Research

at Boston University

2010

What if varying the schedule of chemotherapy could have anti-tumor effects and boost the immune system? What if we looked for a link between Massachusetts health care reform and the reduction of racial and ethnic disparities in the use of medical care? What if there were an app to help us count calories? What if we could prove that the falling divorce rate is due to the growing number of "career women" in the U.S. labor force? What if we found out what makes birds sing? What if we were able to fight breast cancer by using gene therapy and designer T-cells?

What if a major research university gave its faculty the freedom to dream, explore, succeed, and sometimes even fail?

What if we started the first broad-based systematic study of the risks and safety of vaccines and medicines taken by pregnant women? What if we were able to control blood sugar levels in diabetics by developing an artificial pancreas? What if we converted Macedonian folktales into operas? What if we could learn more about society and ourselves by studying the history of cafés in Japan? What if we could help the city protect the environment by measuring its CO_2 and gauging "Boston's Urban Metabolism"? What if we re-created Captain John Ross's expedition to find the Northwest Passage?

BOSTON UNIVERSITY

9 Lower and more frequent doses of chemotherapy shrank tumors more effectively?

What if

11 Increased access to primary care meant fewer costly trips to the ER?

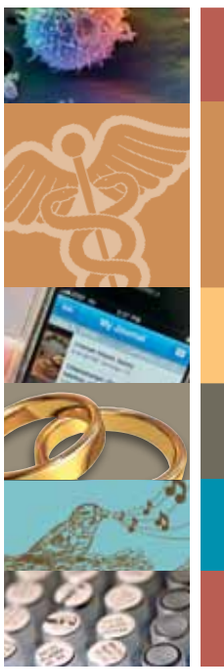
What if

18 Dual-career couples had more stable marriages?

What if

47 An iPhone food journal offered a way to change health behaviors?

What if



What if

8 T-cells could be turned into cancer-attacking "nano-bio-bots"?

What if

30 Songbird learning patterns could shape our understanding of the human brain?

What if

Research at Boston University

34 Insulin pumps became a thing of the past?

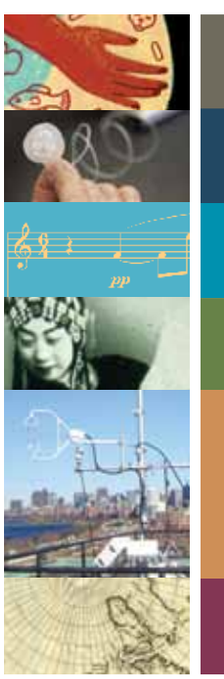
What if

27 Balkan folk songs found a new life—and a new audience—as opera?

What if

What if

15 New data on prenatal drug exposure helped keep mothers and babies safe?



What if

22 Cafés offered surprising insights into Japanese life and leisure?

What if

48 Urban gardens held the key to offsetting carbon emissions?

What if

40 Exploring the Northwest Passage inspired a novel?

4

12

20

32

40

44

What if?

contents

FROM THE **VICE PRESIDENT AND ASSOCIATE PROVOST FOR RESEARCH**

Andrei E. Ruckenstein

Welcome to *Research at Boston University 2010*. In this issue, you will meet more than 45 faculty members whose work exemplifies the enterprising, interdisciplinary, and international spirit of research at BU. Their diverse projects—on subjects ranging from cancer to the role of calligraphy in 19th-century Chinese political life, epilepsy to the evolution of the Milky Way—offer a glimpse into the vibrant scientific, scholarly, and creative endeavors now engaging our students at the undergraduate and graduate levels, as well as our faculty and research staff across BU's 17 schools and colleges on two campuses.

The stories in this magazine highlight Boston University's commitment to supporting scholarly activities and research in all their varied forms, including both individual efforts in particular departments and collaborative projects that stretch across two or more academic disciplines, or even across institutional, national, and international boundaries. Moreover, these efforts cover a broad range of topics in basic and applied sciences, STEM fields, arts, humanities, and social sciences.

What is more difficult to capture within the magazine-story-format is the intrinsically dynamic and unpredictable nature of the *research process*—from the initial idea to the "eureka" moment of discovery to the published results. It is the roller coaster of fits and starts, together with the excitement of uncovering new truths while venturing into uncharted territories, that gives the *research process* its indescribable sense of exhilaration. This unpredictable process of discovery can be as informative as the final destination, and can often lead researchers in an entirely new and promising direction of inquiry. At BU we aspire to go beyond providing support for and facilitating the end point of research: our goal is to empower our faculty, research staff, and students to dream and take risks at every point of the *research process* defining the path to discovery, a goal symbolized by the "what if" theme of this year's *Research* cover.

All aspects featured in this year's magazine—the focus on integrating scholarly activities and research with our educational mission; the entrepreneurial, collaborative spirit of our faculty, staff, and students in developing programs within the University and in building partnerships outside of the institution; and a global engagement with industry, government, and academia focused on translating basic ideas into applications for societal good—are a reflection of Boston University's vitality and its ascending trajectory into the top tier of major research universities.

To learn more, visit www.bu.edu/research.

