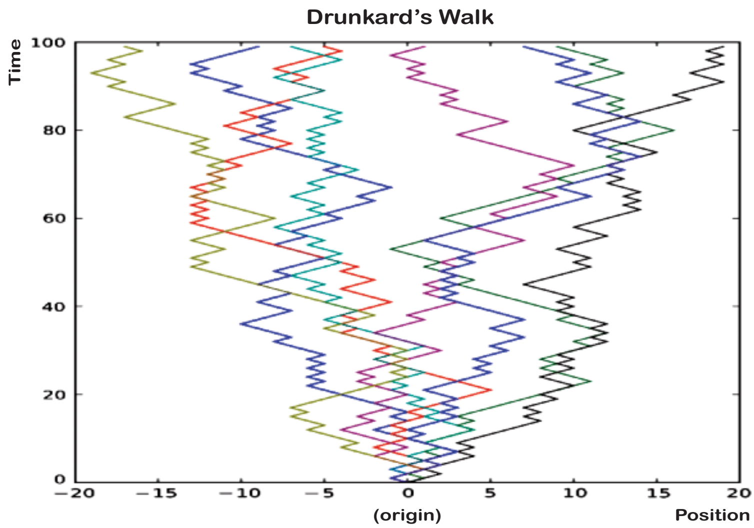
IAS

The Institute Letter

Summer 2009



AVI WIGDERSON

Computational Intractability and Pseudorandomness

The areas of computational intractability and pseudorandomness (see article by Avi Wigderson, Herbert H. Maass Professor, page 1) have been among the most exciting scientific disciplines in the past decades, with remarkable achievements, challenges, and deep connections to classical mathematics. For example, the Riemann Hypothesis, one of the most important problems in mathematics, can be stated as a problem about pseudorandomness, as follows. The image above represents a "random walk" of a person or robot along a straight (horizontal) line, starting at 0. The vertical axis represents time, and each of the colored trajectories represents one instance of such a walk. In each, the robot takes 100 steps, with each step going Left or Right with probability 1/2. Note the typical distance of the walker from its origin at the end of the walk in these eight colored experiments. It is well known that for such a *random* (or "drunkard") walk of n steps, the walker will almost surely be within a distance of only about $\sqrt{n}$ from the origin, i.e., about ten in this case.

One can study walks under a *deterministic* sequence of Left/Right instructions as well, and see if they have a similar property. The Riemann Hypothesis, which probes the distribution of prime numbers in the integers, supplies such a sequence (called the Möbius sequence), roughly as follows (see article for more detail). At each step t, walk Left if t is divisible by an odd number of distinct primes, and walk Right if it is divisible by an even number. Walking according to this sequence maintains the same distance to the origin as a typical drunkard walk *if and only if* the Riemann Hypothesis is true.

Research at the Institute into some of the deepest and hardest problems in the areas of computational intractability and pseudorandomness is being supported by grants from the National Science Foundation. The first, a $10 million grant, is being shared by a team of researchers at the Institute (led by Wigderson and Russell Impagliazzo, Visiting Professor), Princeton University, New York University, and Rutgers, the State University of New Jersey, which is seeking to bridge fundamental gaps in our understanding of the power and limits of efficient algorithms.

A second grant of $1.75 million is funding research directed by Jean Bourgain and Peter Sarnak, Professors in the School of Mathematics, along with Wigderson and Impagliazzo into central questions in many areas of mathematics (analysis, number theory, ergodic theory, and combinatorics) and computer science (network theory, error correction, computational complexity, and derandomization) to gain a better understanding of fundamental pseudorandomness phenomena and their interaction with structure. This has the potential to revolutionize our understanding of algorithmic processes.

IAS
The Institute Letter

Institute for Advanced Study

Summer 2009

Social Anthropologist Didier Fassin Appointed First James D. Wolfensohn Professor

ANNE-CLAIRE DEFOSSEZ

Didier Fassin

Didier Fassin, whose pioneering work is situated at the intersection of social, cultural, political, and medical anthropology, has been appointed as the first James D. Wolfensohn Professor in the School of Social Science at the Institute. The Professorship, intended for a scholar who uses ethnographic methodology to analyze the history and cultures of non-Western countries, was established in honor of James D. Wolfensohn, Chairman of the Board of Trustees of the Institute from 1986 to 2007 and former head of the World Bank.

"We are delighted that Didier Fassin has joined our Faculty," said Director Peter Goddard. "He is a scholar of exceptional breadth, whose profound work has redefined the subjects on which he works. With his great energy and unique range of accomplishments, he will provide outstanding leadership in the field of anthropology at the Institute."

Fassin, whose appointment took effect on July 1, was trained as a medical doctor and practiced internal medicine and public health for a decade in France beginning in 1979. During this time he also served as an advocate for international medical cooperation in Chad, Guinea, Congo, Namibia, Peru, and Bolivia. Much of his early research sought to bridge the disciplines of medicine and social science, work he refers to as the "political anthropology of health." This research was based on field studies in Senegal, Ecuador, South Africa, and France, and resulted in publications that illuminated important aspects of urban and maternal health, public health policy, and the AIDS epidemic. It also inspired critical dialogue across fields and disciplines. Focusing on how societies address social inequalities, their causes and mechanisms, Fassin investigated power relations around disease in urban Senegal, gender issues and maternal morality among Indian communities in rural Ecuador, and an epidemic of lead poisoning in children of sub-Saharan African origins in inner-city Paris. His books during this time, *Pouvoir et Maladie en Afrique* (Presses Universitaires de France, 1992), *L'Espace Politique de la Santé* (Presses Universitaires de France, 1996), and *Les Enjeux Politiques de la Santé* (Karthala, 2000), as well as his many articles, focused new thinking in the field. Fassin also provided a broader anthropological perspective on the rising significance of health in contemporary societies, especially the way social problems were becoming redefined as medical problems.

Beginning in the late 1990s, Fassin articulated a larger vision for his work and for a field that he termed "critical anthropology," arguing that morality should be treated as a legitimate object of study for anthropologists and analyzed in its political context. Through his work with humanitarian organizations such as Médecins Sans Frontières (Doctors Without Borders), where he served as Administrator and then Vice President from 1999 to 2003, Fassin was uniquely positioned to analyze ethical ambiguities stemming from international conflicts in Kosovo, Iraq, and Palestine. He offered insights into decision-making in wartime and discussed more broadly the emergence of a global humanitarianism in the management of adversity.

Fassin's recent work is concerned with what he terms the "politics of compassion," including the various ways in which inequality has been redefined as "suffering," violence reformulated as "trauma," and military interventions qualified as "humanitarian." In his recent book *The Empire of Trauma: An Inquiry into the Condition of Victimhood* (with Richard Rechtman, Princeton University Press, 2009), Fassin uses ethnographic work among asylum seekers to analyze the significance of trauma, the advent of the victim in the contemporary world, and the ways in which suffering and trauma are leveraged for social and political ends.

(Continued on page 10)

Randomness and Pseudorandomness

BY AVI WIGDERSON

The notion of randomness has intrigued people for millennia. Concepts like "chance," "luck," etc., play a major role in everyday life and in popular culture. In this article I try to be precise about the meaning and utility of randomness. In the first part I describe a variety of applications having access to *perfect* randomness, some of which are undoubtedly familiar to the reader. In the second part I describe *pseudo*randomness, the study of random-looking phenomena in non-random (or weakly random) structures, and their potential uses.

Perfect randomness and its applications

The best way to think about perfect randomness is as an (arbitrarily long) sequence of coin tosses, where each coin is *fair*—has a 50-50 chance of coming up heads (H) or tails (T)—and each toss is *independent* of all others. Thus the two sequences of outcomes of twenty coin tosses,

HHHTHTTTTHTTHHTTTTTTHT and

HHHHHHHHHHHHHHHHHHHH,

have exactly the same probability: $1/2^{20}$.

RANDALL HAGADORN

Avi Wigderson, Herbert H. Maass Professor in the School of Mathematics

Using a binary sequence of coin tosses as above, one can generate other random objects with a larger "alphabet," such as tosses of a six-sided die, a roulette throw, or the perfect shuffle of a fifty-two-card deck. One of the ancient uses of randomness, which is still very prevalent, is for gambling. And indeed, when we (or the casino) compute the probabilities of winning and losing in various bets, we implicitly assume (why?) that the tosses/throws/shuffles are perfectly random. Are they? Let us look now at other applications of perfect randomness, and for each you should ask yourself (I will remind you) where the perfect randomness is coming from.

Statistics: Suppose that the entire population of the United States (over three hundred million) was voting on their preference of two options, say red and blue. If we wanted to know the *exact* number of people who prefer red, we would have to ask each and every one. But if we are content with an *approximation*, say up to a 3 percent error, then the following (far cheaper procedure) works. Pick *at random* a sample of two thousand people and ask only them. A mathematical theorem, called "the law of large numbers," guarantees that with probability 99 percent, the fraction of people in the sample set who prefer red will be within 3 percent of that fraction in the entire

(Continued on page 6)

News of the Institute Community

JEAN BOURGAIN, Professor in the School of Mathematics, has been named to the Royal Swedish Academy of Sciences as a Foreign Member.

The Medieval Institute has presented the 2009 Otto Gründler Book Prize to CAROLINE WALKER BYNUM, Professor in the School of Historical Studies, for her book *Wonderful Blood: Theology and Practice in Late Medieval Northern Germany and Beyond* (University of Pennsylvania Press, 2007). According to the award citation, "the topic is sweeping, the thought sophisticated, and the writing elegant." She received the award, which honored the best book in medieval studies for 2007, at the International Congress on Medieval Studies, held in May in Kalamazoo, Michigan. Bynum was also presented with an honorary Doctor of Letters degree by Columbia University at their May commencement ceremonies.

The American Cancer Society's National Awards Committee has selected ARNOLD J. LEVINE to receive its 2009 Medal of Honor at ceremonies scheduled for November. This award is the highest honor bestowed by the American Cancer Society and is given annually for outstanding contributions in three categories: clinical research, basic research, and cancer control. Levine is being honored for his contributions in basic research.

The Swiss Federal Institute of Technology (ETH) in Zurich has announced that ROBERT MACPHERSON, Herman Weyl Professor in the School of Mathematics, will receive the inaugural Heinz Hopf Prize. Scheduled to be awarded every two years, the prize honors outstanding work in pure mathematics. MacPherson will be honored in Zurich in October, when he will present the Heinz Hopf Lectures on current mathematical research.

Contents

Questions and comments regarding the *Institute Letter* should be directed to Kelly Devine Thomas, Senior Publications Officer, 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/about/publications.

In April, ERIC S. MASKIN, Albert O. Hirschman Professor in the School of Social Science, was awarded an honorary Professorship by the State University–Higher School of Economics in Moscow.

JOAN WALLACH SCOTT, Harold F. Linder Professor in the School of Social Science, received an honorary Doctor of Humane Letters degree from the University of Wisconsin–Madison at their May commencement. A collection of her essays, *Théorie Critique de l'Histoire: Identités, Expériences, Politiques* (Fayard, 2009), has been published in France. In April, Scott gave the Ursula Hirshmann Annual Lecture on Gender and Europe at the Robert Schuman Centre for Advanced Studies of the European University Institute in Florence.

