Institute for Advanced Study Spring 2017

Black Holes and the Butterfly Effect

How a solvable description of a black hole might shed light on quantum gravity's deep mysteries

BY DOUGLAS STANFORD

One of the surprising things about chaos is that it took so long for physicists to appreciate how common it is. This is despite the fact that people seem to come naturally programmed with intuition for the basic phenomenon: that small changes to the state of a complicated system can lead to dramatic changes a short while later. This idea is often referred to as the butterfly effect, and it was on display in creative works like the movie *It's a Wonderful Life* (1946) and

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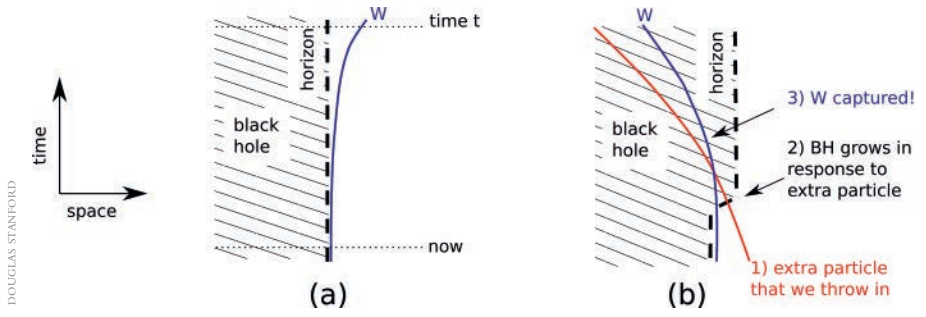


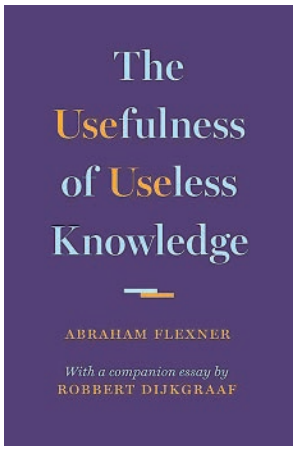
DOUGLAS STANFORD

The butterfly effect, as implemented by a black hole: a small perturbation (red particle in b) can have a large impact on the fate of a particle (blue line) that otherwise would have escaped.

The Usefulness of Useless Knowledge

IAS founding Director Abraham Flexner's compelling belief in the power of human curiosity

BY ROBBERT DIJKGRAAF



Abraham Flexner's perspective on the "usefulness of useless knowledge" has only gained in substance and breadth since his time. First and foremost, as Flexner argues so elegantly, basic research clearly advances knowledge in and of itself. Fundamental inquiry moves exploration as far up to the headwaters as possible, producing ideas that slowly and steadily turn into concrete applications and further studies. As it is often stated, knowledge is the only resource that increases when used.

Second, pathbreaking research leads to new tools and techniques, often in unpredictable and indirect ways. A remarkable, late-twentieth-century example of such a fortuitous outgrowth was the development of automatic information-sharing software, introduced as the World Wide Web in 1989. What began as a collaboration tool for thousands of particle physicists working at the CERN particle accelerator laboratory entered the public domain in 1993, unleashing the power of the Internet to the masses and facilitating large-scale communication around the

(Continued on page 4)

The Institute's Founding Ethos in Our Precarious Present

On scientific progress, the autonomy of scientific research, and the mobility of researchers

BY HISTORY WORKING GROUP

This article, among three in this issue, was written by a Member-organized History Working Group that mobilized in response to the January 27 executive order initially banning travel and immigration from seven predominantly Muslim countries.

Sanctuary rites

The Institute for Advanced Study came into being at the most inauspicious of times. Founded in the early years of the Great Depression, it took shape during the buildup to the Second World War and under the growing shadow of authoritarian regimes. Its first Director Abraham Flexner published his manifesto on the "The Usefulness of Useless Knowledge" in October 1939, barely a month after the outbreak of hostilities in Europe. Surely this was a daunting moment to defend "the fearless and irresponsible thinker" and advocate for the free expression of knowledge and curiosity.

The very adversity of the era, however, also created opportunities for the fledgling institution, primarily in the form of sudden availability of renowned and newly mobile scholars from the upper echelons of the German university system. After expressing initial hesitation, Flexner followed the urging of influential faculty members, particularly the mathematician Oswald Veblen, in seeking to provide a haven for some of these new refugees, a sanctuary tradition continued by Director Frank Aydelotte, Flexner's successor. In association with the Emergency Committee in Aid of Displaced Foreign Scholars (on which Veblen and Flexner served and whose name initially specified German rather than Foreign Scholars), the Rockefeller Foundation, and the Carnegie Foundation, IAS played a leading role in this farsighted, if ever elite, rescue effort.

UNITED SERVICE FOR NEW AMERICANS

Albert Einstein at his home with a group of World War II European Jewish refugee children

We find ourselves today, nearly nine decades after the Institute's founding in 1930, at another inauspicious juncture. Global political forces in power from Turkey to the United States are posing serious threats to the autonomy of scientific research and the mobility of researchers, undercutting two cardinal conditions for scientific progress. Walls, fences, bans, blocks, restrictions, cuts, and expulsions are slowly becoming run-of-the-mill terms for us to navigate in an increasingly precarious political landscape.

Travel restrictions involving pure accidents of birth, documented by passports from flagged countries, have prompted us to revisit today the Institute's history not because we believe that history repeats itself. Rather, we seek to provide the IAS community

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News of the Institute Community

JEAN BOURGAIN, IBM von Neumann Professor in the School of Mathematics, has received the 2017 Breakthrough Prize in Mathematics for multiple transformative contributions to analysis, combinatorics, partial differential equations, high-dimensional geometry, and number theory. MOHAMMED ABOUZAID, current Visitor in the School of Mathematics, was among the four recipients of the 2017 New Horizons in Mathematics Prize. Two former Members of the Institute's School of Natural Sciences, ANDREW STROMINGER (1982–87) and CUMRUN VAFA (1994), share the 2017 Breakthrough Prize in Fundamental Physics with Joseph Polchinksi. Additionally, three former Visitors in the School, PETER GRAHAM (2008), FRANS PRETORIUS (2012–13), and XI YIN (2010), were awarded the 2017 New Horizons in Physics Prize.

DIDIER FASSIN, James D. Wolfensohn Professor in the School of Social Science, has authored *Punir. Une passion contemporaine* (Seuil, 2017) and *La Razón Humanitaria. Una historia moral del tiempo presente* (Prometeo Libros, 2016). A book on his work, edited by Debora Diniz, has also been published by Editora da Universidade do Estado do Rio de Janeiro (2016).

Brill Academic Publishers has launched *Shii Studies Review* in collaboration with SABINE SCHMIDTKE, Professor in the School of Historical Studies, and HASSAN ANSARI, Member in the School.

VLADIMIR VOEVODSKY, Professor in the School of Mathematics, has received an honorary doctorate from the University of Gothenburg in Sweden.

JONATHAN ISRAEL, Professor Emeritus in the School of Historical Studies, has been awarded the 2017 Comenius Prize by the Foundation of the Comenius Museum in the Netherlands for his work on the age of Enlightenment, Dutch history, and European Jewry.

By presidential decree, JOAN WALLACH SCOTT, Professor Emerita in the School of Social Science, has been named a Chevalier de la Legion d'Honneur of France. She has also been honored with the 2016 Talcott Parsons Prize of the American Academy of Arts and Sciences for her distinguished contributions to the social sciences.

Princeton University Press has published *The Usefulness of Useless Knowledge*, which features IAS founding Director Abraham Flexner's classic essay of the same title, first published in *Harper's* magazine in 1939, alongside a new companion essay by ROBBERT DIJKGRAAF, Director and Leon Levy Professor.

Institute Trustee ERIC SCHMIDT has received the Woodrow Wilson Award, one of Princeton University's highest honors for alumni.

Institute Trustee Emeritus VARTAN GREGORIAN was awarded the medal of Chevalier of the French Legion of Honor at a ceremony at the Cultural Services of the French Embassy in New York City.

JAMES G. ARTHUR, former Institute Trustee (1997–2007) and Member (2000–02, 1994–95, 1984, 1976–77) in the School of Mathematics, has received the 2017 AMS Leroy P. Steele Prize for Lifetime Achievement for fundamental contributions to number theory and harmonic analysis.

The Social Science Research Council has awarded the 2016 Albert O. Hirschman Prize, the Council's highest honor, to AMARTYA SEN, Institute Trustee (1987–94).

ELIZABETH MERTZ, Visitor in the School of Social Science, has received the Association for Women Lawyers' Award for Mentoring Excellence.

JOHN PARDON, Visitor in the School of Mathematics, has received the Alan T. Waterman Award from the National Science Foundation for generating solutions that provide new tools for geometric analysis.

The Joint Policy Board for Mathematics has honored SIOBHAN ROBERTS, Director's Visitor, with the 2017 Communications Award for Expository and Popular Books, which recognizes outstanding achievement in communicating about mathematics to non-mathematicians.

The American Mathematical Society has recognized six former Institute Members with several major prizes. JOHN FRIEDLANDER (Member 2009, 2004, 1999–2000, 1995, 1983–84, 1972–74) and HENRYK IWANIEC (Member 1984–86, 1983–84) have received the 2017 AMS Doob Prize. DUSA MCDUFF, a frequent Member and Visitor who has long been affiliated with the Institute's Program for Women in Mathematics, and collaborator Dietmar Salamon have received the 2017 AMS Steele Prize for Exposition. LÁSZLÓ ERDŐS (Member 2013–14) and HORNG-TZER YAU (Member 2003, 1987–88; Visitor 1991) have received the 2017 Leonard Eisenbud Prize for Mathematics and Physics.

SHARON GERSTEL, Member (2010–11) in the School of Historical Studies, has been awarded the Runciman Book Prize for the book she was working on at IAS, *Rural Lives and Landscapes in Late Byzantium* (Cambridge University Press, 2015), which has also been selected as the recipient of the 2016 inaugural book prize of the International Center of Medieval Art.

The Mathematical Association of America has honored ROBERT D. HOUGH, Member (2015–16) in the School of Mathematics, with the David P. Robbins Prize for novel research in algebra and combinatorics.

CHRISTOPHER P. JONES, Visitor (2005–06, 1990–91, 1987) and Member (1982–83, 1971–72) in the School of Historical Studies, has been elected as an Associé étranger of the Academie des Inscriptions et Belles-Lettres, Paris.

The Association for Slavic Studies, East European, and Eurasian Studies and the Stanford University Center for Russian and East European Studies have recognized MICHAEL KUNICHIKA, Member (2015–16) in the School of Historical Studies, with an Honorable Mention award for the 2016 Wayne S. Vucinich Book Prize for his book *"Our Native Antiquity": Archaeology and Aesthetics in the Culture of Russian Modernism* (Academic Studies Press, 2015), which he completed during his stay at the Institute.

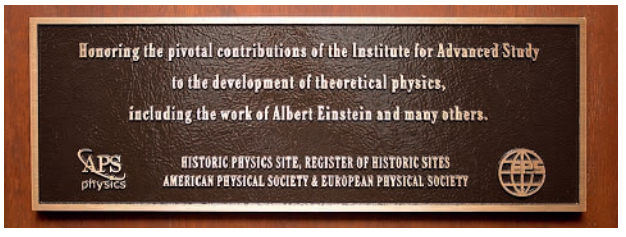
The American Historical Association has awarded the 2016 George Louis Beer Prize to VANESSA OGLE, Member (2013–14) in the School of Social Science, for her book *The Global Transformation of Time, 1870–1950* (Harvard University Press, 2015), which she completed during her stay at the Institute.

RICHARD SCHOEN, Distinguished Visiting Professor (1992–93) in the School of Mathematics and Member (1983–84, 1979–80) in the School, has been awarded the 2017 Wolf Prize for his contributions to geometric analysis and the understanding of the interconnectedness of partial differential equations and differential geometry.

W. ANTHONY SHEPPARD, Member (2011–12) in the School of Historical Studies, has been awarded the H. Colin Slim Award from the American Musicological Society for his article "Puccini and the Music Boxes," published in the *Journal of the Royal Musical Association* in 2015.

AKSHAY VENKATESH, Member (2005–06) in the School of Mathematics, has been awarded the 2016 Infosys Prize in Mathematical Sciences by the Infosys Science Foundation for his exceptionally wide-ranging, foundational, and creative contributions to modern number theory.

CHENYANG XU, Member (2014, 2008) in the School of Mathematics, has been awarded the 2016 Ramanujan Prize for Young Mathematicians from Developing Countries in recognition of his outstanding work in algebraic geometry.



The Institute for Advanced Study was recognized by the American Physical Society and the European Physical Society as their first Joint Historic Physics Site in the United States. This award recognizes the Institute's pivotal contributions to the development of theoretical physics. Following the ceremony, George Dyson, frequent Director's Visitor, presented a lecture on the creation of the Institute and its early years. View the video from the event at http://bit.ly/2faF3yH.

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Questions and comments regarding the *Institute Letter* should be directed to Kelly Devine Thomas, Editorial Director, via email at kdthomas@ias.edu or by telephone at (609) 734-8091.

Issues of the *Institute Letter* and other Institute publications are available online at www.ias.edu/publications.

Articles from issues of the *Institute Letter* are available online at www.ias.edu/ideas.

To receive monthly updates on Institute events, videos, and other news by email, subscribe to *IAS eNews* at www.ias.edu/enews.

IAS Response to Executive Orders Restricting Travel and Immigration

In recent months, the Institute for Advanced Study has issued public statements in response to the original and revised executive orders that restrict travel from predominantly Muslim countries. The orders, currently suspended, cause us great concern and alarm given the Institute's international scope and unwavering belief in nondiscrimination. Our founding principles are rooted in inclusion and excellence. From 1930 on, our scholars have been selected on the basis of their ability alone and with no regard to race, creed, or gender.

I would like to take the opportunity to share the Institute's formal responses to the executive orders and related activities. I immediately wrote a letter on January 30 to the Institute's Board of Trustees, Faculty and Emeriti, current Members and Visitors, and Staff.

> To the Institute community,
>
> I write to you with great concern regarding the federal executive order, which, on Friday, established travel restrictions for refugees and those coming to the U.S. from seven predominantly Muslim countries.
>
> From our founding, the Institute has welcomed academics from around the world, irrespective of race, gender, and creed, with the simple requirement that they be dedicated to advancing scholarship. Bringing leading scholars from all of the world's countries and regions and supporting their unfettered academic research, wherever it may take them, are among our core values. This was true in the 1930s when Faculty like Einstein, Weyl, and von Neumann came from Europe to the Institute, and it is true today as we welcome Faculty and Members from more than thirty countries.
>
> As an institution, we take seriously the potential of the new federal executive order to interfere with our scholars' ability to pursue their academic work. Since the order was issued, IAS staff have been working actively with affected scholars, and we will continue to provide support, guidance, and information as matters develop.
>
> Should you or any of your colleagues have questions or concerns or need assistance at this time, please contact Michael Klompus, Chief Human Resources Officer, or Jennifer Hansen, Visa and Visitor Services Coordinator. Michael or Jennifer will provide whatever support members of our community need and will guarantee privacy.
>
> True to its mission and history, the Institute will always be a strong advocate for the unobstructed flow of scholars across the world. In the meantime, we are committed to doing everything we can within the limits of the law to protect and support those who are affected by this executive order. We will provide updates and information as the situation evolves and the implications of the executive order are more clearly known. In the meantime, please do not hesitate to reach out should you wish to be in touch.

The Institute Faculty authored a subsequent statement, signed by Faculty, Emeriti, and Trustees, on February 1.

> The Institute for Advanced Study, since its founding in 1930, has provided an unbiased environment for international scholars to pursue vital and groundbreaking work in the sciences and humanities. Its mission is to recruit the world's most prominent scholars, "in the spirit of America at its noblest" and "with no regard whatsoever to accidents of creed, origin or sex." Against the backdrop of Fascism's rise in Europe and in the best tradition of American higher education, some of the intellectual giants of the twentieth century, immigrants and refugees themselves, found a safe haven within our walls, among them Albert Einstein, Kurt Gödel, Erwin Panofsky, and John von Neumann.
>
> It is therefore with deep conviction regarding the freedom of inquiry and intellectual exchange and the respect for the principles of justice and non-discrimination that we, the undersigned, condemn and oppose the recent federal executive order that suspends the entry of refugees, immigrants, and other visitors. It unnecessarily and unfairly impedes scholars, students, and more generally individuals and families, in particular those fleeing persecution, from traveling to the United States. It is contrary to the values of the international community to which we belong. We believe that the advancement of the sciences and humanities must make no distinction—geographical, political, or religious—among people. We stand unified against the unjust and discriminatory restrictions of the executive order, and we are committed to doing everything we can within the limits of the law to protect and support those who are affected.

A subsequent statement was issued in response to the revised executive order on March 7.

> The revised executive order unnecessarily and unfairly singles out and impedes the ability of people from six Middle Eastern and African countries from traveling to the United States unless they already hold visas or green cards. This order, as with the previous order issued in January, continues to directly conflict with the Institute for Advanced Study's founding principles and values, unwavering belief in non-discrimination and inclusion, and fundamental mission to provide a free and open environment for basic research in the sciences and humanities.
>
> As an institution, we oppose the revised travel ban on the principles of justice and non-discrimination and stand in unison for the advancement of knowledge without borders and prejudice.

In addition, the Institute is among nearly two hundred professional scientific, engineering, and education societies, national associations, and universities that have signed a letter sent to President Trump by the American Association for the Advancement of Science (AAAS). Given the uncertainty that has ensued since the orders were issued, the Institute invited current Members and our campus community to participate in a forum for discussion and exchange on this and related concerns. An outcome of these meetings was the formation of the History Working Group, which includes six Members across three of our four Schools, who were prompted to study materials in the Institute's Leon Levy and Shelby White Archives Center and collaboratively write the three articles in this issue.

We are taking the current political climate and its incursion into academic freedom very seriously. The Institute is deeply committed to protecting the integrity of its fundamental mission—to provide a free and open environment for curiosity-driven research in the sciences and humanities. We will continue to advance knowledge without borders and prejudice, and to act as a strong advocate when this is challenged.

Robbert Dijkgraaf
Director and Leon Levy Professor

Janine Purcaro Appointed IAS Chief Operating Officer

The Institute for Advanced Study has appointed Janine Purcaro as its new Chief Operating Officer and Associate Director for Finance and Administration. Purcaro was most recently the Chief Financial Officer for the Division of Intercollegiate Athletics at Rutgers University, where she was responsible for the management and supervision of all financial affairs, strategic planning, human resources, information technology, and facility operations. Purcaro also served as the Chief Financial Officer and Assistant Treasurer for the Rutgers University Foundation, where she directed financial, human resources, and operations departments, managed the Board of Overseers, and played a pivotal role in the Foundation's successful $1 billion capital campaign. Purcaro succeeds John Masten, who served in his position as Associate Director for Finance and Administration for eleven years.

As the Chief Operating Officer and Associate Director for Finance and Administration, Purcaro will provide operational, financial, and administrative leadership to the Institute. Purcaro will also ensure the integrity of the Institute's finances, and will be responsible for oversight of accounting and related communication with the Institute's Board of Trustees and Robbert Dijkgraaf, Director and Leon Levy Professor. Dijkgraaf commented, "I am very pleased to welcome Janine Purcaro to the Institute with her outstanding record of accomplishments and wealth of knowledge. Janine is deeply committed to the mission of the Institute and will be an essential figure in shaping its future success."

DAN KOMODA

Janine Purcaro

Regarding her appointment, Purcaro said, "I am delighted to join the dedicated Board of Trustees and staff in supporting the Faculty and scholars who continue to transform the world with their research. It will be my privilege to work with Robbert toward the continued growth and success of the Institute, whose mission and vision are so important for the future."

Purcaro has worked for nearly thirty years in financial, operations, and strategic planning for a wide range of institutions and organizations. Prior to joining Rutgers University in 2004, she was a Certified Public Accountant for the accounting firms KPMG and Romano, Hearing, Testa & Knorr CPAs; served as Vice President of Administration for Ware's Van & Storage Company, Inc., and as Manager of Technical Analysis at the Continental Corporation; and ran her own accounting and consulting practice. Purcaro earned her undergraduate degree in professsional accounting from The State University of New York at Plattsburgh and her Master of Public Administration degree from Rutgers, The State University of New Jersey. She is also a Certified Public Accountant in the state of New Jersey and a member of the American Institute of Certified Public Accountants. ■

globe. To store and process the vast amount of data produced in the same particle experiments, so-called grid and cloud computing were developed, linking computers in huge virtual networks around the world. These cloud technologies now drive many Internet business applications, from services and shopping to entertainment and social media.

A third attribute is the attraction of curiosity-driven research to the very best minds in the world. Young scientists and scholars, drawn to the intellectual challenges of fundamental questions, are trained in completely new ways of thinking and using technology. Once these skills carry over to society, they can have transformative effects. For example, scientists who have learned to capture complex natural phenomena in elegant mathematical equations apply these techniques to other branches of society and industry, such as in the quantitative analysis of financial and social data.