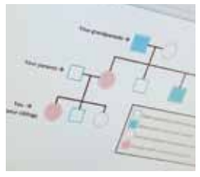
BY CHRIS BERDIK

Confronting Cancer

About half of all men and one third of all women in the United States will get cancer at some point in their lives. The disease kills more than half a million Americans every year, and within two decades it will surpass heart disease as the nation's leading cause of death, according to the American Cancer Society. Boston University researchers are attacking this disease on many fronts—spreading the word on risk and prevention, finding innovative ways to increase the effectiveness of established therapies, training the next generation of cancer fighters, uncovering new drug targets, and enlisting the body's immune system as an anti-cancer warrior.

CHEMOTHERAPY SCHEDULING AND THE IMMUNE SYSTEM

UNDERSTANDING HOW AWARENESS OF GENETIC CANCER RISK AFFECTS LIFESTYLE CHOICES



CHEMICAL, BIOLOGICAL, AND MECHANICAL BASES OF TUMOR INVASION

COMPREHENSIVE ONCOLOGY AND RADIOLOGY EDUCATION FOR MED STUDENTS

USING DESIGNER T-CELLS TO FIGHT BREAST CANCER

New direct-to-consumer genetic risk tests could be a help or a hindrance, says public health expert Catharine Wang, depending on the way genetic risk information motivates behavior.

Cracking the Cancer Code

Is some disease risk riskier than the rest?

Last May, under pressure from the Food and Drug Administration, Walgreens postponed its plans to sell a test that claimed to show genetic risk for cancer and other diseases. These types of direct-to-consumer genetic tests worry many public health experts, including Catharine Wang, an assistant professor of community health sciences in the School of Public Health. Wang studies how the public interprets and acts on disease risk—or doesn't. Much of her recent work has focused on how people understand genetic cancer risk.

Wang believes that direct-to-consumer tests give people an incomplete sense of their cancer risk, which may cloud public health messages about health behaviors—such as eating right, exercise, and routine physicals and screenings—that are known to reduce the onset and lethality of the disease. She notes that an individual's chance of contracting any disease typically involves a complicated interplay of genetics and lifestyle choices, with a lot of unknowns.

"Every day, there are more findings of genetic associations from minor DNA variants, and industry jumps on those discoveries," she says. "But the public health community is saying, we're not ready."

Some of the open questions include whether people will overestimate risk when it stems from their genes and whether knowing something about their genetic predispositions will make them more or less likely to make the health behavior choices that reduce disease risk.

In a study published last year in the journal *Cancer Causes and Control*, Wang found that the vast majority of more than 400 healthy women who were surveyed ranked heredity as the most important causal factor for both breast and colon cancer—84 and 78 percent respectively, despite the fact that prior studies have estimated that 38 percent of breast cancers and 45 percent of colon cancers are preventable through a combination of healthy eating, exercise, and weight management.

Suzanne Miller, director of the psychosocial and behavioral medicine program at the Fox Chase Cancer Center in Philadelphia and one of Wang's research collaborators, says, "As we learn more and more about cancer and its treatment at the genetic level, Catharine's work shows us that we need to intervene at the level of the whole person, not just at the level of their molecular genetics."

> "There are a lot of people saying, 'I'm smart enough to make decisions; give me the information and get the doctors out of the way.' But they're making some serious decisions about their health after seeing only part of the picture."

What is needed now, says Wang, is an understanding of what genetic risk information will motivate people to choose healthy behaviors and what risk information, if any, might actually impede these healthier lifestyle choices. For example, a "high" genetic risk could scare some people into fatalism, while a "low" genetic risk might give others a false sense of security. She says that the "rush to market" of direct-to-consumer genetic tests ignores these basic questions about genetic risk interpretation and behavior that public health researchers are only starting to answer.

"There are a lot of people saying, 'I'm smart enough to make decisions; give me the information and get the doctors out of the way,'" says Wang. "But they're making some serious decisions about their health after seeing only part of the picture."

Tracking a Killer

Muhammad Zaman's fight against brain cancer in kids began with a wrong turn. A few years ago, while searching for a colleague's lab in the University of Texas's M.D. Anderson Cancer Center, he got lost and ended up in the pediatric ward.

"My daughter had recently been born, and it pained me to see how many of these kids were probably not going to make it," says Zaman, an assistant professor of biomedical engineering.

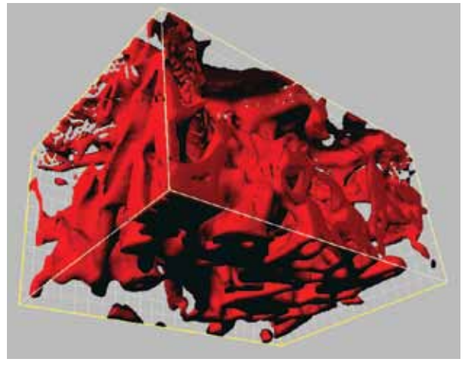
Zaman had been seeking a clinical application for his research into the physical, chemical, and biological details of cancer cell migration in the body, what's known as metastasis. Partnering with researchers at the Massachusetts Institute of Technology and the University of Manchester (UK), he decided to focus on pediatric brain cancer, which gets much less research attention than the most common childhood cancer, leukemia. Zaman's goal is to use his intricate computational and experimental models of pediatric brain cancer cell migration to pinpoint the key biochemical mechanisms that support metastasis.