PIERRE DELIGNE, Professor Emeritus in the School of Mathematics, has been elected to the American Philosophical Society. Deligne has also been named as a Foreign Member of the Royal Swedish Academy of Sciences.

OLEG GRABAR, Professor Emeritus in the School of Historical Studies, has had a new book published simultaneously in French and English. The French edition, *Images en Terres d'Islam*, is published by the Réunion des Musées Nationaux in Paris (2009). The English edition, *Masterpieces of Islamic Art: The Decorated Page from the 8th to the 17th Century*, is published by Prestel (2009).

An award in honor of the late JOHN N. BAHCALL, Professor (1971–2005) in the School of Natural Sciences, has been established at the University of California, Santa Cruz, by ENRICO RAMIREZ-RUIZ, former Member (2003–06) in the School of Natural Sciences and recipient of the John N. Bahcall Fellowship at the Institute in 2006. The new John Bahcall Award will annually support an outstanding undergraduate physics student from Mexico for an eight-week research internship at the university. Recently the International Astronomical Union named an asteroid in honor of Bahcall, asteroid "113949 Bahcall (2002 TV313)."

The Letter, a new opera by PAUL MORAVEC, former Artist-in-Residence (2007–08), with a libretto by Terry Teachout, had its world premiere on July 25 at the Santa Fe Opera. Moravec, who most recently served as the Institute's Artistic Consultant (2008–09), composed the music during his stay.

FREDDY CACHAZO, Member (2002–05, 2009–10) in the School of Natural Sciences, has been awarded the Gribov Medal by the European Physical Society. The medal is awarded every two years for outstanding work in theoretical particle physics and/or field theory by a physicist under the age of thirty-five. Previous winners of the Gribov Medal on the Institute Faculty include Nima Arkani-Hamed (2003) and Matias Zaldarriaga (2005).

JOSÉ MANUEL FERNÁNDEZ DE LABASTIDA, former Member (1986–88) in the School of Natural Sciences and currently Director General of Research in the Spanish Ministry of Science and Innovation, has received the Medal of Physics from the Spanish Royal Society of Physics and the BBVA Foundation. He was honored for his salient research contributions in theoretical physics and his outstanding service to the academic and scientific community.

WEINAN E, former Member (1991–94, 2002–03) in the School of Mathematics and Professor of Mathematics and Applied and Computational Mathematics at Princeton University, was awarded the Ralph E. Kleinman Prize by the Society for Industrial and Applied Mathematics for his work connecting mathematics with applications outside the field.

PENNY SACKETT, former Member (1992–95) in the School of Natural Sciences, has been named Australia's Chief Scientist, serving as an adviser to the government as well as an advocate of science. Sackett was previously Director of the Mt. Stromlo Observatory in Canberra.

FRANK SHU, former Member (1982) in the School of Natural Sciences and Professor Emeritus at the University of California, San Diego, has received the 2009 Shaw Prize in Astrophysics. SIMON K. DONALDSON, former Member (1983–84) in the School of Mathematics, is one of two recipients of the 2009 Shaw Prize in Mathematics. Donaldson is currently Royal Society Reasearch Professor of Pure Mathematics and President of the Institute for Mathematical Sciences at Imperial College London.

DANIEL WOOLF, former Member (1996–97) in the School of Historical Studies, has been named Principal and Vice-Chancellor of Queen's University in Kingston, Ontario, where he will also serve as Professor of History.

William H. Sewell Jr. Appointed to the Board of Trustees

JAN GOLDSTEIN

William H. Sewell Jr.

William H. Sewell Jr., Frank P. Hixon Distinguished Service Professor Emeritus of Political Science and History at the University of Chicago, has been appointed to the Board of Trustees of the Institute for Advanced Study. Sewell, whose scholarship has focused on the relationship between history and social theory, was nominated as an Academic Trustee by the Institute's School of Social Science. He succeeds Peter Galison, Joseph Pellegrino University Professor at Harvard University, who served for the last five years.

Sewell earned his undergraduate degree at the University of Wisconsin in 1962 and his Ph.D. at the University of California, Berkeley, in 1971. Sewell served on the faculties of the University of Chicago (1971–75), the University of Arizona (1980–85), and the University of Michigan (1985–90). In 1990, he returned to the faculty of the University of Chicago, where he became Professor Emeritus in 2007. He was a Member in the School of Social Science at the Institute in 1971–72, 1975–80, and 2002–03. Sewell's wife, Jan Goldstein, Norman and Edna Freehling Professor of History at the University of Chicago, was a Visitor in the School of Social Science in 2002–03.

The author of numerous books and articles, Sewell is the recipient of the 1981 Herbert Baxter Adams Prize from the American Historical Association for his book *Work and Revolution in France* (Cambridge University Press, 1980) and the 2008 Theory Prize from the Theory Section of the American Sociological Association for *Logics of History: Social Theory and Social Transformation* (University of Chicago Press, 2005). In 2004, he was named a Fellow of the American Academy of Arts and Sciences. ■

Fantasy Echo: History and the Construction of Identity

The phrase "fantasy echo" has its origins in a mistake made by a student in George Mosse's class at the University of Wisconsin in 1964 who had failed to understand the heavily accented pronunciation of *fin de siècle* by his German-born professor of history. The error, which the student had used in his final exam, stuck with Joan Wallach Scott, Harold F. Linder Professor in the School of Social Science, who was a teaching assistant for Mosse at the time.

Nearly forty years later, Scott published "Fantasy Echo: History and the Construction of Identity," in *Critical Inquiry* (Winter 2001), which used the phrase to articulate how historical identity is established in the context of feminism, while suggesting much wider applications to other historical categories of personal, social, and national identity.

CLIFF MOORE

Joan Wallach Scott, Harold F. Linder Professor in the School of Social Science, pays close attention to how, in her words, "meanings are always sliding even as they are being declared inviolate."

According to Scott, by extracting coherence from confusion and reducing multiplicity to singularity, fantasy "enables individuals and groups to give themselves histories." It can be seen as "a formal mechanism for the articulation of scenarios that are at once historically specific in their representation and detail and transcendent of historical specificity." Echo, meanwhile, raises issues of distinction between origination and resonance. "Where does an identity originate? Does the sound issue forth from past to present, or do answering calls echo to the present from the past? If we are not the source of the sound, how can we locate that source? If all we have is the echo, can we ever discern the original? Is there any point in trying, or can we be content with thinking about identity as a series of repeated transformations?"

For the past three decades, Scott has paid close attention to language, its figures of speech, its allusions and symbolism, and how, in her words, "meanings are always sliding even as they are being declared inviolate." In doing so, she has challenged the foundations of conventional historical practice, including the nature of historical evidence and historical experience and the role of narrative in the writing of history. The American Historical Association, when presenting a 2009 Award for Scholarly Distinction to Scott, noted, "Few historians have had a greater impact on the field of history, and through it, on the ways in which society understands and acts on its framing of fundamental issues like the nature of social relations between the sexes, the concepts of gender and experience, and the role of the historian in shaping our understanding of who we are and how a just society might be framed."

In a recent interview, Scott explained the critical perspective that has informed her work on gender, questions of difference, and underlying ideological systems. "It is about unpacking the premises that seem to be taken for granted," says Scott. "It is about always being in the position of a critic who won't accept an explanation without asking what the words that are being used actually mean, because they don't always mean the same thing, and they need to be given a history themselves."

A collection of three of Scott's essays on critical history —"Fantasy Echo," "The Evidence of Experience" (University of Chicago Press, 1991), and "Manifestos for History" (Routledge, 2007)—was recently published in France under the title *Théorie Critique de l'Histoire: Identités, Expériences, Politiques* (Fayard, 2009). In the essays, Scott describes organizing categories of difference—among them class, gender, sexuality, race—as reliant on attempts at universality and continuity and argues for a vigorous analysis of the foundational premises upon which ideas of "experience" rest.

"When experience is taken as the origin of knowledge, the vision of the individual subject (the person who had the experience or the historian who recounts it) becomes the bedrock of evidence on which explanation is built," Scott writes. "The evidence of experience then becomes evidence for the fact of difference, rather than a way of exploring how difference is established, how it operates, how and in what ways it constitutes subjects who see and act in the world." In other words, it is not individuals who have experience, notes Scott, but subjects who are constituted through experience. Rather than accepting experience as uncontestable evidence, Scott advocates for a historical approach that investigates the emergence of concepts and identities as events in need of explanation.

As a labor historian drawn to French history and later French poststructuralism—her dissertation (and first book) was about the political and social effects of industrialization on the glassworkers of Carmaux—Scott was accustomed to looking at constructed categories like "class" when she began tackling women's history in the 1970s. In *Women, Work, and Family* (Holt, Rinehart and Winston, 1978) she began to insist with her coauthor Louise Tilly that the category of "woman" needed to be historicized.

A year after joining the Faculty of the School of Social Science in 1985, Scott published

(Continued on page 10)

Dewey Seminar to Explore Pressing Issues in Education

Every society and political regime develops educational institutions and practices that substantially shape its evolution, revolutions, and stabilization over time. In the 2009–10 academic year, the School of Social Science's annual theme, "The Dewey Seminar: Education, Schools, and the State," will explore the interrelationships among these components.

Because of the centrality of education to the continuity of sociopolitical orders, its analysis embraces virtually all the social sciences. Though the theme will not be the exclusive focus of the School, a significant number of the School's Members in 2009–10 will pursue work related directly to this theme—from exploring how diverse educational practices are linked to specific political orders to studying contemporary pressures on education and its capacity to support democratic political systems.

The activities of the Dewey Seminar, which is being organized by Danielle S. Allen, UPS Foundation Professor at the Institute, and Rob Reich, Associate Professor of Political Science at Stanford University, will include seminars, practitioner symposia, and a scholarly workshop that is expected to produce an interdisciplinary and agenda-setting book on education. Working journalists will also participate, in collaboration with the Columbia University Graduate School of Journalism.

"In 1916 the philosopher John Dewey published *Democracy and Education: An Introduction to the Philosophy of Education*," says Allen. "He sought an account of education that could enable human flourishing both individually and collectively in democracies. Our seminar takes its inspiration from his aspirations."

> *To say that education is a social function, securing direction and development in the immature through their participation in the life of the group to which they belong, is to say in effect that education will vary with the quality of life which prevails in a group. Particularly is it true that a society which not only changes but which has the ideal of such change as will improve it, will have different standards and methods of education from one which aims simply at the perpetuation of its own customs.*
>
> *—John Dewey, from Democracy and Education: An Introduction to the Philosophy of Education (Macmillan, 1916)*

The seminar, which will focus intensively on the most critical questions facing education today, will bring together sociologists, philosophers, anthropologists, historians, psychologists, economists, lawyers, political scientists, journalists, and specialists in education. Among its goals will be to begin framing a consideration of the entire educational sphere, including preschool through higher education; public and private education; market, state, for-profit, and nonprofit sectors; and global education. While concentrating primarily on education in the United States, seminar participants will also consider the rapidly shifting global framework, historic levels of migration, and other effects of globalization. They will address theoretical questions about democracy, education, justice, social opportunity, and the common good. By unearthing theoretical presuppositions and ethical choices that lie beneath current approaches to education and, where appropriate, revising or clarifying them, the organizers hope the seminar will shift the analytical framework within which education is considered in policy discussions while also facilitating a deeper understanding of the relation between education and democratic ideals.