Fourth, much of the knowledge developed by basic research is made publicly accessible and so benefits society as a whole, spreading widely beyond the narrow circle of individuals who, over years and decades, introduce and develop the ideas. Fundamental advances in knowledge cannot be owned or restricted by people, institutions, or nations, certainly not in the current age of the Internet. They are truly public goods.

Finally, one of the most tangible effects of path-breaking research appears in the form of start-up companies. The new industrial players of the past decades show how powerful technologies are in generating commercial activities. It is estimated that more than half of all economic growth comes from innovation. Leading information technology and biotech industries can trace their success directly to the fruits of fundamental research grown in the fertile environments around research universities such as in Silicon Valley and the Boston area, often infused by generous public investments. MIT estimates that it has given rise to more than thirty thousand companies with roughly 4.6 million employees, including giants such as Texas Instruments, McDonnell Douglas, and Genentech.

The two founders of Google worked as graduate students at Stanford University on a project supported by the Digital Libraries Initiative of the National Science Foundation—possibly the government grant with the highest payoff ever.

Flexner was not the first to argue for the power of curiosity and imagination. In "The Usefulness of Useless Knowledge," he writes, "Curiosity, which may or may not eventuate in something useful, is probably the outstanding characteristic of modern thinking. It is not new. It goes back to Galileo, Bacon, and to Sir Isaac Newton, and it must be absolutely unhampered."

While the big-picture arguments for blue-sky research driven by curiosity and imagination are as timely and relevant as ever, much has happened since the publication of Flexner's essay. The seminal contributions of scientists during the war years, as exemplified by the Manhattan Project, led to the broad realization that basic research is crucial to the survival of the nation and the world. As director of the Office of Scientific Research and Development during World War II, Vannevar Bush produced a report in 1945, at President Roosevelt's request, that captured and communicated that insight. Bush's *Science, the Endless Frontier* ushered in a postwar boom in public funding of basic science, first in the United States and soon across the Western world. Remarkably, despite the obvious immediate need for weapons research, the intrinsic cultural value of science and scholarship was consistently emphasized. As physicist Robert Wilson would testify in a 1969 congressional hearing about the possible Cold War use of the Fermilab particle accelerator, "This new knowledge has all to do with honor and country, but it has nothing to do directly with defending our country, except to help make it worth defending." During this same period, the American liberal arts tradition in education was revitalized, embracing the humanities as an anchor for the fundamental values for which World War II had been fought.

This article is an adapted excerpt from The Usefulness of Useless Knowledge *by Abraham Flexner, founding Director of the Institute for Advanced Study, and Robbert Dijkgraaf, ninth Director of the Institute. The book, which was published by Princeton University Press in March, celebrates Flexner's classic essay of the same title, first published in* Harper's *magazine in 1939. It includes a new companion essay by Dijkgraaf wherein he describes how basic research has led to major transformations in the past century and explains why it is an essential precondition of innovation and the first step in social and cultural change.*

DAN KOMODA

Above: The Institute celebrated the publication of *The Usefulness of Useless Knowledge* on March 13 with a panel discussion with Robbert Dijkgraaf (center) and special guests (from left) Peter Dougherty, Shirley Tilghman, and Vartan Gregorian. *Below*: On March 20, Robbert Dijkgraaf (left) and William P. Kelly, New York Public Library's Andrew W. Mellon Director of the Research Libraries, discussed Flexner's ideas during an event, "Curious Paradox: The Usefulness of Useless Knowledge," at the New York Public Library.

Recommended Reading and Viewing:

"The Usefulness of a March for Science" by Alan Burdick, *New Yorker*, April 24, 2017, www.newyorker.com/tech/elements/the-usefulness-of-a-march-for-science

"In Praise of 'Useless Endeavors'" by Gillian Tett, *Financial Times*, March 23, 2017, http://bit.ly/2nJNBEZ

"Curious Paradox: The Usefulness of Useless Knowledge" with Robbert Dijkgraaf and William P. Kelly, New York Public Library, March 20, 2017, http://on.nypl.org/2owpDvH

"Knowledge Is a Kind of Infrastructure" by Robbert Dijkgraaf, *Scientific American*, March 10, 2007, http://bit.ly/2od0Oli

Celebrating "The Usefulness of Useless Knowledge" with Robbert Dijkgraaf, Peter Dougherty, Vartan Gregorian, and Shirley Tilghman, March 13, 2017, https://youtu.be/rb4CyvY54Eg

"We Need More 'Useless Knowledge'" by Robbert Dijkgraaf, *The Chronicle of Higher Education*, March 2, 2017, http://bit.ly/2mXor4w

"A 1939 Essay Resonates Today" by Craig A. Tovey, *Science*, February 22, 2017, http://bit.ly/2pbNSR3

As a consequence, the postwar decades saw an unprecedented worldwide growth of science, including the creation of funding councils like the National Science Foundation and massive investments in research infrastructure. Another crucial impetus came with the launch of a basketball-sized Soviet space vehicle on October 4, 1957. Sputnik was a watershed moment for American education and research. It reformed the science curriculum with an emphasis on hands-on experiments, led to the creation of NASA and the space race, set up the advanced research agency DARPA within the Department of Defense, and substantially increased research funding for science and engineering. The present age of microelectronics and the Internet can trace its beginnings directly to the Sputnik effect.

Recent decades have seen a marked retrenchment from that positive trend. One can argue that the state of scholarship has now reached a critical stage that in many ways mirrors the crisis that Flexner addressed. Steadily declining public funding is currently insufficient to keep up with the expanding role of the scientific enterprise in a modern knowledge-based society. The U.S. federal research and development budget, measured as a fraction of the gross domestic product, has steadily declined, from a high of 2.1 percent in 1964, at the height of the Cold War and the space race, to currently less than 0.8 percent. (Note that roughly half of that budget has remained defense-oriented.) The budget for the National Institutes of Health, the largest funder of medical research in the United States, has fallen by 25 percent over the past decade.

Flexner writes eloquently about how fearless thinking helps to answer fundamental questions about nature and identity: Who am I? Where am I? What does it mean to be a human being? Freedom of thought is essential to human welfare, not only as a tool for advancing knowledge, but also as a crucial element of democracy and tolerance. Like the arts, unfettered scholarship uplifts the spirits, heightens our perspective above the everyday, and shows us a new way to look at the familiar. It literally changes our world. In Flexner's words, "The real enemy of the human race is not the fearless and irresponsible thinker, be he right or wrong. The real enemy is the man who tries to mold the human spirit so that it will not dare to spread its wings."

In many ways, Flexner's essay can be seen as a time capsule, written in a time of great upheaval and anxiety, but fundamentally positive in its long-term outlook. Looking back, it is remarkable how relevant and timely his observations about the power of human curiosity are to the world of today. It's not hard to imagine that this will also be true for the world of tomorrow. ■

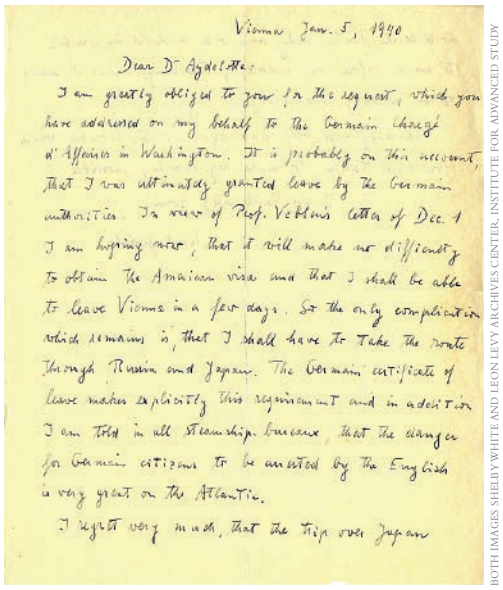
Robbert Dijkgraaf is Director and Leon Levy Professor of the Institute for Advanced Study. Dijkgraaf is advocating for the importance of basic research and the pursuit of curiosity-driven knowledge at multiple venues and public events across the country and in the United Kingdom. For more information, visit www.ias.edu/about/usefulness-useless-knowledge.

with sketches of scholarly lives and scientific cultures, interrupted by nationalist forces of exclusion. That these lives and cultures managed to reconstitute themselves and enrich our common human heritage is thanks only to efforts to provide them with sanctuary.

The conversion of Abraham Flexner

At the end of January 1933, Adolf Hitler became chancellor of Germany. Over the next two months, the Nazi Party moved quickly to consolidate its power, expanding executive authority through emergency decrees following the Reichstag fire and swiftly moving into a formal dictatorship. An edict in April initiated a purge of civil servants who were of non-Aryan descent or exhibited suspect political sentiments. This law directly impacted German universities, and it had a particularly strong effect in the fields of mathematics and natural sciences, where Jews had enjoyed better prospects of pursuing a scholarly career. As a consequence, many of the country's strongest intellectual centers lost leading figures in the space of just a few months, including the renowned Mathematical Institute at the University of Göttingen, home of David Hilbert, Richard Courant, Hermann Weyl, and Emmy Noether. This upheaval produced a sudden wave of refugee scholars seeking to emigrate and desperate to find positions elsewhere. It also coincided with the transition of IAS from a concept to an embodied institution, through the founding of the inaugural School of Mathematics.

The crisis of refugee scholars presented Flexner and Veblen with a challenging opportunity. The Institute had already pulled an extraordinary coup in recruiting Albert Einstein and John von Neumann shortly before Hitler's coming to power. But how far should they continue in recruiting additional émigrés? Flexner initially expressed ambivalence on the topic, torn between a desire to live up to founding ideals and concern over the need to support and foster local talent. As he wrote to Veblen on March 27, 1933: "Mr. Bamberger and Mrs. Fuld were very anxious from the outset that no distinction should be made as respects race, religion, nationality, etc., and of course I am in thorough sympathy with their point of view, but on the other hand if we do not develop America, who is going to do it, and the question arises how much we ought to do for others and how much to make sure that civilization in America advances." On May 2, again responding to Veblen, he expanded on the same theme: "We are certainly in the devil of a fix. Unable to care for our own younger men, we are pressed by applications from foreign countries. It seems to me clear that we must in the first place endeavor to find work for those whom we have encouraged to train themselves in this country on the theory that, if they were worthy, there would be jobs waiting for them. Until we have done that, what else can we do? Our opportunities for making places for foreigners are therefore at the moment limited to a few outstanding personages such as Einstein and Weyl…"



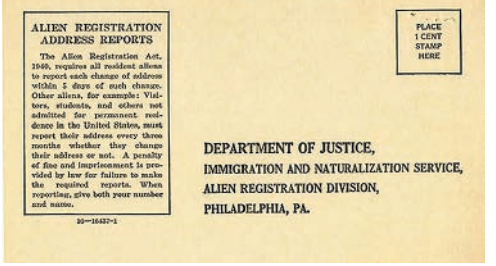
Vienna, Jan. 5, 1940

Dear Dr. Aydelotte:

I am greatly obliged to you for the request, which you have addressed on my behalf to the German charge d'Affaires in Washington. It is probably on this account, that I was ultimately granted leave by the German authorities. In view of Prof. Veblen's letter of Dec. 1 I am hoping more, that it will make no difficulty to obtain the American visa and that I shall be able to leave Vienna in a few days. So the only complication which remains is, that I shall have to take the route through Russia and Japan. The German certificate of leave makes explicitly this requirement and in addition I am told in all steamship bureaux, that the danger for German citizens to be arrested by the English is very great on the Atlantic.

I regret very much, that the trip over Japan

Letter from Kurt Gödel to IAS Director Frank Aydelotte, January 5, 1940, expressing gratitude for his and Flexner's help in securing permission for the Gödels to leave Vienna



ALIEN REGISTRATION ADDRESS REPORTS

The Alien Registration Act, 1940, requires all resident aliens to report each change of address within 5 days of such change. Other aliens, for example: Visitors, students, and others not admitted for permanent residence in the United States, must report their address every three months whether they change their address or not. A penalty of fine and imprisonment is provided by law for failure to make the required reports. When reporting, give both your number and name.

PLACE 1 CENT STAMP HERE

DEPARTMENT OF JUSTICE,
IMMIGRATION AND NATURALIZATION SERVICE,
ALIEN REGISTRATION DIVISION,
PHILADELPHIA, PA.

Even after they succeeded in reaching the United States, refugees needed to stay bureaucratically alert. Under the Alien Registration Act of 1940, the U.S. Immigration and Naturalization Service required noncitizens to record all changes of address, and even local travel could necessitate permission.

BOTH IMAGES SHELBY WHITE AND LEON LEVY ARCHIVES CENTER, INSTITUTE FOR ADVANCED STUDY

For his part, Veblen pressed for a more active stance, not only advocating that the Institute do all it could, but also endorsing the establishment of a formal network to provide assistance to scholars in need. As he wrote to Flexner on May 5: "Some kind of a committee to raise funds for the purpose of enabling some of them to live and continue their scholarly work in the countries adjacent to Germany or elsewhere might be feasible. The existence of such a committee would in itself be an eloquent protest." That same month, the Institute of International Education in New York City set up an Emergency Committee in Aid of Displaced German Scholars (later renamed to include all Foreign Scholars), headed by Edward R. Murrow, to assist scholars fleeing Europe. Veblen would join its board soon thereafter.

Over the course of the ensuing years, Flexner would undergo a conversion, becoming more deeply involved in assistance projects—he followed Veblen into the Emergency Committee—and increasingly willing to mobilize the Institute to this effect. In a 1938 letter to George Birkhoff at Harvard, he insisted that national origin should never stand in the way of higher goals. "Let us keep firmly in front of our eyes our real goal, namely the development of mathematics, not American mathematics or any other specific brand of mathematics, just simply mathematics. It can be developed only by having first-rate men in important posts, and every time an institution gets one first-rate man he creates opportunities for other first-rate men, and every such center that is developed stimulates some other institution to do likewise. Hitler has played into our hands and is still doing it like the mad man that he is. I am sorry for Germany. I am glad for the United States. I will undertake to get a position within a reasonable time for any really first-rate American mathematician, and I will also undertake simultaneously to do the same for any first-rate foreign mathematician whom Hitler may dismiss. The more the merrier."

In his Director's Report the following spring, Flexner even cast the matter as heralding a seismic change in the geography of knowledge: "We are living in an epoch-making time. The center of human culture is being shifted under our very eyes. Once it had its home in Athens. A few centuries later it had its home in Italy, a few centuries later in Paris, and thereafter also in Great Britain and Germany. It is now being unmistakably shifted to the United States. The scholars of Europe are refugees driven out of their own countries sometimes for political or religious reasons and sometimes because they are too unhappy and too distracted to pursue the work to which they are giving their lives. They have come to the Institute or have corresponded with the Institute literally by the hundreds. We cannot, of course, undertake either to give them places or to find them places, though we have done something substantial under both heads. Fifty years from now the historian looking backward will, if we act with courage and imagination, report that during our time the center of gravity in scholarship moved across the Atlantic Ocean to the United States. It is a grave responsibility which is thus being thrust upon us all." From a vantage point almost eighty years later, Flexner's claim seems more prophetic than hyperbolic. Although the transference in scientific work away from German and toward global English may have begun earlier, the center of gravity clearly shifted in the second half of the twentieth century. Germany's leading share of Nobel Prizes plummeted after the war, even as the number of American laureates soared (one third of whom were foreign born).

"A wall of bureaucratic measures"

The actual process of reaching the United States was far from simple for most would-be immigrants, who had to navigate not just an ocean, but also a maze of paperwork to obtain the requisite permission to exit and enter. To assist them, Flexner and Aydelotte used their extensive contacts and pulled strings as much as possible. When the mathematical logician Kurt Gödel found himself unable to leave Vienna in October 1939, Flexner contacted the chief of the visa division at the Department of State to plead on his behalf. Although Gödel had been legally admitted as a permanent resident earlier in the 1930s, he had returned to the annexed country that used to be Austria, and was facing difficulty getting authorization to return to the United States. "Is there anything that the State Department or the Consul General can do," Flexner asked, "to suggest some helpful method of procedure?" The American authorities answered that the problem seemed to be with German authorities, and so Flexner's successor Aydelotte contacted the German embassy in Washington, D.C. Eventually Gödel and his wife Adele were permitted to leave. By German directive they traveled east instead of west, avoiding British surveillance of the Atlantic by crossing Siberia and eventually getting to Japan in 1940, where they found a boat to San Francisco.

> THE CRISIS OF REFUGEE SCHOLARS PRESENTED FLEXNER AND VEBLEN WITH A CHALLENGING OPPORTUNITY. THE INSTITUTE HAD ALREADY PULLED AN EXTRAORDINARY COUP IN RECRUITING ALBERT EINSTEIN AND JOHN VON NEUMANN … BUT HOW FAR SHOULD THEY CONTINUE IN RECRUITING ADDITIONAL REFUGEES?

Even after refugees succeeded in reaching the United States, they needed to stay bureaucratically alert, and often required assistance. Under the Alien Registration Act of 1940, the U.S. Immigration and Naturalization Service collected fingerprints and required noncitizens to record all changes of address. Even local travel could necessitate permission, such that Gödel, once finally settled in Princeton, had to request permission to travel with his wife to visit a doctor in New York City in January 1942. They always went by train, Gödel assured the U.S. Attorney, and returned on the same day. Three weeks later, Aydelotte's secretary sent a follow-up plea, noting, "If you could grant them this permission promptly it would be a great relief to them and would be very much appreciated."

(Continued on page 6)

The IAS faced other hurdles in its attempts to assist refugee scholars, including the criteria established by the very bodies seeking to provide aid. The case of Ernst Kapp illustrates the poignant complications involved. In 1937, Kapp, an eminent classicist, lost his position in Hamburg due to his liberal beliefs and his wife's classification as "non-Aryan." Already in England for a visit to Oxford, Kapp managed to get himself to New York by 1939, and began desperately seeking a position. At IAS, the art historian Erwin Panofsky and Aydelotte sought to assist him, contacting possible means of support. After extensive efforts Kapp managed to find an instructorship at the H. Sophie Newcomb Memorial College for women at Tulane University in New Orleans, but it only paid $750 a year, not the $2,000 required to receive the necessary visa. The Oberlaender Trust offered an additional $650, and Panofsky wrote to the Emergency Committee to plead for the remainder. This last-minute success only brought a year's reprieve, and more than two hundred applications later he still had nothing; classicists were not in demand. Moreover, he fell between categories for assistance. As Aydelotte discovered when trying to assist him, the New School's University in Exile had no room for scholars who were already in the United States. Kapp returned to New York for a temporary editing project. At the end of 1940, Aydelotte noted that despite potential support from the Emergency Committee and others, scholars were lost without an institutional home: "All that Kapp needs is an appointment with some institution, so that the institution can make a request for these contributions. In addition, I think some of Kapp's friends would, if necessary, put up small sums such as they could afford (from $10 to $25 a month each) to ensure a modest livelihood for him. Kapp is not eligible for Dr. Alvin Johnson's scheme because he is already in this country. The fact is that if he does not get some help he will not be here long, for he is likely to starve to death. He is at the moment down almost to his last dollar." Again, Kapp found last-minute rescue in the form of an unorthodox appointment at Columbia, partly subvented by the Emergency Committee.

The Institute's most famous scholar in exile, Albert Einstein, underscored the unending hassles that hindered attempts to welcome foreign scholars in a letter he wrote to Eleanor Roosevelt on July 26, 1941: "A policy is now being pursued in the State Department which makes it all but impossible to give refuge in America to many worthy persons who are the victims of Fascist cruelty in Europe. Of course, this is not openly avowed by those responsible for it. The method which is being used, however, is to make immigration impossible by erecting a wall of bureaucratic measures alleged to be necessary to protect America against subversive, dangerous, elements."

A call for vigilance

As we immersed ourselves in the thicket of correspondence at the heart of the Institute's archives, the sense of urgency expressed by scholars like Flexner, Veblen, Aydelotte, Einstein, Kapp, and Noether resonated deeply. Their notes and exchanges, not to mention the Emergency Committee that Flexner and Veblen served on, had an unsettling contemporary ring to them. This part of the Institute's history testifies to the individual courage of these men and women who extended a helping hand and built institutional networks to provide sanctuary for displaced refugees. In doing so, they overcame the nationalist siege-mentality that sees foreigners, whether they are mathematicians or fruit pickers, as a threat to be warded off. An unintended consequence of their acts was the shifting of the center of intellectual research from Germany to the United States, enriching the country that gave them refuge. Their individual initiatives and collective institution-building endeavors provide us with much-needed exemplars of moral fortitude.

