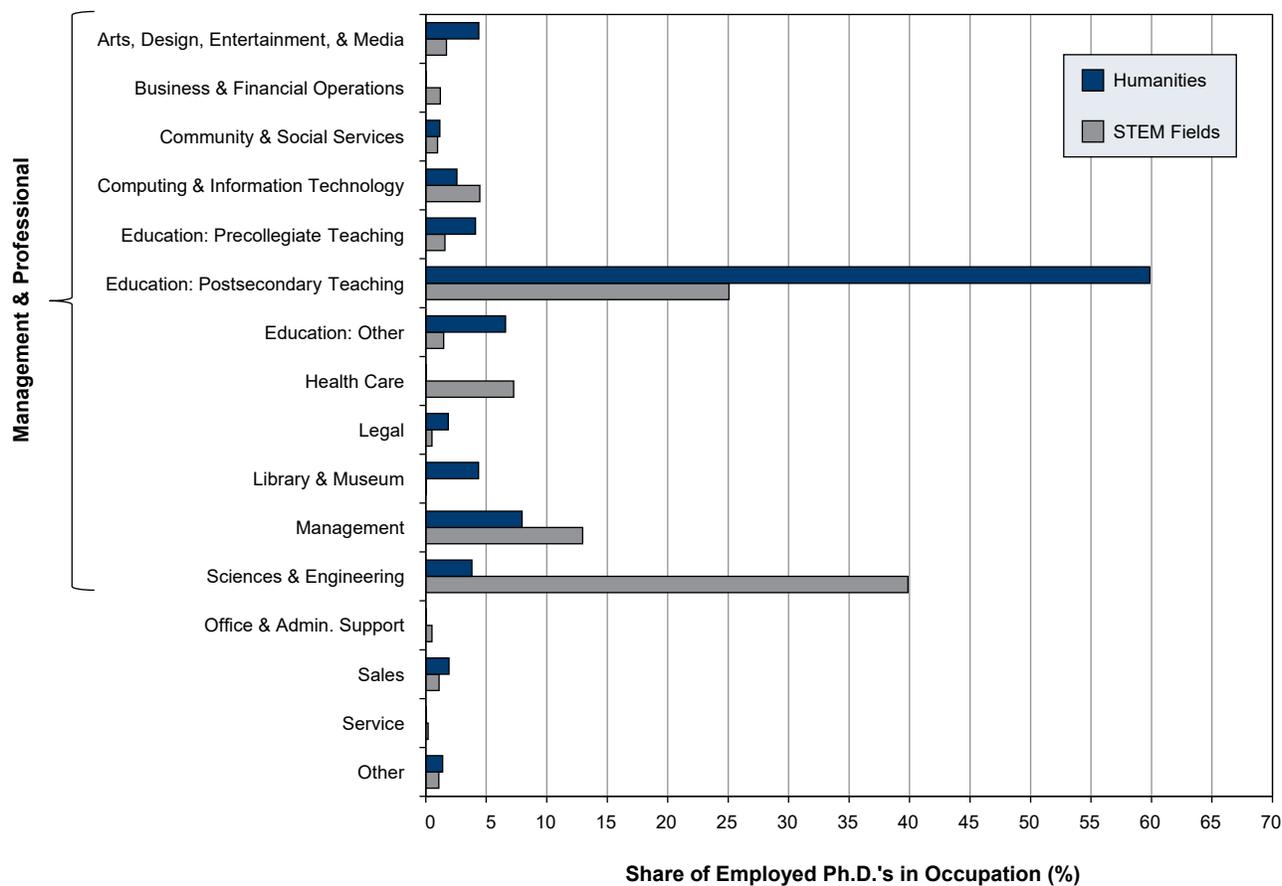


Figure 2

Source and details at <http://humanitiesindicators.org>.

bined. In 2014, the median age of new humanities Ph.D.'s was 34.2 years; among doctoral degree recipients in engineering and the life and physical sciences, the median age was 31 years or less.⁴

A Mix of Occupations for Ph.D.'s

Alongside the new insights into the challenges involved in earning a doctoral degree, the Indicators released cross-field comparisons of the occupations of Ph.D.'s. An original analysis of data from the

National Science Foundation's National Survey of College Graduates (NSCG) highlights the wide differences among the fields in the occupational outcomes of their graduates (Figure 2).⁵

As of 2013, 60 percent of employed humanities Ph.D.'s were in postsecondary teaching jobs, as compared with less than a third of the doctoral degree recipients from each of the STEM fields. Only Ph.D.'s from the fine and performing arts had a comparable share employed in postsecondary teaching (55 percent).

4. See <http://humanitiesindicators.org/content/indicatordoc.aspx?i=11126>. Data drawn from federal Survey of Earned Doctorates.

5. See <http://humanitiesindicators.org/content/indicatordoc.aspx?i=69>. Data drawn from National Science Foundation, National Survey of College Graduates, 2013.

The new findings highlight the much larger array of applied and practical occupational positions available for doctoral degree recipients from the STEM fields, with substantial shares employed in science and engineering jobs rather than in postsecondary teaching positions – ranging from 36 percent of employed Ph.D.'s in the behavioral and social sciences to 49 percent of the doctoral degree recipients in the life sciences.

Beyond the large gaps among the fields in the shares employed in postsecondary teaching, as opposed to science and engineering occupations, substantial shares of Ph.D.'s from most fields were in management positions – from 8 percent of humanities and health and medical sciences Ph.D.'s to 19 percent of those who received doctoral degrees in business. The one exception was among arts Ph.D.'s: less than 3 percent of doctoral degree recipients in the arts were employed in management positions.

Earnings for Ph.D. Recipients

The field with the highest concentration of Ph.D.'s in academic employment – the humanities – also had the lowest median earnings, according to the Indicators. Humanities Ph.D.'s working full time had a median salary of \$75,000, well below the median for all fields combined (\$99,000)⁶.

Some humanities Ph.D.'s made considerably more, however. Earnings for the top 25 percent of doctoral degree recipients in the humanities were greater than the median earnings of Ph.D.'s in each of the other fields.

The report also notes that there was a substantial gender earnings gap among doctoral degree recipients in every field except education. Ph.D.'s from business and the humanities had the largest gender gap among employed Ph.D.'s – with a 34 percent gap in median annual earnings between men and women employed full time (the median earnings for men were \$95,000 compared with \$63,000 for women). Among the STEM fields, the gap was 30 percent in the life sciences (the median earnings for men were \$100,000 compared with \$70,000 for women), and even smaller in the other STEM fields.

Prompted by the interest generated by these reports, the Indicators staff is using the NSCG data to answer additional questions, such as how levels of earnings and job satisfaction for those employed in postsecondary teaching compare to that of advanced degree recipients who are employed outside the professoriate. ■

For more information about the Humanities Indicators, please visit the Academy's website at <http://www.humanitiesindicators.org> or contact the Indicators staff at humanitiesindicators@amacad.org.

6. See <http://humanitiesindicators.org/content/indicatordoc.aspx?i=70>. Data drawn from National Science Foundation, National Survey of College Graduates, 2013.

The Academy at Work: Projects and Studies

On October 8, 2016, as part of the Academy's 2016 Induction weekend program, new Members were briefed on the Academy's research projects and studies. The speakers, who play an active role in one or more Academy projects, highlighted the studies' current activities and the many opportunities for new Members to participate. The presentations focused on Humanities and Education; Global Security and International Affairs; Science, Engineering, and Technology; American Institutions; and Exploratory Projects. What follows is an edited version of the speakers' remarks.

Humanities & Education



Pauline Yu

Pauline Yu is President of the American Council of Learned Societies. Elected a Fellow of the American Academy in 1998, she is a Member of the Academy's Board of Directors. She also serves on the Advisory Group for the Lincoln Project: Excellence and Access in Public Higher Education and is a member of the Commission on the Humanities and Social Sciences.

At critical times over the past century, the Academy has assumed a leadership role in American higher education, particularly in support of the humanities. The Academy worked behind the scenes to develop new institutions, such as the National Hu-

The Humanities Indicators make high-quality data available to anyone interested in the current state of the field, allowing them to study the context of present conditions, follow key trends, and predict emerging issues for the humanities disciplines.

manities Center in North Carolina. In recent years, the Academy has taken a more public role, as the sponsor of the National Commission on the Humanities and Social Sciences, which released its influential report, *The Heart of the Matter: The Humanities and Social Sciences for a Vibrant, Competitive, and Secure Nation*, in 2013. The projects we will discuss today all follow in that tradition, as large groups of experts drawn from diverse fields come together to share their expertise and offer recommendations to support our nation's educational institutions.

Before opening the discussion, I want to talk briefly about the Humanities Indicators project, so ably directed by the Academy's Robert Townsend in our Washington, D.C., office. An ongoing Academy effort—launched in 2009—this project represents a valuable resource for educators, policy-makers, journalists, and all those seeking data to assess the welfare of the humanities in the United States. Modeled on the Science and Engineering Indicators of the National Science Foundation, the Humanities

Indicators make high-quality data available to anyone interested in the current state of the field, allowing them to study the context of present conditions, follow key trends, and predict emerging issues for the humanities disciplines. The Indicators are regularly updated at humanitiesindicators.org, providing an empirical basis for the ongoing national conversation on the state of the humanities. On this topic, I will just say that I'll never forget the comment of Phyllis Franklin, who was the executive director of the Modern Language Association when this project was being discussed. When queried as to the necessity of a quantitative approach, she quipped, "If you can't count, you don't count."

Commission on the Future of Undergraduate Education



Michael S. McPherson

Michael S. McPherson is President of the Spencer Foundation. Prior to joining the Spencer Foundation, he served as President of Macalester College in St. Paul, Minnesota. He was elected a Fellow of the American Academy in 2014 and serves as Cochair of the Academy's Commission on the Future of Undergraduate Education.

The diverse membership of the Commission on the Future of Undergraduate Education reflects the fact that undergraduate education has become an extremely broad category in the United States. We are taking on a range of institutions, focusing on the many opportunities that are available to people who have graduated from high school in the United States, from community colleges and for-profit institutions to the broad public universities and the great research universities.

The mission of the Commission is not a modest one. We're influenced by the principle of making no small plans. We have undertaken a three-year project to examine the state of undergraduate education in America, and to provide ideas for how to ensure that individual Americans receive the ed-

We are arriving at this work at a very challenging time for American society and the American economy, and with a strong belief that higher education has a critical role to play in the future of this society – not only as a successful, prosperous economy, but as a fair and progressive society with opportunities for all.

ucation they need to thrive in the twenty-first century. We're thinking about this challenge of the future from a generational perspective. At a time of great social demographic and technical change in education in the United States, we're attempting to look ahead as far as twenty or twenty-five years. We are excited by the challenge, somewhat intimidated by the challenge, but determined to address this important topic in a very serious way.

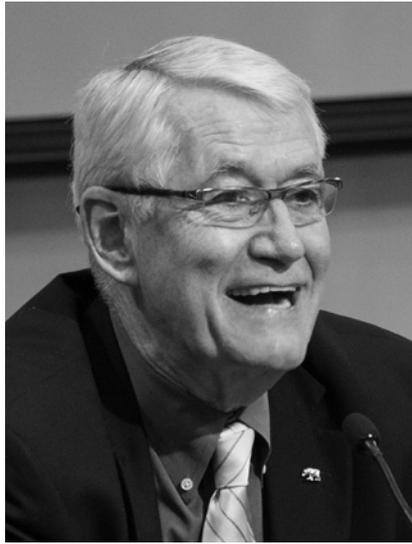
There are seven main topic areas under discussion: framing the future of undergraduate education; inequality and inequity; costs and affordability; teaching and learning; the liberal arts and vocational education; the role of government regulation in an innovative age; and anticipating and responding to future trends. We are arriving at this work at a very challenging time for American society and the American economy, and with a strong belief that higher education has a critical role to play in the future of this society – not only as a successful, prosperous economy, but as a fair and progressive society with opportunities for all. At this time, more than 85 percent of all people who graduate from high school in the United States have some contact with a college or university – some experience of college enrollment – in the subsequent eight years. We're coming very close to an idea of almost universal access for high school graduates. It's not necessarily access

on equal terms, but it is access. Success in college is a much more challenging proposition, and graduation rates fluctuate across different population groups tremendously. We know that even though higher education is important to most Americans – and that most Americans seek it – there is also increasing doubt about higher education, about the fairness of its provision, about the affordability of college and the burdens of loans, and even about the integrity of higher education, with some collegiate institutions being shut down by the federal government because they're not being run in a responsible way. We want to tackle all of the practical projects and challenges that face higher education, but I want to emphasize that we will not limit ourselves to the narrow questions of paying for college and getting a job after college. Appropriately for this august institution, we intend to take on topics that address the values and the larger purposes of higher education. So you will see in our focus areas that we will have something to say about the liberal arts in relation to the occupational purposes of higher education. We will have something to say about what goes on inside colleges and universities; not simply what goes in and what comes out the other end, but the challenging process of studying, teaching, and learning. And perhaps most important of all, we will have something to say about the looming problems of educational opportunity in a time of

The Lincoln Project: Excellence and Access in Public Higher Education

growing material inequality in our society. We are at an early stage. We don't yet have answers to any of these questions. We don't have recommendations at this point. But those are some of the directions in which the commission is heading.

Debate about higher education is often based on rather elusive facts, and so we began early on to work with a data advisory group to make sure we have a good command of the best-available research and facts. The work of the data advisory group enabled us to produce our first publication, a fact-based, largely quantitative account of the current situation in undergraduate higher education in the United States, *A Primer on the College Student Journey*. It has, so far, been very well received. Aided by this data-rich foundation, we have also begun to undertake, and will continue to undertake, outreach efforts, congressional visits, meetings with students and faculty, and other forms of conversation around the country. We have so far had two meetings, and have another coming up next month. The final report will be published in the fall of 2017, something I keep reminding myself. And thereafter, we will go to great effort to communicate the conclusions and recommendations widely, and we are very interested in your perspectives on these issues. If you have questions, if you want to offer any input or thoughts, please let us know.



Robert J. Birgeneau

Robert J. Birgeneau is Chancellor Emeritus and the Arnold and Barbara Silverman Distinguished Professor of Physics, Materials Science and Engineering, and Public Policy at the University of California, Berkeley. He was elected a Fellow of the American Academy in 1987 and serves as Co-chair of the Academy's Lincoln Project.

We are at the exact opposite end of a project lifespan, so to speak, from the Commission on the Future of Undergraduate Education. Mary Sue Coleman – who was, when we began, president of the University of Michigan, and is now president of the Association of American Universities – and I are the cochairs of the Lincoln Project: Excellence and Access in Public Higher Education. The Lincoln Project has, in essence, looked at the specific challenges facing the approximately 145 public research universities across the United States. Our mission is to understand how we are going to maintain both the excellence and the accessibility of these institutions in the face of massive state disinvestments. How can we guarantee that these universities will continue to be public in character and serve the public

in the way intended when President Lincoln established them through the Morrill Act more than 150 years ago?

The Lincoln Project advisory group consists primarily of members of the Academy and, by design, includes a broad cross section of disciplines and interests. This is because we believe that all sectors – the federal government, state governments, business, foundations, nonprofits, students and their families, and the universities themselves – all will have to contribute in order to guarantee the health of our great public research universities.

We have produced a series of five publications, each with a different focus: *Why They Matter* documents in detail the role of public research universities in our society. *Changes in State Funding* tells the rather desultory story of the massive disinvestment in higher education by state governments. *Understanding the Financial Model* explains the basic financial model that now obtains at most public research universities. We all suffer from the fact that no newspaper or major magazine seems to understand public university finances, and further, most university faculty do not seem to understand their own university's financial model either. *Serving the Public Good* focuses on the many ways public research universities contribute to the educational, economic, and civic health of U.S. society, in addition to their major contributions in health care and quality of life. The final and longest publication, *Recommitting to Lincoln's Vision—An Educational Compact for the 21st Century*, provides the project's detailed recommendations for ensuring that public research universities can meet their core mission in the twenty-first century. I cannot do these publications justice in our short time today; accordingly, I encourage you to visit the Academy's website to read these publications in full. I believe that overall these publications are very well done thanks to the terrific work by the Academy staff.

It is important to recognize first that there is at least one outstanding public research university in every single state in the union, and many of these states, like Michigan and Washington, have no elite private research university at all. Overall, public universities are overwhelmingly responsible for the collegiate education of this country: 88 percent of all students pursuing a B.A. attend a public university. This is in no way meant to denigrate the role that our outstanding private universities play, but relative to the postsecondary student population as a whole, their educational contributions are limited.

The progressive increases in tuition, which public universities have vigorously fought to keep as modest as possible, have been driven almost entirely by state disinvestment.

Given that public universities bear the responsibility for educating the great majority of college students, it is chilling to look at their budgets, as measured by expenditures per full-time equivalent student, compared with those of the corresponding privates. Specifically, private universities belonging to the Association of American Universities spend between three and four times more per student than do the publics. My colleague, Henry Brady, dean of the Goldman School of Public Policy at UC Berkeley, likes to say that this proves how efficient we are or, more colloquially, that we offer a Cadillac education at a Chevy price. Said less positively, this expenditure disparity demonstrates just how financially deficient we are.

We have seen an extraordinary state disinvestment in public higher education and a concomitant increase in tuition. These are in lockstep with each other: the progressive increases in tuition, which public universities have vigorously fought to keep as modest as possible, have been driven almost en-

tirely by state disinvestment. So why has the state disinvested in public higher education? Elementary and secondary education costs, the states' largest general fund expenditures, have steadily risen. Meanwhile, the cost of Medicaid, the second greatest state expenditure, has skyrocketed, eating away at public funds. Higher education is the third largest general fund expenditure, but is followed closely by corrections. Over the last thirty years, state investment in higher education has been static, while funding of corrections has gone up by 141 percent. In fact, twelve states, including California,

spend more money putting people in prison and keeping them there than they spend providing Californians with a higher education. This is a national disgrace.

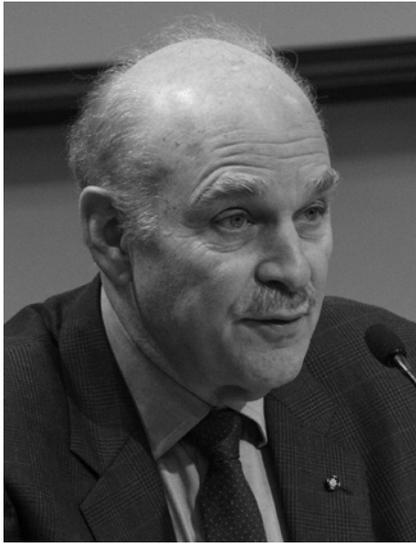
Of course this disinvestment directly affects tuition. Decreased state support is responsible for driving 80 percent of tuition increases at public research universities, while increased spending on instruction and spending on administration and support are responsible for only 9 and 6 percent, respectively. The data show that, on the whole, administrative bloat is a myth, and that administration costs have been kept under control at public universities across the country. There has been essentially no change in workforce composition at public research universities, except for, on average, a decrease in upper administration.

The Lincoln Project held regional meetings across the country, which produced some of our core conclusions. These include, first and foremost, that state disinvestment is a national phenomenon, and appears to be

irreversible. Disinvestment has largely been compensated for by increases in tuition and greater reliance on out-of-state and international students, both of which do not appear to be sustainable. Further, commitment to access varies wildly between different states. Some states are deeply committed to addressing income inequality through higher education, while others, disturbingly, appear to have no interest in this core societal issue. One important conclusion of the regional meetings was the ubiquitous need to improve graduation rates. We also learned that while corporate America often provides support for contract-based applied research, the amount of support from American corporations for either core university operations or student financial aid is disappointingly small. We were gratified to find that, across the country, we have great public research university leadership. One of the primary responsibilities of this leadership is to ensure that universities continue to improve on their operational efficiency.

To conclude, I will briefly mention four of our specific recommendations: 1) institute a federal-state-private matching endowed chair program at public research universities in all fifty states; 2) repatriate offshore corporate funds, which now stand at more than \$2.4 trillion, at a reduced tax rate and appropriate 1 percent of the gains for public higher education; 3) launch large-scale industry-sponsored undergraduate scholarships; and 4) increase financial aid for low-income students through private-donor, state, and university matching programs. We need both the federal government and major corporations to step up and begin to provide support for the operations of our public research universities, if these universities in turn are to continue to underpin the economic and civic health of the nation. Finally, this support must have access as an essential component.

Commission on Language Learning



Rubén G. Rumbaut

Rubén G. Rumbaut is Distinguished Professor of Sociology at the University of California, Irvine. He was elected a Fellow of the American Academy in 2015 and is a member of the Academy's Commission on Language Learning.

The United States has acquired a well-deserved but dubious reputation as a language graveyard. No other country in the world has received more multilingual peoples, and yet in no other country has a switch to monolingual English occurred as rapidly as it has in the United States. There are, today, some six thousand languages in the world, many of which are dying at a rapid pace. There are roughly two hundred nation-states; so there are many more languages in the world than there are states. The experience of bilingualism and multilingualism is normative in most countries around the world, but not in the United States. Still, as a result of an era of international migration to the United States over the last several decades, the percentage of people in the United States who speak English-only has declined from about 90 percent in 1970, the country's linguistic nadir, to about 79 per-

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cent in the most recent American Community Survey (ACS) in 2015. In other words, 20 percent of the people of the United States now indicate that a language other than English is spoken in their home. But the ACS doesn't ask how well they speak that other language, whether it be Chinese or Spanish or German or Tagalog. It turns out that only about half of that 20 percent speak a language other than English well.

Most people in the United States who speak a non-English language did not learn it in school. They are heritage learners. They're immigrants or children of immigrants. The children of immigrants are losing that language, their home language, more rapidly than first generation immigrants – we can actually measure language death with survey methods. And so we have American-born residents failing to acquire second-language skills through school, and we have immigrants and children of immigrants who are not retaining and passing on their non-English language skills. The result is a self-inflicted national disadvantage in global business, in international diplomacy and security, in the exchange in research and ideas, and in our ability to communicate with our own neighbors.

In 2013, the American Academy's Commission on the Humanities and Social Sciences released its report, *The Heart of the Matter: The Humanities and Social Sciences for a Vibrant, Competitive, and Secure Nation*. That report inspired a two-year campaign to support humanistic activity of all kinds, in partnership with universities, learned societies, academic associations, and humanities councils across the country. Among its recommendations, the committee declared,

“We cannot ensure that people will be empathetic, but we can ensure that they have the knowledge and experience they need to be able to see the world as others see it.” *The Heart of the Matter* made a very strong case for the importance of the humanities in international and multicultural contexts, and it made a strong case in particular for language acquisition. Based on the strength of that Commission's efforts, the American Academy received two letters in November 2014 expressing a bipartisan request – from eight members of Congress, four each from the Senate and the House of Representatives – to undertake a new study of the nation's language education needs. The letters noted, “The ability to communicate in languages other than English has never been more important, given that American jobs and exports are more dependent than ever on foreign markets. The American population is increasingly multilingual, Americans are more engaged, diplomatically and militarily, around the globe than ever before, and challenges like poverty and disease, and opportunities in scientific research and technological innovation, all require international understanding and cooperation.” They concluded by asking the Academy to provide answers to the following two broad questions. First, how does language learning influence economic growth, cultural diplomacy, the productivity of future generations, and the fulfillment of all Americans? And second, what actions should the nation take to ensure excellence in all languages, as well as international education and research, including how we may more effectively use current resources to advance language attainment?

In response to this request, the Academy created the Commission on Language Learning, of which I am a part, currently funded by the Andrew W. Mellon Foundation, the Henry Luce Foundation, and the Academy's own New Initiatives Fund. It was clear from the beginning that this Commission would capture some public excitement. The initial press release received more Web hits and views than any other announce-

ment of an Academy project. The Academy's excellent staff, some of whom are here today, continue to receive calls from philanthropic, news, and professional organizations, asking for details about publication dates. This public interest reflects both the importance of the subject matter and the timeliness of the forthcoming report.

Monolingualism is a curable disease. But we cannot wait until middle school or high school to attack it. It is critical to start early; by age two or three, the brain is generating trillions of new synapses, and language is acquired most easily during the first ten years of life.

The Academy began to organize the Commission in 2015, first by soliciting a series of white papers, four of which have been published on the Commission's website. The full Commission has now met three times, in December 2015, February 2016, and last June, and we will meet once more, in November. In addition to full committee meetings, four subcommittees have met throughout the year. The research and data subcommittee, on which I serve, has developed a short publication that provides a statistical overview of the United States' current language capabilities. You can expect to receive our published report in a few weeks. The technology subcommittee is looking for

innovative ways to address outdated classroom resources and the diminishing supply of language teachers. Third, a subcommittee called "America in the World" is considering how the development of more robust language capabilities will make the United States more effective, politically and economically, in an international context. And finally, the fourth subcommittee has been charged with evaluating how enhanced lan-

guage capacity contributes to a more welcoming, productive, and peaceful society. The Commission is now writing its final report, which is scheduled for release in early 2017. Like the statistical portrait, it will be published in both hard copy and electronic form, and will be distributed nationally. It will also be supported by a busy schedule of events across the country over a six-month period. We are also, naturally, considering the translation of the executive summary into languages other than English.

Throughout this process, the Commission has been in contact with organizations and congressional offices both for advice and to ensure that the Commission's initiatives align with those of possible partners, including the National Foreign Language Center, the National Endowment for the Humanities, the Department of Education, the National Humanities Alliance, Gallaudet University, the British Academy, and the Yale Center for Language Study. At its most recent meeting, the Commission chose to

highlight eighteen different recommendations in the final report, drawn from a list of more than sixty ideas discussed over the past year and a half. They fall into five broad categories: recommendations for increasing the teaching workforce; for streamlining teaching and assessment across cities and states; for encouraging heritage speakers to flourish both in their heritage languages and in English; for enhancing dual language learning opportunities for students who come from homes in which English is the dominant language and for students who come from multilingual families; and for the effective deployment of technology and digital resources in language learning. Not all eighteen ideas will be given equal weight in the final report. Some are merely illustrative of broader themes, or are parts of a menu of possible responses to particular challenges.

I'll briefly mention one recommendation. As the report will make clear, monolingualism is a curable disease. But we cannot wait until middle school or high school to attack it. It is critical to start early; by age two or three, the brain is generating trillions of new synapses, and language is acquired most easily during the first ten years of life. So one specific recommendation is to begin language learning as early as possible, not to wait until it's needlessly late, starting at a deficit.

The final report's overarching argument is clear: language learning is a vital part of the American educational enterprise and is critical to the nation's prosperity and security, as well as to the success of communities and the fulfillment of individuals in the United States. Our challenge has been to make the recommendations as strong as possible, not only to outline a strategy to improve language education in the United States, but to meet the urgent needs of our current moment in history.

Global Security & International Affairs

Committee on International Security Studies & The Global Nuclear Future



Steven E. Miller

Steven E. Miller is Director of the International Security Program at the Belfer Center for Science and International Affairs at the Harvard Kennedy School. He was elected a Fellow of the American Academy in 2006 and serves as Cochair of the Academy's Committee on International Security Studies and Codirector of the Academy's Global Nuclear Future Initiative. He is a Member of the Academy's Council.

Let me add my voice to those congratulating you. I would add that, if I extrapolate from my own personal experience, what you have in front of you is not only an honor, but a wonderful opportunity. Over the last twenty years, a large portion of my own personal research agenda has been undertaken through and under the auspices of the American Academy. It provides tremendous support. It creates openings for both work and impact that wouldn't otherwise exist. I would very strongly encourage you to get involved in the Academy's projects and works and take advantage of the support provided by its members, its governing bodies, and its staff.

I have two responsibilities here. First I will briefly describe the history of the Commit-

Many of the technologies associated with nuclear power are dual-use, meaning that they have direct weapons applications or implications. The spread of these technologies to new states can increase the risk that nuclear weapons will spread to new actors.

tee on International Security Studies (CISS) and then I will give a quick overview of one of our current projects, the Global Nuclear Future. For some six decades, the Academy, through CISS, has played a prominent role in the international security debates in this country. In the late 1950s, under Academy auspices, CISS generated the original work that was absolutely formative in establishing the notion of arms control as a useful instrument of national policy. What started out in 1958 or 1959 as an interesting academic, experimental project would, fifteen years later, give rise to the first strategic arms control agreements between the Soviet Union and the United States. And over a four-decade period, we were able to put into place a set of negotiated structures that governed and constrained the dangers of the nuclear arms race between the Soviet Union and the United States. You can trace the intellectual origins of that whole exercise right back to the American Academy. During the 1980s, the Academy was a key player in the debate over ballistic missile defenses and the reaction to President Reagan's so-called star wars program. In the 1990s, prompted by the protracted crisis in the Balkans, the Academy did some very thoughtful and influential work on issues of sovereignty and intervention: under what circumstances and what cases are international actors entitled to intervene militarily in the affairs of individual states, in violation of the deeply embedded norm of sovereignty.

Another recent CISS project undertaken under Robert Legvold's leadership was the

study of the security organization of what we call the post-Soviet space: the fifteen independent states established in Eurasia following the Soviet Union's disintegration. How would that space be structured and organized in a way that could produce stability and security? The provisional answer today is that the international community has failed in that particular exercise. Our late colleague, John Steinbruner, with whom I had the privilege of being cochair of this committee, was a pioneer in championing and exploring what you might call the governance and constraint of unregulated, dangerous technologies. He did work on bio warfare. He did work on the military uses of space. In the last phase of his life, just before he fell so ill, we began to creep into the area of cyber warfare. How do you think about creating a governance mechanism that enables us to exploit the benefits of these technologies while avoiding or minimizing the adverse security consequences that might flow from them? Earlier this year, the Academy published a volume, edited by Elisa Harris, on this subject, *Governance of Dual-Use Technologies: Theory and Practice*.

Turning from the past to the present, we now have four projects underway: Understanding the New Nuclear Age; New Dilemmas in Ethics, Technology, and War; Civil Wars, Violence, and International Response; and the Global Nuclear Future, which is our longest-standing active project and which I will briefly introduce.

The Global Nuclear Future Initiative is looking at the global appetite for nuclear

power and trying to assess and help constrain the potential nuclear proliferation implications of the spread of nuclear power. In the last decade, we have seen a tremendous upsurge in the interest and the pursuit of nuclear power. Some of this had to do with triple-digit per-barrel fossil fuel prices, which no longer exist. Some of it has to do with climate change. Some of it has to do with energy security and diversification of energy portfolios. But in places as far flung as Vietnam, Indonesia, Malaysia, Turkey, Abu Dhabi, and Iran, we see decisions already being taken and substantial investments being made in the pursuit of nuclear power, for the generation of nuclear electricity. But many of the technologies associated with nuclear power are dual-use, meaning that they have direct weapons applications or implications. The spread of these technologies to new states

with them. We've had meetings around the world. We've produced a number of publications on topics from insider threats and nuclear disarmament to used-fuel storage and nuclear liability. We've done extensive work in places like Turkey, Abu Dhabi, and, to a lesser extent, Vietnam.

For several decades, we had a very stable global nuclear order, consisting of thirty nuclear power states and roughly 440 installed reactors around the world. But in recent years, more than sixty additional states have approached the International Atomic Energy Agency and expressed a serious interest in pursuing nuclear power. Many of those countries will never get very far down the road toward nuclear power, but the so-called spearhead states are moving ahead. Iran, for example, already has an operational reactor connected to the electricity grid and generating electricity. There

dual-use technologies that made the Iran crisis so troublesome over the last dozen years. You can do a similar kind of exegesis of the situation in Southeast Asia, a region where there has been no nuclear power in the past but where there is widespread interest in nuclear power today. So the future is not going to be like the past. The world is changing, and we're trying to do something about it.

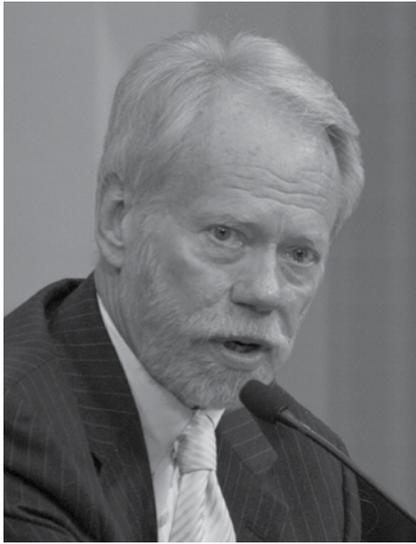
If these states are going to have nuclear power, whether we like it or not, how can we maximize the likelihood that they do so in a safe, secure, and proliferation-resistant way?

can increase the risk that nuclear weapons will spread to new actors. That's generally regarded as undesirable. Certainly from the point of view of American security, that is undesirable. So how do we think about addressing this problem?

We have focused this project on what we call the nuclear newcomers, asking the question: if these states are going to have nuclear power, whether we like it or not, how can we maximize the likelihood that they do so in a safe, secure, and proliferation-resistant way? Part of the answer is by engaging with the scientific and political communities in these countries, trying to build networks and share best practices

are well-known worries about Iran's possible interest in nuclear weapons, but whatever else Iran is doing, it is pursuing nuclear electricity. It is the first new nuclear power state in the world in a quarter of a century. Similarly, Abu Dhabi has four reactors under construction. The first reactor will be connected to the grid next year. Turkey has two large contracts, each for four reactors, which may go into operation in the span of ten or twelve years. Saudi Arabia has a very ambitious medium-term program to build a dozen or more nuclear power reactors, plus a declaratory policy of having all of rival Iran's technology portfolio, meaning they claim to be pursuing exactly the worrisome

Understanding the New Nuclear Age



Robert Legvold

Robert Legvold is Marshall D. Shulman Professor Emeritus in the Department of Political Science at Columbia University. He was elected a Fellow of the American Academy in 2005 and serves as Chair of the Academy's project on Understanding the New Nuclear Age.