In particular, the Dewey Seminar will examine three questions:

- Which democratic ideals in education should be pursued?
- What are the current conceptual and practical obstacles to achieving these ideals?
- What sorts of ethical choices are involved in concrete decisions about teaching practice, school design, funding structures, admission practices, legislative and judicial decisions about schooling, and so on?

To advance a national conversation about education, the Ford Foundation is funding biweekly visits to the Institute by leading education practitioners, all of whom will lead seminar discussions and some of whom will give public presentations. The practitioner symposia will be organized into four units: the goals of education; socioeconomic issues; the current structure, practices, and major challenges of education in the United States; and education financing and national–local interactions. They will alternate weekly with seminars by Members so that education practitioners and scholars may learn from one another, identify common questions, refine insights, and translate gains into enduring knowledge about education and democracy.

Additionally, a group of twenty scholars, five of whom will be participants in the Dewey Seminar, will participate in an intensive workshop on education, democracy, and justice funded by the Spencer Foundation. The workshop, which will focus on normative and empirical approaches to the study of education, will include a selection of

(Continued on page 10)

Nuclear Weapons and Clear Lines

BY BARRY O'NEILL

CLIFF MOORE

Barry O'Neill, Professor of Political Science at the University of California, Los Angeles, uses game theory to study international decision-making with a view to preventing war. He was the Leon Levy Foundation Member in the Institute's School of Social Science in 2008–09. His Leon Levy Lecture, "Honor and International Violence," may be viewed on the Institute's website at http://video.ias.edu.

It was two generations ago that Bertrand Russell composed his single-sentence history of the world. "Since Adam and Eve ate the apple," he wrote, "mankind has never refrained from any folly of which it was capable." Experts were especially pessimistic about the nuclear folly. Even if there were no global war, they expected that the weapons would become accepted as regular and used in smaller conflicts.

Sixty-four years have passed since the bombings of Hiroshima and Nagasaki without a nuclear explosion in war. Economist and strategist Thomas Schelling calls this the stunning non-event of our era. He posits a "nuclear taboo," a growing revulsion against the weapons that has put their use off the table.

If nations hold a taboo against using nuclear weapons, it is puzzling that they strive to acquire them for the sake of national prestige. Saddam Hussein held the prestige motive according to his CIA interviewer. India and Pakistan sought domestic and international prestige from their bombs, and even after the Cold War had ended Britain and France retained most of their arsenals, partly for international status.

Leaders have offered military rationales for building a bomb, but these often have been weak and concocted. Nuclear weapons have one plausible military function, to deter a threat to the state's very existence. In India's case this was not a realistic worry, and its bomb has in fact made it less secure, since Pakistan built its own bomb, increasing the dangers of an accidental war and of the weapon slipping into the hands of terrorists. In a lesser political conflict, nuclear retaliation is not a credible threat, and in smaller wars possessing the weapons gives no advantage—they were no help to the United States in Vietnam or to the Soviet Union in Afghanistan.

It is hard to reconcile the prestige of acquiring nuclear weapons with the taboo against using them. An analogy would be a society that abhors cannibalism but continues to manufacture large cauldrons and dream up recipes. I have investigated whether a certain factor promotes both the prestige motive and the taboo: the clear, publicly recognized line between nuclear and non-nuclear explosions. As a matter of physics there is no such thing as a semi-nuclear weapon, at least in any practical sense. This fact contrasts with advances in human welfare, which are typically not clear or dichotomous. Making one's country more democratic, giving the citizens a richer cultural life, or increasing their literacy are either poorly defined or continuously variable.

Evidence for the association of prestige with clear lines comes from other kinds of national achievements. Searching databases of historical studies, I found countries winning attributions of prestige by, for example, possessing colonies beyond their territories, aircraft carriers, nuclear submarines, supersonic airlines, or space programs. Thanks to the sound barrier, planes separate into subsonic or supersonic, and a mission to the moon is all or none. Sometimes the clear line constituted being the first in time to achieve a goal—the British expedition climbing Mount Everest—or ranking number one by some other objective measure—possessing the largest collider, the fastest train, or the tallest building. Countries spend great amounts of money on these kinds of projects even when the practical benefits are low.

More evidence that prestige needs a clear public line comes from our regular lives. We join an exclusive club, acquire a professional title by which we are addressed in public, drive a prestigious make of car, live in a prestigious neighborhood, or finish a marathon. These accomplishments are public and dichotomous. High professional standing can bring a prize, which is typically conferred at a public ceremony. You win it or not, with no middle ground, and people know whether you won it.

The reasons for the connection of clear lines with prestige are subtle. I distinguish quality, reputation, and prestige: quality means that we really are accomplished, reputation means that members of our group think we are accomplished, but "prestige" is one step higher, roughly that members of our group *think that each of the others think* we are accomplished. Game theory models clarify how this definition works. Without a line, the members' beliefs about beliefs would become diffuse, but the line gives each one greater confidence that others recognize that we have passed a certain threshold of achievement.

The nuclear/non-nuclear dichotomy has a fortunate side since it supports the taboo against nuclear use. A war that might otherwise escalate to nuclear weapons might stay limited because a line gives the combatants a mutually understood stopping point. The effect of no line, of the metaphorical "slippery slope," appeared during World War II when the norm against bombing civilians that was strong at the beginning soon broke down.

In taking account of prestige and taboos, this approach treats nuclear matters as influenced by psychology, symbolism, and attributed meaning, not just military strategy, and it leads to different prescriptions for anti-proliferation policy. The current reassessment of nuclear strategy by the United States should avoid mental frames that group nuclear and non-nuclear weapons, such as the Bush Administration's "New Triad" in its 2002 *Nuclear Posture Review*. Governments should refrain from making nuclear threats in response to non-nuclear provocations. In confronting North Korea and Iran over their nuclear programs, they should face the perplexing question that in applying coercion, they are increasing the prestige value to these governments of defying outside pressure and continuing their programs. ■

Studying the Qur'an in Cultural Terms

KATE ABLUTZ

A Qur'an colloquium at the Institute in June brought together leading Islamicists, including Angelika Neuwirth (far right), Agnes Gund and Daniel Shapiro Member during the spring term.

Western Biblical scholarship has existed as a historical enterprise independent from church and synagogue as far back as the eighteenth century. The Western study of the Qur'an, however, has more recent roots, with interest taking hold in the early nineteenth century.

"Western Qur'anic studies started with a striking non-synchronicity with both Biblical studies, which it only superficially resembled, and Muslim Qur'anic studies, which, from the outset, it excluded from its scope," says Angelika Neuwirth, the Agnes Gund and Daniel Shapiro Member in the School of Historical Studies last spring. "In the second half of the nineteenth century, reformed thinkers put forward new approaches that shared important ideas with Western Biblical scholarship. Those approaches were, however, sidelined and have remained detached from Western developments."

These disjointed approaches, along with limited access to Islamic texts, have impeded the study of the Qur'an, which Patricia Crone, Andrew W. Mellon Professor in the School, describes as "an extremely enigmatic and elusive document. We can't claim to have a very good understanding of what is going on in it, what it is referring to, who the people are that it is addressing, or what the relationship between them is."

Crone, whose research is focused on the Near East from late antiquity to the coming of the Mongols, works on the cultural and religious traditions of Iraq, Iran, and the formerly Iranian part of Central Asia, and also on the Qur'an. Each year, she brings a group of leading Islamicists to the Institute to exchange ideas and share research. A Qur'an colloquium and associated lecture, supported by the Dr. S. T. Lee Fund for Historical Studies, were held at the Institute in June. Among the participants was Neuwirth, Professor at the Freie Universität Berlin, who is currently overseeing a major research project in Berlin using, among other things, archival photos of ancient manuscripts of the Qur'an long thought to have been destroyed during World War II. Neuwirth and her collaborators are working to develop a new understanding of the Qur'an in cultural terms with the eventual aim of producing a critical edition of the Qur'an that will include documentation of its text, commentary on its content, and a collection of materials on recent literature.

In association with the colloquium, Neuwirth gave a lecture, "The 'Late Antique Qur'an': Jewish-Christian Liturgy, Hellenic Rhetoric, and Arabic Language," in which she discussed how, before it was recognized as Muslim scripture, the Qur'an was communicated to an audience whose education was based on late-antique traditions—Judeo-Christian, Hellenic, and Arabian. According to Neuwirth, despite the highly political notion that the Qur'an is a text fundamentally alien to European culture, it is rooted in the same geographical area and is in the same line of tradition of other writings that have been assimilated as founding documents of European identity, most prominently Biblical and post-Biblical literatures.

"We have, in my view, to face a long-neglected political dimension of our work," says Neuwirth. "Qur'anic studies today can no longer be confined to textual or historical analysis. Scholars in the field, like it or not, have become interlocutors in a political discourse involving Western, Eastern, and Near-Eastern intellectuals. It is a discourse that I would identify as the quest for a new and more comprehensive Western/Eastern cultural identity." ■

Are there Sources for Human Rights Policy in Chinese Tradition?

BY MARTIN POWERS

About a year ago the China News Agency announced that it would unveil a national plan for implementing human rights in 2009. Admitting that there had been mistakes in the past, and that China still faced challenges to an adequate human rights environment, Hu Jintao and other officials invited dialogue from the international community. The plan, which was published in April, emphasized the following human rights principles: people first; people's right to livelihood; people's right to better their circumstances; and the equal right of all citizens to participate in government and society.

To a considerable degree, international response to the plan, which to date has been slight, will be shaped by how China's history is interpreted. In the past, two views have dominated Western discussions of human rights in China: that arguments promoting the value of life, equality, or freedom of speech are lacking in Chinese history and therefore people in China are fundamentally incapable of understanding Western values; or, alternatively, that despite its lack of a history of human rights, these values are universal and therefore people in China can learn to embrace them. Because each of these views presumes that Chinese and Western values are incommensurable, they radically narrow options for negotiation.

BENTLEY DREZNER

Martin Powers in conversation with Freeman Dyson, Professor Emeritus in the School of Natural Sciences

In 2004, Orville Schell advanced a third view suggesting that China has its own history of human rights and that its leadership might find inspiration there. Is there any basis for such a claim? Well, the value of human life, for example, is taken as a given in most classical writings and was codified in a law of 35 CE: "It is the nature of heaven and earth that mankind is noble; whomever shall kill a male or female slave shall be punished to the full extent of the law." In Han times, a law was passed requiring capital cases to be reviewed by a higher court because "people's lives are valuable." Under Confucianism, which held the government responsible for the people's welfare, China's social spending (famine relief, orphanages, prison inspections) typically outstripped that of any premodern European state.

Equality as a principle also underlies the critique of hereditary privilege in classical China. When Han Feizi advocated equality under the law, it became a staple of classical bureaucratic theory. The term *bianhuqimin* appears early and says that all registered citizens are equal under the law. In fact, there are cases in which slaves brought imperial relatives to court and won.