Traditionally, he says, clinicians followed a "Mini-Me strategy" when it came to treating cancer in kids, simply cutting the dose of the same chemotherapy drugs used for adults. But children's rapid development means that the environment in which cancer grows and migrates in their bodies is far different than it is in adults.

In addition, one of the major reasons why so many chemotherapy drugs fail when transitioning from the lab to the clinic, Zaman says, is that they are developed by watching cancer cells move on two-dimensional plastic surfaces. The key for more successful drug development, therefore, is to study cancer cell migration and test therapeutics using a more lifelike model of a biological system.

Supported by nearly $2 million in funding from the National Institutes of Health, Zaman and his research partners use a laser-scanning microscope to track cultured cancer cells moving through three-dimensional "matrices" of a common protein such as collagen, or a synthetic soft-tissue. They then assemble the time-lapse microscopic images into detailed computer simulations of real-time cell movement.

"This is what the cells see as they travel through the matrix," says Zaman, as he plays one such video on his computer; it shows a tunneling journey through the amorphous network of a porous protein structure. The experiments are used in combination with computational models Zaman has built from what is already known about cell signaling and cell binding, and about the stresses and the forces operating within the matrix. He periodically refines and improves the models based on experimental data.



Quantitative visualizations like this model of a tumor's extracellular matrix offer a better understanding of how tumor metastasis functions in children and adults.

"We're trying to find out what enables or hinders cancer cell migration and invasion, so that people will be able to develop therapeutics that specifically target those mechanisms," says Dewi Harjanto, a biomedical engineering doctoral student who works with Zaman.

(continued on next page)

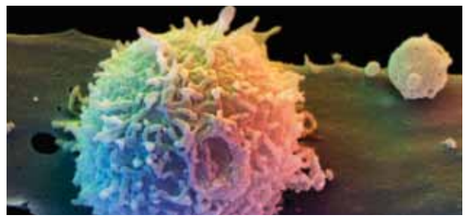
Muhammad Zaman

"It's not about looking at a single gene in isolation. It's about how genes and the environment interact, how one protein influences another, and how those interact with the cellular systems and with the structures inside the body."

While most studies look at individual cancer cell migration, Harjanto is investigating how clusters of cancer cells, mini-tumors, sometimes migrate away from the main tumor. She is focusing on how the density of the collagen matrix affects this movement.

Another collaborator, Roger Kamm, an MIT professor of mechanical and biological engineering, is using microfluidic systems to see how cancer cell movement is affected by varying the fluid flow through the matrix. Other experiments alter the pH of the matrix or the DNA of the cancer cell. Eventually, says Zaman, they will introduce different drugs to these systems, "to see what happens to those cells and their ability to move, divide, and form tumors."

No matter what variable is being altered, "this is a systems question," Zaman stresses. "It is not about looking at a single gene in isolation," he says. "Instead, it's about how multiple proteins inside the cell interact with the environment of the tumor, how one protein influences another, and how those interact with the cellular systems and with the structures inside the body."



Well-known for their role in fighting infection, T-cells may be programmable to recognize and attack cancer cells as well.

Engineering a New Line of Defense

Part of what makes cancer so deadly is subterfuge—even while it invades and destroys the body's organs, most cancers appear "normal" to our immune system's T-cells, a type of white blood cell and the core of our defense against disease.

But the jig may soon be up for some cancers, thanks to Richard Junghans, an associate professor of surgery and an oncologist and hematologist at the BU-affiliated Roger Williams Medical Center in Providence, Rhode Island.

Funded by a 2009 $5.9 million Impact Award from the Department of Defense's Breast Cancer Research Program, Junghans is genetically modifying T-cells to recognize cancer cells and kill them.

"These are living drugs, made from the patient's own cells," says Junghans, who is currently overseeing Phase I clinical trials of the designer T-cells—which he affectionately calls "nano-bio-bots"—to fight metastatic breast cancer. "Using the immune system is the fourth arm of cancer therapy with the hope of succeeding even when we have a patient whose cancer is growing despite chemotherapy, radiation, and surgery," he says.

Cancer patients travel to Roger Williams from around the country to receive treatment in the clinical trials. At the Roger Williams Cancer Center, in a building adjacent to Junghans's office, T-cells are harvested from the patients' blood. Downstairs, in a cleanroom, researchers use a genetically engineered virus that cannot reproduce to carry a bit of new genetic code into the T-cell chromosomes, programming a new receptor to recognize a signature molecule, known as carcinoembryonic antigen, or CEA for short, that is present in half of all breast cancers.

These genetically modified T-cells are cultured until about 400 billion are grown per patient. Then, they're infused through an IV back into the patients in varying amounts, after which patients are observed over several weeks as outpatients. The current trials are using a "second generation" of designer T-cells. The first generation was tested about a decade ago. They were effective in killing cancer cells, but didn't keep at it for long, because not only do T-cells need to be educated about what to attack, they also need to be activated by signals from other cells in the immune system, called dendritic cells. Junghans's second-generation T-cells have a special signaling chain—engineered to activate when the T-cells encounter a tumor—built in along with the CEA receptor. This signaling chain should allow the T-cells "to proliferate, and survive, and maintain their active status," he explains.