It only took a few months and one edict purging civil servants of non-Aryan descent or exhibiting suspect political sentiments in April 1933 to drain the German university of many of its brightest minds and its intellectual vigor. Of course, the contemporary political situation in the United States remains far from this extreme case. Nonetheless, knowledge of this history should serve as a call for vigilance in the face of policies such as travel bans and immigrant deportations, as well as attempts to curb scientific inquiry and cut funding to arts and humanities endowments that now threaten the autonomy of research and the pursuit of a dignified human life. Unfortunately, history suggests it takes much less time to destroy than to build. As it did in the 1930s, the Institute can play a leading symbolic role in our contemporary predicament. ■

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The History Working Group articles (see also pages 7 and 8) were authored by Fadi Bardawil, Member in the School of Social Science; Thomas Dodman, Member in the School of Historical Studies; Ian Jauslin, Member in the School of Mathematics; Pascal Marichalar, Visitor in the School of Social Science; Klaus Oschema, Gerda Henkel Stiftung Member in the School of Historical Studies; and Peter Redfield, Member in the School of Social Science.

The authors acknowledge the help and past work of Josie Faass, Director of Academic Affairs; Peter Goddard, Professor Emeritus in the School of Natural Sciences and past Director of the Institute; Erica Mosner, Archival Assistant; Kelly Devine Thomas, Editorial Director; and Karen Uhlenbeck, Visitor in the School of Mathematics and Professor and Sid W. Richardson Regents Chairholder at the University of Texas at Austin.

FALL AT THE INSTITUTE

by Erika Michael

for my husband, Ernest A. Michael 1925–2013

and we bopped to a sync of dry leaves' kick and crackle
with the Skip-To-My-Lou of daughter Hillary hailing
Princeton's pre-school bus that mustered those fledgling

flocks set to soar and sing like the Wood's warblers,
while you tackled complex proofs fixing worlds of infinite
dimension in signs, numbers, mappings and lines.

In the ambient flow of Fuld Hall Commons at Tea —
the gathered minds' ruminations on lapsed and present time
glowed like past light striking one flame

in memoriam for the ghost tenants of those well-worn
leather chairs; seedbed of thought crunched like biscuit and nuts —
the bubbling urgency rising as Earl Grey steam from

fragile vessels. Before snow brushed the grounds strewn
with sugar maple, hawthorn, chalkboard, and villaged in Georgian
brick and Breuer white — our son Josh appeared for early

entrance into the what is this jive! of an awesome world,
come alive in the chromatic-historic-topologic toy box, that
unified field of his first home at 45 Einstein Drive.

O the reach, the clasp, the pull or push of gravitas, mind-bending
warp of space-time's bouncy house whose quasars glow on galaxies,
astound star-gazers dopplerized by red shift, the bosons and

quarks — the not yet measured ninety-six percent of stuff
that's dark, the part we know we don't yet know about
fluorescing brainscape synapses and circuitries.

The trace of us — the flint, the clay, the
bundled reeds, the marbles, consecrated glass, the signs on
stone and skin and rag in oil and ink, the chants, the

pipes, the strings, the leap and sway — the genius, the
witness sealed in celluloid and gigabyte, what all we think
about, what all we write, the chronicles we fantasize to

deconstruct the relics of an interstellar take-away.
The awe, the play, the gist of things, the gentleness,
the truth of us, this place — the omnibus.

Erika Michael is an art historian, painter, poet, and widow of Ernest A. Michael, a frequent Member in the School of Mathematics from 1951 to 1968. The Institute is deeply grateful for a gift Erika made to dedicate the apartment they shared, 49 Flexner Lane (previously 45 Einstein Drive), in Ernest's honor.

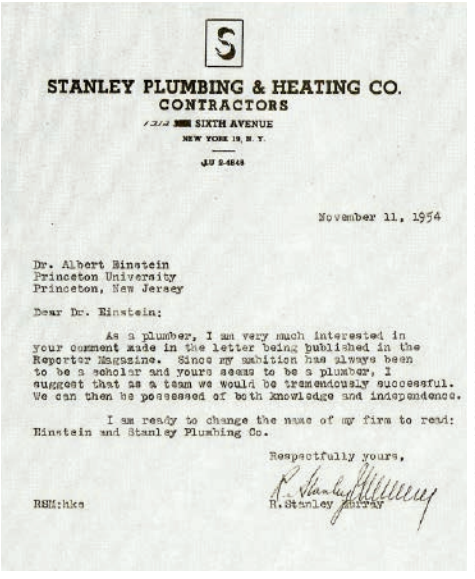
Einstein, Plumbers, and McCarthyism

Einstein's response to a political climate increasingly hostile to scientists and teachers

BY HISTORY WORKING GROUP

In November 1954, Albert Einstein wrote a letter to a magazine in which he declared that, were he a young man again, he would not try to become a scientist: "I would rather choose to be a plumber or a peddler in the hope to find that modest degree of independence still available under present circumstances." Around the United States, plumbers responded. The famous physicist was offered membership in the Chicago plumbers union, and Stanley Murray, a New York plumber, wrote to him: "Since my ambition has always been to be a scholar and yours seems to be a plumber, I suggest that as a team we would be tremendously successful. We can then be possessed by both knowledge and independence. I am ready to change the name of my firm to read: Einstein and Stanley Plumbing Co."

Einstein was only half-joking, however, when he issued his statement. The physicist sincerely considered that the political climate in the country was becoming increasingly hostile to scientists and teachers. Our own troubled times have many aspects in common with the dreadful period of the McCarthy investigations: the attacks on the freedom of academics, teachers, and the press, the silencing and censorship of government workers, the idea that the United States is threatened by certain creeds. It is worth describing the dire sequence of past events, and learning from Einstein's clairvoyant and courageous response to them, in order to best address the present situation.



STANLEY PLUMBING & HEATING CO.
CONTRACTORS
SIXTH AVENUE
NEW YORK 19, N. Y.

November 11, 1954

Dr. Albert Einstein
Princeton University
Princeton, New Jersey

Dear Dr. Einstein:

As a plumber, I am very much interested in your comment made in the letter being published in the Reporter Magazine. Since my ambition has always been to be a scholar and yours seems to be a plumber, I suggest that as a team we would be tremendously successful. We can then be possessed of both knowledge and independence.

I am ready to change the name of my firm to read: Einstein and Stanley Plumbing Co.

Respectfully yours,

R. Stanley Murray

RSM:hks

Letter from Stanley Murray, a New York City plumber, to Albert Einstein, dated November 11, 1954

THE ALBERT EINSTEIN ARCHIVES AT THE HEBREW UNIVERSITY OF JERUSALEM

A campaign of untruth

On February 9, 1950, Senator Joseph McCarthy from Wisconsin announced that he had a list of 205 workers of the State Department who were members of the Communist Party. The next day, a journalist asked to see the list. But McCarthy could not find it; his explanation was that he had left it in another suit. The Senate committee that was created to investigate these claims concluded a few months later that McCarthy's accusations represented "perhaps the most nefarious campaign of half-truths and untruth in the history of this republic." Historians are now sure there never was such a list.

Nevertheless, at the time, mainstream Republicans ignored the findings of the Senate committee. They saw McCarthy's tactics as something that would help them take control of the White House, after a sixteen-year absence. They invited him to meetings where he ranted about the "plot" at the highest levels of government. McCarthy's staff also circulated a doctored photograph, purportedly showing the leader of the Senate committee in close conversation with leaders of the Communist Party.

The 1952 elections were a great success for the Republicans, who gained control of the White House, the House of Representatives, and the Senate. Senator McCarthy's power was unchecked. During a speech on the Senate floor, he piled hundreds of documents on a table, claiming they contained evidence of the infiltration. No one was permitted to examine them. McCarthy was nominated Chair of the Permanent Subcommittee on Investigations, and he extended the loyalty inquisition to many sectors, foremost among them, the nation's educational system. As a former president of the University of Chicago noted, "The entire teaching profession of the U.S. is now intimidated."

Teachers at risk

William Frauenglass, a teacher in a Brooklyn high school, was called before the Senate subcommittee in April 1953. In his case, the accusation of disloyalty stemmed from a course he had given six years before, in a session for other teachers organized by the Board of Education. It was called Techniques of Intercultural Teaching, and it reviewed methods to "help ease intercultural or interracial tensions" in the classroom. One witness called upon by the committee declared that such teachings were "against the interests of the United States." Frauenglass was shocked: "Imagine such an accusation when one of the fundamental objectives of public education is the creation of intercultural understanding among our many minorities!" he wrote in a later letter. The teacher was also asked which organizations he belonged to, and he refused to answer.

Frauenglass needed help and decided to ask it from someone he greatly respected, who had recently described himself as an "incorrigible nonconformist": Albert Einstein, Professor of Theoretical Physics at the Institute for Advanced Study in Princeton, undoubtedly the most famous scientist in the world, and also a notorious antiracist and antiwar activist. "A statement from you would be most helpful in rallying educators and the public to meet this new obscurantist attack," Frauenglass wrote. Einstein obliged. His May 16, 1953, letter of reply—which, he specified, "need not be considered confidential"—was quoted extensively by the *New York Times*:

> The reactionary politicians have managed to instill suspicion of all intellectual efforts into the public by dangling before their eyes a danger from without. Having succeeded so far, they are now proceeding to suppress the freedom of teaching and to deprive of their positions all those who do not prove submissive, i.e., to starve them.

Einstein strongly advised the teacher to refuse to testify any longer. He should be prepared, Einstein wrote, "for the sacrifice of his personal welfare in the interest of the cultural welfare of his country." The physicist added, "This kind of inquisition violates the spirit of the Constitution. If enough people are ready to take this grave step, they will be successful. If not, then the intellectuals of this country deserve nothing better than the slavery which is intended for them." When Frauenglass and Einstein met in Princeton a few days later, Einstein said he himself was ready to go to jail for these principles. Frauenglass followed his advice. As was foreseen, he was fired from his job, but nevertheless thanked the scientist for a "historic letter": "Its echoes are still reverberating throughout the world."

The right to search for truth

McCarthy was quick to react to Einstein's stand. He told the media that whether his "name is Einstein or John Jones," the giver of such advice was undoubtedly an "enemy of America," "a disloyal American," and "not a good American." But Einstein was in no way deterred. In remarks he made to an assembly of lawyers, he continued to criticize practices "which have become incomprehensible to the rest of civilized mankind and exposed our country to ridicule." And he warned, "The existence and validity of human rights are not written in the stars."

Einstein was concerned about the curtailing of academic freedom. In a public statement in March 1954, he advocated for "the right to search for truth and to publish and teach what one holds to be true." He regretted that in this dark age "freedom of teaching, mutual exchange of opinions, and freedom of press and other media of communication are encroached upon or obstructed," adding that "this is a state of affairs which a democratic government cannot survive in the long run."

For some, these statements were proof of Einstein's disloyalty and continued foreignness—he the German Jew who had been granted American citizenship in 1940. In March 1954, a woman from Los Angeles wrote to the Director of the Institute for Advanced Study: "The man needs lessons in Americanism. I have no patience with this idea that a person who has performed a great deed or discovered something, should be excused from what citizens of U.S.A. must conform to, or that they need not account for questionable acts of theirs." A man from New York City put it more bluntly: "I suggest he move to Russia—and soon! We don't need him."

The Director of the Institute at the time, Robert Oppenheimer, himself a target of McCarthy's inquisition, remained steadfast in his support of his famous colleague. Six months later, in December 1954, McCarthy was finally "condemned" by a large majority of his Senate colleagues for "contemptuous" and "reprehensible" conduct. Of course, Einstein's actions did not by themselves cause McCarthy's downfall. But they certainly facilitated it, by reaffirming essential principles that date back to the Enlightenment, and by empowering many others to keep up the continuing fight to protect democracy. ■

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Emmy Noether's Paradise

How IAS helped support the first female professor in Germany when she became a displaced refugee

BY HISTORY WORKING GROUP

To Albert Einstein, she was "the most significant creative mathematical genius thus far produced since the higher education of women began." More straightforward in his praise, Einstein's fellow Professor at the Institute for Advanced Study, Hermann Weyl, called her a "great woman mathematician […indeed] the greatest that history has known." It was April 1935, and Einstein and Weyl were each paying tribute to a recently deceased colleague who had, like them, fled Nazi persecution across the Atlantic only two years earlier. Her name was Emmy Noether, and her short but remarkable life left an indelible mark not only on the history of mathematics, but also on that of IAS in its critical first years.

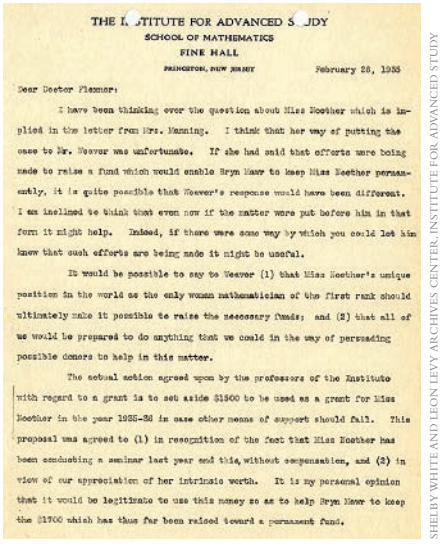
A woman in Göttingen

Amalie Emmy Noether was born in 1882 into an affluent family from the Bavarian town of Erlangen. She followed her father's footsteps to study mathematics at the University of Erlangen and, in 1907, she became the second woman to obtain a Ph.D. in mathematics from a German university. A female maverick in a man's world, Noether taught for several years without pay before being invited, in 1915, to join the University of Göttingen, home to the most prestigious mathematics department in the world at the time. She lectured for other professors and was only allowed to pass her habilitation following the collapse of the *Kaiserreich* and sweeping university reforms in 1919. Noether became an adjunct professor in 1922—the first female professor in Germany—but only started receiving a modest compensation for her teaching the following year. Despite international recognition, she never obtained a permanent position in Göttingen, and her situation took a turn for the worst with the rise to power of the Nazi party. In 1932, she was denounced by a neighbor as a "Marxist Jewess" and had to leave her apartment. The following year, she was removed from all teaching duties at the university and was eventually forced to flee Germany like many other purged academics. Thanks to the intervention of the Emergency Committee in Aid of Displaced German Scholars (set up in 1933 by the Institute for International Education in New York City) Noether was able to take a temporary position at Bryn Mawr College. Once in Pennsylvania, she reconnected with her former Göttingen colleague Weyl, himself freshly recruited to the Institute for Advanced Study by its first Director Abraham Flexner and resident Professors Oswald Veblen and Einstein.

A most significant creative mathematical genius

It was during her years in Göttingen that Emmy Noether developed an international reputation as a formidable mathematician. She made seminal contributions to the field of "abstract algebra," where she identified a simple, yet elegant, property of number systems, which proved instrumental in the study of arithmetic and geometric phenomena such as prime decomposition and dimension. Noether brought similar clarity to her pioneering research in physics, where she understood the relationship between symmetries of the laws of nature and the notion of "conservation laws." As an illustration, consider the "principle of energy conservation," a paradigmatic conservation law, which states that the total "energy" of an isolated system cannot change. When a car accelerates, for instance, its energy increases, implying that it must have drawn energy from somewhere, according to the principle of energy conservation (in this case, from burning gasoline). On the other hand, consider "time-translation invariance," a fundamental symmetry of the laws of nature, which states that an experiment performed today would give the same outcome if performed tomorrow: the speed of a free-falling cannonball is the same now as it was in the time of Galileo. Noether was able to connect these two seemingly unrelated concepts: energy conservation comes from time-translation invariance and vice versa. Scientists had long known the connection between energy and time, but Noether was the first to theorize a systematic correspondence: symmetries and conservation laws are related, *in general*. The idea arose out of a debate between David Hilbert, Felix Klein, and Albert Einstein over the notion of energy in Einstein's recently formulated general theory of relativity. Noether's theorem not only laid this controversy to rest, but, due to its striking generality, has been widely used in many other fields of physics, perhaps most notably in the study of elementary particles.

AMERICAN INSTITUTE OF PHYSICS



THE I. ..TITUTE FOR ADVANCED S..UDY
SCHOOL OF MATHEMATICS
FINE HALL
PRINCETON, NEW JERSEY February 28, 1935

Dear Doctor Flexner:

I have been thinking over the question about Miss Noether which is implied in the letter from Mrs. Manning. I think that her way of putting the case to Mr. Weaver was unfortunate. If she had said that efforts were being made to raise a fund which would enable Bryn Mawr to keep Miss Noether permanently, it is quite possible that Weaver's response would have been different. I am inclined to think that even now if the matter were put before him in that form it might help. Indeed, if there were some way by which you could let him know that such efforts are being made it might be useful.

It would be possible to say to Weaver (1) that Miss Noether's unique position in the world as the only woman mathematician of the first rank should ultimately make it possible to raise the necessary funds; and (2) that all of us would be prepared to do anything that we could in the way of persuading possible donors to help in this matter.

The actual action agreed upon by the professors of the Institute with regard to a grant is to set aside $1500 to be used as a grant for Miss Noether in the year 1935-36 in case other means of support should fail. This proposal was agreed to (1) in recognition of the fact that Miss Noether has been conducting a seminar last year and this, without compensation, and (2) in view of our appreciation of her intrinsic worth. It is my personal opinion that it would be legitimate to use this money so as to help Bryn Mawr to keep the $1700 which has thus far been raised toward a permanent fund.

SHELBY WHITE AND LEON LEVY ARCHIVES CENTER, INSTITUTE FOR ADVANCED STUDY

Left: Mathematician Emmy Noether, who had been forced to flee Göttingen, began giving weekly lectures at IAS as a Visitor in the School of Mathematics.
Right: Letter from Oswald Veblen to Abraham Flexner, dated February 28, 1935, regarding a $1,500 grant for Noether

Rethinking the scholar's paradise in the 1930s

Emmy Noether was thus already a household name among mathematicians when Veblen approached Flexner about supporting her in the United States. Their personal correspondence reveals how the Institute was forced to reconsider its mission in the face of unprecedented assaults on scholars in Europe. Noether's position at Bryn Mawr was funded by the Rockefeller Foundation (as part of their $1.5 million aid package for displaced scholars) but was only temporary. At Veblen's invitation, she began giving weekly lectures at the Institute as a Visitor in the School of Mathematics, where she joined the first cohort of IAS Members. Noether was happy to be at the Institute—and not at Princeton's "men's university, where nothing female is admitted," as she once said—but she didn't receive any honorariums for her lectures, unlike seventeen other occasional visiting lecturers, all male, who spoke at the Institute throughout the 1930s. On the other hand, Veblen did request a "small grant-in-aid," to help keep her at Bryn Mawr through 1935 and 1936, on the grounds of "Miss Noether's unique position in the world as the only woman mathematician of the first rank." Flexner was sympathetic to Noether's plight, but worried about the Institute overcommitting, and he repeatedly encouraged Veblen to view the question as an administrator (a crucial step, in his opinion, in establishing a credible system of faculty governance). Flexner wondered what such a short-term commitment could achieve and expressed concern at the Institute doing any more than what it already had for German scholars, as it needed to be "careful not to create the impression that [it was] overlooking Americans in order to help these unfortunate foreigners." Sidestepping the thorny issue of nationality, Veblen was eventually able to secure a $1,500 grant and continued soliciting larger donations for a "permanent commitment on the part of the Institute." As he put it, Noether was not merely unique as a "woman mathematician," she offered the Institute an opportunity to capitalize on the brain-drain from Göttingen by supporting "one of the most important scientists" displaced by the events in Germany.

Assisting endangered scholars presented, in other words, as many opportunities as it entailed risks and burdens for the newly established IAS. Flexner himself came around to seeing this, albeit only after Noether's untimely death on April 14, 1935. No doubt inspired by Weyl's and Einstein's stirring obituaries, he invoked her memory in a lecture on "The Usefulness of Useless Knowledge"—an idea he had long pursued and would, two years later, publish as his famous article in *Harper's* magazine—that he gave at Bryn Mawr on June 2, 1937. Noether, he had come to believe, "was driven from Göttingen for no better reason than that she was a Jewess." Bryn Mawr had "welcomed her with open arms," as many other institutions had done for other scholars at risk across the country. "This is civilization," Flexner concluded, "this is culture.… a country like America, of which only a small fraction has been culturally developed, can only be enriched by the folly which drives great thinkers, novelists, dramatists, and poets out of the Old World to make a fresh start in the New." Flexner's words ring loud today, as a reminder of how the Institute found a new *raison d'être* in challenging times, and as an admonition of how fragile and contingent "scholars' paradises" such as the IAS, or Göttingen before it, can be. ■

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Women in French Politics: Rank and File More Often Than Leaders

How gender affects political roles and positions

BY ANNE-CLAIRE DEFOSSEZ

In 2007, when Ségolène Royal announced her candidacy to the Socialist primary for the presidential election, Laurent Fabius, former prime minister under President François Mitterrand, ironically commented: "But who will take care of the kids?" an obvious reference to the fact that her partner, François Hollande, also a politician, was above such mundane domestic tasks. While Royal won that primary, she eventually lost the second presidential round to Nicolas Sarkozy. Ten years later, for only the second time in French history, a woman, Marine Le Pen, leader of the far-right party *Front National*, is running for president with a high probability of participating in the decisive second round, according to all opinion polls. In today's France, a woman running for the highest political office does not seem to make news any more. It is indeed the case that, after centuries of political ostracism, women have recently become more present in French political life: from less than 20 percent in state and local governments until 2000, their proportion rose to 41 percent in 2016.