The expansion of political participation during the Song dynasty, when the civil service examination system allowed men of ordinary birth to pursue a career in government, was made possible by the principle of equality. By that time all taxpayers, including women, could bring civil suits to court, and petition bureaus permitted anyone to lodge complaints against government policy or officials.

Nor were Chinese taxpayers strangers to dissent. The public need to voice dissent was recognized in many classical texts. China witnessed the world's first organized student demonstrations during the second century CE; they were not suppressed. Published social criticism was a regular mode of political action, and most major poets were admired for their trenchant exposés of social injustice.

There is much more. Some of the policies stressed in recent communique's resonate with these historical practices, while others seem absent from current discussions of human rights in China. As for the West, most of the population remains largely ignorant of China's historical record. Were it better known, possibilities for dialogue might well improve, with both China and the West as potential beneficiaries. ■

Martin Powers, Sally Michelson Davidson Professor of Chinese Arts and Cultures at the University of Michigan, was a Gladys Krieble Delmas Foundation Member in the Institute's School of Historical Studies in 2008–09 (additional funding for his Membership was provided by the Andrew W. Mellon Foundation). This article was inspired by a talk he gave at the Institute as part of After Hours Conversations, a program of informal talks for the Institute community organized by Caroline Walker Bynum, Professor in the School of Historical Studies, and Piet Hut, Professor in the Program in Interdisciplinary Studies, to promote inter-School conversations. A schedule of After Hours Conversations for the 2009–10 academic year is available online at www.ids.ias.edu/conversations0910.html and will be updated throughout the year.

Institute Receives $1.1 Million Grant from the Andrew W. Mellon Foundation

The Institute for Advanced Study has received a five-year $1.1 million grant from the Andrew W. Mellon Foundation that enables assistant professors to come to the Institute as Members in the School of Historical Studies. The grant is a renewal of previous support from the foundation for the program, which demonstrates the joint commitment of the Institute and the foundation to assist academics at a critical point in their careers. The funds will be used to provide Mellon fellowships to Members who have not yet achieved tenure in their home institutions.

The program, which began in 1996, fosters relationships between the Mellon scholars and the Institute's permanent Faculty and more senior Members.

"The Institute is very grateful to the Andrew W. Mellon Foundation for its support of this important program, which provides opportunities for scholars at a crucial time in their careers," said Peter Goddard, Director of the Institute. "It has brought to the Institute individuals of exceptional promise and achievement, who have contributed greatly to our academic community."

This support has been instrumental in advancing the academic careers of many former Mellon scholars. Matthew Stanley, a former Member (2006–07) supported by a Mellon fellowship, is currently an Associate Professor at New York University. "As a junior scholar, the opportunity to be a Member of the IAS was immensely valuable for a number of reasons, though two stand out," Stanley says. "First, dedicated research time before being evaluated for tenure is extremely helpful, especially in such a productive environment as this. Second, the opportunity to work with senior scholars from a variety of institutions and fields provides resources and an intellectual context unmatched anywhere."

Brooke Holmes, another former Member (2007–08) supported by a Mellon fellowship, who is now an Assistant Professor at Princeton University, had a similarly positive experience. "I found my year at the School of Historical Studies as a recipient of the Mellon fellowship to be enormously beneficial, both to my research and to my intellectual growth. The community of scholars at the Institute offered the perfect balance between isolation and engagement—I cannot think of a better place to have spent the year."

Since the inception of the program more than a decade ago, some twenty-seven scholars have participated, studying in fields that include French music and manuscripts in the thirteenth and fourteenth centuries, the transmission of learning in the medieval Islamic world, the intellectual history of Western Europe, and the early development of Chinese literary thought. ■

KATE ABLUTZ

Patricia Crone (left), Andrew W. Mellon Professor in the School of Historical Studies, with Wiebke Denecke, a Member (2008–09) funded by the Andrew W. Mellon Foundation Fellowships for Assistant Professors population. Remarkably, the sample size of two thousand, which guarantees the 99 percent *confidence* and 3 percent *error* parameters, does not depend on the population size at all! The same sampling would work equally well if all the people in the world (over six billion) were voting, or even if all atoms in the universe were voting. What is crucial to the theorem is that the two thousand sample is completely random in the entire population of voters. Consider: numerous population surveys and polls as well as medical and scientific tests use such sampling—what is their source of perfect randomness?

Physics and Chemistry: Consider the following problem. You are given a region in a plane, like the one in Figure 1. A domino tiling of this region partitions the region into 2x1 rectangles—an example of such a tiling is given in Figure 2. The question is: how many different domino tilings does a given region have? Even more important is counting the number of partial tilings (allowing some holes). Despite their entertaining guise, such counting problems are at the heart of basic problems in physics and chemistry that probe the properties of matter. This problem is called the "monomer-dimer problem" and relates to the organization of di-atomic molecules on the surface of a crystal. The number of domino tilings of a given region determines the thermodynamic properties of a crystal with this shape. But even for small regions this counting problem is nontrivial, and for large ones of interest, trying all possibilities will take practically forever, even with the fastest computers. But again, if you settle for an estimate (which is usually good enough for the scientists), one can obtain such an estimate with high confidence via the so-called "Monte-Carlo method" developed by Nicholas Metropolis, Stanislaw Ulam, and John von Neumann. This is a clever probabilistic algorithm that takes a "random walk" in the land of all possible tilings, but visits only a few of them. It crucially depends on perfect random choices. In the numerous applications of this method (and many other probabilistic algorithms), where is the randomness taken from?

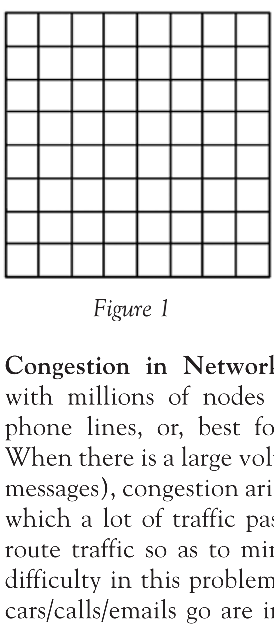


Figure 1

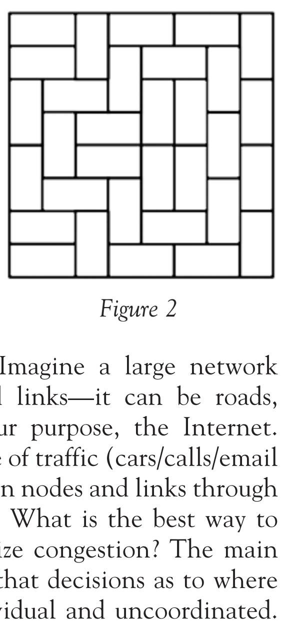


Figure 2

Congestion in Networks: Imagine a large network with millions of nodes and links—it can be roads, phone lines, or, best for our purpose, the Internet. When there is a large volume of traffic (cars/calls/email messages), congestion arises in nodes and links through which a lot of traffic passes. What is the best way to route traffic so as to minimize congestion? The main difficulty in this problem is that decisions as to where cars/calls/emails go are individual and uncoordinated. It is not hard to see that (in appropriate networks) if the many source-destination pairs were random, congestion would, almost surely, be quite small in *every* node. However, we don't tend to choose where we go or whom we call randomly—I call my friends and you call yours, and in such cases high congestion is bound to arise. To fix this problem, Leslie Valiant proposed the following ingenious idea, which is used in practice. Whenever A wants to send an email to B, she will actually choose a random intermediate point C, send the email to C, and ask C to forward it to B (forget privacy and compliance issues—they are beside the point here). While doubling the number of email messages, Valiant proved that (in appropriate networks) the congestion drops by huge factors with very high probability. Again, perfect randomness and independence of different decisions are essential for this solution to work.

Game Theory: Sometimes the need for perfect randomness arises not for improved efficiency of some task (as in the previous examples), but for the very understanding of fundamental notions. One such notion is "rational behavior," a cornerstone of economics and decision theory. Imagine a set of agents (e.g., people, companies, countries, etc.) engaged in a strategic interaction (e.g., traffic, price competition, cold war) in which each agent influences the outcome for everyone. Each agent has a set of optional strategies to choose from, and the choices of everyone determine the (positive or negative) value for each. All agents have this information—what set of actions then would constitute rational behavior for them all? John Nash formulated his (Nobel Prize–winning) notion of "Nash equilibrium" sixty years ago, which is widely accepted to this day. A set of strategies (one for each agent) is said to be a Nash equilibrium if no player can improve its value by switching to another strategy, given the strategies of all other agents (otherwise, it would be rational for that player to switch!). While this is a natural stability notion, the first question to ask is: which games (strategic situations as above) possess such a rational equilibrium solution? Nash proved that *every* game does, regardless of how many agents there are, how many strategies each has, and what value each agent obtained given everyone's choices . . . provided that agents can toss coins! Namely, allowing *mixed* strategies, in which agents can (judiciously) choose at random one of their optional strategies, makes this notion universal, applicable in every game! But again, where do agents in all these situations take their coin tosses?

Cryptography: This field, which underlies all of computer security and e-commerce today, serves perhaps as the best demonstration of how essential randomness is in our lives. First and foremost, in cryptographic situations there are *secrets* that some know and others don't. But what does that mean? "Secret" is another fundamental notion whose very definition requires randomness. Such a definition was given by Claude Shannon, the father of information theory, who quantified the amount of uncertainty (just how much we *don't* know about it) using another fundamental notion, *entropy*, which necessitates that the objects at hand be random.

For example, if I pick a password completely randomly from all decimal numbers of length ten, then your chances of guessing it are precisely $1/10^{10}$. But if I choose it randomly from the set of phone numbers of my friends (also ten-digit numbers), then your uncertainty is far smaller: your probability of guessing my secret is larger, namely 1/the number of my friends (and yes, cryptography assumes that my adversaries know everything about me, except the outcomes of my coin tosses). But secrets are just the beginning: *all* cryptographic protocols like public-key encryption, digital signatures, electronic cash, zero-knowledge proofs, and much more, rely completely on randomness and have no secure analog in a deterministic world. You use such protocols on a daily basis when you log in, send email, shop online, etc. How does your computer toss the coins required by these protocols?

Pseudorandomness

A computational view of randomness: To answer the repeatedly asked question above, we have to carefully study our ubiquitous random object—the coin toss. Is it random? A key insight of theoretical computer science is that the answer depends on who (or which application) uses it! To demonstrate this we will conduct a few (mental) experiments. Imagine that I hold in my hand a (fair) coin, and a second after I toss it high in the air, you, as you are watching me, are supposed to guess the outcome when it lands on the floor. What is the probability that you will guess correctly? 50-50 you say? I agree! Now consider a variant of the same experiment, in which the only difference is that you can use a laptop to help you. What is the probability that you will guess correctly now? I am certain you will say 50-50 again, and I will agree again. How can the laptop help? But what if your laptop is connected to a super computer, which is in turn connected to a battery of video recorders and other sensors around the room? What are your chances of guessing correctly now? Indeed, 100 percent. It would be trivial for this machinery to calculate in one second all the required information: speed, direction, and angular momentum of the coin, the distance from my hand to the floor, air humidity, etc., and provide the outcome to you with certainty.