Richard Junghans

Because CEA is also expressed by some healthy tissues, the Phase I trials are using "escalating exposures" to the new T-cells in order to identify what Junghans calls "a window of therapeutic opportunity between anti-tumor effectiveness and patient toxicity."

The Phase I trials will continue for another year, and Junghans's research team is continuing to make small modifications to the designer T-cells. Phase II and III clinical trials will follow, with the goal, Junghans says, of curing breast cancer that expresses CEA within the next five years.

Enhanced Chemotherapy

When it comes to killing cancer, sometimes timing is everything. In studies backed by the National Institutes of Health, David Waxman—who is a professor of biology and a professor of medicine, as well as associate director for basic research at the BU Cancer Center—has found that simply altering the scheduling of chemotherapy may enlist the body's immune system as an additional cancer fighter.

Waxman's research builds on the idea of "metronomic chemotherapy," conceived about a decade ago by the late Judah Folkman, the famous cancer researcher of Children's Hospital Boston. Instead of giving patients several, widely spaced rounds of a "maximum tolerated dose" of chemotherapy, which poisons both cancerous and healthy tissue, Folkman proposed using lower chemotherapy doses more frequently. In his studies, metronomic chemotherapy not only killed cancer directly through toxicity, it also shrank tumors. The theory on the latter effect was that more frequent drug doses did sustained damage to the blood vessels that supply tumors with oxygen and nutrients, a process known as "anti-angiogenesis."

David Waxman

Altering a patient's treatment schedule to maximize his or her immune response—by giving lower doses more frequently, and by utilizing an older chemotherapy drug—can shrink tumors more efficiently.

In Waxman's own metronomic chemotherapy studies, which involved administering an older drug called cyclophosphamide every six days to mice with induced tumors, he observed tumor regression to an extent "that we had never seen using maximum tolerated dose." Some tumors even disappeared completely.

But, says Waxman, "we reasoned that there had to be another mechanism," beyond destroying blood vessels. They based this suspicion partly on the relatively weak tumor-shrinking performance of a new class of anti-cancer drugs that specifically work as anti-angiogenesis therapies, targeting the tumor-feeding blood vessels.

And they were right. When Waxman and his team compared some of the new, anti-angiogenesis drugs directly with metronomic chemotherapy, the anti-angiogenesis drugs were better at knocking out blood vessels, but not nearly as effective in actually shrinking the tumors. In addition, says Waxman, studies carried out by Joshua Doloff, a doctoral student in Waxman's lab who graduated this May, revealed "lots of immune cells populating the tumors" of the mice receiving metronomic chemotherapy. That raised the astounding possibility that an older chemotherapy drug not only out-performs a new drug specifically designed to starve tumors of their blood supply, but that this older drug was recruiting a cancer fighter that researchers have been trying to harness for years—the body's innate immune system.

Unlike the adaptive immune system, which attacks only specific pathogens it identifies as foreign, the innate immune system is a more general defense against infection. Waxman and his collaborators are now trying to determine why metronomic chemotherapy might trigger this response. One hypothesis favored by Doloff is that the repeated damage to cells by metronomic chemotherapy triggers a sustained inflammation response. "In that case," says Doloff, "the immune system is going in basically to clean up the mess."

The mystery is complicated by the fact that the treatments are remarkably effective against some tumor types but relatively ineffective in shrinking others, including some types of colon, lung, and prostate tumors. "We need to understand more about the mechanism to know whether there's a way to stimulate this process in humans," says Waxman.

Knowing the Enemy

Behind the 1.4 million new cancer cases in America every year are even more stories—about lives before and after the diagnosis and about the ups and downs of treatment. Last April, second-year Boston University School of Medicine students heard one of these stories from a 67-year-old woman who recently completed surgery and radiation for breast cancer.

The students listened, and then they asked questions ranging from, "How did you first react to the diagnosis?" to "Is it okay for oncologists to hug their patients?"

The class is part of the Oncology Education Initiative, spearheaded by Ariel Hirsch, an assistant professor of radiology, and Karen Antman, dean of the School of Medicine.

"No matter what field they choose, every medical student is going to encounter cancer at some point in their career," says Hirsch, whose education initiative began in 2007 when she arranged to give a single lecture on radiation oncology to all fourth-year medical students during the core radiology rotation.

In 2009, her efforts were helped by an education grant from the Radiological Society of North America, and she became the leader of a new two-week oncology block in the medical school's second-year curriculum. Previously, BU medical students learned about cancer in a piecemeal fashion—covering lung cancer in the pulmonary block and colon cancer when learning about the gastrointestinal system, for instance. In addition, the fourth-year rotation in radiology was expanded to third-year students, giving more students the chance to shadow Hirsch as she treats patients and to collaborate in her research.

Such comprehensive cancer education, particularly the instruction in radiation oncology, is rare in medical schools, says Hirsch. In fact, a 2009 literature review found only seven journal articles in ten years that mentioned teaching radiation oncology to medical students, and two of them were about the efforts at Boston University.