But the presence of a few prominent female figures and seemingly favorable statistics do not tell the whole story. Although 40 percent of municipal counselors are women, only 16 percent of them are mayors; and if women do represent 48 and 50 percent of departmental and regional counselors, respectively, only 10 percent are president of a department and not more than 17 percent preside over a region. No woman has ever been the speaker of the National Assembly or the Senate. The only female prime minister that a French government ever had, Edith Cresson, survived eleven months in office—the shortest duration ever—and from day one faced strong sexist hostility. On the very day of her nomination, a conservative representative declared, "It is the Pompadour entering Matignon," comparing her to the famous mistress and confidante of King Louis XIV.

ELENA STEKNICOVA

The Power Ladder, a poster that was part of a public campaign on equal rights for women and men in France

Thus, despite the law on *parité*, first passed in 2000 and reinforced five times since then, which requires that as many women as men be nominated in local and national elections (except for local elections in towns with fewer than one thousand inhabitants), women remain marginalized in the actual exercise of political power. They continue to confront offensive stereotypes and contemptuous attitudes. Women legally take part in the political game, but they are still considered illegitimate by their male colleagues, whose power position they challenge. This illegitimacy of women in politics has deep historical roots.

The long tradition of excluding women from exercising political power can be traced to the Ancien Régime, when the second Salic Law, passed in the fifteenth century, ruled that no woman could inherit the French crown. During the 1789 Revolution, the legislators favored women's civil emancipation while establishing their political incapacity as an absolute principle, despite their active participation in the revolutionary process. Although acknowledging many important principles (strict separation between legislative, judicial, and executive powers; recognition of freedom of press, religion, and association; abolition of slavery; and adoption of universal manhood suffrage), the 1848 Constitution, which founded the second Republic, still left women disenfranchised. And for yet another century, women were ruled out of the public and political sphere. Whereas in Britain the Suffragist Movement, after years of repression, obtained political rights for women in 1918, and while many European countries followed the same path before World War II, in France, the feminist leaders and their allies could not overcome the strong opposition to women's political rights.

In France, World War II heralded a turning point in the history of women's political rights. Women had played an active role during the war, both economically while men were on the battle front, and politically in the Resistance against the Nazi occupation. Thus, in April 1944, an ordinance of the national government, enacted by the Provisional French Government, included an amendment proposed by a Communist congressman, a member of the Resistance, stating that "women are voters and eligible in the same conditions as men." In April 1945, women participated for the first time in municipal elections. The same year, out of 586 representatives, thirty-three women, most of them having been *résistantes*, and some having endured captivity and even torture, entered the National Assembly for the first time.

This major legal reform, however, went unheeded for fifty years, and no more than a handful of women held a political office during that period. Becoming a subject of legal political rights did not suffice to erase the "cultural underpinnings of misogyny in politics" in Mary Beard's words. A second decisive legal shift was needed to transform that formal right into more effective political equality. In 1992, Françoise Gaspard (sociologist and Socialist politician), Claude Servan-Schreiber, and Anne le Gall (both journalists and feminists), published the book *Take Power, Female Citizens! Liberty, Equality, Parité*, transforming the French motto *Liberty, Equality, Fraternity*. The demand for *parité* opened a decade of heated debates. Declarations and manifestos abounded in newspapers: in 1993, 577 men and women (symbolically the number of deputies in the Assembly) published in the newspaper *Le Monde* a "Manifesto for an equal democracy" in which they declared that "*Parité* is a condition for democracy, as are the separation of powers and universal suffrage." In 1996, ten former female ministers, from across the political spectrum, published another manifesto demanding that the concept of political *parité* be enshrined in the French Constitution: "From condescending indifference and contempt to open hostility, we have been able to measure the gap between public principles and reality in the behavior of the political class. To reach real equality between women and men at every level and in every sector of French society, politics has to set a good example. And for that purpose, the time of constraint has come."

One year later, the newly appointed Socialist Prime Minister Lionel Jospin announced in his inaugural declaration a constitutional modification, unanimously adopted by the Parliament in July 1999: "The law favors equal access for women and men to elected mandates and offices. Political parties shall contribute to the application of this principle under conditions determined by the law." And, in 2000, the law on *parité* enforced this principle by determining that public subsidies to political parties would be adjusted according to their observance of *parité* in nominating candidates for elections.

In her analysis of the movement for *parité* in France, Joan W. Scott underlined that the designers of the law were fully aware that the law itself, though opening political space to women and acknowledging inequality between women and men, would not suffice to change mentalities, at least in the short term. The law certainly could limit the control that men exercised in politics, but not terminate it. From the perspective of 2017, it is clear that the law did not deliver on all its promises. In my research interviewing women on their experience of *parité* since the law in 2000, I found this to be the case. In particular, three major structural factors contribute to women's political underrepresentation.

First, the electoral system itself, established in 1958 by the Fifth Republic, has long disadvantaged women, mainly in two ways. On the one hand, it favors safely entrenched incumbents who consider their constituency as their stronghold, and who remain candidates in every election. In the current legislature, more than half of the representatives and senators have been in office for at least two consecutive mandates, that is to say ten years (in the Assembly) to twelve years (in the Senate). Low turnover, a direct result of incumbency, provides fewer opportunities for newcomers, notably women, to increase their presence. On the other hand, the system allows for the possibility of holding multiple offices simultaneously, leading to the concentration of political positions in the hands of very few. While 80 percent of representatives and senators hold at least one additional political office in France, only 24 percent do so in Germany, 20 percent in Spain, 13 percent in Italy, 6 percent in the Netherlands, and 3 percent in Britain. This French exception may nevertheless soon disappear. A law passed in 2012, which will be in effect by June 2017, forbids, from then on, the holding of a national and a local executive office by the same person at the same time.

Second, political parties, ruled almost exclusively by men, have long been key factors for women's marginalization in politics, the left-wing parties being ideologically more open to the question of equality. The French Communist Party was for a long time the only one nominating a certain quota of women in each election. The Socialist Party waited until 1974 to determine a quota in its executive body and until 1996 to apply this quota system to House elections, which happened only under great pressure from feminist party activists. Its statutes now respect strict *parité* in every election. By contrast, no conservative party adopted any rule favoring women's participation before the 2000 law, and the new statutes adopted by the Republicans in 2015 make a general statement of the principle of *parité* without any concrete means to achieve it.

As a result of these contrasting policies, Socialist and Communist parties have nominated 48 percent of women as candidates for the upcoming legislative election in June 2017, many of whom are already in office, whereas the Republicans did so for only 31 percent, and mostly in districts where they are more likely to lose. In doing so, they choose financial sanctions over *parité* and

(Continued on page 10)

The Professor and the Politician

Two approaches to trying to solve a problem

ANDREA KANE

BY NILS A. BAAS

On a beautiful overlook near the university, a middle-aged man is enjoying the view of the majestic fjord. Judging from his clothing, he is a stonemason from the quarry just below him. But actually, he is a professor at the university who often comes up here just to sit and think about deep and complex problems. Up here many good ideas have come to him over the years.

A man in a suit and tie rushes up the path, breathing heavily, cheeks flushed, and appearing quite worn out by the walk. He is a politician—the Secretary of the Ministry of Science and Research on his way to a meeting in the government's new Committee of Effectivity in Research.

The politician—quickly taking in the view—politely greets the professor and inquires, "who are you and what are you doing here in the middle of the day?"

"I am a professor at the university and I am sitting here to think about things. I've had many good ideas here over the years. At the moment I am working on a deep and complex problem that will require some time until it is solved," he answers.

The politician is surprised to find a professor idling here without any apparent purpose in the middle of the working day.

"Wouldn't it be better to sit in your office and work?" asks the politician.

"No!" says the professor. "I feel less stressed and much more open to thoughts here."

"Listen," says the politician, "it would be much better for you to sit in your office and write an article about problems that are not as difficult."

"I don't think that would be very interesting and not as relevant for the development of my field. So, why should I do that?" answers the professor.

"But that is exactly what we would like to achieve in our Effectivity Committee. Scientists should not think about problems that are too difficult, but rather focus on problems that will increase the number of publications. Then our numeric criteria can be applied to evaluate your work in a simple way, which will allow us to confirm the quality of your work immediately."

"I don't believe that would work. So, why should I do that?" answers the professor.

The politician is about to give up, but continues: "When you get a high publication rating according to our numeric scale, third parties, including myself, will appreciate your work more, and you will get an opportunity to receive a lot of research resources and to hire many people."

"That won't solve my problem, because I will spend most of my time with management tasks instead of using it to work on the problem."

"If you write articles about simpler problems, you will have so many resources that you can also hire a manager. Maybe you will even get your own department."

"That is not appealing to me," says the professor. "More people does not mean that I will be able to solve my problem, and they will just distract me."

"I don't think so," says the politician. "We think that when we give money in order to increase the volume, the quality will improve as well."

"Nonsense!" says the professor.

The atmosphere becomes a little bit tense at this point. But the politician who is used to this kind of debate presses on: "Wouldn't it be wonderful, if you were in charge of a large group of scientists and had your own department where everybody could work on your problem?"

"So, what would I do?" asked the professor.

The politician is completely taken by surprise and answers: "You could simply sit somewhere and take your time to think."

"But that is exactly what I am doing now," answers the professor.

The politician barely listens to the answer and rushes to his meeting with the Effectivity Committee. Perhaps with some new thoughts and a bit of envy? ■

This article was freely adapted from Heinrich Böll, "Anekdote zur Senkung der Arbeitsmoral" (Anectdote about the Lowering of Productivity). It was originally published by Dagens Næringsliv *(Oslo, September 29, 2016) and has been translated from Norwegian to German and to English. Nils A. Baas, frequent Member in the School of Mathematics and in the School of Natural Sciences, is a Professor at the Norwegian University of Science and Technology in Trondheim, Norway.*

IMPOSTER SYNDROME

An hour south of Wall Street,
past tulips, toddlers on swings,
cyclists, runners, Frisbees tossed
by girls in shimmering orange shorts,
I walk to the Institute library
to borrow the Shorter O.E.D.
laid by to welcome my stay.
A lay guest here before,
haunted by my familiar hissing
You have no business in this place,
today a librarian's courtesy,
and spring, rout the devil at my ear,
and for an afternoon depose the fear
You're a wannabe from a trading floor.

—Dan Burt, poet and periodic visitor to IAS (April 2016)

FRENCH POLITICS *(Continued from page 9)*

favor male incumbents.

Third, the institutionalization of *parité* in politics, first seen as a great democratic advance by the feminist movement, has in fact contributed to a certain demobilization on this issue: since there is a law, it should work! So, it is only recently, when evidence showed that *parité* has not necessarily led to men's sharing effective power with women, that this question has been recognized and included once again on the feminist political agenda.

The experience of *parité* has also revealed the limits of the law for transforming the social and political framework in which French politics takes place. The law has had no major impact on the rules that govern political space, which favor men's participation. Gendered language permeates the political landscape—politics and elections are most often described in terms of analogies and metaphors drawn from the traditionally masculine domains of war and sports; female politicians take the floor less often than men and are more likely to be interrupted while speaking; machismo and sexism are still frequent attitudes expressed without shame.

The law has had no major impact either on gendered stereotypes. When they do hold office, women are more likely to be confined to sectors considered feminine, such as family, health, child, or elderly care, and education, while finance, budget, and security—seen as more strategic domains—remain in men's hands. Political decisions even reinforce stereotypes. Under the presidency of François Hollande, a Ministry for Women's Rights was first created in 2012; it has since been dissolved, and incorporated into the Ministry of Family, Childhood, and Women's Rights, once again relegating women to the domestic sphere.

Finally, the law has had no major impact on social roles: women and men still don't equally share domestic work and care for children and family. On average, women spend ninety minutes more than men in daily domestic and parental tasks, even when both have a professional full-time occupation. Becoming a politician under these conditions remains more challenging for women than for men.

Thus, for fifty-five years, from the recognition of their right to vote in 1945 to the enactment of the law on *parité* in 2000, women have largely stood at the margins of political office in France. Indeed, despite the positive public consensus and the favorable legal framework, the achievement of *parité* largely remains a matter of wishful thinking, and every legal interstice is found to get around the law. The presence of women in political office has certainly increased between 2000 and 2017, but they are still excluded from high-power positions and confined to so-called feminine domains. Political life in France continues to be deeply and unequally gendered. ■

Anne-Claire Defossez, Visitor in the School of Social Science, conducts research on the question of women's political participation and representation by exploring the trajectory and experience of women formally involved in politics at local and national levels in France. In the Paris Region, she worked as city manager in Cergy and Aubervilliers for eleven years and was elected municipal counselor in Osny from 2007 to 2015.

Ernst Kantorowicz: A Life

From ardent German nationalist to critic of state power and demagogues

BY ROBERT E. LERNER

Few twentieth-century historians deserve a full-scale biography more than Ernst Kantorowicz (1895–1963) on the basis both of "work" and "life." More than fifty years after his death Kantorowicz remains one of the most influential of all medieval historians, perhaps the most influential. To be sure, the work of others might count as equally great … [but] nothing written by any of them continues to sell as well as Kantorowicz's *The King's Two Bodies*. This book has been kept in print by Princeton University Press since its first appearance in 1957; it has been translated into German, French, Italian, Spanish, Portuguese, Polish, Slovenian, and Japanese. The steady sales and numerous translations reflect the fact that Kantorowicz's book has had extraordinary resonance in several disciplines: not only in history but in art history, literary criticism, and political thought. Fifty years after the book's publication, Stephen Greenblatt wrote that it "remains a remarkably vital, generous, and generative work." Giorgio Agamben has called it "unquestionably a masterpiece" and "one of the great texts of our age on the techniques of power."

Although Kantorowicz's reputation rests primarily on *The King's Two Bodies*, substantial claims can be made for his other works. His first book, published in German in 1927 as *Kaiser Friedrich der Zweite (Frederick the Second)*, was one of the most discussed history books in Weimar Germany. Establishment academic historians attacked it because of its alleged "mythical view" of the Hohenstaufen emperor, but others welcomed it as marking a liberation of historiography from positivism. Whereas the book appeared without footnotes, leading many to suppose that the author was inventing things, Kantorowicz embarrassed his critics in 1931 by publishing a "supplementary volume" that documented most of what he had written. Although other biographies of Frederick II have superseded it, the work remains a historiographical monument, and the supplementary volume remains basic for scholarship. ("You don't want to go into thirteenth-century Italian history without your Kantorowicz.")

Then there is *Laudes Regiae*, written over the course of a decade but first published in 1946. Whereas the main methodological claim for the importance of *Friedrich der Zweite* lay in its use of literary sources (poems, prophecies, panegyrics), and that for *The King's Two Bodies* its use of legal sources, the claim for *Laudes Regiae* lies in its use of liturgical sources. As Kantorowicz remarked in his preface, he hoped it soon would no longer be possible for scholars "to deal cheerfully with the history of mediaeval thought and culture without ever opening a missal."

All this said, the lives of scholars are seldom stuff for engrossing reading. "Stay close to your desk and you may be the winner of an endowed chair." Yet the life of Ernst Kantorowicz is an exception. Born of a wealthy Jewish liqueur manufacturing family in Posen (now Poznań), in his early career Kantorowicz was an ardent German nationalist. He volunteered to fight for the Kaiser in the First World War, winning an Iron Cross for his service on the western front (he was wounded during "the hell at Verdun"), and an Iron Crescent from the Ottoman Empire for his service in Anatolia. At war's end, he took up arms three times in the space of a few months: against the Poles in his native city, against the Spartacists in Berlin, and against the "reds" of the short-lived Soviet Republic in Munich. Supposedly, Kantorowicz said in the postwar period "right of me is only the wall"; in 1922 he wrote that German policy should be dedicated to the destruction of France. Closely connected to his politics was his membership in the elitist circle of the German poet-prophet Stefan George. Widely considered at the time to be Germany's greatest living poet, George was a riveting cult figure who espoused antirationalism, antimodernism, hero-worship, and faith in the country's subterranean resources (the "Secret Germany"). George dedicated himself to grooming a coterie of handsome and clever young men: they were expected to address him in the third person, hang on his every word, and propagate his ideals by their writings and example. The goal was to transform Germany into a land of truth and purity. Kantorowicz was one of the most prominent "youths" in the George circle (another was Claus von Stauffenberg, later Hitler's near assassin), and he wrote his biography of Frederick II with the "Meister's" encouragement.

After the Nazis took power, Kantorowicz spoke against them courageously as a full professor from the lecture platform to an overflowing crowd in Frankfurt in November 1933. (This may have been the only time that a German professor expressed himself publicly against the regime.) Unable to continue teaching because of Nazi student boycotts, he was forced to "retire" and become a private scholar. In 1938, he barely escaped Kristallnacht and fled first to England and then the United States, where in the fall of 1939 he took a one-year position at Berkeley. This was succeeded by further interim appointments there until 1945, when he finally gained a full professorship. He would have been happy to stay in Berkeley for the remainder of his career, but the loyalty oath controversy at the university prevented that. Kantorowicz, of course never a communist, immediately became a leader of faculty opposition to the oath and remained a stalwart "nonsigner" until he was fired in August 1950. Then he "fell up the ladder" by an appointment at the Institute for Advanced Study in Princeton, where he pursued his scholarly interests while maintaining friendships with a considerable number of the most noted intellectuals of his day.

ROBERT E. LERNER ARCHIVE

Ernst Kantorowicz at his desk at the Institute for Advanced Study

Kantorowicz had a fascinating personality. He was urbane and witty (and sometimes nasty). He was a natty dresser, a noted wine connoisseur, and a flamboyant cook. He flourished at night and resented being called in the morning before ten. From 1934 until his death, his closest friend was the Oxford don Maurice Bowra, widely thought to have been the wittiest man in Oxford. The two traveled together through Europe in the mid-1930s and summered together in Greece in the 1950s. Other friends included a roll call of Weimar intellectuals and Institute notables. Kantorowicz was a brilliant lecturer and a renowned teacher at Berkeley. He could be seen on campus surrounded by one group of students, who delivered him to another group, who then escorted him further. He had girlfriends and boyfriends. He was transferred out of the German Fifth Army in Turkey because of an affair with the mistress of the commanding general. In the early 1920s, he had affairs successively with the wife of one his good friends and an aristocratic young man in the George circle. Shortly afterward, he entered into a relationship with the half-sister of the young aristocrat, and then he and Bowra became lovers. In the United States, he had a long-term intimate relationship with his first cousin.

Ernst Kantorowicz's life and work became an ambitious research project for me in 1988. In the fall of that year, I was asked to participate in a conference on "German-Speaking Refugee Historians in the United States after 1933" to mark the opening of the German Historical Institute in Washington. Because my assignment was to speak on prominent medievalists, I decided to choose Kantorowicz. Coincidentally in that academic year I was holding a membership at the Princeton Institute, and accordingly I was able to talk with a considerable number of local eminences who had known Kantorowicz well. That did it. After I gave my Washington lecture, I resolved to gather materials "toward a biography." Around that time, I came to thinking of Kantorowicz as "EKa" (from the German for his initials and pronounced to rhyme with "Hey, Ma") because that was the way he asked to be called by his friends. I follow that usage here. One might say then that I have been working at this biography for twenty-five years, but that is not entirely true because I began the actual work of writing four years ago. But because EKa was someone who "combined depth of mind with abundance of spirit" (I borrow the phrase from his friend Felix Frankfurter), the long engagement has never ceased to be rewarding. ■

This article is an adapted excerpt from Ernst Kantorowicz: A Life *(Princeton University Press, 2016) by Robert E. Lerner, Member (1988–89) in the School of Historical Studies. A medieval historian working on millenarian movements, heresy, and religious, intellectual, and cultural history, Lerner is currently the Peter B. Ritzma Professor in the Humanities Emeritus at Northwestern University. Ernst H. Kantorowicz was a Professor in the School of Historical Studies from 1951 until his death in 1963. During his tenure at the Institute, he authored* The King's Two Bodies, *published by Princeton University Press in 1957.*

Recommended Reading and Viewing:

A video of a recent Institute talk by Robert Lerner on Ernst Kantorowicz: www.ias.edu/ideas/2017/lerner-kantorowicz

"The Kantorowicz Conundrum" by Jacob Heilbrunn, *The National Interest*, May–June 2017, http://nationalinterest.org/feature/the-kantorowicz-conundrum-20194

"He Remade Kings: A Scholar's New Views" by George Prochnik, *New York Times*, January 5, 2017, https://nyti.ms/2jLvkBj

A World of Emotions: The Making of an Exhibition

Acknowledging collective and individual emotions in historical processes

BY ANGELOS CHANIOTIS

Emotions penetrate every aspect of our lives. Interwoven with memory, attention, cognition, and decision-making, they determine our interpersonal relations, our private life, the public sphere, and religious worship. Emotions are the background of every form of art and literature. In recent years, we have seen how financial crises, corruption, and the failure of political institutions have triggered collective anger in European countries and how fear has influenced the outcome of the Brexit-referendum, the presidential election in the United States, and elections in European Union countries that are confronted with increased numbers of refugees.