The coin toss remained the same in all three experiments, but the observer changed. The uncertainty about the outcome depended on the observer. Randomness is in the eye of the beholder, or more precisely, in its computational capabilities. The same holds if we toss many coins: how uncertain the outcome is to a given observer/application depends on how they process it. Thus a phenomenon (be it natural or artificial) is deemed "random enough," or *pseudorandom*, if the class of observers/applications we care about cannot distinguish it from random! This viewpoint, developed by Manuel Blum, Shafi Goldwasser, Silvio Micali, and Andrew Yao in the early 1980s, marks a significant departure from older views and has led to major breakthroughs in computer science of which the field of cryptography is only one. Another is a very good understanding of the power of randomness in probabilistic algorithms, like the "Monte-Carlo method." Is randomness actually needed by them, or are there equally efficient deterministic procedures for solving the monomer-dimer problem and its many siblings? Surprisingly, we now have strong evidence for the latter, indicating the weakness of randomness in such algorithmic settings. A theorem by Russell Impagliazzo and Wigderson shows that, assuming *any* natural computational problem to be intractable (something held in wide belief and related to the P≠NP conjecture), randomness has no power to enhance algorithmic efficiency! Every probabilistic algorithm can be replaced by a deterministic one with similar efficiency. Key to the proof is the construction of pseudorandom generators that produce sequences indistinguishable from random ones by these algorithms.

Random-like behavior of deterministic processes and structures: What can a clever observer do to distinguish random and non-random objects? A most natural answer would be to look for "patterns" or properties that are extremely likely in random objects, and see if the given object has them. The theorem mentioned above allows the observer to test *any* such property, as long as the test is efficient. But for many practical purposes, it suffices that the object has only *some* of these properties to be useful or interesting. Examples in both mathematics and computer science abound. Here is one: A property of a random network is that to sever it (break it into two or more large pieces), one necessarily has to sever many of its links. This property is extremely desirable in communication networks and makes them fault-tolerant. Can one construct objects with such a random-like property deterministically and efficiently?

This question has been addressed by mathematicians and computer scientists alike, with different successful constructions, e.g., by Gregory Margulis, Alexander Lubotzky, Ralph Philips, and Peter Sarnak on the math side and by Omer Reingold, Salil Vadhan, and Wigderson on the computer science side. An even more basic fault-tolerant object is an *error-correcting code*—a method by which a sender can encode information such that, even if subjected to some noise, a receiver can successfully remove the errors and determine the original message. Shannon defined these important objects and proved that a random code is error-correcting. But clearly for applications we need to construct one efficiently! Again, today many different deterministic constructions are known, and without them numerous applications we trust every day, from satellites to cell phones to CD and DVD players, would simply not exist!

Proving that deterministic systems and structures possess random-like properties is typically approached differently by mathematicians and computer scientists. In mathematics the processes and structures are organic to the field, arising from number theory, algebra, geometry, etc., and proving that they have random-like properties is part of understanding them. In computer science, one typically starts with the properties (which are useful in applications) and tries to efficiently construct deterministic structures that have them. These analytic and synthetic approaches often meet and enhance each other (as I will exemplify in the next section). A National Science Foundation grant to further explore and unify such connections in the study of pseudorandomness was recently awarded to Jean Bourgain, Sarnak, Impagliazzo, and Wigderson in the Institute's School of Mathematics (see cover).

Randomness purification: Returning to the question of providing perfect randomness to *all* (as opposed to specific) applications, we now put no limits on the observers' computational power. As true randomness cannot be generated deterministically, one cannot help but assume some, possibly imperfect, source of random coin tosses. Can one deterministically and efficiently convert an imperfect random source to a perfect one? How should we model imperfect randomness?

Experience with nature gives some clues. Without getting into (the interesting) philosophical discussion of whether the universe evolves deterministically or probabilistically, many phenomena we routinely observe seem at least partly *unpredictable*. These include the weather, stock market fluctuations, sun spots, radioactive decay, etc. Thus we can postulate, about any such phenomena, that their sequence of outcomes possesses some entropy (but where this entropy resides we have no clue). Abstractly, you can imagine an adversary who is tossing a sequence of coins, but can choose the bias of each in an arbitrary way—the probability of heads may be set to 1/2, 1/3, .99 or even $1/\pi$, so long as it is not 0 or 1 (this would have zero entropy). Moreover, these probabilities may be correlated arbitrarily—the adversary can look at past tosses and accordingly determine the bias of the next coin. Can we efficiently use such a defective source of randomness to generate a perfect one? The (nontrivial) answer is no, as shown twenty years ago by Miklos Santha and Umesh Vazirani, who defined these sources, extending a simple model of von Neumann. But while dashing hope in one direction, they also gave hope in another, showing that if you have *two* (or more) such sources, which are independent of each other, then *in principle* one can utilize them together to deterministically generate perfect randomness. So if, for example, the weather, stock market, and sun spots do not affect each other, we can hope to combine their behavior into a perfect stream of coin tosses. What was missing was an efficient construction of such a randomness purifier (or *extractor* in computer science jargon).

The solution of this old problem was recently obtained using a combination of analytic and synthetic approaches by mathematicians and computer scientists. Some time ago David Zuckerman suggested the following idea: suppose A, B, and C represent the outcome of our samples of (respectively) the weather, the stock market, and sun spots (think of them as integers[1]). He conjectured that the outcome of the arithmetic $A \times B + C$ would have more entropy (will be more random) than any of the inputs. If so, iterating this process (with more independent weak sources) will eventually generate a (near) perfect random number! Zuckerman proved that this concept follows from a known mathematical conjecture. While this mathematical conjecture is still open, recent progress was made on a completely different conjecture by Bourgain, Nets Katz, and Terence Tao (extending the work of Paul Erdös and Endre Szemerédi). They studied properties of random *tables*, and tried to find such properties in specific, arithmetic tables, namely the familiar addition and multiplication tables. Here is an intuitive description of the property they studied. Consider a small "window" in a table (see Figure 3).

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	21	32	111	74	5	16	5	66	198	101	43	91	1
2	97	66	208	148	62	132	185	27	37	127	74	115	193
3	45	209	179	204	124	10	202	89	212	39	75	26	6
4	129	1	134	45	8	156	224	14	162	130	96	143	35
5	113	53	69	81	41	109	68	130	21	51	140	73	180
6	182	216	142	[illegible]	105	206	[illegible]	[illegible]	175	88	66	9	127
7	173	33	26	120	30	221	33	69	25	207	188	36	31
8	111	163	179	28	112	79	210	195	216	24	197	39	138
9	90	161	171	88	79	27	222	170	130	94	58	55	61
10	117	119	133	206	64	19	155	27	94	186	99	118	151
11	161	112	1	28	124	109	217	16	152	108	7	191	222
12	161	43	45	187	208	152	155	130	216	34	193	184	55
13	197	53	1	18	195	120	39	109	143	82	87	210	11
14	192	53	124	57	171	113	177	128	155	64	8	178	18
15	10	163	7	95	26	6	140	117	86	148	24	203	25

Figure 3: A random table and a typical window

Call such a window *good* if only a "few" of the numbers in it occur more than once. It is not hard to prove that in a random table, *all* small windows will be good. Now what about the addition and multiplication tables? It is very easy to see that each has bad windows![2] However, Bourgain, Katz, and Tao showed that when *taken together* these two tables are good in the following sense (see Figure 4): for every window, it is either good in the multiplication table or in the addition table (or both)! Boaz Barak, Impagliazzo, and Wigderson gave a statistical version of this result, and used it to prove that Zuckerman's original extractor works!

+	1	2	3	4	5	6	7	8	9	10	11	12	13
1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	3	4	5	6	7	8	9	10	11	12	13	14	15
3	4	5	6	7	8	9	10	11	12	13	14	15	16
4	5	6	7	8	9	10	11	12	13	14	15	16	17
5	6	7	8	9	10	11	12	13	14	15	16	17	18
6	7	8	9	10	11	12	13	14	15	16	17	18	19
7	8	9	10	11	12	13	14	15	16	17	18	19	20
8	9	10	11	12	13	14	15	16	17	18	19	20	21
9	10	11	12	13	14	15	16	17	18	19	20	21	22
10	11	12	13	14	15	16	17	18	19	20	21	22	23
11	12	13	14	15	16	17	18	19	20	21	22	23	24
12	13	14	15	16	17	18	19	20	21	22	23	24	25
13	14	15	16	17	18	19	20	21	22	23	24	25	26
14	15	16	17	18	19	20	21	22	23	24	25	26	27
15	16	17	18	19	20	21	22	23	24	25	26	27	28

x	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	2	3	4	5	6	7	8	9	10	11	12	13
2	2	4	6	8	10	12	14	16	18	20	22	24	26
3	3	6	9	12	15	18	21	24	27	30	33	36	39
4	4	8	12	16	20	24	28	32	36	40	44	48	52
5	5	10	15	20	25	30	35	40	45	50	55	60	65
6	6	12	18	24	30	36	42	48	54	60	66	72	78
7	7	14	21	28	35	42	49	56	63	70	77	84	91
8	8	16	24	32	40	48	56	64	72	80	88	96	104
9	9	18	27	36	45	54	63	72	81	90	99	108	117
10	10	20	30	40	50	60	70	80	90	100	110	120	130
11	11	22	33	44	55	66	77	88	99	110	121	132	143
12	12	24	36	48	60	72	84	96	108	120	132	144	156
13	13	26	39	52	65	78	91	104	117	130	143	156	169
14	14	28	42	56	70	84	98	112	126	140	154	168	182
15	15	30	45	60	75	90	105	120	135	150	165	180	195

Figure 4: The addition and multiplication tables

The above story is but one example. Fundamental results from number theory and algebraic geometry, mainly on the "random-like" behavior of rational solutions to polynomial equations (by André Weil, Pierre Deligne, Enrico Bombieri, and Bourgain) were recently used in a variety of extractor constructions, purifying randomness in different settings.

Million-dollar questions on pseudorandomness: Two of the most celebrated open problems in mathematics and computer science, the Riemann Hypothesis and the P vs. NP question, can be stated as problems about pseudorandomness. These are two of the seven Clay Millennium problems, each carrying a $1 million prize for a solution (see www.claymath.org/millennium for excellent descriptions of the problems as well as the terms for the challenge). They can be cast as problems about pseudorandomness despite the fact that randomness is not at all a part of their typical descriptions. In both cases, a concrete property of random structures is sought in specific deterministic ones.

Avi Wigderson, Herbert H. Maass Professor in the School of Mathematics, is a widely recognized authority in the diverse and evolving field of theoretical computer science. His main research area is computational complexity theory, which studies the power and limits of efficient computation and is motivated by fundamental scientific problems. Since being appointed to the Faculty in 1999, Wigderson has overseen the Institute's activities in theoretical computer science, which began in the 1990s, initially organized by visiting professors with the involvement of Enrico Bombieri, IBM von Neumann Professor in the School.