Ariel Hirsch

WEB EXTRA
See more at **www.bu.edu/research/magazine**

"Cancer is the second leading cause of death in this country, and rising. And about 60 percent of cancer patients will be treated with radiation," says Hirsch. "We need to make sure we're as prepared as we can be for that."

Being prepared includes understanding the emotional side of patient care, says Hirsch, whose office is decorated with gifts from former patients—a doll from Trinidad, a decorative plate adorned with a Jamaican flag, a wood figurine carved by a Haitian patient.

It also means learning about the cutting-edge radiation equipment that sits behind thick, shielded doors down the hallway from Hirsch's office, such as the "CyberKnife," installed in 2008, which uses a large, robotic arm to deliver a high dose of radiation from multiple angles, and has image-guided tracking software and a camera that syncs the radiation beam to a patient's breathing cycle for increased accuracy.

Finally, it means exposure to research. Hirsch invites students to collaborate with her in ongoing studies, on topics such as radiation therapy after robot-assisted prostate cancer surgery, and the effects of embedding radiation-emitting radioisotopes in the cement used to reinforce vertebrae and alleviate the pain of malignant compression fractures that result from cancer spreading to the spinal column.

Hirsch also involves students in measuring the effectiveness of the oncology education initiative and in finding ways to improve and expand it, with the ultimate aim, she says, of creating a model for oncology education at other medical schools. One of Hirsch's advisees, Nick DeNunzio, who is pursuing a joint MD/PhD in physiology and biophysics, is the lead author on a paper recently accepted by the *Journal of the American College of Radiology*. It recommends that medical schools reinforce oncology education with extracurricular initiatives such as lunch-time faculty seminars, student interest group advising, mentoring programs, and summer research internships.

"It's these auxiliary pieces of education, not necessarily in the classroom, that can supplement and strengthen an understanding of the field," says DeNunzio. After all, he says, "you only have so many hours in a day, and you have all of medicine to cover during those four years."

"Cancer is the second leading cause of death in this country, and rising. And about 60 percent of cancer patients will be treated with radiation. We need to make sure we're as prepared as we can be for that."

Patient Vernon Buchanon, MD/PhD student Nick DeNunzio, Assistant Professor of Radiology Ariel Hirsch, and MED student Roxanne Handal, *above (l–r)*, discuss treatment options and outcomes.

BY KATHERINE CALVER HAWKINS

Massachusetts: Health Care Reform's Guinea Pig?

Ever since Massachusetts became the first state to mandate health insurance in 2006, the nation has been watching to see how the reforms would impact patients and hospitals. A recent study conducted by School of Medicine faculty members Amresh Hanchate and Nancy Kressin may offer some clues.

The study has caught the attention of policymakers, researchers, and others across the country who are interested in how previously uninsured and underinsured individuals may be benefiting from health care legislation. In particular, Hanchate and Kressin are investigating whether minority populations that did not have access to affordable health insurance before 2006 have started to seek medical attention for referral-sensitive procedures. Hanchate defines these as "inpatient surgical procedures for which most admissions are scheduled by physician referral and not via the Emergency Department or transferred from other inpatient facilities," and which are therefore likely to be sensitive to insurance status. Such procedures are traditionally underutilized by minorities.

For their study, Hanchate and Kressin focused on a range of cardiovascular, cancer, and musculoskeletal procedures. They began, says Kressin, with a fundamental question: "If somebody now has an insurance card that they could take to a primary care provider, would they be more likely to get care (e.g., a procedure) that requires the provider's referral?"

To ascertain whether access to health insurance had made an impact, Hanchate and Kressin analyzed data collected from Massachusetts hospitals on referral-sensitive procedures performed between 2004 and 2008—two years before and two years after the health care legislation passed. They used inpatient discharge data on 2,656,554 white patients, 195,481 African American patients, and 172,852 Hispanic patients.

The results were staggering. The data showed a marked increase in the use of these procedures across the board, but especially among the minority groups. African American patients, for instance, had a 25 percent increase in heart surgeries after the passage of health care reform. For knee replacement surgeries, there was a 17 percent increase among African Americans, and a 9 percent increase among Hispanics. "We have shown that health care reform has positively impacted minority patients in Massachusetts," says Hanchate.

In addition to referral-sensitive procedures, Hanchate and Kressin are also interested in examining the impact of health reform on the use of emergency admissions. Without insurance, patients with nonemergency conditions tend to wait until their health deteriorates to the point where they cannot continue without medical care. Then they go to the emergency room. As a result, says Hanchate, "Any time a patient comes into the ER because of complications of asthma or diabetes, we say it's in some sense a failure of proper care."

There are several problems with this strategy. Emergency room visits are expensive, for one thing, and patients who cannot afford health insurance can rarely afford to pay thousands of dollars for emergency care. There is a human cost, too, for the lack of health insurance that goes far beyond the price of a trip to the ER. "One response from the patient would be just to delay, and people can delay to some extent things like knee replacements," says Hanchate. "The way some people cope is just by cutting down on their activity level and postponing." In many cases, the decision to postpone can be life-threatening.