To say that emotions matter in historical studies may seem today a trivial observation, but this has not always been the case. For decades, the prevailing trend in historical research was to dissociate emotion and cognition and to ban emotions from historical inquiry. For the greatest part of the twentieth century, influential schools of historical interpretation, such as Marxism and structuralism, preferred to look for laws that determine human life instead of turning their attention to the part played by collective and individual emotions in historical processes. A few years back, I told a prominent German ancient historian that I was working on a research project dedicated to emotions in Greek history, and he expressed his surprise. History, he responded, is the answer to the questions "who," "when," "where," and "why." Inadvertently, he had offered the most eloquent advocacy for the historical study of emotions. The "whos" of history, the agents and subjects of history, are individuals and groups with feelings; the search for a "why" cannot ignore emotions—if one had doubts about this, then the election of Donald Trump as U.S. president teaches us otherwise; and the "where" and "when," the contexts of history, always have emotional components. Today, the "history of emotions" is firmly established as a dynamic research area.[1]

The idea to organize an exhibition dedicated to emotions in Greek antiquity was born in 2013, when my research project "The Social and Cultural Construction of Emotions: The Greek Paradigm" (Oxford, 2009–2013) attracted the interest of Amalia Cosmetatou, Executive Director and Director of Cultural Affairs of the U.S.-based Onassis Foundation. I gladly accepted her invitation to curate an exhibition at the Onassis Center in New York. Two prominent art historians and archaeologists, Nikolaos Kaltsas, Director Emeritus of the Athens National Archaeological Museum, and Ioannis Mylonopoulos, Associate Professor of Ancient Art, Archaeology, and Architecture at Columbia University and former Member (2011–12) in the School of Historical Studies, were invited to join the curatorial team. The concept of the exhibition was jointly developed over the course of two years.

Is there anything special about the ancient Greeks and their emotions? How could one avoid triviality in addressing this subject? Did the death of a beloved person not cause grief among the Greeks as in any other culture? Was economic inequality not the source of envy and hatred, a perceived danger the cause of fear, the birth of a child reason to rejoice, and disappointed love a source of sorrow?

As far as we can see, the basic emotions that we know from our era existed in the Greek world as well: fear and courage, joy and grief, hope and pride, affection and hatred, love and jealousy, desire and disgust, gratitude and envy, contempt, anger, and indignation. An interesting, almost unique, feature of Greek culture is the fact that they not only personified emotions, but that they worshiped them. Eros is not the *personification* of erotic desire or a *patron god* of love; Eros is a god, for whom people set statues and built temples, whom they propitiate, to whom they pray and offer sacrifices. Another important fact is that Greek intellectuals were the first to develop theories of emotion in the West as early as the late fifth century B.C.E.—more or less the same time during which Chinese intellectuals were addressing similar questions in the East. And thirdly, the sociocultural context in which emotions were manifested in ancient Greece was peculiar. Let us take the famous example of the Spartans and their response to fear. The Spartans worshiped the personification of Fear (*Phobos*) as a god, offering sacrifices; doing this, they hoped that Fear would conquer their enemies. They marched in battle without fear of death. But this proverbial courage does not mean that the feeling of fear was unknown to them. Rather, more than death, they feared their mothers, who gave them shields with the words "it, or on it"—admonishing them either to bring it back or be carried back on it. The way emotions are controlled, expressed, concealed, displayed, performed, described, valued, and aroused depends on social and cultural factors that may range from education and values, religious beliefs and gender, philosophical doctrines and social conventions to legal institutions and economic conditions. For this reason, the manner in which emotions are represented in the source material is influenced by cultural change. Although we can never know what people in the Greek world really felt—there are rare exceptions—we can certainly study the external stimuli that generated emotions. We can also study the cultural and social parameters that determined when and how emotions were manifested in texts. And we can study how emotions are represented in images and other expressions of material culture.

ATHENS, ACROPOLIS MUSEUM, ACR. 670.

Marble Statue of a Kore from the Acropolis in Athens, ca. 520–510 B.C.E. The young woman gathers up her long garment as she approaches the goddess to whom she will offer a fruit, a bird, or a flower, in expression of gratitude and piety. Colors and metal ornaments contributed to the girls' grace.

BASEL, ANTIKENMUSEUM UND SAMMLUNG LUDWIG, BS 298; BS 214.

Marble Head of Penthesileia from Italy, second century A.D. The amazon Penthesileia was fatally hit by Achilles. While holding Penthesilea's dying body, Achilles lifted the helmet to see the adversary and upon discovering her beauty, youth, and valor, he fell in love with her. The sculptor has captured the moment of Penthesileia's death, with her eyes turned upward and her mouth is open in pain, and Achilles' recognition of his love.

With such considerations in mind, it was decided to organize the exhibition around four general themes: the art of emotions, the spaces of emotions, conflicting emotions, and uncontrolled emotions. The theme "Art of Emotions" confronts the visitor with two questions: What are the means through which ancient artists represented the emotions of gods, mythical heroes, and "real" people? How were images and texts exploited to arouse emotions in an ancient (and modern) audience? Although every exhibit is ultimately related to these questions, a few selected images can show the importance of body language, facial expressions, and composition for the representation and arousal of emotion. The theme "Spaces of Emotions" highlights the importance of emotions in major types of interpersonal relations and social life, and in the main spaces in which emotions are manifested: the family and the group of friends, the public spaces of the city and the battlefield, the sanctuaries and the cemeteries. The last two themes focus on the most complex, darkest, and relevant aspects of emotions. They present mortals, gods, and mythical figures struggling with conflicting emotions such as envy and affection, facing dilemmas, and being dominated by uncontrolled emotions—from erotic passion to hatred and fear.

The selection of objects, completed in April 2015, was a very difficult process, certainly not because of lack of abundance. Is there a work of art that is not directly or indirectly connected with emotions, if for no other reason, simply because of an artist's affectionate dedication to his work? But an exhibition is continually confronted with practical considerations: the budget, the fragile state of some objects, their size and weight, requests by lenders, and problems of transportation and insurance. Other aspects that had to be taken into account include the balanced representation of objects of different provenance, date, material, and type, and the representation of a broad range of emotions and aspects. Some emotions are prominently present in Greek art—joy, fear, grief, anger, and love—and yet others are difficult to detect without knowledge of the context—envy and pride—and still others are hardly ever represented in the material evidence—e.g. disgust. And, of course, a great challenge in such an exhibition is to familiarize a non-specialized audience with the significance of emotions in Greek culture, approximately from Homer to the end of antiquity (ca. 700 B.C.E.–200 C.E.). The list was continually revised, and many (perhaps most) objects on the original wish-lists of the three curators had to be excluded and replaced. But we succeeded in assembling 130 objects, including some masterpieces of Greek sculpture and vase-painting, from twenty-two Greek museums and nine museums in France (Louvre), Germany (Munich), Italy (Naples and Rome), Switzerland (Basel), the United Kingdom (British Museum), the Vatican, and the United States (Boston and the Metropolitan Museum). The exhibits range from life-size statues and grave reliefs to golden grave masks and coins, from magical texts to representations of Greek myths on vases, and from oracular inquiries to theater masks. Diverse artifacts reveal in a paradigmatic way the emotional background of material culture. They range from objects as simple and elementary as a relief plaque that shows the apotropaic symbol of a phallus, threatening intruders, and averting evil, or a cup used for libations to *Philia* (affectionate friendship) by the participants in a banquet, and the grave inscription for a much loved and talented pig that fell victim to a traffic accident, to artistically sophisticated representations of the emotional interaction between lovers and family members, narrative scenes inspired by complex myths, moving grave inscriptions, curses, and "voodoo-dolls" full of hatred, and oracular inquiries full of worries.

The "story" or narrative of this exhibition is indicated by its title: *Greece Is a World of Emotions.* The Greeks told myths, wrote literature, performed tragedies, and made

(*Continued on page 13*)

1 For recent overviews, see J. Plamper, *The History of Emotions: An Introduction*, Oxford, 2015; R. Schnell, *Haben Gefühle eine Geschichte? Aporien einer History of Emotions*, Göttingen, 2015.

art because they were driven by emotions, because they expressed emotions, and because they wanted to arouse emotions. The *Iliad*, the earliest work of Greek literature—traditionally dated to ca. 700 B.C.E. or a few decades later—narrates a dramatic episode of the Trojan War. The poem's very first word, the very first word of European literature, is an emotional term: *menis*, "wrath." "Sing to me of the wrath of Achilles" is the poet's appeal to the Muse. The subject of the *Iliad* is not a war, as we often think, but an emotion: Achilles's indignation, caused by an insult. The *Iliad* begins by explaining the cause of the wrath, describes its manifestations and consequences—Achilles's retreat from battle and the death of his friend Patroclus—continues with Achilles's return to combat, the killing of Hector, whose corpse is dragged behind Achilles's chariot, and finds closure in the mourning of Achaeans and Trojans for their fallen heroes Patroclus and Hector. Emotions dominate also the second early epic, the *Odyssey*: its main subject is Odysseus's desire to return home (*nostos*). It is also the narrative of the loyal affection shown to Odysseus by his wife, his son, his slaves, and his dog. From its very beginning, Greek literature made emotions the center of its observation and treatment. While the rhapsodes were singing of the emotions of past heroes, Archilochos, a Parian poet of the mid-seventh century B.C.E., was singing about his own emotions: affectionate friendship, love, hatred because of betrayal, fear of death, and courage. He is the first poet who addresses his soul (*thymos*), urging himself to take joy and bear grief with measure, and to be stronger than hope and fear. The lyric poets of the next generation were quick to follow, and Sappho was honored as the "tenth Muse" for a love poetry that still gets under our skin.

Emotions shaped Greek culture no less than reason. This is a simple and straightforward message. But, still, the story is full of tensions, contrasts, contradictions, and conflicts. There are many ways to tell this story, but an exhibition must chose one, otherwise it will confuse the visitor; it will be incoherent and unclear. And although the visitors may want to see something twice or may want to spend more time in front of an object than another, nevertheless, they should be gently guided from one theme to the next. This exhibition does not require any pre-existing knowledge. For this reason, a meaningful itinerary had to proceed from simple and familiar images to the more complex, shocking, and puzzling.

Our itinerary starts in the sheltered domestic space, and roughly follows a lifecycle. It begins with birth and childhood, with harmony and peace, and gradually proceeds from inside to outside, from harmony to conflict, from light to darkness, from life to death, from reason and order to a lack of control. The first images show mothers who tenderly hold their children in their arms; the last images show mothers who kill their children driven by emotion. According to this concept, the natural movement is from the house to the sanctuary, the cemetery, the public space, and the battlefield. From the real life experiences of the ordinary mortals, the exhibition gradually moves to the larger-than-life experiences of heroes and gods. As with any good story, the exhibition must have an apex, so that when the visitors reach the end they feel—as in Aristotle's famous definition of tragedy—catharsis through fear and empathy. The climactic point is the last section, which is dedicated to uncontrolled emotions and proceeds from the impact of intense erotic desire to the results of hatred, rage, and jealousy. The last images that the visitors see on a projection wall are images from modern productions of Euripides's *Medea*. Exiting the exhibition from the basement of the Olympic Tower, they ascend a staircase, thus moving from the past to the present, from darkness to light, from emotion to cognition.

At the entrance of the exhibition, the visitor is greeted by two Archaic life-size statues of a young man (a *kouros*) and a maiden from the Acropolis (*kore*); their faces wear the Archaic smile, whose interpretation is ambiguous: joy, pride, delight, or a vague expression of life? The visitor is also confronted with a "wall" of sculpted faces, roughly in a chronological arrangement from the sixth century B.C.E. to the early third century C.E. These faces, as well as examples of vase-painting, exemplify the physical manifestation of emotions through facial appearance and body language. Behind the two statues and the wall, the visitor recognizes two statues that dominate the central space of the exhibition: the statue of Pothos, the personification of Longing and Desire (Musei Capitolini in Rome), and the statue of Eros from the Louvre, who playfully shoots his arrows, arousing erotic desire in gods and mortals.

The visitors then move from right to left, examining manifestations of emotions in the domestic space (affection between parents and children, children and animals, lovers, joy in banquets), the sanctuary (gratitude and hope in the relations between mortals and gods), the cemetery (grief and hope for afterlife), the public space (gratitude for benefactors, hatred against political enemies), and the battlefield (rage, pride for victory). The battlefield confronts the visitor with violence and conflict, two predominant themes in the following sections of the exhibition. A fresco from Pompeii, depicting the sacrifice of Iphigeneia, dominates the main wall of the exhibition and a section dedicated to emotional conflicts. Other important exhibits

HERAKLION ARCHAEOLOGICAL MUSEUM, T.367

Marble Relief with the Amorous Embrace of Leda and the Swan (Zeus) from Knossos (Crete), first-second century A.D. The artist captured a moment of erotic desire as Zeus, transformed into a swan, approaches Leda. The naked Leda is leaning in, with her knees bent to receive the advances of the swan. A winged Eros assists in the coupling by pushing the swan from behind with his hands and right leg.

Recommended Viewing and Reading: The exhibition "A World of Emotions: Greece, 700 BC–200 A.D.," cocurated by Angelos Chaniotis, and designed by Daniel Kershaw, is on view at the Onassis Cultural Center New York from March 9 to June 24. The exhibition is free and open to the public. Additional information is available at http://onassisusa.org/exhibitions/a-world-of-emotions.

"'A World of Emotions' in Greek Art Unmasks the Stony Faces" by Holland Cotter, *New York Times*, March 23, 2017, http://nyti.ms/2pAP3Gu

are representations of the particularly moving myth of Achilles and Penthesileia, the Amazon queen. The hero slays the Amazon but when he removes her helmet and sees her dying face, he falls in love with her.

From emotional conflicts, the visitor then moves to actions driven by uncontrolled emotions: desire, rage, hatred, jealousy, and fear. This section assembles both artifacts of everyday life—curse tablets against enemies and apotropaic symbols—and representations inspired by myth, including strong images of erotic desire—Zeus approaching Leda in the guise of a swan and abducting Ganymede in the guise of an eagle—and shocking images of uncontrolled rage. The last displays highlight one of the most shocking ancient myths of uncontrolled emotions, the myth of Medea. Driven by her love for Jason, she dismembered her own brother; later, abandoned by Jason and driven by jealousy and indignation, she took revenge on him by killing not only his new wife but also her own children.

There are good reasons why the emotions of the Greeks matter today. First, because of the exceptionally good source material, consisting of literary texts, scientific and philosophical treatises, inscriptions, papyri, and works of art, we can study in a paradigmatic way the factors that determine the manifestation of emotions in a primarily urban and literate culture for a millennium, from the time of the first recorded literary texts to the establishment of Christianity. Secondly, emotions have shaped all the sources that we have at our disposal, from the verses of a great potter to the image of a humble painter who shows a satyr tenderly holding an infant satyr in his arms.

We do not study Greek texts and works of art in order to understand emotions. We study emotions in order to be able to understand fully the texts and works of art that Greek culture produced. Our perception of classical Greek antiquity is dominated by an interest in its rational aspects. We tend to understand the development of Greek culture as a movement from myth to reason, focusing on achievements that were based on objective observation and cognition. This approach is not wrong, but it is incomplete. From the very first word of Greek (and European) literature—*menis*, "wrath"—to the coming of Christianity, we observe the presence of emotions in every expression of Greek history, culture, institution, and society.

Thirdly, Greek art and literature, transmitted through the centuries, incorporated into education, and elevated into the status of "classic," have confronted men and women of any time and culture with fundamental problems of human nature, archetypal emotional conflicts, and recurring behavioral patterns. Let us take the passions of larger-than-life figures such as Medea, whose emotional conflicts have influenced world literature. Performed time and again and included in canons of literary texts, Greek tragedies, such as Euripides's *Medea*, became part of the world's cultural heritage, transcending the borders of time, language, and culture. It inspired six operas between 1649 and 1797 alone—the best known being Luigi Cherubini's *Medea* of 1797.[2] The most impressive staging of Euripides's *Medea* is a 1984 cross-cultural version of the Greek poet's innovative treatment of the themes of love, betrayal, jealousy, anger, and revenge: the work of the Japanese director Yukio Ninagawa. In one of the most memorable scenes of world theater, Medea, played by the actor Mikijiro Hira, renounces her love by endlessly pulling a red ribbon out of her mouth.[3]

Hopefully, this exhibition will trigger thoughts about the importance of emotions in our world and show why the study of emotions in classical antiquity may help us better understand the contemporary social and cultural environment. We may often be puzzled by emotions, but we cannot ignore them. ■

Angelos Chaniotis, Professor in the School of Historical Studies since 2010, is engaged in wide-ranging research in the social, cultural, religious, legal, and economic history of the Hellenistic world and the Roman East. Significant questions and dialogues in the field have grown out of his contributions, which have helped to advance understanding of previously unexplored aspects of the ancient world.

2 *Giasone* by Francesco Cavalli (1649), *Thésée* by Jean-Baptiste Lully (1674), *Médée* by Marc-Antoine Charpentier (1693), *Teseo* by Georg Friedrich Händel (1713), *Medea* by Georg Anton Benda (1775), and *Medea* by Luigi Cherubini (1797).

3 M. Smethurst, Ninagawa's Production of Euripides' *Medea*, *American Journal of Philology* 123, 2002, 1–34.

The Zaydi Manuscript Tradition

Preserving, studying, and democratizing access to the world heritage of Islamic manuscripts

BY SABINE SCHMIDTKE

Reducing the intellectually rich and diverse Islamic literary heritage to a bare minimum of what is seen as allegedly authentic is a strategy that is characteristic of Wahhabism, Salafism, and jihadism and their respective proponents. Whatever goes against their interpretation of Islam is classified as "heretical" and banned from distribution. Moreover, libraries holding books and manuscripts that are seen as containing deviant views are targeted for destruction, as is also the case with historic monuments, shrines, and religious sites, which have been destroyed over the past decades by Muslim extremists in an attempt to allegedly "purge" Islam.

Mention should be made of the attempts by Islamic militants to destroy the important manuscript holdings in Timbuktu in 2013,[1] or the destruction of books and manuscripts in the libraries of Mosul at the hand of ISIS in 2015.[2] Another example has received less public attention, though the significance of the literary material and the level of destruction go far beyond the case of the Timbuktu or the Mosul collections. It concerns the Zaydi Manuscript Tradition, which is primarily preserved in the numerous private and public libraries of Yemen. Many manuscript collections have been severely damaged, looted, or even destroyed over the past decade, and the continuing war in the country, with its daily bombardments, constitutes an imminent threat not only to the local population, but also to the cultural heritage of the country, including its many libraries.[3]

SABINE SCHMIDTKE

A Yemenite digitization team at work in the Maktabat al-Awqāf

To be sure, the world heritage of Islamic manuscripts in its entirety is an extraordinarily rich one and the extant Islamic literary tradition of the premodern period surpasses by far what is preserved, for example, in Latin and Greek. The three most renowned digital collections of classical Arabic texts, al-Jāmiʿ al-kabīr, Shamela.ws, and ShiaOnlineLibrary.com, include at present about 7,895 individual titles, circa 1.1 billion words in total.[4] Not included in any of these counts are printed Arabic materials that are not available in digital form. Moreover, the manuscript tradition continued longer in the Islamic world than anywhere else, and only a fraction of the Islamic literary heritage is available by now in print. Preserving this vulnerable heritage and making it accessible to a wider audience is therefore of imminent significance.

The Zaydi manuscript tradition: An endangered cultural heritage

The Zaydi community is a branch of Shii Islam that has flourished mainly in two regions, namely the mountainous Northern Highlands of Yemen and the Caspian regions of Northern Iran. The two Zaydi states that were established in the ninth century C.E. initially constituted separate political and cultural entities. The situation changed in the early twelfth century, when a rapprochement between the two communities began that eventually resulted in their political unification. The political development was accompanied by a transfer of knowledge from Northern Iran to Yemen that comprised nearly the entire literary and religious legacy of Caspian Zaydism.

During the reign of Imam al-Manṣūr bi-Llāh ʿAbd Allāh b. Ḥamza (r. 1197–1217), the knowledge transfer to Yemen reached its peak. The Imam founded a library in Ẓafār, his town of residence, for which he had a wealth of textual sources copied by a team of scholars and scribes. More than seven hundred years later, in 1929, the rich holdings of his library, which had continued to grow under his successors, were transferred from Ẓafār to the newly founded al-Khizāna al-Mutawakkiliyya (nowadays: al-Maktaba al-Sharqiyya or Maktabat al-Awqāf), which is housed in the complex of the Great Mosque of Ṣanʿāʾ.