At the end of the Cold War, attention shifted from the threat of nuclear armageddon resulting from the aggression of two nuclear superpowers to the proliferation of weapons of mass destruction, including nuclear weapons. In the process, we stopped thinking about the complex dynamic that was emerging among the nine nuclear powers—that is, what is today a multipolar nuclear world as opposed to essentially a bipolar nuclear world in the Cold War—and the challenges and the dangers that this new, multipolar world raises.

In this rapidly evolving new nuclear order, bilateral nuclear relationships, like that between Russia and the United States or India and Pakistan, are rapidly evolving into trilateral, or triangular, nuclear relationships. Here, the nuclear advances of China have become an increasingly important compli-

In the new nuclear order, the advance of nonnuclear weapons capable of attacking nuclear facilities, nuclear defenses, and their auxiliary components threatens the firebreak between conventional and nuclear war.

cating factor. Further, the determination of China, India, and Pakistan to create strategic nuclear triads—that is, nuclear weapons on land, at sea, and in the air—combined with commitments by Russia and the United States to modernize their existing triads, is transforming the overall nuclear landscape in substantial ways. The return to a competition between offense and defense—missile defense and the missiles to overwhelm it—are adding to the upset, and this time in multiple forms, because India, China, and Pakistan are headed down the same route, with the United States and Russia in the lead.

Another dimension of significant change in the new nuclear order is the advance of nonnuclear weapons capable of attacking nuclear facilities, nuclear defenses, and their auxiliary components, thereby threatening the firebreak between conventional and nuclear war. Growing cyber capabilities, when incorporated into nuclear war-fighting, are also a fundamental threat to the premises that underlie the notion of strategic stability, the concept that emerged from the Academy's arms control work in the 1950s. Finally, thinking about nuclear weapons and their reasons for being has taken on an ominous quality, in all quarters: more countries are assigning these weapons deterrence functions that go far beyond simple deterrence of a nuclear attack against them, while at the same time devising strategies for the use of these weapons in war.

The purpose of the Understanding the New Nuclear Age project is to bring all of these parts and the many increasingly complex di-

mensions together to develop a way of thinking about the whole—and to prod government and the broader expert community to begin doing the same. Then, ultimately, we will explore what can and should be done to deal with the overarching challenge, not merely the pieces of it, however important they are and however much expertise and experience we already have in addressing them. To proceed, we've assembled a working group of some of the country's most seasoned specialists, who focus on different parts of the problem, and we've added to it a cohort of the brightest young members of the successor generation. We have commissioned a number of papers to stimulate the group's thinking, which will eventually be published as either a monograph series or as a book intended to serve as a first cut on the subject. That is, the first effort to think about the new age in its complexity and whole, rather than just the composite parts. From there we'll push the analysis deeper, pursuing collaborations, both here and abroad, that will allow some of these ideas to begin gaining traction and, one hopes, to shake audiences, beginning with policymakers, from their current complacency.

In all of this we're mindful that the fading fortunes of arms control, the worsening tensions between the United States and Russia, and the risk that the U.S.-China relationship could veer toward a genuine strategic rivalry, represents an inauspicious context for this work. But at the same time, never could it be more important. Thank you.

New Dilemmas in Ethics, Technology & War



Tanisha Fazal

Tanisha Fazal is Associate Professor of Political Science and Peace Studies at the University of Notre Dame. She is a Member of the Steering Committee of the Academy's New Dilemmas in Ethics, Technology, and War project.

I want to add my congratulations to this year's new inductees to the Academy, on behalf of those of us who would one day like to be on that side of the table. I'm delighted to be here today to talk to you about this project on New Dilemmas in Ethics, Technology, and War. At the heart of this project is the ongoing adaptation of what is called "just war theory" to a new and changing international landscape, driven in part by new weapon systems and technologies. Just war theory is not just about war, but is about a set of ethical questions around the commencement, conduct, and conclusion of war, including the peace (or not) that follows. Are there conditions under which it is morally defensible to actually engage in war? What are the moral obligations of powers that take prisoners of war? There's a relatively new segment of just war theory that is talking about the ethics of war termi-

nation, and here there are some very serious questions about the trade-off between justice, especially for the victims of war, and peace. We saw this in action earlier this week, with the failed referendum on the Colombian peace agreement.

The project exemplifies the ways in which the Academy can bring together high-quality scholarship and high-level policy outreach. One example is the Fall 2016 and Winter 2017 double issue of *Daedalus* produced by this project. Following the publication of the first volume earlier this fall, Scott Sagan, the project chair, and Jeffrey Lewis condensed their essay into an op-ed for *The Washington Post*, in which they call for a revision of U.S. nuclear targeting policy to conform to the laws of war, including a commitment not to use nuclear weapons against any target that could be reliably destroyed by conventional weapons.

The political aims of different rebel groups condition how they fight and their relationship with the laws of war. . . . My research shows that secessionists, for example, are significantly less likely to target civilians than other types of rebel groups.

Another example of our project's marriage of high-quality scholarship and policy outreach is the set of briefings that several of us, including myself, presented this past May in Geneva. We were principally talking to the United Nations High Commission on Refugees (UNHCR), and I have to say this was a really exciting opportunity, but was also very challenging, because none of us in our contributions, or really in our own research, were directly addressing questions concerning refugees. And so we were forced to think about how new technologies of war, like drones and autonomous weap-

on systems, might be applied to a humanitarian context. In what ways could they be used to aid humanitarians in their work? We also discussed ethical issues concerning taking testimony from refugees that might, later on, be used to prosecute war criminals.

Another strength of this project has been that it has pushed just war theory forward by spotlighting the most common form of war today, civil wars. Both modern just war theory and also the modern body of multilateral treaties that make up the laws of war, like the Geneva Conventions, were created in an era when wars between states – interstate war – was the most common form of armed conflict. But that's no longer the case. Today we're much more likely to see wars within states. One of the essays to be published in the second *Daedalus* volume this January is Allen Weiner's legal analysis arguing that there are certain conditions un-

der which soldiers from rebel groups ought to be accorded the rights and privileges of lawful combatants, including prisoner-of-war status. My own contribution, also out in January, reverses the lens and looks at the laws of war from the perspective of rebel groups. My basic argument is that the political aims of different rebel groups condition how they fight and their relationship with the laws of war. In particular, I look at secessionist rebel groups – groups that want their own independent, internationally recognized state – and argue that, because they seek membership to the club of states, they

Civil Wars, Violence, and International Responses

want to send signals of being good and capable members of the international community, including by being better abiders of the laws of war than rebel groups with other types of political aims, such as overthrowing the central government. My research shows that secessionists, for example, are significantly less likely to target civilians than other types of rebel groups. And not only are they better behaved than other types of rebel groups, but they also tend to publicize this behavior, oftentimes contrasting it with the behavior of the governments against which they're fighting, who are, very frequently, very badly behaved.

Finally, let me mention that these *Dædalus* issues bring in new perspectives on just war theory from not just political scientists and moral philosophers, but from other disciplines. There's a terrific essay by Paul Wise, a pediatrician, who argues that we have to consider the long-term health impact of war in order to be able to evaluate the conditions under which it is or can ever be just. And with that mention of Paul Wise's essay, I'm going to turn the baton over to Karl Eikenberry, who leads a project that both Paul Wise and I are also a part of.



Karl W. Eikenberry

Karl W. Eikenberry is the Oksenberg-Rohlen Fellow and Director of the U.S.-Asia Security Initiative at the Shorenstein Asia-Pacific Research Center at Stanford University. He is the former United States Ambassador to Afghanistan and a retired U.S. Army Lieutenant General. He was elected a Fellow of the American Academy in 2012 and serves as Cochair of the Academy's project on Civil Wars, Violence, and International Responses.

I'm pleased to introduce a new Academy project that I lead with Stanford University professor and American Academy Fellow Stephen Krasner: *Civil Wars, Violence, and International Responses*. After 9/11, I ended up serving most of the first decade of this century in Afghanistan, or at NATO Headquarters in Brussels, working on issues related to Afghanistan. The conflict has been a protracted war, with many disappointments along the way. My experiences served as a personal inspiration to work with the Academy and colead this enterprise on civil wars.

We are addressing four overarching questions. What is the scope of internal conflicts and civil wars, and to what extent are they

attributable to domestic factors or international factors? What threats – new and old – emanate from civil wars and collapsed states, and when and how do they jeopardize U.S. and global security? Under what conditions should the international community cooperate with authoritarian regimes to facilitate a peaceful transition to democracy, or at least to stability and reduced levels of violence? And what are the policy options available to the international community to deal with these threats? Significantly, we have found that cooperation with other great powers has become more problematic in this new era.

Some of the highlights of our study: First, following World War II, colonial wars declined in frequency as new states emerged, becoming virtually extinct in 1975. Since 1946, interstate warfare has also followed a general trend of decline, becoming quite rare by about 2005. But over this same period, civil wars have persisted, more than doubling in frequency and increasing in duration. So this study on civil wars and intrastate violence is examining what is the dominant form of global conflict in the early twenty-first century.

Second, concerning the threats posed by civil wars and intrastate violence. While a point of debate within our research group, it seems that the severity and complexity of threats to the United States and to global security emanating from countries suffering from civil wars are increasing. Threats caused or encouraged by civil wars include terrorist organizations with international ideological appeal and territorial ambitions, like ISIS; proxy wars being fought by regional powers, such as in Syria, where Russia, Iran, Turkey, the United States, and Saudi Arabia have already been drawn in; criminality, such as in Afghanistan, which accounts for 90 percent of the world's poppy production; massive flows of refugees and migrants, which have clearly influ-

Threats caused or encouraged by civil wars include terrorist organizations with international ideological appeal and territorial ambitions; proxy wars being fought by regional powers; criminality; massive flows of refugees and migrants; and pandemics.

publication of the *Dædalus* volumes and subsequent outreach activity. Our hope is that through this effort, we will produce useful analysis and recommendations for the policy community in the United States and abroad, improving responses to civil wars. We are hopeful that we will foster debate and encourage young scholars from nonwestern countries to participate in efforts to design more sustainable conflict prevention policies. And we are hopeful we can serve as a bridge between the Academy and the policy community.

enced domestic politics in Europe and the United States; and, finally, the potential for pandemics to emerge from regions characterized by a complete breakdown of internal control.

Our project features thirty-five participants from universities, think-tanks, the media, NGOs, government, and the military in the United States and in Belgium, Colombia, Ethiopia, Germany, Norway, Sri Lanka, and the United Kingdom. Our efforts will build toward the publication of two volumes of *Dædalus*, the first in the fall of 2017 on why ending civil wars and state disorder is so difficult, the second in the winter of 2018 on the risks emanating from civil wars and policy prescriptions that address them. These publications will be followed by active outreach efforts with policy officials in Washington, D.C., the host institutions of our authors, international organizations in Europe, Africa, and North and South America, the media, and, of course, the Academy.

These efforts will lead to the publication of what we call an occasional paper, which will draw on what we learned during the

Science, Engineering & Technology

New Models for U.S. Science and Technology Policy



Nancy C. Andrews

Nancy C. Andrews is Dean of the Duke University School of Medicine and Vice Chancellor for Academic Affairs. She is also the Nanaline H. Duke Professor of Pediatrics and Professor in the Department of Pharmacology and Cancer Biology. She was elected a Fellow of the American Academy in 2007 and serves as a Member of the Academy's Board of Directors. She is a Committee Member for the New Models for U.S. Science and Technology Policy study.

I'm going to talk about a somewhat more mature project than those described so far, the New Models for U.S. Science and Technology Policy study. This project produced the 2014 report *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream*. *Restoring the Foundation* includes three prescriptions, which, broadly speaking, address the facts that innovation requires sustainable funding and long-range planning, that current policy and practices actually impede productivity and impact, and that we need a strong ecosystem, including a new government-university-industry partnership. *Restoring the Foundation* asserts that American science, engineering,

In approximately six years, China is projected to outspend the United States in research and development, both in absolute terms and relative to the size of their economy. We risk losing America's long-held advantage as an engine of innovation that generates new knowledge and products, as well as new jobs and industries.

and technology are at a critical inflection point, and that the decisions of policy-makers and leaders over the next few years will determine the trajectory of American innovation for many years to come.

In the words of project cochair Norman Augustine, "We must start to think about our future if we hope to have a future." The benefits of investing in science and engineering research are evident in each of our lives. Our life expectancy is nearly twice that of our grandparents, largely due to victories over devastating infectious diseases, supported by curiosity-driven research. And while new diseases continuously appear, conditions like cancer and coronary artery disease are much less likely to be lethal than they were a generation ago. We carry devices in our pockets – and I'm sure some people are looking at them right now – that not only let us communicate with each other from almost any place on earth, but can instantly provide more information than a library. One point the report makes is that smartphones represent the convergence of multiple lines of basic, publicly supported investigation. The past seventy years of research and innovation have also provided enormous economic benefit through new efficiencies, new businesses, and new careers. But America's future does not look as bright. We can no longer claim preeminence in many of the areas that we've taken for granted. Internationally, our students

rank seventeenth in reading, twentieth in science, and twenty-seventh in math. As a country, we are seventh in the world in basic research investment, and over the past twenty years we have dropped from first to tenth place in total research and development investment as a percentage of GDP. As our investment in research has languished, other countries have recognized how vital a strong research enterprise is for economic growth and for the quality of life of their citizens. They're using our playbook, emulating our twentieth-century commitment to basic research, and in approximately six years, China is projected to outspend the United States in research and development, both in absolute terms and relative to the size of their economy. We risk losing America's long-held advantage as an engine of innovation that generates new knowledge and products, as well as new jobs and industries.

Our project committee and the American Academy staff have worked hard to bring this message to key decision-makers, including academic leaders, faculty, students, business CEOs, and members of Congress. In the two years since the report was published, the Academy has organized dozens of meetings across the nation, and we have distributed twelve thousand copies of the report. These meetings have included presentations in our nation's capital. Committee members have been invited to present the report at professional society meetings

The Academy is not content simply to publish policy recommendations and hope that they'll be adopted. Rather, we actively engage the key partners and target audiences that will be needed to implement our ideas.

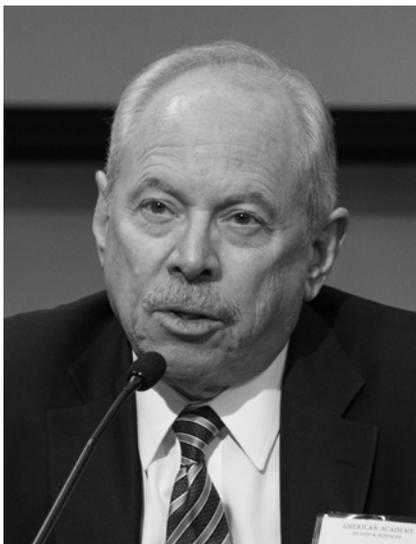
and to federal agencies. We've participated in over 150 meetings with members of Congress and their staff, including two Congressional briefings. And we were invited to testify twice in front of the Senate Committee on Commerce, Science, and Transportation, which authorizes research funding for the NSF, the NIST, the DOD Office of Science, and NASA.

Restoring the Foundation also inspired a statement from ten American business leaders called "Innovation: An American Imperative." The statement calls for Congress to take seven actions to strengthen American research, including five recommendations from the Academy's report. Signatories include the CEOs or chairmen of Lockheed Martin, Boeing, John Deere, Northrop Grumman, Merck, Novartis, Microsoft, as well as the National Association of Manufacturers. The statement has now been endorsed by over five hundred companies, universities, and professional societies from across America, including at least one from each of the fifty states. The Academy and its partners issued a report card this past summer on the one-year anniversary of the release of "Innovation: An American Imperative." One of the seven actions has already been implemented: Congress made permanent a strengthened R&D tax credit at the end of last year. Recently, the Senate Commerce Committee introduced a bill called the American Innovation and Competitiveness Act, which includes several other of our recommendations, such as reducing paperwork burdens on researchers and reaffirm-

ing the value of peer review. The bill passed out of the committee on a voice vote, and is awaiting action by the full Senate.

It's gratifying that so many other organizations have joined the Academy in raising the visibility of the *Restoring the Foundation* report over the last two years. The Academy will continue to work with partners in years ahead to bring greater visibility to key policy issues pertaining to research, both in Washington and across the nation. As just one example – and I hope some of the Academy's new members might be interested in this – we're launching an effort to recruit additional business leaders and public figures from outside of the research community to speak publicly about the importance of investing in basic research, and to lend their voices to the Innovation Imperative effort. All of this activity, I hope, will demonstrate to you that the Academy is not content simply to publish policy recommendations and hope that they'll be adopted. Rather, we actively engage the key partners and target audiences that will be needed to implement our ideas.

The Public Face of Science



Alan I. Leshner

Alan I. Leshner is CEO Emeritus of the American Association for the Advancement of Science. He was elected a Fellow of the American Academy in 2005. He is an Advisor to the Academy's project on the Public Face of Science.

I'm going to speak today about a relatively new Academy project, which began just last spring. Over the next three years, the Public Face of Science project will try to understand the factors that shape the public's attitudes toward science and the ways in which the public uses science. The diverse project committee is led by Richard Meserve and Geneva Overholser, who unfortunately could not be here today. What actually inspired this study, in part, is the disconnect between the public's great regard for science and technology, and the discontinuity between what scientists and the public believe about an array of critical issues. For example, 37 percent of U.S. adults believe it's safe to eat genetically modified foods, whereas 88 percent of the scientific community believe GMO foods are safe. There are similar disconnects about whether humans have evolved over time, or

whether some childhood vaccines should be required. What this shows is that the public either doesn't fully understand what science is showing or doesn't accept science or the scientific consensus. This is a difficult concept for scientists. We all believe that if we ignore, distort, or in some way abuse scientific evidence, we'll be struck by lightning. The public, of course, can ignore or distort scientific facts at will, with relatively few short-term consequences. And so the issue here is not whether the public likes or appreciates science, or even, at times, understands what the science is showing, but whether the public accepts science – and what to do about it.

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This study itself comprises three different pieces. The first concerns trust and perception. We are working with a data advisory group to prepare a benchmark publication featuring data related to public attitudes on science and the nature and outcomes of science engagement experiences. And we are forming new hypotheses to explain emerging trends in the public's perception of science, while also developing an agenda for generating new data. The second piece will focus on public and media engagement. This includes convening both a public engagement working group and a journalism working group. I was fortunate to attend an Academy meeting in June that brought together a large number of people working around science, communication, and the use of science information. Among other things, the meeting emphasized that science

literacy, in fact, is not the driver of public attitudes or the way in which science is used. So these working groups will convene to discuss best practices for scientific journals and public affairs offices and will help connect Academy members with engagement opportunities with nonscientific audiences. The third piece of the project focuses on how science is used to inform specific categories of policy and action. For example, working with Academy Fellows Shari Diamond and Richard Lempert, scientists and legal experts will examine the barriers to effective engagement between science and the legal system. We are currently surveying Academy members about their own experi-

ences with the legal system, which will inform a contribution in an issue of *Daedalus* devoted to the topic of science and the legal system. We will also look toward how scientific expertise could be more effectively employed in response to crises, especially natural disasters. Led by Gary Machlis, Rita Colwell, and Kristin Ludwig, we will convene a high-level meeting with communication experts, crisis managers, and scientific leaders to develop best practices for involving scientists in disaster response, which will be published in a benchmark white paper.

Through this quick summary, you can see that the common objective of these three pieces is to build a clearer understanding of public interactions with science, technology, and medicine by exploring the broader social contexts that shape how the public uses and considers scientific information.

American Institutions

I invite you and encourage you to participate in any way you can. There will be a series of discussions launched with Fellows across the country and, frankly, the Academy hopes to exploit all of you to get a better handle on this topic that has long confounded scientists.



Nannerl O. Keohane

Nannerl O. Keohane is a Senior Scholar at the University Center for Human Values at Princeton University. She served as President of Wellesley College and of Duke University. She was elected a Fellow of the American Academy in 1991 and serves as a Member of the Academy's Board of Directors.

I'm delighted to welcome all the members of this very distinguished assembly. It's a great pleasure to share news of some of the work of the Academy, and as you've heard, we hope that you will want to become involved. I'm going to give a report, very briefly, on one of our program areas and some of our priorities for the years immediately ahead (in an area we call American Institutions). I'm sure you'll agree that that focus is warranted, given the current concern about the health and functioning of a number of our national institutions, both public and private. There's an overlap with some of the other things you've heard – public research universities, research investment. But to provide just one other example, for a variety of reasons, a number of members of the Academy have encouraged us to launch

a new effort on the civic education of future generations of citizens in this country. There's ample evidence that young people today are often ill-educated in what we used to call civics: knowledge about our system of government and how to be a responsible citizen of our democracy. As the Academy's recent projects in the humanities and the education and sciences have suggested, the preparation of American citizens is a lifelong endeavor. We're all increasingly aware of the importance of lifelong learning, not simply an educational system that pays attention solely to K-12 or even postgraduate degree training. Keeping citizens well-prepared is a moving target, as is, of course, technology and culture change.

Now, the founders of the American Academy, about whom you will hear a lot this afternoon, understood both the importance and some of the difficulties of lifelong education, and they created the Academy partly to address this need. First, they encouraged the creation and sharing of new knowledge for a new republic, but second, they organized the Academy deliberately as a steward of the intellectual life in America more generally. "The end and design of the Academy," they wrote in the 1780 charter, "is to cultivate every art and science which may tend to advance the interest, honor, dignity, and happiness of a free, independent, and virtuous people." That objective is our fundamental mission. Trying to ensure that all participants in the American experiment, young and old alike, will be well-prepared. The Academy will soon consider a variety of projects that would return to these roots. A commission on K-12 education, perhaps. The study of particular institutions like our legal system, which Chief Judge Wood will discuss in a moment. These build on past work. For example, the recent *Dædalus* issues on mass incarceration and immigration, as well as a 2013 issue on American institutions and the common good. So stay

A great deal has changed for women and for men since 1987, and we think it's high time to revisit this topic. . . . Understanding global feminism in the broadest sense is what we have in mind.

tuned for future projects with the same basic aim, and please do share with us your own ideas for these programs. It's particularly important because the projects that I've just described, and others yet to be envisioned, will help build to our 250th anniversary in 2030, which will be an auspicious time to renew our commitment to our founding principles.

I want to mention briefly a brand-new project that will address another critical social issue from a slightly different angle. In early December, the Academy will convene an exploratory meeting. That's the lowest level of our projects, from exploratory meetings through major projects through commissions. Our task in that exploratory meeting is to have a number of scholars and policy-makers come together to assess the current state of knowledge in the social sciences about the situation of women around the world. We'll also explore the contemporary debate on issues relating to gender equality and feminism, and then we'll discuss what role the Academy might play in encouraging the advancement of knowledge about the situation of women around the world, and clarifying and strengthening the debate about the future of women today in all the parts of the world. I'll be cochairing this meeting with Frances Rosenbluth, professor of political science at Yale and a member of the Academy Council.

This will be the first time that the Academy has addressed gender issues in several decades. There was an issue of *Dædalus* in 1987 entitled *Learning about Women, Gender, Politics, and Power*, and one earlier issue of *Dædalus* in 1964 called *The Woman in Amer-*

ica. It included a path-breaking essay by Alice S. Rossi that some of you may have heard of, "An Immodest Proposal," which became a classic in the field. But a great deal has changed for women and for men since 1987, and we think it's high time to revisit this topic. Frances and I will work closely with Eliza Berg and Francesca Giovannini of the Academy staff, and we hope that the meeting will lead to a larger project that will help us understand the factors that have allowed women to achieve virtual equality in some domains, but remain considerably less than equal in others, and also some of the factors that make crucial life circumstances so different for women in different parts of the world, including education, health, access to resources, experience in marriage, opportunities for leadership. Understanding global feminism in the broadest sense is what we have in mind. This project will draw on multiple disciplines, and we will learn from women around the world and hope to bring together a rich perspective.

Making Justice Accessible



Diane P. Wood

Diane P. Wood is the Chief Judge of the United States Court of Appeals for the Seventh Circuit and a Senior Lecturer at the University of Chicago Law School. She was elected a Fellow of the American Academy in 2004. She serves as the Chair of the Academy's Council, the Vice Chair of the Academy's Board of Directors, and a Member of the Academy's Trust.

This project deals with access to justice in our country – justice in many forms. Each year, millions of Americans are unable to afford a lawyer for cases brought forth in the civil courts. The situation on the criminal side is, perhaps surprisingly, not much better. But these problems are sufficiently different not to fit into this project's purview. Reflecting this, I'm going to focus our discussion today primarily on the civil courts.

In 2014, which is the last year for which census data were available, sixty-three million Americans were at 125 percent of the federal poverty line or lower. That means, give or take, \$30,000 a year for a family of four. At current funding levels, these Americans are not obtaining lawyers for civil court cases. That's despite the fact that we have a fed-

erally chartered agency, the Legal Services Corporation (LSC), dedicated to providing access to legal counsel, in addition to many state-level institutions. These advocates simply do not have the resources to serve every qualified person and, in fact, something on the order of four out of five eligible low-income Americans are not getting assistance through these programs. So millions of Americans are navigating an intimidating, confusing, and complicated legal process without the assistance of a legal professional.

In a report to the chief judge of New York in 2010, a task force to expand access to civil legal services noted that 99 percent of tenants are unrepresented in eviction cases, 99 percent of borrowers in consumer credit cases are unrepresented, and 97 percent of parents are unrepresented in child support matters.

What do we mean when we say *civil*? We mean the person whose landlord is going to evict her. We mean the person whose mortgage is going to be foreclosed. We might mean the person who bought a product that just didn't work, and who would like to return it to the store. Or a person who is being hounded by a debt collector despite having made a payment the previous month. We mean the victims of domestic violence. Civil courts deal with all sorts of issues of great importance to our society.

So we recognize the dangers of a legal system built on the user-pays model, which is what we have on the civil side. The federal government created the Legal Services Corporation in 1974 to help ensure equal access to justice, but the LSC is overwhelmed by the amount of need, and congressional funding is at an all-time low. Adjusted for inflation, the LSC's current budget, which

is \$385 million a year for the entire country, represents less than half of its original appropriation in 1970. I'll just give you one comparison that the president of the Legal Services Corporation – a man by the name of Jim Sandman – likes to give in his speeches, because it will appall you. Every year at Halloween time, Americans spend more on costumes for their pets than we spend on the Legal Services Corporation. Never mind your kids; it's the cat. I say this as a cat-lover, by the way.

The resources are simply inadequate, and the effects are immediately recognizable. In Massachusetts, where we happen to be right now, 64 percent of eligible residents were turned away, and that may be a rosy picture, because here the state actually throws in some resources to help. Many people don't realize that their problem is a legal problem and that they might be able to get some assistance for it, as in the case of a family being evicted from their apartment. In a report to the chief judge of New York in 2010, a task force to expand access to civil legal services noted that 99 percent of tenants are unrepresented in eviction cases, 99 percent of borrowers in consumer credit cases are unrepresented, and 97 percent of parents are unrepresented in child support matters. That's in New York City. These local statistics are gathered at the behest of the local courts or various NGOs. The data are quite spotty,

The federal government created the Legal Services Corporation in 1974 to help ensure equal access to justice, but the LSC is overwhelmed by the amount of need, and congressional funding is at an all-time low.

and aren't uniform across states. So it's very difficult to see what's going on at the national level. What data we do have are often unreliable and fall short of enabling more than surface-level analysis of this giant problem. This finding was echoed by a White House legal aid interagency roundtable.

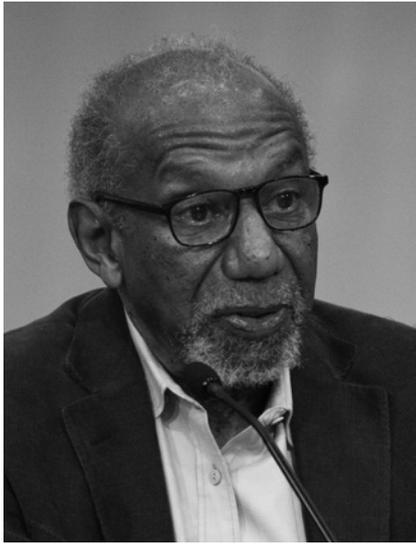
On November 11 and 12, 2015, just about a year ago, the American Academy hosted a very successful symposium on the state of legal services for low-income Americans. This symposium was organized by a small committee led by John Levi, an Academy Fellow and chair of the board of the Legal Services Corporation, and it was sponsored by the Academy's Exploratory Fund, which has been a wonderfully flexible tool to try out and develop an idea and see if there is potential for further study and Academy involvement. At a minimum, the fund has brought together Academy Fellows and other experts across disciplines to discuss problems of shared interest. Our meeting included federal and state judges, legal scholars, and legal-services providers. Those present quickly reached the conclusion that this is a social problem of the highest magnitude, demanding a country-wide social and political response. The symposium also concluded that we could not think sensibly about the topic until we knew what data we have, what they cover, what data we're lacking, and how to go about getting the missing information. So with realistic expectations, we launched a data collection project.

And that is, in fact, where we are now. Mark Hansen and Rebecca Sandefur are the chairs of the project and are working to set a

research agenda. Our group, with the Academy's help, is investigating what funding sources and potential partners are out there, what the obstacles to further research are, what is possible with the resources we now have, and what data need to be collected. Further, we are organizing – this is a common theme you've heard this morning – an issue of *Dædalus* on this topic, which will be edited by four leading experts on the issue: David Tatel, who is a judge on the United States Court of Appeals for the District of Columbia Circuit; Lance Liebman, professor and former dean of the Columbia Law School; Rebecca Sandefur, whom I mentioned a minute ago, professor of sociology at the University of Illinois; and Lincoln Caplan, who's a visiting lecturer at Yale. This will be another way in which we will get the word out and try to take advantage of the Academy's convening capabilities. The Academy isn't just one little narrow group of lawyers or social scientists, but a diverse group of people who can think sensibly about the scope of this problem, the costs of not solving it, and what might be done. The final thing I will say is that the Academy has often served as a catalyst for a national discussion about issues. That's exactly what happened with our *Heart of the Matter* report on the humanities and social sciences. And as the Academy approaches its 250th birthday, this project may very well help shape a national conversation.

Exploratory Projects

The Future of Jazz in American Life



Felton Earls

Felton Earls is Professor of Human Behavior and Development, Emeritus, at the Harvard T. H. Chan School of Public Health, as well as Professor of Social Medicine, Emeritus, at Harvard Medical School. He was elected a Fellow of the American Academy in 1993.

I'd like to be a little autobiographical about this. I grew up in the shadow of jazz in New Orleans. In 1963, I joined a group of senior undergraduate students at my university, Howard University, and went to the dean of the music school, whose name was Warner Lawson, and proposed to him that we – the university – grant Duke Ellington an honorary degree that year. Much to our surprise, Dean Lawson said that he would not consider that, because jazz, even with a distinguished composer like Duke Ellington, was a degenerate form of music; that only spirituals had the integrity and the musicality of something that deserved an honorary degree. And so it came as a great surprise to me, in 1993, thirty years later, when I was inducted into the Academy, to find out that Ellington had been inaugurated as a Fellow in 1970, four years before he died

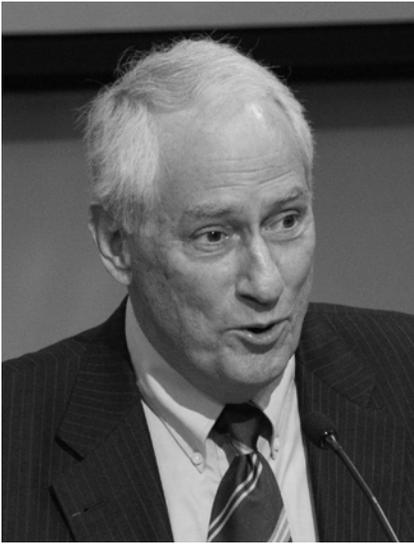
This music that originated in America has become a truly global art form. But the soil it grew in is being depleted.

in 1974. So that put a cricket in my brain, and it rested there until Academy President Jonathan Fanton proposed the exploratory grant mechanism, and right away the cricket started to chirp. Wouldn't it be interesting to have the Academy review the vitality, the vulnerability, and the fragility of this truly American art form?

And so I got together with William Damon, a jazz buff buddy of mine who had just been inducted, and we applied for the grant Jonathan had announced. We wrote a letter, saying we'd like to convene a group of professors and performers and people interested in the marketing of jazz – to get an eclectic group around the table to think through the vitality of this music in contrast with its vulnerability in the market. Jazz, over the last thirty years, has gone beyond Europe and Africa, and is having quite an impact internationally, in Korea, Japan, and China, among other places. So this music that originated in America has become a truly global art form. But the soil it grew in is being depleted. So we convened the meeting last May, and as a result, Gerald Early from Washington University in St. Louis and Ingrid Monson from Harvard, two professors of music and art, have agreed to put together a volume of *Dædalus* on the future of jazz.