"We have shown that health care reform has positively impacted minority patients in Massachusetts."

Yet another step in their research will involve taking a closer look at what hospitals are doing to reduce the rate of readmission. "If people have better access to outpatient care when they come home from the hospital," says Kressin, "that may prevent them from needing to be quickly readmitted for something that didn't get resolved once they were discharged from the hospital." Currently, 20 percent of people who are hospitalized return to a hospital within a month, which could mean that hospitals need to do a better job of explaining to patients when and how they need to follow up with their primary care physician for treatment and medication.

Last year Hanchate and Kressin were selected to share their early findings in a plenary talk at the Society of General Internal Medicine's annual meeting, reflecting the wide appeal and interest of their work.

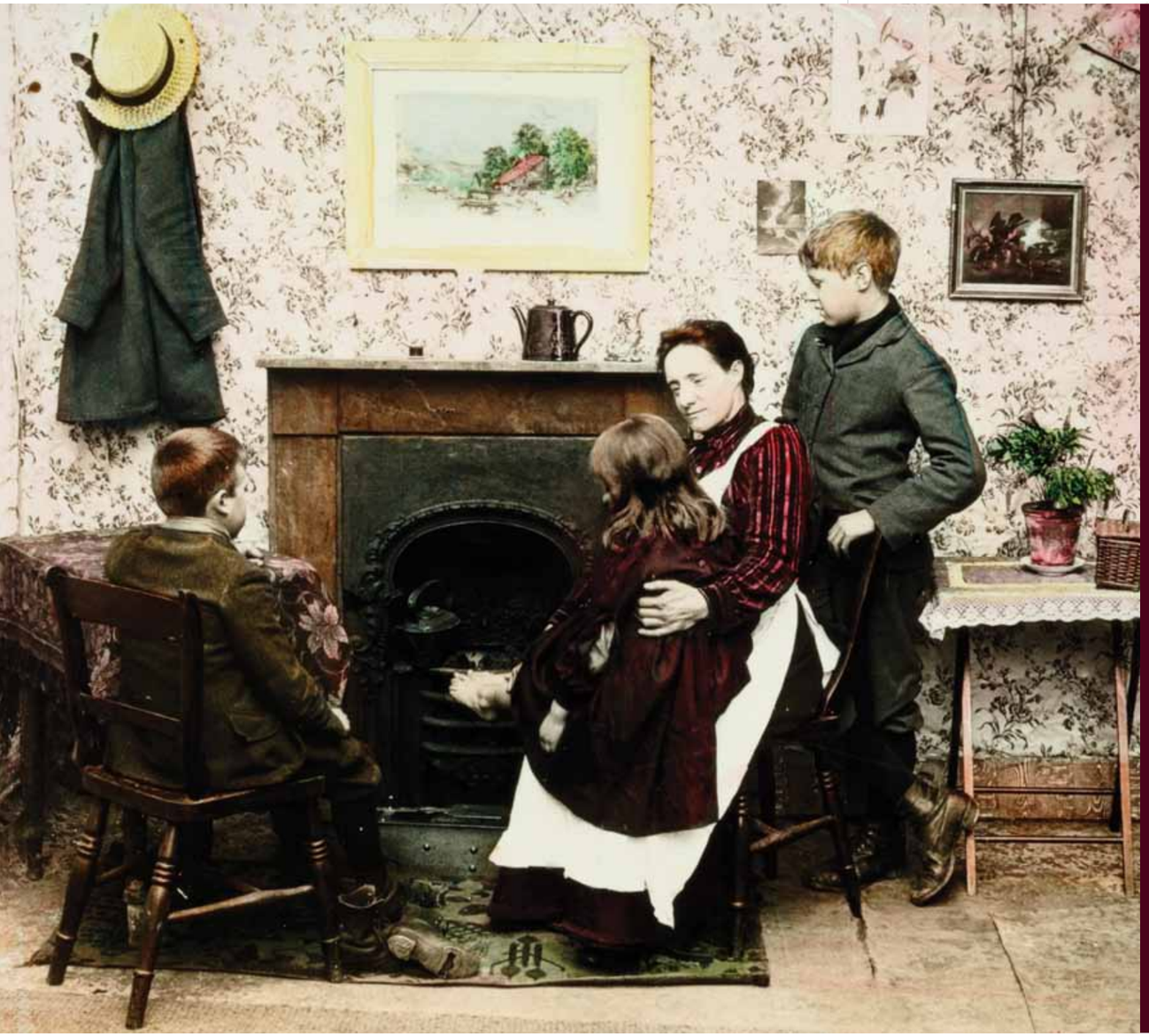
"The national health reform law that passed earlier in the year is very similar, in many respects, to the Massachusetts reform law," says Hanchate. "The entire nation is going to be watching how Massachusetts turns out, and any effects that we see here are going to directly get the attention in Washington, DC."