The European Association for Theoretical Computer Science and the Association for Computing Machinery Special Interest Group on Algorithms and Computation Theory recently awarded the 2009 Gödel Prize for outstanding papers in theoretical computer science to Wigderson and former Visitors Omer Reingold (1999–2003) and Salil Vadhan (2000–01). The three were selected for their development of a new type of graph product that improves the design of robust computer networks and resolves open questions on error correction and derandomization. The papers cited are "Entropy Waves, the Zig-Zag Graph Product, and New Constant Degree Expanders" by Reingold, Vadhan, and Wigderson (conceived and written at the Institute) and a subsequent paper, "Undirected Connectivity in Log-Space," by Reingold. The prize is named for Kurt Gödel, who was a Member (1933–34, 1935, 1938, 1940–53) and Professor (1953–78) of the Institute.

For the P vs. NP question the connection is relatively simple to explain. The question probes the computational difficulty of natural problems. It is simple to see that *random* problems[3] are (almost surely) hard to solve, and P vs. NP asks to prove the same for certain *explicit* problems, such as "the traveling salesman problem" (i.e., given a large map with distances between every pair of cities, find the shortest route going through every city exactly once).

Let's elaborate now on the connection (explained on the cover of this issue) of the Riemann Hypothesis to pseudorandomness. Consider long sequences of the letters L, R, S, such as

SSRSLLLLLSLRRLSRRRRRSLSLSLL...

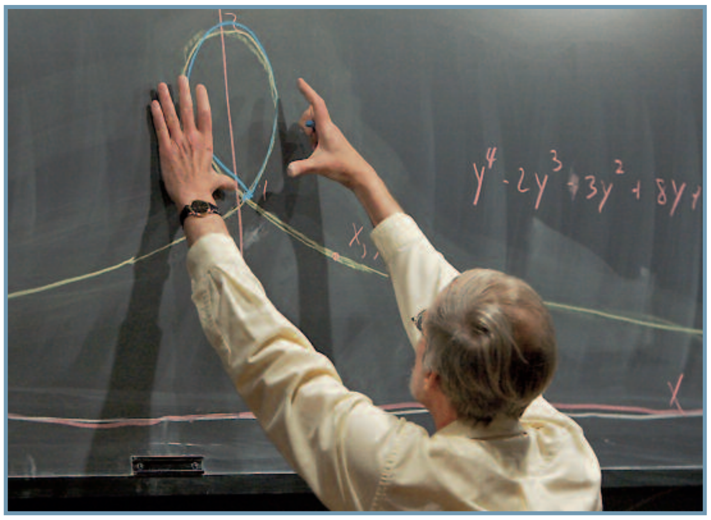
Such a sequence can be thought of as a set of instructions (L for Left, R for Right, S for Stay) for a person or robot walking in a straight line. Each time the next instruction moves it one unit of length Left or Right or makes it Stay. If such a sequence is chosen at *random* (this is sometimes called a random walk or a drunkard's walk), then the moving object would stay relatively close to the origin with high probability: if the sequence was of n steps, almost surely its distance from the starting point would be close to $\sqrt{n}$. For the Riemann Hypothesis, the explicit sequence of instructions called the Möbius function is determined as follows for each step t. If t is divisible by any prime more than once then the instruction is Stay (e.g., t=18, which is divisible by 3^2). Otherwise, if t is divisible by an *even* number of distinct primes, then the instruction is Right, and if by an odd number of distinct primes, the instruction is Left (e.g., for $t=21=3\times7$ it is Right, and for $t=30=2\times3\times5$ it is Left). This explicit sequence of instructions, which is determined by the prime numbers, causes a robot to look drunk, if and only if the Riemann Hypothesis is true! ■

1 Actually they should be taken as numbers modulo some large prime p, and all arithmetic below should be done modulo p.

2 If rows and columns of a window form an arithmetic progression, the addition table will be bad. If they form a geometric progression, the multiplication table will be bad.

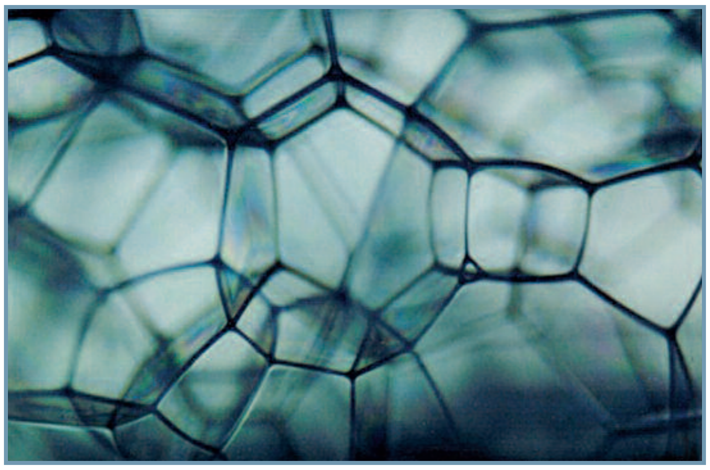
3 This has to be formally defined.

Identifying Order in Complex Systems



ANDREA KANE

Robert MacPherson, Hermann Weyl Professor in the School of Mathematics, is interested in applications of topology beyond high-energy physics.



Models of three-dimensional grain growth developed by MacPherson and a collaborator have implications for materials such as foam (seen here close up).

What explains "the unreasonable effectiveness" of mathematics, as the late Princeton University physicist Eugene Wigner phrased it, in answering questions about the real world? Natural phenomena could have been structured in a way that couldn't be understood at all, or that could only be understood using another method. Instead, we repeatedly find they are understood using the most precise tools we have for studying something: mathematics.

Applied mathematics historically has concerned quantitative areas, such as calculus, rather than qualitative areas, such as topology (the study of properties that are preserved in geometric figures despite continuous deformations). Of interest to Robert MacPherson, Hermann Weyl Professor in the School of Mathematics, is the possibility that topology has applications—beyond high-energy physics, where it has proven very fruitful (for example, Chern-Simons theory)—to areas such as biology, or the breaking of ocean waves.

"What would it be to understand the breaking wave?" asks MacPherson. "Well, certainly not understanding every little bubble of every foam piece. Quantitative mathematics is not going to capture whatever is going on there. There is just too much data. What would you do with it? It is not useful. It doesn't answer any interesting questions. What you want to extract is something simpler that you can deal with. And you know there is something simpler there because every wave that comes up breaks in more or less the same way. It is not as if it is some totally chaotic thing that can't be understood at all. You can see that there is order in this, because it happens repeatedly."

During the last century, topology developed largely in Princeton due to the foresight of topologist Oswald Veblen, who became the Institute's first Professor in 1932 and started Princeton on the trail of being a world center in the field. One of MacPherson's prized documents is a copy, previously owned by André Weil, Professor in the School of Mathematics (1958–98), of *Analysis Situs* by Henri Poincaré that was published in 1895. "I love it because it has André Weil's personal handwritten notes," says MacPherson. "This is the paper that established the whole subject of topology. In the introduction he writes about why he is doing this and why a new language is needed. His justification is that it actually comes up in applications, and he gives examples of three applications in which topology had come up."

What is striking to MacPherson is that despite Poincaré's citation of these applications topology has not been developed with applications in mind, at least not until recently. "In fact, most topologists have not thought about applications at all," says MacPherson. "It is my belief that these qualitative topological methods are very powerful in describing the real world."

Several years ago, MacPherson started attending graduate courses in the engineering department at Princeton University with the idea that there were problems involving materials that could benefit from topological thinking. Two years ago, MacPherson with David Srolovitz, then Chair of Princeton University's Department of Mechanical and Aerospace Engineering, used topology to discover a three-dimensional (and higher) solution to an open problem that had existed since 1952 when John von Neumann, Professor in the School of Mathematics (1933–57), solved it in two dimensions.

Von Neumann derived an exact formula—R=K (V−6) where R is the growth rate of the area of a cell, K is a constant depending on the temperature and the material, and V is the number of vertices of the cell. Von Neumann's formula applies to the cells formed by crystals in a metal or a ceramic, or by bubbles in a foam. What made the three-dimensional solution to the problem challenging is that a three-dimensional cell can curve in many complicated ways whereas a cell boundary in two dimensions can curve in essentially only one way.

MacPherson and Srolovitz generalized von Neumann's formula for three-dimensional cell growth as follows: R=K (E−6L) where E is the length of all the edges of the cell and L is the "mean width" of the cell, a measure of its linear size. The mean width L is a "natural" concept from pure mathematics that was developed by many mathematicians, including Hermann Weyl (Professor, 1933–55) and John Milnor (former Professor, 1970–90) at the Institute.

Three-dimensional cellular structures in hard materials such as metals or ceramics, and in soft materials such as foams, influence the material properties that are important in applications, such as strength and magnetization of hard materials, or complex fluid behavior in soft materials, such as in breaking waves. This is why the three-dimensional von Neumann formula is useful. The study of these ideas continues at the Institute. In the upcoming academic year the School of Mathematics will host two materials scientists—Jeremy Mason, a postdoctoral specialist in hard materials from the Massachusetts Institute of Technology, and Randall Kamien, Professor at the University of Pennsylvania, who studies soft materials.

MacPherson with Konstantin Mischaikow of Rutgers, the State University of New Jersey, organized a series of seminars last spring to discuss the current and future applications of topological techniques, both theoretical and computational, for organizing and understanding the data of a breadth of complicated phenomena—from neural activity to laboratory fluid flows.

The seminars, which alternated between the Institute and Rutgers and will continue this fall, featured three talks for a broad interdisciplinary audience—one by a mathematician with techniques that might solve a problem; one by a scientist with problems that might be solved; and one by an expert at computer algorithms who could study whether these techniques predict a particular solution. "We'll have to wait twenty years," says MacPherson, "to see whether we are witnessing the beginning of a significant new connection between topology and applications." ■

Chern Numbers of Algebraic Varieties: The Evolution of a Classification Problem

When Friedrich Hirzebruch was a Member in the School of Mathematics in 1954, his paper, "Some problems on differentiable and complex manifolds," was published in the *Annals of Mathematics*. In it he asked whether Chern numbers in algebraic geometry could be understood topologically. Specifically, which Chern numbers are topological invariants of complex-algebraic varieties?

Classification problems exist in both topology, which studies qualitative properties of geometric objects (flexible properties unchanged by continuous deformation), and algebraic geometry, which studies more quantitative properties. "Classification problems are very interesting in both subjects because they tend to be solved slowly over long periods of time," says Robert MacPherson, Hermann Weyl Professor in the School of Mathematics. "You have questions where successive generations of people all contribute to the same problem."

An example of this type of progress led to the recent solution by Dieter Kotschick, former Member in the School of Mathematics (1989–90, 2008–09) and Professor at Ludwig-Maximilians-Universität München, of the classification problem that Hirzebruch proposed at the Institute more than fifty years ago. The solution was made possible by several mathematicians (and surprisingly physicists) at the Institute and elsewhere. It concerns Chern numbers, which emerged from work Shiing-Shen Chern conducted at the Institute as a Member between 1943 and 1945 (see article, page 9).

To solve a classification problem one needs to find "invariants" (ways to distinguish topologically different objects, or different objects in algebraic geometry) and also one needs to develop techniques to show that two apparently different objects are topologically the same. In algebraic geometry, Chern numbers are invariants that distinguish between algebraic varieties. Hirzebruch was interested in how they could be understood as a classification problem in topology.