What the Exploratory Fund has allowed me to do, living in the shadow of jazz all these years, is to plant this seed. I think that the *Dædalus* volume will be a great opportunity to enrich the environment, to move the Academy a step closer to representing jazz as an art form that is uniquely American in its origin and global in its influence.

Preserving Intellectual Legacies in a Digital Age



Robert Darnton

Robert Darnton is the former Carl H. Pforzheimer University Professor and Director of the University Library at Harvard University. He was elected a Fellow of the American Academy in 1980.

I would like to offer a few words on an Exploratory Fund project entitled “Preserving Intellectual Legacies in a Digital Age.” Twenty-six participants met here at the Academy on September 23. We sat around a donut-shaped table in the other room and talked and talked. People came from many different disciplines, and they all addressed the same problem, which all of you, I’m sure, have thought about: how to preserve digital material now that we are deep in the digital age. You might ask, how deep? Well, we now have what we call digital natives. That is, children who learned to play on screens before they learned to read. We also have digitally born documents, which left no trace on paper whatsoever. The conjunction of these two, I think, is pointing us toward a future in which the dangers of nonpreservation are tremendous, for ourselves today, but also for future generations.

We now have what we call digital natives: children who learned to play on screens before they learned to read. We also have digitally born documents that left no trace on paper whatsoever. The conjunction of these two is pointing us toward a future in which the dangers of nonpreservation are tremendous.

I’ll give you a rapid-fire version of some of our prophecies of doom and some of our suggestions in response. One speaker, Abby Smith Rumsey – former program manager at the Library of Congress – reminded us that 80 percent of silent films have just disappeared. We have no record whatsoever of this major art form. I don’t know how many jazz performances have been lost, but I would think the great majority have also vanished into the air. Movies and videos continue to be lost, in part because the Library of Congress does not require that copies of them be deposited in its archives. All sorts of commercial companies now provide cultural content without even giving a thought to the preservation of that content. We need to make the Library of Congress an obligatory deposit library for digital works in all formats, Abby Smith Rumsey concluded.

Another speaker, Jonathan Zittrain, a professor of law at Harvard and also the Harvard Law librarian, offered an equally chilling reminder. Seventy-five percent of the articles in the *Harvard Law Review* are inaccessible online because of link rot. He favors some kind of compulsory licensing that would provide for preservation. A third speaker, Dan Cohen, who is the executive director of the Digital Public Library of America, concurred. Facebook, he remarked, now produces the largest amount of data among all companies, yet it does nothing whatsoever to preserve the material. He argued that we need to develop a default to preservation

in our communication systems so that digital ephemera will be saved for the use of future generations. Mahadev Satyanarayanan, the professor of computer science at Carnegie Mellon known for developing Dropbox and the so-called Internet of Things, which is a fascinating topic, emphasized the importance of one poorly understood aspect of preservation: not just the preservation of hardware and software, but the preservation of what he called software executability. That is, the necessity of developing technology to ensure that software that has been preserved for the future will actually function as it did in the past, which requires a very difficult process of aligning all sorts of moveable, digital parts. And as if that were not difficult enough, Kenneth Prewitt, former director of the U.S. Census Bureau who is now a professor at Columbia, reminded us that a great deal of this technology, of course, depends on algorithms that are trade secrets.

By this time, the mood in our group was shifting toward disconsolate pessimism, but there were optimistic moments, which I’ll mention very quickly. Brewster Kahle, the head of the Internet Archive, set a positive tone through a rousing talk at a dinner before the workshop met the following day. He represents what you could call seat-of-the-pants pragmatism. A great representative of the MIT ethos, he says, “just do it.” The idea is to jump in, to take risks, to try out solutions, weed out the failures, and keep what works. That sounded pretty good. Then the

Preserving Cultural Heritage

poet Robert Pinsky expressed the pessimistic outlook the following day. “We can learn to succeed in creating works,” he said, being a great creator himself, “but we can’t wrap our minds around the problem of preserving them.” “What does a hog know about bacon?” he asked. Well, that left us really uncomfortable.

Then the discussion shifted to the theme of accessibility, even in the present, as well as the future. Mike Furlough, the executive director of the digital library HathiTrust, challenged the notion – and I think it’s a very widespread illusion – that everything is, or soon will be, available online. It’s absolutely false. Although HathiTrust’s gigantic preservation repository contains thirteen million digitized volumes, deposited by 115 institutions, it lacks an enormous amount of material that belongs to this famous category you keep hearing about, the unknown unknown. So, he argued, we should develop a strategy for assessing what we have failed to preserve nationwide, and how we should make it accessible. Pamela Samuelson, Carla Hesse, and Molly Shaffer Van Houweling, all from the University of California, Berkeley, discussed the ways copyright laws prevent that kind of access, including access to most of the books published in the last century. They advocated changes in copyright, such as a provision for authors to disseminate their own work if it is no longer being sold by publishers. The workshop was actually inspired, in large part, by Pamela Samuelson and Carla Hesse. They have created a project known as the Authors Alliance, which is trying to do exactly that. Perhaps I could say that we didn’t leave the meeting feeling happy about the problems of preservation, but we raised our consciousness.



James Cuno

James Cuno is President and CEO of the J. Paul Getty Trust. Elected a Fellow of the American Academy in 2001, he serves as the International Secretary of the Academy and is a Member of the Academy’s Council.

I should say that the meeting I am about to describe was born from a conversation that Jonathan and I had after a panel discussion just like this, one year ago. So I encourage you to follow through on your own interests, or interests that may develop from today’s meeting.

On February 26, 2001, the Taliban leader Mullah Mohammed Omar called for the destruction of all statues of non-Islamic shrines in Afghanistan. He said that these statues have been and remain shrines of unbelievers, who continue to worship and respect them; God almighty is the only real shrine, and fake idols should be destroyed. A few days later, the sixth-century monumental statues carved into a cliff in the Bamiyan Valley of central Afghanistan – which testified to the majesty of Buddhist art and its transmission from India into Central and Eastern Asia – were hit by an-

ti aircraft and tank fire before being blown up by dynamite. Neither a meeting between the Taliban foreign minister and the Secretary General of the United Nations, Kofi Annan, nor the statues’ inscription on the UNESCO World Heritage Site list could prevent their destruction.

The Great Mosque of Aleppo was built between the eleventh and fourteenth centuries on the site of the former agora of the Hellenistic period – and purports to contain the remains of Zechariah, the father of John the Baptist. In April 2013, for unclear reasons, its minaret was destroyed, some say by Syrian rebels, others say by the Syrian Army. Both the mosque and the minaret were inscribed as an UNESCO World Heritage Site, though, again, this did not preserve them.

On February 26, 2015, ISIS released a video showing its fighters attacking and destroying statues and artifacts in Mosul, Iraq, dating from the Assyrian and Akkadian empires from the eleventh to eighth centuries BC. The ISIS attackers justified their actions by referencing the Prophet Muhammad’s destruction of idols in Mecca, arguing that if God ordered the removal of these statues and idols, these artifacts become worthless to us. In response to these and similar attacks, the UN Security Council adopted eight resolutions affirming the sovereignty and territorial integrity of Syria and Iraq, and condemned ISIS and its destruction of cultural heritage. On May 28, 2015, the UN General Assembly unanimously adopted a similar resolution.

Most recently: the oasis town of Palmyra, which was one of the great trading centers of antiquity, connecting the civilizations of the Mediterranean with Mesopotamia and the empires of the East. For centuries, its Roman-era ruins stood as monuments to Arab glory and Levantine cosmopolitanism. Then it was attacked by ISIS fighters. Its most important shrine, a first-century temple dedicated to the Mesopotamian

god Bel was reduced to rubble. Then a second temple, dedicated to the other Palmyran deity Baalshamin, was blown up. Then the triumphal arch on the colonnaded main street, which may have commemorated the Roman victory over the Parthians, was destroyed, followed by the demolition of several of the city's tower tombs. Finally, the local archeological museum was sacked, although much of its collection had been removed to Damascus for safekeeping, given that they were moveable heritage items. Not stopping at the museum and its artifacts, ISIS also beheaded the eighty-one-year-old Palmyran antiquity scholar, Khaled al-Assad, and hung his mutilated body on a column in a main square, because he allegedly refused to reveal to them where the artifacts had been moved for safekeeping. Needless to say, Palmyra was inscribed on the list of UNESCO's World Heritage Sites, and still was heavily damaged.

To date, the international community's responses have been limited to declarations of outrage, inscribing important cultural heritage sites on a world list, and passing UN resolutions condemning such acts of violence. Clearly, more needs to be done.

Such deliberate attacks on cultural heritage have not been limited to the Middle East. In 2012, al Qaeda-linked rebels occupied a breakaway mini-state in the northern half of Mali, including the Saharan city of Timbuktu. They enforced a strict interpretation of Islamic law, and destroyed nine mausoleums with pickaxes, hoes, and Kalashnikovs. Among the mausoleums were those of Sidi Mahmoud Ben Amar, a renowned Muslim scholar and Sufi saint who died in 1547, and the Sidi Yahya, whose mausoleum also served as one of the three great

The question we will explore is, if states have the obligation to protect cultural heritage within their sovereign borders, what responsibility does the international community have when the state is unable to or unwilling to exercise that obligation.

mosques in the city, dating from the fifteenth century. A year later, a French-led military force recaptured Timbuktu and arrested Ahmad al-Faqi al-Mahdi for participating in the destruction of the mausoleums. Al-Mahdi's conviction by the International Criminal Court in the Hague was the tribunal's first conviction for the destruction of religious buildings or historic monuments, and whether it will lead to additional convictions for the attacks in Mali, Iraq, and Syria is unclear, for al-Mahdi was apprehended first, and was turned over to the ICC

with the formation of new nation-states following the collapse of empire, cultural heritage that fell within the sovereign borders of those states has become state property. This has limited, and in most cases stopped, the practice of partage, which distributed archeological finds between excavators and local authorities. It has also made it difficult to create safe harbors for moveable cultural heritage, such as sculptures, mosaics, and manuscripts. A recently signed U.S. law, for example, allows for safe havens only on the basis of a waiver of import restrictions at the invitation of the country that owns the artifacts. In any case, this law does not address threats to the immovable cultural heritage, like those temples that we saw blown up in Palmyra, the Great Mosque of Aleppo, or the mausoleums in Timbuktu. And so the American Academy and the J. Paul Getty Trust have joined together to invite international legal scholars, museum and conservation professionals, and government and diplomatic leaders to a meeting to be held at the British Academy in London next month, where together, in cooperation and collaboration with colleagues around the world, we will explore the feasibility of a broad legal and diplomatic framework modeled on the responsibility to protect framework adopted by all members of the United Nations General Assembly at the 2005 World Summit. That framework was directed at the prevention of genocide and mass atrocities, and our task is to see whether something comparable couldn't be directed at the prevention of destruction of

cultural heritage. The question we will explore is, if states have the obligation to protect cultural heritage within their sovereign borders, what responsibility does the international community have when the state is unable to or unwilling to exercise that obligation, such as in Syria, where the state does not have control over its sovereign territory.

The American Academy is well-positioned to take on this task, because the committee that wrote the original responsibility to protect report was chaired by Academy Fellow Lloyd Axworthy, with support from Academy Fellow Kofi Annan, and financial backing from Academy President Jonathan Fanton, then head of the John D. and Catherine T. MacArthur Foundation. The Academy is not new to this kind of work. In 1947, the Academy sent Bart Bok as its representative to the First National Conference on UNESCO. He worked actively for UNESCO's program in the natural sciences. Then, in November of that year, the Academy's Committee on UNESCO issued a conference report to the State Department, which served as preparatory material for the U.S. National Commission to UNESCO. It's on this foundation that we intend to explore the legal framework for the protection of cultural heritage, recognizing that in times of violent conflict, innocent people and the world's cultural heritage are both at risk. ■

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Induction Ceremony 2016: Presentations by New Members

On October 8, 2016, the American Academy inducted its 236th class of members at a ceremony held in Cambridge, Massachusetts. The ceremony featured historical readings by Robert Millard (MIT Corporation) and Melody L. Hobson (Ariel Investments, LLC), as well as a performance by the Boston Children's Chorus. It also included presentations by five new members: Terry A. Plank (Columbia University), Jay D Keasling (University of California, Berkeley; Lawrence Berkeley National Laboratory; Joint Bioenergy Institute), Andrea Louise Campbell (Massachusetts Institute of Technology), Theaster Gates, Jr. (Rebuild Foundation; University of Chicago), and Walter Isaacson (The Aspen Institute). The ceremony concluded with a performance by the singer-songwriter Judy Collins.



Terry A. Plank

Terry A. Plank is the Arthur D. Storke Memorial Professor in the Department of Earth and Environmental Sciences at the Lamont-Doherty Earth Observatory at Columbia University. She was elected a Fellow of the American Academy in 2016.

Thank you, Academy leadership, for giving me an opportunity to say a few words. It is an incredible honor to represent Class I, the Mathematical and Physical Sciences, with these remarks.

There is some foreboding to a meeting that requires checking the hurricane forecast prior to attending. As Matthew is bearing down on the Carolinas, it is hard not to feel awe at the fury and force of nature.

The next eruption of Rainier will be a disaster for Seattle; the next eruption of Yellowstone will disrupt life as we know it on the planet.

It is also important to remember, however, how lucky we are to have satellites in the sky and scientists on the ground, with the ability to predict the location and strength of the storm in a timeframe that gives people at least a chance to get out of the way. The situation is very different for earthquakes. There is no warning, no chance to get out of the way.

Volcanic eruptions can have lots of precursors, but we don't know how to read them. Sometimes there is a lot of unrest and no eruption. That is an embarrassment. Sometimes there is an eruption with little prior unrest. That is a disaster. Volcanic ash brings down aircraft; the next major eruption of Rainier will be a disaster for Seattle; the next super-volcanic eruption of Yellowstone will disrupt life as we know it on the planet.

So hurricanes, earthquakes, and eruptions – yes, there is a hierarchy among natural hazards. Hurricanes are well forecast, but the destruction of property is vast. Earthquakes can't be forecast, but earthquakes don't kill people, buildings do. Volcanoes are poorly forecast and have the ability to affect life as we know it on the planet. You can tell what I work on, and what I think "wins." This reminds me a bit of that scene in the movie *Thank You For Smoking*, where the lobbyists from alcohol, tobacco, and

firearms – the merchants of death – sit and gossip over their weekly lunch.

What I want to talk about is potentially the most exciting discovery in earth science in the next ten years: the ability to forecast earthquakes and volcanic eruptions. It is a great time to be an earth scientist, though, in fact, I have found it has always been a great time to be an earth scientist. In my lifetime, we have discovered plate tectonics and global warming and we are ripe for another breakthrough in our understanding of the earth.

Most of us study the earth because it is fun – we get outdoors – and it allows us to connect the rocks at our feet to planet-scale processes. Nowhere was this more obvious to me than as a graduate student, on a ship in the middle of nowhere in the Pacific Ocean, drilling the seafloor.

We wanted to see what went down the Marianas Trench, but it takes a leap of faith to drill mud that is headed on a journey you can't see into the earth, to be transformed at high pressure and temperature into magma that finally erupts out a volcano.

My early work examined this invisible process with chemical tracers, and I have been following the path of subduction my whole career, into the trench and to the hot core of the mantle wedge, and back out, now face to face with the volcano.

For many of us, the volcano is a portal, like Jules Verne's journey to the center of the earth; it conveys information from the deep and is really a bit of an annoyance that it erupts. But my recent work tracing water through the subduction zone and into magma has found that the water content doesn't seem to relate to eruptive explosivity. This is a problem for the standard selzer bottle model, that the gas drives the eruption. But as anyone who has been handed a shaken bottle knows, it isn't so much the amount of gas in the bottle, but how fast you open the cap. So timing is everything, and eyes are now trained on volcanoes to see how rapidly magma and gas rise and decompress on the way to the surface.

These new phenomena are giving earthquake scientists optimism for understanding the timing and physics of run-up to rupture.

And we are just beginning to read these signs of volcanic unrest: swarms of migrating tiny deep earthquakes, the ground literally swelling, that we can capture with GPS and satellite interferometry, and CO₂ burps that presage magma moving under the ground. Lots of signs, but will it erupt next week, next month, ever? What is actually happening under the ground?

This is where our work comes in. The ash and crystals that are erupted record chemical patterns, and using the principles of chemical diffusion we can clock the disequilibrium processes that occur, like magma mixing or gas exsolution (bubble formation). This is the key needed to interpret the precursory signals: what is actually happening under the ground, which of the precursors matter, and what leads to imminence in eruption.

There are similar rumblings and new omens in the study of earthquakes. Japanese instruments happened to be in the

right place at the right time, on the seafloor before the big Tohoku-Oki earthquake in 2011 – the one that generated an enormous tsunami and led to the Fukushima nuclear disaster. These instruments caught migrating swarms of small earthquakes that occurred weeks before the main shock. Earthquake precursors used to be a dirty word; too many scientific careers have been burned looking for them. But these new phenomena are giving earthquake scientists optimism for understanding the timing and physics of run-up to rupture, now that they know where to look and what to look for.

So we as a community are trying to organize a new initiative of observatories that

peer into the earth instead of outward to space. This requires a newer model than the usual small-team hypothesis-driven proposal submissions to the NSF, which are largely what have supported our field. In this, we can take lessons from the 1960s.

I work at Columbia University, on a special campus called the Lamont-Doherty Earth Observatory. The campus was established in the 1950s as a quiet place outside Manhattan to test seismometers, but it quickly became a home base for seagoing scientists. The research vessel *Vema* was in constant motion sailing back and forth across the oceans, with ships full of graduate students and a mix of scientists working in close quarters for months at a time. The standing order was to stop and take a mud core a day from the seafloor, and to drag magnetometers and run gravimeters continuously, punctuated by charges of dynamite lobbed off the side to take sounding of the seafloor. This systematic but essentially

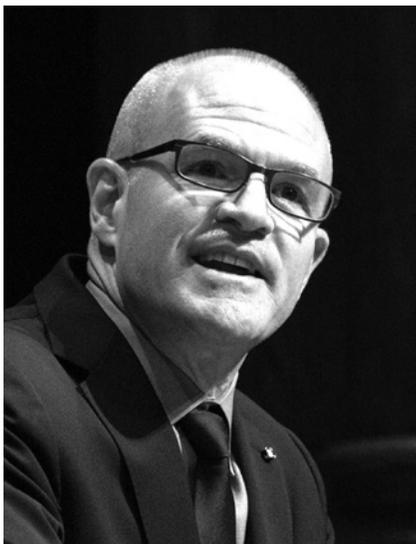
blind data collection back and forth across the ocean for years led to the discoveries of plate tectonics, and the cores are still being mined for their records of climate change. (My fellow newly elected member Lisa Tauxe studied those magnetics data.) All these seagoing voyages were block funded by the Navy, at a scale that does not happen today, but could – and probably with great benefit to our science and society.

At a large planning meeting last week, we planted the seeds for a subduction zone observatory. We can expect another five magnitude >8 “great earthquakes” in the next five to ten years. There are about fifteen volcanoes in a state of unrest right now; we have no idea when or if each will erupt. We need arrays of seismometers and seafloor GPS, real-time gas sniffers, and rapid response collections of samples to catch events as and before they happen. When we have them, we're going to discover new phenomena, with repercussions we can't now predict.

In 1989, KLM Flight 867 was heading to Anchorage, Alaska, when it flew into Redoubt volcano's ash cloud, lost power in all engines, and entered a free fall for four minutes before regaining power. All passengers survived, but the aircraft sustained \$80 million in damage.

Let's just say it costs a fraction of that to monitor volcanoes in Alaska each year; yet monitoring funding continually gets cut. There are thirty-five historically active volcanoes in Alaska – two that have erupted this year. Thirty thousand passengers fly over Alaska volcano air space each day. For any of you who might fly from the United States to Asia, the flight path takes you over Alaska. Many of the active volcanoes have no monitoring equipment. The situation is worse for many other volcanoes in many other countries. My hope is that ten years from now, if you are flying to some fancy meeting like ours today, you will have a volcano forecast to check.

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Jay D Keasling

Jay D Keasling is the Hubbard Howe, Jr., Distinguished Professor of Biochemical Engineering at the University of California, Berkeley; Associate Laboratory Director for Biosciences at the Lawrence Berkeley National Laboratory; and Chief Executive Officer of the U.S. Department of Energy's Joint BioEnergy Institute. He was elected a Fellow of the American Academy in 2016.

I am deeply honored to be inducted into the American Academy of Arts and Sciences and to represent my fellow honorees in the Biological Sciences.

My experience with biology started at a very young age.

I was raised on a farm in rural Nebraska. My father grew corn and soybeans and raised pigs and cattle. As a young boy, every evening I came home from school to do an hour or two of chores: feeding cattle, watering pigs, laying out irrigation pipe. On Saturday afternoons, my father made me clean pigpens with a shovel. From the time I was eight years old until the time I was eighteen, I had the smell of pig manure on my hands. When I left the farm to go to college my father sold the farm because he had no one to

Biological engineering has had a tremendous impact on agriculture, but it has not yet solved some of the most important problems. . . . We've consumed our natural resources; we've polluted our water, land, and air; and people are needlessly dying because they can't get access to high quality, low-cost pharmaceuticals.

scoop the manure. So I had lots of practical experience with biology.

I was eight years old when the first genetic engineering experiments were published, and I remember reading a few years later about the founding of Genentech. I was fascinated by the potential to engineer life. Although I went to college with the idea of becoming a medical doctor, my first genetics course rekindled my fascination with genetic engineering and drove me down a completely different path, one I am still on today.

My area of research is biological engineering, or synthetic biology. My colleagues and I seek to create tools to manipulate biology in a highly controlled and reproducible manner and then use those tools to solve some of the world's most important challenges in human health, the environment, and energy. Our ability to engineer biology has accelerated by leaps and bounds over the last four decades since the advent of genetic engineering. We have sequenced a significant, but still small, fraction of the world's genomes. We can insert or delete genes in almost any organism. We can simulate biological systems on the computer and predict their behavioral responses to changes in their genomes. We can design and construct new genomes from scratch. We can build tissues and organs from a single progenitor cell.

In just four decades, biological engineering has had a tremendous impact on society,

and nowhere is it more evident than in agriculture. When I was on the farm in the 1970s, it was the height of chemistry's impact on agriculture. The seeds my father planted in the fields were hybrids created using traditional crop breeding and they were covered in noxious chemicals to keep rodents and other pests from eating them. Farmers sprayed other noxious chemicals on the crops from the tractor and from airplanes. And the pesticides and fertilizers leached from the fields and into the groundwater.

After I left the farm in the 1980s, genetically modified crops began to appear. Corn and soy were engineered to be resistant to relatively innocuous chemicals like Roundup and to be resistant to corn bores and other pests; many noxious chemicals were no longer needed. The amount of energy needed to farm decreased dramatically relative to that used in the chemicals era. Wildlife partially came back to the farm. And nationally, crop yields increased dramatically. We are now advancing into an era where microbiomes in the soil are being added or cocultivated with the crops to increase yields.

Biological engineering has had a tremendous impact on agriculture, but it has not yet solved some of the most important problems. One percent of the world's energy is consumed to make nitrogen-based fertilizer, largely for U.S.-produced corn. We spread a huge amount of phosphate-based fertilizer on the ground, with only a small

fraction actually going to crops, since it is not in a form that plants can take up. Weeds have acquired resistance to Roundup. And plants are relatively inefficient in photosynthesis and require large inputs of water. In theory, these challenges can be solved with biological engineering.

The world faces many other problems, problems created by our generation and the generations before us: we've consumed our natural resources; we've polluted our water, land, and air; and people are needlessly dying because they can't get access to high quality, low-cost pharmaceuticals.

Biology has the potential to solve many of these problems. We can engineer plants and microbes to produce renewable, carbon neutral, transportation fuels. We can engineer plants and microbes to clean up the environment. We can prospect the biological diversity of the planet for new drugs to diseases and produce those drugs affordably. And eventually we will be able to effectively engineer humans to eliminate genetic disease.

We need to know how organisms can survive and thrive in extreme environments. We need to know how the brain works. And we need to know how a changing climate will affect the growth and proliferation of all organisms on the planet.

This basic science does not need any other justification than curiosity itself. We are sometimes so focused on solving problems that we forget that the technology we have in our phones, our gas tanks, our medicines, and even our clothes was built on a foundation of basic science and serendipity. The United States has been a leader in its support of basic science and, in particular, basic biology. Unfortunately, our government does not always support basic science in a manner that will ensure that the United States remains at the technological cutting edge. We, as scientists and engineers, must be willing to speak with policy-makers and the public to help them understand the science and how some seemingly far-fetched pursuits could have unknown and outsized impacts.

embrace it and participate in a dialogue in an unbiased and meaningful way.

Through smart regulation and public support, biology will continue to be one of the most exciting areas of basic science, will continue to grow as a fraction of the U.S. economy, and will make the world a better place.

Again, I am deeply honored to be inducted into the American Academy of Arts and Sciences.

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We, as scientists and engineers, must be willing to speak with policy-makers and the public to help them understand the science and how some seemingly far-fetched pursuits could have unknown and outsized impacts.

But solving these challenges requires an understanding of basic biology. We need to know how cells grow and divide, how enzymes inside the cell catalyze reactions and build the basic molecules of the cell. We need to know how plants capture the energy of sunlight, fix carbon dioxide in the atmosphere, and turn that fixed carbon into more plant material. We need to know how microbes in the soil and in our guts interact with us and other multicellular organisms.

Finally, we need smart regulation of technology. The United States is one of the few places where biological engineering can be practiced, particularly for agriculture. We must not take that technological and scientific freedom for granted. Regulation lags far behind technology development, and the stakes are too high in biological engineering for something to go awry. Scientists should not shy away from participating in the development of regulation. Rather, we should



Andrea Louise Campbell

Andrea Louise Campbell is the Department Head and Arthur and Ruth Sloan Professor of Political Science at the Massachusetts Institute of Technology. She was elected a Fellow of the American Academy in 2016.

Thank you to the Academy for the opportunity to speak on behalf of Class III, the Social Sciences. I am honored to be elected to this esteemed institution.

To be an academic, especially a tenured one, is an incredible pleasure and privilege. But occasionally we fat and happy faculty get our comeuppance. Usually, from the expected sources:

- We lose an intellectual debate to a colleague.
- We face critiques from editors and reviewers.
- We encounter energetic young graduate students who reanalyze our data with new techniques and challenge our findings. (That's a good one.)

I never thought I would receive my comeuppance from the very programs I had spent years analyzing: from a car accident that rendered my sister-in-law a quadriplegic and

These are programs I had long studied but quickly discovered I really didn't know anything about. I could rattle off program parameters and statistics and technical terms. But I didn't truly appreciate what these program designs meant for people on the ground – how they shape and distort people's lives – until my own family members were enrolled.

plunged her and my brother into the world of means-tested programs in the United States, the “safety net” of social welfare programs.

These are programs I had long studied but quickly discovered I really didn't know anything about. I could rattle off program parameters and statistics and technical terms. But I didn't truly appreciate what these program designs meant for people on the ground – how they shape and distort people's lives – until my own family members were enrolled.

Four years ago my sister-in-law was on the highway in California on her way to nursing school when a hit-and-run driver caused her car to roll over, leaving her paralyzed from the chest down. She was pregnant. Fortunately, the baby survived and my nephew is now a healthy four-year-old.

But her disability and need for help with the activities of daily living meant enrollment in Medicaid, the health insurance program for low-income Americans. Why? She wasn't poor. But Medicaid is the only source of help for the long-term supports and services the disabled need.

Medicare, for which the disabled can qualify after a two-year waiting period, doesn't cover long-term supports. Private long-term care insurance is time-limited, not meant for those who need decades' worth of help. Plus my sister-in-law didn't have long-term care insurance: she was thirty-two years old. So Medicaid it was.

As a disabled person, she was categorically eligible for Medicaid. But because it is a program for the poor, she and my brother also had to become poor. That meant meeting Medicaid's income and asset caps.

They had to keep their income below 133 percent of the federal poverty level. That's \$2,100 per month for their family of three. Studies show that that's half the income needed for a “modest living standard” in most parts of the country.

And while about half the states no longer have an asset limit for Medicaid eligibility, California does. The cap for my brother and sister-in-law? \$3,150. Except for their home and one vehicle, their total financial assets could not exceed \$3,150. I should add: this cap was last adjusted in 1989.

So they had to spend down their modest bank account. My sister-in-law had to liquidate a small 401(k) plan from an earlier job – and pay the early withdrawal penalty. And as luck would have it, my brother's hobby was working on old cars; those had to go.

Their liquidated assets could only go toward the exempt items: the house and the wheelchair van they had to buy. They couldn't pay off their credit card bills, or college loans. Nor could I help them – well, not officially – lest I violate their income cap.

Here's my comeuppance. As a social policy scholar – I will never again use the term expert – I “knew” all this. I knew there were

asset and income limits. But I didn't fully understand the implications.

If you are a citizen – a citizen! – in need in the United States who is enrolled in a means-tested program, the government can tell you how you can spend your *own* money. The government could tell *me* how I could spend *my* own money. This offended the inner libertarian I didn't even know I had.

Then there are the incentives, or disincentives, built into the program designs. First, the disincentive to work: any money my brother made above their allowance of \$2,100 per month would simply go to Medicaid. So he rolled back his work hours in the face of this 100 percent marginal tax rate.

And the disincentive to save: my brother and sister-in-law can't do any of the things families are always told to do for financial security: Have an emergency fund. Save for college (a 529 fund counts against the asset test in California). Save for retirement (IRAs also count against the asset test in

them and fix the disincentives and Draconian parameters.

I hope in some less polarized future we can bring left and right together for reform. I believe there could be common ground. I'll leave it to the other political scientists to explain how we get to that less polarized future.

But in the meantime, I try to spread word of what I've learned. I now appreciate that we need to know more about the lived experience of poverty and the role government programs play. A number of my fellow social science inductees do wonderful work in these areas. The recent interest in inequality among scholars and the broader public gives me hope.

I now recognize the need for a multiprogram perspective. Academics and policy-makers tend to focus on one program at a time, but it's the interactions among programs that matter for recipients. The Obama administration proposed raising

I will sum up by saying that at the end of the day, we have to recognize that we're all needy. That is the deepest lesson I have learned. As University of Chicago health policy scholar Harold Pollack says, "We are all vulnerable. We have to take care of each other."

Thank you.

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I now recognize the need for a multiprogram perspective. Academics and policy-makers tend to focus on one program at a time, but it's the interactions among programs that matter for recipients.

California). Here it's worth noting the multitude of studies that show that outcomes for children – in education, economic mobility, criminal justice – are worse for lower income families. And among low-income families, they are worse for those with lower assets. And yet government programs for the poor force people to raise their children in a state of financial instability, fostering intergenerational poverty.

Conservatives might argue: if these programs are so terrible, we should get rid of them. Liberals might argue: no, let's reform

the asset cap on federal assistance programs like food stamps to \$10,000, which is wonderful. But for a recipient also on Medicaid in a state with a \$3,000 asset cap, the federal reform would be moot. We have to be more holistic in our analysis and policy-making.

We need to socialize the costs of catastrophically expensive risks like disability. The lifetime risk that each of us will be disabled or need to care for a family member who becomes disabled approaches 100 percent. Imagine if we had true, universal social insurance for these needs.



Theaster Gates, Jr.

Theaster Gates, Jr., is a Chicago-based artist whose practice includes space development, object making, performance, and critical engagement with many publics. Founder and Executive Director of the Rebuild Foundation, he is also Professor in the Department of Visual Art and Director of Arts + Public Life at the University of Chicago. He was elected a Fellow of the American Academy in 2016.

For the last couple months, I have been trying to simplify the way I talk to nonartists about the artist life and artist processes, and it seems there might be a few nonartists in this room. The words that I have come up with, that seem to sum up my practice, are three: love, administration, and iteration. I have been thinking about these words a lot.

Love, administration, iteration. I thought I would try to talk to you today about what I do in my studio, and what I do and see outside my studio, in relation to these three words. When you're a young artist, you are given an opportunity to be subject to crits (short for critiques). Basically you hang some work on a wall or you put some art out or you do a performance, and you give

When I start to look at the possibilities for artistic practice today, and I look at the kind of troubles that exist just outside of my studio, I think this is a moment when serious iteration is needed within our administration, and a tremendous amount of love is needed, especially in Chicago.

your peers and teachers in the crit – ten or fifteen of them, or even thirty to forty – permission to tell you how bad your work is. We can call that a kind of administration. People take turns, one after another, telling you it should have been black, it should have been blue, you should stick to photography and not change to video, you should stick to economics and not be a painter at all.

As an undergraduate or graduate student, you're in a process of iterating. In fact, at Iowa State, I started out in pre-pharmacy, and I moved from pre-pharmacy to urban planning. Already then I was understanding the importance of iteration, and that there was a way in which iteration was calling me to the University of Cape Town in South Africa. Two years after Mandela had been released, I thought maybe I could continue my studies of traditional African religion, sculpture, and space.

It was at the University of Cape Town that I started to really consider this idea of love and administration: That there was a way in which Mandela had so gracefully imagined that those years of sacrifice in jail had created a platform by which he could be not just himself, but a kind of symbol for the possibility of peace and reconciliation in South Africa. That, in a way, for me, Mandela had become the most beautiful work of art of that time, combining a symbolic life with a pragmatic life, a life of forgiveness. Mandela as a work of art, as a symbol of love.

