AMERICAN ACADEMY OF ARTS & SCIENCES

CHERISHING KNOWLEDGE 225th SHAPING THE FUTURE

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AMERICAN ACADEMY
OF ARTS & SCIENCES

Calendar of Events

Saturday, October 8, 2005

Stated Meeting and National Induction Ceremony – Cambridge

Location: Sanders Theatre, Harvard University

Wednesday, November 9, 2005

Stated Meeting – Cambridge

Speaker: David McCullough

Location: To be announced

Saturday, November 19, 2005

Stated Meeting – Chicago

Speakers: To be announced

Location: Art Institute of Chicago

Friday, December 2, 2005

Stated Meeting – Cambridge

Speaker: Robert Levin, Harvard University

Location: House of the Academy

Fall meetings in New York and California to be announced.

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

Academy News

Academy Begins Yearlong Celebration of 225th Anniversary

"Cherishing Knowledge, Shaping the Future" sets the theme for the Academy's 225th anniversary lectures and publications. Meetings will be held throughout the country to mark this special occasion, with a focus on the principles underlying the founding of the nation and the Academy – how they have been transformed throughout history and how they are interpreted today.

To inaugurate these events, Vice President and Chair of the Academy Trust Louis W. Cabot welcomed several hundred guests to a special program on April 21, 2005, celebrating the Academy's historic mission and its accomplishments over three centuries. The evening began with Fellows James Carroll and Linda Greenhouse reading an August 1776 exchange of letters between John and Abigail Adams that foreshadowed the creation of the Academy. Members of the Council and Trust read from the Massachusetts Constitution and from the Academy's Charter, acknowledged sister organizations established in the founding period, and spoke of the Academy's work in science, social policy, and the arts and humanities.

Several speakers recalled the evolution of the Academy's work over the past three centuries. Neal Lane (Rice University) called attention to the Academy's ongoing concern with both pure research and the practical applications of science – from an expedition to observe an eclipse of the sun in the midst of the War for Independence to one of the first Darwinian debates in America in the mid-eighteenth century and the establishment of the field of arms control in the twentieth century. Robert C. Post (Yale Law School) traced the changing meaning of social welfare in the Academy from improving crop production in 1780 to a conference on the social impact of science and technology held two months before Pearl Harbor, a series of path-breaking studies on race and poverty in the 1960s, and current studies on corporate and nonprofit accountability. Executive Officer Leslie Berlowitz considered humanistic study within the Academy, beginning with a focus on the language of the new nation and extending to the creation of important institutions in the humanities, particularly the National Humanities Center, and a study of the challenges facing the humanities in contemporary America.

James Carroll (Boston, Massachusetts) and Linda Greenhouse (*The New York Times*)

Highlights of the evening included congratulatory remarks by Mary Maples Dunn, Co-Executive Officer of the American Philosophical Society in Philadelphia; video tributes from Senator Edward M. Kennedy, Supreme Court Justice Stephen G. Breyer, U.S. Secretary of Energy Samuel W. Bodman, and Chief Justice Margaret H. Marshall of the Massachusetts Supreme Judicial Court; and musical performances by members of the Lydian String Quartet, Sergeant Dan Clark of the Massachusetts State Police, and the Lincoln Minutemen Fife and Drum Corps.

As Peter Nicholas, Chairman of Boston Scientific Corporation and Co-Chair of the Academy Trust, observed in his remarks at the celebration, "what is particularly exciting about the Academy is its ability to adapt its historic mission to ensure that we remain a vital resource for contemporary society. The Academy's success is due to its capacity to use its traditions imaginatively, while always promoting constructive change." ■

Neal Lane (Rice University)

Peter Nicholas (Boston Scientific Corporation)

225th Celebration

Order of Speakers

Readings from the Letters of John and Abigail Adams
James Carroll
Linda Greenhouse

Welcome and A Remembrance by John Adams
Louis W. Cabot

A Tribute to the Academy
The Honorable Margaret H. Marshall

Chapter 5, Section 2 from the Massachusetts Constitution
Cheryl Finley

The Charter of the American Academy
John S. Reed

A Tribute to Sister Organizations
Louis W. Cabot

Acknowledgment from the American Philosophical Society
Mary Maples Dunn

A Tribute to the Academy
The Honorable Samuel W. Bodman

The Academy's Work: Science and Global Security
Neal Lane

A Tribute to the Academy
The Honorable Stephen G. Breyer

The Academy's Work: Social Policy and American Institutions
Robert C. Post

The Academy's Work: The Humanities and Culture
Leslie C. Berlowitz

A Tribute to the Academy
The Honorable Edward M. Kennedy

Wolfgang Amadeus Mozart, *Allegro* movement from the Divertimento in E Flat, K. 563
Members of the Lydian String Quartet
Introduced by Jerrold Meinwald

An Appreciation
Leslie C. Berlowitz

Proclamation from the White House
Jesse H. Choper

The Academy's Future
Peter Nicholas

"America the Beautiful"
Sergeant Dan Clark

Chief Justice Margaret H. Marshall of the Massachusetts Supreme Judicial Court

U.S. Secretary of Energy Samuel W. Bodman

Senator Edward M. Kennedy

Supreme Court Justice Stephen G. Breyer

Members of the Lydian String Quartet: Daniel Stepner (violin), Joshua Gordon (violoncello), and Mary Ruth Ray (viola)

John S. Reed (Citigroup, retired)

Patricia Meyer Spacks

At a dinner honoring members of the Council and the Trust, President Patricia Meyer Spacks (University of Virginia) toasted the legacy and the promise of the Academy:

> As President of the Academy, I want to celebrate the accomplishments of my forty-one predecessors. Beginning with merchant and astronomer James Bowdoin, they laid the foundation for an institution that has advanced change while remaining faithful to a 225-year-old mission celebrating the life of the mind in service to society. They never lost sight of the distinctive characteristics that define the Academy. We remain interdisciplinary, independent, reflective, pragmatic, and always aimed at promoting the common good.
>
> Lest you think that presidents alone set the Academy's course, let me assure you otherwise. My fellow officers, members of the Council and the Trust, the leaders of our research programs, and all those who work with us to advance our goals are critical to our success. Thinkers and doers, working under no academic or political pressure and with no collective preconceptions, join forces to develop fresh approaches to difficult problems. Just as we cherish knowledge, we cherish all of you who value the Academy's past and inspire its future. ■

Louis W. Cabot (Cabot-Wellington, LLC), Cheryl Finley (Visiting Scholar, American Academy), Carolyn S. Shoemaker (Lowell Observatory)

Jerrold Meinwald (Cornell University) and Robert G. Stone, Jr. (Kirby Corporation)

225th Celebration

Leslie Berlowitz (American Academy) and William T. Golden (New York, New York)

Robert C. Post (Yale University) and Michael E. Gellert (Windcrest Partners)

Members of the Lincoln Minutemen Fife and Drum Corps

Charles M. Haar (Harvard Law School) and Allan Robinson (Harvard University)

Banners of some of the sister organizations established in the founding period of the Academy.

John Holdren (Harvard University) and Hugh Huxley (Brandeis University). Holdren spoke on "The Energy/ Well-Being Nexus: Economy, Security, Environment" at a dinner following the program.

Sergeant Dan Clark of the Massachusetts State Police

Carl H. Pforzheimer III (Carl H. Pforzheimer and Co.) and Father J. Bryan Hehir (Harvard University)

Record-Breaking Support for the Academy

William and Flora Hewlett Foundation Awards Academy $3 Million Grant

A $3 million capacity-building grant from the William and Flora Hewlett Foundation will significantly strengthen the Academy's research program, expand outreach, and build a more secure financial base. Plans call for increasing the number of projects with public policy implications, involving more Fellows and Visiting Scholars in this work, and broadening Academy activities across the country.

In acknowledging the award, Executive Officer Leslie Berlowitz noted, "This new grant will advance all aspects of our work, as we enhance our role as an independent, intellectual center for addressing pressing issues of our time. The Academy is extremely grateful to the President of the Hewlett Foundation, Paul Brest, and to the members of its board of trustees for recognizing the need and providing the critical support to realize the Academy's ambitious goals."

President Patricia Meyer Spacks added, "The Hewlett award represents a strong vote of confidence in the important work of the Academy. It will increase our ability to draw on the Academy's unique assets – a distinguished membership, unparalleled convening power, and institutional independence – to sustain and strengthen a 225-year tradition of advancing scholarship and serving society." ■

Expanded Support for Academy Research

The Academy is the beneficiary of important new funds to support both its research program and the work of the Visiting Scholars. These gifts will help the Academy to initiate new projects on topics such as the governance of the Internet, corporate and nonprofit responsibility, higher education, and challenges to American science. Several of the grants will support the Visiting Scholars Program, now completing its third year.

Lead gifts have been received from:

The Annenberg Foundation
The Cabot Family Charitable Trust
The Virginia Wellington Cabot Foundation
The Carl and Lily Pforzheimer Foundation
The Charles and Suzanne Haar Fund
The Esther Haar Scholar Exchange Program
The National Endowment for the Humanities. ■

Annual Giving at New Level

Over the past year, the Academy reached two important milestones in its fund-raising efforts. Gifts and grants to support projects and programs totaled over $5 million, and the Annual Fund surpassed the $1 million mark for the fifth consecutive year, exceeding $1.25 million for the first time.

"Every gift is important to us," emphasized Vice President and Chair of the Trust Louis W. Cabot. "The Academy relies on Annual Fund gifts to underwrite research projects and a growing schedule of programs across the country. We extend our deep appreciation to all of the Fellows, friends, and foundations who have helped us to exceed our goal again this year."

Setting the pace in individual giving with leadership gifts were Leonore Annenberg, Stephen D. Bechtel, Jr., Louis W. Cabot, Lewis B. Cullman, William T. Golden, Walter B. Hewlett, Martin Lipton, Peter Nicholas, Carl H. Pforzheimer III, John and Cynthia Reed, and E. John Rosenwald, Jr.

The Academy is indebted to the co-chairs of the Development Committee, Louis W. Cabot and Robert A. Alberty, and to the Committee's members – Jesse H. Choper, Michael E. Gellert, William T. Golden, Charles M. Haar, and Jack W. Peltason – for the dedication and hard work that has helped to make this year's Annual Fund such a success.

A full list of all contributors to the 2004 – 2005 Annual Fund will appear in the Academy's Annual Report, to be issued in fall 2005. ■

2004–2005 Visiting Scholars' Appointments for the Coming Year

The Visiting Scholars Program was created to expand the Academy's research by supporting the work of the next generation of scholars and investing in their professional development. Free of regular teaching and administrative responsibilities, postdoctoral scholars and junior faculty combine their independent research with participation in conferences, Stated Meetings, and informal gatherings.

Over the past three years, response to the program has been overwhelmingly enthusiastic. Participants welcome the opportunity to engage with Fellows in a "vital, stimulating atmosphere that spins off new insights, ideas, and projects, even as it encourages basic study, writing, and research."

Eight Visiting Scholars completed their yearlong residency in Cambridge in May. Their new university and professional positions and the topics of their research at the Academy follow:

Christopher Capozzola: Assistant Professor of History, Massachusetts Institute of Technology.

Research: *Uncle Sam Wants You: Citizenship and Obligation in World War I America*

Cheryl Finley: Postdoctoral Scholar, Ford Foundation; Assistant Professor in the History of Art Department, Cornell University (on leave).

Research: *Committed to Memory: The Slave Ship Icon in the Black Atlantic Imagination*

Hsuan Hsu: Assistant Professor of English, Yale University.

Research: *Scales of Identification: Geography, Affect, and Nineteenth-Century U.S. Literature*

Christopher Klemek: Assistant Professor of History, Florida International University.

Research: *Urbanism and Transition: Modernist Planning and the Crisis of Urban Liberalism in Europe and North America, 1945 – 1975*

Matthew Lindsay: Associate at the Boston law firm, Foley Hoag.

Research: *In Defense of "Racial Balancing": Accounting for Inequality in the Post-Civil-Rights Era*

Robert McDougall: Assistant Professor of History, University of Western Ontario.

Research: *The People's Phone: Rewriting the History of the Gilded Age and the Progressive Era*

Asif Sidiqqi: Assistant Professor of History, Fordham University.

Research: *Science and Repression in the Twentieth Century: Revisiting Soviet Science*

Lisa Szefel: Lecturer in History and Literature, Harvard University.

Research: *The American Poetic Community: 1890 – 1920* ■

Emory Joins University Affiliates

Emory University is the 42nd institution to become a member of the Academy's consortium of University Affiliates – a group of colleges and universities from across the country that provide support and guidance for Academy research, including the Visiting Scholars Program and inter-university projects. The Academy is deeply grateful to President James W. Wagner of Emory and to the leaders of all the Affiliates for their confidence in the Academy's efforts to support interdisciplinary research and to expand opportunities for postdoctoral scholars and junior faculty.

University Affiliates

Boston University – Aram V. Chobanian, Interim President
Brandeis University – Jehuda Reinharz, President
Brown University – Ruth J. Simmons, President
Columbia University – Lee Bollinger, President
Cornell University – Jeffrey Sean Lehman, President
Dartmouth College – James Wright, President
Duke University – Richard H. Brodhead, President
Emory University – James W. Wagner, President
George Washington University – Stephen J. Trachtenberg, President
Harvard University – Lawrence H. Summers, President
Indiana University – Adam W. Herbert, President
Johns Hopkins University – William R. Brody, President
Massachusetts Institute of Technology – Susan Hockfield, President
Michigan State University – Lou Anna Kimsey Simon, President
New York University – John Sexton, President
Northwestern University – Henry Bienen, President
Ohio State University – Karen Holbrook, President
Pennsylvania State University – Graham Spanier, President
Princeton University – Shirley Tilghman, President
Rice University – David W. Leebron, President
Smith College – Carol T. Christ, President
Stanford University – John L. Hennessy, President
Tufts University – Lawrence S. Bacow, President
University of California, Berkeley – Robert J. Birgeneau, Chancellor
University of California, Davis – Larry N. Vanderhoef, Chancellor
University of California, Irvine – Ralph J. Cicerone, Chancellor
University of California, Los Angeles – Albert Carnesale, Chancellor
University of Chicago – Don Michael Randel, President
University of Illinois at Urbana-Champaign – Richard Herman, Interim Chancellor
University of Iowa – David J. Skorton, President
University of Maryland – C.D. Mote, Jr., President
University of Michigan – Mary Sue Coleman, President
University of Minnesota – Robert Bruininks, President
University of North Carolina, Chapel Hill – James Moeser, Chancellor
University of Notre Dame – Rev. Edward A. Malloy, President
University of Pennsylvania – Amy Gutmann, President
University of Pittsburgh – Mark A. Nordenberg, Chancellor
University of Southern California – Steven B. Sample, President
University of Texas, Austin – Larry R. Faulkner, President
University of Virginia – John T. Casteen, III, President
University of Wisconsin, Madison – John D. Wiley, Chancellor
Virginia Polytechnic Institute and State University – Charles W. Steger, President

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The Predicament of American Health Care

Harvey Fineberg

This presentation was given at the 1883rd Stated Meeting, held at the Seattle Art Museum on October 30, 2004.

Harvey Fineberg is President of the Institute of Medicine. He has been a Fellow of the American Academy since 1994.

The predicament of American health care today is a concern for virtually every citizen in this country. When we think about American health care, as a matter of perspective, it may be useful to remember where we've come from. At the beginning of the twentieth century, life expectancy at birth in the United States was only about forty-eight years. Infant mortality (deaths among newborns before the age of one) was greater than one hundred per one thousand live births. From 1900 to the year 2000, life expectancy increased by more than 50 percent (greater than seventy-five years), and infant mortality in the United States declined by an order of magnitude, to less than ten. Heart disease, which is the major killer, has actually diminished by half in its age-specific mortality since the 1950s. As a cause of death, stroke similarly decreased by more than 50 percent in that period of time. If you think about the broad sweep of progress and the outcomes of health in the United States over the twentieth century, it is historically unprecedented, dramatic, and stunning. Never before in human history had anything like that improvement in population health been achieved.

Thinking about our current health-care system, how many of you would say that you are very satisfied or somewhat satisfied with the health-care system of the United States? It looks like about 20 percent. How many would say that you're somewhat unsatisfied or very unsatisfied with the health-care system of the United States? That looks like about 80 percent. Now, particularly for those of you who are unsatisfied, what is it about our health system that makes you unsatisfied? What things stand out as something you'd say is a problem with our health care today? The lack of health insurance for all Americans, the high cost of services that are sometimes of poor quality, disparities in care, and lack of emphasis on preventive medicine are key components of the predicament of health care in America today.

In 2003, there were 46.5 million Americans without health insurance, and the number is increasing. This figure, keep in mind, is not a reflection of the number of people who in the course of a year may go without health insurance; it reflects the number who lack health insurance for the *entire* year. If we take into account the number of people who at any one time do not have health insurance because of changing jobs, or graduating from school, and so on, that number would about double.

People today are rightly concerned about the rising cost of health care and of prescription drugs. Right now in the United States we're spending more than a trillion and a half dollars a year for health care. We in the United States spend more money on health care than the poorest half of the world spends for everything. Right now, about one in every seven dollars in the economy goes to health care, and it seems like there's no end in sight. So we have a big problem with cost.

But why is cost a problem? Why do we care about the cost of health care relative to what people spend for travel or binoculars? So what if we spend a trillion and a half dollars a year on keeping well. Recently, we had a very interesting debate about the cost of health care at the annual meeting of the Institute of Medicine. One argument put forward was that cost *per se* is not a problem; another was

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that cost is a real and growing problem. What is it about the expenditures that is causing so much concern? Part of the problem of cost is affordability. But you could argue that distribution of cost is mainly an exchange problem, a task of moving resources to where they are needed. One concern about costs is that consumers don't really have a choice. If you have a serious illness, you go to the hospital, whether you like it or not, or else you may die. Collectively we are demanding care that is technologically more sophisticated and that from the provider's point of view is increasingly complex and costly to provide.

One concern is the expectation and pressure to keep people alive at all costs. The problem of the end stage of disease, its cost and human burden, raises profound questions of professional ethics and individual choice. From the vantage point of cost, approximately one quarter of the total Medicare expenditures are in the last year of life.

Interestingly, malpractice probably does *not* play a big part in increasing health-care costs, although it is a significant burden on doctors and contributes to declining professional morale and loss of practitioners, particularly in selected geographic and specialty areas. Malpractice deserves notice as a problem, but not as a cost driver.

Compared to other economically developed countries, the United States spends much more on health care. For example, compared to Germany and Switzerland, we spend 50 percent more per capita in dollar equivalent purchasing power. We spend twice as much per capita as Sweden and more than twice as much per capita as the United Kingdom. The question then is what are these expenditures buying us? What's our life expectancy compared to other countries in the world? Answer: not in the top ten. What's our infant mortality compared to other countries in the world? Answer: not in the top twenty. What are we doing in terms of quality of care as judged by people getting the care? In this audience, about 80 percent of the people said they're somewhat dissatisfied or very dissatisfied with our health-care system. In a number of other countries, including Canada and parts of western Europe, there's a lot of dissatisfaction, but it's not as high as in the United States. Interestingly, if you ask people the question a little bit differently, if you ask are you satisfied with your personal physician, a much higher proportion of Americans will say, yes.