The first progress on this problem was made at the Institute in 1958–59 when Armand Borel, then a Professor at the Institute, and Hirzebruch developed a technique that showed how certain pairs of different algebraic varieties were the same topologically. A subsequent breakthrough came in 1994 with the introduction of equations developed for theoretical physics by Nathan Seiberg, who would become a Professor in the School of Natural Sciences in 1997, and Edward Witten, a Professor in the School since 1987. The Seiberg-Witten equations provided powerful techniques for determining when two algebraic surfaces are smoothly different although they may be topologically the same. Such examples later turned out to be crucial for the solution of Hirzebruch's problem.

Kotschick had been thinking about Borel and Hirzebruch's joint work for years. Some time after arriving at the Institute last September, he began to ponder a seemingly unrelated question about the Pontryagin numbers of smooth manifolds admitting

(Continued on page 9)

Major New Prize Honors Shiing-Shen Chern

Shiing-Shen Chern

The International Mathematical Union and the Chern Medal Foundation have announced the creation of a major new prize in mathematics in honor of Shiing-Shen Chern (1911–2004), a former Member of the Institute's School of Mathematics (1943–46, 1954–55, 1964).

The Chern Medal Award, which will be awarded for the first time in August 2010 at the opening ceremony of the International Congress of Mathematics, commemorates Chern's lasting influence on mathematics. Chern redefined the subject of geometry, producing results in differential geometry and topology that have found wide application in fields including string theory, condensed-matter physics, and computer graphics.

The Chern Medal Award will be given every four years to an individual whose lifelong outstanding achievements in mathematics warrant the highest level of recognition. Of the $500,000 monetary award, half will be donated to organizations of the recipient's choosing to support research, education, outreach, or other activities to promote mathematics. "My dad donated quite a bit of money to mathematical causes, particularly in China," says May Chu, President of the Chern Medal Foundation, who remembers living at the Institute with her family when Chern was a Member in 1954–55. "The philanthropic aspect of the award is very much in line with my dad's life."

Based on the model of the Institute, Chern helped found the Mathematical Sciences Research Institute in Berkeley as well as mathematics institutes at Academia Sinica in Taiwan and Nankai University in China. Over the years he maintained close ties with the Institute, in particular with Phillip Griffiths, Professor Emeritus in the School of Mathematics and former Director of the Institute (1991–2003), who will serve as the first Chair of the Chern Medal Award Committee.

"His time at the Institute was absolutely critical in his mathematical development," says Griffiths, who first met Chern as a visiting graduate student at the University of California, Berkeley, where Chern was teaching, in 1961. "He was one of two main influences in my life."

It was during his time at the Institute that Chern discovered an intrinsic proof of the n-dimensional Gauss-Bonnet formula, which was the forerunner of other invariants that bear his name: Chern classes, Chern-Weil homomorphism, and Chern-Simons invariants.

Chern-Simons invariants were first described in a paper in 1974, coauthored by Chern and James Simons, a former Member in the School of Mathematics (1972–73) and a current Trustee of the Institute. The Simons Foundation, established by Simons and his wife, Marilyn Hawrys Simons, has funded the Chern Medal Award in partnership with the S. S. Chern Foundation for Mathematical Research.

In 2004, the S. S. Chern Foundation contributed $100,000 to the Institute, which is used to support a Member in the School of Mathematics who is either Chinese or of Chinese descent. In the 2008–09 academic year, income generated from the gift supported Member Qingyu Wu, whose research concerns automorphic forms and representation theory. In a letter to Institute Director Frank Aydelotte dated February 23, 1945, Chern wrote, "The years 1943–45 will undoubtedly be decisive in my career and I have profited not only in the mathematical side. I am inclined to think that among the people who have stayed at the Institute, I was the one who has profited the most, but the other people may think the same way." ■

CHERN NUMBERS *(Continued from page 8)*

Riemannian metrics of nonnegative sectional curvature. He was able to prove that there is one such number, the signature, that is up to multiples the only Pontryagin number that is bounded on connected manifolds of nonnegative curvature.

It was this work that motivated his interest in the structure result for the rational complex cobordism ring by John Milnor, former Institute Professor (1970–90). Kotschick was able to construct a new sequence of generators for this ring using differences of diffeomorphic algebraic varieties, which are constructed as projective space bundles over certain algebraic surfaces.

This construction led to Kotschick's solution of Hirzebruch's problem in all dimensions. He concluded that, with the obvious exceptions, Chern numbers do depend on the algebraic structure of a variety, not just on topological properties. "It was the peace and quiet at the IAS that allowed me to zero in on the solution," says Kotschick. "This is one of those cases where the freedom to ponder things quietly and to concentrate without distractions led to unexpected payoffs. Sometimes the crucial idea appears through thinking about seemingly unrelated problems, or by transposing methods from one area of mathematics to another." ■

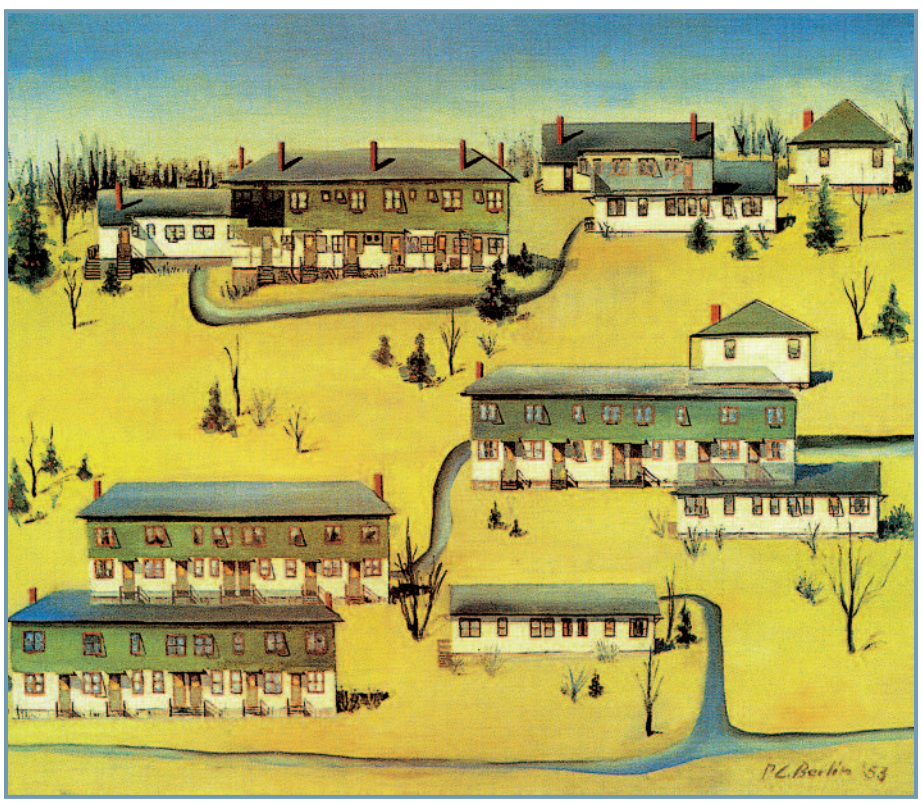
Of Historical Note

Excerpt from The Strangest Man: The Hidden Life of Paul Dirac, Mystic of the Atom *(Basic Books, 2009) by Graham Farmelo, who researched and wrote much of the book while a Director's Visitor at the Institute*:

In Göttingen, Dirac made another of his unlikely friendships. This one was with Robert Oppenheimer, who had fled Cambridge and was flourishing in Max Born's department of theoretical physics as a Ph.D. student of rare ability and self-confidence. Ever the intellectual peacock, Oppenheimer was thinking about more than physics: his eclectic reading list included F. Scott Fitzgerald's collection of short stories *Winter Dreams*, Chekhov's play *Ivanov*, and the works of the German lyric poet Johann Hölderlin. He was also trying his hand at writing verse, a hobby that puzzled Dirac. "I don't see how you can work on physics and write poetry at the same time," he remarked during one of their walks. "In science, you want to say something nobody knew before, in words everyone can understand. In poetry, you are bound to say something that everybody knows already in words that nobody can understand." For decades to come, Oppenheimer loved to recount this anecdote over cocktails, no doubt having polished Dirac's original phrasing to give it the bite of one of Wilde's paradoxes.

An anecdote from spring 1950 as recalled by the late Raoul Bott, Member in the School of Mathematics, to George Dyson, former Director's Visitor and son of Freeman Dyson, Professor Emeritus in the School of Natural Sciences:

And we had tremendous wild parties. It was a high point in my life. . . . My wife was interested in poetry and Dylan Thomas came into town and did some readings. And we all went, with my friend Specker too, and it was my wife's birthday. At about 10:30 in the evening, or maybe 11, we were having a great party in one of those shacks there, and I thought, "Well, wouldn't it be great to bring Dylan Thomas here now." So I called the hotel—I was a brash young man—and got Dylan Thomas, and he had been in bed. And he said, "Oh, I'd love to be woken up, by all means," you know, and he was ready for partying. And so I drove there—we had this 1935 convertible Buick—with my wife, she of course all excited, and right away when he got in the car I could see that there would be a little bit of a problem because obviously she was going to be his girl for the night. So I brought him to the party, which had, in the meantime, cooled a bit, and he opened the door and started in, and there was Mrs. ____ sitting, just like you're sitting there, near the door. And he said, "My, aren't you big!" And there was silence in the room, and he later claimed that he loved big women, but somehow the whole party turned into a bit of a nightmare. So, for instance, my friend Specker, who could not speak English too well, he told him, "Well, we liked your reading, but I think you spoke down to the audience a bit, didn't you?" and Dylan Thomas let loose, swear words of an order that we didn't use, that were no-nos. So it was quite a fiasco. In the end actually I took him home, and the next day I took him to Princeton Junction to make up for this, and he said, "Well, it was just that you people are all cooped up together all this time, and I was sort of a catalyst . . ."



In 1946, then Institute Director Frank Aydelotte purchased eleven structures formerly used as World War II barracks to serve as the first Member housing at the Institute. In the late 1950s, Institute Director J. Robert Oppenheimer replaced these buildings with the current Member housing, designed by the Bauhaus architect Marcel Breuer. This view of the Barracks was painted in 1953 by Patricia Clearly Berlin, whose husband Theodore Berlin was then a Member in the School of Mathematics.

The Choir of St John's College, Cambridge

CLIFF MOORE

The Choir of St John's College, Cambridge, dates from 1670 and is one of the finest collegiate choirs in the world. On Friday, March 27, the choir performed for the Institute community in Wolfensohn Hall in a concert featuring music of the sixteenth to twentieth centuries by composers such as Thomas Tallis, Henry Purcell, Benjamin Britten, and Gerald Finzi. The choir consists of fifteen Choristers, boys between the ages of nine and thirteen, and fifteen Choral Scholars, aged eighteen to twenty-three, who are usually undergraduate members of the college. The choir is directed by Andrew Nethsingha.

IDENTITY *(Continued from page 3)*

her groundbreaking essay "Gender: A Useful Category of Historical Analysis" in the *American Historical Review* (December 1986). In the essay, Scott examined the ways feminists had begun to use "gender" as a category of analysis, while providing a history of its usage, its pitfalls, and a framework moving forward. "Gender is a useful category only if differences are the question, not the answer," Scott observed, "only if we ask what 'men' and 'women' are taken to mean wherever and whenever we are looking at them, rather than assuming we already know who and what they are." Last December, the *American Historical Review* published a forum about the enduring influence of the essay, calling it "undoubtedly one of the most widely read and cited articles in this journal's history."