Administration. When I left the University of Cape Town, I was bored, trying to fig-

ure out what was next. Slowly, my art career started to grow, but only alongside a full-time day job, because my parents were determined not to help me out. They were like, look, if you want to make it in this world, you're going to have to do it on your own. So my mom would quietly give me a couple hundred bucks every once in a while, and I would say, yes, dad, I'm totally independent. Love. Love and good house administration.

In those years, I found myself trying to grow my knowledge of urban planning and my knowledge of the city, while also advancing my knowledge of ceramics. I was a craftsman. I didn't consider myself a conceptual artist or a contemporary artist. I had my studio, but during the day, I had my bowtie on. I didn't wear a jacket today because now I get to be wholly an artist. I'm no longer a civil servant, I'm just a servant.

It was really the studio that helped me learn how to be a better administrator. In my studio, I could make a work of art, look at it from all sides, and imagine if it was working. If it wasn't, I could change what surrounded it, I could add to it, I could put it back in the kiln. I could glaze it and reglaze it. I could turn it on its head. I could let other people come to my studio and critique me until I didn't want to hear them anymore. I was engaged in acts of iteration. And when I start to look at the possibilities for artistic practice today, and I look at the kind of troubles that exist just outside of my studio, I think this is a moment when serious iter-

ation is needed within our administration, and a tremendous amount of love is needed, especially in Chicago.

Terry Plank spoke to us about how it's possible that we could track minor ruptures to predict a tremendous volcanic blow, that there is a kind of precursive possibility to this explosion. When I travel, people always ask me what I think about gun violence in Chicago, what I think about young black men killing each other, what I think about

ning says, no, they're zoned as two-flats and they're going to stay two-flats. Here is where I think an artist who practices thinking about the city, thinking about policy, has the ability to show an administrator in Detroit that if in two square miles of residential zoning there aren't enough people to fill those houses, maybe those houses could be repurposed for other uses. Or if there are huge tracts of vacant land in Chicago where there are homeless people and hungry peo-

ple can be something else. But it requires a tremendous act of love. When we enter policy through an act of love, we start to find new ways of exploring policy, of making more room for more people.

And so I'm convinced today that I am an artist. It took me a long time to be able to say that. But inside or outside my studio, the thing I'm most interested in making is a transformed world. My work is an attempt at making meaning. It's an attempt, like Mandela, to understand the possibility of the symbolic. Sometimes it includes paintings, but a lot of times it's about how you can use the creative process to change what's around you. I want to believe that beauty is a basic service, but I've found the only way you can get to that beauty is through a hell of a lot of work.

So I want to commend the Academy for allowing me to be a part of its membership. And I want to commend my cohorts, because artists are the amazing workers who convince the world and convince cities and their occupants that they can be beautiful, bold, and powerful again. I hope that I can be a part of that legacy. Thank you so much.

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As much as it might be a kind of vocation, urban planning has more to do with sculpture. Urban planning is, in fact, one's capacity to shape the city, and urban planners and scientists, like artists, are equipped with the tools whereby they might reshape their subjects.

police brutality and these travesties. Well I think that there might be ways we could get ahead of the volcanic explosion, by tracking these minor ruptures that are happening below sea level, below deck, below our houses, within the education system. And that requires a tremendous amount of care and administration. If the rupture destroys your equipment, if your equipment is water damaged, you have to commit to the next iteration of it. If for some reason my studio isn't working the way that I want, I'll start with a tar painting, I'll make another, and another, until I find myself with an iteration that I love. The same is true with the city.

There's a series of abandoned two-flat buildings in Chicago that could be transformed into a great series of cultural centers. No one lives on this block. But the Department of Planning can only see that the buildings are zoned to be houses, not cultural centers. Unwilling to administrate with iteration or love, the Department of Plan-

ple, surely there's a way, through love and administration and great iteration, those things could reconcile themselves.

What I've realized is that, as much as it might be a kind of vocation, urban planning has more to do with sculpture. That urban planning is, in fact, one's capacity to shape the city, and that urban planners and scientists, like artists, are equipped with the tools whereby they might reshape their subjects. The challenge is that no one has taught the planner, like they've taught the artist, that iteration is OK. No one has shared with the urban planner, with the public policy-maker, or with the elected official that it's OK to be creative, to identify when policies aren't working anymore, and to revise. Chicago is no longer the city it was when it was all wooden; it transformed to brick, and planners and policy-makers had to iterate. Now, maybe these empty postindustrial buildings could be something else, maybe these men returning from prison



Walter Isaacson

Walter Isaacson is President and Chief Executive Officer of The Aspen Institute. He was elected a Fellow of the American Academy in 2016.

Recent speakers for Class V (Public Affairs, Business, and Administration) have addressed broad and daunting challenges, such as my friend Darren Walker, who last year spoke on inequality, and previous speakers who discussed the breakdown of civil discourse, the loss of faith in our political institutions, and the decline of productivity and financial inclusion.

The challenge I wish to address today is more focused, but is also a contributor to all of these larger problems. It is that, after forty years, the Internet is broken. We broke it, we allowed it to corrode, and now we have to fix it.

There are bugs in the foundation, bats in the belfry, and trolls in the basement. The anonymity that is embedded into its transmission control protocols has poisoned civil discourse, enabled hacking, permitted cyberbullying, and made email a risk. It has prevented easy transactions, thwarted financial inclusion, destroyed the business

After forty years, the Internet is broken. There are bugs in the foundation, bats in the belfry, and trolls in the basement.

models of content creators, unleashed deluges of spam, and forced us to use passwords and two-factor authentication schemes that would have baffled Houdini.

The trillions being spent and the IQ points of computer science talent being allocated to tackle security issues makes it a drag, rather than a spur, to productivity in some sectors.

This talk is not intended to be one of those technophobic rants about the Internet rewiring our brains to give us the twitchy attention span of Donald Trump on Twitter, nor about how we have to log off and smell the flowers. Those qualms about new technologies have existed ever since Plato fretted that the technology of writing would threaten memorization and oratory.

Instead, I speak as someone who loves the Net and bemoans its decline.

The Internet began as a way for the Pentagon's Advanced Research Projects Agency (ARPA, now DARPA) to connect the computers they were funding at various research universities. The network was packet-switched, which meant that the information was broken up into little digital packets that were sent scurrying separately through the fishnet of network nodes by whichever path was at that instant most efficient. The packets were encoded with headers that told them where to go and how to rejoin with the other packets when they got there.

The universities were told to come up with a way to connect their big mainframes to the ARPANET's routers. So they did what research professors often do. They delegated the task to their graduate students.

As graduate students in the late 1960s, they tended to resist authority. The most ge-

nia, Steve Crocker, was designated to take notes, which he called "requests for comments," to indicate that this was a collaborative process with no hierarchy of control. That was cool. It's particularly cool that we're still doing it this way. The RFC process is up to number 7,900.

The architecture Crocker and company created was radically decentralized and distributed. Each and every node had equal power to originate and forward any packet. If a node got taken out or someone tried to censor things, the Net would route around it.

This has been explained as a survival mechanism against a Soviet attack. But I interviewed Crocker and his colleagues and they denied that this was the case. "We were grad students," they said. "Why? Because we were avoiding the draft and Vietnam. We weren't interested in helping the Pentagon create a military system."

Some of them wrote a letter to *Time* magazine explaining as much. *Time* was arrogant back then. I know, because I was there. The *Time* editors claimed to have a better source on the topic, and didn't print their letter.

Years later, when I was writing *The Innovators*, I went back to the *Time* archives to find the "better" source. And it actually was a good one: Stephen Lukasik, who was in charge of the funding for ARPA at the Pentagon. He said that of course the network was meant to survive a Russian attack; that was the rationale for getting the colonels at the Pentagon and members of Congress to fund it.

"You tell Crocker," he said, "that I was on top, he was on bottom, so he didn't know what was happening."

When I reported this back to Steve Crocker, he paused, stroked his chin, and replied: “You can tell Lukasik that we were on bottom and he was on top, so *he* didn’t know what was happening.”

So that’s how the Internet works. There is no central control or authority.

The separate but near-simultaneous invention of the Internet and the personal computer in the 1970s had a transforming effect on information flow not seen since Gutenberg. It meant that anyone anywhere could publish anything and get anything published from anywhere.

Those in this room may not understand the import. We all have plenty of opportunities – too many – to be published. But 99

percent of this country never had the opportunity to write or have their opinions disseminated until the advent of the Internet and its related services, such as Twitter, Facebook, Medium, and blog sites.

If people wanted to communicate and surf anonymously, they could. But those of us who choose, at times, not to be anonymous and not to deal with people who are anonymous should have that right as well.

percent of this country never had the opportunity to write or have their opinions disseminated until the advent of the Internet and its related services, such as Twitter, Facebook, Medium, and blog sites.

There was one fundamental trait embedded in the genetic code of the ARPANET, one that was replicated when Bob Kahn and Vint Cerf wrote the set of protocols that allowed the ARPANET to internetwork with other networks, thus forming the Internet. The packets were encoded or enveloped with their destination address, but not with their place of origin. With a circuit-switched network, you could track or trace back the origins of the information. Not with the Internet.

Compounding this was the architecture that Tim Berners-Lee and the inventors of

the early browsers created for the World Wide Web. It brilliantly allowed the whole of the earth’s computers to be webbed together and navigated through hyperlinks.

But the links were one-way. You knew where the links took you. But if you had a webpage or piece of content, you didn’t exactly know who was linking to you or coming to use your content.

All of that enshrined the potential for anonymity. You could make comments anonymously. Go to a webpage anonymously. Consume content anonymously. With a little effort, send email anonymously. And if you figured out a way to get into someone’s servers or databases, you could do it anonymously.

For years, the benefits of anonymity on the Net outweighed its drawbacks. People felt more free to express themselves, which was especially valuable if they were dissidents or hiding a personal secret. This was celebrated in the famous 1993 *New Yorker* cartoon, “On the Internet, nobody knows you’re a dog.”

Now the problem is nobody can tell if you’re a troll. Or a hacker. Or a bot.

A long, long time ago, John Finley strode this stage and tried to teach the wisdom of Plato. In the *Republic*, we learn the tale of the Ring of Gyges. Put it on, and you’re invisible and anonymous. The question that Plato asks is whether those who put on the ring will be civil and moral. He thinks not. The Internet has proven him correct.

Anonymity has caused a host of problems: We can’t trust email. I’ve now been involved in four hacks. I am no longer comfortable using email for anything of substance.

Our notions of privacy have been twisted. We oppose the right of the government to get into the iPhone of a mass murderer, we are appalled that the government might be monitoring the metadata of Internet traffic, yet we merrily read Colin Powell’s and Hillary Clinton’s and Sony’s email when the North Koreans, Russians, or private actors try to influence our movie preferences or political process.

We are inundated with spam. Every day I get four or five emails offering me breast augmentation. How many people open an email from an unknown address and are persuaded to have their breasts augmented? I don’t know. But if the Net is so good at personalization, why am I on these lists?

The Web is no longer a place of community, no longer an agora. Every day more sites are eliminating comments sections.

What are some solutions to these problems? If we could start from scratch, here’s what I think we would do:

- Charge a tenth of a penny for email. If you send twenty emails a day, you can afford the two cents. If you’re a spammer, you would have to think twice.
- Create a system that enabled content producers to negotiate with aggregators and search engines to get a royalty whenever their content is used, like ASCAP (American Society of Composers, Authors and Publishers) has negotiated for public performances and radio airings of its members’ works.
- Embed a simple digital wallet and currency for quick and easy small payments for songs, blogs, articles, and whatever other digital content is for sale.
- Encode emails with an authenticated return or originating address.

- Enforce critical properties and security at the lowest levels of the system possible, such as in the hardware or in the programming language, instead of leaving it to programmers to incorporate security into every line of code they write.

Most Internet engineers think that many of these reformations are possible, from Vint Cerf, the original TCP/IP coauthor, to Milo Medin of Google, to Howard Shrobe, the director of cybersecurity at MIT. “We don’t need to live in cyber hell,” Shrobe has argued.

DARPA, which created the first segment of the Internet, has set up a project to explore such possibilities. It is called Clean Slate. It asks what would we do if we could rebuild networks and computer systems from scratch.

It would be possible, they concluded, to build servers and host computers that used operating systems that defied or corrected security flaws that were in whatever software ran on them. They also came up with a plan, Active Authentication, that would provide various ways to securely identify any user.

People can be verified biometrically and by other means. Their communications and activity can be authenticated and certified. If they choose, they can allow only authenticated users so send them email, use their site, or get into their systems.

This could be done by having chips and machines that update the notion of an Internet packet. These packets could be encoded or tagged with metadata that describe what is contained in the packet and give the rules for how it can be used. It would then be encrypted and sent to another computer, which would not accept it unless the metadata met its standards.

Implementing some of these is less a matter of technology than of social will. Some civil libertarians will resist any diminution

of anonymity, which they sometimes mistakenly label privacy.

The best approach, I think, would be to try to create a voluntary system, for those who want to use it, to have verified identification and authentication of users.

People would not be forced to use such a system. If they wanted to communicate and surf anonymously, they could. But those of us who choose, at times, not to be anonymous and not to deal with people who are anonymous should have that right as well. That’s the way it works in the real world.

And the benefits would be many: Easy and secure ways to deal with your finances and medical records. Small payment systems that could reward valued content rather than the current incentive to concentrate on clickbait for advertising. Less hacking, spamming, cyberbullying, trolling, and the spewing of anonymous hate. And the possibility of a more civil discourse. ■

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To view or listen to the presentations, visit <https://www.amacad.org/induction2016>.

Educating Students Who Have Different Kinds of Minds

On October 9, 2016, as part of the Academy’s 2016 Induction weekend program, Temple Grandin (Professor of Animal Science at Colorado State University and a world-renowned autism spokesperson) discussed the education of students who have different kinds of minds, as well as her own upbringing and work experience as a woman with autism. An edited version of her remarks appears below.



Temple Grandin

Temple Grandin is Professor of Animal Science at Colorado State University. She was elected a Fellow of the American Academy in 2016.

Really great to be here! I’ll start out with a little bit about autism. Autism varies from Einstein, who had no language at age three, to a boy who can’t dress himself. Over the years, doctors have kept changing the diagnosis guidelines. It is maybe half science and half doctors squabbling in conference rooms in nice hotels like the Marriott and Hyatt. Nobody’s doing that with the diagnosis of tuberculosis. But with autism, you may have a kid who has normal speech, an awkward, geeky kind of kid, on the very mild end of the spectrum. A child’s brain can be either more thinking-oriented, or it can be more social-emotional. Some of these differences are just normal personal-

How about Thomas Edison? He was a hyperactive high school dropout. His teachers labeled him as “addled.” What would happen to a kid like that today?

ity variation. I’ve been out to Silicon Valley. Half of those programmers are on the autism spectrum. At some point you can get enough geeky traits to label it “mild autism.” With too much of the trait, you can get kids who struggle to function and may remain nonverbal. It’s a continuous trait with complicated genetics.

But what I want to talk to you about today is the educational system. I spent a lot of time reading biographies of great innovators who had unconventional educational paths. For example, look at Jane Goodall. I was really shocked to learn that she had a two-year secretarial degree. She was actually hired as a secretary by Dr. Louis Leakey before she started her famous study of chimpanzee social life in Tanzania in 1960. Jane had some difficulty remembering faces, and she liked the solitude of the woods. She went on to obtain her Ph.D. at Cambridge University without a bachelor’s degree! What would happen to Jane in today’s educational system? How about Thomas Edison? He was a hyperactive high school dropout. His teachers labeled him as “addled.” What would happen to a kid like that today? Well Edison patented the light bulb. How about Steven Spielberg? He was rejected from a top film school because he had poor grades. He was bullied throughout school and was dyslexic. What would happen to him today?

How about Elon Musk? He was always different, in a slightly nerdy way, and was severely bullied. You’ll see that bullying is something that keeps coming up. I was bullied in high school. It was terrible! And now they can bully you online, which makes it even worse. But Elon actually grew up in South Africa. He was exposed at an early age to mechanical things in his father’s shop; today, he’s developing rockets for space exploration. He has greatly reduced the cost of rockets through innovations with different kinds of valve seals. And you know what? Even if his Tesla electric car fails, he’s succeeded. He’s begun to change the car industry over to electric. But as a grade-school student today, would Elon get the same opportunities to develop?

Common Denominators of Success for Unique Minds

What were some of the common denominators of the paths these unique minds took? What helped them be successful? To start, they grew up in educated families. Even though Edison dropped out of school, he was in a house full of books, of all different kinds. They also had early exposure to career interests. And they learned how to work hard at an early age, which is a deficiency today with a lot of kids who are quirky and different. These individuals also

weren't overspecialized and they had mentors. I had a science teacher in high school who turned me completely around and got me motivated to study for the first time in my young life.

Jane Goodall was looking at chickens when she was five years old, trying to figure out how they laid their eggs. She was a good high school student, raised in a home full of books. She spent her time reading all about chimpanzees and other animals. Her favorite novels were *Dr. Doolittle*, *Tarzan*, and *The Jungle Book*. In her era in England, girls became secretaries. Dr. Leakey hired her as a secretary, but had it in mind to employ her as a chimpanzee researcher, and he mentored her. The rest is history.

Edison cleanly fit this model. He ran chemistry experiments as a child. He was exposed early to railroads and grain elevators. In fact, he almost drowned in grain at a grain elevator and he burned up the baggage car on a train. That didn't make the railroad real happy, but he was given the opportunity to make mistakes. He also worked as a newsboy (who would start his own paper) and he became a telegraph operator at age fourteen. He learned how to work.

And Thomas Edison asked questions, constantly. I used to ask lots of questions. My grandfather and grandmother used to live right over there on Memorial Drive, right next to the church, near Harvard Yard. My grandfather, John C. Purves, was the coinventor of the autopilot for airplanes. I asked endless science questions. Why do tides go in and out? Why is grass green? My curiosity met its match.

Elon Musk was a compulsive reader. He loved *The Hitchhiker's Guide to the Galaxy*, and he spent long hours at a local bookstore that let him just sit in there and read. Again, exposure to books and to skilled trades, through his father's engineering projects, drove his curiosity and focused his mind on work, without overspecialization.

Musk also traveled extensively outside of his native South Africa. Some of my very first trips to look at cattle facilities were overseas, and that totally changed my perspective. It's a big world out there, and Musk started getting to know it at a young age. And at eleven, he got a computer and taught himself programming. He was a hard worker. He sold the code for a video game to a magazine at age twelve. He tried to lease a space to open up a video game store, though he was too young to do that. In his twenties, he did really grubby manual labor and

what many photo-realistic visual thinkers struggled with: I absolutely couldn't do algebra. Didn't make any sense. I found other opportunities with math, but today, too many smart kids are getting screened out on account of the algebra requirement. Because they can't do algebra, they aren't allowed to substitute geometry or statistics, which they're more likely to understand.

We all suffer when we screen out brilliant visual thinkers. Think about the Fukushima Daiichi nuclear disaster: When the earthquake hit, the reactors automatically shut

These pioneers had early exposure to career interests. They learned how to work hard at an early age, which is a deficiency today with a lot of kids who are quirky and different. They had mentors. And they weren't overspecialized.

later got an internship at the Bank of Nova Scotia. Musk completed college, and went on to create PayPal. These creative people generally didn't follow a conventional educational path. These shared experiences are explored more in the books *Creativity in Science: Chance, Logic, Genius, and Zeitgeist* by Dean Keith Simonton and *The Geography of Genius* by Eric Weiner.

Three Different Kinds of Thinking

Our inventors had to have different kinds of minds. Different kinds of minds rely on different kinds of thinking. The three types are: photo-realistic visual thinking, pattern mathematical thinking, and verbal/auditory thinking. I'm a photo-realistic visual thinker. Everything I think about is recalled as a picture. When I was young, I assumed everybody else thought in pictures too. My book *The Autistic Brain* contains references to scientific studies that provide evidence for different ways of thinking. I struggled with

down, powering down the plant. The reactor core still required cooling, though, which required power – except the plant's backup generators, kept in the basements of the reactor turbines, were flooded by the tsunami that followed the shock. It was completely beyond my imagination how they could let that happen. It's not my area to design a nuclear reactor, but if I had been drawing up the plans for the concrete work, no emergency equipment would have been located in a non-waterproof basement. I would have looked at the design and visualized the water coming in. All they needed were simple watertight doors. But mathematical thinkers can't always see the mistake that way.

Mathematical thinking is usually pattern thinking, spatial visualization. Mathematicians, like musicians, tend to think in patterns, not in pictures. The verbal thinker, the person who thinks in words and meanings and who tends to also be an auditory learner, has totally taken over the domain

Different kinds of minds rely on different kinds of thinking. The three types are: photo-realistic visual thinking, pattern mathematical thinking, and verbal/auditory thinking.

of education. Conventional education today doesn't value nonverbal forms of thinking, and so some students hit dead ends. Though most so-called normal people are mixtures of these three kinds of thinking.

Parts of our education system today are just crazy. A few weeks ago, I had dinner with a general education third-grade teacher who got in trouble for teaching subtraction using borrowing, the old-fashioned way many of us were taught. I'm not suggesting we throw out some of the new ways of teaching math, but if some of these older or nonstandard methods are more inclusive of other kinds of thinkers, why can't we teach both? Also within the last month, I met with a whole bunch of college students, and not one of them could find the area of a circle. I design hydraulic and pneumatic equipment. You've got to be able to find the area of a circle! So I taught them old-fashioned practical math.

My mind works like Google Images. Put in a keyword, I get images. The HBO biopic showed that perfectly. At the Academy's Friday night program, when I was listening to that wonderful description of the owl and what it ate, I was seeing the mice and bones and all that stuff. It painted me a picture of how the owl lives. Whether you're building a Cargill plant or a Tyson plant, or you're building a nuclear reactor, or you're just making a consumer electronic product, you need all the different kinds of minds. Thomas Edison was not a mathematician. I think he was more likely a photo-realistic visual thinker, and he knew how important this was: "I can always hire some mathematicians, but they can't hire me," he said.

Overspecialization May Hinder Creative Problem Solving

I mentioned the danger of overspecialization. At a plant science meeting I was asked, "How can you justify eating meat?" I've been learning a little introductory crop science. Two years ago, our animal science department at Colorado State University invited a plant scientist to our cattle meeting. I learned something I didn't know: that the very best soils in Illinois and Iowa were created by herds of grazing animals. The grazing animal is a part of the land, so they have a place on our property or in our diet. We need to start getting the grazing animals back with cropland as part of a crop rotation system.

We've all seen overspecialization in medicine. I'm getting older, so I have to complain about my sciatic nerve and a bunch of other problems I've got, so I'll meet with friends to discuss all the stuff going wrong with us. One poor lady, within the last year, had a whole lot of nasty symptoms and went to a lupus specialist at a top medical center. And the lupus specialist did hive biopsies. I'm not kidding. Hive biopsies? Later, when she was down in Mexico, she got a rash, and the old Mexican doctor said: "Well, you just need to take some Benadryl." It turned out she was allergic to an ingredient in one of her medications. She got rid of the medication, took some Benadryl, and she was fine, no more symptoms. No hive biopsies needed; but the specialist could only see what he knew.

Isaac Asimov, the science fiction writer, once said: "A degree is the first step down a ruinous highway. You don't want to waste it so you go on to graduate work and doctoral

research. You end up a thoroughgoing ignoramus on everything in the world except for one subdivisional sliver of nothing."

At one of the Induction receptions, somebody told me that robots are going to replace people who fix power lines. I'm thinking, *BS!* I'll tell you what robots are going to replace: super-specialized doctors. Artificial intelligence is going to replace our super-specialized areas of knowledge. An AI expert quoted in *The Economist* noted that an AI system can read x-rays better than a doctor – but it can't do the doctor's administrative assistant's job! That job is much more variable.

Visual Thinkers, AI, and People with Autism are All Bottom-Up Thinkers

Artificial intelligence works from the bottom up. You train the program using specific examples of x-rays showing different types of problems. The program is told which x-rays contain pathology and which ones are normal. The artificial intelligence system then uses this knowledge base to diagnose patients. That is bottom-up thinking, and that's the same way people with autism think. Verbal thinkers are top-down thinkers, and they tend to overgeneralize. Education has gone crazy on grandiose top-down stuff that just doesn't work for many kids. A bottom-up thinker works like an epidemiologist. Epidemiologists solve food poisoning cases through observation – what was served, where was the food consumed, where was it prepared, where did the ingredients come from, who else suffered the symptoms – until they can piece together that, for example, the lettuce from a certain grower had *E. coli* on it. That's the bottom-up approach. Concepts are formed from specific examples.

I think bottom-up. What would happen to me today? I had no speech until age four. I would probably get into a good childhood early intervention program, which is something they're doing better now. If you

have little kids that are not talking? Once you rule out deafness, you've got to do twenty hours a week of one-on-one teaching. I was taught turn-taking with board games, and by practicing taking turns in conversation. I was severely autistic at age three and learned to talk when I was four. I would have been a prime candidate for video game addiction. What little bit of video game playing I've done has shown me it is a drug I absolutely cannot touch.

Today I'd also have fewer opportunities for hands-on learning at school, for developing art skills, and for work experience. Many schools have eliminated all the hands-on classes: cooking, art, sewing, and wood working. This is a horrible mistake. I loved sewing. In fourth grade, I had a wonderful little Singer sewing machine. Loved making things with it! And it taught me skills I later put to work. But kids aren't making things in school anymore, and they miss the chance to explore and use different skills or ways of working. The millwrights I worked with on my corral projects were really smart people who built, designed, and repaired complicated structures. They took welding in high school and it saved them. I know a guy who is dyslexic, ADHD, bad stutterer, and was a horrible student. In high school, he took welding and he now owns a metal fabrication company. I've got to keep some confidentiality so I can't tell you what he makes. But he is doing fine. Kids today aren't learning hands-on skills. Hands-on projects are important because they teach practical problem solving. We're missing that.

Instead of getting out and learning to work, fully verbal, quirky kids who are different get diagnosed with autism, ADHD, or some other condition, because you need a diagnosis now to get special educational services in school. This puts some families and kids in a handicap mentality, where they believe they *can't* work. Some moms over-protect their kids and they have difficulty

letting go and allowing their kids to get out and learn basic life skills. My mother knew how to stretch me and get me doing new things, starting out with being a hostess at her dinner parties at age seven. I saw a thirteen-year-old kid the other day, fully verbal, looked like a young man who should be on his way to Silicon Valley, but he had never even gone shopping on his own. He had never gone into a store, bought something, checked it out, and brought back the change and receipt. I was doing that at age seven. I tell parents and teachers: "Don't chuck 'em into the deep end of the pool, but you gotta stretch 'em just outside their comfort zone."

Helping Different Kinds of Minds to Learn

When I get a chance to try out all the new brain scanning equipment, I do. It's fun to play around with state-of-the-art equipment. But I have parents ask me all the time:

My mother encouraged me to draw lots of different things, to take what I was interested in and expand on it. Does your kid like trains? That's a real common one. Let's read about trains. Let's do mathematics with trains. Physics with trains. Broaden it out. Use that specialized interest to motivate learning.

"Do I need to get my kid's brain scanned?" No – you don't need a scan because both the kid's areas of strength and learning problems will show up in the classroom. And you can respond to what shows up, and work with those strengths. I've got a big visual-thinking circuit, and when I was in third grade, my ability to draw showed up. My mother encouraged me to draw lots of different things, to take what I was interested in and expand on it. Does your kid like

trains? That's a real common one. Let's read about trains. Let's do mathematics with trains. Physics with trains. Broaden it out. Use that specialized interest to motivate learning.

But I grew up in a different time. What helped me in my childhood journey? First, an educated family. Mother read books to us. We were brought up to have an absolute love of books and literature. She'd read us parts of Dickens, and she'd skip the boring parts. She always nurtured my interest and ability in art. I spent hours drawing and making kites and helicopters. And you know what? I recently tried to recreate one of those kites and it wasn't easy! I've got to experiment some more to get it to fly. Sometimes it takes trying to replicate things as a grownup to see the challenges you could take on as kid. The kites also taught me that I could make mistakes, and I could learn from them. A lot of kids today, they're scared to

death to make a mistake. They'll destroy work that's not absolutely perfect. A lot of my kites didn't work. When they didn't fly, I just had to try something else. I moved on and tried again.

My favorite book as a child was about famous inventors. I loved reading about Thomas Edison and the light bulb, Elias Howe and his sewing machine, Eli Whitney and the cotton gin, and the inventors of the first mechanical reapers. I also loved *Black*

Beauty, both the grownup version that mother read to us and my childhood version.

But how did a girl who lived outside of Boston, with a grandfather who lived on Memorial Drive, looking out on the Charles River, get into cattle? Mother remarried when I was fourteen. That brought a ranch into the family. I was attending the Hampshire Country School, a boarding school, and my mother wanted me to get out and try some new things so I wouldn't become too set in my ways. At age fifteen I went out to the ranch. I was afraid to go at first. But she gave me a choice: I could go for a week, or I could go all summer – not going was not gonna be one of the choices! She knew just how hard to push me. And I ended up loving it. On the ranch Aunt Ann helped me learn to build gates, to drive, and to type. And I could apply some of what I learned at the Hampshire School.

When I was away at the Hampshire School, I did very little studying. I learned carpentry; I learned roofing; I learned riding and horse barn management, all kinds of things like that. The headmaster realized I was learning how to work. But I did well in two subjects: biology and writing. I learned how to write because in fourth grade, the teachers marked-up my work in red pen; they copyedited it. That's not the practice today, but that's how I learned to write. Some kids learn diagramming sentences. That's not for me.

My work experience was varied; I didn't overspecialize. I got a sewing job in the neighborhood at age thirteen that allowed me to save some money and buy a few really ugly striped shirts that my mother hated and I loved – she'd "lose" them in the laundry. I cleaned horse stalls at fifteen, did roofing at sixteen. And I'm not suggesting roofing to parents of autistic children today. I'm suggesting learning how to shop. I'm suggesting maybe editing some video at the church office just down the street. Simple, harmless stuff – but real.

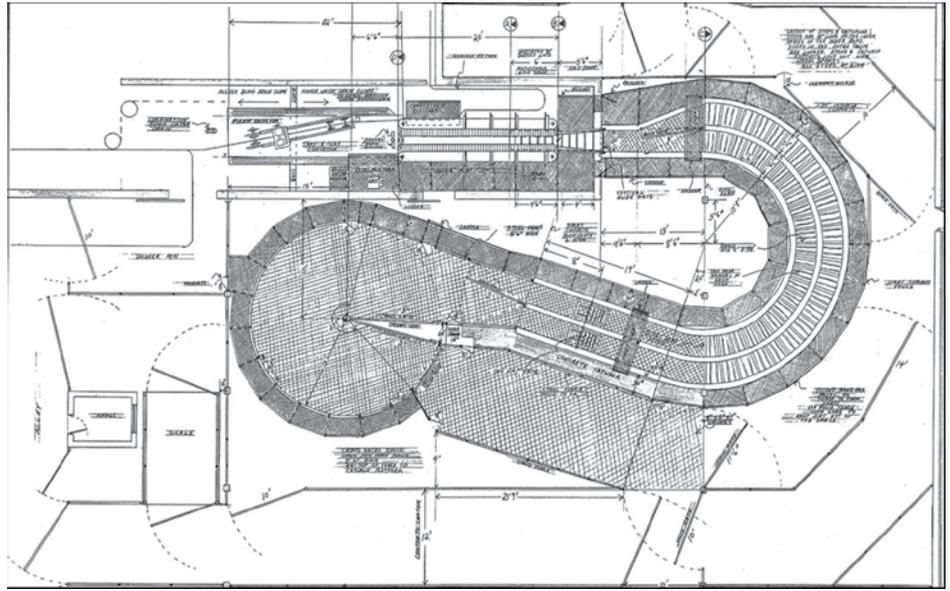


Figure 1: Early Drawing of a Cattle Corral

I was saved by finite math courses, especially statistics and probability. In 1967, algebra wasn't required for college. So with the help of my mother, who talked to the dean, I was accepted to Franklin Pierce College, which was only two years old at the time up in Rindge, New Hampshire. I was now motivated to study because I wanted to become a scientist. After I failed my first math quiz, wonderful Mr. Dion, a brand new math teacher, tutored me. (Back in those days, help to avoid failing a course was called getting tutored.) With a ton of work, I managed to get a B, as in *beautiful*, both semesters I took finite math. I entered college on probation and graduated second in my class.

What I really loved in college was animal behavior. I was lucky that a retired professor – and I think he was from Harvard, Dr. Tom Evans – came in twice a week to teach classical ethology. This was during the time of B. F. Skinner and the belief that operant conditioning explained everything. In Dr. Evans's class, I learned that animals have a lot of hardwired instinctual behavior. In an

other class, we could get into experimental psychology and optical illusions, which spoke to my interests.