Part of the cost driver is that what we expend when we go to buy health care is often not our own dollars. Those of us with insurance that offers first dollar coverage are spending the money of everyone who is part of our insurance group. The health-care market is far from an economically functional market with informed consumers, competition, and free choice. In a market that works, the person who makes the decision to buy, the person who receives the product and experiences the good or the bad, and the person who pays for that product is the same person. You decide, for example, that you're going to go to the market and buy some grapes; you pick out the bunch, you pay with your money, and you eat them. By contrast, in health care, it is often the professional who decides what you

Health care today in the United States is very costly, and relative to what many other countries seem to be buying for their expenditures, we seem to be buying less for ours.

do most of the time. It is the doctor who decides on the treatment and orders the tests. It is the insurer who pays. It is you the patient who gets whatever degree of satisfaction from the experience. But you have less than full control over the basic decisions that produced those results.

Health care today in the United States is very costly, and relative to what many other countries seem to be buying for their expenditures, we seem to be buying less for ours. On average, we don't have the quality of care and the outcomes that we should. At its best, U.S. health care compares favorably with any in the world, but on average, we have some serious deficiencies.

Five years ago, the Institute of Medicine published its landmark report on errors in health care: *To Err Is Human*. The report estimated that every year in the United States tens of thousands of people die in hospitals because of medical errors. Other studies examining the problem also found shortcomings in quality. For example, in 2003, a report published in the *New England Journal of Medicine*, by Beth McGlynn and her colleagues at the RAND Corporation, looked at the care received by thousands of people in thirty different communities around the country. They considered a number of specific medical conditions where there are specific guidelines about how patients should be treated. These include testing for diabetes, measurement and control of high blood pressure, and treatment of people with heart attacks, among others. The general conclusion across the board was if you are a patient in the United States today with one of these conditions and you go to your doctor in one of these communities, on average, you have about a fifty-fifty chance of getting the care that is indicated for your condition. Overall, 46 percent of the people in that study did not receive the recommended standard of care.

In some cases, failure to meet the standards of care can mean the difference between life and death. For example, it is well established that most persons who have myocardial infarctions should be treated with a kind of agent called a beta-blocker, which slows the nerve impulses and reduces the work burden on the heart. Clinical studies have demonstrated repeatedly that this is a life-saving intervention. The McGlynn study found that

The United States has a triple problem: we are spending a lot of money, our quality is substandard, and we have 46.5 million people without health insurance.

beta-blockers were prescribed for fewer than 60 percent of people recovering from a heart attack. I have a theory about why beta-blockers are underprescribed: they are simply too cheap; they cost pennies per dose, and nobody has a reason to promote them. If they were the "purple pill," I can assure you that we would be demanding beta-blockers. But it is up to the doctor to prescribe them, and physicians are not doing it often enough. The situation is similar for diabetes: people have about a fifty-fifty chance of receiving basic tests indicated for the care of persons with diabetes.

The United States has a triple problem: we are spending a lot of money, our quality is substandard, and we have 46.5 million people without health insurance. That number of uninsured has a cost impact on the health-care system because those people do not stay completely out of the system. They delay care, but when they get seriously ill, the cost of caring for them is higher than if they had received preventive or earlier therapeutic care.

Another dimension of the quality problem is to improve training at every level in the medical profession. We are not doing a good job in sufficiently educating for quality, which has a number of dimensions beyond the mastery of a current body of knowledge. It requires educating people who have a lifetime capacity for learning.

We also need to place more emphasis on training across the professions because the treatment of people with chronic diseases often requires a team. Caregivers must be able to respond to the needs of patients with chronic illnesses – 100 million plus people in the United States, with the number increasing as the population ages.

On a positive note, there is a very encouraging degree of experimentation now going on in medical education, particularly in terms of improving the clinical elements of training. The difficulties here are in part the changes in the nature of practice, as patients on average spend much less time in the hospital than they ever did before. Hospital-based training, then, is not the sufficient model that it previously was for clinical education. And there is a lot of room for improvement. As part of what we call the "quality chasm series" in the Institute of Medicine, we are working on a whole array of related elements of quality improvement, and education is a big part of it. A year ago we brought together leaders from different professional schools (pharmacy, nursing, social service, and medicine) for a summit meeting on education for quality.

Many other countries face shortfalls in quality of care, as measured against the kinds of standards that I have been discussing. In Australia, for example, a study that replicated an assessment in U.S. hospitals found similar levels of error and similar problems. The United Kingdom is also dealing with the challenge of reducing errors and improving quality. Its National Health Service has made a commitment to put an automated record system into every general practitioner's office within the next two years. General practitioners will be linked to a database system for their patients and their prescriptions, with automatic checks of the side effects and the incompatibilities of different medications that a patient is taking. In the United States, incorrect medication is still the most frequent source of error, though individual hospitals and care groups have model systems in place.

Some countries are working more aggressively than we are at the present time in acknowledging the problems of health-care quality and taking steps to solve the problems. The current administration has championed automating health-care records. The questions are what is the best mechanism and what resources are needed to accomplish this.

The mix of uninsured patients, high cost, quality that's less than our patients deserve, disparities in care, and underinvestment in prevention represents the ingredients of the American dilemma in health care. Looking at the three at the top – insurance, cost, and quality – you cannot solve one without solving them all. We need a comprehensive approach that looks at all three together. There is an ambivalence in this country about whether health is a social good or a market good, and from that philosophical difference follows many other distinctions. We need leadership with a political will and skill to bridge those philosophies, to find common ground for solutions. From the Right we need acceptance that the idea of universal coverage is necessary and required as a society. From the Left, we need a recognition that there are individual responsibility and income-related burdens of care that will affect decisions about utilization.

The health predicament in America will not be resolved quickly or easily. However, unless we commit as a nation to making progress on its several dimensions, we will never work our way out of the predicament. ■

Western Meeting–Seattle

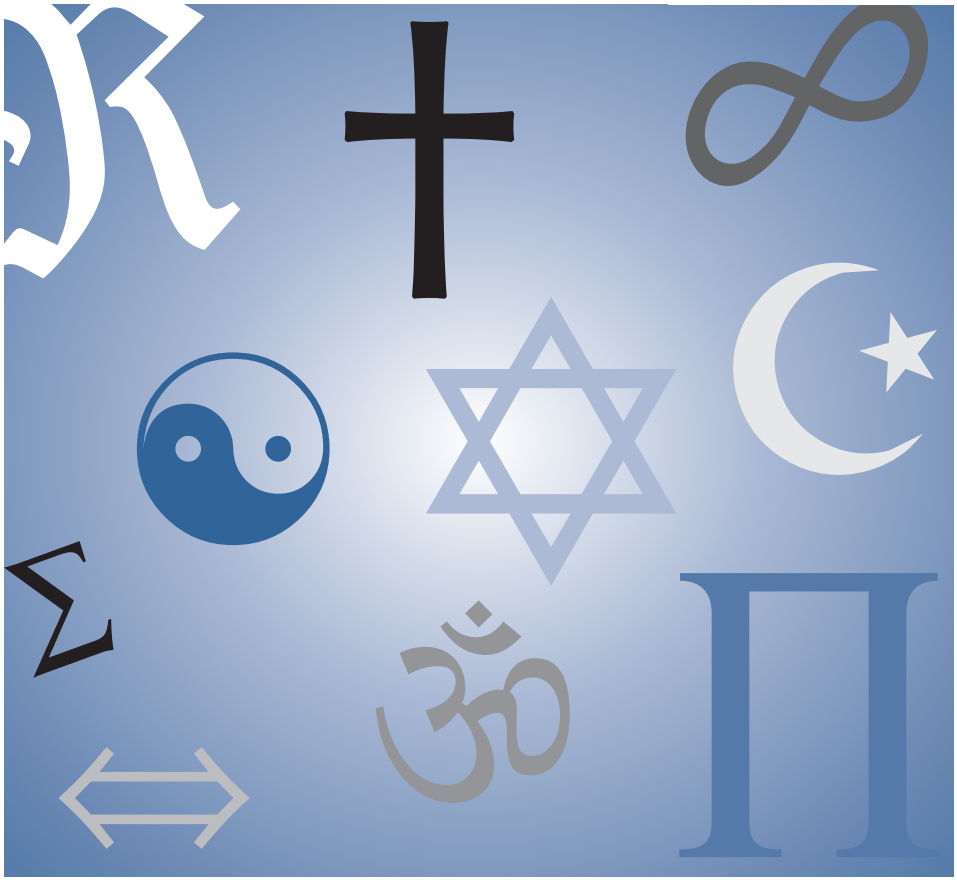
Harvey Fineberg speaking on American health care.

Daniel J. Evans and Robert H. Waterston (both, University of Washington)

Patricia Gill, Gordon N. Gill, co-chair of the Western Center (University of California, San Diego), and John R. Hogness, former Vice President of the Western Center (University of Washington), who was honored for his service to the Academy and for his long and distinguished career in medicine and higher education.

Academy President Patricia Meyer Spacks (University of Virginia) and William H. Gates, Sr. (Bill and Melinda Gates Foundation)

Gerald J. Wasserburg (California Institute of Technology), Edward A. Feigenbaum (Stanford University), and Eugene Wong (University of California, Berkeley)



Russian Religious Mystics and French Rationalists: Mathematics, 1900–1930

Loren Graham and Jean-Michel Kantor

This presentation was given at the 1884th Stated Meeting, held at the House of the Academy on November 10, 2004.

Loren Graham is Professor of the History of Science in the Program in Science, Technology, and Society at the Massachusetts Institute of Technology. He has been a Fellow of the American Academy since 1981.

Jean-Michel Kantor is a mathematician at the Institut Mathématiques de Jussieu, Université Paris.

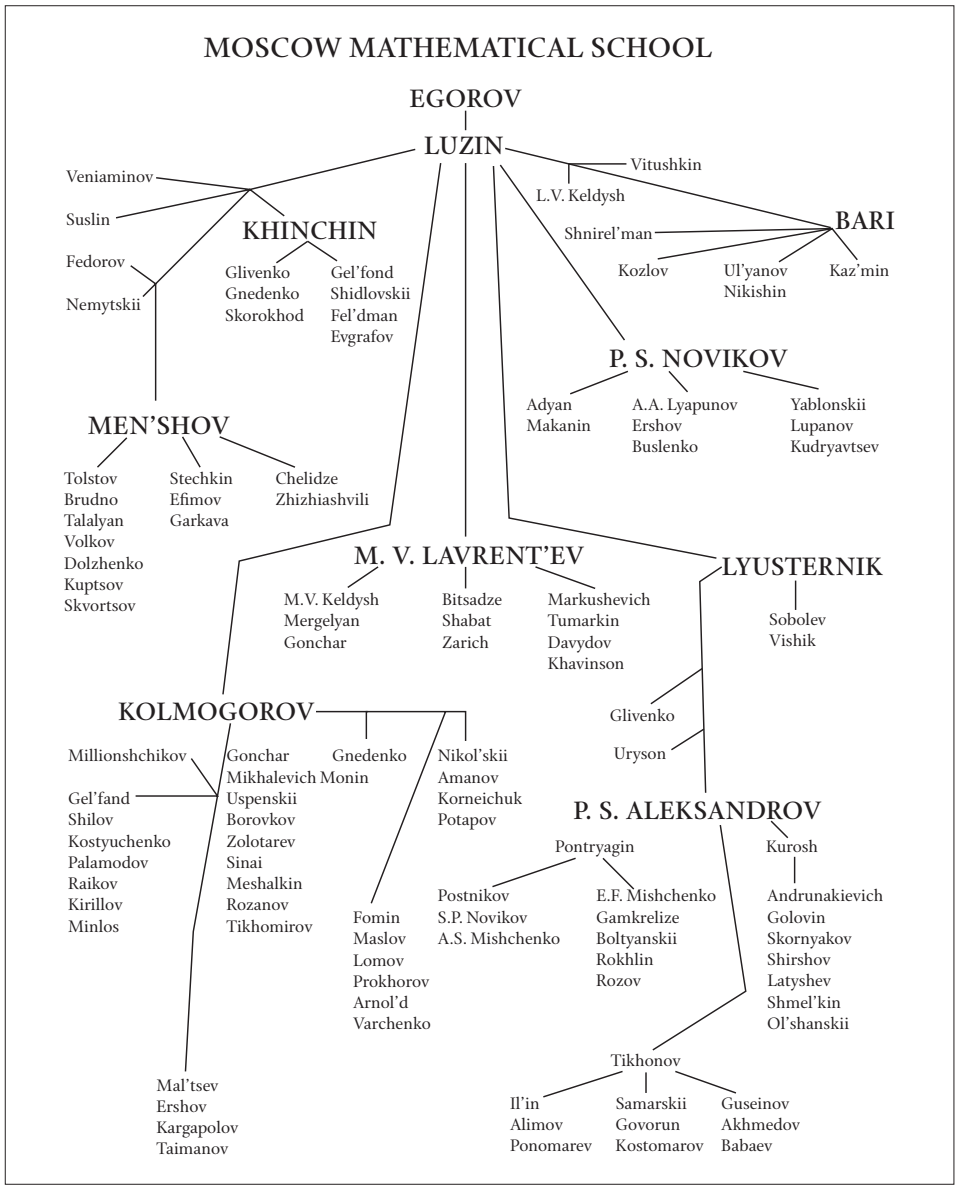
Loren Graham

If someone were to ask me what I think was the greatest intellectual contribution that Russians made in the twentieth century, I would answer, without much hesitation, mathematics and fields closely connected with it, such as theoretical physics. The Moscow School of Mathematics was one of the most influential movements in twentieth-century mathematics. In particular, the study of functions and the descriptive theory of sets (the application to real numbers of set theory), initiated by Dmitrii Egorov, Nikolai Luzin, and their students in the first decades of the twentieth century, has had a worldwide impact.

If you go today to the mathematics department of Moscow University, where this movement began, you might see on a bulletin board, as I have seen, a genealogical chart depicting the founders of this impressive mathematical movement and their succeeding generations of students. Mathematicians or those familiar with the world of mathematics would recognize the names of some of the most influential mathematicians of the last century: for example, Andrei Kolmogorov, perhaps the greatest probabilist of the twentieth century; Sergei Novikov; Vladimir Arnol'd; Lev Pontriagin; Pavel Aleksandrov; and Mstislav Keldysh, one-time president of the Soviet Academy of Sciences and the theoretician of the Soviet space program.

At the top of the genealogical tree are Egorov and Luzin. Who were these men? Where did they come from? What motivated them? How did they differ from other leading mathematicians, especially the French who were at the time considered pioneers in the same fields? My colleague from Paris, Jean-Michel Kantor, and I have been investigating these questions, and we have come to a conclusion that surprises us and runs counter to our own secular predispositions: at the heart of the birth of the Moscow School of Mathematics was a mystical religious impulse. This mystical doctrine was defined by the established Russian Orthodox Church as a heresy and hence condemned. Yet the heresy, known as Name Worshipping (*imiaslavie*), never died and it even has a small life in Russia today; indeed, it has gained some strength in recent years. Several outstanding mathematicians are involved with it at present, but their interest in it remains hidden, as it always has been.

During the last two years, I have been in Moscow a number of times, and I have visited with Russian scholars who are familiar with the Name Worshipping movement. One of them was a mathematician – a rather well known one whom I prefer not to name in order to preserve his privacy. I knew that he was philosophically and religiously interested in Name Worshipping, and so I asked if it would be possible to witness Name Worshippers practicing their faith. His answer was no: "Name Worshipping is an intimate practice that is best done alone." I asked if there was any place where Name Worshippers particularly liked to worship. He replied that Name Worshipping cannot be done openly in established churches or cathedrals because the official church disapproves of the practice. He added, however, that there was one place particularly sacred to Name Worshippers: the basement of the Church of Saint Tatiana the Martyr in Moscow. I knew where this church was. Before the Russian Revolution it was the official church of Moscow University, and now that the Soviet Union has disappeared, it has become so again. For many years the mathematics department of the university was located next to it. During the Soviet years it was converted into a sort of student club, and one time in the early 1960s I went to a dance there with my young wife,



Patricia. We did not know at the time that we were dancing in what had once been a church, nor did we have any idea that this place would become important to my research.

I asked the Moscow mathematician how I would know when I had reached the spot sacred to Name Worshippers. He told me that I would know when I got there. I went there this past July and wandered around, searching the whitewashed walls of the basement. Then I found a peculiar corner, and I knew immediately I was in the right place. On the walls were two photographs of the two men who were instrumental in establishing Name Worshipping among mathematicians, namely, Dmitrii Egorov and Pavel Florenskii.

Dmitrii Egorov (1869 – 1931) and Nikolai Luzin (1883 – 1950) founded the Moscow School of Mathematics. They had close connections with French and German mathematicians. Egorov spent the year of 1902 in Paris, Berlin, and Göttingen and talked with, among others, the mathematicians Henri Lebesgue, Henri Poincaré, Jacques Hadamard, and Kurt Hensel. Luzin first went to western Europe in 1905, later visited France and Germany a number of times, and had frequent contacts with mathematicians there.

In the first years of the twentieth century, Luzin studied mathematics in Moscow University under Egorov and as a fellow student with Pavel Florenskii (1882 – 1937), who were influential in forming the ideas of the Moscow School. In their mature and professionally active years, all three men – Florenskii, Egorov, and Luzin – were deeply religious. Florenskii, disappointing his teachers, abandoned mathematics for religious studies and became a priest. Egorov and Luzin went on to become outstanding mathematicians who helped create an explosion of mathematical research in Moscow in the 1920s and early 1930s. Florenskii and Egorov would eventually be arrested by the Communist authorities, accused of mixing mathematics and religion. They subsequently died in prison. (Parenthetically I would observe that it is one of the cruel ironies of history that the Communists' charge that Florenskii and Egorov mixed mathematics and religion was correct; although contrary to the assumption of the Communists, the mixture was amazingly fruitful to the field of mathematics.) Luzin narrowly escaped imprisonment, even though he was put on "trial" for ideological deviations and severely reprimanded. Florenskii is credited with developing a new ideology of mathematics and religion that played a role in the pioneering mathematics work of Egorov, Luzin, and their students.

Florenskii was one year older than Luzin and entered Moscow University in 1900; Luzin followed him in 1901. Both studied with Egorov, who was a young professor of mathematics. Luzin at that time was not the religious believer that he later became. By his own admission he was a "materialist," like many other young Russian intellectuals, and he knew very little about philosophy or politics.

From 1905 to 1908 Luzin underwent a psychological crisis so severe that several times he contemplated suicide. One precipitating event in Russia was the unsuccessful revolution of 1905, a moment that sobered many left-wing members of the intelligentsia who had talked romantically of their hopes for a revolution without comprehending the blood and violence that revolutions often bring. Shocked by the suffering, a number of intellectuals, in both the natural and social sciences, began to rethink their positions.