Amresh Hanchate

Nancy Kressin

ASSESSING THE RISKS OF VACCINE AND MEDICINE USE DURING PREGNANCY

BY BARI WALSH



FAMILY MATTERS

By the end of the 20th century—a century that saw women secure the right to vote, begin to follow educational and professional pathways long blocked to them, and gain control over their fertility—it was easy to think that the "Woman Question" raised by Victorian-era suffragists had at last been resolved. And yet the role of women in global society continues to change and to be contested. Women's own perceptions of their status—and consequently, their advocacy for their own needs and the needs of their families—ripple out to affect the health and well-being of entire communities. New research from across BU's two campuses is shedding light on the evolving roles, rights, and responsibilities of women historically and in the present day.

REDUCING INFANT MORTALITY RATES IN ZAMBIA

THE ROLE OF MEN IN MODERN BRITISH FEMINISM

DUAL-CAREER COUPLES AND THE FALLING DIVORCE RATE


1


2


3


4

New Hope for Newborns

Clean, dry blankets. Antibiotics. Immediate, exclusive breastfeeding. A sterile blade for cutting umbilical cords. The tools for ensuring the health and safety of newborn babies are humble—and frustratingly elusive in many parts of the world. Even as overall childhood mortality has declined, nearly four million babies die each year within their first month, the majority from entirely preventable disorders.

How to bridge the distance between what we know will save newborns' lives and the stubbornly high neonatal mortality rate in places like Africa and South Asia? One way is to attack the problem on the ground—to go into poor, rural communities, look at exactly what happens and who surrounds a woman as she delivers her baby, and find practical, easily implementable methods of influencing those events.

WEB EXTRA
Davidson Hamer spent three months in Zambian clinics observing malarial diagnostic testing and treatment. Learn more at **www.bu.edu/research/magazine**


Davidson Hamer

That's what Davidson Hamer has done for the past 15 years, and that's what the Bill and Melinda Gates Foundation is doing by funding his latest project, one that looks at the effects on infant survival of a beautifully simple postnatal intervention to improve umbilical cord care in Zambia's Southern Province.

Hamer, a professor of international health and medicine, has a five-year, $8.4 million grant to study the effectiveness of getting mothers to apply a 4 percent solution of chlorhexidine, a topical disinfectant, to umbilical cords in the days immediately following birth. Chlorhexidine helps to prevent sepsis, "a severe bacterial infection that probably accounts for between 20 and 40 percent of neonatal deaths, depending on the region," Hamer says. Sepsis can arise when bacteria get into the bloodstream, either through infection of the umbilical cord stump, treatment of the cord with contaminated substances, or by cutting the cord with an unsterile knife. "The newborn's immune system has not fully developed," Hamer says, "and the bacteria can cause it to become very sick, very quickly." Hamer will be assisted by Katherine Semrau, an assistant professor of international health and epidemiologist who has extensive experience living and conducting research in Zambia.

Very few large-scale neonatal survival interventions have been tried in Africa, due in part to the lack of population density in many regions. Hamer has worked in Zambia before, so navigating through the country's topographical challenges and complex system of health ministry officials, local chieftains, community health workers, and traditional birth attendants (TBAs)—all of whom he needs to involve and engage—is familiar.

Hamer and colleagues at the Center for Global Health & Development conducted a study in the north-central Lufwanyama District. Hamer's project trained TBAs—minimally educated women who act as midwives—to treat the most preventable causes of newborn death: sepsis, neonatal asphyxia (respiratory failure), and postpartum hypothermia. The results were so encouraging—with approximately 40 percent fewer neonatal deaths in newborns tended by the trained TBAs—that Save the Children has helped convert the study site into a five-year, community-based program to improve maternal, neonatal, and child health and to serve as a model training center for other organizations interested in carrying out similar work in poor rural populations in Africa.

His current project, Hamer hopes, will have similar long-range impact, especially when assessed alongside another Gates-funded study, also looking at chlorhexidine and umbilical cord care, in Tanzania. "If these two large, well-designed studies show similar impact—a 10, 20, 30 percent reduction in mortality—that, along with recent findings from South Asia, will be enough evidence for the World Health Organization to change global policy," he says.

Poverty, poor infrastructure, and a lack of education have conspired to produce high infant and maternal mortality rates in Zambia's Lufwanyama District *(1, 2)*. But early results of a study by Davidson Hamer suggest that by training traditional birth attendants *(4)* to avoid the three most common causes of neonatal death—sepsis, asphyxia, and hypothermia—infant mortality can be reduced by 40 percent, leading to healthier and happier mothers and babies *(3)*.

Safety in Numbers

When the thalidomide tragedy of the 1960s revolutionized the drug regulatory system in the United States and elsewhere, the only group that did not benefit from the new safety net was the same group devastated by thalidomide's destructive effects: pregnant women and their babies.

The drug, touted as safe and effective, was given to treat morning sickness in pregnancy; after its dire consequences became apparent, in children born with shortened limbs and other malformations, thalidomide was quickly banned, and stricter testing protocols for medications and pesticides were later mandated.

"But when a drug comes onto the market today, it has almost never been tested in pregnant women," says Allen Mitchell, professor of epidemiology and pediatrics and director of the Slone Epidemiology Center. There are good reasons for that, he says—ethical clinical trials would be impossible to construct—"but it means that the only time you can study the safety and risks of a drug in pregnancy is when it's in the marketplace."