Starting My Business

Yes, I was weird. So how did I start a business designing corrals? The meat industry had no academic barrier of entry; it was full of quirky people who had taken welding class or drafting class in school, and who were now building and designing things. I found a place there. How did I impress potential clients? By showing a portfolio of my work. I sold my work by showing off my drawings (Figure 1). When I would show people my drawings, they'd go, "You did that?" Couldn't believe it. I didn't have the money to advertise in farm magazines, but I'd write about my designs in articles for them. I also had a very nice brochure (Figure 2). They're how I sold Cargill on my designs. I sent Bill Fielding, the head of Cargill, the brochure, that drawing of my design, and a bunch of my photographs and articles. As a result, I eventually designed a front-end of

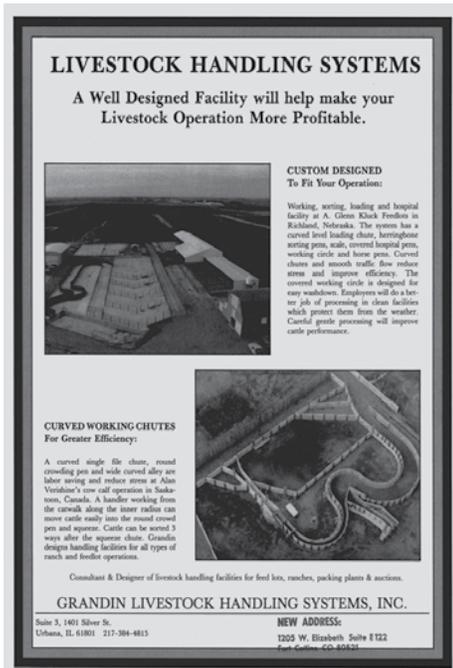


Figure 2: Grandin Livestock Handling Systems Brochure

every Cargill beef plant in the United States and Canada.

When I was young, I thought I could fix everything with engineering. If I could just build a perfect thing, it would all be fine. Then, in 1996, I was hired by the USDA to survey handling and stunning practices in beef and pork slaughter plants. I found that only 30 percent of the plants could shoot 95 percent of cattle dead on the first shot. You know why they were so bad? Busted equipment! Broken equipment. This is a management problem, a people problem; you can only fix half the problems with engineering.

In 1999, I was hired by the McDonald's Corporation to teach their food safety auditors how to audit animal welfare at slaughter plants. I developed a very simple scoring system using five simple, measurable outcome variables that were like traffic rules. They were 1) percentage of cattle stunned with a captive bolt on the first shot; 2) how

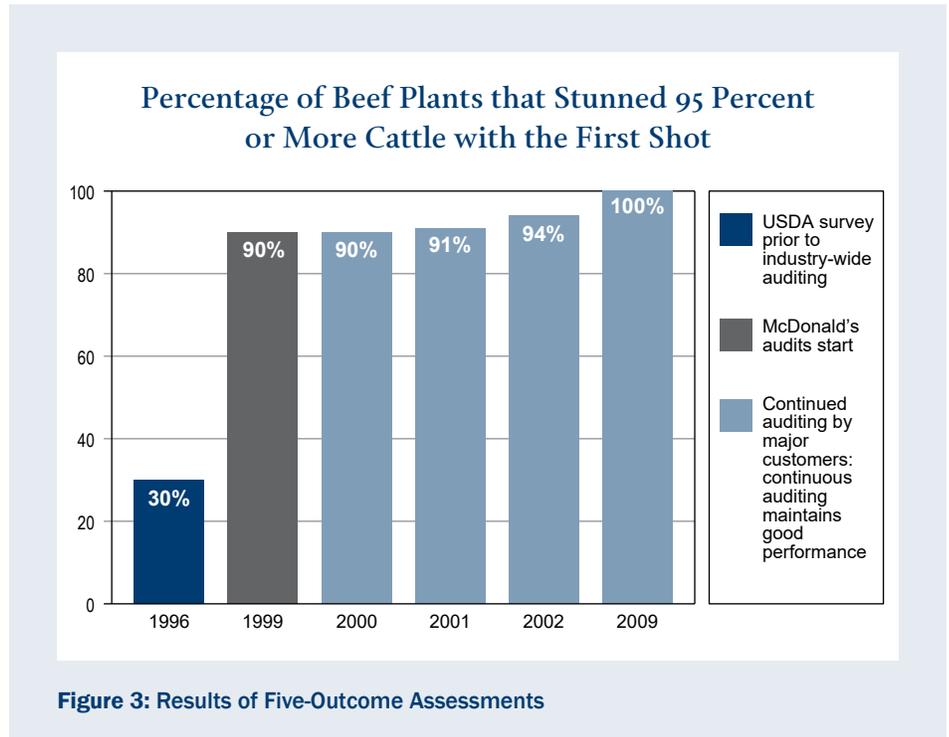


Figure 3: Results of Five-Outcome Assessments

many fell down during handling; 3) how many were mooing their heads off during handling, 4) how many you put the electric prodder on; and 5) they have to be 100 percent dead before you cut anything off. We went in there and first made them fix all the broken equipment – the busted side adjusters on my center track restrainer, broken hydraulics on my center track restrainer, and so on. Then we had them install nonslip flooring. We also worked with lighting: cattle don't like the dark, but if you put a light up in the right place, they'll go toward it. Out of the seventy-five pork and beef plants audited, only three had to build an expensive new front-end. With everybody else, we fixed the simple things: made repairs, installed lighting, put up a solid panel so the cattle didn't see people walking by. With these changes the plants very quickly and very dramatically improved their numbers (Figure 3). The average first-shot stunning

score in 2015 is about 99.7 percent. They can't get any better than that. And the one they miss, they immediately re-shoot it, because you automatically fail the audit if you hang the cow on the line alive. They needed these simple five-outcome scores to improve, not vague instructions to "handle cattle properly."

Different Kids of Minds Complement Each Other

Let's look at who does what in heavy commercial construction. There are the draftsmen, who usually get stuck in the basement service corridor with all the cable trays. They don't get enough respect. They aren't degreed engineers, but they lay out the whole plant, including all the complicated conveyor systems. In an airport, they'd lay out all the baggage conveyors. The millwrights, the weird guys in the shop, invent all the really intricate, interesting mechanical engineer-

Good collaboration requires different kinds of minds. . . . Sadly our education system is screening out kids who think in different ways. So the right people might not be there to work on tomorrow's projects.

ing equipment. The new stuff. And the degreed engineers, they'll do the more abstract work: boilers, refrigeration, steam pipes, soil compaction, roof truss calculation. But the thing is, you need the whole team. The roles complement each other, and you can't get the job done without each type of person on the team. So we've got to see to it that all kinds of thinkers can learn how to work, and learn the skills they need to succeed at work. Plant managers right now are going crazy because they can't find industrial mechanics. The trucking companies are going nuts because they can't get diesel mechanics. You think robots are gonna fix all these trucks? That's nonsense. Artificial intelligence might be able to diagnose some of the problems, but the industry needs these people. Don't underestimate what diesel mechanics can do. I've worked with a bunch of talented skilled trades people. Pretty sure most are on the autism spectrum or dyslexic.

Science fields are dominated by the more verbal and mathematical thinkers. You need that thinking to run a controlled experiment. But observation, the strength of visual thinkers, is a key part of science, too. Look at astronomy, which has always relied on the observation powers of the naked eye or observation through instruments. Look at epidemiology, which tends to begin with anecdotal reports. What Jane Goodall did was observation. At five years old, she went out to the neighbor's henhouse to figure out how the chickens laid their eggs. Observation doesn't get enough credit, but you'd struggle in the sciences without it.

Learning how my visual thinking is different and the ways it contributes in group projects has been an interesting journey. When I was in my twenties and thirties, I didn't understand that other people didn't think in pictures the way I did. I didn't understand that they couldn't see the visual mistakes like I could. But when I learned how my visual thinking was different from verbal thinking, it gave me insight into how different people's brains approach problem solving.

The first step of good collaboration in science or on any project is recognizing that there are different kinds of thinkers. I worked with a lady named Camille King, a fabulous dog behavior specialist. She observed that dogs get gray hair the same way that presidents do, and that it's the anxious, impulsive stressed dogs that got gray. We had a great statistician, our mathematical thinker. My part of the work was figuring out which photographs we should use for judging the different degrees of gray. There had to be clear categories of graying dog muzzles for us to get interobserver reliability. I did the methods part of the experiment and Camille did hours of work collecting data on many dogs. But we needed different kinds of minds to complete the research. One more example: iPhones. Steve Jobs was an artist. You don't need a Ph.D. in engineering to operate the phone because an artistic visual thinker designed the easy-to-use interface. The engineers just had to make the insides work. You needed both approaches to build a good phone.

Sadly our education system is screening out kids who think in different ways. So the right people might not be there to work on tomorrow's projects. There's two million people right now that have no electrical power because of Hurricane Matthew, and it's a lot of quirky, different guys who are gonna go out there after the storm and put those wires back up. Utilities are hiring right now. We can't afford to screen out students with unique skills who might succeed in these roles, or even reshape an industry. The world needs all kinds of minds. ■

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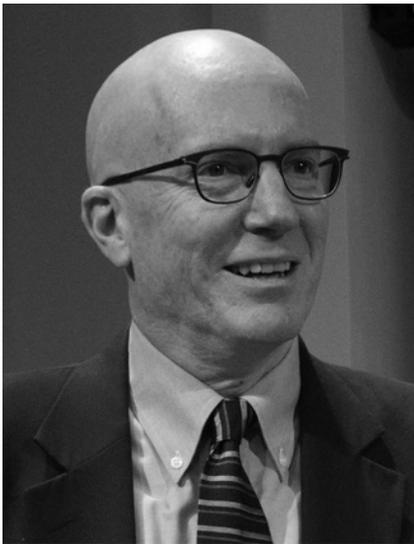
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Populism and the Future of American Politics

On November 10, 2016 – two days after the election of Donald Trump as the forty-fifth president of the United States – Charles Stewart III (Kenan Sahin Distinguished Professor of Political Science, Massachusetts Institute of Technology), Lawrence D. Bobo (W. E. B. Du Bois Professor of the Social Sciences, Harvard University), and Jennifer L. Hochschild (Henry LaBarre Jayne Professor of Government and Professor of African and African American Studies, Harvard University) discussed “Populism and the Future of American Politics.” The program, which served as the Academy’s 2045th Stated Meeting, was introduced by Jonathan F. Fanton (President of the American Academy). What follows is an edited transcript of the discussion.



Charles Stewart III

Charles Stewart III is the Kenan Sahin Distinguished Professor of Political Science at the Massachusetts Institute of Technology and the MIT Director of the Caltech/MIT Voting Technology Project. He was elected a Fellow of the American Academy in 2011.

Sometimes when you make plans several months ahead of time, you never realize what a great opportunity you’ll have. When we decided at the end of the summer to participate in this panel and to organize it around the theme of “populism and the future of American politics,” we had already experienced a presidential nomination process in which major candidates from each party

Donald Trump’s campaign provided very few specifics about how he proposes to address the underlying issues that made his populist appeal successful. If his policy proposals don’t show results in short order, has he unleashed a political force that even he can’t contain? In other words, could the future hold mainstream politicians who will be more Trumpian than Trump himself?

plugged into populist urgings, both from the right and the left. Indeed, even if Donald Trump had received one percentage point less of the popular vote on Tuesday in a couple states, leading to a different outcome, the arc of the general election confirms that we are in unsettled times in which populist appeals are quite powerful across the political spectrum.

We are meeting two days after the general election, with its stark outcome that will land Donald Trump in the Oval Office next January 20. Everyone in this room knows that his message was specifically directed at voters – and specifically white working class voters – in ways that appealed to anger over the long-term loss of jobs and status. The postelection analysis reveals that this appeal worked. We see it in the exit polls, and we see it in macroanalysis. For instance, in a posting today on fivethirtyeight.com, which I think is trying to redeem itself after a miserable season of primary predictions, the

economist Jed Kolko reported that the vote swing from Romney in 2012 to Trump in 2016 was greatest in counties where the economy is most likely to be based on routine tasks, such as manufacturing, retail sales, and clerical work – precisely the tasks that could be eliminated easily through automation.

This election reveals a lot about the mix of globalization, stagnating work skills, racial tensions, economic inequality, and the like. What it doesn’t necessarily reveal is what the future holds, both for policy and for politics.

As for policy, Donald Trump’s campaign provided very few specifics about how he proposes to address the underlying issues that made his populist appeal successful. If his policy proposals don’t show results in short order, has he unleashed a political force that even he can’t contain? In other words, could the future hold mainstream politicians who will be more Trumpian than Trump himself?

And there is of course the question of how Democrats respond to the fact that they are losing hold on a population that used to be a core part of the party constituency. The Democratic Party has largely embraced the new economy and globalization, and those who benefit from the new economy and globalization probably outnumber those who don't. The Democrats could wait it out. However, Donald Trump has shown that the intensity of appeals to those losing out to the new economy can beat a larger group that may be complacent.

But finally, of course, the appeal of Bernie Sanders to a significant portion of the Democratic base is also evidence that the genie is out of the bottle on the left, too. Is there a response in the Democratic Party that can appeal to disaffected voters on both sides of the political spectrum, or are we in an era in which distinct populisms will grow in response to a common set of political concerns?

There is a lot to be said on the topic of populism and the future of American politics, and I don't want to delay too long getting to our panelists, who actually know something about this topic. When we were thinking about how to focus our remarks this evening, there was a very good chance that the result of the election could turn on questions of election law and administration, which is one of the areas I work in. Donald Trump's repeated charges that the electoral process was "rigged" worried many of us in this field that the result itself would be contested, and that we would find ourselves today not knowing who the next president would be. For better or worse, that ended up not being the case, and all accounts suggest that Tuesday's election was pretty typical, as far as administering elections goes. So we can focus here on the meaning of the election from a substantive perspective, although issues of the legitimacy of the electoral process still linger.



Lawrence D. Bobo

Lawrence D. Bobo is the W. E. B. Du Bois Professor of the Social Sciences at Harvard University, where he holds appointments in the Department of Sociology and the Department of African and African American Studies. He was elected a Fellow of the American Academy in 2006.

I'm going to engage this topic as someone who's trying to finish a book on the question of postracialism in America, and I'm going to pivot off that possibility in most of my remarks here this evening. Prejudice and politics have been intertwined in the United States throughout my lifetime. Indeed, one could say the same thing about the full arc of the development and transformation of the United States of America over its nearly three-hundred-year history. Yet the current moment does feel like a time of deeply acute polarization and, unexpectedly, almost indigestible racialized divisions, political identity divisions, and ideological divisions. As we near the end of a second term for a popular African American president, having just elected as our next president a man who many believe ran an openly bigoted campaign, we're confronted with a

deep, puzzling question: how on earth did we get here?

The short answer is threefold: first, we've just experienced an electoral contest in which a billionaire Republican was able to more effectively cast himself as a champion of the lower, working, and middle classes than his Democratic rival; this was in part made possible, second, by the power of race and racial prejudice in our national politics and political discourse, and, frankly, third, by a sort of paralysis that comes about by the powers of the economic elite and fear of direct appeals to minority voters.

I want to begin by recalling for all of you the old term *Reagan Democrats*, and I want to read you a paragraph from the definitive book on the subject, *Chain Reaction: The Impact of Race, Rights, and Taxes on American Politics* by journalists Thomas and Mary Edsall. They were trying to understand why Republicans kept winning the White House, and, based on research by pollster Stanley Greenberg, they offered the following diagnosis:

These white Democratic defectors express a profound distaste for blacks, a sentiment that pervades almost everything they think about government and politics. Blacks constitute the explanation for their vulnerability and for almost everything that has gone wrong in their lives; not being black is what constitutes being middle class; not living with blacks is what makes a neighborhood a decent place to live. The special status of blacks is perceived by almost all of these individuals as a serious obstacle to their personal advancement. Indeed, discrimination against whites has become a well-assimilated and ready explanation for their status, vulnerability, and failures.

We might now just replace that word "blacks," or add to it "Mexican immigrants," and we've updated that analysis

to 2016. Surely, it will not surprise many of you here this evening, but America has neither shed nor, in my estimation, honestly confronted its legacy of racism or, more provocatively, white supremacy. There are deep, ongoing, and highly adaptive conditions of racism at the institutional, cultural, and individual levels that prefigure and play out in our national political discourse. I believe there are strong prohibitions against direct, honest discourse on this matter, and I hope tonight we can consider some of those. Scholars will surely look back on these times and observe, as philosophers of race Robert Gooding-Williams and Charles Mills

of appeals to black and minority voters. I'll come back to that at the end.

For most of the period from 1945 to 1973, as our economy grew, incomes grew for everyone, and the income gap between the most affluent and the least affluent in the United States actually shrank. A quite different story has characterized the post-1973 period, particularly the post-1980 era. Since the Great Recession, a disproportionate share of income and wealth has gone upward to the already most well-off segments of the population. A recent report from the Institute for Policy Studies emphasized that income disparities have become so pronounced that

Brookings Institution senior fellow William Frey have shown that 64 percent of the U.S. population could be classified as white in 2010. Between 2010 and 2050, that percentage is expected to steadily decline, with the United States probably becoming a majority-minority population by 2040. In fact, we hit one important benchmark five years ago, when the majority of new births in this country were children of color. Experimental research shows that when presented with evidence of these demographic trends, many white Americans tend to express a sense of threat from minorities and a greater emotional animosity toward them. They also begin to think, even more than they may have already, in zero-sum terms about opportunities and resources. Moreover, there's some experimental work showing that drawing attention to these demographic terms has direct political effects. Psychologists Maureen Craig and Jennifer Richeson found that experimentally manipulating awareness of this racial population shift increases white identification with conservative political ideologies and the Republican Party.

Enter Donald Trump. It should surprise no one that this nexus of conditions – sharply rising inequality and an increasingly acute sense of economic vulnerability for lower- and middle-income Americans, in the context of rapid population change as we transition from a solid majority white population to a nation without a clear ethnoracial dominant group – opens the door to a powerfully resonant blend of antimorality populism. But what role has partisanship played in the routine mobilization of race in our body politic?

If we were to go back to the presidential contest of 1956 or 1960, you would find that the major party platforms of the Republican and Democratic Parties contained largely similar language about issues of civil rights and race. Indeed, both parties, at that time,

As we near the end of a second term for a popular African American president, having just elected as our next president a man who many believe ran an openly bigoted campaign, we're confronted with a deep, puzzling question: how on earth did we get here?

have written, "It was the most postracial of times, it was the least postracial of times." I believe that only when we get beyond the fallacy of colorblindness and the distorting narrative of postracialism that we can hope to rise to a point of honest, clear-eyed engagement with how and why politics, prejudice, and polarization so often roil our democratic and collective lives.

In the brief time I have here, I want to draw attention to three points of contradiction: one, stemming from the tensions involving the conflict of simultaneous growth of income inequality and of ethnoracial diversity of the population; two, the tensions that arise from both deepening partisanship, on the one hand, and what has become the routine racialization of our politics, on the other; and three, this paralysis around the power of the economic elite, versus fear

America's top 10 percent of earners now make, on average, nearly nine times the income of the bottom 90 percent. Moreover, the top 1 percent of the population now holds a share of wealth roughly equivalent to that of the same population at the time of the onset of the Great Depression. For much of the past two decades, the real value of income stagnated for the middle-income distribution, and those in the lower quintiles actually saw their purchasing power decline. These economic trends have consequences: more and more Americans are experiencing a sense of serious economic vulnerability and worry that they're not going to be able to pass on better prospects to their children.

At the same moment, we've witnessed a sharp rise in the share of the population coming from Asia and Latin America, as well as other parts of the globe. Figures by

actively competed for the black vote, to a degree. So there is no necessary connection between partisanship and issues of race. Beginning with the 1964 election, however, the two major parties began to sharply diverge on issues of civil rights and race. Ultimately, the Democratic Party clearly became the party of the effective governmental enforcement of full citizenship for African Americans. With that came a sea change in partisan alignments. The South went from being solidly Democrat-controlled to largely Republican-controlled. Black loyalty to the party of Lincoln, once something you could take for granted, started to weaken during the Franklin Roosevelt and New Deal era, accelerated under President Kennedy, and vanished and

can to constrain the influence of Democratic voters, who increasingly are minorities. Not only is race thus increasingly aligned with voting by party identification, but political scientists and political psychologists have shown us that attitudes that we would characterize as racial resentments play an increasingly strong role in defining the meaning of those party attachments. The end result is what legal scholar Ian Haney López has termed “dog-whistle politics.” Given improved racial attitudes and the successes of the civil rights era, however, openly bigoted appeals are fraught with the risk of backfiring, at least if directed at African Americans (the same can’t yet be said of Mexicans, as we’ve just seen). But carefully crafted slo-

ing America back,” and then in 2016, we return to Reagan’s 1980 slogan, “make America great again.” The rhetoric of the Trump campaign is not some strange aberration, but merely the next iteration in a worrisome pattern and trend. The racially tinged reaction against the passage of the Affordable Care Act, the emergence of the Tea Party, the solidification of Republican intransigence in the House and Senate, must be read, at least in part, through a racial lens. Donald Trump’s openly bigoted demonization of those of Hispanic heritage, especially Mexican Americans, when he launched his candidacy would be astounding, except that it is of a piece with the long-standing practice of dog-whistle politics and tacit racial appeals. Trump merely exploited the vulnerabilities of the moment, and upped the ante. Those who underestimated the power of this appeal included sixteen major mainstream career Republican politicians, including some with otherwise bankable Republican political credentials and huge financial backing. Witness Jeb Bush. What is the bottom line? We inhabit a troubling moment of alignment of race, and racial-policy-related commitments, with basic party identities. This is not a healthy circumstance for our democracy.

My third and final point here is the paralysis produced by the power of an economic elite that is constraining political discourse, and fear of appealing to and mobilizing the power of minority voters. If I had to diagnose the current moment, I’d go back to where I started: somehow, a billionaire, who has a gold-plated toilet in his rooftop condominium in Manhattan, has a stronger appeal to poorly educated, working-class whites than a woman running as the head of the Democratic Party with some of the greatest egalitarian credentials in politics you might have. How does that happen? One explanation is that she wouldn’t go after Wall Street, at least not in the way Bernie

Race has always been an ingredient of American national politics. Its salience, explicitness, and centrality vary from one election cycle to the next, but it’s never been an irrelevance. We’ve got to forget this postracial fantasy.

was replaced by a near-complete capture – and I do mean that word capture – by the Democratic Party in subsequent years.

An unfortunate effect of these developments is that both major parties, to a degree, depend on racial division for their electoral success. On the one hand, then, in a context in which Republicans are content to completely cede the black vote, Democrats only need to do so much to expect black loyalty. After all, where are black voters going to go? So even under Obama, nothing you could construe as a truly strong minority or black agenda is articulated within the confines of major party politics. On the other hand, especially as the population changes, the Republican Party worries more and more about mobilizing its base, and doing what it

gans and rhetoric that play on underlying racial resentments and sensitivities has been a routine staple of Republican Party politics.

Thus, in Nixon’s 1968 campaign, we get the Southern strategy and “law and order” message. In 1980, we see Reagan launch his campaign for the White House in Philadelphia, Mississippi, where civil rights workers Andrew Goodman, Michael Schwerner, and James Chaney were murdered, with a speech calling for the enforcement of states’ rights. Reagan also frequently deployed the “welfare queen” stereotype, or later that of the “strapping young buck” using government-provided food stamps and welfare to live better than the rest of “hard-working America.” By 1988, we get Willie Horton. In 2010 and 2012, we hear chants of “tak-

Sanders did. Clinton's campaign was clearly afraid to say, "I'm going to represent you guys against these economic elites." That economic message just wasn't there, especially at the end, when her whole campaign was directed *against* Trump, and not *for* the rest of you.

The alternative is to say she failed to double down on the Obama coalition, recognizing that Obama got reelected in 2012 by hyper-black turnout, more than replacing the

intolerance. If anything, a two-term Obama presidency signals something important about the majoritarian character of the mass public at this point, underlying racial inequality and division notwithstanding, and the real ultimate closeness in the overall vote – and, in fact, Hillary won the overall vote. Second, the success of the Trump candidacy should worry us all the same, because it didn't implode. In this context of economic anxiety, rising inequality, popula-

We inhabit a troubling moment of alignment of race, and racial-policy-related commitments, with basic party identities. This is not a healthy circumstance for our democracy.

two million white votes he lost with two million-plus African American voters. And here's the thing that hasn't gotten much coverage to this point: in the upper Midwest states that Clinton lost – and I'm going to include Wisconsin, Michigan, and Pennsylvania – the entire margin of Trump's victory in each of those states can be accounted for by her lower black percentage vote, and lower black turnout, compared with Obama. I want you to think about that. As it turns out, despite what you might have read in the *National Review*, if Obama had gotten just his 2012 numbers, and Trump had exactly his 2016 numbers, Obama would have been elected to a third term.

It is not my intention to sound an unremittingly pessimistic note. If there are takeaways here, they are perhaps threefold. First, the current moment is best read as complex. Changes in our institutions and norms, and in the outlooks and attitudes of the mass of Americans, have been significant, and are not easily overridden or reversed. There are clearly contending political alliances out there. There's no single, overarching axis of

tion change, and enduring problems of racism and racial inequality, there's something there that needs to arouse real concern, and to be fought against with vigor, because it's not hard to envision scenarios in which this dangerous mix becomes even more divisive and volatile. Third, to reiterate the point I started on, race has always been an ingredient of American national politics. Its salience, explicitness, and centrality vary from one election cycle to the next, but it's never been an irrelevance. We've got to forget this postracial fantasy. The only way to make progress on racial issues is to face them directly and honestly. Assuming these inequalities, identities, and divisions are not there, or are somehow just willy-nilly and will naturally heal themselves, is a serious error, as Donald Trump just proved beyond all doubt. Thank you very much.



Jennifer L. Hochschild

Jennifer L. Hochschild is the Henry LaBarre Jayne Professor of Government at Harvard University, Professor of African and African American Studies, and former Harvard College Professor. She holds lectureships in the Harvard Kennedy School and Harvard Graduate School of Education. She is currently Chair of the Government Department. She was elected a Fellow of the American Academy in 1996.

As Charles mentioned, we had been toying with this topic for some time, and I had prepared two or three different versions of this talk. The one that I was developing systematically over the last week or two began with the challenge of – once Clinton wins the election – reincorporating those forty or fifty million Trump supporters, those voters we might think of as a populist population, and gaining their support for the new Democratic agenda, or at least their acceptance of the legitimacy of the new administration. I dropped that speech, for obvious reasons. Instead, like many of you, I've spent the last couple of days trying to figure out what just happened. And that's what I'd like to do tonight: aided by a little

As one of my students pointed out, in the end this is a partisan story. Some prominent Republicans said, “Never Trump,” and many Republicans may still have concerns about our next president. . . . Nonetheless, on balance: Republicans voted for Trump, and Democrats voted for Clinton.

bit of data, let's see if we can trace where this thing came from. Why did Trump win the election, but more broadly, what are the contours and elements of right-wing populism?

The first thing to look at is the turnout. As Larry just explained, turnout was down in 2016, and not just among black voters, according to the incomplete results that we now have available. We had an enormously engaged population in terms of interest and visibility, but for a bunch of reasons we could spend a long time studying, turnout overall was down a percentage point or two from 2012 – again, if current calculations hold up once all votes are counted. As Larry has also just told us, if turnout among parts of the population had been one or two percentage points higher in just a few states, the outcome would have looked different.

Setting aside overall turnout and focusing instead on vote shares among the candidates, the short version of the story is that in almost all population groups, the 2016 Democratic candidate, which is to say Clinton, won a slightly smaller share than did Obama in 2012. Consider that Trump had an enormous advantage over Clinton among whites with no college degree. Clinton received a much higher share of the black, Latino, and Asian American votes, but for all three groups, it was a slightly smaller share than Obama received in 2012. So her majority from these groups just wasn't great enough to win the states she needed. This is a major pattern in the data.

Finally, looking at the overall vote; as one of my students pointed out, in the end this is a partisan story. Some prominent Republicans said, “Never Trump,” and many Republicans may still have concerns about our next president. So we may see a lot more controversy in Congress than one would expect, given that the same party will control the executive and a majority in both houses. Nonetheless, on balance: Republicans voted for Trump, and Democrats voted for Clinton. (Independents did vote more for Trump than they did for Clinton, which was not the case in 2012.) So we have a big partisan story, along with a complicated demographic story.

Moving more deeply into the election results than voting percentages alone permit, I want briefly to talk through a series of potential explanations for the growth of U.S. populism, before spending a little time on how they combine. Note that here I am offering only suggestions of the kind of evidence you'd need for a serious, full-fledged debate, but it's a start.

Let's look first at the change in wealth distribution in the United States since 1984 for various segments of the population. From 1984 to 2005, the bottom quarter of the population, in terms of wealth holding, basically held their own, although they didn't gain any wealth either. Following the 2007 crash, the bottom quartile lost an enormous amount of its wealth, and it hasn't recovered any ground since 2013, the last year

for which we have data. The median wealth holder followed a similar script, with a slight rise of wealth up through the early 2000s, and considerable decline since 2007. The 75th percentile lost wealth in the Great Recession, but still ended up marginally better off in 2013 than in 1984. The 90th percentile also lost a little in 2007, but this did not offset their massive gains in wealth since 1984. Most dramatically, the 95th percentile has increased their share of wealth by about 90 percent since 1984, despite the 2007–2008 crash. So the median wealth-holders and the least wealthy Americans have lost the most since 1984, and especially since 2007, while the best-off have gained. (You could tell the same story about income, but wealth, in the long run, is a more important measure.)

There's clearly a class story here. A nontrivial fraction of the population, roughly half, are a lot worse off than their families had been four, five, or six years ago – and no better off than their parents had been – and there's no reason for them to think that they or their children are going to be any better off moving forward. That is frightening and infuriating.

Of course, there's also a race, ethnicity, and immigration story that must be parsed to understand the rise in right-wing American populism. These stories aren't identical, but they're all entwined in the Trump campaign and in this election in complicated ways. In the most comprehensive exit poll from the 2016 election, with about twenty-five thousand respondents in hundreds of precincts, for example, 70 percent of the surveyed population agreed that "Illegal immigrants working in the United States should be offered legal status," as opposed to "should be deported." If you believe these data, then, American voters are not flat-out xenophobic. Nonetheless, one-third of those who favor offering legal status to the undocumented still voted for Trump. Of the 30 percent of the population who endorse deportation, of course, a majority voted for Trump.

Other data show the same pattern: relatively high support for Trump even among those who reject his expressed views on Muslims, Mexicans, or President Obama, along with very strong support among those who share those views. Thus right-wing populism has not only a strong class story, but also a race, ethnicity, and immigration component.

There's a third possible explanation of right-wing populism: a focus on gender. We heard many challenges from Trump and his supporters about Hillary Clinton's looks, stamina, and capacity to be commander-in-chief. And you have all seen the bumper sticker, "Trump That Bitch," and the like. But rather than focus on Hillary, I

There's clearly a class story here. A nontrivial fraction of the population, roughly half, are a lot worse off than their families had been four, five, or six years ago – and no better off than their parents had been – and there's no reason for them to think that they or their children are going to be any better off moving forward. That is frightening and infuriating.

thought it would be more interesting to look at the broader question in the exit poll: "Does Trump's treatment of women bother you?" Seventy percent of American voters said yes, it bothers them; but of that group, 30 percent still voted for Trump. The remaining 30 percent of the whole were not bothered by Trump's behavior toward women, and unsurprisingly, the vast majority of them voted for Trump. This expressed unconcern about – or hostility to – gender equality is reinforced by Trump's strength among women voters, especially white women and even well-educated white women. That's remarkable.

Another possibility: is populism about distrust of government? A host of survey

questions might inform us: "Is the country on the right track or the wrong track?" "Do you trust the elites?" "Do you believe that public officials act in the interests of people like you?" "Do you think public officials understand the problems of people like you?" But more simply, let's look once again at the 2016 exit poll: "What are your feelings about the federal government?" Here respondents had four choices: "enthusiastic," "satisfied," "dissatisfied," or "angry." Only 6 percent of respondents said they were enthusiastic, and another 24 percent were satisfied. That means that three in ten voters were on the positive end of this spectrum – not a lot. Of this group, 20 percent voted for Trump.

The "dissatisfied" group, almost half, split evenly between Trump and Clinton. But a quarter of the population described themselves as "angry" – a strong word in a public opinion survey – and three-fourths of them voted for Trump.

We also have to look at context. One version of the story is that virtually every city voted for Clinton, and every noncity voted for Trump. That may not be exact, but it's a good starting point. This is a very old trope, the urban-rural, urban-suburban, big town–small town division. It goes back to Thomas Jefferson, it goes back to the Bible, it goes back to, I've been told, Gilgamesh, and it's more powerful now than ever in U.S. elections.

One way of understanding right-wing populism is, roughly speaking, that racism, sexism, xenophobia, and religious prejudice are embedded in the nature of class antagonisms: they are constitutive of contemporary populism in the United States and elsewhere.

But other contexts are equally important. Let's look at counties that went for Trump in the primaries of Super Tuesday. What we see in the data is that the higher the death rate among middle-aged whites in a county, the greater the share of votes that Trump got, compared with other Republicans. Increasingly, the high and perhaps rising death rate for adult whites is a consequence of alcohol use, obesity, opioids, suicide, and a variety of diseases that correlate with people living pretty terrible lives; people living in such communities are disproportionately Trump supporters.