Luzin possessed a tender, somewhat naive personality, and he was not prepared for the pain he saw around him during and immediately after the revolutionary events. In an effort to relieve his spiritual crisis, his teacher Egorov sent him abroad in December 1905, but the trip did not solve Luzin's spiritual and intellectual problems. Not only did Luzin's materialist worldview collapse, but his faith in science and mathematics did as well. He was totally without a purpose in life. In despair on May 1, 1906, he wrote Florenskii from Paris:

> You found me a mere child at the University, knowing nothing. I don't know how it happened, but I cannot be satisfied any more with the analytic functions and Taylor series. . . . To see the misery of people, to see the torment of life . . . this is an unbearable sight. . . . I cannot live by science

alone. . . . I have nothing, no worldview, and no education. I am absolutely ignorant of the philological sciences, history, philosophy.

In a long correspondence and in numerous meetings at Sergeev Posad, Zagorsk, a monastery town outside Moscow, Florenskii, already a devout believer, supplied Luzin with a new worldview. It combined both religion and mathematics and, as we will see, gave the desperate Luzin reason to believe that he could renew his mathematical research while at the same time serving moral and religious purposes.

If someone were to ask me what I think was the greatest intellectual contribution that Russians made in the twentieth century, I would answer, without much hesitation, mathematics.

Many of the ideas Luzin found stimulating and reassuring were presented in an essay Florenskii wrote in 1903, when he was only twenty-one years old and still a mathematics student at Moscow University. In this essay, entitled "The Idea of Discontinuity as an Element of World View," Florenskii displayed a characteristic that was very common among members of the Russian intelligentsia of his time: the belief that all intellectual life forms a connected whole and that therefore ideas in mathematics and philosophy could be extended to the social and moral realms, and vice versa.

Florenskii thought that much of the nineteenth century had been a disaster from the standpoint of philosophy, religion, and ethics and that the particular type of mathematics that reigned during that century was one of the important causes of this misfortune. The governing mathematical principle of the nineteenth century, which Florenskii saw as responsible for ethical decline, was deterministic "continuity": the belief that all phenomena pass from one state to another smoothly. In substitution of this "false" principle of continuity, Florenskii proposed its opposite, discontinuity, which he saw as morally and religiously superior. The nineteenth century was, according to him, the unfortunate apogee in faith in deterministic continuity; indeed, he wrote that in the nineteenth century "the cementing idea of continuity brought everything together in one gigantic monolith." The mathematical approach that created this monolith was infinitesimal analysis and differential calculus. This method became all-powerful because differential calculus was at the heart of the physical sciences through Newtonian mechanics. One of the results of its seeming omnipotence was that mathematicians concentrated only on continuous functions, since "continuous functions are differentiable" and therefore susceptible to analysis by the calculus.

Florenskii believed that, as a result, mathematicians and philosophers tended to ignore those problems that could not be analyzed by calculus, namely, the discontinuous phenomena. Seeing continuous functions in mathematics as "deterministic," Florenskii believed the expansion of the philosophy of determinism throughout psychology, sociology, and religion was the destructive result of a temporary emphasis in mathematics. Thus he held nineteenth-century mathematics responsible for the erosion of earlier beliefs in freedom of will, religious autonomy, and redemption.

Florenskii thought that the field that was "guilty" of the glaring overestimation of continuity – mathematics – was destined to lead thinkers out of the blind alley that it had created. In the 1880s the German mathematician Georg Cantor, the founder of set theory, had analyzed "continuum" as merely a set among possible other sets and had therefore deprived the concept of its metaphysical, dogmatic power. Now the road was open, maintained Florenskii, to restore discontinuity and indeterminism to their rightful place in one's worldview. He saw the power of discontinuity in recent developments in many fields outside mathematics, such as the theory of mutations in biology (delivering, according to Florenskii, biology from the "heartless" continuity of Darwinism), new ideas about molecular physics, and concepts of "subliminal consciousness" and "creativity" in psychology. Surveying these developments, Florenskii called for "the dawn of a new discontinuous worldview" and challenged his mathematician colleagues, such as Luzin and Egorov, to foster this new approach, one that would combine mathematics, religion, and philosophy.

In the years just before the Russian Revolution of 1917, the world of Russian Orthodoxy, the state religion, was shaken by a theological struggle that further influenced Florenskii, Luzin, and Egorov and their ideas about the relationship between mathematics and religion. A polemic developed between two groups of religious believers: the Worshippers of the Name, or Nominalists (*Imiaslavtsy*), and the Anti-Nominalists (*Imiabortsy*). The dispute was rooted in an ancient question about how humans can worship an unknowable deity. If God is in principle beyond the comprehension of mortals (and holy scripture contains many such assertions), how, in complete ignorance of his nature, can human beings worship him? What does one worship? The most common response given to this dilemma throughout religious history was the resort to symbols: icons, names, rituals, music, relics, scents, tastes, art, architecture, literature. Symbolism is the term given to a perceptible object or activity that represents to the mind the semblance of something that is not shown but realized by association with it.

Mathematical objects cannot be shown so both religion and mathematics make heavy – but different – use of symbols. Mathematics uses such symbols as:

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Religion uses a great variety of symbols, such as the Star of David and the cross, as well as icons, prayers, chants, and hymns.

But some questions naturally arise: What reality, if any, lies behind the symbol? What does a religious icon or a mathematical symbol really represent? Does the symbol acquire any sort of autonomy?

The issue of religious symbols took on an unusual sharpness in Russia in the years 1908 – 1930, the same years in which the Moscow School of Mathematics was created. Priests and mathematicians were involved in both the religious and the mathematical discussions. In 1907 a monk of the Orthodox Church, Ilarion, who had earlier spent years in a Russian monastery in Mount Athos in Greece, published a book, *In the Mountains of the Caucasus*, that seized on an existing

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tradition in Orthodox liturgy, especially the chanting of the Jesus Prayer (*Iisusova molitva*), and raised it to a new prominence. In the Jesus Prayer, the religious believer chants the names of Christ and God over and over again, hundreds of times, until his whole body reaches a state of religious ecstasy in which even the beating of his heart, in addition to his breathing cycle, is supposedly in tune with the chanted words "Christ" and "God." (A state vividly described by J. D. Salinger in *Franny and Zooey*.) According to Ilarion, the worshipper achieves a state of unity with God through the rhythmic pronouncing of his name. This demonstrates, said Ilarion, that the name of God is holy in itself, that the name of God is God (*Imia Bozhie est' sam Bog*).

At first this book was well received by many Russians interested in religious thought. Ilarion's views became very popular among the hundreds of Russian monks in Mount Athos, who gradually spread the views elsewhere. But the highest officials in Russian Orthodoxy, in Saint Petersburg and Moscow, soon began to consider the book not just as a description of the reality of prayer but as a theological assertion. For many of them, the adherents of Ilarion's beliefs were heretics, even pagan pantheists, because they allegedly confused the symbols of God with God himself. On May 18, 1913, the Holy Synod in Saint Petersburg condemned the Name Worshippers; soon thereafter the Russian Navy, with the approval of Tsar Nikolai II, sent several ships (the Donets and the Kherson) to Mount Athos to bring the rebellious monks forcibly to heel. Over six hundred unrepentant monks were flushed out of the monastic cells with fire hoses, arrested, and brought under guard to Odessa. In later detentions, the number grew to approximately one thousand. The dissidents strongly protested their treatment and obtained promises of further investigation and reconsideration.

With the advent of World War I, the issue receded into the background, but until the end of the tsarist regime, the adherents of the "heresy" were forbidden to return to Mount Athos or to reside in major cities like Saint Petersburg and Moscow. The most fervent of them retreated to monasteries, where they continued to practice their variant of the faith. After the Bolshevik Revolution in October and November of 1917, the Name Worshippers, now living all over rural Russia, were more successful than most other religious believers in continuing their practices out of view of Soviet political authorities, who were trying to suppress religion. After all, the Name Worshippers had already been defined as heretics and excluded from the established churches. But in secret they continued their faith, and as a result they were not compromised by association with the Bolsheviks, as some of the established church leaders soon became. The dissidents claimed to be representatives of the undefiled "true faith," increasing their popularity with some religious opponents of the new Communist regime.

In the 1920s the German writer and journalist Rene Fulop-Muller spent much time in Russia and in his remarkable book *The Mind and Face of Bolshevism*, he wrote that Name Worshipping was "a movement to which a great part of the intelligentsia as well as a considerable part of the peasantry belong. The best men of Russia lead this school, which proclaims the magic power of the divine name."

After the Bolshevik Revolution, Florenskii lived in Sergeev Posad, Zagorsk, and he was close religiously and intellectually to the Name Worshipper dissidents. He communicated their ideas to Luzin and Egorov, his mathematician colleagues, and he translated these religious concepts into mathematical parlance. In the early 1920s, there was a Name Worshipper Circle (*imeslavcheskii kruzhok*) in Moscow where the ideas of the religious dissidents and the concepts of mathematics were brought together. Florenskii and the philosopher A. F. Losev attended meetings of the circle, which included fifteen or sixteen philosophers, mathematicians, and religious thinkers. Sometimes the circle met at Egorov's apartment and Florenskii gave papers at the meetings. At these meetings, Florenskii maintained that "the point where divine and human energy meet is 'the symbol,' which is greater than itself." To Florenskii, religious and mathematical symbols could attain full autonomy.

Florenskii saw that the Name Worshippers had raised the issue of "naming" to a new prominence. To name something was to give birth to a new entity. God said in Genesis, "Let there be Light, and there was Light." He named it first, and then He created it. Names are words. In the Gospel according to Saint John, the statement occurs, "In the beginning was the Word, and the Word was with God, and the Word was God." Florenskii believed that mathematicians who created new entities like sets by naming them came as close as humans are permitted to approaching the divine.

Contrary to the Marxists who connected science and mathematics to the material world, Florenskii was convinced that mathematics was a product of the free creativity of human beings and that it had a religious significance.

When a mathematician created a set by naming it, he was giving birth to a new mathematical being. The naming of sets was a mathematical act, just as the naming of God was a religious one, according to the Name Worshippers.

The famous sentence of Georg Cantor, "The essence of mathematics lies precisely in its freedom," clearly had a strong appeal to Florenskii. In mathematics, more than in the threatening Soviet world he was facing, men like Florenskii could exercise their free will and create beings (sets) by just naming them. For example, defining the set of numbers such that their squares are less than 2, and naming it "A," and analogously the set of numbers such that their squares are larger than 2, and naming it "B," immediately brought into existence the real number $\sqrt{2}$ (essentially the Cauchy construction).

The development of set theory was to Florenskii a brilliant example of how renaming and reclassifying can lead to mathematical breakthroughs. A "set" was simply a renaming of

The answer for Florenskii and later for Egorov and Luzin was that the act of naming in itself gave the object existence. Thus naming became the key to both religion and mathematics.

entities according to an arbitrary mental system, not a recognition of the types of real material objects. When a mathematician created a set by naming it, he was giving birth to a new mathematical being. The naming of sets *was* a mathematical act, just as the naming of God *was* a religious one, according to the Name Worshippers. A new form of mathematics was coming, said Florenskii, and it would rescue mankind from the materialistic, deterministic modes of analysis so common in the nineteenth century. Indeed, set theory and new insights on continuous and discontinuous phenomena became hallmarks of the Moscow School of Mathematics.

Leading mathematicians everywhere at this time were wrestling with the problem of what is allowed in mathematics and what is to be considered a good definition of a mathematical object. As the French mathematician Lebesgue wrote to his colleague Emile Borel in 1905, "Is it possible to prove the existence of a mathematical object without defining it?" To Florenskii the question was the analogue of, "Is it possible to prove the existence of God without defining him?" The answer for Florenskii and later for Egorov and Luzin was that the act of naming in itself gave the object existence. Thus naming became the key to both religion and mathematics. The Name Worshippers gave existence to God by naming him and worshipping him, and mathematicians gave existence to sets by naming them and working with them. The Russian mathematicians asked, for example, "How can we know that there are numbers greater than infinity – transfinite numbers – if infinity is defined as the largest possible number? We know because we can name them – we call them 'aleph numbers' – and we work with them."

The idea that naming is an act of creation goes back very far in religious and mythological thought. The claim has been made that the Egyptian god Ptah created with his tongue that which he conceived. In the Jewish mystical tradition of the Kabbala (Book of Creation, Zohar), there is a belief in creation through emanation, and the name of God is considered holy.

The connection between the religious dissidents in Russia and the new trends in Moscow mathematics went beyond the suggestions and implications so far discussed. There was a direct linguistic connection. The Moscow mathematicians Luzin and Egorov were in close communication with French mathematicians with similar concerns. Lebesgue introduced in 1905 the concept of "effective sets," and he spoke of "naming a set" (*nommer un ensemble*); such a set was then often called a "named set" (*ensemble nommé*). The Russian equivalent was *imennoe mnozhestvo*. Thus the root word *imia* (name) occurred in the Russian language in both the mathematical terms for the new types of sets and the religious trend of *imiaslavie* (Name Worshipping). Indeed, much of Luzin's work on set theory involved the study of effective sets (named sets). To Florenskii this meant that both religion and mathematics were moving in the same direction.

Jean-Michel Kantor

The French mathematicians were not ready for the new mathematics that occurred with the birth of set theory. They were rather skeptical of this "German metaphysics" founded by Georg Cantor. If we want to give an overview of French reaction at this time, in order to compare their attitude with that of the Russians, we need to comprehend a very different cultural context. The French cultural milieu is strongly marked (through centralized education, for example) by at least three different influences.

First, there is the old cultural tradition of Cartesianism: *Le primat de la raison*. *Penser* (to think), this is the main activity in science. The main activity of thought is *la raison* (reason). One can think about mathematics (*penser les mathématiques*); it is not purely formal logic, as Bertrand Russell would say later. If I can think about a mathematical notion, then it exists; conversely, if I cannot think of it, it surely does not exist.

This is a very important concept for Lebesgue and Borel, who could not think of nondenumerable infinities and so denied their existence (after a short period of juvenile enthusiasm by Borel). It accounts for their reservation about the Russian approach (see, for example, Lebesgue's description of Luzin's "philosophical" mind in the preface of his 1930s book). Also important is the tradition of the Cartesian method as described by René Descartes: If you have a problem, just cut it into parts as long as you can and you'll solve the problem.

A second strong influence is Auguste Comte's positivism. Science cannot reach the primal causes (*les causes premières*) but can, after liberating itself from all metaphysical influence and any theological tendency, reach a perfect form of discourse. Comte's philosophy builds a wall between the metaphysical and the scientific order of things. Once science enters the "positive stage," its goal is no longer a metaphysical quest for truth nor a rational theory purporting to represent reality. Science is composed of laws, not theories. Laws are correlations of observable facts that we need in order to predict. Mathematics, through the theory of functions (an old French tradition going back to Joseph-Louis Lagrange and Charles Fourier), is suitable for the analysis of natural phenomena via the laws of physics expressed since Isaac Newton by differential equations.

A third, more subtle, factor is Blaise Pascal's *esprit de géométrie*. I remind you that geometry for Pascal is much broader than what we imagine today as geometry. The universal, unique, human truth comes from geometry through *la lumière naturelle*, a very religious approach in Pascal, but also very deeply involved in philosophy, without being ever able to reach the deepest of things. Geometry's real content allows one to distinguish between nominal and real definitions (*la définition de noms et la définition de choses*).

Georg Cantor (1845 – 1918) created set theory around 1870. It started with a revolutionary definition of infinities, the first new step since Aristotle (384 – 322 B.C.) distinguished between potential and actual infinities in his *Physics*, denying that the actual infinite exists and allowing only the potential infinite. Cantor gave it a name; he called it the first infinite "aleph-zero," the denumerable, the number so to say of all integral numbers: 0, 1, 2 . . . . Galileo had already noticed that there are just as many integers as there are even integers: that is, there are just as many 1, 2, 3, 4, 5, as there are 2, 4, 6, 8. Cantor turned this apparent contradiction into a definition of what is an "infinite" set. He defined many more infinite numbers. It is interesting to notice at this point that the creation of these alephs was very close in Cantor's mind to the crea-

tion of irrational numbers starting from rational numbers, which allows a precise mathematical definition of what we call today the continuum – the continuum of space or of lines. Applying his new theory to the continuum – the real line, the set of all real numbers – was the next revolutionary step. Was this allowed? How the continuum could be made out of points, like matter from atoms, was an issue at the time.

German mathematician Paul Du Bois-Reymond (1831 – 1889) had already rejected a part of the new set theory. He accepted "actual infinite" but rejected the philosophy of the continuum (points on the line or points of our space) as presented by Cantor. For Cantor the continuum was a reduction of continuous quantities to discrete entities; for Du Bois-Reymond the continuum had a mystical nature outside of mathematical knowledge. This direction of thought would be developed further by Herman Weyl (1885 – 1955) and Jan Brouwer (1881 – 1966), leading to an important current in mathematical thought called intuitionism.

For Cantor the continuum was a reduction of continuous quantities to discrete entities; for Du Bois-Reymond the continuum had a mystical nature outside of mathematical knowledge.

A natural question to ask was, is there another infinite between aleph-zero and the power of the continuum? This is the famous Continuum Hypothesis, stated as the first problem in the famous list of problems given by David Hilbert (1862 – 1943) at the Paris International Congress of Mathematicians in 1900 under the title "*Problème de M. Cantor relatif à la puissance du continu*."

Since 1878, the main purpose of Cantor's research had been to prove the Continuum Hypothesis, which led (through important results in analysis) to the birth of descriptive set theory. His strategy was to invent and construct more and more complicated subsets of the continuum. For example, he invented the "Cantor ternary set," which he defined in an endnote to Grundlagen in 1883: It is the limit of the sets obtained by taking one out from one-third intervals at each step. It is equal to its set of accumulation points, not isolated points; it does not contain any interval; and it has "the power of the continuum" (number of elements).

On September 26, 1904, Ernst Zermelo (1871 – 1953) wrote to Hilbert, telling him that he had developed a proof that in any set there is a way to put all elements in a good order (*Beweis, dass jede Menge wohlgeordnet worden kann*): that is, an order with essentially the same properties as the order of positive integers. In the proof, he used a fact that would later be called the Axiom of Choice: for any family of nonempty sets, there exists a way to associate one particular element to each of these sets. Of course, one may ask what is meant by "associate" and "particular element." After Zermelo's declaration, the fight began!

The debate was especially strong in France, where most of the important young mathematicians exchanged strong-worded letters. The five letters that Baire, Borel, Lebesgue, and Hadamard exchanged in 1905 describe the point of view of the most active young mathematics leaders with respect to the new set theory.