The Zaydi literary tradition is among the richest and most variegated strands within Islamic civilization, and at the same time one of the least studied. The literary production by Zaydi scholars stretches over more than a thousand years covering a wide spectrum of traditional disciplines. Moreover, Zaydis were at all times intimately familiar with the relevant intellectual strands beyond the confines of their own community, and they actively engaged in them. The typical library of a Zaydi scholar would comprise not only works belonging to his own religious tradition, but also an array of titles of authors from other communities, including the literary legacy of the Muʿtazila, one of the most important rational schools in the history of Muslim theology. The Yemeni manuscript collections thus constitute a unique treasure trove for large segments of the Islamic intellectual tradition—Sunni as well as Shii—much of which has not survived anywhere else in the Islamic world.

It is fortunate that the majority of Zaydi literature is still extant, mostly in the form of manuscripts. On the downside, the Zaydi manuscript tradition is widely dispersed. The most significant and by far largest collections of Zaydi manuscripts are housed by the many public and private libraries of Yemen (estimates of their holdings range between 40,000 to 100,000 manuscripts). In addition to this, several European libraries own considerable numbers of Zaydi manuscripts (about 10,000 manuscripts), as is also the case with North American libraries (fewer than 1,000 manuscripts). Of great importance are also the many libraries of the Middle East, especially in Egypt, Saudi Arabia, Turkey, Iran, and Iraq, and other places with significant numbers of Zaydi manuscripts.

In view of the poor state of scholarship in the area of Zaydi studies, the challenges that result from the dispersal of the material, and the disastrous situation in present-day Yemen, the tasks at hand are threefold, namely "preserving" and "studying" the Zaydi manuscript tradition, as well as "democratizing" access to these materials.

The scholarly discovery of Zaydism

As a result of the geographical isolation of Yemen, the scholarly exploration of its political and intellectual history and of its rich manuscript holdings started later than was the case with most other parts of the Islamic world. Toward the end of the nineteenth century, a number of European explorers and merchants sojourned to Yemen where they brought together considerable collections of manuscripts that they later sold to European libraries. Mention should be made of the Austrian Eduard Glaser (1855–1908) who visited Yemen on four occasions between 1882 and 1894 and sold his nearly nine hundred manuscripts to the Königliche Bibliothek zu Berlin (now Staatsbibliothek zu Berlin), the British Museum in London, and the Austrian National Library in Vienna. The most significant collection of Yemeni manuscripts outside of Yemen (ca. 1,700 manuscripts) was purchased between 1906 and 1914 by the Biblioteca Ambrosiana in Milan. Important collections of Zaydi manuscripts from Yemen are also owned by Leiden University Library, the Bavarian State Library in Munich, the *Biblioteca Apostolica Vaticana*, Princeton University Library, and Yale University Library.

On the basis of the European collections of Yemeni manuscripts, it was mostly German and Italian Arabists who initiated the scholarly investigation of Zaydism during the early decades of the twentieth century. The German scholar Rudolph Strothmann (1877–1960) began to study the holdings of the Berlin Glaser collections during a visit to the city in October 1908, and his rich scholarly output on Zaydism (published between 1910 and 1923) laid the foundation for what was then an entirely new field of study. Dutch scholars were also engaged in Zaydi studies, as were Italian Arabists, who had the largest collection of Yemeni manuscripts at their disposal: Eugenio Griffini (1878–1925), Ignazio di Matteo (1872–1948), Michelangelo Guidi (1886–1946), and Renato Traini (1923–2014).

Strothmann's erstwhile student, Wilferd Madelung, provides in his seminal 1965 book *Der Imam al-Qāsim ibn Ibrāhīm und die Glaubenslehre der Zaiditen* an unsurpassed analysis of the doctrinal developments of the Zaydis from the time of Imam al-Qāsim b. Ibrāhīm (d. 860) until ʿAbd Allāh b. Zayd al-ʿAnsī (d. 1269). Over the past decade, a number of Madelung's students and other Western scholars have continued to developed the field of Zaydi studies.[5] Yemeni scholars also contributed to advancing our knowledge of the political and intellectual history of Zaydism in Yemen, among them Ismāʿīl b. ʿAlī l-Akwaʿ (1920–2008).[6] Outside of Yemen, Egyptian scholars have contributed significantly to furthering the scholarly study of Zaydism.[7]

Toward an open and democratic research culture

Over the course of the second half of the twentieth century and during the early twenty-first century, various microfilming and digitization projects have been carried out by teams from Egypt, Kuwait, Iran, Germany, and the United States in an attempt to facilitate access to the manuscript holdings of the libraries in Yemen.

Despite the enormous significance of all these efforts, there are also several downsides. The Egyptians, and later the Kuwaitis, had a selective approach in their choice of manuscripts to be microfilmed (they were aiming particularly at the literary legacy of the Muʿtazilites, a theological movement with a rationalist approach that dominated Islamic doctrinal thought from the ninth through the thirteenth century). They managed to publish a fair amount of works they had brought from Yemen during the late 1960s and 1970s, and with this rendered a

(Continued on page 15)

great service to scholarship. Moreover, the publication of these works evoked a reappraisal of rationalism as evidenced in the theological writings of the Muʿtazila, resulting in a movement that was summarized under the label Neo-Muʿtazila. The Iranians, who microfilmed and later digitized significant amounts of Yemeni manuscripts during the early 2000s, had a far more comprehensive approach—in many cases they filmed entire collections. The various digitization efforts supported by the German Foreign Office[8] and the Deutsche Forschungsgemeinschaft in conjunction with the National Endowment for the Humanities[9]—both carried out in cooperation with the Imam Zayd bin Ali Cultural Foundation—aimed at digitizing a select number of private collections in their entirety.

The handlists that were produced for the digitized materials often omit the whereabouts of the original manuscripts, which is a major hurdle for the accurate scholarly usage of the material and subsequent scholarly communication about the manuscripts, as well as for future efforts to digitize additional private collections. Generally, the cataloguing of the holdings of the libraries of Yemen, especially the private ones, is in a very poor state and their history has not been studied up until now. Moreover, as a result of the political vicissitudes of Yemen during the twentieth and twenty-first centuries, and the fact that most private libraries are in family ownership, those libraries are subject to constant change, and it is often unclear whether a library, quoted for example in a handlist created by Egyptian scholars in the 1960s, still exists, and, if so, under which name.

While scholars outside of Yemen are able to access only a fraction of the relevant manuscript materials housed in Yemeni libraries, scholars of Yemen are for all practical purposes unable to consult any of the Zaydi manuscripts housed by European or North American libraries—the costs for digital images render them unaffordable, and only a fraction of the close to eleven thousand manuscripts have so far been digitized.

The Zaydi Manuscript Tradition: A Digital Portal

The most recent initiative to preserve the Zaydi manuscript culture and to democratize access to it is "The Zaydi Manuscript Tradition (ZMT): A Digital Portal," a joint project initiated by the Institute for Advanced Study in partnership with the Hill Museum & Manuscript Library (HMML) in Minnesota. It consists of two components: a digital portal, which is housed on the website of the Institute for Advanced Study,[10] and HMML's virtual reading room, vHMML, which serves as the repository of digital surrogates of manuscript codices.[11]

The purpose of the ZMT is threefold. Through its digital portal, it serves as a *comprehensive research guide* to relevant collections of Zaydi manuscripts, providing precise information on the location of each collection with a full list of its holdings (shelf marks) and the relevant bibliography for every single codex. Each entry is linked to a corresponding entry in the virtual reading room of the Hill Museum & Manuscript Library. This provides a stable HMML Project Number and permanent link for each manuscript. In a second phase of the project, full metadata will be produced for the manuscripts included in the project using the vHMML reading room's cataloging tools.

In addition to this, the digital portal functions as a *gateway to manuscripts* within the confines of the ZMT that have already been digitized. Provided a repository has uploaded digital images of its own holdings, the portal links the user directly to those repositories. Images of holdings of other collections of Zaydi manuscripts, to the extent that these are available or can be produced, will be uploaded to the digital reading room of vHMML, and links to the respective digital codices are again provided through the portal.

The project, which aims to provide open access to an estimated number of about fifteen thousand digitized manuscripts over the course of the next three years, will help to salvage the rich Yemeni heritage, which is on the verge of destruction. These measures will also effectively *democratize* access to the Zaydi Manuscript Tradition, which is expected to result in an upsurge of this important field of study and will serve as a model for other fields within Islamic studies where scholars face similar challenges. At the same time, the ZMT project will help to bring more of the enormous richness and intellectual diversity of Islamic culture to the forefront and make it accessible for everyone.

Most importantly perhaps, the preservation and dissemination of the mostly unknown Zaydi theological and legal literature will underscore the fact that a rationalist epistemology continued in Islamic thought for a longer period than is generally recognized. The preservation, dissemination, and study of these rich manuscript materials will thus not only have an immediate impact on several fields of scholarship in the humanities but also bring the rational heritage of Islam to the forefront and thus contribute to a more nuanced picture of the Islamic intellectual tradition and culture among Western observers. ■

Recommended Reading:

"Institute for Advanced Study Partners with Hill Museum & Manuscript Library to Share Threatened Manuscripts from Yemen and Neighboring Countries," Hill Museum & Manuscript Library, April 11, 2017, http://bit.ly/2oHjzB9

Sabine Schmidtke, Professor in the School of Historical Studies since 2014, has played a central role in the exploration of heretofore unedited and unknown theological and philosophical writings. Schmidtke has applied rigorous study to the edition and critical analysis of manuscripts in Arabic, Judeo-Arabic, and Persian, and her work extends from Arabic-speaking countries to Israel, Iran, Russia, and Turkey.

Member Columba Stewart: The Monk Who Saves Manuscripts

Father Columba Stewart, a Benedictine monk, George William Cottrell, Jr. Member in the School of Historical Studies, and Executive Director of the Hill Museum & Manuscript Library, was recently profiled in the *Atlantic* for his efforts to save Christian and Islamic manuscripts (http://theatln.tc/2lMGI3u). Stewart, with his team from the Hill Museum & Manuscript Library, has traveled across the Middle East to rescue artifacts, which have been under threat for centuries, with the aim of digitizing the materials for scholarship and to encourage a deeper understanding between different religious groups.

"If we don't find deeper affinities, we will always be stuck on our superficial differences. We will remain afraid and suspicious of each other. Relations were not always easy in the past, but if we learn from places where they lived together, we might learn how to live together."—Columba Stewart in "The Monk Who Saves Manuscripts from ISIS," *The Atlantic*, February 23, 2017

View an IAS lecture about Stewart's project at http://bit.ly/2nFGzkY.

Columba Stewart (left) and team digitizing the famous Abba Garima gospels, possibly the oldest Ethiopian manuscripts in existence, in 2013

1. It is mostly thanks to the courageous attempts of the people of Timbuktu that most of the manuscripts were saved and clandestinely smuggled out to Bamako. They are currently being preserved through digitization, with generous support by various international funding agencies and private donors, under the aegis of the Hill Museum & Manuscript Library (HMML), https://goo.gl/v7hGEd.
2. Cf. Muna Fadhil, "ISIS Destroys Thousands of Books and Manuscripts in Mosul Libraries," *The Guardian*, February 26, 2015, https://goo.gl/xNCzZZ; Henri Neuendorf, "8,000 Books Burned by ISIS in Massive Iraqi Libricide," *Artnet News*, February 25, 2015, https://goo.gl/anUEJj.
3. For cases of looting and destruction between 2014 and 2016, see David Hollenberg and Anne Regourd, "Manuscript Destruction and Looting in Yemen: A Status Report," *Chroniques du manuscrit au Yémen* 21 (2016): 157–177.
4. Maxim Romanov, "Chronological Coverage of an Arabic Corpus: An Experiment with Data Statements," https://alraqmiyyat.github.io/2016/03-29.html.
5. See, e.g., the contributions to *The Neglected Šīʿites: Studies in the Legal and Intellectual History of the Zaydīs*, ed. Sabine Schmidtke, *Arabica: Journal of Arabic and Islamic Studies* 59 (2012): 3–4; and *The Yemeni Manuscript Tradition*, ed. David Hollenberg, Christoph Rauch, and Sabine Schmidtke (Leiden: Brill, 2015).
6. See, e.g., the obituary by Adel al-Aulaqi at http://al-bab.com/albab-orig/albab/bys/obits/alakwa.htm.
7. See also the references to the relevant primary and secondary sources included in the Zotero Group Library "Zaydi Studies" at www.zotero.org/groups/zaydi_studies, which is an ongoing project.
8. "Preserving Yemen's Cultural Heritage: The Yemen Manuscript Digitization Project" (YMDP), 2010. See Sabine Schmidtke and Jan Thiele, "Preserving Yemen's Cultural Heritage: The Yemen Manuscript Digitization Project," *Fair Observer* (2011), www.fairobserver.com/region/middle_east_north_africa/preserving-yemens-cultural-heritage-yemen-manuscript-digitization-project/
9. "The Yemen Manuscript Digitization Initiative" (YMDI), 2010 through 2013, https://ymdi.uoregon.edu
10. www.ias.edu/digital-scholarship/zaydi_manuscript_tradition
11. www.vhmml.org

Editing the Qur'ān in Sixteenth- and Seventeenth-Century Europe

Newly discovered manuscripts reveal the arduous, and often ill-fated, efforts of scholars, typographers, and traders to print the Qur'ān

BY ROBERTO TOTTOLI

As Alastair Hamilton stated in 2008 in *The Forbidden Fruit: The Koran in Early Modern Europe*, "few books were as feared and coveted, as abhorred and desired, as the Qur'ān in early modern Europe." Religious polemics, trading activities, and travellers' accounts, reflecting political and social confrontation, have marked Christian Europe's interest in Islam and its holy book. Along with the life of Muhammad, the Qur'ān is a fundamental piece in Europe's picture of Islam. European history has struggled through the centuries to relate to and study the Qur'ān, mostly in order to better refute it, but also to advance a growing knowledge of what the text actually states.

For this reason, the Qur'ān has been not only translated, but discussed and polemically attacked, since the twelfth century. It was also studied in the original Arabic through the few manuscripts that reached Europe—knowledge of the Qur'ān was akin to the final step for scholars wishing to demonstrate proficiency in Arabic. The humanist interest in going back to original sources and the invention of printing gave new momentum to interest in the Qur'ān between the fifteenth and sixteenth centuries. In particular, printing and the business interest in the production of books fueled the diffusion of culture. Furthermore, the Reformation broke the unity of western Christianity, which prompted references to Islam for inner rivalries and confrontation. Suddenly, the Qur'ān was not just the book of the enemy, but the aim of scholars and students of Arabic and Islam and the desideratum for typographers and traders. Thus, the first Arabic typefaces were created, and the first books in Arabic, though still a rare enterprise, appeared. The Qur'ān was also printed. Paganino and Alessandro Paganini first printed the Qur'ān in Venice, in 1537–38, with the illusion that they could trade it to the Ottoman Empire. The endeavor failed, and a copy of this Qur'ān was only discovered, and thus proved to exist, in 1987.

In a Europe crossed by inter-Christian fights following the Reformation, a number of scholars of the so-called Republic of Letters cultivated their knowledge of Arabic and of the Qur'ān and, in several cases during the sixteenth and seventeenth centuries, tried to translate and print its Arabic text. Just a few attempts succeeded in producing partial editions, with good or not-so-good typefaces, but most failed, as did Johann Zechendorff's (d. 1662) work. Thus, complete editions of the Qur'ān in Arabic were printed only at the end of the seventeenth century, thanks to the efforts of Abraham Hinckelmann (d. 1694) and Ludovico Marracci (d. 1698).

The emergence and discovery of new materials, however, are changing the field. Not only is Paganini's Qur'ān now under the eyes of scholars, but the fifteen personal manuscripts of Marracci and the complete copy of the Arabic edition with interlinear Latin translation by Zechendorff have been found in Rome and in the Egyptian National Library in Cairo in recent years. The newly discovered manuscripts of Marracci show that he spent decades in his studio in Piazza dei Campitelli in Rome, the place of his religious order, not only answering questions and attending to Vatican politics in which he was influential, but also working on the Qur'ān. He produced almost 10,000 pages of text in Arabic, Latin, and Italian, obsessed with finding the best way to render the Arabic Qur'ān into Latin. He even claimed in his printed work (Padua, 1698) to have translated the whole Qur'ān four times, but his words were thought to be the typical rhetoric of an author who wants to promote his product. Indeed, the discovered manuscripts include all four of the different versions of the Qur'ān he produced over decades, wherein all of the translator's doubts emerge, revealing the influences behind the changings, erasures, and rewritings in the years before the final version was printed.

ROBERTO TOTTOLI

MS Roma Ordine della Madre di Dio Marracci II (B69 ML VII), beginning of sura 18. The photo is taken from the manuscript (in two volumes), including Marracci's handwritten transcription of the Qur'ānic commentary of Ibn Abī Zamanīn (d. 1008), of which he had a Maghrebi copy. He made the first version of his translation in the margins of this commentary in the 1650s, after underlining the Qur'ānic verses in the commentary.

The Qur'ān of Zechendorff, found in the Egyptian National Library in Cairo, is a testimony to the sad fate of a years-long work that did not have a happy end. Zechendorff was able to find neither an Arabic typeface nor economic support for printing his edition and translation of the Qur'ān. On European and German soil devastated by the Thirty Years' War, he could produce only a pair of booklets containing small excerpts of his translation, and an awful Arabic typeface engraved in wood.

These materials and further analysis of other sixteenth- and seventeenth-century products evidence how polemical attitudes and the threat of the Ottoman Empire, at least until the siege of Vienna in 1683, did not discourage scholars of Arabic from dedicating years of their lives trying to solve the puzzles of the sacred Muslim text. The complicated Qur'ānic orthography and the exact meaning of some words and passages were major problems, since they had few commentaries, and not even one work on Qur'ānic readings and recitations was available in European libraries and collections. They thus produced, or tried to produce, the first printings of the Qur'ān by overcoming Christian opposition and suspicion; the shortage of Arabic manuscripts, which were brought in small numbers by traders, diplomats, and even fighters on the borders as booty; and all the difficulties the Qur'ān in Arabic presented to the reader. Their activities are thus significant for the history of modern Europe, the translation history of religious texts, and the evolution of European scholarship on Arabic and Islam before the nineteenth century. The challenge for contemporary historians is now to see how the polemical surface hides a deep commitment to knowledge in the face of enormous difficulties. From this perspective, lapses and mistakes, which are necessary to better understand the extent of these works and their limits, are in this case not indicative of a limited knowledge, but testimony to an outstanding lust for knowledge in very difficult conditions that really made the Qur'ān not only a forbidden fruit but also an almost unreachable one before contemporary times. ■

Roberto Tottoli, AMIAS Member in the School of Historical Studies, is analyzing the history of editing and printing the Qur'ān, working with the known European editions, which range from the Paganini Venice edition of the beginning of the sixteenth century to the edition by Gustav Flügel in the nineteenth.

Talking Points

On global capitalism, Trump, and democracy

Some of the ideals of the far left are ideals that many people still cherish—the end of exploitation, racial and ethnic equality, the emancipation of women, national self-determination, etc. Believing that workers should be paid more or that immigrants should be treated fairly does not mean condoning the secret police or the Gulag. Reducing all leftist ideals to Stalinism and calling anyone who questions the long-term sustainability or desirability of global capitalism a communist, I believe, is an intentional rhetorical strategy of the political and economic elite who have the most to lose from any challenge to the current status quo.

*—**Kristen Ghodsee**, Member (2006–07) in the School of Social Science and President of the Association of Members of the Institute for Advanced Study, in "The Left Side of History: World War II and Re-emergent Nationalisms in Contemporary Eastern Europe," IAS Lecture, October 14, 2017, http://bit.ly/2peUFcM*

Such an unanticipated change in government in the United States for all its undoubted strength cannot, of course, alter overnight the entire course of international relations. The overwhelming fact is that the substance of change must answer the core needs of the neglected: cutting corporate and personal tax rates to re-energize the economy and attain genuine full employment. It has been in anticipation of this that the stock market has risen so fast and so high. But it will only sustain such levels if policy produces results. And those results will depend to some degree on a foreign policy that promotes stability, not disruption, in the international arena.

*—**Jonathan Haslam**, George F. Kennan Professor in the School of Historical Studies, in "The Significance of the Trump Presidency," The International Security Studies Forum, January 24, 2017, http://bit.ly/2oumMCc*

We are a nation shaped by immigrants, as the Statue of Liberty reminds us, but now, horrifyingly, immigrants are increasingly subjected to prejudice for both their ethnic identity and their religion. Older and equally repellent anti-Semitism and anti-Catholicism, both of which were rampant when I grew up, have now been transformed into a vile intolerance of Muslims. We have never achieved the toleration to which we aspire, although there have been corrections, and our society has undoubtedly been better at absorbing ethnic and religious differences than many other countries. But the present election process has revealed that an ignorant, mendacious, and incoherent bully can find support among important segments of the American people. The impact of this support is potentially catastrophic.