The New York Times offered more context for the primaries by examining census data for characteristics of people residing in counties that supported Trump on Super Tuesday. High percentages of whites with less than a high school education; of people who identify their ancestry on the census as "American"; of mobile homes in the county; of "old economy" jobs, including manufacturing and retail jobs that are, as Charles mentioned, relatively easily automated or offshored; of voters who had supported George Wallace; of evangelical Christians and of native-born Americans – all had strongly positive correlations with support for Trump. Labor force participation rates went the opposite way: the higher the share of the population in that county who participate in the labor force, the less support Trump received.

With this sort of evidence, we can start to form a picture of counties with a high pro-

portion of Trump supporters: the counties are rural or at least not urban, economically depressed, and disproportionately comprised of residents who seem psychologically and interpersonally depressed as well.

At this point, I want to stop examining the data and reflect for a minute on how to make sense of what we're seeing. Anybody who's taken a history course knows something about the phenomenon of leftist populism. We typically think of William Jennings Bryan, though the 1890s Populist movement is a little complicated, given that "left" and "right" today don't quite mean what they did a century ago. Still, roughly speaking, we would identify the Populist movement of the American Midwest as a phenomenon of the left, much of which got incorporated into Progressive era and New Deal laws and policies. Huey Long was a kind of left populist; perhaps you could call Andrew Jackson a leftist populist, though only with regard to white Americans; there is a radical leftist populism in Greece today. We might include Bernie Sanders in this group, although it's a little hard to figure out exactly how to characterize him.

But setting aside complexities of the left, the point is that what we're seeing with Trump, like what we saw with George Wallace or Father Coughlin, is a right-wing or reactionary populism. It is not unique to the United States, of course – consider Brexit, France's Marine Le Pen, The Netherlands' Geert Wilders; and many others. Here is my final point; we need to think hard about

how to characterize the different varieties of populism.

One way of understanding right-wing populism is, roughly speaking, that racism, sexism, xenophobia, religious prejudice (and prejudice against sexuality and gender identity, although those were less salient in this campaign) are embedded in the nature of class antagonisms: they are constitutive of contemporary populism in the United States and elsewhere. Hostility to government, fears about the future, discouragement about the economic and employment prospects for myself and my family are causally linked to racism, sexism, and xenophobia. The logic here is: "Immigrants are taking our jobs, blacks are getting too much government money, and women are abandoning their traditional roles in society and the family – all of which is harming my family's and my community's situation." Simply: "My family is suffering *because* those Others have allied with government elites."

There's a second way of thinking about populism – and this is the slightly more benign version of Trumpian populism, if there is such a thing. In this version, racial, gendered, and xenophobic views are not causally linked to class-based populism, but rather are additive. You could remove the dislike of the Other, for example, without eliminating the core populist story of context and economic change. In simple terms, this would be: "My family is doing badly because of those government elites, *and* I don't want a woman or black or Muslim president."

In a third form of populism, race, gender, and xenophobia aren't a central part of the story. Populist fury is driven by class anxieties and antagonisms: "government elites, or Wall Street bankers, or pointy-headed academics are causing my family and my community to suffer and lose our economic security and mobility."

Finally, a fourth form of populism is more deeply leftist, in the sense of seeking to

unite rejection of racial, gender, religious, legal, *and* class injustice. The early stage of the 1890s Populist movement, for example, witnessed a racially egalitarian movement as part of the rejection of the gold standard and capitalist exploitation (though that stage died pretty quickly). Bernie Sanders was trying to create this form of left populism. In his politics, the blame for all kinds of inequality rests with elites, with the government, with an economic enemy not defined by race, gen-

outcome of the election had only eighteen-to-twenty-five-year-olds voted: it shows an almost uniformly blue land mass, with 504 electoral votes for Clinton, 23 for Trump. Now most members of that age group don't vote, and there are problems with this analysis, so this may not be an accurate portrayal of the youngest cohort of voters. And we don't know whether today's youth will retain their political liberalism as they age and become taxpayers, or if they will become

A crucial political question is how we understand the relationship between vilification of Others, or the Other, and mistrust of people who hold illegitimate political and economic power.

der, sexuality, country of origin, and so on. Put most simply: "My family and my community are doing badly because of powerful elites, and so are the families and communities of other Americans of different races/religions/legal statuses. We are all victims of the same injustice."

In short, a crucial political question is how we understand the relationship between vilification of Others, or the Other, and mistrust of people who hold illegitimate political and economic power. There's a very strong argument about necessary and causal links between populism and racism, at least in the United States – but history, political activism, and moral reasoning all suggest that some populist impulses can be accidentally supremacist, or not at all. The trajectory of the links that Trump on the one hand, and Sanders on the other, sought to forge in 2016 will ramify through American politics for at least the next decade.

I'd like to end on a less discouraging note. Is right-wing populism likely to remain dominant? Some of you may have seen the map from fivethirtyeight.com showing the

disillusioned, racist or xenophobic, economically discouraged and infuriated, or any one of the many things that eighteen-year-olds mostly aren't but sixty-year-olds often are. Still, this fivethirtyeight map does suggest the possibility of a genuine generational cohort change in which, sooner or later, people who grew up after 9/11, after the rise in immigration, and after the 2008 crash will be running our country. Perhaps if we can just hang on for another twenty-five or thirty years, it's going to get better. Thank you. ■

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

Global Warming: Current Science, Future Policy

On November 15, 2016, the Academy's San Diego Program Committee hosted a Stated Meeting at the Sanford Consortium in La Jolla, California. Veerabhadran Ramanathan (Distinguished Professor of Climate Sciences, Scripps Institution of Oceanography, University of California, San Diego) and David G. Victor (Director of the Laboratory on International Law and Regulation, and Professor in the School of Global Policy and Strategy, University of California, San Diego) discussed the state of the scientific understanding of climate change and the implications of this knowledge for the development of future policy. Gordon N. Gill (Chair of the San Diego Program Committee; Professor of Medicine and of Cellular and Molecular Medicine Emeritus, University of California, San Diego School of Medicine) moderated the discussion. The program served as the Academy's 2046th Stated Meeting. The following is an edited version of the presentations.



Veerabhadran Ramanathan

Veerabhadran Ramanathan is Distinguished Professor of Climate Sciences at the Scripps Institution of Oceanography at the University of California, San Diego. He was elected a Fellow of the American Academy of Arts and Sciences in 1995.

I just returned from a UN organized climate summit (COP-22) in Marrakesh, attended by many of the world's leaders. I participated as an appointed member of Pope Francis' Holy See delegation. In addition, I was cochair of an international working group that came up with a roadmap on

Carbon dioxide is probably one of the deadliest gases as far as the environment is concerned. Once that CO₂ is released, about 50 percent of it stays in the atmosphere for roughly a hundred years, and about 20 percent stays in the atmosphere for thousands of years.

how to keep global temperatures from rising more than two degrees. Our report was released for comments at Marrakech, and it was in support of the UN Paris Agreement of 2015, which set out a global plan to avoid dangerous climate change by limiting global warming to well below 2°C. The warming magnitude mentioned in this document is in reference to temperatures of the pre-industrial era (before 1800).

Let me begin with some background about climate change by using a familiar example. Most of our cars burn gas. What comes out of the tailpipe is basically carbon dioxide. Fuel is a hydrocarbon, so the carbon in the fuel combines with oxygen and becomes carbon dioxide. This is probably one of the deadliest gases as far as the environment is concerned. Once that CO₂ is released, about 50 percent of it stays in the atmosphere for roughly a hundred years, and about 20 percent stays in the atmosphere for

thousands of years. I'm confident that whatever James Watt's first steam engine emitted is still there. It doesn't go away, and that's the problem.

So from James Watt's time to 2010, we have emitted two trillions tons of carbon dioxide. Our best understanding is that each trillion ton warms the planet by roughly three-quarters of a degree. There is a three-fold uncertainty in any number I give linking emissions to global warming. At the current rate of emission, we are putting out about 40 billion tons of carbon dioxide every year. If the current growth of emissions continues unchecked, by 2035, we will have emitted the third trillion ton of carbon dioxide, and that's enough to warm the planet by more than two degrees, particularly since we are emitting other greenhouse gases. Because of the inertia of the oceans, it takes some time for the full effect. By 2030, I predict that the planet will warm by a degree

At the current rate of emission, we are putting out about 40 billion tons of carbon dioxide every year. If the current growth of emissions continues unchecked, by 2035, we will have emitted the third trillion ton of carbon dioxide, and that's enough to warm the planet by more than two degrees, particularly since we are emitting other greenhouse gases.

and a half. It has already warmed by one degree, and by the time you emit the third trillion the planet will be on its way to warm beyond two degrees. So the steep climate changes we are talking about are not a hundred years or even fifty years from now, but closer to fifteen to thirty years. For a past example of the planet warmer by a degree and a half, you have to go back to the Eemian Period of 130,000 years ago, and the warmth then was enough to raise the sea level by about 4 to 6 meters (approximately 20 feet). It likely took centuries to millennia for the sea level to rise by that amount.

So what does the warming mean for California? Every degree rise in the soil temperature – I'm using the Celsius scale – increases evaporation of moisture by somewhere between 7 to 15 percent. The soil eventually becomes dry if the increase in evaporation is not compensated by an increase in rainfall. And when the soil dries the trees dry and become combustible. These facts are well known. At this stage, you might logically ask, "How can you make a prediction fifteen to thirty years in advance?" Let me explain by showing you my track record. In 1980 – that was thirty-six years ago – I teamed up with a meteorologist, and we studied natural variability. We predicted that the carbon dioxide greenhouse effect would show up by the year 2000. As some of you may know, this prediction was verified in 2001, when about two thousand scientists concluded that they were seeing a discernible warming in the temperature record, which was good news for climate science but not good news

for the planet. But as you know, science is judged by the predictions it makes.

So how does the carbon dioxide warm the planet? Since the gas stays in the atmosphere for centuries, it has covered the entire planet like a blanket. One of the first persons to document this was David Keeling, whose recording of carbon dioxide at the Mauna Loa Observatory first alerted the world to the buildup of carbon dioxide in the atmosphere.

We see CO₂ everywhere, and we take measurements in the Arctic and Antarctic, Pacific Ocean and Indian Ocean. There's no place on the planet that is not polluted with carbon dioxide. As I said previously, it covers the planet like a blanket. And just like a blanket that warms you by trapping body heat, this is exactly how CO₂ works: it traps the infrared heat emitted by the surface and the atmosphere. But how do we know how much heat it traps? The answer basically follows from the quantum mechanics of the CO₂ molecule. The carbon atom is in the center, surrounded by two oxygen atoms, which vibrate back and forth around the carbon atom. This vibration is what heats the planet. Arrhenius, the famous Swedish Nobel laureate, made the first prediction 110 years ago that a warmer planet would be more humid. The increase in humidity would cause the rainfall to be more intense with many more floods. All of this was predicted.

Until 1975, we thought carbon dioxide was the only manmade greenhouse gas. I was not studying atmospheric science then. I was not

a meteorologist. I was working on the greenhouse effect on Venus. At the time, I was researching chlorofluorocarbons (CFCs), which were used as a refrigerant, and my discovery somewhat shocked the community. I found that one ton of CFCs has the same warming effect as more than 10,000 tons of CO₂. The previous year, two chemists – Mario Molina and Sherwood Rowland, both at UC Irvine – published an article that claimed that CFCs were chemically damaging the ozone layer. Because of the effect on the ozone layer, the Montreal Protocol, which was really ratified during the Reagan administration, banned CFCs. However, the Montreal Protocol did not recognize my work on the global warming potential of CFCs. As a result, CFCs were replaced by hydrofluorocarbons (HFCs), which are a thousand to four thousand times more potent than CO₂. But finally, forty-one years later, on October 16, 2016, the Kigali Amendment to the Montreal Protocol banned HFCs because of their greenhouse effect – and this was the first ratified, legally enforceable treaty that recognized the greenhouse effect of non-CO₂ gases. I had to wait for forty-one years for my discovery of the super warming effect of halocarbons (CFCs and HFCs) to be recognized.

The discovery of the greenhouse effect of halocarbons opened a Pandora's box, and numerous other manmade non-CO₂ greenhouse pollutants were discovered. Among them were the super pollutants (that is, much more potent than CO₂): Methane; Ozone, HFCs, and black carbon. Black car-

bon is an aerosol (particle) and it warms the planet by trapping sunlight (not infrared radiation as in the case of greenhouse gases). These four super pollutants are called short-lived-climate pollutants (SLCPs) since their lifetimes in the air are very short (from a week to a decade) compared with that of CO₂.

Many people think we can see an immediate effect if we decrease CO₂ emissions, but because of its long lifetime in the atmosphere, it will take thirty or forty years. How will the president of the United States explain to his citizens that they have spent a lot of money to cut CO₂ emissions, and they will not see anything for thirty or forty years? Well, with the short-lived pollutants (SLCPs), you see the effect immediately. Here California can serve as a model, a type of living laboratory. If California's pathway for reducing carbon dioxide and the short-lived pollutants is followed by the rest of the world, we can keep the warming under

The steep climate changes we are talking about are not a hundred years or even fifty years from now, but closer to fifteen to thirty years.

safe levels. California is going to ban the black carbon emissions from diesel vehicles. And now the United Nations – in fact, then Secretary of State Hillary Clinton began this – has started a coalition to cut the short-lived pollutants.

Let me come back to the report we released at Marrakesh. My cochairs for this report are Mario Molina (a Nobel laureate in chemistry) and Durwood Zaelke (an environmental lawyer), with a team of thirty that included David Victor, diplomats, people from the military in the United States and India, and scientists from China and all of the EU countries. We followed a strate-

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gy with four building blocks. The first one is the Paris Agreement, which David will talk about shortly. The second building block is the sister agreements, and I mentioned an example previously, which is the Kigali Amendment to the Montreal Protocol. Other examples include two other major agreements to reduce emission from aircrafts on ships. The third one is an effort called Under2 MOU (Subnational Global Climate Leadership Memorandum of Understanding). California Governor Jerry Brown spearheaded the effort to get 156 jurisdictions to sign onto the agreement, including ten cities from China alone. The

that is already up in the air; and the current cost of that can be as high as \$100 a ton. Society will have a huge price to pay if we don't take action in the next four or five years.

In my work with the Pontifical Academy of Sciences, I have been calling for an alliance between science, religion, and policy. I have been in the Pontifical Academy for ten years; Pope Saint John Paul elected me. It is a small academy with eighty members, and about 30 percent are Nobel laureates in biology, physics, and chemistry. So you might ask, what business does religion have in science? In fact, in the case of the environment, science and religion seem to want the same thing. Science calls it protecting nature; religion calls it protecting creation. So there is that commonality, and we are trying to take advantage of that.

Let me conclude with a final point. I am working closely with all ten campuses of the UC system, and with our president, Janet Napolitano. Starting this spring, we will be offering an undergraduate course on climate solutions. Our goal is to branch out to other four-year colleges – we have already started conversations with CSU – and two-year colleges, and then take it nationwide. We want to train a million climate warriors armed with knowledge of solutions. And then we want to reach the K-12 level. I have teamed up with the dean of education at UCLA, Marcello Orozco, and we are planning an education summit in the fall. So, I'm optimistic together we can solve this problem in time.



David G. Victor

David G. Victor is Professor in the School of Global Policy and Strategy at the University of California, San Diego, and Director of the Laboratory on International Law and Regulation.

I've been asked to talk about policy around climate, and I'm going to focus on three things. First is the evolution of international policy strategies on climate change. Fundamentally this is an international issue – not just because most of the pollution that causes climate change mixes in the global atmosphere, but also because cutting emissions probably will be expensive and thus affect the competitiveness of national economies. Nations – as well as cities and many other units – have shown that they are willing to do a lot. But they probably won't get anywhere close to zero emissions – which is more or less what's required to stop warming – unless countries have confidence that other countries with which they are competing economically in the global economy are also doing something.

Globalization for the most part is going to make this an easier problem to address because it has radically accelerated the speed

This is an international issue – not just because most of the pollution that causes climate change mixes in the global atmosphere, but also because cutting emissions probably will be expensive and thus affect the competitiveness of national economies.

with which technologies move around the global economy, and that means that new ideas, such as new low-emission technologies, are going to get adopted quickly in all corners of the world. When I travel, I like to visit power plants and refineries. I look at who built the plant and I talk to managers about the factors that affect the operation of their facilities. And it really struck me that twenty years ago or so when I started visiting power plants in all corners of the globe, what you would see on an Indian power plant was an Indian nameplate, and you would see on a Chinese power plant a Chinese nameplate, and the same in an American power plant, and on and on. Today, when you visit the best plants or the best industrial facilities almost anywhere in the world, you see the best nameplates and best technologies adopted very quickly. So globalization for the most part is going to make the problem easier to solve. But one of the ways in which it's going to make it much harder is the extent to which countries are attentive economically to the effect of regulation on economic competitiveness, growth, and jobs. Certainly we saw some of that in the last election and it makes them very nervous about whether other countries are doing their part, so I want to talk about how you organize international cooperation in this area.

From the early 1990s until just a few years ago, the answer was that we didn't do it very well. We had a series of international agreements that had essentially no impact on the emissions that are actually causing the cli-

mate change problem. We had the Kyoto Protocol, which the United States didn't join, but when you actually look closely at whether the Kyoto Protocol had an impact on emissions, the answer was essentially no. The Paris Agreement, the framework set up almost exactly a year ago in Paris, has a very different and new approach and one that is poised to be dramatically more effective than the earlier efforts. This is true for a lot of reasons, but I think the central reason is that it's much more flexible and decentralized. It relies on countries making their own pledges and, in the months leading to Paris, 185 countries made those pledges. What's really interesting is that when you look closely at the pledges, every country has a different strategy, because every country has a different set of national priorities and capabilities. They're thinking about how climate change is going to map onto what they're trying to do at home. The Chinese strategy and, now, increasingly the Indian strategy are very much focused on how do they control local air pollution and a variety of other things that are urgently important but also happen to reduce emissions of the pollutants that cause warming. Here in the United States our strategy is different, and the European strategy is different yet again. Brazil's strategy is focused on the area where Brazil has had the highest emissions, which is around deforestation. They've made extraordinary progress over the last decade or so in part because outside funders, Norway and others, have helped them find and fund new solutions.

What makes climate so difficult from a policy point of view is that the topic is intrinsically highly decentralized, and it's impossible to imagine how you could create a single integrated treaty system.

What's smart about the Paris approach is it decentralizes this process of countries setting their own commitments, making pledges, and then periodically reviewing those commitments and those pledges. It's a very different approach than what we see in many other areas of international environmental cooperation, which are much more integrated. The Montreal Protocol that Ram mentioned is a tightly integrated treaty system that initially focused on one or two classes of pollutants, and then, as diplomats and firms gained confidence in how to regulate those pollutants they added still more pollutants to that same, integrated core. What makes climate so difficult from a policy point of view is that the topic is intrinsically highly decentralized, and it's impossible to imagine how you could create a single integrated treaty system. Instead, what diplomats have learned the hard way over the last twenty-five years is that they needed to decentralize these activities and give countries more flexibility to figure out what's going to work in their own contexts.

I'm extremely optimistic that this is going to work. I wrote a book, *Global Warming Gridlock*, that explains why most of the things we've tried to implement with climate change haven't worked very well, because the problem is, structurally, a very difficult one to address. One of the core arguments in that book is that the diplomatic effort would continue to fail unless it decentralized the process more and relied more on national commitments. That model is now being followed with the Paris Agreement.

The second of the three things I want to talk about is our expectations. It's really im-

portant when we think about climate policy to keep our expectations grounded in reality of how quickly this process can unfold. And I want to concentrate briefly on two areas where I'm most concerned. One of them is the goals. This is a disagreement that Ram and I have been having since Charlie Kennel at Scripps and I wrote a paper in *Nature* more than two years ago that said that the goal of stopping warming at two degrees was impossible to achieve. When I look at this from the point of view of a political scientist who studies technology and regulation, I don't see how you get to two degrees. It's not that I can't imagine all the levers being pulled – I was a coauthor on the paper with the three levers that Ram described. But what I have a hard time seeing is how you pull the levers fast enough and hard enough in order to really stop warming at two degrees. I think we need some sobriety around how quickly we can actually stop this warming both from a policy point of view and in terms of how the energy system changes, because historically the energy system needs about three or four decades if not longer to completely turn over the technological base.

The problem, of course, is that the time horizons needed for change in the energy system are a lot longer and move more slowly than the rate of change that many climate scientists say will be needed. That's the brutal political reality of this problem.

If there's any simple prediction that a political scientist can make studying the climate change issue, it is that society as a whole will under-mitigate emissions and will therefore be forced to over-adapt. That is, compared with a society in which a be-

nevolent, all-knowing person is in charge, the real society in which we live will not make adequate investments in a timely enough way to control emissions. This will therefore force us and our successor generations to adapt to the effects of climate change that will be greater than what would be socially optimal. That brutal political truth reflects that the problems of controlling emissions and adaptation to climate impacts have a very different political structure. Controlling emissions require that countries cooperate on a difficult problem over many decades, implementing expensive policies in order to make a difference. The benefits of this action are far into the future; the costs are diffused and visible today. By contrast, if societies wait recklessly for climate impacts to be apparent then the benefits of action are more visible and accrue locally. If you build a sea wall, the jobs accrue locally. The concrete is bought from local firms. And so, as a general rule, I think we're going to see a global strategy that will under-mitigate and over-adapt.

The other area where I think we need to keep the right expectations is the balance between what's going to be done globally in institutions like the Paris Process, which has an official meeting underway in Marrakesh right now, and what's going to be done in other groups. Even as the wheels of global climate diplomacy grid on, there are more focused groups of countries working on specific pollutants – as seen in recent weeks with the Kigali Agreement to the Montreal Protocol. I spent a lot of time in Norway, working with the Norwegian government to develop a strategy to regulate soot in the Arctic region. In the Arctic, all you need are ten or eleven countries, maybe not even that, working hard on soot pollution to have an enormous impact on the pollution that ends up in the Arctic. So what you see right now is a shift between talking globally and being friendly to everybody glob-

ally. Most of the real progress in managing the climate problem, however, is occurring in places that are focused on specific pollutants or in very small groups of countries where the cost of organizing that group and implementing policies is much lower than the cost of working in a group of 185 countries. The Paris Process offers an umbrella under which many more focused efforts can flourish.

The last thing I want to talk briefly about is the unavoidable topic of Trump. The man has become like a national Rorschach test for your view of government. Some people see in him a successful businessman who is on television and who is out there getting things done – he is going to fix the problems that they see in society and tell it like it is. Other people envision a horror show for all manner of public policies, protection of minority rights, and so on. And that Rorschach test in some sense is playing out right now with climate. The last six days since his surprising victory have been extraordinary. I've spoken with thirty or forty reporters from around the world – the shock here in the United States has been palpable, but that shock is reverberating around the world.

How do we make sense of what the Trump administration will do on climate policy? I think the areas of greatest harm of the Trump administration are going to be in the places where the president has the most immediate leverage, which is not domestic policy. Almost all of the significant domestic policies that affect our emissions are beyond easy control of a president. Most of these national policies are written into statute or in finalized administrative rules that are difficult to reverse. But the place where the president can have a big impact – what's already being felt in Marrakesh – is on international policy, where stopping the flow of international funds is going to have an immediate effect on U.S. credibility. The Paris Agreement, we have to remember, is not a

single event but a process in which they settled on what was agreeable and then left all the details, like how this pledge and review process are going to work, for later. It requires countries to step up and say, "Here's how we're going to do it." The United States was in a position to do that along with some other countries, and I think we're probably not going to play that role now.

To me, one of the most interesting things is that I suspect the Chinese will fill the vacuum. The government of China has become much more comfortable talking openly and internationally about its climate policy and

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about its efforts to control emissions. The architecture of the Paris Agreement in many respects is one created by the United States and China together when the leadership of our two countries jointly announced our pledges to cut emissions about a year before the Paris Agreement came into effect. With the Americans off the scene, I think you're going to see the Chinese play a much bigger role, and this could actually end up being a kind of watershed event for how the Chinese see their engagement with global institutions.

I want to close with a couple of observations. Everybody has been talking about the negative impacts of the Trump administration on climate policy, and I do think we need to worry about the discourse around climate change policy. When polarizing figures are in power the entire debate becomes highly polarized – are we in favor of climate policy or opposed to climate policy – whereas the most serious debates that we

need to have, especially inside the university, are about how do you design the policy? What really works? Do these efforts to try and stop pipelines have any impact on emissions? The short answer is no. They're completely symbolic activities.

So I think climate policy is going to take a hit in the Trump administration. There's no question about it. But we have to remember that there's a tremendous amount of inertia in the system. There are other countries willing and able to step up and replace U.S. leadership on this issue – even China, which traditionally has not really been a leader in

the sustenance of international institutions. We have to remember that technological change continues, and to me, as someone who studies energy and energy markets, it's just extraordinary how much is changing in the direction of new technologies that have reduced costs for controlling emissions. I think this is going to make the problem easier to solve over time. But it won't automatically make it possible to stop climate change quickly – the world is in for big changes. ■

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

A Collective Moral Awakening: Ethical Choices in War and Peace

On November 16, 2016, at the Huang Engineering Center at Stanford University, **Scott D. Sagan** (Caroline S. G. Munro Professor of Political Science, Mimi and Peter Haas University Fellow in Undergraduate Education, and Senior Fellow at the Center for International Security and Cooperation at Stanford University), **Joseph H. Felter** (Senior Research Scholar at the Center for International Security and Cooperation and Research Fellow at the Hoover Institution at Stanford University), and **Paul H. Wise** (Richard E. Behrman Professor of Child Health and Society and Professor of Pediatrics and Health Policy at the Stanford University School of Medicine) discussed “A Collective Moral Awakening: Ethical Choices in War and Peace,” which is, in part, the subject of the Winter 2017 issue of *Dædalus*. The program, moderated by **Debra Satz** (Marta Sutton Weeks Professor of Ethics in Society at Stanford University), served as the Academy’s 2047th Stated Meeting. The meeting included a welcome from **Mark Tessier-Lavigne** (President of Stanford University) and **Jonathan F. Fanton** (President of the American Academy of Arts and Sciences). The following is an edited transcript of that discussion.



Debra Satz

Debra Satz is the Marta Sutton Weeks Professor of Ethics and Society at Stanford University.

We’re living at a time when technological and social changes have put tremendous pressure on our ordinary ethical concepts. Commonsense morality tends to favor near effects over far ones. The present seems more real than the future, or as the economist G. L. S. Shackle put it: “Tomorrow’s hunger can’t be felt today.” And

The competing tendencies in our world between greater economic and political integration, on the one hand, and greater ethnic national identification, on the other, are, to my mind, symptomatic of our current difficulty in understanding the scope of our responsibility.

it favors individual effects over group effects. We see our own agency as less implicated when many people, of whom we’re only one, produce an outcome than when we produce that outcome alone. This privileging of the near over the distant and the individual over the group makes a lot of sense if we keep in mind that our commonsense morality was developed in the context of interactions between small groups of individuals.

But as the peoples of the world become increasingly interrelated – as technological advances make communication and interaction across borders easier, as institutions like markets link the lives of millions, if not billions of people around the world, and as the effects that we have on the natural environment stretch into the distant future – this view of individual responsibil-

ity is under pressure. For example, I can’t make sense of my obligation to diminish global warming from the perspective of my immediate and individually produced effects on the atmosphere, since they are completely negligible. At the same time, there’s no obvious alternative to our ordinary understanding of individual responsibility. Indeed, the competing tendencies in our world between greater economic and political integration, on the one hand, and greater ethnic national identification, on the other, are, to my mind, symptomatic of our current difficulty in understanding the scope of our responsibility. Who these days is my neighbor? Technologies like Twitter and Facebook break down geographical barriers; suddenly we are placed in the middle of events across the world as they unfold in real time. We’re living through profound

and rapid technology-driven changes. Few areas of life have been untouched by these upheavals and it's no surprise that our ethical concepts are also not untouched by them.

War is one of the most consequential arenas in which our technological and social circumstances have created new moral dilemmas. There's a long tradition of ethical thinking, dating back to the *Mahabharata* in India and to St. Augustine in the West, that lays down the rules of just war. This is a rich and honorable tradition, but none of the writers in this tradition envisioned drone warfare or the use of autonomous robots, or the phenomena of asymmetric warfare or the development of nuclear weapons. The concepts and principles we've inherited from just war theory, which is now our commonsense thinking about the rules of war – including the principles of proportionality and distinction, the injunction to minimize collateral damage, the prohibition on intentionally killing civilians, and the moral equality of all soldiers fighting in a conflict regardless of which side they are on – are all under pressure today. What, for example, can the prohibition on the intentional killing of civilians mean in the context of nuclear weapons? What difference does a uniform make to the rights of combatants? The technology of war now makes possible immense damages with repercussions across time and space. As citizens, as soldiers in the field of battle, and as members of a fragile global community, we face difficult and sometimes agonizing choices in war. Some of these choices challenge our inherited and commonsense moral ideas. To address these requires input from many disciplines and perspectives, including but not only philosophers.



Scott D. Sagan

Scott D. Sagan is the Caroline S. G. Munro Professor of Political Science, Mimi and Peter Haas University Fellow in Undergraduate Education, and Senior Fellow at the Center for International Security and Cooperation at Stanford University. Elected a Fellow of the American Academy in 2008, he is the Chair of the Academy's project on New Dilemmas in Ethics, Technology, and War, and the guest editor of the Fall 2016 and Winter 2017 issues of Dædalus on "Ethics, Technology & War" and "The Changing Rules of War," respectively.

In his historic May 2016 speech in Hiroshima, President Barack Obama highlighted the need to strengthen the institutions that govern, however imperfectly, the initiation, conduct, and aftermath of war. The speech marked the first time a sitting American president had visited Hiroshima, a city that the United States had destroyed in August 1945 with a single atomic bomb, killing well over one hundred thousand men, women, and children. Obama ended his speech with a call for new institutions to address the destructive power of nuclear weapons. "Hiroshima teaches this truth," Obama

said: "Technological progress without the equivalent progress in human institutions can doom us."

The American Academy, over the past two years, has brought together a remarkable and diverse group of scholars and practitioners to analyze and address the challenge of creating progress in such institutions – including theories about justice, military rules of engagement, and different legal and organizational mechanisms – that address dilemmas of technology and ethics in war. At Stanford, at the American Academy, and at West Point, we have brought together political scientists and physical scientists, physicians and philosophers, lawyers, historians, statesmen, soldiers, and even a pilot and a poet. And while we did not try to come up with one consensus position or set of recommendations, we helped each other understand these dilemmas and improve our collective arguments. And that's important because the kind of progress in human institutions that President Obama called for will not come about unless soldiers, scholars, and citizens alike are engaged in a debate. Clemenceau famously noted during World War I that "war is too important to be left to the generals." Similarly, just war doctrine is too important to be left to the philosophers and the political theorists. And I hope these debates begun at the American Academy will encourage many other scholars and citizens to discuss the institutions we need for a more just and secure world.

We have never had a president who cared as much about justice and questions of ethics and war as Barack Obama. Indeed, he took advantage of his Nobel Peace Prize speech to talk about just war doctrine. And he made the case at West Point in 2014 that we should uphold standards that reflect our values even in warfare – taking strikes only when we face continuing imminent threat and only when there's near certainty of no civilian casualties, because, as he put it, we

must not create more enemies than we take off the battlefield. Obama also gave guidance to the U.S. military, stating that even in planning nuclear weapons strikes, the United States must always follow the fundamental principles of the laws of armed conflict, including distinction, proportionality, and minimizing collateral damage.

Clemenceau famously noted during World War I that “war is too important to be left to the generals.” Similarly, just war doctrine is too important to be left to the philosophers and the political theorists. And I hope these debates begun at the American Academy will encourage many other scholars and citizens to discuss the institutions we need for a more just and secure world.

In the piece that Jeffrey Lewis and I wrote for the Fall 2016 issue of *Dædalus*, entitled “The Nuclear Necessity Principle,” we note that military organizations are better than most organizations at following orders. They are also better than most organizations at creatively interpreting the guidelines that they are given to fit their biases and standard operating procedures to get their job done. We argue that the nuclear employment strategy of the United States has created some pushback behind the scenes, evident in the interpretation of laws and resulting practices that have changed. For example, the new Joint Chiefs of Staff guidelines *Joint Targeting* states: “Civilian populations and civilian/protected objects may not be intentionally targeted, although there are exceptions to the rule.” What are those exceptions? “Civilian objects consist of civilian property and activities other than those used to support or sustain war-fighting capability. Acts of violence *solely* intend-

ed to spread fear among civilian population are prohibited [emphasis added].” Solely intended. This document implies that if you attack a legitimate military target, but “intend” “to spread fear among civilian population” as a side benefit, that is acceptable. Moreover, there have been two new definitions in the list of legal military targets

in this document. The official statement of what is a legitimate military objective now includes, and I quote, “its future intended or potential military use.” The given example of such a legitimate military target is a civilian airport because while it may not now be used as a military facility, it could be in the future. The Department of Defense considers that a legitimate war target. Further, they have changed the definition of a legitimate target set from “war-supporting industry” to “war-sustaining industry.” This was done in part to fight ISIS, allowing the United States to target war-sustaining facilities like oil refineries that do not contribute directly to military power, but making war-sustaining industry the new standard for a legitimate military objective opens up the possibility for many new targeting options.