The men who faced the new mathematics were very different in character as well as in social personalities. Henri Poincaré (1854 – 1912) was the master of French mathematics, the last universal mathematician, and a philosopher of mathematics. René Baire (1874 – 1932) came from a very poor family in the region of Beauvais. He had a strict, serious life. He taught in colleges for most of his career and suffered from psychosomatic diseases, with his life ending very sadly. Emile Borel's (1871 – 1956) life is a typical success story of the French intellectual elite of the Third Republic. He was a brilliant, successful mathematician, a journalist, and an active participant in the Parisian scene. At the same time, Borel had strong country roots: his father was a protestant priest in the southwest (Rouergue).

For Borel, numbers had a reality almost like flesh. He required that mathematics provide Cartesian evidence that was as close to the sensual as to the rational. This is why he later abandoned mathematics when he realized that set theory was taking a path too abstract for him.

Henri Lebesgue (1875 – 1941) was a passionate, pure spirit; more precisely, he was an aristocrat of geometry. Lebesgue and Borel had a long friendship based on mutual admiration. But Lebesgue looked for quarrels concerning intellectual priorities, and their friendship ended with a remarkable sad letter of farewell from Lebesgue: "I kept too much hidden friendship for you not to be sad about my current state of mind." Both Baire and Lebesgue have left their names in the domain called analysis; both had a strong obsession with rigor inherited from the school of Cauchy.

The issues mixed philosophy, linguistics, psychology, and mathematics and the results were too much to handle. How would one separate and use the Cartesian method?

Lebesgue, Baire, and Borel did not anticipate the events of 1900 and 1904 in Paris and then in Germany. The French mathematician Jacques Hadamard (1865 – 1963) accepted the new axiom, while Lebesgue, Baire, and Borel essentially opposed the consequences of the axiom. Borel later published articles and books about set theory and applications, trying to explain fifty years of varying opinions concerning set theory.

The axiom discussion centered on what could be done in mathematics, how mathematical beings could be defined in order to be accepted in the process of mathematics, and what was a good definition. Among the motivations for this attitude, I mention the Cartesian principle of separating the problems, the disciplines, and the absolute truth of mathematics. As Borel put it: "We are serious people; this at least is not philosophy; a disagreement can only be due to a misunderstanding." But what is allowed in mathematics? Here are a few sentences from Lebesgue about the Axiom of Choice: "If you have to choose in a set, you talk about objects as if they were in a bag, and you know nothing about them. You just know they have a certain property, which other elements in the bag don't have. So you cannot define any order about the elements."

This is the French approach to ontological issues. As Lebesgue put it, "What we say has only some meaning if precise laws are given, if we apply our reasonings to precise data."

We come close to meta-mathematics, and you meet the two opposite schools. These schools fight together, like the scholastics in the Middle Ages, and discuss what meaning to give to the word 'existence' in mathematics.

The discussion about the Axiom of Choice was lively for yet another reason. If the Axiom was accepted, many consequences would follow from it, even in the familiar realm of geometry (such as the Hausdorff paradox, which led, in 1924, to a surprising fact in geometry called the Banach-Tarski paradox).

As a result of this discussion, French mathematicians limited themselves, for example, to the first infinite (aleph-zero). Borel, in a typical Cartesian attitude, would not accept big infinities if he could not imagine them or think of them. Lebesgue called a set "*nommé*," and then later "*ensemble effectif*," where there would be no construction using the existence of a Zermelo correspondence.

The issues mixed philosophy, linguistics, psychology, and mathematics and the results were too much to handle. How would one separate and use the Cartesian method? Take, for example, Richard's paradox, which appeared in 1905. Richard was a young, provincial math teacher in Dijon who wrote an article in which he described, in a simple way, a number given by a seemingly paradoxical definition: For example, call *N* the smallest number that could not be described with less than thirty words in English. Now I just defined a number that has been defined by the sentence above. The definition defines it, although it cannot be defined!

This mixing of fields was frightening to the French. For example, in 1919, reporting on Lebesgue's work, Paul Appell (Borel's father-in-law and a very powerful mathematician) wrote, "We come close to metamathematics, and you meet the two opposite schools. These schools fight together, like the scholastics in the Middle Ages, and discuss what meaning to give to the word 'existence' in mathematics." Now the same word can be found with a big "E" and with very different tonality in Luzin's manuscripts, but not with the same connotations.

Incidentally, Luzin's manuscripts, copied by R. Cooke in 1979 and not yet completely analyzed, reveal dramatic efforts including psychological approaches to mathematical issues. I quote: "Everything seems to be a daydream, playing with symbols, which, however, yield great things." French mathematicians limited the direct search into the *gouffre du continu*, the black hole of the continuum. Other constructions, more down-to-earth, with numbers defined by decimal expansions, were proposed by Borel. For example, he was interested in a concrete definition of normal numbers in connection with probability and measure theory. But the French mathematicians still used set theory for the classification of functions, as in a remarkable text of Lebesgue's in 1905, where he defined a new class of function called "analytically representable."

The new field of mathematics that resulted from first the trials of the French school and then Luzin's work, which would be called descriptive set theory, can be assigned a precise birth day: the day Mikhail Suslin (1894 – 1919), a young student, rushed to see his thesis-advisor, Luzin, to show him the mistake he had found in a ten-year-old seminal article of Lebesgue's. This famous mistake has been the subject of much discussion. It is neither subtle nor trivial and can be seen from different points of view. In particular, there has been some phenomenologist analysis of this mistake (by J. Toussaint-Desanti). This error has been corrected with difficulty. Here is another way of stating the radical novelty of Luzin and Suslin's approach. But of course we don't pretend to go along with a religious explanation just as we do not believe in a phenomenological deconstruction.

In order to see what could be saved from Lebesgue's study, Suslin and later Luzin introduced a scheme, called Suslin's scheme, which can be represented symbolically by an infinite tree. It's basically a graph. Starting with zero, you have an infinite number of numbers: 0, 1, 2, and so on. It symbolizes the right way to "come close" to infinity, to approximate infinities with a finite construction of sets: a geometrical look at the old distinction between potential and actual infinity made by Aristotle.

An idea of the richness of the analytic subsets of the continuum, discovered by Luzin and his school, can be seen in a drawing made from the continuum of the plane, given by fractal pictures of the plane. The notations themselves lead naturally to considering non-denumerable cardinals. The class of analytic sets is rich and complicated. They satisfy the Continuum Hypothesis – that is, every uncountable analytic set is equinumerous with the set of all real numbers.

Of course, our example is not the only one of close connections between mathematical and philosophical thoughts. Interesting conclusions may be obtained by studying old and new examples, as in Pascal's "geometry of chance."

In another approach, Baruch Spinoza gives a very important role to infinity in his philosophy "*more geometrico*." And finally, one of the principal mathematicians of the recent period, Alexander Grothendieck, has provided penetrating analyses of the role of naming in the process of discovery. Remembering thirty years later his approach to a new geometry in 1958 with the notion of "*topoi*," he writes, "This vision was so obvious that I had not thought to give it a name, although it has always been my passion to name things that occur to me just as a first mean to apprehend them."

In the recent period, mathematics has developed new fields, with new symbols like the diagrams of arrows in categorical theories, thereby stimulating new intuitions that go well beyond what was known before. But there is still a mystery in the infinity and the continuum, as described beautifully by Gottfried Wilhelm Leibniz: "There are surely two labyrinths for the human mind: one is concerned with the making of continuum, the other with the nature of freedom, and they are born both from the same infinity." ■

Jean-Michel Kantor and Loren Graham, who spoke on Russian Religious Mystics and French Rationalists.

Allan Robinson (Harvard University) and Ronald Probstein (MIT)

Everett Mendelsohn (Harvard University) and Renate Mayntz (Max-Planck-Institut für Gesellschaftsforschung)

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Biodiversity and Our Common Future

Peter Raven

This presentation was given at the 1885th Stated Meeting, held at the Missouri Botanical Garden on November 13, 2004.

Peter Raven is Director of the Missouri Botanical Garden and George Engelmann Professor of Botany at Washington University in St. Louis. He has been a Fellow of the American Academy since 1977.

Before I begin my presentation on biodiversity, I would like to say a brief word about the Missouri Botanical Garden. Established in 1859 – the same year that Charles Darwin's *Origin of Species* was published – it is the oldest surviving botanical garden in the United States and it is still going strong.

In 1880, Chancellor William Greenleaf Elliot of Washington University, the founder of Washington University and later its chancellor, went to Henry Shaw – the English merchant who came to St. Louis in 1819 and founded this garden – and said, "Mr. Shaw, why don't you turn your garden and all your money over to Washington University. We can really manage it very well for you." Shaw, who was eighty then, said, "At my age, I need time to think over serious proposals like this."

And he thought it over and consulted his botanical advisors. They advised him it would be better to remain independent, like the other major botanical institutions of the world. What he did later, however, was a stroke of genius. It was a great benefit for both institutions when, in 1885, Shaw endowed the School of Botany at Washington University and put in his will that the Professor of Botany at Washington University should either be the first or second in command at the Garden. In 1889, Shaw passed away at the age of eighty-nine, after running the Garden personally for thirty years. William Trelease, who was a graduate of Cornell University and who had come to Washington University in 1885, was selected first director of the Garden after Shaw's death.

The first doctoral graduate from Washington University in any field and fourteen of the first twenty graduates with master's or doctoral degrees were products of the Washington University-Missouri Botanical Garden joint program. Subsequently, similar liaisons were established with the University of Missouri at St. Louis and St. Louis University, so that in residence at the Garden at any one time are thirty-five to forty graduate students from those institutions.

Many museums and other institutions like the Garden are seeking ways to project themselves onto the graduate stage and to be deeply involved with graduate students. But the formula that Shaw devised, along with officials of Washington University in the 1880s, appears to be the most durable and best that I know about. And it certainly has served both institutions well, as hundreds of graduates have been products of the joint program over the years.

We have permanent staff in eight foreign countries and eight other states. And since I've been here for thirty-three years, our way of operating has always been to encourage people to be in the best places to do their work. And that's why we have staff members living in Madagascar, Peru, Bolivia, Paraguay, Argentina, Vietnam, China, Britain, and France.

Why are we so anxious to develop scientific expertise throughout the world, to learn

about plants and, more especially, to empower people around the globe to be able to deal with that knowledge for their own benefit? We know, intuitively, that our lives are supported by the wonderful biodiversity of plants, animals, and microorganisms that exists on our planet. But we sometimes forget – particularly when we live in cities – just how very important that biodiversity is for our happiness and for our lives. At the Garden, we try to get people out of the country or to our nature reserve, which is four square miles on the edge of the Ozarks, thirty-five miles away, to remind people of our interdependence – interdependence that I'll illustrate as we go along.

Unfortunately, much of the world is not living sustainably, although it's hard to remember that when one lives in a place like the United States or Europe where we take overconsumption for granted. One out of two people – that's 50 percent of the world's population – lives on less than $2 a day. One in eight people is, literally, starving, in terms of the United Nation's recommended minimum caloric intake. And one out of two people is malnourished in respect to at least one critical dietary element as calculated by the World Health Organization.

It's the condition of the human race and its numbers that is the major problem concerning biological diversity. If you live in a country like the United States, it is easy to say that population is the major problem. But if you think about it a little more deeply, you could rapidly come to understand that consumption and the kinds of technology that we use are also very important in setting the stage for the world of the future.

For example, people in rural Brazil or rural Indonesia live at about one-fortieth of the consumption level of people in the United States. If you consider that we've added 135 million people to the population of the United States since the end of World War II, then you realize that the impact of the extra people in the United States on the world – in terms of levels of consumption, levels of pollution, uses of inappropriate technologies that may themselves be destructive – is about equal to the impact on the world of all the entire population of developing countries – 4.2 billion people. It is not justifiable to say that population is the only factor. It's our lifestyle and our way of dealing with the world that is truly significant. There are various ways of gradually showing the impact that people have on the environment.

We know, intuitively, that our lives are supported by the wonderful biodiversity of plants, animals, and microorganisms that exists on our planet. But we sometimes forget just how very important that biodiversity is for our happiness and for our lives.

Look at the kinds of zoning that we like in the United States. For example, from 1945 through 1973, we paved over an area the size of the state of Ohio, as people fled to distant suburbs and got cars to get out there. The next time you hear people screaming about an intolerable two-cent increase in the gas tax that is bringing this country to its knees, remember that before the war in Iraq ever started, America had been spending, on the average, $30 to $60 billion a year around the Persian Gulf to help stabilize the political situation there and protect our supply of oil. It becomes a kind of a vicious circle – people living farther and farther away, depending more on automobiles, using up more and more land and resources.

Jack Benny used to say that Los Angeles would wake up to the coughing of the birds. David Letterman, I think, came up with a better one when he said; "Autumn is my favorite time of the year in Los Angeles. It's when the birds change colors and fall out of the trees."

Human impact really began in earnest with the development of crop agriculture. In the Fertile Crescent, at the eastern end of the Mediterranean, people were living in small villages before they developed crop agriculture. But with the growth of agriculture and the ability to get supplies of food that would let local populations outlast difficult seasons, those villages began to grow into towns, and eventually into even larger entities.

This growth began only about 10,500 years ago, around 425 generations, which is not very long. At that time, the entire human population of the world amounted to something like three or four million people – about the population of Greater St. Louis. And those three or four million people were scattered throughout Eurasia, North and South America, and Australia and Africa. With the invention of crop agriculture, the human population began to increase rapidly.

In the complex societal systems that emerged, most of what we think of as civilization today began to develop. Thus, for example, our first written language comes from about 5,500 years ago in Sumeria – between Baghdad and Fallujah: two place names that we wish we weren't quite so familiar with. Written languages began to develop as people became specialists in many different professions: scribes, philosophers, religious and civic leaders, and many others. In the 2-million-year history of people on Earth and the 10,500-year history of agriculture, this all took place over a very short time.

By the time of Christ, there were several hundred million people in the world; and between Medieval and Renaissance times, about half a billion. When the Reverend Thomas Malthus was saying that human population growth was bound to overcome our ability to feed ourselves in the 1790s, there were about 800 million people in the world. By comparison, there are now 1.3 billion in China and 1.1 billion people in India. We reached a billion people early in the nineteenth century, 2 billion people in 1930, 2.5 billion people in 1950. And since then, in the ensuing fifty-four years, the population has gone from 2.5 billion people – which already was an unprecedented level that would have been unimaginable earlier – to the 6.3 billion people who are living today.

Since 1950, we've lost about 20 percent of the world's topsoil – much of it in developing countries, where its loss could least be afforded. We've lost about 20 percent of the agricultural land in the world, partly due to urban sprawl, partly to desertification, partly to overfertilization. So we're presently feeding 6.3 billion people on 80 percent of the land that we had available to feed 2.5 billion people in 1950. We cut about a third of the forests without replacing them. We increased carbon dioxide, the main factor in global warming, in the atmosphere by about six times. Over the last fifty years, we have lost about 6 to 8 percent of the ozone layer, which increases the incidence of malignant skin cancer by about 20 percent.

Much agriculture now depends on drawing up artesian water. In the north China plain, which feeds about 40 percent of the 1.3 bil-

lion people of China, the water table is dropping 1.5 meters a year. And over much of India, which has 1.1 billion people, the water table is dropping by about a meter a year. Since energy is subsidized in India, it's theoretically cheaper to drill more from below than it is to deal with surface water. So much of the surface water is polluted, it is simpler to keep drilling more wells than to clean it up.

With the total population growth not expected to level off for fifty years or more, when an extra two billion or more people will have been added, and with half of the world living in a state of poverty and/or malnutrition, it's pretty obvious that it's going to be very difficult to live up to any happy dreams in the future.

We must adjust our consumption, our technology, and our population levels in order to attain a sustainable world in the future.

Experts estimate that we use about 55 percent of the renewable supplies of fresh water, most of it for agriculture at rates that are subsidized. What do we do to increase our supplies of water, when a very large portion of people in the world have no access to dependable supplies of fresh water to begin with, and there are no obvious options now? This will be an increasingly serious problem in the future.

The obvious question laid out by the Brundtland Report, the report of the World Commission on the Environment and Development, is: Can all nations achieve the standards of prosperity now in developed countries, using available technologies?

In 1947, when Gandhi was visiting England, a reporter said, "Mr. Gandhi, now that India is going to become independent, will it achieve a standard of living like that of the United Kingdom?" And Gandhi said, "When I look at the map, about half of it is colored red, which means it's the British Empire. The wealth of the British Empire comes from these countries all over the world. And it's not obvious to me how India – a much larger country in population, with no empire – can achieve those standards of living."

So how many planets do we need to have all nations achieve the same level of prosperity now in developed countries? If we were to use our present population and our present standards of living, our affluence and our technology, to bring everybody up to the standards of Europe and the United States, we would use about 120 percent of what we grow and produce per year – up from 70 percent as recently as 1970. That's definitely a frightening relationship, because it indicates that we would need another two copies of the planet Earth to enable all of the people who are living today to enjoy the same level of prosperity that we do now in industrialized countries. It means that the productive systems of the world – the potentially sustainable systems of the world – are being progressively degraded by the way we're using them at the present time. This projection strongly suggests that not only do we need to reach a level population, but we need to find levels of affluence and consumption that can be sustained in the long run, and we also need to develop technologies that are not as damaging as the ones that we use at present, and to keep improving them into the future.

When I was on the faculty at Stanford in the 1960s, we calculated that if you used the entire gross economic product of the world, you could export twelve people to the nearest planet that was likely to be habitable each year. That calculation indicates clearly that we must depend on our existing resources in our efforts to develop sustainability, and we must adjust our consumption, our technology, and our population levels in order to attain a sustainable world in the future.

In the middle of our runaway consumption – which is well beyond the levels that the world can sustain – we have the problem of biodiversity. Over 80 percent of the organisms in the world – not counting bacteria – are completely unknown, lacking even scientific names. If you breed a tropical rain forest, nineteen of the twenty kinds of organisms that you'll be bringing up will never have been seen by a scientist, will be completely unknown, and will have no name. Even if it does have a name, what that name is likely to tell you is: There's a dead one in the bottom of a bottle on a shelf in The Natural History Museum in London that somebody got somewhere in the Central Amazon in 1860.

The number of species of organisms for which we have a reasonable amount of information is more like fifty thousand or one hundred thousand, and that's it. For all the others, even knowing what they are won't lead to any useful information. Without a reliable census of the species of organisms on Earth, it is very

We'll very soon be eliminating tens of thousands of species per year. The vast majority of them will be unknown at the time that they're lost. We won't even have known that they existed.

difficult to estimate how many species are becoming extinct. We can, however, estimate extinction rates by reference to well-known groups of organisms, especially those that have hard body parts and are well documented in the fossil record – about one per million per year over the past sixty-five million years – since the great extinction at the end of the Cretaceous period.

Then we come to a written record that we can compare directly with that of about four hundred years ago. Over the last four hundred years, about one hundred species per year have become extinct. Now we're up to several thousands per year, and with the rate of habitat destruction and the other forces that I have discussed, we'll very soon be eliminating tens of thousands of species per year. The vast majority of them will be unknown at the time that they're lost. We won't even have known that they existed.