Throughout her work, which is currently focused on the ways in which difference poses problems for democratic practice, Scott says she is most interested in the discontinuities of history rather than illusions of continuity. "Like an echo, things that seem familiar in fact are only impartial returns of sound," says Scott. "In exposing the underlying premises that organize our ways of seeing things as if they were natural, as if they were eternal, the possibility for thinking differently exists. If constructed categories can be seen as working for a certain end and having effects that we may not like, if they can be seen as products of history—if history is what is producing them—then we can imagine that they can be changed." ■

DEWEY SEMINAR

(Continued from page 3)

philosophers who have done exceptional work on education already, along with other philosophers who are beginning to work on education or may be enticed to do so through participation in the workshop. The group will meet three times during the course of the year, with the goal of publishing a book as a result of their work. All workshop participants will be expected to contribute a chapter, and some of the year-long participants will also be invited to contribute. The volume will be edited by Allen and Reich.

In addition to financial support from the Ford and Spencer foundations, Paula and James Crown have generously provided funding for Anat Zohar, Associate Professor of Education at the Hebrew University of Jerusalem, to participate in the year's programs as a Member in the School of Social Science. At the Institute, Zohar plans to examine the transition from an emphasis on rote learning to an emphasis on deep understanding and higher-order thinking through the lens of the Israeli school system. ■

Carnegie–IAS Commission Issues Report on Education

The Carnegie Corporation of New York–Institute for Advanced Study Commission on Mathematics and Science Education has released "The Opportunity Equation," a report that calls for a transformation of mathematics and science education in America. Among its recommendations are establishing new common standards in mathematics and science that are simpler and more ambitious, improving professional education for teachers, and redesigning schools and school systems. The report, available online at www.opportunityequation.org, was released at an event in Washington, D.C., that featured prominent leaders and educators. The Carnegie–IAS Commission on Mathematics and Science Education is chaired by Phillip Griffiths, Professor in the School of Mathematics, Chair of the Science Initiative Group (SIG) at the Institute, and former Institute Director (1991–2003).

NSF Funds New Positions in Mathematics

The National Science Foundation (NSF) is funding forty-five new postdoctoral positions in mathematics beginning in the 2009–10 academic year to offset a decrease in the availability of such positions in the current economic climate. The recipients of five of these one-year positions, one of whom will work at the Institute for Advanced Study, have been selected by the Faculty of the Institute's School of Mathematics.

Jonathan William Bober, who will be a Member in the School in 2009–10, will work on analytic number theory, birational geometry, and hypergeometric functions. The other Institute-selected recipients will be based at Rutgers, the State University of New Jersey; the Courant Institute of Mathematical Sciences at New York University; and the University of California, Berkeley. These individuals will be encouraged to visit the Institute for at least one week per term and give a seminar on their research. ■

FASSIN *(Continued from page 1)*

The exploration of a tragic past in the present also led Fassin to post-apartheid South Africa, a country confronted with the AIDS epidemic. For seven years he investigated then President Thabo Mbeki's handling of the crisis, and he provided a rich ethnography of Soweto and Alexandra by casting the vivid stories of AIDS patients against the historical backdrop of segregation, discrimination, and exploitation. His book *When Bodies Remember: Experiences and Politics of AIDS in South Africa* (University of California Press, 2007) investigates the puzzling resistance of many South Africans to medical science and the controversy surrounding it. Fassin considers this type of interpretation through a combination of ethnographic work and theoretical reflection to be a major challenge for contemporary anthropology.

"Didier Fassin is an important addition to the School's Faculty," commented Joan Scott, Harold F. Linder Professor in the School of Social Science. "His original and path-breaking scholarship will broaden our horizons and bring anthropology to prominence here once again."

Fassin earned his M.D. from the Université Pierre et Marie Curie in 1982, and his Ph.D. in social science in 1988 from the École des Hautes Études en Sciences Sociales (EHESS). He served as a researcher for the Institut National de la Santé et de la Recherché Médicale in Senegal from 1984–86, and then was Assistant Professor in Infectious Diseases and Public Health at the Hospital Pitié-Salpétrière in Paris from 1987–89. After conducting research with the French Institute for Andean Studies in Ecuador, he became Assistant Professor of Sociology at the Université Paris Nord in 1991 and then Professor in 1997. In 1999, he was appointed Director of Studies in Political and Moral Anthropology at EHESS. In 2007, Fassin established the Institut de Recherche Interdisciplinaire sur les Enjeux Sociaux (IRIS), whose research on five continents focuses on social, political, and moral change. Fassin is the author of seven books as well as numerous articles in social-science and medical journals, and he serves as international editor of the *Medical Anthropology Quarterly*. In 2007, in recognition of his academic achievements and leadership, he was appointed Professeur de Classe Exceptionnelle and also a Chevalier des Palmes Académiques.

"The appointment to the Institute Faculty represents an unprecedented opportunity to continue my work in association with outstanding scholars from many fields," Fassin said. "It seems particularly fitting that I hold a chair that honors James Wolfensohn, who has drawn international attention to the importance of the contribution ethnographers can make in furthering our understanding of culture and politics in the developing world."

The James D. Wolfensohn Professorship in Social Science was funded by donations from Institute Trustees and Faculty as well as Wolfensohn's colleagues and friends to acknowledge his twenty-one years of distinguished service to the Institute as Chairman of its Board of Trustees. A new Membership associated with this Professorship has also been created by a generous donation from the Wolfensohn family. The first of these Members will be Matthew J. Nelson, Lecturer in Politics at the University of London, who will explore during the 2009–10 academic year the relationship between religious education and citizenship in Pakistan. ■

An Invitation to Members and Visitors to Support the Institute

KATE ABLUTZ

Members and visiting scholars at the outdoor blackboard

Every ten years since 1965, the Institute has undertaken a Decadal Review to seek further clarification of the Institute's essential purpose, how that purpose is being fulfilled, and how it may continue to be fulfilled in the future. In a recent survey conducted in conjunction with the Decadal Review currently underway, 95 percent of Members and Visitors rated their overall Institute experience as very or extremely rewarding.

To achieve this level of excellence the Institute relies heavily on its endowment and on donations from individuals, which are essential to maintain for future generations the independence upon which the Institute's mission depends. Many former and current Members and Visitors have elected to financially support the Institute's fundamental goal of fostering theoretical research and intellectual inquiry, and for this the Institute is very grateful.

Upon making a donation earlier this year, one Member observed, "This modest contribution has nothing to do with the value to me of our stay at the Institute, which was inestimable. But it has everything to do with my gratitude for this wonderful and unforgettable experience." Members and Visitors who wish to make a financial contribution to the Institute are invited to contact Linda Geraci, Development Officer, at (609) 734-8259 or llg@ias.edu. Members and Visitors who wish to discuss a bequest or planned gift should contact Catie Newcombe, Senior Development Officer, at (609) 951-4542 or cnewcombe@ias.edu.

Rethinking Retirement Strategies

The Einstein Legacy Society, which recognizes those who have included the Institute for Advanced Study in their wills and estate plans, hosted a talk on May 21 by Brett Hammond, Managing Director and Chief Investment Strategist at TIAA-CREF. The talk, "Dreams Deferred? Rebuilding Your Retirement Strategy," examined the events that led up to the recent crisis in the financial markets and proposed several new rules for retirement investing, with a focus on securing a retirement income rather than accumulating wealth. A video of Hammond's talk may be found on the Institute's website at http://video.ias.edu. Following the talk, Peter and Helen Goddard were hosts of a dinner honoring members of the Einstein Legacy Society at Olden Farm.

Retirement savings require special attention in the estate planning process, as they are not generally governed by one's will, but by the beneficiary designations of the retirement account. Since estate and income taxes may apply to bequests made from your retirement plan to individuals other than your spouse, such as your children, it may be preferable to make a charitable gift to the Institute from your retirement assets. This would avoid taxes and provide a charitable deduction for your estate. Retirement plan bequests to the Institute can be simple, such as designating the Institute as a primary or contingent beneficiary for a portion of the account. More complex options include naming a charitable remainder trust as the beneficiary, which would provide a stream of income to an individual and the remaining amount to the Institute. Issues to consider when planning for the disposition of retirement accounts include the size of your estate, your marital status, family needs, and charitable objectives. It is always recommended that you consult with professional advisers when making estate planning decisions. For more information on planned giving and the Einstein Legacy Society, please contact Catie Newcombe, Senior Development Officer, at (609) 951-4542 or cnewcombe@ias.edu.

KATE ABLUTZ

Brett Hammond, Managing Director and Chief Investment Strategist at TIAA-CREF, discusses retirement and estate-planning strategies in a talk hosted by the Einstein Legacy Society.

Friends of the Institute, Then and Now

Nearly thirty years ago, on the occasion of the fiftieth anniversary of the Institute's founding, a small circle of individuals came together to create the Friends of the Institute for Advanced Study. Membership in the Friends grew steadily, and in 1990 a governing board known as the Friends Executive Committee was established. Frank E. Taplin Jr., a noted philanthropist and Institute Trustee (1971–88), served for a year as the Friends' first Chair and brought invaluable experience to the flourishing group.

Taplin was succeeded by Mary P. Keating, who served from 1991 to 1995. A prominent leader in the Princeton community and a committed advocate for arts and culture, Keating played an important role in helping to raise the profile of the Friends, resulting in increased membership and growing financial support for the work of the Institute. Keating died in January of this year, and Taplin passed away in 2003, but the impact of these early leaders is seen in the ongoing success of the Friends.

RANDALL HAGADORN

Mary P. Keating and Frank E. Taplin Jr., the first Chairs of the Friends Executive Committee

Donations from Friends have continued to rise annually, with more than $582,000 contributed this past fiscal year, representing the highest level to date. Over the last five years, more than $2.2 million has been raised. These contributions provide the greatest source of completely unrestricted income the Institute receives. Membership in the Friends has also increased, with forty new Friends joining last year, and membership in the Circles—the Friends' higher-level donor groups—has also grown. Last year, just over a quarter of all donors to the Friends gave at one of the Circle levels.

In addition to the many benefits extended to Friends, members of the Founders', Chairman's, and Director's Circles enjoyed several special events with two of the Institute's newest Faculty members. In the fall, Peter Goddard was host of a luncheon and talk by Nima Arkani-Hamed, one of the leading phenomenologists of his generation. Arkani-Hamed spoke about the Large Hadron Collider and the theoretical and experimental work surrounding this monumental endeavor. Most recently, Peter and Helen Goddard were hosts of a dinner and a talk by Danielle Allen, a democratic theorist and historian of political thought, who led a timely discussion on citizenship in the twenty-first century.

Beyond their financial support, the Friends make a significant contribution by connecting the Institute to the wider community, and acting as informed ambassadors for the work of its Faculty and Members. For more information about the Friends, including how to join, please contact Pamela Hughes, Senior Development Officer, at (609) 734-8204 or phughes@ias.edu. ■