In our essay, we argue that U.S. military organizations should follow “the principle of nuclear necessity” and should never plan to employ a nuclear weapon against any tar-

get that we have a reasonable probability of destroying with conventional weapons. We recognize that this change in doctrine would lead to a major new focus on conventional deterrence over nuclear deterrence and would require much consultation with our allies. We also note that reasonable people can disagree about how best to define what is a “reasonable probability” of destroying a target.

In addition to the *Dædalus* essay, we summarized our argument in a *Washington Post* op-ed, and I’ve been pleased with the debate the argument has sparked. On the one hand, the argument has created consternation among some specialists in Washington and elsewhere who think this change in nuclear doctrine would weaken U.S. deterrence policy. On the other hand, there are others who have stated that such a doctrine that prioritizes conventional weapons above nuclear weapons is just common sense and are surprised to learn that this version of the necessity principle is not already embedded in U.S. targeting practices.

If there’s that much disagreement within the Beltway, there clearly needs to be a more open and transparent debate about the future of deterrence that will place ethical concerns at the heart of our national strategy, which is where our principles surely belong.



Joseph H. Felter

Joseph H. Felter is Senior Research Scholar at the Center for International Security and Cooperation and Research Fellow at the Hoover Institution at Stanford University. His essay “Limiting Civilian Casualties as Part of a Winning Strategy: The Case of Courageous Restraint” appears in the Winter 2017 issue of Dædalus.

I’m going to start out with a thought experiment, to set everyone’s frame of mind. Imagine you are a twenty-two-year-old platoon leader just a few months out of West Point and you’re in Kandahar, a small village in Southern Afghanistan. You’re on a presence patrol and your platoon starts taking fire, separating you into different squads. Your platoon sergeant, who’s a senior NCO and has the respect and admiration of the entire platoon, calls you on the radio and says, “We’re taking fire. We need to drop a JDAM [basically a precision-guided bomb] onto this building that we’re taking fire from to neutralize the threat.” He’s expecting you to say, “Roger that, Sergeant. Let’s go for it.” But you delay because you don’t know what is the right thing to do. You’ve been in this village before. You know

Laws around just war require us to take measures to protect civilians and exercise restraint, accepting risk to protect noncombatants. And I would argue that’s always a moral imperative in any conflict. And in asymmetric conflicts like counterinsurgency especially, exercising restraint and reducing civilian casualties can also be part of a winning strategy.

the target is a compound that’s normally occupied by an extended Afghan family. On the same transmission, your platoon sergeant says, “And we’ve got two wounded in action, one seriously. What are we going to do, Lieutenant?”

They continue to take sporadic fire from the compound. And then your platoon sergeant says, “If we tie our hands any longer, we’re going to lose half the platoon, Lieutenant. What are you going to do?” All eyes are on you. You know there’s a good chance there are noncombatants in the building. You also know that you’ve received guidance from your battalion commander, your company commander, and even a four-star general back in Kabul, General McChrystal, that says: “This is a counterinsurgency fight in which the relationship with the population is important. Therefore we want you to do all you can to limit civilian casualties and protect the population from harm. We want you to refrain from using these types of munitions, like aerial delivered munitions, if you think there may be civilian casualties at risk.” But then your platoon sergeant breaks in again on the radio and says, “Private Jones, the wounded-in-action, he just died and we just took two more wounded.”

You’ve got about three options here. One, drop the bomb. It’s actually consistent with the laws of land warfare: you’re under attack, and you need to protect yourself. That

would make you a hero with your platoon, and you wouldn’t have to write letters to any more of the perished soldiers’ parents or loved ones and avoid the gut-wrenching guilt and responsibility that comes with this and can haunt you for a lifetime. But there may be civilians trapped inside and you know that you may put them at risk. Two, you can lead your platoon to fire and maneuver onto the building, clear the building with direct fire weapons where there’s a much greater chance that you can avoid engaging noncombatants. You can neutralize the threat, but you’re putting your platoon at much greater risk, not to mention yourself, by exposing them to enemy fire as you approach and attempt to clear the compound. And three, just back off; leave. Let the Taliban get away, live to fight another day, face your platoon sergeant and your soldiers who just lost some of their comrades, and deal with the platoon thinking that you let the enemy get away without avenging the deaths of your brothers-in-arms and allowing these Taliban the chance to attack you again in the future. What do you do?

We can work to methodically figure out what one *should* do in a situation like that. But try to put yourself in that position. As Debra Satz said, the present seems a lot more real than the future. And in this case, your present is chaos and fear, and every visceral emotion in your body says, “Protect my soldiers, protect myself, drop the bomb.”

Laws around just war require us to take measures to protect civilians and exercise restraint, accepting risk to protect noncombatants. And I would argue that's always a moral imperative in any conflict. And in asymmetric conflicts like counterinsurgency especially, exercising restraint and reducing civilian casualties can also be part of a winning strategy.

When General Stanley McChrystal took command of the International Security and Assistance Force in Afghanistan in 2009, this is how he felt. He said, "We've got to protect the population. We've got to limit civilian casualties because that's the only way we're going to make progress and win this fight." He made a concerted effort to limit civilian casualties. He developed a revised tactical directive in which he said, "We're not denying you the ability to defend or protect yourself, but we are encouraging you to use restraint, to avoid using the types of weapons systems that are more likely to create civilian casualties if civilians are present." In these revisions of various directives and standard operating procedures, soldiers are required to take more risks in the interests of not harming civilians who may be in the way. And he developed a concept called "courageous restraint," with the notion that soldiers should be encouraged and in some cases rewarded for exercising restraint in combat situations when it helps protect the civilian population. But it wasn't popular with some military practitioners who criticized the idea of rewarding soldiers for *not* fighting.

I was in Afghanistan at the time and my mission was both to educate the deployed forces around the theater and to get them to understand and buy in to the strategy. I had to communicate that we weren't asking soldiers to tie their hands behind their back, but rather, if a soldier can use another option that will safeguard the lives of civilians, then he or she should do so. We also had to sell this concept by reminding them that not

only is it morally correct, but it is also a part of winning. And I tell you, it was a tough sell in theater.

But there were a lot of examples in which exercising restraint was not only the morally correct thing to do, but also helped achieve successes on the battlefield. In January 2010, soon after I got there, in Garmisir, near Helmand, a Marine battalion was surrounded by angry locals because a rumor had gotten out that the Marines had defaced a Koran – an egregious offense. The locals surrounded the platoon and started throwing rocks and bricks at them. One Marine got hit right in the face. Our rules of engagement authorized them to use deadly force in response, but they didn't. They held back; they held their ground. Fortunately, the locals eventually discovered that

I came back to the United States on midtour leave and realized, boy, in some ways you can make just as great a difference as a scholar as you can as a soldier, in some cases more.

this was a rumor planted by the Taliban, and the villagers dispersed. The Marines' courageous restraint was responsible for not escalating a bad situation, which could have resulted in civilian casualties and increased hostilities. But there's more to it. Following the incident, this unit had the highest rate of tips that led to finding and clearing improvised explosive devices (IEDs). It takes a lot of trust and cooperation from the local population to get those tips and the practice of exercising courageous restraint went a long way in garnering that trust.

My coauthor, Jake Shapiro, came out to Afghanistan to collect empirical evidence on the level of civilian casualties and the relationship with the local population. Fortunately, General McChrystal's chief of intel-

ligence, Major General Mike Flynn, cleared the civilian casualty information for unclassified use so we could do the study. Our study showed that a civilian casualty incident resulted in increased attacks at the district level in Afghanistan for a three-week period if it was ISAF-caused, and it resulted in a one-week increase in violence even if it was Taliban-caused. We found through anecdotal evidence that people blamed the United States for the attack either way, since if we weren't there, the Taliban wouldn't be attacking them in the first place. We briefed General McChrystal on our findings and he was relieved to hear that his gut feeling on the importance of protecting the population – what he had been talking about for months – was shown through evidence to be true. That was my epiphany. I came back to

the United States on midtour leave and realized, boy, in some ways you can make just as great a difference as a scholar as you can as a soldier, in some cases more.

Jake Shapiro and one of his research assistants, Andrew Shaver, did another study in Iraq and have produced some preliminary results, which are going to be published in the *Journal of Conflict Resolution*. These results show the weekly flow of tips provided to coalition forces in Iraq from the local province for about a sixty-week period approximately from June 2007 to July 2008. They were able to get the briefing reports declassified and collected data that showed how week-to-week changes in civilians harmed by either the coalitions or the insurgents led to week-to-week changes in the rate of information

sharing. We had direct evidence that proved that harming civilians lead to less cooperation in the form of locals sharing of information on insurgents, which is the key to winning this kind of fight.

Exercising restraint is a moral responsibility, and can also be key to developing and maintaining the support from the local population needed for operational and strategic success. But it's also hard. It's really difficult to overcome the instincts to survive and retaliate, and protect your comrades if you can. You need educated, trained, and well-led forces to succeed. So we need to keep making these investments in the quality of the men and women who are serving in these kind of situations with the discipline to achieve the results we want.

Thucydides once said, "The strong do what they can, the weak do what they must." But in an asymmetric conflict, like the ones we've fought in Iraq and Afghanistan and expect to experience going forward, the strong must also do what they must. Protecting noncombatants, and accepting greater risk in the process, is something strong states must do to set conditions for accomplishing their mission. Exercising restraint is both a moral obligation and, in many cases, a strategic imperative.



Paul H. Wise

Paul H Wise is the Richard E. Behrman Professor of Child Health and Society and Professor of Pediatrics and Health Policy at the Stanford University School of Medicine. His essay "The Epidemiologic Challenge to the Conduct of Just War: Confronting Indirect Civilian Casualties of War" appears in the Winter 2017 issue of Dædalus.

Health workers are always the ultimate inheritors of a failed social order. Sooner or later, a breakdown in the bonds that define collective peace and ensure social justice will find tragic expression in the clinics, on the wards, or in the morgue. This reality has always given health workers the opportunity, if not responsibility, to bear witness and provide a human narrative of suffering, particularly in what has always been the most extreme challenge for health workers: the human consequences of war.

Most have seen the picture of Omran Daqneesh, a five-year-old child who was pulled from a destroyed building after it was bombed by either the Syrian government or a Russian aircraft in the North Syrian town of Aleppo. The power of this image is mag-

nified by the recognition that Omran's injuries were not unique or even unusual. They were typical. Omran was but one of twelve children brought in with similar injuries to the same hospital on that same day – what was, in fact, a typical day for Aleppo. My comments here are in some ways an attempt to make sense of the photograph, and of the other eleven children brought in that day who were not photographed, in the context of a moral framework that has justified and constrained the initiation and the conduct of war.

As powerful as that photograph is, my approach is not rooted in anecdote. It is rooted in epidemiology, a story whose contours are shaped not by individual histories, but by patterns of illness and death in large civilian populations. Just war principles have been around for a long time. Their roots lie in early Christian theology and have evolved to incorporate the insights and approaches of international law, human rights, and philosophy. However, their central focus has always been on the most essential human consequence of war, and that is violent death – the destruction of human life through direct exposure to combat. This has long been the predominant preoccupation of just war theorists, be they saints, generals, or philosophers, and they approach these issues in a sequential temporal format: prewar, war, and postwar. *Jus ad bellum* speaks to when states can initiate the use of force. *Jus in bello* describes how states can use force, the conduct of combat operations, and the use of force in war settings. And more recently, *jus post bellum* focuses on disciplining the provision of the elements for a just peace once the guns have fallen silent. This framework – these principles and aspirations – have been crafted to protect civilian populations, to protect Omran Daqneesh from direct violent injury and death. However, war also generates death, illness, and hardship not through direct exposure to combat, but through the indirect effects secondary to the

destruction of the means of human survival: food supplies, water, shelter, and health care systems.

We do have evidence regarding the importance of these indirect effects. A study was done in Darfur at the height of the fighting in Western Sudan to assess the epidemiology of mortality. And, indeed, they found much higher levels of mortality associated with the fighting in Darfur. However, only 15 percent of the increased mortality in Darfur at the height of the fighting was due to violent combat exposure. Eighty-five percent was due to the indirect effects of the destruction of the social fabric of community life, of food supplies, of water, and of what remained of the health care system that had been there before.

War also generates death, illness, and hardship not through direct exposure to combat, but through the indirect effects secondary to the destruction of the means of human survival: food supplies, water, shelter, and health care systems.

Another study looked at child mortality patterns in the Kivu region of the Eastern Congo at the height of the fighting. And, like Darfur, child mortality was much elevated in this area. But, in this case, the causes associated with the elevation in mortality were fever and malaria, diarrhea, acute respiratory infections and pneumonia, and neonatal measles, which are the same causes of child mortality in these populations without war. However, the absolute numbers of deaths occurring from these causes was much higher in these circumstances, and the indirect mortality was far more profound and more prevalent than direct exposure to combat related violent deaths.

We can talk abstractly, we can talk through the epidemiology, but this is what

it looks like to health workers in the real world: newborn illnesses, young child mortality associated with infectious diseases like malaria, diarrheal diseases, dehydration, cholera, and, of course, malnutrition and starvation. These are some of the indirect effects of war. We also know something about the scale of indirect effects in different settings. In Iraq, researchers estimate that civilian casualties due to indirect deaths were three times higher than direct deaths during the invasion and subsequent civil war. In East Timor, it was five times higher. In the Congo and South Sudan, it was nine times higher. And in Sierra Leone, at the height of the fighting, the number of indirect deaths was fifteen times higher than violent direct deaths.

A closer look at the nature of these conflicts gives us some clues as to why they have been associated with such high indirect effects, clues that raise an even more fundamental question about the utility of a traditional just war framework. Prewar/war/postwar is the paradigmatic framework for just war theory. However, the reality of these conflicts is that they don't generally conform to this vision of war and its aftermath. What's prewar and postwar in the Congo, Northern Nigeria, Gaza, or even Iraq? Fighting explodes and then recedes. Ceasefires are established and broken. Peace accords come and go. In these settings, postwar becomes prewar – there's no reconstruction *post bellum* phase. What you see is a kind of churning, chronic conflict that

continues to generate some direct deaths, but primarily indirect suffering and death. Displacement is profound. The destruction of normal markets, food, water, and shelter is traumatic.

The largest refugee camp in the world is in Northern Kenya, where some 350,000 people currently reside, although the Kenyan government is threatening to close it shortly. It also is important to recognize that the average length of stay in a UN refugee camp worldwide now is twenty years – these are no longer acute refugee situations. This is a kind of prolonged conflict that just war theory must, and has so far failed to, address. Likewise, just war theory must address the indirect effects, rather than consider them peripheral problems that pediatricians like myself have to deal with in conflict areas. If you list the top twenty countries in the world for young child mortality, nineteen are in conflict or are profoundly politically unstable. Nearly half of all young child deaths in sub-Saharan Africa are occurring in countries plagued by chronic violence, political instability, and conflict. Global child health has become global child health in conflict settings.

Indirect effects of war are not new. The plague of Athens killed Pericles and almost killed Thucydides. During The Thirty Years' War, the indirect effects were catastrophic. However, what makes the indirect effects particularly important now, and perhaps more than ever before, is technical innovation. Technological advances have dramatically altered our ability to measure and, most importantly, to mitigate the indirect effects of war. We have new technical capacity to assess the indirect effects using mobile technology and sophisticated epidemiologic modeling techniques. We can get a pretty good idea of what the indirect effects are in any given population at a given time. But one could only imagine what the indirect effects are in Syria right now, for example, because

We are trying to craft new cross-disciplinary approaches to the delivery of critical health services that recognize the political governance and security requirements of service provision in contested environments, where organized violence and coercion dominate social and community life.

we have no system or infrastructure to actually measure and report the indirect effects.

Counting in this context may seem beside the point, but an unnoticed death implies an unnoticed life. There is a justice requirement that indirect effects be measured, that there's some accounting, some attribution. But we can also focus on preventing indirect deaths and suffering through remarkable advances in public health and medical care. In the Eastern Congo, the best estimates are that 70 percent of the excess mortality is preventable with interventions we have now: immunizations, adequate nutrition, bed nets, and medications. We could have eliminated the vast majority of these indirect deaths.

For the first time in any university program, we at Stanford are bringing together physicians and public health specialists with political scientists and global security experts to create new integrated technical and political strategies that can function in areas of conflict and political instability. We are trying to craft new cross-disciplinary approaches to the delivery of critical health services that recognize the political governance and security requirements of service provision in contested environments, where organized violence and coercion dominate social and community life.

My argument here is based not on the modern origins of indirect effects, but rather their modern neglect. The dramatic advances in our technical capabilities matter. They matter to the negotiation of jus-

tice, because as technical capacity grows, so too does the burden on society to provide it equitably to all those in need. The death of any child is always a tragedy, but the death of any child from preventable causes is always unjust. Efficacy and justice are inextricably linked. I recognize the many complexities of any form of intervention. But the failure to act to reduce both direct and indirect deaths when the opportunity exists or can be created is a core dereliction. It reflects a level of complacency that is increasingly consequential and, from my perspective, must not be allowed to persist in silence. The essential challenge lies in renegotiating the tension that exists between the exercise of power and the claims of the vulnerable – a tension that is playing out in the lives of some of the poorest and most vulnerable people on earth. ■

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Why is There a Literature in the Latin Language?

Denis Feeney

I have spent the last few years trying to understand why the Romans developed a literature in their Latin language, when the balance of historical probability was against this happening.¹ It is very easy to take the existence of vernacular literatures for granted, but when Rome was developing into a Mediterranean power in the third century BCE, the Greeks were the only people the Romans knew of who had an extensive range of widely disseminated texts, in a variety of literary genres, that were a core part of their education and sense of identity. The process by which the Romans developed their own equivalent began in earnest around the year 240 BCE. In a move without any precedent, the Roman state systematically began to commission translations into Latin of Greek tragedies and comedies for performance at the state's main religious festivals, starting with the festival of their chief god, Jupiter. Translations of other texts, such as Homer's *Odyssey*, soon followed. Even though we now think of the translation of literary texts as perfectly normal, this was not at all the case in the ancient world, and so far as we know no one had ever translated a literary text from Greek into any other language before. Within a generation the authors of these first translations had branched out into independent compositions, such as narrative poems and dramas about the Roman past. A scant century after the first translated Greek dramatic script was staged in Rome, the Romans already had a well-developed Latin literature at their disposal, with dramas, epics, histories, and satires, together with the beginnings of a tradition of scholarship devoted to those texts. A century later still, in 40 BCE, the great Cicero has just died, Virgil and Horace are beginning their careers, and schoolboys throughout Italy are reading not just Homer and Euripides but the classics of the early Latin tradition, such as Ennius or Terence.

How did this happen? It was not inevitable. In fact, I think it is a very strange phenomenon, and comparisons with other significant moments of cultural transfer in world history only highlight how odd the Romans' choices were. A millennium later, during the extraordinary period of translation from Greek into Arabic under the 'Abbasid Caliphate in Baghdad (750–1000 AD), we see the opposite pattern to the Roman one. Virtually all of Greek philosophy, science, medicine, and mathematics was translated into Arabic, but high literature was left completely untouched – as was virtually all of Plato, in an act of exclusion that deserves more attention (was his mode of philosophy too “literary,” were his naturalistic dialogues too culturally embedded?). The Romans, conversely, translated only literature out of Greek at first, while technical works of medicine, for example, were left untouched for almost two centuries.

The beginning of the Roman translation project, around 240 BCE, is not a well-documented period, and the Romans' precise motivations are irrecoverable in detail, but we must look for a general explanation of this remarkable phenomenon in the context of Rome's long-standing dialogue with Greek culture, which had acquired a new urgency and focus by the middle of the third century. In the generation leading up to the first staged translations, Rome had become a major Mediterranean power following the defeat of the Car-

thaginians in the First Punic War (264–241 BCE) and the consequent annexation of Sicily. It seems that they wanted to raise their status as a cultural as well as a military and political center, by emulating some of the distinctive features of the other leading Hellenistic powers with whom they were now in direct competition. In pursuit of this objective, they turned to one of the most prestigious, glamorous, and appealing of all Greek cultural products – the theater.

Greek dramatic productions were popular all over southern and central Italy and in Sicily as well, and the Romans themselves had long before developed hybrid and improvisational forms of performance in response to Greek drama. Such shows had been staged at Jupiter's festival for well over a hundred years. What began around 240 BCE, however, was quite new. The Romans wanted to participate more directly in the world of Greek theater, staging close equivalents of the plays that were so popular all around the world that they were now taking over: the old hybrid medleys could not discharge this function. Nor did the Romans want to have plays in Greek as the focus of their national festivals, in the way that aspiring Hellenistic powers such as Macedonia could do. Canonical Greek plays translated into Latin could provide the ideal solution. In this way, the Roman state could foster prestigious shows that were modern, while maintaining a certain distance from a wholehearted identification with Greek culture – becoming *too* Greek, merely mimicking Greek, was a cultural strategy that never appealed to them. Translations of acknowledged classics from the respected

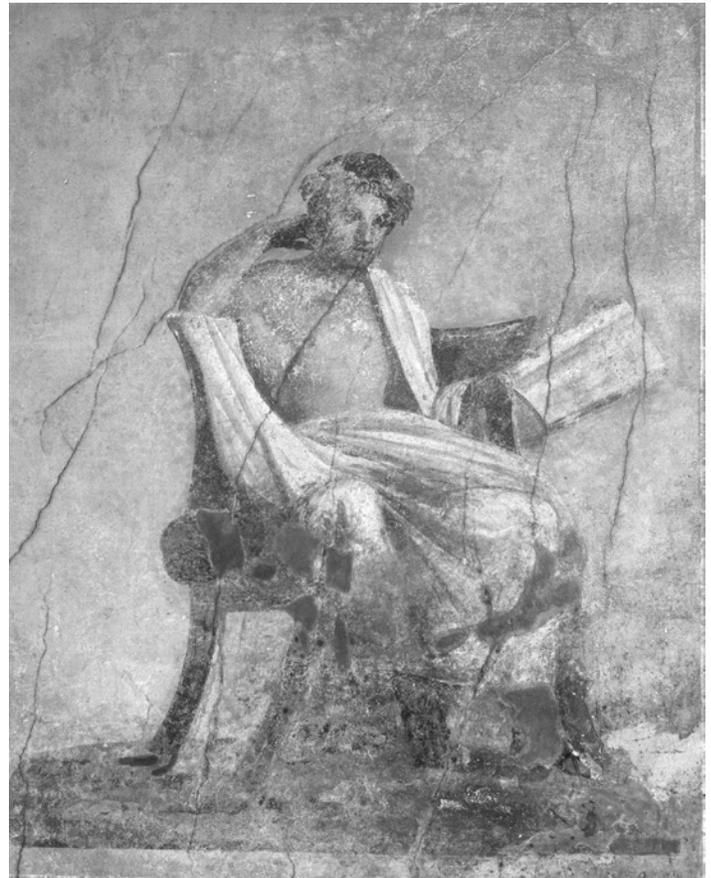
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canons of Greece allowed the Romans to have their cake and eat it too – they could have a national theater of their own, based firmly on an internationally acknowledged repertoire, but they could do so independently, on their own terms.

The writers who provided the translations, and who in time went on to create literary works that were not adaptations of Greek originals, were not born as Roman citizens, but came from a fascinating range of interstitial cultural contexts created by the Romans' rapid conquest of Italy. They are classic cases of the middle-men and cultural brokers who have so often been the agents of cultural transfer throughout history. The man who was remembered by later tradition as the first to put on a translated play in Rome, Lucius Livius Andronicus, was originally a Greek, "Andronikos," and it seems that he was brought to Rome after his native city of Tarentum, in southern Italy, was taken over by the Romans in 272 BCE. One of his successors, Quintus Ennius, is more representative in claiming to have "three hearts," since he knew how to speak Greek, Latin, and Oscan (the main language of central southern Italy). Trilingualism, not bilingualism, was the norm for these pioneers, who in addition to Greek and Latin could also speak Oscan (Naevius, Ennius, Pacuvius), Umbrian (Plautus), or Punic (Terence).

The dramatically swift Roman conquest of Italy had created new constellations of allegiances and affinities, and these poets were products of the new circumstances, moving back and forth between different linguistic cultures, and helping to mediate between Roman and Greek culture above all. With their school training in Greek and in the Greek canonical curriculum, together with their knowledge of the Roman state and its history and ideology, they were able to exploit new opportunities for self-promotion and self-advancement, becoming an indispensable element of the ever-expanding Roman festival program. Surprisingly quickly, a new kind of linguistic and cultural umbrella developed in the Latin-speaking West, providing a smaller mirror-image of the Hellenism of the Eastern Mediterranean. After the conquests of Alexander the Great, when Greek became the dominant language of government and culture in the East, the diverse local elites – Syrians, Lycians, Jews – became adept at joining the mainstream of Hellenism and writing in Greek for a transnational audience. Similarly, by around 150 BCE, the Roman world was fostering an environment in which writers from all kinds of backgrounds could participate in a transnational Latin-based enterprise of literary production and education.

The diffusion and reach of the new literature in Latin are very striking. Fragments of Virgil's *Aeneid* have been found at Hadrian's Wall and in the palace of Masada. Major towns throughout the Latin West had substantial libraries, and individuals in towns like Pompeii or Herculaneum had private collections of books, running up to hun-



dreds, perhaps even thousands, of volumes: the Villa of the Papyri in Herculaneum has so far yielded remains of perhaps up to 1,000 scrolls, only a portion of the original holdings. The illustration above shows an idealized image of a reader from a colonnade in a house at Pompeii, painted on a wall right where the owner of the house would go to read in the sunlight by his indoor garden, having taken a scroll from the shelves in his library.² This painting is conventionally said to depict the Greek comic playwright Menander, and the house is therefore known as "the house of Menander." Whoever this person was, he is caught at the very moment when he has finished reading a volume, so that he is not holding it in both hands to unscroll it, but reflecting abstractedly on what he has just been reading. If you follow the line of his vision, you see that he is not looking at the scroll itself, but into the middle distance to the right of his book, preoccupied with his impressions. We all know what that feels like.

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ENDNOTES

1. See Denis Feeney, *Beyond Greek: The Beginnings of Latin Literature* (Cambridge: Harvard University Press, 2016).
2. I would like to thank my friend Reid Byers for his help on the libraries of Pompeii and Herculaneum.

Appreciating Biological Variation

Ary Anthony Hoffmann

Like many biologists, I had an early fascination with nature. As a seven- or eight-year-old child, I was particularly taken with mushrooms and toadstools, collecting them in woods outside The Hague, and studiously comparing them to pictures in my precious field guide. I remember being particularly struck by the sharp colors, symmetrical shapes, and intricate gills of the toadstools. This was my first taste of biodiversity even though the woods where my fungi grew were undoubtedly highly managed ecosystems!

At the age of ten, my family migrated to New Zealand and we lived on a vegetable farm. I became concerned about quite a different form of biodiversity; namely, the thrips that were eating our onions, nematodes that were boring through our potatoes, and weeds that were smothering our lettuce and cabbage seedlings. I was fascinated by the rapid destruction caused by these animals, along with diseases that could turn a wholesome looking pumpkin or potato into a soggy mess in a matter of days. Nature provided an ongoing set of challenges for my father, who tried to fight back chemically with the help of a brass knapsack sprayer and later a boom sprayer mounted onto an old Ferguson tractor. However, I admired the fact that weeds could grow so quickly and keep coming back no matter how many times we hoed the soil or sprayed them. I was particularly impressed by their flexible growth patterns, such as the way barnyard grasses could grow to become almost invisible by hugging the soil, then to throw up seed heads that could disperse into the wind. And I became aware of the insects that became rapidly immune to the chemicals we were using to try to control them, seemingly untouched by the toxic mix that was hated by my father.

Much of the biological variability I encountered in my childhood stays vividly with me now and very much forms part of my ongoing research drive. Growing up on the farm I appreciated the endless variation in bugs and weeds that we were trying to control, as well as the variation in crop plants that we grew, such as the brassicas that included cauliflower, cabbage, and Brussels sprouts, and tomatoes that varied from staked plants with perfectly round fruit to bushes with huge wrinkled fruit. After leaving school, I worked on a large sheep, cropping, and beef farm on the Canterbury Plains of the South Island. There I encountered a different type of variability in the shape of many breeds of cattle, including large Charolaise and compact Hereford breeds as well as the solid Angus, all of which were being crossed. I learned to separate my Corriedales from Romneys and how breeding could build up lines for different purposes.

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All this variability forms the basis of the disciplines of evolutionary biology and genetics. It is surprisingly easy to utilize it experimentally, much as breeders have done across the centuries. I recall that as a Ph.D. student, I was keen to generate some diversity in the lab and play at evolution, so I generated lines of flies that could smell unusual compounds and that were attracted to different types of fruit. I came to appreciate the speed of evolution that is so well used by our plant and livestock breeders, and that also underlies ecological adaptation, allowing populations to exploit new habitats. I discovered native flies around Melbourne that had evolved and adapted to take advantage of fruit orchards, new environments that had not existed a few hundred years previously.

And yet throughout my career I kept coming across situations where rapid adaptation had not occurred, where the fly species I was studying were restricted to wet patches of ferny forest, using native fruit and fungi, just like they had for millions of years previously. These species with narrow ecological distributions seemed destined to become threatened species. Ongoing variation and evolution seem insufficient to protect these species, and extinction remains an inevitable outcome when our environments are changing so rapidly as land degradation, climate change, and deforestation rates accelerate. What makes these species different from others that can adapt to stressful conditions?

I have more recently started to wonder if evolutionary adaptation might be enhanced even in species that are threatened or with long generation times. I want to know how we might reduce extinctions by helping these evolutionary laggards adapt, so we are not left with a world full of adaptable weeds and invasive species. This could be achieved by boosting genetic variation in populations that lack it, such as through the introduction of new alleles into populations of threatened species that have lost it; such alleles could come from other larger populations or even related species. I've been involved in a recent success using this strategy to reinvigorate a population of mountain pygmy possum, a threatened marsupial restricted to the alpine areas of South Eastern Australia.

In other cases, it may be possible to move "pre-adapted" genotypes around the landscape. This is a strategy we are trying for long-lived trees whose persistence is threatened by climate change, which is producing extended droughts and increasingly intensive

heat waves. By introducing genetic material of the same species from several hundred kilometers away, where conditions are drier and hotter, it might be possible to ensure at least some trees survive into the future. There is an urgency here because the effects of climate change are already starting to impact all levels of biodiversity – from genes to ecosystems around the world. The same strategy might help corals to survive higher water temperatures.

Novel ways in which adaptation might happen really quickly are starting to emerge. One method is to use “epigenetics,” which refers to the ability of organisms to change their patterns of gene expression for several generations as a direct response to environmental effects. In this way, when a parent is exposed to heat stress, it may lead to modifications in the expression of proteins that are used to protect molecules from denaturing under heat stress, which are then passed on to their offspring and so on. Later generations then become better at dealing with heat stress directly. Such effects have been shown to occur in some plants and fish.

We still don’t know how common epigenetic effects are in organisms and whether they help them deal with stressful situations. Parents exposed to stress might also be damaged in some way. For instance, the offspring of flies exposed to thermal stress show developmental abnormalities. Rather than increasing adaptation, parental heat stress might then also decrease the fitness of the next generation. A challenge is to understand when parental exposure produces adaptive epigenetic effects while avoiding damage at the same time.

Another rapid way in which organisms might adapt is through the microorganisms that live in their gut, in their cells, or on their surface (in the case of plants). It has long been known that microorganisms living inside the cells or tissues of animals and plants can provide various nutritional benefits to their hosts. Recent research also points to microorganisms being important in other forms of environmental adaptation. For instance, microorganisms carried by aphids affect their ability to counter the effects of hot conditions, while microorganisms carried by mosquitoes and flies as well as by many other insects influence their resistance to viruses.

These rapid forms of adaptation to stressful conditions might be exploited not only to generate populations that are more resistant to stressful conditions, helping environmental adaptation, but also within the context of human health. Mosquito-borne diseases – like malaria, dengue, and zika – remain an enormous burden to human health in tropical countries. Microorganisms that block the ability of mosquitoes to transmit malaria and viruses might provide a way to decrease the incidence of these diseases. My group is currently involved in programs in the tropics to take advantage of this opportunity. But we are also investigating the interactions be-



tween microorganisms and climate, because the strains of microorganisms that are suitable for disease suppression in different parts of the world will vary with climatic conditions. In this way, we can “pre-adapt” organisms to particular situations.

Adaptation and evolution have formed a rich field of study for me, providing opportunities to build resilience in threatened species and to control organisms that pose threats. We have made massive progress over the last few years in understanding rapid adaptation and we are only just beginning to appreciate how we can generate and use variation in organisms from natural environments. I can only hope that it may yet prove possible to discover new ways to trigger rapid evolution in novel ways that help protect the planet, assist in food production, and decrease disease burden.

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A Scientist's Work on Vaccines

Paul Offit

In 1980, I began my fellowship in pediatric infectious diseases at the Children's Hospital of Philadelphia. My mentor was Dr. Stanley Plotkin: the inventor of the RA27/3 strain of rubella vaccine – the one that by 2005 had eliminated the disease from the United States.

The year before I arrived in Philadelphia, Dr. Plotkin, along with Dr. Fred Clark, had started a program to study rotaviruses, a common cause of vomiting, diarrhea, fever, and dehydration in infants and young children. In the United States, every year about 3 million children would be infected, 250,000 would seek medical attention, 75,000 would be hospitalized, and 60 would die. In the developing world, about 2,000 children would die *every day* from rotavirus-induced dehydration. There was a desperate need for a vaccine.