We are currently spending tens of billions of dollars trying to determine if there was one species on Mars, two to three billion years ago, which might be preserved in the rocks to demonstrate that life once existed there. Now place yourself on Mars, coming to Earth to find this great diversity of organisms that we've been treating with a cavalier kind of disdain, low funding, and disinterest.

Habitat destruction is a major force in driving organisms extinct. It is estimated that the Amazon Forest will be about 5 percent of its present size by the middle of this century. Couple this fact with our well-established relationships between members of species and size of habitat. Habitat destruction is the only force taken into account in estimating that two-thirds of all the species on Earth will be extinct by the end of this century if present trends continue. But then, there are many other factors. What about gathering plants in the wild? Ginseng, for example, is hound-

ed throughout its range in North America and it is not alone. Most people in the world depend on wild plants as their source of medicine and are basically harvesting them very rapidly.

The importance of bush meat – hunting for animals in natural forests – is increasing year after year in Africa and throughout the tropics. When an oil company goes to Africa or South America to drill, it doesn't say, "Here's some food." It says "Here are some guns. Go out and get what you need to feed yourself." Another very important factor: all along the coast of Africa, European fishing boats are sucking the fisheries dry so that in places like Ghana, which really depend on fish, there aren't any fish. The fish are all being brought back to Europe as luxury foods. As a result, people in Africa are turning more and more to bush meat, leading rapidly to the extinction of many species.

There are three major causes for extinction – alien invasive species, climate change, and hunting and gathering – that aren't even taken into account when we say that two-thirds of the species may be lost over the course of this century.

Then there's the matter of introduced species such as the zebra mussel in the United States. Alien invasive species of plants and animals are the likely cause of extinction of at least a third of the endangered plants and animals in this country. They are moving around the world at a frightening pace; in Hawaii, for example, they are the cause of extinction or likely extinction of every endangered plant and animal. It's estimated that in the United States we lose about $140 billion a year to alien invasive species.

In comparison to the $155 billion spent on the entire criminal justice system in the United States, $140 billion looks pretty big. It's also about a third of our military budget, giving you an idea, even in nonbiological terms, of how important the problem of invasive species is. Yet people continue to drag plants and animals all over the world and they literally eat up biodiversity wherever they are introduced.

Next we come to climate change. The International Panel on Climate Change (IPCC), now in its fourth cycle of climate modeling, has made it very clear that climate is changing rapidly, in some places more rapidly than in others. Human-produced gasses are the major component in climate change. For example, all alpine and sub-alpine habitats in the United States will be lost by the end of this century. In the Alps, not only are the glaciers receding rapidly, but famous climbs, like the north face of the Eiger, can no longer be undertaken: the north face never freezes and you can't climb up the rotten rocks.

So there are three major causes for extinction – alien invasive species, climate change, and hunting and gathering – that aren't even taken into account when we say that two-thirds of the species may be lost over the course of this century. This is an extraordinarily serious development for human beings because we depend entirely on biodiversity, and specifically on plants, as our source of food. Moreover, 70 percent of the people of the world depend directly on plants as their source of medicine, and at least 25 percent of the prescription drugs written in the United States also have a "suborder" base. With the hunger for nutraceuticals in Japan, Europe, and the United States, plants that people are using as their source of medicine are being scrounged right out of existence. For example, curare, used for muscle relaxation in thoracic surgery, is based on knowledge gained from groups of Indians hunting in the Amazon who use it as a muscle relaxant as well.

It's also important to remind ourselves that we live in the very early days of a revolution in biology – the double helix: fifty-one years ago, the first transfer of a gene from one unrelated kind of organism to another; thirty-one years ago, widespread use of genetically altered products in medicine and then, fifteen to twenty years ago, in crops; in the last five years, knowledge about genomics and the comparison of gene families across different kinds of organisms. Here is the biology and the technology that we expect to be able to use to make the world sustainable. Can you think of anything more stupid than driving two-thirds of these kind of organisms into extinction, 80 percent of them completely unknown before we even get our hands on them to see how they might be useful?

Where are we heading? If you think that human ingenuity is going to get us out of this, well, it's not. Human ingenuity is extremely important in finding better ways to move into the future, but I think that we are sapping the productive capacity and the diversity of the world extremely rapidly, yet slowly enough that a single lifetime doesn't give us a very clear focus on it. Think about what the place where you grew up looks like now, and you will have a pretty good snapshot of what rapid change means. It is leading to better ways to fight diseases, travel, talk on the telephone, and, heaven help us, communicate on the Internet, but it's not making the world more beautiful or interesting or diverse or philosophically better, more musical or more cultured or more poetic or anything else.

By our pell-mell rush toward success, development, and consumption, we are destroying the world at a rate that is unworthy of us in terms of the benefits we have.

By our pell-mell rush toward success, development, and consumption, we are destroying the world at a rate that is unworthy of us in terms of the benefits we have. But what we do now is going to affect the final product when we do achieve some kind of stability. We're not engaged in a pell-mell rush toward extinction; we're engaged in a pell-mell rush toward a less interesting, duller world. What are the individual parts going to look like? What's Chicago, St. Louis, Boston, or Bolivia going to look like? What is going to be the sum total of the activities of a lot of people doing a lot of different things to affect the outcome?

Preserving and keeping national parks and other kinds of similar reserves is a very important strategy for conservation, but it can be badly impacted by climate change. The coexistence with organisms that we can tolerate in modified lands is going to have a great deal to do with how many organisms survive. Alien invasive species must be controlled. We need to save plants and other organisms in cultivation or, when we can, try to keep tissue culture slides in order to try to

keep them for the future. We must do a great deal of education and communication with one another about the importance of biodiversity. Otherwise, none of this effort will be supported by anyone.

Increasing scientific capabilities around the world, by any means possible, is one of the most important things that scholars can do to secure the future not only for the United States, but for the entire world. We've got to reach a higher level of morality and realize that people around the world don't have the opportunities that we do. The alienation of women and children throughout the world is unforgivable, unmistakable, and a true characteristic of world civilization. There is no way that women and children can contribute their unique talents to a sustainable world until they're encouraged to be part of their societies, achieving similar levels of education with men, sharing the same privileges, benefits, and work as men.

We need to deal seriously with air pollution, especially the air pollution that affects climate change. In 1991, Stephen Schmidheiny, a Swiss industrialist who developed the World Business Council for Sustainable Development in the years prior to the Rio summit, wrote in a brilliant opinion piece in the *New York Times*: "There is no greater gift that American industry can give to European and Japanese industry than going on pretending that global warming does not exist. By doing so, you are giving us time to invent and patent all the things that you will want to buy desperately from us later, when you come to your senses. And basically, once again, putting yourself in the same position that you did in the early 1970s, when you wisely decided that small, efficient Japanese cars had no place in the American economy. Thank you, America."

We need to deal seriously with air pollution, especially the air pollution that affects climate change. We need to find alternative sources of energy and energy conservation. Ultimately, sustainability begins with every one of us.

We need to find alternative sources of energy and energy conservation. In constant dollars, the U.S. Department of Energy now spends 15 percent of what it did in 1979 for energy conservation and alternative energy and in 1979, we thought there was a problem. Shell and British Petroleum, the two major European oil companies, spent 15 percent of their pretax income in these areas. American oil companies – virtually none. Which would you rather invest in?

Ultimately, sustainability begins with every one of us. As I pointed out, in the United States, we consume thirty to fifty times what the poorer people of the world do and we can make many, many choices here that will be significant, including promoting internationalism, learning more and spreading that knowledge, and especially voting, being engaged in the political process. What about automobiles? Choices about places to live? What are we going to do about it, individually? To say that none of this makes any difference is simply to postpone the obvious outcomes. It all makes a huge difference. What about sustainable use of seafood? What about composting? Catching rainwater? Green architecture – building with things that can be recovered later and building with materials that have low cost to the environment? Building energy effectively? Recycling? Environmental literacy? In every university that I have anything to do with, I say that environmental literacy for undergraduates is a prerequisite to living intelligently in a modern world. So far, only the University of Georgia has an environmental requirement for every single undergraduate. Should we be optimists or pessimists? Does the tree get cut down or are we about to learn something about it?

As Gandhi said, the world provides enough to satisfy every man's need, but not every man's greed. Let's be more thoughtful. Let's try to remember how much we enjoy evenings of companionship like this and the finer things that we've achieved and realize that without attending to the sustainable base of all of this, the biodiversity of our world cannot and will not be preserved for our grandchildren and their grandchildren. ■

Robert M. Wald (University of Chicago) and John Katzenellenbogen (University of Illinois at Urbana-Champaign)

Gerald Early (Washington University in St. Louis), Leslie Berlowitz (American Academy), and Patricia Meyer Spacks (University of Virginia)

Midwest Meeting–St. Louis

Peter Raven speaking on biodiversity

Missouri Botanical Garden

Priscilla McDonnell, John McDonnell (McDonnell Douglas Corporation), and David Forney (MIT)

Martin Dworkin (University of Minnesota), Vice President of the Midwest Center, presided at the meeting.

A Bach Cult in Late-Eighteenth-Century Berlin: Sara Levy's Musical Salon

Christoph Wolff

This presentation was given at the 1886th Stated Meeting, held at the House of the Academy on December 15, 2004. It was followed by a musical performance by Academy Fellow Malcolm Bilson (Cornell University), Christopher Krueger (University of Massachusetts at Amherst), Academy Fellow Robert Levin (Harvard University), and Daniel Stepner (Lydian String Quartet). The program consisted of works by Johann Sebastian, Wilhelm Friedemann, and Carl Philipp Emanuel Bach from the collection of Sara Levy, individually introduced by Christoph Wolff.

Sara Levy, drawing by Anton Graff, 1786

Christoph Wolff is Adams University Professor at Harvard University. He has been a Fellow of the American Academy since 1982.

A Problem of Musical Historiography

The rediscovery of Johann Sebastian Bach in the Romantic period long after the composer's death belongs among the most widespread misconceptions in the historiography of music. The following quote is symptomatic: "Bach and his works have met a strange fate at the hands of posterity. They were fairly well recognized in their day; practically forgotten by the generations following his; rediscovered and revived; and finally accorded an eminence far beyond the recognition they had originally achieved."[1]

Scholarship of recent decades has found it necessary to turn away from a Bach image that resembles the metaphorical paradigm of "Death and Resurrection" – the characteristic heading of the pertinent chapter in Albert Schweitzer's *J. S. Bach* of 1908, arguably the most influential Bach book of all time. Today we differentiate between two complementary factors. First, the beginning of a broadly based public reception of Bach's music in the early nineteenth century, for which Mendelssohn's 1829 performance of the *St. Matthew Passion* represents a decisive landmark. Second, the uninterrupted reception of a more private kind, primarily confined to professional musical circles where Bach's compositions

The phenomenon of historicism, which first arose in eighteenth-century England, had a growing impact on the public taste. It contributed significantly to an increasing interest in music of the past.

were regarded as a continuing challenge, a source of inspiration, and a yardstick for measuring quality.

My remarks today will focus on a third and largely unexplored aspect: the role played by a small circle of early bourgeois Bach devotees in an atmosphere of emerging musical historicism. The phenomenon of historicism, which first arose in eighteenth-century England, had a growing impact on the public taste. It contributed significantly to an increasing interest in music of the past and eventually led to an ostensibly irreversible paradigm shift. Up to the period of Haydn, Mozart, and Beethoven, it was contemporary music that overwhelmingly dominated the scene. Today it is the music of the past that, in terms of classical performance statistics, practically marginalizes new music.

Musical historicism advanced in Germany and on the European continent during the early decades of the nineteenth century. A programmatic milestone was set in 1835 by Felix Mendelssohn Bartholdy, who, in his first season as music director of the Leipzig Gewandhaus, established so-called "Historische Concerte" specifically featuring compositions of the past. Works by J. S. Bach played an essential role in this respect. In his first such program, Mendelssohn performed, for instance, the solo part in Bach's keyboard Concerto in D Minor, BWV 1052. The work, unknown at the time, received great praise from the general public but especially from the music critic Robert Schumann. Nobody, however, including Mendelssohn himself, knew that this same concerto had actually been played in public almost thirty years earlier, before Mendelssohn was even born, by a certain Sara Levy at a concert of the Berlin Sing-Akademie.

Madame Levy, who stands at the center of my talk, was none other than Mendelssohn's great-aunt, the younger sister of his maternal grandmother. Young Mendelssohn is generally credited with bringing about one of the most seminal events in musical historicism, the aforementioned 1829 performance of Bach's *St. Matthew Passion* by the Sing-Akademie in Berlin. He certainly deserves credit as the inspired musical leader of this most influential performance attended by Friedrich Wilhelm IV and the royal family, the Prussian nobility, and notably the intellectual elite of the capital, headed by the theologian Schleiermacher, the philosopher Hegel, and the historian Droysen. However, the true origins of that particular event must be sought in the remarkable musical traditions of Mendelssohn's extended family – a tradition underemphasized, underresearched, or neglected if not suppressed by earlier historical German scholarship for reasons of an apparent anti-Semitic bias.

1 *The Bach Reader: A Life of Johann Sebastian Bach in Letters and Documents*, ed. Hans T. David and Arthur Mendel, rev. ed. (New York: W. W. Norton, 1966), 358.

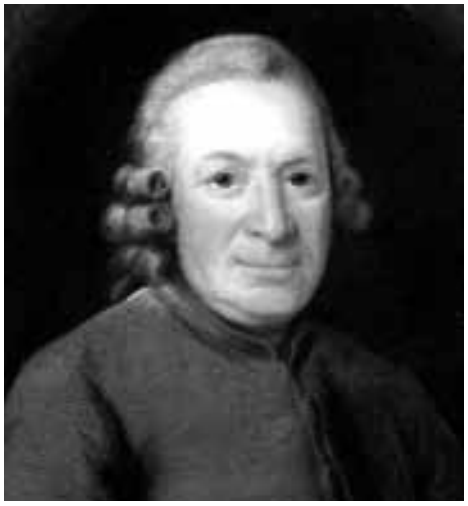
Early Bach Veneration in the Itzig and Mendelssohn Families

Johann Friedrich Reichardt, last Kapellmeister in the service of Prussia's Friedrich II ("the Great"), refers in his autobiography of 1813 to "a veritable Sebastian and Emanuel Bach cult" transpiring in the early 1770s at the house of Felix Mendelssohn's great-grandfather, Daniel Itzig of Berlin, banker of the king and the most privileged and highest-ranking Jew in all of Prussia. Bach esteem, in-

Madame Levy's music collection was quite comprehensive, consisting almost exclusively of instrumental music by all major composers active in the second half of the eighteenth century.

deed adoration, in professional music circles of the later eighteenth century was nothing special; one need only remember Beethoven's growing up with Bach's *Well-Tempered Clavier*. Yet, neither Haydn, Mozart, nor Beethoven pursued anything like a Bach cult. Hence, this particular characterization of reverence and cultivation in the Itzig family is a most unusual phenomenon. Moreover, it indicates a surprising continuity of interest in the music of J. S. Bach after his death in 1750, not traceable elsewhere in private homes.

Daniel Itzig, born in 1723 in Berlin, began his banking career as the principal supplier of the Prussian mint to the court and the army and was instrumental in assisting the king in funding the Seven-Years War against Maria Theresa's Austria (1756 – 1763). While it is conceivable that Itzig heard J. S. Bach on the occasion of the latter's visit to the Prussian court in 1747, he certainly would have known Bach's second son, Carl Philipp Emanuel, a prominent member of the king's capelle through 1768. Be that as it may, Itzig had great interest in music, found the best possible music instructors for his children, and paid them well. For his two oldest daughters, Hanna and Bella, he hired Johann Philipp Kirnberger, one of J. S. Bach's most prominent students and the one who codified Bach's teachings in a two-volume treatise on strict musical composition, published in 1772.



Top row, left to right: Daniel Itzig, anonymous painting, c. 1770; Moses Mendelssohn, painting by Johann Christoph Frisch, c. 1780. Bottom row, left to right: Abraham Mendelssohn Bartholdy, drawing by Wilhelm Hensel, 1834; Felix Mendelssohn Bartholdy, watercolor by James Warren Childe, 1829.

Bella Itzig, incidentally, became Felix Mendelssohn's maternal grandmother. She shared the same keyboard instructor with Felix's paternal grandfather, Moses Mendelssohn, who also took lessons in music theory from Kirnberger. Mendelssohn, a faithfully practicing Jew, successful businessman, eminent philosopher of the German Enlightenment, along with Daniel Itzig and David Friedländer (Itzig's son in-law), "devoted himself to the emancipation, both civil and intellectual, of Europe's ghettoized Jewish community."[2] Abraham Mendelssohn, his second son, received no particular musical training, but he joined in 1793 the newly established Sing-Akademie, a bourgeois choral society modeled after the Academy of Ancient Music in London and founded in 1791 by Carl Fasch, C. P. E. Bach's assistant and later successor as harpsichordist to the Prussian court. In 1796, Abraham Mendelssohn's future wife, Lea Salomon, joined the same organization. He probably knew her from earlier family connections, for she was the daughter of Bella Itzig, now married to the Berlin banker Jacob Salomon. An accomplished pianist, Lea is known to have played the *Well-Tempered Clavier* regularly.

The newly-wed Mendelssohns moved to Hamburg in 1804, the year in which C. P. E. Bach's daughter Anna Carolina, last custodian of the Bach family estate, died. When the estate came up for auction in 1805, the Mendelssohns quickly decided to buy the bulk of the music in order to donate it to the Sing-Akademie in Berlin, now under the direction of Carl Friedrich Zelter with whom they had developed a warm relationship. Mendelssohn's acquisition of the Bach estate, which included not only the complete works of C. P. E. Bach but also a significant portion of the surviving works of J. S. Bach, represented a genuine rescue operation with respect to

2 Steven P. Meyer, "Moses Mendelssohn and the Bach Tradition," *Fidelio Magazine* 8 (2) (1999): 27.

the latter's music. Its importance for the survival of J. S. Bach's music, contained in more than a hundred unique autograph scores, must not be underestimated and it is safe to say that, without Abraham Mendelssohn's efforts, the losses of Bach's music would be significantly greater than what we have to deplore already.

The acquisition of the Bach estate for the Berlin Sing-Akademie forms the immediate salient background for the later performance of the *St. Matthew Passion* under the baton of nineteen-year-old Felix Mendelssohn. This background, however, is even more directly and concretely connected with the Mendelssohn family. Shortly after Abraham Mendelssohn had donated the Bach manuscript scores of unpublished works to the Sing-Akademie in 1811, Carl Friedrich Zelter began to perform excerpts from the Passions, Masses, and cantatas of J. S. Bach based on the materials saved by Mendelssohn. Meanwhile, Abraham Mendelssohn's family relocated to Berlin. At age ten, Felix joined the Sing-Akademie and, more importantly, was put under Zelter's private tutelage. He could have had no better teacher who, among other things, exposed him to Bach's vocal works, including the *St. Matthew Passion* – but almost exclusively in the form of excerpts. Zelter did not consider the large-scale work performable, for musical-technical reasons as much as for its "wretched texts," referring to the baroque-style poetry. But young Felix eagerly wanted to see and study the whole piece. Finally, grandmother Bella Salomon fulfilled his wish, had a professional copy made from the manuscript of the unpublished work in the collection of the Sing-Akademie, and gave it to Felix for Christmas in 1823. He was fourteen then and it took him another five years to persuade his teacher Zelter to agree to a complete performance.