*—**Glen Bowersock**, Professor Emeritus in the School of Historical Studies, in "On the Election," The New York Review of Books, October 22, 2016, http://bit.ly/2eFcWXV*

The Chief Eunuch of the Ottoman Imperial Harem

An expanding sphere of influence amid institutional, social, and economic change

BY JANE HATHAWAY

One rarely finds [a eunuch] who has, like him, an open forehead, a well-made nose, large, clear eyes, a small mouth, rosy lips, dazzlingly white teeth, a neck of exact proportion without wrinkles, handsome arms and legs, all the rest of his body supple and unconstrained, more fat than thin.

—Jean-Claude Flachat, *Observations sur le commerce et sur les arts d'une partie de l'Europe, de l'Asie, de l'Afrique et même des Indes orientales* (Lyon: Jacquenode père et Rusand, 1766), II: 127–28 (translation by Jane Hathaway)

So runs a description of the Chief Harem Eunuch of the Ottoman Empire by the French merchant Jean-Claude Flachat, a frequent visitor to the Ottoman palace during the early 1750s. He was speaking of a man who had been enslaved in his native Ethiopia, transported to Upper Egypt for castration, then sold on Cairo's slave market. He would have been presented to the imperial palace by the Ottoman governor of Egypt or one of Egypt's grandees, and entered the harem as one of several hundred subordinate harem eunuchs. He would have worked his way up the harem eunuch hierarchy over several decades before achieving the ultimate office on the death of his predecessor.

An illustration of the Chief Harem Eunuch, depicted by a seventeenth-century British observer

PAUL RYCAUT, *THE PRESENT STATE OF THE OTTOMAN EMPIRE*, 3RD ED. (LONDON: J. STARKEY AND H. BROME, 1670), 36

In employing East African eunuchs in this way, the Ottomans were following a venerable tradition. The use of eunuchs as guardians of a ruler's inner sanctum dates to some of the world's earliest empires. Stone friezes from the Neo-Assyrian Empire, which ruled northern Iraq and Syria from 911–612 B.C.E., depict smooth-cheeked young men—eunuchs—attending the heavily bearded emperor during his hunts. In fact, virtually all pre-modern empires in the Eastern Hemisphere, with the notable exceptions of western Europe and Russia, employed eunuchs at their courts.

The great Islamic empires, beginning at least with the Abbasids (750–1258 C.E.), likewise employed eunuchs. East African eunuchs seem to have been particularly popular as harem guardians for reasons that remain unclear. Lascivious African harem eunuchs are a trope in the *Thousand and One Nights* tales, many of which depict life at the Abbasid court in Baghdad. In actual fact, the harem eunuchs kept the sexuality of the harem residents in check rather than facilitating it, just as their counterparts in the barracks and the ruler's privy chamber kept the sexuality of the male pages-in-training in check.

But why Africans? Availability was a key factor. Egypt could easily tap into the ancient slave caravan routes that ran through Sudan, while the Muslim kingdoms that emerged along Africa's Red Sea coast during the medieval period raided the kingdom of Ethiopia for slaves, whom they transshipped across the Red Sea to the Arabian peninsula. The Ottomans in the late sixteenth century went so far as to conquer a good chunk of the Horn of Africa, as well as part of Sudan, giving them direct control, at least temporarily, over the slave trade routes. Apart from availability, the sheer cultural and linguistic differences between the African harem eunuchs and the harem residents, who, under the Ottomans, came predominantly from the Balkans and the Caucasus, would have prevented any meaningful contact—political, romantic, sexual—between the eunuchs and the women they were guarding—at least in the case of young harem women and young harem eunuchs. In later life, harem women, and above all the sultan's mother, forged influential political partnerships with the most senior harem eunuchs.

Even the earliest Ottoman sultans had harems guarded by eunuchs, and there was presumably always a head eunuch, or at least a *primus inter pares*. But the office of Chief Harem Eunuch was created only in 1588, nearly three hundred years after the Ottoman state's emergence and well over a century after the Ottoman conquest of Constantinople from the Byzantines. Sultan Murad III (r. 1574–95) inaugurated the post when he transferred supervision of the imperial pious foundations for the Muslim holy cities of Mecca and Medina to the head of the harem eunuchs from the head of the white eunuchs who patrolled the third court of Topkapı Palace, where the sultan had his privy chamber. The Ottoman sultan derived a good part of his international prestige from his status as "custodian of the two holy cities," and the pious foundations, which supplied grain and services to the poor of Mecca and Medina, as well as to Muslim pilgrims, contributed to his status. Since land and properties throughout the empire were endowed to these foundations, the Chief Harem Eunuch cultivated a network of clients in every province who could ensure that the requisite grains and revenues were delivered every year. Egypt loomed particularly large in the Chief Eunuch's considerations, for the holy cities' grain came almost entirely from a large number of Egyptian villages endowed to the pious foundations. This continuous connection to Egypt perhaps helps to explain why, beginning in the early seventeenth century, most Chief Eunuchs were exiled to Cairo on being removed from office. By the 1640s, an entire exiled eunuch neighborhood had sprung up to the west of Cairo's citadel.

In certain respects, the evolution of the office of Chief Harem Eunuch mirrored institutional, social, and economic developments in the Ottoman Empire as a whole. The office was created just before the onset of the prolonged crisis of the seventeenth century, when a series of sultans died in their twenties or even in their teens, leaving no heirs or only tiny children. In this atmosphere, the Chief Harem Eunuch, along with the sultan's mother, became the main influence on the sultan's development as a statesman, or lack thereof. The crisis ended in the latter half of the century with the rise of the reforming grand viziers of the Köprülü family, who promoted Chief Harem Eunuchs from their own household. By the early eighteenth century, the empire had adapted to the crisis. Its economy grew again as trade with western Europe, and France in particular, boomed. The Chief Harem Eunuchs of the era directly encouraged this trade by serving as conduits for European luxury goods to the women of the harem. El-Hajj Beshir Agha (term 1717–46), the longest-serving and most powerful Chief Eunuch in Ottoman history, presided over elaborate nighttime garden parties at which luxurious European baubles were conspicuously consumed.

El-Hajj Beshir Agha was, according to European observers, a "vizier-maker," in stark contrast to the Chief Eunuchs of the Köprülü era, who served at the pleasure of the grand viziers from that family. But following his death in 1746, Ottoman grand viziers began to compete with the Chief Eunuch for influence, and they often prevailed. The Westernizing reforms of the mid- to late nineteenth century finally eclipsed the Chief Harem Eunuch's power; the office was in abeyance from the 1830s through the end of the empire following World War I.

> CLEARLY, THE CHIEF HAREM EUNUCH WAS FAR MORE THAN A HAREM FUNCTIONARY. HIS ACTIVITIES REINFORCED THE OTTOMAN SULTAN'S RELIGIOUS AND POLITICAL AUTHORITY, CONTRIBUTING TO THE PROMOTION OF SUNNI ISLAM IN GENERAL AND THE HANAFI LEGAL RITE IN PARTICULAR.

But the Chief Harem Eunuch's influence extended beyond palace politics, on the one hand, and the holy cities, on the other. Through his personal pious endowments, he founded mosques, madrasas, Qur'an schools, and libraries throughout the empire that had a profound effect on Ottoman religious and intellectual life. In frontier provinces such as what are now Bulgaria and Romania, these foundations reinforced the presence of the Ottoman brand of Sunni Islam of the Hanafi legal rite, not least by supplying manuscripts of canonical works of Hanafi law and theology. In venerable Muslim cities such as Cairo and Medina, such foundations reinforced Hanafism in regions where adherents of other Sunni legal rites formed a majority. Revenue for these institutions came from markets, farmland, mills, warehouses, and residential properties scattered across the same territories.

Clearly, the Chief Harem Eunuch was far more than a harem functionary. His activities reinforced the Ottoman sultan's religious and political authority while contributing to Ottoman promotion of Sunni Islam in general and the Hanafi legal rite in particular. In the course of endowing religious and educational institutions, furthermore, he contributed to infrastructural development in the Ottoman capital and in the provinces. ■

Jane Hathaway, Gladys Krieble Delmas Foundation Member in the School of Historical Studies, is completing a book on the Ottoman Chief Harem Eunuch, to be published by Cambridge University Press. She is Professor of History at the Ohio State University.

My Search for Ramanujan

From Bombieri to Fermat's last theorem to the absence of a "simple law"

BY KEN ONO

In November, out of the blue, I received a letter from the Institute for Advanced Study in Princeton. Nothing about the envelope suggested that the letter inside would be important. It was an ordinary white office envelope with Institute for Advanced Study as the return address. It could have been an announcement of the seminar schedule for all I knew. But it was much more than that. I was like the boy Charlie from Roald Dahl's children's book *Charlie and the Chocolate Factory* when he tore the wrapper off his Wonka bar to discover the last of five golden tickets, offering a tour of the magical factory and a lifetime supply of chocolate. Instead of all the chocolate I could ever want, I had been given an even sweeter prize. The letter was from the renowned number theorist and Fields medalist Enrico Bombieri. It consisted of a single paragraph offering me a two-year membership at the Institute.

KEN ONO

Ken Ono (right) stands with his father, Takashi Ono, in front of the White House after receiving a Presidential Early Career Award in April 2000.

Andrew Granville had recommended me to Bombieri, praising my goal of searching for Ramanujan's number theory, and Bombieri had apparently found my goal worthy of support. I had only one duty—to pursue my search for Ramanujan. The letter was a dream come true. I would have the privilege of working at an institution made famous by the likes of Einstein, Dyson, Gödel, Oppenheimer, and Weil, among many other luminaries.

And of course, the Institute had played a special role in my family history. André Weil, who had discovered my father in Japan forty years earlier, was a longtime faculty member. Over the years, he had arranged several visiting positions for my father, including the 1968–1969 academic year, the year I was born. My mother would take long walks on the Institute campus, pushing me in a carriage. Erika and I would have our first child, Aspen, at the Institute in 1996, and history would almost repeat itself: instead of long walks pushing a carriage, Erika and I would glide around the grounds on roller blades with Aspen strapped safely in a pink baby jogger.

Thanks to the strong support of my mentors Paul Sally, Basil Gordon, and Granville, I had somehow reached a level beyond my wildest dreams. I had dropped out of high school ten years earlier, and four years later, my complex analysis professor at the University of Chicago had tried to talk me out of pursuing a doctorate. Now I was pursuing my own research program at the Institute for Advanced Study. And woven through all that history was my faithful guide Ramanujan.

My decision to search for Ramanujan the mathematician would mean going a bit more distance out of my way. I wanted to increase my knowledge, and that would slow down my publication rate, something that anyone trying to land a permanent job must take into account. The Institute's offer was therefore a godsend. I could concentrate on my mathematics in an environment free of other distractions and responsibilities; I had access to world-class libraries at the Institute and Princeton University, and I would be able to learn from some of the world's most brilliant and talented mathematicians. I vowed to make the most of this special opportunity.

Erika and I moved to Princeton in August 1995, my third consecutive August move. We lived in a two-bedroom Bauhaus apartment at 69 Einstein Drive. Erika found work as a nurse in Trenton, and I did my number theory research. My first task was to complete my web of modularity. After that initial investment, I would then turn to my search for Ramanujan's mathematics.

The 1995–1996 academic year at the Institute was devoted to an examination of the proof of Fermat's last theorem. Although it turned out that the original proof by Wiles had a flaw, he was able to correct it in a supplementary paper written with his former graduate student Richard Taylor. Due to the importance of their work, the Institute had invited many of the world's leading number theorists to spend the year in a collaborative environment in which they could push number theory even further. It was an awesome year, one that would contribute to my growth as a mathematician and help my career in many ways. With so many experts to talk to, I was able to complete the bulk of the work for my web of modularity in good order.

We made many friends that year, mostly other young mathematicians. Two of our closest friends were Princeton graduate students Kannan "Sound" Soundararajan and Chris Skinner. Sound would later become a professor at Stanford, and Chris would become a professor at Princeton. We were fans of the TV show *X-files*, and we made frequent trips to nearby Iselin, New Jersey, for Indian food. Chowpatty was our favorite restaurant, and that is where I developed a taste for south Indian vegetarian dishes like pav bhaji and masala dosa.

My enthusiasm for cycling rubbed off on Chris and Sound. I helped them shop for mountain bikes, and we rode often on the trails in the area, even after one of us flipped over the handlebars on a narrow and rocky descent and landed in the emergency room. When our daughter Aspen was born in June 1996, Chris and Sound became her first "uncles."

I wrote papers with Chris and Sound during my Princeton years. Chris and I would ultimately write three papers on mathematics related to the Birch-Swinnerton-Dyer conjecture, one of the notorious "Millennium Problems" whose solution would bring a million-dollar prize. This was part of filling in my web, the groundwork I felt was necessary before I could begin my search for Ramanujan's mathematics in earnest.

When I wasn't thinking about that problem, Ramanujan's words were on my mind, as if he were somehow speaking to me. In addition to his comments about the absence of further "simple properties" for the partition numbers, I was deeply interested in a 1916 paper on quadratic forms in which similar puzzling words appeared, this time about the absence of a "simple law." Sound and I became enamored with the problem implied by Ramanujan's words. We had to figure out what he meant. . . .

Quadratic forms are objects that mathematicians have studied for centuries. One of the most famous theorems about them is due to the eighteenth-century mathematician Joseph Lagrange. He proved that every positive integer—no exceptions!—can be expressed as the sum of four perfect squares. It's like a magic trick: Pick a number, any number. How about 374? Then I can pull four integers out of my hat such that their squares add up to 374. For example, $374 = 0^2 + 2^2 + 9^2 + 17^2$. I could also have written $374 = 6^2 + 7^2 + 8^2 + 15^2$ (as you can see, there is nothing necessarily unique about such representations). Lagrange proved that there is nothing special about 374. You can find a similar representation for *every* positive integer.

Now in solving a mathematical problem, it is crucial to ask the question in a way that leads to a solution. So instead of asking whether every positive integer can be written as a sum of four squares, Lagrange considered the quadratic form $a^2 + b^2 + c^2 + d^2$ and proved that by plugging in all possible integer combinations for a, b, c, d into that *quadratic form*, you obtain all of the numbers 1, 2, 3, 4, ...

> THERE SEEMED TO RAMANUJAN TO BE NO SIMPLE LAW THAT WOULD EXPLAIN HIS LIST AND SHOW HOW IT CONTINUES. WHAT DID HE MEAN THAT THERE DOESN'T APPEAR TO BE A "SIMPLE LAW"?

In the 1916 paper that had intrigued Sound and me, Ramanujan was considering the quadratic form $x^2 + y^2 + 10z^2$, in relation to which he wrote, "the odd numbers that are not of the form $x^2 + y^2 + 10z^2$, viz., 3, 7, 23, 31, 33, 43, 67, 79, 87, 133, 217, 219, 223, 253, 307, 391 ... do not seem to obey a simple law." Whereas Lagrange's quadratic form could represent every positive integer, there are numbers that cannot be written in the form $x^2 + y^2 + 10z^2$ (the reader can easily verify that the numbers in Ramanujan's list above cannot be thus represented).

There are plenty of odd numbers that can be obtained by this quadratic form, such as $57 = 1^2 + 4^2 + 10 \times 2^2$, where we have chosen $x = 1$, $y = 4$, and $z = 2$. There seemed to Ramanujan to be no simple law that would explain his list and show how it continues. What did he mean that there doesn't appear to be a "simple law"?

In 1990, Bill Duke and Rainer Schulze-Pillot proved a fantastic theorem that implied that all odd numbers *from some point on* must be represented in this way. That meant that Ramanujan's list petered out eventually, since the number of odd integers that cannot be represented by the quadratic form in question is finite. You could say, then, that Ramanujan was right: there was no simple law. Indeed, you could say that there was no law at all! It was just a finite list of the relatively few (however many it might be, a finite number is small compared to infinity) integers that happened not to have such a representation. On the other hand, for us, the law that we had to find was this: what is the last number on the list? And was finding it going to be simple, or was it going to be hard?

Sound and I ran a computer program, and we found that Ramanujan's list could be extended by the odd numbers 679 and 2719. But after that, the well ran dry. For every larger odd number we tried—and we tried all the way up to the super-huge number 1,000,000,000,000,000—we found that it *could* be expressed by the quadratic form using some choice of x, y, and z. We concluded that we

(Continued on page 19)

BLACK HOLES *(Continued from page 1)*

the science fiction short story "A Sound of Thunder" (1952) even before it became widely appreciated in physics.

Part of the reason for this historical blind spot is that chaotic systems tend to be difficult to analyze. So, even though non-chaotic systems (where small changes don't lead to large effects) are rare, there is a strong selection effect in favor of studying them. This changed in a fundamental way in the 1960s, with the help of computers. Computers are great at solving the equations of classical physics, and numerical study of many different systems has led to a beautiful and rich phenomenology of classical chaos.

Unfortunately, computers do not have the same power at simulating quantum systems, particularly quantum field theories (theories of interacting quantum particles). This is because the memory and central processing unit requirements of simulating a quantum system increase exponentially with the number of particles involved. To a large extent, our understanding of these systems is therefore limited to problems that can be solved by hand. And, just as in classical physics, these normally do not include systems complicated enough to exhibit much chaos. So we are more or less still in the dark when it comes to quantum chaos.

A small region of insight is provided by the AdS/CFT (anti-de Sitter/conformal field theory) correspondence, proposed by IAS Professor Juan Maldacena almost twenty years ago. A special case of this correspondence is an exact equivalence between a nicely chaotic quantum field theory (the strongly coupled large N super Yang-Mills theory at finite temperature) and one of the simplest objects in general relativity: a black hole. This means that for this example, it is possible to analyze chaotic dynamics in a quantum field theory (hard) using black hole dynamics (easy-ish).

IT SEEMS THAT BLACK HOLES HAVE TO BE THE BEST AT EVERYTHING THEY DO.

Before we get any further, it is helpful to have in mind a thought experiment that tests for the butterfly effect. We can illustrate this by thinking about an unusual state for a familiar chaotic system: a bath of water. Imagine that we have a full tub in a very special configuration where, if we leave it alone, a little whirlpool will spontaneously form somewhere on the surface a few minutes from now. Instead of leaving it alone, we could add an extra water molecule somewhere else in the tub and then wait and check for the whirlpool. Such a very tiny change to the overall state of the system would get amplified over time, and at the expected moment a few minutes from now, the whirlpool would fail to appear. This is a sharp diagnostic of chaos.

Now let's run the same experiment, replacing the bath of water with a black hole. First, one needs an analogue of the state where a whirlpool will form in a few minutes. The simplest thing is to consider a state where the black hole will emit an extra photon at some time t a few minutes in the future. Let's call the extra photon W for "whirlpool." Then, before it emerges, W will be very close to the horizon (the point of no return for the black hole), traveling on a trajectory where it will just barely manage to escape. If t is far in the future, trajectories of this type hug the horizon very closely for a while, before finally pulling away and emerging to safety at time t. This is illustrated in part (a) of the drawing (see page 1).

For the second step of the thought experiment, we are supposed to add a small perturbation to the system. Here, the simplest thing is to imagine that we just throw an extra particle into the black hole. This would have the effect of making it a tiny bit bigger. In particular, the extra particle would move the horizon out by a small amount. Now, the key point is the following: if the time t is sufficiently far in the future, then at time zero W would be so close to the horizon that even this small increase in mass would be enough for the black hole to capture W. The whirlpool will not form! This is illustrated in part (b) of the same drawing (see page 1).

One can analyze this in more detail, and find that the strength of the effect of the perturbation on the "whirlpool" W grows exponentially with the time difference t, as $e^{\lambda t}$ with λ given by 2ϖ times the temperature. In work with Maldacena and with Steve Shenker from Stanford University, we showed that this rate of exponential growth is the fastest possible in quantum mechanics. So, although it sounded like a very simple effect, this is actually a manifestation of the strongest chaos allowed by the laws of nature. (This is part of a pattern of hypercompetitive behavior that has been observed in black holes before: it seems that they have to be the best at everything they do.)

In a surprising twist, Alexei Kitaev from Caltech found a quantum system where it is possible to analyze this type of thought experiment by direct calculation, without appealing to the AdS/CFT correspondence and black holes. And Kitaev found that his system has the same rate of growth that we described above: 2ϖ times the temperature. This suggests the interesting possibility that the Kitaev model might be a black hole in disguise.

For me, this is tremendously exciting, because having a solvable description of a black hole might help shed light on some of the deep mysteries about quantum gravity. Normally, (as in the discussion above) one uses the AdS/CFT correspondence to learn about quantum field theories using gravity and black holes. But this solvable system might make it possible to turn the arrows around and learn about gravity using Kitaev's model. I should mention that there has been another twist, which is that closer inspection has revealed that the dual description is a black hole in a rather unfamiliar theory of quantum gravity. But many of us remain hopeful that it will be possible to learn some lessons from the model.

The lesson one would most like to learn is how to describe the region behind the horizon of the black hole using the dual quantum system. In the analogy to the bath of water, this might be a bit like asking for a mathematical theory of whirlpools that never quite form. It is a problem so stubborn that it has led some researchers to believe that the region doesn't exist at all! But the concentration of interest in this problem at the IAS makes me optimistic that we will soon know the answer. Perhaps we should take a lesson from the past and look for hints in the science fiction literature. ■

Douglas Stanford is a Member in the School of Natural Sciences with funding provided by the Simons Foundation. His areas of interest include quantum gravity, quantum field theory, and string theory. He has worked on the AdS/CFT description of black hole interiors and the relationship to chaotic dynamics in quantum field theory.