During the next ten years, our team at Children's Hospital developed a small animal model (mice) to study the disease, determined which rotavirus genes caused diarrhea, and which rotavirus genes coded for proteins that evoked protective immunity. Next, we isolated a strain of rotavirus from a calf with diarrhea that didn't cause disease in children. Finally, we created a series of recombinant viruses between this calf strain and human rotavirus strains that didn't include the human genes that caused diarrhea but did include the human genes that could evoke protective immune responses.

With our recombinant rotavirus strains in hand, we approached four vaccine makers hoping that one would be interested in determining whether what we thought was a rotavirus vaccine actually *was* a rotavirus vaccine. Merck was the first to step forward. Between 1990 and 2006, Merck Research Laboratories performed a series of studies to prove that all of the strains that were in our vaccine had to be there (proof-of-concept studies), that we didn't have too much or too little vaccine virus in the final preparation (dose-ranging studies), that we had the right buffering and stabilizing agents (real-time stability studies), that our vaccine didn't interfere with the safety or immunogenicity profiles of other vaccines that would be given at the same time (concomitant use studies), and that the fully liquid preparation could be easily administered to children at two, four, and six months of age. The final so-called Phase 3 study was a prospective, placebo-controlled, 11-country, 4-year, 71,000-person trial that cost about \$350 million to perform and generated individual clinical reports that if stacked one on top of the other would have exceeded the height of the Sears Tower.

What I learned from all of this was how hard it was to make a vaccine.

In 1998, while we were in the midst of developing our vaccine, Andrew Wakefield and colleagues at the Royal Free Hospital in London published a paper claiming that the measles-mumps-rubella (MMR) vaccine caused autism. Wakefield reported the cases of eight children who had developed autism within one month of receiving the MMR vaccine. Because Wakefield's "study" didn't include a control group, the only thing he had proven was that the MMR vaccine didn't prevent autism. Later, seventeen studies showed that children who had received MMR were at no greater risk of autism than those who hadn't received the vaccine. Nonetheless, Wakefield's paper touched off an international firestorm. Thousands of parents in the United Kingdom and Ireland chose not to vaccinate their children with MMR, hundreds were hospitalized, and four died from measles – died from a disease that could have been safely and easily prevented by a vaccine.

What I learned from this was while vaccines were hard to make, they were easy to damn.

In 2000, Charlotte Moser and I launched the Vaccine Education Center at Children's Hospital of Philadelphia. The goal was to create a series of educational materials to inform the press, the public, and lawmakers about what vaccines are and how they work – to demystify vaccines. During the past sixteen years we have created tear sheets, videos, mobile apps, coloring books, online games, vaccine hero trading cards (in the same format as baseball cards), booklets, and a full-length feature film – *Hilleman: The Perilous Quest to Save the World's Children* – that won the award for best documentary film at two international film festivals. In addition, I have written several books about vaccines: *The Cutter Incident: How America's First Polio Vaccine Led to the Growing Vaccine Crisis* (Yale University Press, 2005), which details a biological tragedy that occurred in 1955 when one of the companies that made Jonas Salk's polio vaccine failed to fully inactivate the virus; *Vaccinated: One Man's Quest to Defeat the World's Deadliest Diseases* (Smithsonian Books, 2007), which tells the story of Maurice Hilleman, the scientist who developed nine of the fourteen vaccines currently given to infants and young children; *Autism's*

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False Prophets: Bad Science, Risky Medicine, and the Search for a Cure (Columbia University Press, 2008), which pulls back the curtain to expose some of the nefarious characters behind the vaccines-cause-autism controversy; and *Deadly Choices: How the Anti-Vaccine Movement Threatens Us All* (Basic Books, 2011), which describes the impact of antivaccine sentiment in the United States.

Although performing scientific studies has in no way taught me how to deal with the media, our educational efforts at the Center and our books about vaccines have landed me on news programs such as *Today*, *Good Morning America*, *CBS This Morning*, *NBC Nightly News*, *ABC World News Tonight*, *CBS Evening News*, *60 Minutes*, *Stossel*, *MSNBC*, *Dateline NBC*, the *Jim Lehrer NewsHour*, *Fox News*, *National Public Radio*, *The Colbert Report* (twice), and *The Daily Show*, as well as allowed me to participate in documentaries on *NOVA*, *Frontline*, and *CNN*. I've learned a lot along the way.

One thing I have found, which I wouldn't have predicted, was that I had inadvertently put myself in the crosshairs of the antivaccine movement. Consisting of politicians, filmmakers, celebrities, parent activists, and personal-injury lawyers, the antivaccine movement is an unholy alliance dedicated to scaring parents away from vaccines. I've been the victim of hate mail, death threats, and lawsuits, and parents have been victims of bad information. It's been an education. But I can't quit. Too much is at stake. Not a year goes by at our hospital without a child dying from a vaccine-preventable disease: most commonly influenza, but occasionally pertussis, pneumococcus, and varicella. Invariably, these parents had chosen not to vaccinate their children. As is invariably the case, it is always the children who suffer our ignorance.

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China's Repeated Reunifications

Patricia Ebrey

Why has China, for so much of its history, been the most populous country in the world? How were the states that were formed in China able to rule larger territories and populations and maintain centralized structures longer than governments elsewhere? Six times in China's history states were able to defeat their rivals until they controlled both the Yellow River and the Yangzi River regions (my minimum definition of "unified") and last eighty years or more (my minimum definition of "long-lasting"). These states were the Qin-Han (221 BCE–220 CE), Sui-Tang (581–907), Northern Song (960–1127), Yuan (Mongol, 1276–1368), Ming (1368–1644), and Qing (Manchu, 1644–1911) dynasties.

The centuries that China was under the control of these large states and the centralized ways in which they ruled resulted in a large body of words, ideas, and practices shared across the Chinese subcontinent, leading some people to assume that it was China's cultural uniformity that enabled large states to be formed. I think causation, in the early stages at least, was heavily in the opposite direction: Large, centralized states facilitated the spread of language and cultural ideas and practices. In time, of course, the process became more two-way, as shared culture made reunification and strongly centralized governments easier to create and maintain. Thus, I am not persuaded by any of the single-factor explanations of China's unity in terms of its geography, writing system, or Confucian ideas. At a minimum, political practice and international context need to be considered.

To develop a more-nuanced, multifactor explanation, I have been focusing on three consecutive unifications: that of the Sui-Tang, Northern Song, and Yuan. In the first half of my book-in-progress I highlight some of the similarities and differences between the processes involved in these three unifications. All three were achieved overwhelmingly through force of arms. There are differences in how long it took to attain military dominance and the level of resistance aspiring dynastic founders encountered, but no dynasty was established by treaties negotiated by statesmen or by marriage alliances between rivals. Still, the groups that founded these dynasties are quite different. The Sui and Tang ruling groups belonged to the aristocracy of the Northern Dynasties, which included the Xianbei ruling families and the Han Chinese families with whom they intermarried. The Song founder, by contrast, was a professional soldier, who on taking the throne took steps to curb the power of other military men who had aided him. By the time the Mongols subjugated the Southern Song, they already held a huge empire extending into Mongolia, and they had an elaborate government staffed not only by Mongols but also by Chinese from the north and by people from other places in Eurasia.

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These unifications built on each other. Or to put this another way, they did not all start at the same place. Arguably, the first of these reunifications, the Sui-Tang, was not inevitable. In 500, one could conceive of two or three strong countries in East Asia. After all, Korea had been part of the Han, and the Sui and Tang rulers tried repeatedly to reincorporate it. If they failed in Korea, they could have also failed in Fujian or Zhejiang. Quite plausibly, the north and south could have continued indefinitely as rival powers. However, once the Sui-Tang reunification proved to be successful, the superiority of unity over division seemed self-evident to the political elite. The century and more of division during the Southern Song when large areas settled by Chinese were ruled by non-Chinese states did not lead to a shrinkage of the Chinese population. To the contrary, it strengthened Chinese cultural identity.

Some changes brought about by unifications were unique, others recurrent, and still others cumulative. Changes in state-elite relations are a good example of a recurrent development. The Confucian literati were not major power-holders at the beginning of any of these dynasties, but they were brought in more quickly in the Song than either the Tang or the Yuan.

A good example of cumulative change is the movement of people. Large migrations laid the groundwork for unifications of the north and south. These large movements of people from north to south occurred during periods of warfare in the north, such as in the fourth century, the second half of the Tang, the Jurchen invasion in the twelfth century, the Mongol campaigns in north China in the 1210s–1230s, their invasion of Sichuan in the 1230s, and their final campaigns in the Yangzi regions in the 1260s–1270s. These migrations made the next unification somewhat easier because the mixing of people from different regions helped strengthen shared culture. Some ruling houses forced the movement of people as a way to impose their power and reduce any chances of resistance. This was especially common among the non-Han ruling houses: the Xianbei Northern Wei moved tens of thousands of farmers from Hebei to the capital at modern Datong; the Western Wei reportedly moved similar numbers from the captured city of Jiangling to territory they controlled in the north; and the Kitans forced farmers in Hebei and Shanxi into modern Inner Mongolia, Liaoning, and places

further north. To some extent, forced movement to the north balanced the voluntary movement to the south.

Part II of my book-in-progress addresses the question of China's large and long-lasting empires from another angle: How were central governments able to rule effectively at such distances? Did the actual techniques change? Forced migration has been mentioned as a state-building practice, but there are many others. To explore them I narrow my time frame to the Song in order to drill down to the primary source evidence. The richest material by far is for the Song, and the Song is probably also the period with the most creative innovations in statecraft. One good example is regulating succession to the throne. Since longer-ruling dynasties did more to solidify China as a large unified empire than short ones, it is worth considering what made it possible for dynasties to keep putting descendants on the throne for centuries. Song makes advances on Tang in this regard, and there are no cases of usurpations or armed struggles over succession in the Song. From the start, the Song took steps to avoid eunuch interference with succession, which was a major problem in the late Tang. The Song dynasty was also successful in keeping princes away from power struggles. Equally important, the Song avoided succession crises by making the senior widow the king-maker when an emperor died before designating an heir.

The Song was equally inventive, even if less successful, in finding ways to cope with aggressive neighbors. Here it is particularly interesting that Song officials were willing to compare the costs of monetary tribute versus the cost of war. Rather than look at the matter in terms of glory or humiliation, they pragmatically calculated the costs and benefits. To assure adequate revenue for defense purposes, Song statesmen found ways to draw much of their needed funds from commercial taxes, monopolies, and state lands.

The area of Song statecraft that had the largest influence on subsequent dynasties was probably the civil service system. Song officials tried to improve all aspects of the recruitment system, leaving behind a voluminous body of material on schools and teaching, testing, promoting, evaluating, and disciplining officials. The civil service examination system was the centerpiece of state-elite relations in the Song. Officials believed that they had earned their position through merit, so this was their government. Their identification with the dynasty helps explain the amazing civility of the government in Song times. Song rulers dismissed officials they no longer trusted or posted them far from the capital; they did not have them beaten or executed. Factionalism in the court repeatedly turned nasty and there was much name-calling, but officials did not come to blows. No one in Song times ever assassinated a grand councilor or staged a coup.

Finally let me mention the Song government's innovations in reaching down to the common people. They made much use of the new technology of printing to have notices widely posted in towns and villages to alert commoners of changes in policy, upcoming due dates, new opportunities, and fraudulent practices. The Song government also earned the good will of ordinary people by conferring titles and promotions on their gods, something that meant so much to these communities that they often had a stone carved to commemorate the honor.

I have been concentrating on the positive side of Song statecraft because I am trying to explain a positive outcome: the government maintaining order and facilitating prosperity despite serious external threats. This is not the usual story. When historians examine political topics they typically focus on the failures or shortcomings because this is what men of the time wrote about. In comparative perspective, however, the successes require more explanation than the failures, and the successes, I believe, can be attributed in large part to Chinese skill in the art of government. ■

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In Memoriam: Leo L. Beranek (1914–2016)

Elected to the Academy in 1952



It is with profound sadness that the Academy notes the death of former Academy President Leo L. Beranek on October 10, 2016, at age 102. Dr. Beranek served as President from 1989 to 1994. He was an active and devoted member of the Academy, participating on the Council (1994–1999), the Development and Public Relations Committee (serving as its founding Chair, 1997–2003), the Investment Committee (1999–2001), the Budget Committee (1999–2000), and the Strategic Planning Steering Committee (1998–1999). As Chair of the Development Committee, he led the Academy’s first major campaign – the Third Century Fund. Among his many prizes and awards, he was the first recipient of the Academy’s Scholar-Patriot Award, and the Library at the House of the Academy in Cambridge is named in his and his wife Gabriella’s honor.

What a beneficent life! Leo Beranek, born in a simple Iowa farm village of 400 souls, struggling hard during the Great Depression, rose to exemplary leadership in a startling variety of important roles.

He was a scientist, technologist, inventor, industrialist, author, philanthropist, and leader of major institutions. Those ranged from initiating Harvard’s war-time Electro-Acoustic Research Laboratory, to coleading the high-technology company Bolt Beranek and Newman (BBN), to serving as the head of a new kind of television station, to being President of our Academy, and more. At each stage, he envisioned exploring new areas of national importance, and attracted with an easygoing charisma those he wished to work with him.

I recommend his autobiography *Riding the Waves: A Life in Sound, Science, and Industry* (published by The MIT Press in 2008). It is a gripping account of how the fabled “American Dream” may become a fact. Throughout the book, his native generosity and “can-do” attitude come through, starting with an early section entitled “A Momentous Encounter.”

While still a student beset by poverty, he happened one day to see a man glumly trying to change a flat tire. Leo offered to help, and he wrote that after some conversation, “I had a new friend. He wanted to know if I had considered going to a university where, as it happened, the man had been an instructor. ‘No,’ I said, that’s a rich man’s school.” The encounter ended with Leo receiving a recommendation from this man and being admitted to the university with a scholarship.

From then, Leo took off. To paraphrase a popular saying in a new context, a good fate can prepare a person deserving it, and benefits those working with him.

Gerald Holton
Harvard University

Select Prizes and Awards to Members

Bruce M. Alberts (University of California, San Francisco) received the Lasker-Koshland Award for Special Achievement in Medical Science.

Richard Alley (Pennsylvania State University) received the 2016 Climate Communications Prize from the American Geophysical Union.

Federico Capasso (Harvard University) was awarded the 2016 Balzan Prize for Applied Photonics.

Robert A. Caro (New York, New York) is the recipient of the Lifetime Achievement Award, given by the National Book Foundation.

Robert De Niro (New York, New York) was awarded the Presidential Medal of Freedom.

Ronald Drever (California Institute of Technology) was awarded a Special Breakthrough Prize in Fundamental Physics. He shares the prize with **Kip Thorne** (California Institute of Technology) and **Rainer Weiss** (Massachusetts Institute of Technology).

Bob Dylan (Malibu, California) was awarded the Nobel Prize in Literature.

Stephen Elledge (Harvard Medical School) was awarded the 2017 Breakthrough Prize in Life Sciences. He shares the prize with **Harry Noller** (University of California, Santa Cruz), **Roeland Nusse** (Stanford University School of Medicine), **Yoshinori Ohsumi** (Tokyo Institute of Technology), and **Huda Zoghbi** (Baylor College of Medicine).

Sandra Faber (University of California, Santa Cruz) was awarded the Fellows Medal of the California Academy of Sciences.

Bernard L. Feringa (University of Groningen) was awarded the Nobel Prize in Chemistry. He shares the prize with **J. Fraser Stoddart** (Northwestern University) and **Jean-Pierre Sauvage** (University of Strasbourg).

Glenn Fredrickson (University of California, Santa Barbara) received the 2016 William H. Walker Award for Excellence in Contributions to Chemical Engineering Literature.

Elaine Fuchs (Rockefeller University) was awarded the 2016 Vanderbilt Prize in Biomedical Science.

Richard Garwin (IBM Thomas J. Watson Research Center) was awarded the Presidential Medal of Freedom.

Bill Gates (Microsoft Corporation; Bill & Melinda Gates Foundation) and **Melinda Gates** (Bill & Melinda Gates Foundation) were awarded the Presidential Medal of Freedom.

Frank Gehry (Frank O. Gehry & Associates) was awarded the Presidential Medal of Freedom.

Herbert Gleiter (Institut für Nanotechnologie, Germany) was awarded the Medal of Friendship-Order of Merit by the government of China. He was also elected a Fellow of the National Academy of Inventors.

Laurie H. Glimcher (Dana-Farber Cancer Institute; Harvard Medical School) is the recipient of the 2016 Marion Spencer Fay Award.

Terry Gross (WHYY) was awarded a 2015 National Humanities Medal.

F. Duncan Haldane (Princeton University) was awarded the Nobel Prize in Physics. He shares the prize with **J. Michael Kosterlitz** (Brown University) and **David J. Thouless** (University of Washington).

Paula Hammond (Massachusetts Institute of Technology) has been elected to the National Academy of Medicine.

Oliver Hart (Harvard University) was awarded the Nobel Prize in Economic Sciences. He shares the prize with **Bengt Holmström** (Massachusetts Institute of Technology).

Richard H. Holm (Harvard University) received the 2016 Robert A. Welch Award in Chemistry. He shares the prize with **Stephen J. Lippard** (Massachusetts Institute of Technology).

Bengt Holmström (Massachusetts Institute of Technology) was awarded the Nobel Prize in Economic Sciences. He shares the prize with **Oliver Hart** (Harvard University).

Gerald Holton (Harvard University) was elected to the Austrian Academy of Sciences.

Jeffrey Immelt (General Electric Company) is the recipient of the 2017 Edison Achievement Award.

Henryk Iwaniec (Rutgers, The State University of New Jersey) was awarded the 2017 AMS Joseph L. Doob Prize by the American Mathematical Society. He shares the prize with **John Friedlander** (University of Toronto).

Philip S. Khoury (Massachusetts Institute of Technology) received a Doctorate of Humanities Honoris Causa from Earth University in Costa Rica.

J. Michael Kosterlitz (Brown University) was awarded the Nobel Prize in Physics. He shares the prize with **F. Duncan Haldane** (Princeton University) and **David J. Thouless** (University of Washington).

Arend Lijphart (University of California, San Diego) was awarded a Wilbur Cross Medal by the Yale Graduate School of Arts and Sciences.

Maya Lin (Maya Lin Studio) was awarded the Presidential Medal of Freedom.

Stephen J. Lippard (Massachusetts Institute of Technology) received the 2016 Robert A. Welch Award in Chemistry. He shares the prize with **Richard H. Holm** (Harvard University).

Wynton Marsalis (Jazz at Lincoln Center) was awarded a 2015 National Humanities Medal.

James McBride (New York University) was awarded a 2015 National Humanities Medal.

Marcia McNutt (National Academy of Sciences) was named the 2017 DRI (Desert Research Institute) Nevada Medalist.

Ira Mellman (Genentech, Inc.) was awarded a Wilbur Cross Medal by the Yale Graduate School of Arts and Sciences.

Louis Menand (Harvard University; *The New Yorker*) was awarded a 2015 National Humanities Medal.

Newton Minow (Sidley Austin LLP) was awarded the Presidential Medal of Freedom.

Joel Mokyr (Northwestern University) was elected as a Corresponding Fellow of the British Academy.

Harry Noller (University of California, Santa Cruz) was awarded the 2017 Breakthrough Prize in Life Sciences. He shares the prize with **Stephen Elledge** (Harvard Medical School), **Roeland Nusse** (Stanford University School of Medicine), **Yoshinori Ohsumi** (Tokyo Institute of Technology), and **Huda Zoghbi** (Baylor College of Medicine).

Roeland Nusse (Stanford University School of Medicine) was awarded the 2017 Breakthrough Prize in Life Sciences. He shares the prize with **Stephen Elledge** (Harvard Medical School), **Harry Noller** (University of California, Santa Cruz), **Yoshinori Ohsumi** (Tokyo Institute of Technology), and **Huda Zoghbi** (Baylor College of Medicine).

Monica Olvera de la Cruz (Northwestern University) was awarded the 2017 Polymer Physics Prize from the American Physical Society.

Robert E. Page Jr. (Arizona State University) has been elected a Fellow of the California Academy of Sciences.

Elaine Pagels (Princeton University) was awarded a 2015 National Humanities Medal.

Thalia Papayannopoulou (University of Washington) received the Wallace H. Coulter Award for Lifetime Achievement in Hematology from the American Society of Hematology.

Alan Perelson (Los Alamos National Laboratory) was awarded the 2017 Max Delbruck Prize in Biological Physics by the American Physical Society.

Joseph Polchinski (University of California, Santa Barbara) was awarded the 2017 Breakthrough Prize in Fundamental Physics. He shared the prize with **Andrew Strominger** (Harvard University) and **Cumrun Vafa** (Harvard University).

Michael Posner (University of Oregon) was awarded the 2017 Benjamin Franklin Medal in Computer and Cognitive Science.

Peter J. Ratcliffe (University of Oxford) received the Albert Lasker Basic Medical Research Award. He shares the award with William G. Kaelin, Jr. (Dana-Farber Cancer Institute; Harvard Medical School) and Gregg L. Semenza (Johns Hopkins University School of Medicine).

Rebecca Richards-Kortum (Rice University) was awarded a 2016 MacArthur Fellowship.

Kay Lehman Schlozman (Boston College) is the recipient of the American Political Science Association's Samuel J. Eldersveld Career Achievement Award.

Laurence Senelick (Tufts University) was awarded lifetime honorary membership in the American Theatre and Drama Society. He was also elected to the College of Fellows of the American Theatre.

Thomas Siebel (C3 IoT) received the 2016 Most Admired CEO Lifetime Achievement Award from the *San Francisco Business Times*.

Leon Simon (Stanford University) is the recipient of the 2017 AMS Leroy P. Steele Prize for Seminal Contributions to Research.

Henry I. Smith (Massachusetts Institute of Technology) was awarded the 2017 IEEE Robert N. Noyce Medal.

Bruce Springsteen (Colts Neck, New Jersey) was awarded the Presidential Medal of Freedom.

Robert A.M. Stern (Robert A.M. Stern Architects; Yale University) was awarded the 2017 Topaz Medallion for Excellence in Architectural Education.

J. Fraser Stoddart (Northwestern University) was awarded the Nobel Prize in Chemistry. He shares the prize with **Bernard L. Feringa** (University of Groningen) and **Jean-Pierre Sauvage** (University of Strasbourg).

Edward Stolper (California Institute of Technology) is the 2017 recipient of the Roebling Medal, given by the Mineralogical Society of America.

Andrew Strominger (Harvard University) was awarded the 2017 Breakthrough Prize in Fundamental Physics. He shares the prize with **Joseph Polchinski** (University of California, Santa Barbara) and **Cumrun Vafa** (Harvard University).

Mark Thiemens (University of California, San Diego) was awarded the Leonard Medal by the Meteorological Society.

John Meurig Thomas (University of Cambridge) has been awarded the Royal Medal for Physical Sciences by The Royal Society.

Kip Thorne (California Institute of Technology) was awarded a Special Breakthrough Prize in Fundamental Physics. He shares the prize with **Ronald Drever** (California Institute of Technology) and **Rainer Weiss** (Massachusetts Institute of Technology).

Cumrun Vafa (Harvard University) was awarded the 2017 Breakthrough Prize in Fundamental Physics. He shares the prize with **Joseph Polchinski** (University of California, Santa Barbara) and **Andrew Strominger** (Harvard University).

Diana Wall (Colorado State University) was elected an Honorary Member of the British Ecological Society.

David R. Walt (Tufts University) has been elected to the National Academy of Medicine.

Rainer Weiss (Massachusetts Institute of Technology) was awarded a Special Breakthrough Prize in Fundamental Physics. He shares the prize with **Ronald Drever** (California Institute of Technology) and **Kip Thorne** (California Institute of Technology).

Peter Wolynes (Rice University) has been elected a Foreign Fellow of the Indian National Science Academy.

New Appointments

David Agard (University of California, San Francisco) has been appointed to the University Council of Yale University.

Ben Barres (Stanford University School of Medicine) has been appointed a member of Cure Alzheimer's Fund's Research Consortium.

Bonnie Bassler (Princeton University) was elected to the Board of Directors of Regeneron Pharmaceuticals.

Emilio Bizzi (Massachusetts Institute of Technology) has been named to the Scientific Advisory Board of PathMaker Neurosystems.

George Q. Daley (Harvard Medical School; Children's Hospital, Boston) has been appointed Dean of Harvard Medical School.

Chi Van Dang (University of Pennsylvania Perelman School of Medicine) has been appointed Scientific Director of the Ludwig Institute for Cancer Research.

Persis Drell (Stanford University) has been named Provost of Stanford University.

Mark Fishman (Harvard University) has been appointed Chairman of the Board of Directors of Semma Therapeutics.

Jeffrey S. Flier (Harvard Medical School) has been appointed to the Board of Directors and Scientific Advisory Board of Scholar Rock.

W. Kent Fuchs (University of Florida) was appointed to the National Science Board.

Michael Gazzaniga (University of California, Santa Barbara) has been appointed to the Advisory Board of Yewno.

Linda Greenhouse (Yale Law School) has been elected President of the American Philosophical Society.

Nancy Ip (Hong Kong University of Science and Technology) has been appointed a member of Cure Alzheimer's Fund's Research Consortium.

Eric W. Kaler (University of Minnesota) has been elected Chair of the NCAA Division I Board of Directors.

Laura Kiessling (University of Wisconsin-Madison) has been appointed to the University Council of Yale University.

David Leebron (Rice University) was elected Chair of the Board of Directors of the Association of American Universities.

Nancy Lynch (Massachusetts Institute of Technology) has been appointed Associate Head of the Department of Electrical Engineering and Computer Science at MIT.

Kelsey Martin (University of California, Los Angeles) has been named Dean of the David Geffen School of Medicine at UCLA.

Mary Miller (Yale University) has been named Senior Director of the Institute for the Preservation of Cultural Heritage at Yale.

Geneva Overholser (New York, New York) has been appointed to Northwestern University in Qatar's Joint Advisory Board.

Julia M. Phillips (Sandia National Laboratories) was appointed to the National Science Board.

David Rockefeller, Jr. (Rockefeller Financial Services, Inc.) has been appointed Chairman of the Board of Directors of Rockefeller & Co.

Robert Rotberg (Harvard Kennedy School) has been appointed Fulbright Distinguished Research Professor at the Institute of International Relations, University of São Paulo, Brazil (2016–2017).

Gary Segura (Stanford University) has been named Dean of the UCLA Luskin School of Public Affairs.

Laurence Senelick (Tufts University) was appointed to the Editorial Advisory Board of *Early Popular Visual Culture*.

James Skinner (University of Wisconsin-Madison) has been named Director of the Water Research Initiative at the Institute for Molecular Engineering at the University of Chicago.

Debora Spar (Barnard College) has been named President of the Lincoln Center for the Performing Arts.

Darren Walker (Ford Foundation) has been appointed to the Board of Directors of PepsiCo.

Maria Zuber (Massachusetts Institute of Technology) has been elected to the Board of Directors of Textron.

Select Publications

Poetry

John Ashbery (New York, New York). *Commotion of the Birds*. Ecco, November 2016

Paul Muldoon (Princeton University). *Selected Poems, 1968–2014*. Farrar, Straus and Giroux, December 2016

Fiction

Margaret Atwood (Toronto, Canada). *Angel Catbird*. Dark Horse Books, September 2016

Margaret Atwood (Toronto, Canada). *Hag-Seed*. Hogarth, October 2016

Paul Auster (Brooklyn, New York). *4 3 2 1: A Novel*. Henry Holt and Co., January 2017

J. M. Coetzee (University of Adelaide, Australia). *The Schooldays of Jesus*. Viking, February 2017

Robert Coover (Brown University). *Huck Out West*. W. W. Norton & Company, January 2017

Emma Donoghue (London, Ontario, Canada). *The Lotterys Plus One*. Arthur A. Levine Books, March 2017

Ha Jin (Boston University). *The Boat Rocker*. Pantheon, October 2016

Ward Just (Vineyard Haven, Massachusetts). *The Eastern Shore*. Houghton Mifflin Harcourt, October 2016

Amos Oz (Ben-Gurion University of the Negev). *Judas*. Houghton Mifflin Harcourt, November 2016

Francine Prose (New York, New York). *Mister Monkey*. Harper, October 2016

Nonfiction

Akhil Reed Amar (Yale Law School). *The Constitution Today: Timeless Lessons for the Issues of Our Era*. Basic Books, September 2016

Rogers Brubaker (University of California, Los Angeles). *Trans: Gender and Race in an Age of Unsettled Identities*. Princeton University Press, October 2016

Benjamin Coates (Wake Forest University; Visiting Scholar, 2011–2012). *Legalist Empire: International Law and American Foreign Relations in the Early Twentieth Century*. Oxford University Press, July 2016

Judy Collins (New York, New York). *Cravings: How I Conquered Food*. Nan A. Talese, February 2017

Daniel C. Dennett (Tufts University). *From Bacteria to Bach and Back: The Evolution of Minds*. W.W. Norton & Company, February 2017

Ruth Bader Ginsburg (Supreme Court of the United States). *My Own Words*. Simon & Schuster, October 2016

Helen Hardacre (Harvard University). *Shinto: A History*. Oxford University Press, December 2016

Charles Hirschman (University of Washington). *From High School to College: Gender, Immigrant Generation, and Race-Ethnicity*. Russell Sage Foundation, August 2016

Kay Redfield Jamison (Johns Hopkins University School of Medicine). *Robert Lowell, Setting the River on Fire: A Study of Genius, Mania, and Character*. Knopf, February 2017

John Kaag (University of Massachusetts, Lowell; Visiting Scholar, 2007–2008). *American Philosophy: A Love Story*. Farrar, Straus and Giroux, October 2016

Eric R. Kandel (Columbia University). *Reductionism in Art and Brain Science: Bridging the Two Cultures*. Columbia University Press, September 2016

Richard Kramer (City University of New York, The Graduate Center). *Cherubino's Leap: In Search of the Enlightenment Moment*. University of Chicago Press, November 2016

Sara Lawrence-Lightfoot (Harvard University). *Growing Each Other Up: When Our Children Become Our Teachers*. University of Chicago Press, September 2016

Wendy Lesser (*The Threepenny Review*). *You Say to Brick: The Life of Louis Kahn*. Farrar, Straus and Giroux, March 2017

George J. Mitchell (DLA Piper) and Alon Sachar (Gibson, Dunn & Crutcher LLP). *A Path to Peace: A Brief History of Israeli-Palestinian Negotiations and a Way Forward in the Middle East*. Simon & Schuster, December 2016

Venkatesh Narayanamurti (Harvard University) and Toluwalogo Odumosu (University of Virginia). *Cycles of Invention and Discovery: Rethinking the Endless Frontier*. Harvard University Press, October 2016

Elaine Scarry (Harvard University). *Naming Thy Name: Cross Talk in Shakespeare's Sonnets*. Farrar, Straus and Giroux, November 2016

Ralph Snyderman (Duke University Medical Center). *A Chancellor's Tale: Transforming Academic Medicine*. Duke University Press, November 2016

Bruce Springsteen (Colts Neck, New Jersey). *Born to Run*. Simon & Schuster, September 2016

Mark V. Tushnet (Harvard Law School), Alan K. Chen (University of Denver Sturm College of Law), and Joseph Blocher (Duke University School of Law). *Free Speech Beyond Words: The Surprising Reach of the First Amendment*. New York University Press, February 2017

Neil deGrasse Tyson (American Museum of Natural History), Michael A. Strauss (Princeton University), and J. Richard Gott (Princeton University). *Welcome to Our Universe: An Astrophysical Tour*. Princeton University Press, October 2016

Lawrence Weschler (*The New Yorker*). *Waves Passing in the Night: Walter Murch in the Land of the Astrophysicists*. Bloomsbury, January 2017

George M. Woodwell (Woods Hole Research Center). *A World to Live In: An Ecologist's Vision for a Plundered Planet*. The MIT Press, February 2016

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Bulletin Winter 2017

Issued as Volume LXX, No. 2

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The Bulletin of the American Academy of Arts & Sciences (ISSN 0002-712X) is published quarterly by the American Academy of Arts & Sciences, 136 Irving Street, Cambridge, MA 02138. Periodicals rate postage paid at Boston, MA, and at additional mailing offices. Postmaster: Send address changes to *Bulletin*, American Academy of Arts & Sciences, 136 Irving Street, Cambridge, MA 02138.

The views expressed in the *Bulletin* are those held by each contributor and are not necessarily those of the Board of Directors and Members of the American Academy of Arts & Sciences.

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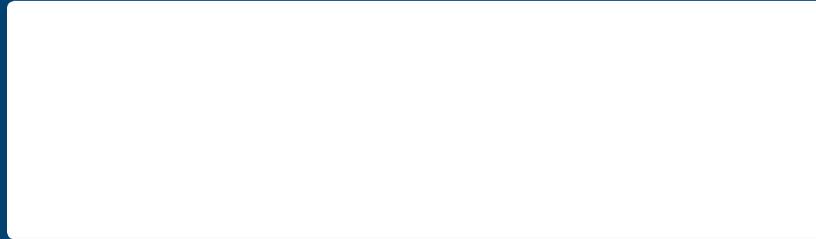
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