Within Levy's music library, the works of J. S. Bach and his four sons – Wilhelm Friedemann, Carl Philipp Emanuel, Johann Christoph Friedrich, and Johann Christian – represent a significant section of a scope and character without parallel elsewhere.

Christmas 1823 was special, for it followed the year in which Abraham and Lea Mendelssohn converted to Protestant Christianity and added "Bartholdy" to their name in order to be distinguished from the Jewish Mendelssohns. The baptism took place in Frankfurt because Abraham wanted to avoid a public rift with his in-laws, especially since Bella Salomon had disowned her son Jacob upon his conversion.[3] Intermarriage and conversion had become a major trend among Jews in Prussia because it opened up new social, commercial, political, and educational opportunities. Bella Salomon, like her father Daniel Itzig, was seriously opposed to what was happening to the younger generation. We don't know the details of the internal family disputes, but seen in this context, the Christmas present to her grandson Felix in the year of his baptism seems a particularly remarkable gesture, perhaps a sign of reconciliation: a work of undeniably Christian art handed down by a faithful Jewess, with Bach's music standing above doctrinal and confessional traditions. She came to tolerate, if not accept, the notion expressed by Abraham Mendelssohn that true Christianity "contains nothing that can lead you away from what is good."[4]

Sara Levy's Salon and Music Collection

Bella's younger sister Sara held similar, probably even stronger, views about conversion. When she died at age ninety-four, childless, she left her considerable fortune to charity by establishing a foundation for a Jewish orphanage in Berlin. Otherwise, like the rest of the Itzigs, Mendelssohns, Salomons, Ephraims, Friedländers, and others in her extended family, she fit perfectly into the environment of intellectual, cultural, and to some extent political liberalism in a period quite unique in German history: the quarter century from 1780 to 1806, when Napoleon conquered Prussia. This was also a period in which a group of wealthy Jewish women in Berlin "achieved social glory by entertaining the cream of gentile society."[5] The literary and philosophical salons of Rahel Varnhagen, Henriette Herz, Rebecca Friedländer, and Dorothea Schlegel were among the most prominent and best known, and the success of these Jewish salonières "was based on defiance of the traditional boundaries separating noble from commoner, gentile from Jew, man from woman. The public happiness achieved in these salons was a real-life enactment of the ideal of *Bildung*, encompassing education, refinement, and the development of character."[6]

Itzig

Daniel Itzig, 1722 – 1799
∞ Miriam Wulff, 1727 – 1788
→ 15 children, among them:

Sara, 1761 – 1854
∞ Samuel Levy
→ no children

Bella, 1749 – 1824
∞ Jacob Salomon
→ 4 children, among them:

Lea, 1777 – 1842

Mendelssohn

Moses Mendelssohn, 1729 – 1786
∞ Fromet Guggenheim, 1737 – 1812
→ 6 children, among them:

∞ Abraham M. (Bartholdy), 1776 – 1835
→ 4 children, among them:

Felix Mendelssohn Bartholdy, 1809 – 1847

3 Jacob Salomon, who, after his conversion, adopted the name "Bartholdy," provided the model for Abraham and Lea Mendelssohn's name change.

4 For Abraham Mendelssohn's views on conversion see Wulf Konold, *Felix Mendelssohn Bartholdy und seine Zeit* (Laaber: Laaber-Verlag, 1984), 69 – 80.

5 Deborah Hertz, *Jewish High Society in Old Regime Berlin* (New Haven and London: Yale University Press, 1988), 3.

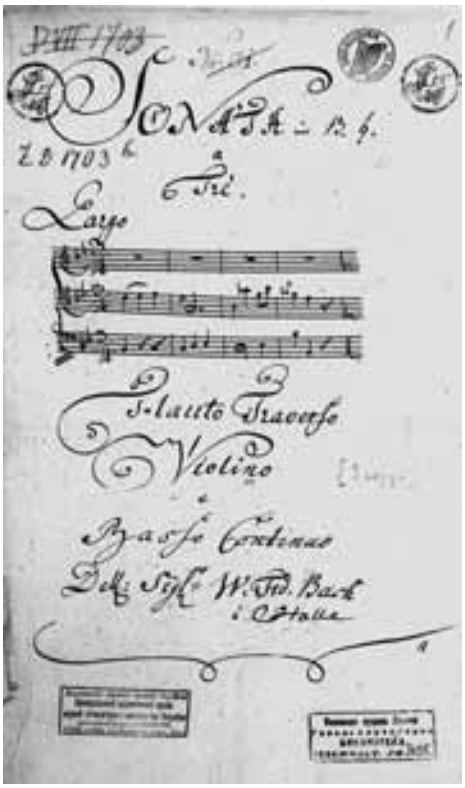
6 Ibid., 3 – 4.

Sara Levy, photograph, c. 1850

Sara Itzig, after her marriage in 1783 to the banker Samuel Levy, established a weekly salon with a strong focus on music at her stately home in old Berlin's poshest neighborhood. For about ten years, from 1774 to 1784, she had studied with Friedemann Bach, J. S. Bach's oldest, and became a keyboard virtuoso in her own right. The silverpoint portrait by Anton Graff of 1786 (see page 26) shows a very attractive young woman at age twenty-five, who regularly performed at the weekly afternoon gatherings in her house but also elsewhere. After the death of her husband in 1806, she became more engaged in the public concerts of the Sing-Akademie where she regularly appeared as a soloist with the orchestra, performing concertos by Bach and his sons but also by other composers. Sometime after 1815, however, in her mid-fifties, she stopped performing in public (grand-nephew Felix most likely never heard her play).

An undated early photograph from around 1850 depicts Sara Levy in her old age; she survived her grand-nephew by almost seven years. The silverpoint and the photograph in juxtaposition show very dramatically the contrast of two different centuries, not just as reflected in the different age, changed face, body, clothing, and habit of one and the same woman, but also reflected in the technique of portraiture: drawing versus photography. More than that, the new industrial age left no room for the salon culture of the late eighteenth and early nineteenth centuries. Sara Levy observed and experienced this first hand.

After giving up public performance Sara Levy donated the bulk of her very large music collection to the library of the Berlin Sing-Akademie. Her substantial gift, never inventoried and evaluated in the past, was not accessible for more than half a century after the end of World War II. The Red Army had confiscated the musical archive of the Sing-Akademie together with numerous other trophy materials. Fortunately, since the archive of the Sing-Akademie was recently repatriated from Kiev



W. F. Bach, Trio Sonata in B-flat Major, title page

to Berlin, the materials can now be examined and the extent of the Levy collection assessed. Only now it becomes clear how prominently this extraordinary woman figures in the early reception of the music of the Bach family.

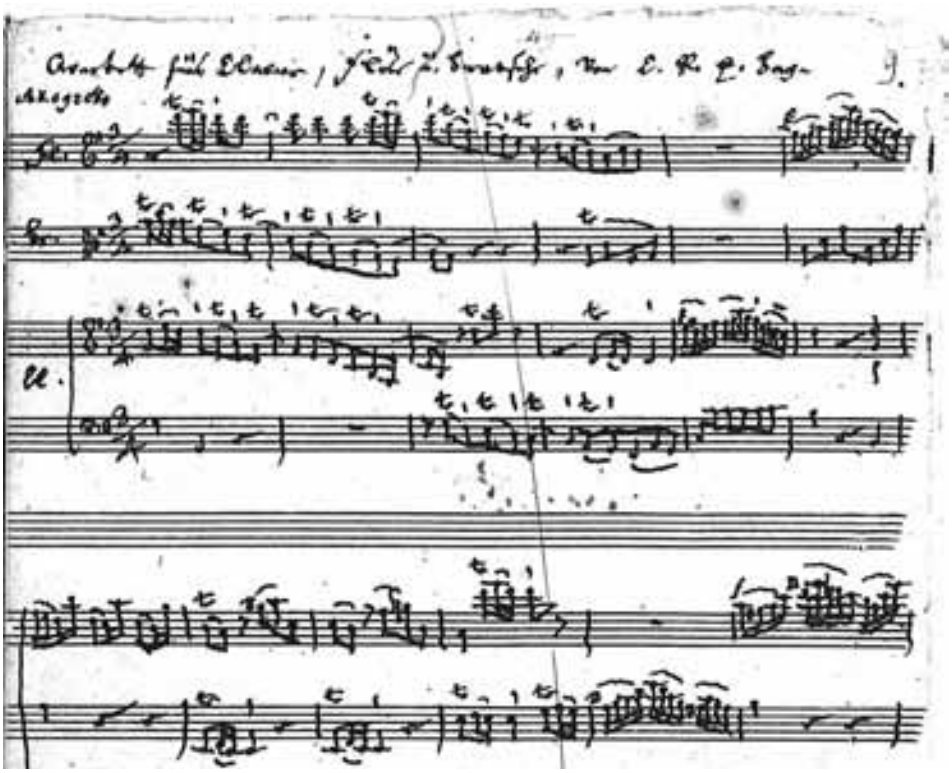
Madame Levy's music collection was quite comprehensive, consisting almost exclusively of instrumental music by all major composers active in the second half of the eighteenth century. The repertoire extended from solo keyboard works and chamber music of different kinds to concertos and symphonies – the music room in her house could easily accommodate an orchestra of eighteenth-century proportions. She owned many keyboard instruments of various kinds and was particularly fond of the fortepianos by Friedrich Silbermann of Strasbourg.

Within Levy's music library, the works of J. S. Bach and his four sons – Wilhelm Friedemann, Carl Philipp Emanuel, Johann Christoph Friedrich, and Johann Christian – represent a significant section of a scope and character without parallel elsewhere. Moreover, her collection formed a library for practical use, that is, the collection contained not only scores but also performing parts. The title wrapper for a set of parts usually provides an incipit of the work for easy identification and usually shows Sara Levy's characteristic round ownership stamp.


Namen der Pränumeranten:

Die Frau Hauptmannin Johanna Maria v. Aderkaß in Breßlau.
Herr Agricola, Königl. Preuß. Hof-Componist in Berlin.
— Ludolph Ahlers, Kaufmann in Hamburg.
— Eberhard Andreas Alffen, J. U. L. in Hamburg.
— Gottlieb Amsink, Kaufmann in Hamburg.
— Will. Avison in Liefland.
— Cantor Ay in Wartenberg.
— Cappellmeister Bach in Eisenach.
— Concertmeister Bach in Bückeburg.
— Bärge, J. U. L. in Hamburg.
— Johann Gottlieb Baum, Kaufmann in Hirschberg.
— Kammer-Commißionsrath Beck in Soran.
— Organist Beckmann in Celle.
— Organist Bertuch in Berlin.
— Oberamtsrath Beyer in Brieg.
— Daniel Bötefeuer in Liefland.
Frau v. Böttticher in Celle.
Herr Buchdrucker Bock in Hamburg.
— Borchmüller, Vicarius und Organist am Dom in Magdeburg.
— Breitkopf und Sohn in Leipzig, auf 2 Exemplare.
— Kanzley-Advocat v. Brinken in Wolfenbüttel.
— Carl Burney, Doctor musices in London, auf 6
Herr Hartknoch in Riga, auf 12 Exemplare.
— Dr. Hinrich Wilhelm Gaspers, Domherr in Hamburg.
Ihro Durchlaucht, die Fürstin v. Hatzfeld in Breßlau.
Herr v. Hedemann, Erbherr zu Dorste bey Nordheim.
— Hein, Juge d' Attribution in Breßlau.
— Cantor Heiser in Altona.
— Heinrich Carl Henneberg, Kaufmann in Quedlinburg.
— Hering, Musikus in Berlin, auf 2 Exemplare.
Se. Hochwürden, der Herr Probst Hermes zum Heiligen Geiste in Breßlau.
Herr Johann Christian Hinrichs in Hamburg.
— Hof, Commißarius und Buchhändler in Warschau, auf 2 Exemplare.
— Hoff in Berlin.
— Ober-Organist J. G. Hoffmann in Breßlau.
— Kammermusikus Horn in Dresden, auf 5 Exemplare.
— Johann David Jentsch, Kaufmann in Schweidnitz.
Mlle Itzig in Berlin.
Herr Conrad Christoph Jung in Ilsenheim.
— Kannengießer, Königl. Preuß. Kammermusikus in Berlin.

The names on the list of subscribers to C. P. E. Bach, Six Concertos for Harpsichord (Hamburg, 1772) includes Mademoiselle Itzig.



C. P. E. Bach, Quartet in G Major, Wq 95; autograph manuscript

Sara Levy not only arranged musical performances, both with and without her participation, but she also occasionally commissioned new works and became a major patron for the two elder Bach brothers. Her teacher W. F. Bach wrote a song for her wedding in 1783 – probably his last composition, for he died a year later. Sara Levy had supported him financially for the last ten years of his life; he in turn provided her with music. It was probably only after Friedemann's death that she established direct contact with his younger brother Emanuel (who had left Berlin for Hamburg when she was only seven) and maintained relations with him and, after his death in 1788, with his widow. Her collection already contained 16 keyboard concertos by C. P. E. Bach when she commissioned him to write another concerto, this time for harpsichord, fortepiano, and orchestra, which turned out to be C. P. E. Bach's last composition. Levy's collection contains the autograph score of this most special piece that deliberately juxtaposes two different types, or if you will generations, of keyboard solo instruments: the traditional harpsichord and the modern fortepiano.

Just prior to this commission she apparently ordered from C. P. E. Bach a set of three quartets, also with an unusual combination of instruments: fortepiano, flute, and viola. Again, the autograph score of 1788 and sole surviving source of the work forms part of her collection. This score also shows the unstable and trembly hand of the seventy-four-year-old composer who suffered from gout and wrote with considerable difficulty. All three pieces are headed "*Quartet fürs Clavier, Flöte u. Bratsche*" (quartet for clavier, flute, and viola) and the layout of the score indicates Bach's definition of quartet: rather than referring to four different instruments he stresses four independent contrapuntal lines of music, one each for flute, viola, fortepiano right hand, and fortepiano left hand. Haydn or Mozart would have called it a piano trio, but their standard scoring would be for violin, cello, and piano.

The unusual and innovative approach that C. P. E. Bach takes here in the last year of his life focuses on a well-adjusted distribution of the four instrumental voices and the clear distinctions between them. The integration of a woodwind and a string instrument adds different colors to the homogeneous keyboard parts. Moreover, using a viola instead of a violin puts emphasis on the middle ground of the score, that is, on the center of the sound spectrum. The result constitutes an evenly balanced instrumental discourse that permits the composer to engage in a lively, intense, and witty musical dialogue – in all likelihood a fitting interlude to the verbal conversations invariably conducted among the guests of Sara Levy's literary-musical salon, which included the Humboldt brothers and other members of Berlin's intellectual elite.

Their discussions are not recorded, of course, but their listening to the music of two different generations of Bachs, the father and his sons, would have invited them to compare stylistic dialects of the past with the best of what was new in the contemporary scene of music – like the works of Mozart, who performed in Berlin in the spring of 1789. This experience undoubtedly would have given them a clear sense of a historical dimension in music together with a sense of urgency in preserving the musical past for the future. That was eventually realized when in 1809 Wilhelm von Humboldt expanded the Prussian Academy of Arts by adding a music division. Its first head was Carl Friedrich Zelter, director of the Berlin Sing-Akademie, Felix Mendelssohn Bartholdy's principal teacher, and the one who consciously started an archive of music that eventually came to incorporate Sara Levy's collection. ■

Sara Levy, drawing by Anton Graff, 1786; Daniel Itzig, anonymous painting, c. 1770; Moses Mendelssohn, painting by Johann Christoph Frisch, c. 1780; Abraham Mendelssohn Bartholdy, drawing by Wilhelm Hensel, 1834; Felix Mendelssohn Bartholdy, watercolor by James Warren Childe, 1829
Photo credit: Mendelssohn-Archiv, Staatsbibliothek zu Berlin – Preussischer Kulturbesitz

Sara Levy, photograph, c. 1850
Photo credit: Bach-Archiv Leipzig

W. F. Bach, Trio Sonata in B-flat Major, title page
Photo credit: Sing-Akademie zu Berlin

C. P. E. Bach, Quartet in G Major, Wq 95; autograph manuscript
Photo credit: Sing-Akademie zu Berlin

Christoph Wolff speaking on A Bach Cult in Late-Eighteenth-Century Berlin.

Robert Levin (Harvard University), Christopher Krueger (University of Massachusetts at Amherst), Daniel Stepner (Lydian String Quartet), and Malcolm Bilson, seated (Cornell University) performed works by Johann Sebastian, Wilhelm Friedemann, and Carl Philipp Emanuel Bach.

James Bowdoin and the Patriot Philosophers

The American Academy and the Dibner Institute for the History of Science and Technology celebrated the publication of a new book entitled *James Bowdoin and the Patriot Philosophers*. Written by the late Frank E. Manuel, an Academy Fellow, and his wife, Fritzie P. Manuel, the study relates in rich detail the founding of the Academy and the life of its first president, James Bowdoin.

In his opening remarks, Louis W. Cabot, Vice President of the Academy and Chair of the Academy Trust, noted that "the book has been in the minds and hands of the Manuels for many years; it is fitting that it comes to us in published form on the eve of the Academy's 225th year."

Gerald Holton, Mallinckrodt Research Professor of Physics and Research Professor of the History of Science at Harvard University, presented the keynote address. He observed that, with this publication, the Manuels have not only "resurrected a fascinating patriot/philosopher but they have provided deep insight into the lives, the politics, the thoughts, and sometimes the mischief of mid-eighteenth-century Boston intellectuals." A merchant by trade but "an amateur Newtonian scientist" by avocation, Bowdoin, like many of his compatriots, justified his interest in science on both religious and utilitarian grounds – a combination that, as the Manuels point out, "made it twice blessed."

As an example, Holton called attention to a scientific paper, published by Bowdoin in the first volume of the Academy's *Memoirs*, reporting on an observation "tending to prove by phenomena and scripture" that a hollow shell surrounding the sun's planetary system was necessary to preserve the universe from collapsing. As Holton described (see accompanying excerpt), the role of religion in understanding the universe was to concern scientists, from Newton to Einstein, for centuries to come and still concerns them.

Following Holton's presentation, George Smith, Acting Director of the Dibner Institute and Professor of Philosophy at Tufts University, reflected on the meaning of the word "Newtonian" in the years from 1780 to 1790 – the decade when the "last serious loose end of the *Principia* was finally resolved." He observed that at the same time that Bowdoin became Governor of Massachusetts, Laplace explained the mystery of the peculiar motions of Jupiter and Saturn. In Smith's words, "from that day forward, observation became secondary to calculation throughout planetary astronomy." Shortly after Bowdoin published his paper on the danger of the universe collapsing inward, Laplace described the first proof of the stability of the system not collapsing outward. "What struck me about reading the Manuels' book," Smith declared, "was the sharp difference between the meaning of the word 'Newtonian' in the city of Boston in 1780 and its meaning in the city of Paris that same year."