MY SEARCH FOR RAMANUJAN *(Continued from page 18)*

had found the "from some point on" from Duke and Schulze-Pillot's theorem. That was the "simple law." It must be true that every odd number larger than 2719 can be expressed by Ramanujan's quadratic form, and we set out to prove it. Although we firmly believed that we were right, we couldn't come up with a proof, no matter how hard we tried. When mathematicians are unable to prove something that they believe to be true, they sometimes are able to give a proof on the assumption that some unproven conjecture is true. In our case, we were able to prove that 2719 is the last number in the sequence on the assumption of the truth of the *generalized Riemann hypothesis*.

The ordinary Riemann hypothesis is one of the most important open problems in mathematics. It involves a certain conjectured property of a certain function of a complex variable. Its truth would resolve many unanswered questions. For example, mathematicians would have a much clearer understanding of prime numbers if the Riemann hypothesis were confirmed to be true. The generalized Riemann hypothesis is a natural generalization of the Riemann hypothesis.

Using a long and complicated argument, we finally found a way to show that the truth of the generalized Riemann hypothesis implies that every odd number greater than 2719 can be written as $x^2 + y^2 + 10z^2$ for some integers x, y, and z. The fact that almost every mathematician believes in the truth of the generalized Riemann hypothesis and the fact that every odd number greater than 2719 up to a very large number can be represented by Ramanujan's quadratic form convinced us that we had found the law. But although the law is simple enough to state, it thus far defies a definitive proof. To be sure, if someone manages to prove the generalized Riemann hypothesis, then our conditional proof will at once become a genuine proof. But the generalized Riemann hypothesis is arguably one of the most difficult open problems in mathematics. So Ramanujan was right that the odd numbers do not obey a simple law, in the sense that they are constrained by one of the most difficult unsolved problems in mathematics.

I had no idea that I would see the number 2719 again ten years later, etched on a wall in the very spot where Ramanujan performed some of his first calculations.

Thanks to my two years in Princeton, I was able to complete a large body of work, and I was rewarded for my efforts with a tenure-track assistant professorship at Penn State University. George Andrews, one of the mathematicians I admired from the BBC documentary and Robert Kanigel's book *The Man Who Knew Infinity*, had recommended me for the position. My work on Ramanujan's mathematics, namely my work on Mathukumali Subbarao's conjecture for the partition numbers and my work with Sound on Ramanujan's quadratic form, were the reasons for my success. ■

Ken Ono, Member (1995–97) in the School of Mathematics, is Asa Griggs Candler Professor of Mathematics at Emory University. This article is excerpted from My Search for Ramanujan, *which Ono authored with Amir D. Aczel (Springer, 2016).*

Preventing Cervical Cancer

Investigating costs, access, marketing, and effectiveness of vaccines

BY DONALD W. LIGHT

When two vaccines appeared on international markets in 2006–07 to protect adults from selected infections that can lead to cervical and related cancers, they were seen as tools of cancer prevention and soon taken up by many countries (Bruni et al. 2016). Their prices also set records, about $120–$190 a dose in the United States. Even with substantial discounts, many lower- and middle-income countries found them unaffordable. Yet more than 85 percent of the 528,000 new cases of cervical cancer and 266,000 deaths per year worldwide occur in these countries to women in their 30s and 40s (Globocan 2015). High prices continue to be a serious barrier to access, prevention, and reducing global health inequality. Could they be lower and still be profitable? Beyond wider access, how effective are they, and why do they remain controversial?

In the spring of 2013, both Merck and GlaxoSmithKline (GSK), the manufacturers of the two vaccines, Gardasil and Cervarix respectively, offered deep discounts, charging about $4.50 a dose to Gavi[1]—the global vaccine alliance that organizes and subsidizes the vaccine market for the world's poorest countries (McNeil 2013). The companies claimed that the price to Gavi was their manufacturing cost without profits or any other costs taken into consideration. Even this price, however, is about nine times what Gavi calculates these poor countries can afford for a vaccine. Gavi-eligible countries contribute about $0.20–$0.70 per dose, and taxpayers in rich countries pay the rest through donations.

The efficacy of preventative cervical cancer vaccines remains questionable. Oversimplified marketing campaigns like the one above neglect these unknowns and disregard present and future risk factors to individuals and the larger population.

The manufacturers did not actually reveal their costs, which are closely held and very difficult to obtain. Kate Elder, a vaccine policy specialist at the international humanitarian organization Médecins Sans Frontières, or Doctors without Borders, responded by asking, "Why are the pharmaceutical companies still making profits off the backs of the poorest countries?"(McNeil 2013) Based on what she knew about probable costs of other vaccines, she sensed that this price was high. Soon after, she called to ask if I could assemble firmer details about the real costs.

It has taken a couple of years for me and a team of student volunteers from Princeton University's Global Health Program and its Department of Molecular Biology to assemble a detailed analysis of the capital, equipment, materials, quality controls, labor, and administrative costs to produce the original two HPV vaccines, Gardasil and Cervarix. This fall, while I was working on a project at IAS, the leading journal *Vaccine* published our results (Clendinen et al. 2016).

Employing sensitivity analysis, we found that manufacturing costs for the first set of batches of Gardasil to affluent nations averaged $2.05–$3.07 a dose, and costs for the second set for developing countries averaged only $0.48–$0.59 a dose. At comparable volume, Cervarix would cost about the same; but because it sells a lower quantity, its per-unit production costs were $6.16–$9.39 a dose.

Gavi countries and others prefer Gardasil because it protects against more serotypes and genital warts. Thus most donations to Gavi to subsidize doses go to extra profits. The article in *Vaccine* concludes that Gavi needs to renegotiate Gardasil's price to affirm its commitment to pricing without profits for poorer nations. This would enable Gavi to put the donations to better use and make Gardasil affordable to countries with incomes just above Gavi's cutoff income for subsidies. Making prices affordable is much better than high prices combined with special gifts and discounts (Torreele and Mazzucato 2016).

Questions about prevention

As soon as one looks beyond costs, prices, and access to the sociologically constructed realities surrounding these vaccines, however, one sees the manufacturers "turning, turning in the widening gyre" (Yeats 1920) around their own simplified accounts of how these vaccines work, around unproven effectiveness across the fifteen- to twenty-year latency period of these viruses, and around the inverse relationship between who takes the vaccines and who needs them. Let's start with the simplified accounts.

In 2008, Keith Wailoo, the Townsend Martin Professor of History and Public Affairs at Princeton, brought together scholars from anthropology, communications, history, medical ethics, pathology, psychology, and sociology to analyze the contentious marketing of Gardasil. One chapter in the resulting book describes how more than three-quarters of women are likely to become infected by precancerous cervical lesions but very few become detectable and even fewer become cancerous (Wailoo et al. 2010). Most of these lesions regress spontaneously without treatment. Routine screening picks up the others, the World Health Organization reports, and "…these can easily be treated and cancer avoided" (WHO 2016). While manufacturers can emphasize the prevalence of lesions, the risk of cancer is low. Cervical cancer ranks only fifty-fourth as a cause of death in the United States and accounts for 0.15 percent of deaths (National Vital Statistics System 2016).

Risk is much higher for poor girls and women. For example, a study in England found that 80 percent of cervical cancer incidence occurred in the bottom two-fifths of the population, while none occurred in the top fifth and 7 percent in the second fifth (Shack et al. 2008). This stark inequality echoes the global picture and calls for a biosocial approach to researching and testing medicines (Bruni et al. 2016). The chances of higher-risk serotypes leading to cancer seem to depend on several cofactors, such as impaired immune responses, which vary inversely with income, lifestyle risks, sexual activity, and frequency of reinfection (Cancer Treatment Centers of America 2017). Thus, framing HPV vaccination as a simple solution deflects attention away from these inequalities of risk between affluent women who have good immune responses, access to routine screening, and good care, and poorer women who do not.

Despite years of impressive research, uncertainties remain at multiple levels about how HPV infections cause cancer. There are more than one hundred HPV serotypes, and about twelve to fifteen are said to be high-risk. But the etiology of any HPV type is problematic, writes Robert Aronowitz, Professor and Chair of the History and Sociology of Science at the University of Pennsylvania and also an experienced internist, "… as are causal claims based upon them, for example, the claim that HPV types 16 and 18 are *the cause* (his emphasis) of 70 percent of cervical cancer" (Wailoo et al. 2010). While numerous studies that show the vaccines are cost-effective assume they prevent cancer, independent critics point out we don't know and "the real impact of HPV vaccination on cervical cancer will not be observable for decades" (Haug 2008).

The commercial marketing of these vaccines, however, disregards such complexities and masks uncertainties (Wailoo et al. 2010). Marketing hides the fact that these are vaccines against sexually transmitted diseases by promoting them as anti-cancer vaccines, even though effectiveness depends on taking them before sexual activity. Sexual activity in the trial subjects clouds outcomes (Lenzer 2011), and fully half of all U.S. females aged fourteen to nineteen report having sex, 52 percent of them with three partners or more (Markowitz et al. 2016).

Meantime, Merck developed an expanded version of Gardasil that protects against nine serotypes associated with cervical, vulvar, vaginal, and anal cancers, which may have other causes. Merck states that Gardasil 9 "does not eliminate the necessity for girls to undergo recommended cervical cancer screening later in life." "The duration of immunity of Gardasil 9 has not been established" (MerckVaccines 2017).

The marketing also hides the importance of administering the vaccines to whole populations and achieving herd immunization. Gardasil's controversial "One Less" marketing campaign promoted it as a vaccine that prevents cancer in individuals: if each adolescent or parent chooses to vaccinate, there will be "one less" victim of cervical cancer (Wailoo et al. 2010). This suggests that each individual who is vaccinated is now safe, protected, even though the fine print states that routine screening is still necessary. Marketing vaccines to individuals illustrates a wider "pharmaceuticalization" of risk factors that may lead in the future to disease (Mamo and Epstein 2014; Wailoo et al. 2010).

Given the necessity of routine screening, despite its false positives and possible unnecessary treatment, how much more will women in affluent countries

(Continued on page 21)

1 GSK's price for Cervarix to Gavi was $4.60. In this and many other ways, I have simplified the story for a general, short essay.

actually benefit from the vaccine? Marketing aims to allay their fears and anxieties. Yet the risks remain after vaccination, and a substantial percentage of females in each country take fewer than the necessary two doses (Harper et al. 2013). To the extent that marketing lulls women into believing they are covered and no longer need routine screening, cancer rates could increase (Lenzer 2011). Further, we know little about whether other serotypes will multiply to replace those blocked by vaccination in a population (Wailoo et al. 2010; Guo, Hirth, and Berenson 2015). Throughout history, viruses have adapted and persisted.

Evidence that HPV vaccines prevent cancer is indirect because the latency period of fifteen to twenty years exceeds the time since use began. Meantime, detailed studies keep reporting impressive declines in the high-risk serotypes, like a 62.6 percent decline despite only a third of females ages fourteen to twenty-nine taking one dose or more (Markowitz et al. 2016). And parents remain wary, despite multipronged campaigns urging vaccination and even trying to mandate it. Their concerns about adverse side effects have increased (Darden et al. 2013). Extensive testing has shown HPV vaccines to be safe, though sponsoring companies test their own products with trials designed to produce such evidence (Lenzer 2011; Gerhardus and Razum 2010), and they fund the FDA reviewers.

We will not know for years how effectively HPV vaccines actually prevent cervical and related cancers or how the population of viral serotypes adapts. Meantime, however, we now know that prices can be much lower and still profitable for countries where most of the cancer, hospitalizations, and deaths occur. ■

Donald Light, Visitor in the School of Social Science, is Professor of Psychiatry and Comparative Health Policy at Rowan University. For his critical work on the ethics of healthcare, he received the Edmund Pellegrino Medal in Bioethics last year. He is currently a visiting researcher at Princeton University where he is writing about access to healthcare among immigrants.

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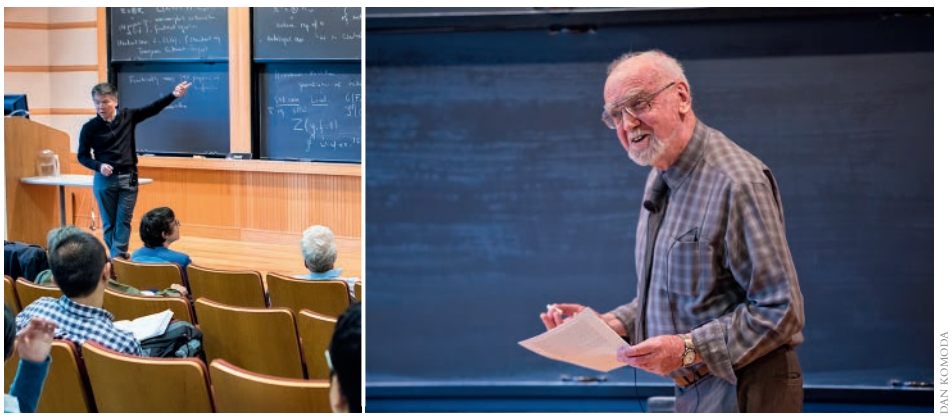
From Computational Complexity and Privacy to Endoscopy and Beyond

This fall, the work and impact of Avi Wigderson, Herbert H. Maas Professor in the School of Mathematics, was celebrated during a conference on mathematics, computer science, and computational complexity, held on the occasion of his sixtieth birthday. Robert P. Langlands, Professor Emeritus in the School, was recognized with a conference, Beyond Endoscopy, which explored issues related to Langland's seminal proposal of the same title. Four Facets of Differential Privacy, a symposium organized by Cynthia Dwork of Microsoft Research, provided an in-depth look at the current context for privacy-preserving statistical data analysis and an agenda for future research. ■

ANDREA KANE

The work of Avi Wigderson (left) was celebrated during a conference held on the occasion of his sixtieth birthday. Speakers, including former Member Dorit Aharonov (right), discussed a range of topics in mathematics and computer science.



DAN KOMODA

Bao Châu Ngô (left), former Member in the School of Mathematics, gave talks on the geometry of arc spaces and the Hankel transform at Beyond Endoscopy, which explored issues related to a seminal proposal of the same title by Robert Langlands (right), Professor Emeritus in the School.

ANDREA KANE

Four Facets of Differential Privacy was organized by Cynthia Dwork of Microsoft Research (left) to look at the context for privacy-preserving statistical data analysis. Helen Nissenbaum (right), former Visitor in the School of Social Science, discussed conceptual and ethical considerations.

Recommended Viewing:

Videos of talks from Avi Is 60: www.ias.edu/ideas/2016/avi-wigderson-60

Videos of talks from Beyond Endoscopy: www.ias.edu/ideas/2016/langlands-beyond-endoscopy

Videos of talks from Four Facets of Differential Privacy: www.ias.edu/ideas/2016/differential-privacy-symposium

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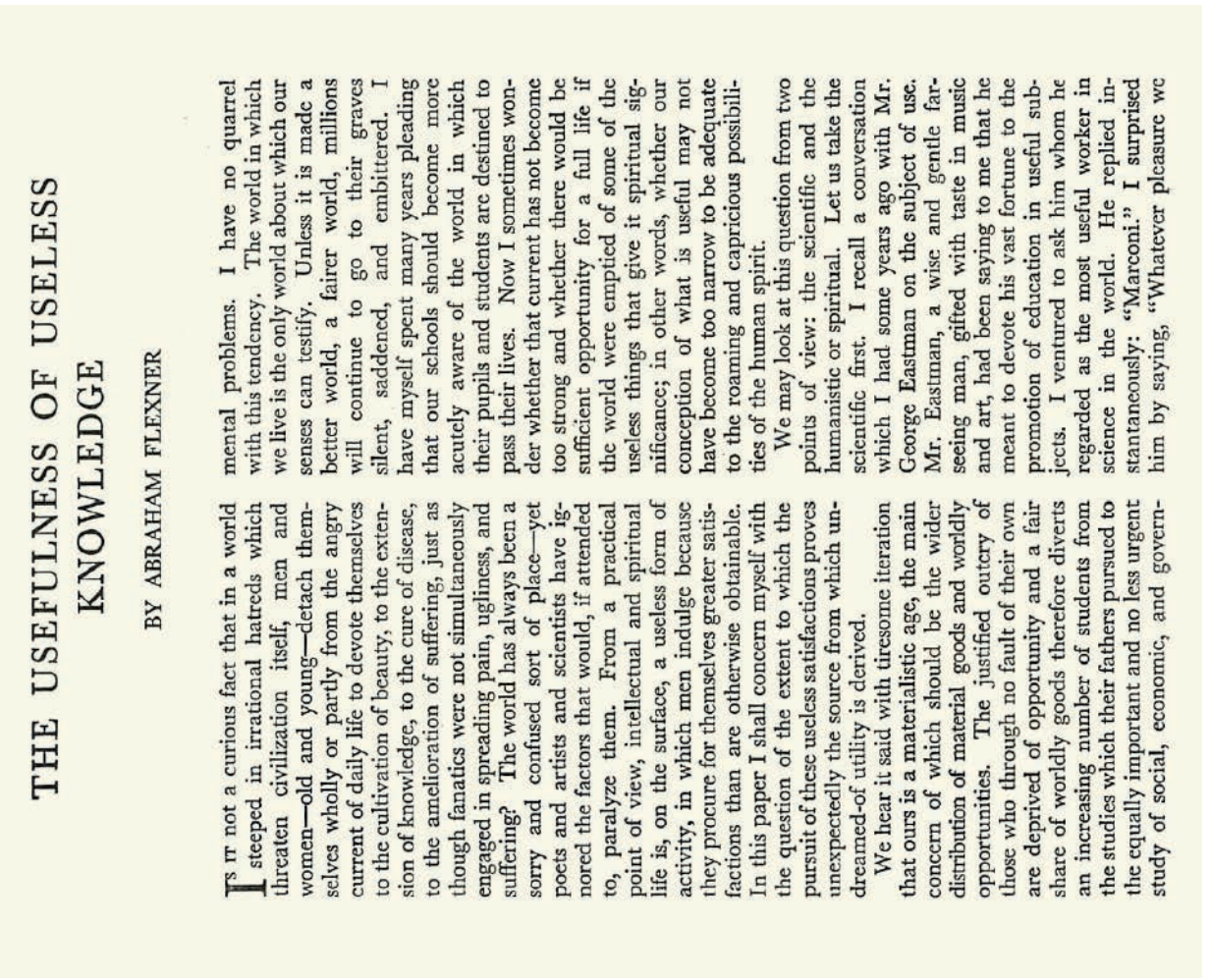

THE USEFULNESS OF USELESS KNOWLEDGE

BY ABRAHAM FLEXNER

IS IT not a curious fact that in a world steeped in irrational hatreds which threaten civilization itself, men and women—old and young—detach themselves wholly or partly from the angry current of daily life to devote themselves to the cultivation of beauty, to the extension of knowledge, to the cure of disease, to the amelioration of suffering, just as though fanatics were not simultaneously engaged in spreading pain, ugliness, and suffering? The world has always been a sorry and confused sort of place—yet poets and artists and scientists have ignored the factors that would, if attended to, paralyze them. From a practical point of view, intellectual and spiritual life is, on the surface, a useless form of activity, in which men indulge because they procure for themselves greater satisfactions than are otherwise obtainable. In this paper I shall concern myself with the question of the extent to which the pursuit of these useless satisfactions proves unexpectedly the source from which undreamed-of utility is derived.

We hear it said with tiresome iteration that ours is a materialistic age, the main concern of which should be the wider distribution of material goods and worldly opportunities. The justified outcry of those who through no fault of their own are deprived of opportunity and a fair share of worldly goods therefore diverts an increasing number of students from the studies which their fathers pursued to the equally important and no less urgent study of social, economic, and governmental problems. I have no quarrel with this tendency. The world in which we live is the only world about which our senses can testify. Unless it is made a better world, a fairer world, millions will continue to go to their graves silent, saddened, and embittered. I have myself spent many years pleading that our schools should become more acutely aware of the world in which their pupils and students are destined to pass their lives. Now I sometimes wonder whether that current has not become too strong and whether there would be sufficient opportunity for a full life if the world were emptied of some of the useless things that give it spiritual significance; in other words, whether our conception of what is useful may not have become too narrow to be adequate to the roaming and capricious possibilities of the human spirit.

We may look at this question from two points of view: the scientific and the humanistic or spiritual. Let us take the scientific first. I recall a conversation which I had some years ago with Mr. George Eastman on the subject of use. Mr. Eastman, a wise and gentle farseeing man, gifted with taste in music and art, had been saying to me that he meant to devote his vast fortune to the promotion of education in useful subjects. I ventured to ask him whom he regarded as the most useful worker in science in the world. He replied instantaneously: "Marconi." I surprised him by saying, "Whatever pleasure we

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