Gerald Holton (Harvard University)

Turning to Bowdoin's role as governor of Massachusetts, Robert S. Cohen, Professor of Philosophy and Physics Emeritus at Boston University, considered the conflicting issues surrounding the suppression of Shays' Rebellion. As Cohen explained, the class struggle and the threat of civil war, demonstrated in what Bowdoin called a "rebellion from below," are evident in society today. Bowdoin himself admitted that the grievances of rural working class farmers against the rich merchants were justified, but as Cohen emphasized, for this "generous, humanistic man, the priority of preventing civil war dominated the ethical problems of the exploited and aggrieved people."

Continued on page 33

George Smith (Dibner Institute and Tufts University), Silvan Schweber (Brandeis University), Fritzie Manuel, and Robert S. Cohen (Boston University)

James Bowdoin
continued from page 32

Reflecting on the impact of the Manuels as scholars and friends, Silvan Schweber, Professor Emeritus of Physics and the History of Ideas at Brandeis University, compared Frank Manuel's classroom with "cooking" in a jazz session: "There would be animated exchanges between Frank and the students at the end of which it was clear that somehow things had fallen into place for them, a new world had been seen, a new understanding had been obtained, and an eagerness to probe more deeply had been imparted." Schweber went on to note that "Fritzie made possible all that Frank accomplished. The research was carried out jointly; she made sure that the narrative was cohesive, and that all the arguments were consistent and convincing. She could do so because she is an impressive scholar in her own right and fiercely independent in her views."

Responding to the remarks of her colleagues, Fritzie Manuel said that the couple's walks through Boston streets with such names as Hancock, Otis, and Bowdoin inspired the book. When Frank retired, they had the time to pursue an interest far removed from their earlier work. Curiosity led them to the area's rich library resources on the colonial period and the happy discovery of the diverse characters and personalities that inspired the early years of the Academy and the country.

James Bowdoin and the Patriot Philosophers is published by the American Philosophical Society Press. The Academy and the Dibner Institute expressed their gratitude to Mary McDonald, Editor of the APS, who worked with the Manuels to produce what is an important contribution to the history of this nation's founding. ■

Excerpt from Gerald Holton's Presentation

After Bowdoin's Inaugural Oration as the Academy's president on 8 November 1780, he began to submit a slew of scientific papers, which were collected and published also in the first volume of the Academy's *Memoirs*. Near the start of the volume are three "physical papers" of his, the third being the most interesting, "the climax of his scientific achievement," with the remarkable title, "Observation tending to prove, by Phaenomena and Scripture, the Existence of the Orb, which surrounds the whole visible material System [of the heavens]; and which may be necessary to preserve from the Ruin to which, without such a Counterbalance, it seems liable, by that universal Principle of Matter, Gravitation." What Bowdoin does here is to propose that a huge hollow sphere of an undefined substance encases the Sun's planetary system, as well as other such spheres for the outlying parts of the visible universe, and so prevent its collapse.

Why? It is an attempt to deal with an old fear: that the universe will not be a stable unity forever and ever, as is God, its Creator, Himself, but that by the mutual gravitational attraction of the planets and stars they will somehow congeal into one shameful lump. This must not happen. As Frank Manuel wrote in his book *The Religion of Newton*, God is one of order, not of confusion. Newton himself had also been deeply concerned with the possible collapse of the solar system by its own gravitation. He said to David Gregory, "a continual miracle is needed to prevent the sun and the fixed stars from rushing together through gravity;" and elsewhere Newton wrote that God's hand is continually needed to put again into order the planets' paths after a passing comet had diverted them.

But of course the grand homogeneous sphere Bowdoin imagined would do nothing to help, since as Physics 101 teaches, in its middle there would be no gravitational attraction to help prevent the collapse, because all parts of such a sphere cancel out in their gravitational effect. Perhaps John Winthrop's lectures had not included that awkward fact.

And yet, this problem of a possible collapse of the universe had to be solved some way or other. When Einstein in 1917 came to include "cosmological consideration" when expanding his General Relativity theory, he found to his dismay that his equations did "not allow the hypothesis of a spatially closed-ness [a constancy] of the world," but permitted expansions or contractions of the universe. That seemed to him dangerous, not least because Einstein had long read and revered Baruch Spinoza's *Ethics*, which in Proposition 20 says "It follows that God is immutable (and) all his attributes are immutable." At any rate, Einstein, to assure an immutable universe, put into his equation famously a fudge factor, "an unknown universal constant," called the cosmological constant, which would keep the universe stable. James Bowdoin would have approved. But in 1929, Hubble discovered that the universe is *not* immutable but expanding, and so the cosmological constant fell into disrepair. But again, just a few years ago, it was discovered that this expansion is not steady but is *accelerating*. Ironically, contra to Newton and Bowdoin, it seems to be tearing itself apart instead of shrinking under mutual gravity. So now some sort of cosmological fix has to be reinserted into the equation. Neither Bowdoin's quasi-religious speculations nor those of the God-filled Spinoza are of any help.

As the great Alexandre Koyré summarized the matter at the end of his book, *From the Closed World to the Infinite Universe*: "The mighty, energetic God of Newton who actually 'ran' the universe according to His free will and decision, became, in quick succession, a conservative power, an *intelligentia supra-mundana*, a 'Dieu fainéant.... The infinite Universe of the New Cosmology, infinite in Duration as well as in Extension, in which eternal matter in accordance with eternal and necessary laws moves endlessly and aimlessly in external space, inherited all the ontological attributes of Divinity. Yet only those – all the others the departed God took away with Him."

So, as scientists, we are now on our own, for better or worse. ■

Around the Country

Over the past several months, campus receptions were held in the Midwest and in California as part of the Academy's expanding outreach activities. President Patricia Meyer Spacks, Vice President Louis W. Cabot, and Executive Officer Leslie Berlowitz participated in many of these events, which provide expanded opportunities for Fellows to meet each other and present their research.

Stanford University

At a meeting at Stanford University on November 23, 2004, **Kathleen M. Sullivan**, Stanley Morrison Professor of Law at Stanford Law School, spoke on the topic "Do we have an emergency Constitution?" (The full text of Sullivan's remarks will appear in a forthcoming Academy publication.) Stanford **President John Hennessy** presided over the campus reception that attracted Fellows and guests from throughout the Palo Alto area.

Kathleen Sullivan (Stanford Law School) and Louis W. Cabot (Cabot-Wellington, LLC)

John Hennessy (Stanford University)

University of California, Berkeley

On November 22, 2004, Vice President of the Western Center and Academy Councilor **Jesse H. Choper** and Academy Councilor **Randy W. Schekman** co-hosted a gathering at the University of California, Berkeley to welcome Berkeley's new **Chancellor, Robert Birgeneau**, who spoke to the group about the challenges and opportunities in higher education.

Robert J. Birgeneau (UC Berkeley)

Jesse H. Choper and David Collier (both, UC Berkeley)

Randy W. Schekman and Charles B. Harris (both, UC Berkeley)

California Institute of Technology

Caltech **President David Baltimore** welcomed Fellows and guests to a campus reception on February 15, 2005, where **Colin Camerer**, Rea A. and Lela G. Axline Professor of Business Economics, spoke about the rapidly emerging field of neuroeconomics. Camerer conducts laboratory experimental research in games, decisions, and markets.

David Baltimore and Colin Camerer (both, California Institute of Technology)

University of California, Los Angeles

Following greetings from **Chancellor Albert Carnesale**, Professor of Astronomy **Andrea M. Ghez** and Richard C. Maxwell Professor of Law and Professor of Policy Studies **Joel F. Handler** discussed their research at an informal meeting of Fellows on the campus of the University of California, Los Angeles on February 16, 2005. Ghez explores star formation and has established the existence of a supermassive black hole at the center of the Galaxy; Handler studies welfare law and policy and has examined current policy issues relating to poverty and high-risk adolescents.

Albert Carnesale and Joel F. Handler (both, UCLA)

Andrea M. Ghez (UCLA)

University of Michigan

At a campus gathering for Fellows on November 11, 2004, **Huda Akil**, Gardner C. Quarton Distinguished Professor of Neuroscience and Psychiatry and Co-Director and Senior Research Scientist of the University of Michigan Mental Health Research Institute, presented a talk on "Stress and Equanimity in Turbulent Times." Akil's research centers on the neurobiology of behavior, especially the molecular mechanisms underlying responsiveness to stress and pain.

Huda Akil

Around the Country

University of California, San Francisco

Dean of the School of Medicine and **Vice Chancellor** for Medical Affairs **David A. Kessler** hosted a reception for Fellows on February 17, 2005, at the University of California, San Francisco. Reflecting on his induction as a new member of the Academy, Professor of Medicine **Jay A. Levy** spoke of the Academy's work in science over the past three centuries, urging the group to propose new ideas for Academy projects in the biological and medical sciences.

David A. Kessler (UCSF)

Jay A. Levy (UCSF)

Northwestern University

Dedre Gentner, Director of the Cognitive Science Program and Professor of Psychology and Education, and **Paul F. Berliner**, Professor of Musicology, spoke at a reception for Fellows at Northwestern University on March 29, 2005. In a talk entitled "Why We're So Smart," Gentner discussed her research on the nature and function of analogical reasoning and on the interplay between language and thought. Berliner considered the fate of the mbria players during Zimbabwe's struggle for independence in his talk "The Heart that Remembers: A Tale of Musicians in a Time of War." Northwestern **President Henry S. Bienen** presided at the meeting.

Dedre Gentner (Northwestern University)

Henry S. Bienen, Ursula Oppens, and Loren F. Ghiglione (all, Northwestern University)

Paul F. Berliner (Northwestern University)

New York City

On December 1, 2004, the Academy hosted "A Conversation on Russia and Its Neighbors," a panel discussion on the issues raised by the project on International Security in the Post-Soviet Space. The meeting was moderated by **Elihu Rose**, an Academy Fellow and professor of military history at New York University. The speakers included **Robert Legvold**, Professor of Political Science at Columbia University, **Dmitri Trenin**, Deputy Director of the Carnegie Moscow Center, and Lieutenant General **William Odom** (U.S. Army, Ret.), former director of the National Security Administration and Senior Fellow at the Hudson Institute.

Lieutenant General William Odom (U.S. Army, Ret.), Robert Legvold (Columbia University), Dmitri Trenin (Carnegie Moscow Center), and Elihu Rose (Rose Associates, Inc.)

New York City

Are institutions of higher education the new catalysts for major trends in urban design? On February 28, 2005, a Stated Meeting of the Academy explored the role of universities as urban planners. Moderated by architect and writer **Robert Campbell**, a panel of speakers – including Columbia University **President Lee Bollinger**, architect **James Polshek** (Polshek Partnership Architects LLP), and University of Pennsylvania Senior Vice President **Omar Blaik** – described their experiences with major construction projects. The group discussed ways in which universities are collaborating with their communities to transform and expand their campuses. **E. John Rosenwald, Jr.** (Bear Stearns Companies), who has been involved with numerous building projects at educational and cultural institutions, presided.

John Brademas (NYU) and Conrad Kenneth Harper (Simpson Thacher & Bartlett)

Left to right: Omar Blaik (University of Pennsylvania), James Polshek (Polshek Partnership Architects, LLP), Lee Bollinger (Columbia University), Robert Campbell (Cambridge, Massachusetts), and E. John Rosenwald, Jr. (Bear Stearns Companies)

Project Update

International Security in the Post-Soviet Space

When Robert Legvold (Columbia University) first proposed that the Academy sponsor a project on security in the countries of the former Soviet Union in early 2000, he believed that the major powers were overlooking the importance of this region and its role in world affairs. Since then, with Legvold's guidance, the Academy has produced a series of four volumes that provide insight into patterns in the post-Soviet space that have received too little scholarly attention.

"Because the woes of this part of the world have not yet produced major dramas or large explosions," Legvold wrote in 2000, "the tendency is to assume that events will remain under control." Since then, events in the region have dramatically confirmed its strategic importance to the United States and the world.

According to Legvold, "each of the challenges featured in these books . . . from the economics of national security to the primal threats to statehood itself, underscores how bound together these states remain, and how imperative it is for the United States and other major powers to adopt policy frameworks transcending single states and single issues."

The project's focus has been the overarching economic and security concerns that tied the disintegrating space of the former Soviet Union together. Most studies of the post-Soviet region tend to focus on isolated issues, such as Caspian Sea oil and gas, "loose nukes," or the election crisis in Ukraine. Although the former Soviet republics are in many ways drifting apart, the security outlook for the region depends on the interactions between them. Bound together by oil pipelines and energy grids, by interdependent markets and defense industries, and by porous borders, the strategic interests of states in this region frequently overlap and conflict.

During the project's first year, Legvold and an international group of scholars met to produce a collection of essays that considered how each of the major powers approached security challenges in Central Asia. The final draft of *Thinking Strategically: The Major Powers, Kazakhstan, and the Central Asian Nexus* was submitted on September 1, 2001. Ten days later, perceptions of the region had wholly changed.

September 11 altered the prominence of Central Asia in international security discussions, and in many ways bore out Legvold's initial call for scholarly analysis of the international security implications of instability in the countries of the post-Soviet space. Global events transformed the volume from a discussion of the need for strategic thinking in a region whose importance had yet to be recognized to a timely analysis of the issues that rapidly developing security strategies should address.

The volume succeeded in directing attention to the need for active international involvement and coordinated planning to promote stability in the region.

As Oslo-based Russian military expert Pavel Baev stated in a recent review, the book conveys the overall picture of "Kazakhstan becoming the center of the increasingly interconnected Inner Asia, where the balance of opportunities and risks is now extremely precarious."

Robert Legvold (Columbia University)

From the strategic interactions of major powers in Central Asia, Legvold turned his focus to the question of how economic instability in Russia affects the countries of the post-Soviet region. Ukraine and Belarus, both vulnerable to changes in the Russian economy but each with a unique security outlook, were the central subjects of the second volume in the series, *Swords and Sustenance: The Economics of Security in Belarus and Ukraine*.

With co-editor Celeste Wallander, of the Center for Strategic and International Studies, Legvold assembled experts from Ukraine, Great Britain, and the United States to consider Russian economic reform and its impact on the defense trends of Ukraine and Belarus.

Contributor Hrihoriy Perepelitsa of the National Institute for Strategic Studies of Ukraine focused on the dominance of the defense sector in Ukraine and Belarus and the dependence of these countries on the Russian economy. This dependence has strongly influenced the security policies of both countries. While Belarus looks to strengthen its ties to the Russian military to encourage the defense production that keeps its economy afloat, Ukraine has sought to create an independent defense capacity and to become an autonomous player in the international arms market.

Since the late 1990s, Ukraine has expressed interest in joining NATO, which Russia continues to view with anxiety. The NATO-Ukraine relationship has steadily deepened, with NATO inviting an "intensified dialogue" on Ukraine's goal of joining the organization.

The move for independence from Russia within Ukraine has been highly visible in recent months. In November 2004, the peaceful protests of the "Orange Revolution" came to a head as the state-sponsored media proclaimed the Moscow-backed candidate to be the victor, while Ukrainians and foreign monitors claimed massive fraud. The hotly contested

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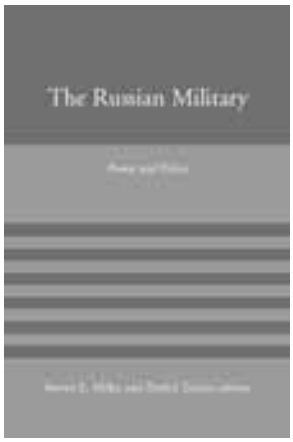

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race focused primarily on the pursuit of Western-style reforms and the development of close ties with Europe.

As contributors to *Swords and Sustenance* emphasize, and as the involvement of Russia, NATO, the E.U. and U.S. demonstrates, complex economic and security choices are not for Ukraine and Belarus to face alone. The book underscores one lesson for policymakers in particular. Despite the "large and unresolved challenge" of creating economic and national security in these countries, the authors see "a moment of opportunity, if leadership in all three quarters – Russia, the West, and the two countries themselves – will seize it." A complex situation is not the same as a hopeless situation, and the volume points these actors toward policies that could lead to a more secure future for all.

Although the security issues at play in the many small, recently independent nations of the post-Soviet region are engaging and complex in and of themselves, an extensive study of security in the post-Soviet region cannot ignore the central role that Russia continues to play. The Russian military has not maintained the immense reach and influence that the Soviet military once held, but it still plays a significant role in directing defense concerns in Eurasia, while Russia's nuclear capabilities remain globally relevant. The third volume published by the project, *The Russian Military: Power and Policy*, edited by Steven E. Miller (Harvard University) and Dmitri Trenin (Carnegie Moscow Center), enlisted both Russian and non-Russian experts to consider the Russian approach to defense and the condition of the Russian military.

The contributors to the volume began with the simple fact that Russia inherited only a fragment of the Soviet military – a large fragment, but a fragment nonetheless. Since the collapse of the Soviet Union, Russian leaders have failed to reshape this military into a force that meets their needs or to develop a defense posture that realistically assesses their new global position.

The Russian Military includes a mix of insiders and expert "outsiders" from Alexei Arbatov, former Duma member, and Vitaly Shlykov, advisor to one of Russia's largest engineering and weapons-production companies, to journalist Aleksandr Golts and research fellow Roy Allison of Oxford's Centre for International Studies. Each tackled a key feature of Russia's military and security policy, shedding light on the complex issues that have stymied reform. They include the role of the defense sector in the Russian economy; discontent among both officers and recruits in the military; a continued focus on facing global opponents, such as NATO, instead of addressing the concerns of such regions as Chechnya; and the use of the Soviet nuclear arsenal as a security crutch. All contributors argued for the necessity of swift reform.

The significance of the Russian military to security in the post-Soviet region may be apparent, but the important role of military dynamics in the smaller countries and subregions is often far less recognized. The final study in the project focuses on military dynamics and security challenges in the Georgia and Caucasus region.

Georgia is an apt choice. In November 2003, protests over the manipulation of legislative elections led to the ousting of the sitting president. The largely peaceful overthrow, called the "Rose Revolution," indicated Georgia's promising steps toward becoming a more democratic nation. It also underscores a basic fact: Georgia, like many countries in the region, continues to struggle with the development of viable political and economic systems in the aftermath of the dissolution of the Soviet Union. In addition to building state capacity, Georgia must also negotiate separatist movements within its borders, its relationship with its immediate neighbors, and Russia's moves to disrupt power balances in the region. The new government under President Mikheil Saakashvili faces complex security problems.

Bruno Coppieters of Vrije Universiteit Brussel joined Legvold in co-editing the volume *Statehood and Security: Georgia after the Rose Revolution* (forthcoming, 2005). Reviewing events in Georgia with the contributors, it became clear to Legvold and Coppieters that security in Georgia must begin with the development of a sound state structure. Only then can a national security policy be defined.

The essays in *Statehood and Security* reveal the breadth of threats that Georgia faces. The Rose Revolution may have pointed Georgia in the direction of a more stable government, but a history of corruption in the state and military, warring national identities, and the agitations of breakaway Abkhazia and South Ossetia constitute significant roadblocks. Outside of Georgia, troubled relations with Russia and the instability of other countries in the South Caucasus create regional turmoil. On an international scale, oil and gas pipelines and the war on terrorism make the region politically important to the United States and other coun-

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Academy's UBASE Project Featured in IMF Quarterly

An article by Fellows Joel E. Cohen (Rockefeller and Columbia Universities) and David E. Bloom (Harvard University) is the lead feature in the upcoming issue of the International Monetary Fund's magazine, *Finance and Development*. Cohen and Bloom are co-directors of the Academy's Project on Universal Basic and Secondary Education (UBASE). The issue, which has a special focus on education, appears in June 2005.

The article, entitled "Cultivating Minds," draws heavily on research completed as part of the UBASE project and sets the framework for the issue. Cohen and Bloom present a summary of progress on achieving universal education to date. They examine rationales for continuing to work toward the goal of universal access to primary and secondary education and emphasize the need to focus on the quality of education that is provided. They also provide an estimate of the cost and the ability of the world to finance this work, as well as a summary of obstacles – political, cultural, informational, and organizational – that stand in the way of achieving universal coverage.

The UBASE project has shown that providing education to all children is not overwhelmingly costly, though the necessary tools may not yet be in hand. Crude estimates of the cost of achieving universal primary and secondary education fall between $34 and $69 billion additional per year. As Cohen and Bloom write, "This is a huge amount of money, but certainly not beyond the ability of the world to fund." ■

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tries of the West. *Statehood and Security* demonstrates that Georgia's problems need to be taken seriously by the great powers.

Eurasia has not exploded since the beginning of the project on International Security in the Post-Soviet Space, but the signs of discontent are visible. Georgia's Rose Revolution and Ukraine's Orange Revolution may be examples of more democratic processes emerging in the area. Other events, such as the Beslan school siege of September 2004, which occurred in the Russian internal republic of North Ossetia, and the ongoing election struggles in Kyrgyzstan, are less encouraging. Speaking of the post-Soviet region in December 2004, Legvold said, "The area itself – given its location, given its resources, given developments within that part of the world – is going to have enormous significance for what happens in international politics now and into the future." Robert Legvold's work at the Academy brings attention to this region at a critical point in time.

The project on International Security in the Post-Soviet Space was funded by a grant from the Carnegie Corporation. Each of the volumes produced by the project is available in both English and Russian editions. ■

U.S. Space Program Assessed

On March 4, 2005, the American Academy sponsored a workshop on the interaction of military, civil, and scientific interests in space. Experts from the United States, Canada, Britain, France, Germany, and China considered the ways in which military plans for space impinge on, or are advanced by, commercial and scientific activity. Participants identified the civilian space operations that might be undermined by increased military usage of space and discussed the development of appropriate legal principles to protect both civilian uses of space and international security.

Neal Lane and George Abbey (both of Rice University) presented their forthcoming paper, "United States Space Policy: Challenges and Opportunities." The paper describes the ways in which national security provisions governing the production of satellites and satellite technology have curtailed the growth of the U.S. commercial space industry and limited possibilities for international cooperation.

Lane and Abbey describe four barriers to a healthy U.S. space program. These barriers include: the strict regulation of satellite exports as munitions under the State Department rules; a projected shortfall in the American science and engineering workforce; unrealistic plans for NASA's future space missions that neglect the important role of science; and faltering international cooperation on existing and planned space missions. As Lane and Abbey write, "U.S. space policy presents a paradoxical picture of high ambition and diminishing commitment." Their study offers recommendations for redirecting policy to ensure the future success of the U.S. space program.

Lane and Abbey's work will appear as part of a series of papers emerging from the Academy's Reconsidering the Rules of Space project. The Academy recently published "The Physics of Space Security," a reference manual that presents technical facts for a general audience about space operations. Also forthcoming are papers that offer international perspectives on U.S. space plans.

The project is directed by John Steinbruner (University of Maryland) of the Academy's Committee on International Security Studies and supported by a grant from the Carnegie Corporation of New York. ■

Theresa Hitchens (Center for Defense Information), Neal Lane (Rice University), Joanne Gabrynowicz (University of Mississippi), George Abbey (Rice University)

Noteworthy

Select Prizes and Awards

National Medals of Science, 2003

Behavioral and Social Sciences
R. Duncan Luce (University of California, Irvine)

Biological Sciences
J. Michael Bishop (University of California, San Francisco)

Solomon H. Snyder (Johns Hopkins University School of Medicine)

Charles Yanofsky (Stanford University)

Engineering
John M. Prausnitz (University of California, Berkeley)

Mathematics
Carl R. de Boor (University of Wisconsin, Madison)

Physical Sciences
G. Brent Dalrymple (Oregon State University)

Riccardo Giacconi (Associated Universities, Inc. and Johns Hopkins University)

National Medals of Technology, 2003

Jan D. Achenbach (Northwestern University)

Robert M. Metcalfe (Polaris Venture Partners)

Lewis C. Cantley (Harvard Medical School) is the recipient of the eighth annual Pezcoller Foundation-American Association for Cancer Research International Award for Cancer Research.

Gordon Davidson (Center Theater Group) received the National Corporate Theatre Fund Leadership Award.

Sidney Drell (Stanford University), **Mildred S. Dresselhaus** (Massachusetts Institute of Technology), and **Mark di Suvero** (Spacetime C.C.) are among the recipients of the Heinz Awards in honor of the late U.S. Senator John Heinz, given by the Heinz Family Foundation.

Stephen Elledge (Harvard Medical School) received the 2005 Genetics Society of America Medal.

David Hackett Fischer (Brandeis University) won a 2005 Pulitzer Prize for his book *Washington's Crossing* (Oxford University Press).

James E. Gunn (Princeton University), **P. James E. Pebbles** (Princeton University), and **Martin J. Rees** (University of Cambridge) have been awarded the Crafoord Prize in Astronomy.

Brian K. Hall (Dalhousie University) and **Linda Hutcheon** (University of Toronto) are among the recipients of the 2005 Killam Prizes, awarded by the Canada Council for the Arts.

Peter D. Lax (New York University) has been awarded the Abel Prize in Mathematics.

Laurie Olin (Olin Partnership), **James Stewart Polshek** (Polshek Partnership Architects LLP), **Cindy Sherman** (New York, New York), and **Rosanna Warren** (Boston University) have been elected to the American Academy of Arts and Letters.

Judith L. Rapoport (National Institute of Mental Health) has been awarded the 2005 Edward M. Scolnick Prize in Neuroscience by the McGovern Institute for Brain Research at MIT.

Manfred R. Schroeder (University of Goettingen, Germany) was awarded the 2004 ISCA Medal of the International Speech Communication Association and the 2004 Technology Prize of the Rhein Foundation.

Eduard Sekler (Harvard University) has been awarded the Austrian Decoration for Science and Art.

Geoffrey R. Stone (University of Chicago) received the Robert F. Kennedy Book Award for *Perilous Times: Free Speech in Wartime from the Sedition Act of 1798 to the War on Terrorism*, given by the Robert F. Kennedy Memorial.

Charles H. Townes (University of California, Berkeley) has been awarded the 2005 Templeton Prize for Progress Toward Research or Discoveries about Spiritual Realities.

Stanford E. Woosley (University of California, Santa Cruz) has been awarded the Bruno Rossi Prize by the High Energy Astrophysics Division of the American Astronomical Society.

New Appointments

Peter C. Agre (Johns Hopkins University) will join Duke University Medical Center in July 2005 as Vice Chancellor for Science and Technology.

A. Paul Alivisatos (University of California, Berkeley) has been named associate laboratory director for physical sciences at the Lawrence Berkeley National Laboratory.

Frederick Alt (Children's Hospital, Boston) has been named scientific director of the CBR Institute for Biomedical Research.

Alan Altshuler (Harvard University) has been appointed dean of the Harvard Graduate School of Design.

Ben S. Bernanke (Princeton University) has been designated by President Bush to be chairman of the White House Council of Economic Advisers.

Ronald E. Cape (San Francisco, California) has been elected to the board of directors of Neurobiological Technologies, Inc.

James DePreist (Tokyo Metropolitan Symphony Orchestra) has been appointed Permanent Conductor of the Tokyo Metropolitan Symphony Orchestra.

Zach W. Hall (University of Southern California) has been appointed interim president of the California Institute for Regenerative Medicine.

Robert B. Shapiro (PricewaterhouseCoopers) has been appointed as an independent director of the Board of Directors of Dyadic International, Inc.

Claude M. Steele (Stanford University) has been appointed director of the Center for Advanced Study in the Behavioral Sciences, effective September 2005.

Keith Yamamoto (University of California, San Francisco) has been appointed chair of the Scientific Advisory Board of Sirna Therapeutics.

Select Publications

Fiction

Seamus Heaney (Dublin, Ireland). *The Burial at Thebes: A Version of Sophocles' "Antigone."* Farrar, Straus & Giroux, November 2004

James Lehrer (NewsHour with Jim Lehrer). *The Franklin Affair*. Random House, May 2005

Reynolds Price (Duke University). *The Good Priest's Son*. Scribner, June 2005

Nonfiction

Robert Alter (University of California, Berkeley). *Imagined Cities: Urban Experience and the Legend of the Novel*. Yale University Press, May 2005

Joyce Appleby (University of California, Los Angeles). *A Restless Past: History and the American Public*. Rowman & Littlefield Publishers, January 2005

Margaret Atwood (Toronto, Canada). *Writing With Intent: Essays, Reviews, Personal Prose: 1983 – 2005*. Carroll & Graf, April 2005

Edward Ayers (University of Virginia). *What Caused the Civil War: Reflections on the South and Southern History*. W. W. Norton, June 2005

Bernard Bailyn (Harvard University). *Atlantic History: Concept and Contours*. Harvard University Press, March 2005

Alfred D. Chandler, Jr. (Harvard Business School). *Shaping the Industrial Century: The Remarkable Story of the Evolution of the Modern Chemical and Pharmaceutical Industries*. Harvard University Press, April 2005

Denis Donoghue (New York University). *The American Classics: A Personal Essay*. Yale University Press, April 2005

Louis Dupre (Yale University). *The Enlightenment and the Intellectual Foundations of Modern Culture*. Yale University Press, June 2004

Harry G. Frankfurt (Princeton University). *On Bullshit*. Princeton University Press, January 2005

Richard Nelson Frye (Harvard University). *Greater Iran: A 20th-Century Odyssey*. Mazda Publishers, February 2005; *Ibn Fadlan's Journey to Russia: A Tenth-Century Traveler from Baghdad to the Volga River*. Markus Wiener Publishers, April 2005

Carlos Fuentes (University of Cambridge, UK). *An A to Z of a Life*. Random House, February 2005

Owen Gingerich (Harvard University). *The Book Nobody Read: Chasing the Revolutions of Nicolaus Copernicus*. Penguin, February 2005

Francine du Plessix Gray (New York, New York). *Them: A Memoir of Parents*. Penguin Press, May 2005

Linda Greenhouse (*New York Times*). *Becoming Justice Blackmun: Harry Blackmun's Supreme Court Journey*. Times Books, May 2005

Russell Hardin (New York University), **Margaret Levi** (University of Washington), and Karen Cook (Stanford University). *Cooperation Without Trust?* Russell Sage Foundation, July 2005

Charles M. Harr (Harvard Law School). *Mastering Boston Harbor: Courts, Dolphins, and Imperiled Waters*. Harvard University Press, March 2005

Gerald Holton (Harvard University). *Victory and Vexation in Science: Einstein, Bohr, Henderson, and Others*. Harvard University Press, May 2005

Diane Johnson (San Francisco, California). *Into a Paris Quarter: Reine Margot's Chapel and Other Haunts of St. Germain*. National Geographic Directions, May 2005

Nathan Keyfitz (Harvard University) and **Hal Caswell** (Woods Hole Oceanographic Institution). *Applied Mathematical Demography*, third edition. Springer-Verlag, January 2005

Jaroslav Jan Pelikan (Yale University). *Whose Bible Is It? A History of the Scriptures Through the Ages*. Viking, March 2005

George Rochberg (University of Pennsylvania). *The Aesthetics of Survival: A Composer's View of Twentieth-Century Music*, revised and expanded edition. University of Michigan Press, January 2005

Exhibitions

John Baldessari (University of California, Los Angeles): *A Different Kind of Order (Works 1962 – 1984)*, Museum Moderner Kunst Stiftung Ludwig Wien, Austria, through July 3, 2005.

Bruce Nauman (Galisteo, New Mexico): *Printed Work in Swiss Public Collections*, Cabinet des estampes, Geneva, June 8 – August 28, 2005.

Ed Ruscha (Los Angeles, California): *Cotton Puffs, Q-tips®, Smoke and Mirrors: The Drawings of Ed Ruscha*, National Gallery of Art, through May 30, 2005.

Bill Viola (Bill Viola Studio): *Surrender* (2001), "Getting Emotional," The Institute of Contemporary Art, Boston, May 18 – September 5, 2005; *The Greeting* (1995), "Marking Time/Moving Images," Miami Art Museum, Florida, May 13 – September 11, 2005.

We invite all Fellows and Foreign Honorary Members to send notices about their recent and forthcoming publications, scientific findings, exhibitions and performances, and honors and prizes to bulletin@amacad.org. ■

From the Archives

The first president of the American Academy, James Bowdoin, was a businessman and a scientist who went on to become governor of Massachusetts. He and the other founders of the Academy were deeply concerned with the role of the arts and sciences in building a new nation. In his inaugural address, Bowdoin voiced the expectations of the fledging society and imagined what a historian living a hundred years after 1780 might say about its founders:

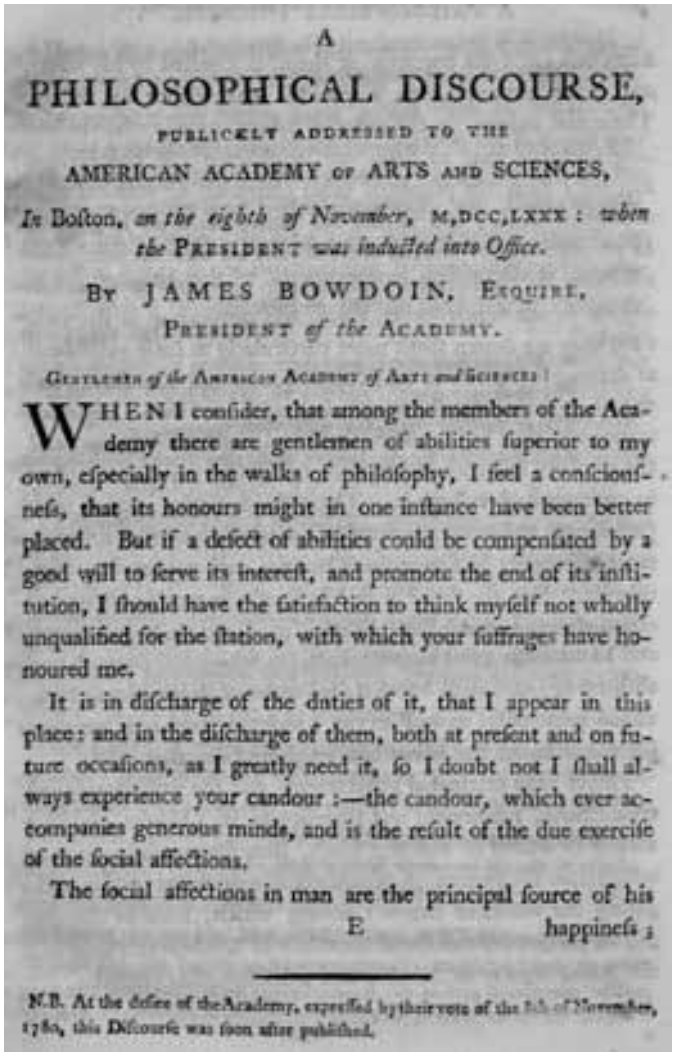
"Rapt into future times," and anticipating the history of our country, methinks I read in the admired pages of some *American Livy, or Thucydides*, to the following effect....

It was not to be expected, that our ancestors, involved as they were in a civil war, could give any attention to literature and the sciences: but superior to their distresses, and animated by their general principles, which liberty and independency inspire, they instituted the excellent society, called *The American Academy of Arts and Sciences*...

...[T]hey proceeded on fact and observation, and did not admit of any reasonings or deductions, but such as clearly resulted from them. This has been the uniform practice of the society: whose members, from time to time, having been chosen from men of every country, from every class and profession, without any other distinction than was dictated by the dignity of their characters, by their morality, good sense, and professional abilities, we find in the printed transactions of this society, the best compositions on every subject, within the line of their department. We find in those transactions new facts, new observations and discoveries; or old ones placed in a new light, and new deductions made from them.

They have particularly attended to such subjects as respect the growth, population, and improvement of their country: in which they have so happily succeeded, that we now see agriculture, manufactures, navigation and commerce, in a high degree of cultivation; and all of them making swift advances in improvement, as population increases. In short, they have, agreeably to the declared end of the institution, "cultivated every art and science, which might tend to advance the interest and honour of their country, the dignity and happiness of a free, independent, and virtuous people."

Reprinted from the *Memoirs* of the American Academy of Arts and Sciences, 1783, volume 1. ■



A

PHILOSOPHICAL DISCOURSE,

PUBLICKLY ADDRESSED TO THE

AMERICAN ACADEMY OF ARTS AND SCIENCES,

In Boston, on the eighth of November, M,DCC,LXXX: *when the* PRESIDENT *was inducted into Office.*

BY JAMES BOWDOIN, ESQUIRE,

PRESIDENT *of the* ACADEMY.

Gentlemen of the American Academy of Arts and Sciences!

WHEN I conſider, that among the members of the Academy there are gentlemen of abilities ſuperior to my own, eſpecially in the walks of philoſophy, I feel a conſciouſneſs, that its honours might in one inſtance have been better placed. But if a defect of abilities could be compenſated by a good will to ſerve its intereſt, and promote the end of its inſtitution, I ſhould have the ſatisfaction to think myſelf not wholly unqualified for the ſtation, with which your ſuffrages have honoured me.

It is in diſcharge of the duties of it, that I appear in this place: and in the diſcharge of them, both at preſent and on future occaſions, as I greatly need it, ſo I doubt not I ſhall always experience your candour:—the candour, which ever accompanies generous minds, and is the reſult of the due exerciſe of the ſocial affections.

The ſocial affections in man are the principal ſource of his

E happineſs;

N.B. At the deſire of the Academy, expreſſed by their vote of the 8th of November, 1780, this Diſcourſe was ſoon after publiſhed.

AMERICAN ACADEMY
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