Since 1976, Mitchell and his colleagues at Slone have done precisely that, collecting data on prenatal drug exposures in more than 40,000 women through Mitchell's pioneering Birth Defects Study (BDS). Now the study is being expanded with a significant federal investment and an infrastructure that promises an unprecedentedly comprehensive view of risk and safety. The goal is to provide critical risk and safety data for women and their doctors, with the initial focus on seasonal flu vaccine, antiviral medicines used to prevent or treat flu, and commonly prescribed asthma medications. As the study expands, it will also gather data on the wide range of medications used by pregnant women, including over-the-counter headache

cures and herbal remedies. Thus, the study will identify as early as possible which medications are relatively safe and which might pose a risk to the fetus.

BDS is one of two data collection components collaborating with the American Academy of Allergy, Asthma, and Immunology on what is being called the first broad-based, systematic study of the risks of vaccines and medicines in pregnancy. The new study—Vaccines and Medication in

(continued on next page)


Allen Mitchell

Pregnancy Surveillance System (VAMPSS)—was launched in September 2009 with the initial mandate to look at H1N1 vaccine, seasonal flu vaccine, two antiviral flu medications, and asthma drugs. It will combine the strengths of complementary—but separately implemented—epidemiological techniques, a case-control surveillance method developed by the Slone Center, and pregnancy registries (cohort studies) conducted by a network of specialists who collaborate through the Organization of Teratology Information Specialists.

Mitchell's group identifies women in four regions of the country who have given birth to children with defects, and a smaller group of women with normal outcomes, and then conducts carefully constructed interviews designed to identify every drug or herbal remedy they took during pregnancy. Among its many findings, the Birth Defects Study has shown that antidepressant use in pregnancy is generally safe, but that among a popular group of antidepressants, SSRIs, Prozac carries the lowest risk of birth defects and Paxil the highest. That finding wound up on the medication label, and Paxil use in pregnancy has since dropped, Mitchell says.

"The Food and Drug Administration has not only the legal authority but a legal mandate to demand post-marketing safety studies for drugs that were not adequately studied in pregnancy prior to marketing—which means just about everything," Mitchell says. The agency has been slow to flex that authority, he adds, but that may be changing. "There is considerable excitement at the FDA, and also at the Centers for Disease Control and Prevention, the National Institutes of Health, and in practitioner groups, about what our study will yield."

WEB EXTRA
Pregnant women with depression can sleep a little easier. Learn more at **www.bu.edu/research/magazine**

Sex and Sensibility

In the history of feminism and the women's rights movement, one group of key actors in late-18th-century Britain has been long overlooked.

Swept forward by the revolutionary currents then swirling, they socialized and debated in mixed-gender clubs, or pushed for broader educational opportunities, or courageously withstood public censure to call for full political participation for women.

Who were these bold thinkers? In a word, men—men who, for a variety of moral, philosophical, and even self-serving reasons, felt strongly that women's rights were not just a women's issue, but a matter of concern to society at large.

In an act of historical recovery, Arianne Chernock has brought this loosely connected group of several dozen dissenters and reformers to the fore in *Men and the Making of Modern British Feminism* (Stanford University Press, 2010). As she shows, these progressive educators, theologians, historians, essayists, and physicians were living in a time when the subject of individual rights—who had them and how they were conferred—was central to the intellectual and political discourse.

These reformers were unconventional, nonconformist, and mostly fringe characters, with the exception of Jeremy Bentham, a radical jurist and philosopher best remembered as the founder of utilitarianism. "I don't claim that they were emblematic of the broader society," says Chernock, an assistant professor of history. "But these were men who really saw women's rights as a social concern that had a lot to say about the health of their own state. They were broadly interested in what it would mean to live in what they called a 'perfect state.' This was a moment of revolution, and so we see a lot of utopian ideas circulating."

Utilitarian philosopher Jeremy Bentham advocated women's suffrage as a key part of the "perfect state."

Those ideas, and the passions they engendered, were eclectic. Most of the men shared an opposition to slavery and to the so-called Test and Corporation Acts, which penalized religious dissenters. Many were also "campaigning for their own political representation," says Chernock, since less than one-fifth of men in Britain could vote at the time. Others championed things like vegetarianism and penal reform, or even argued "that the alphabet should be made more democratic by introducing phonetic spelling. There is a real range of figures there," Chernock says.

Their motivations differed widely, too. Some were clearly driven by personal histories, and by a sense of their own status as second-class citizens. Others "embraced women's rights primarily to be consistent and to avoid hypocrisy," Chernock says, "especially those who subscribed to the theory of natural rights."

(continued on page 18)

Arianne Chernock

BY CASSANDRA NELSON

Building a Better Vaccine

Streptococcus pneumoniae—a bacterium that can cause pneumonia, meningitis, and a host of other invasive infections, resulting in the deaths of between two and three million children each year—is a master of disguise. Its outermost surface is covered by a capsule made up of sugars, and can come in any of 91 different capsular variants, or serotypes, depending on the composition of the sugars. The large number of serotypes—each with a different antigen that must be recognized by the body's immune system in order for the bacteria to be destroyed—has so far thwarted efforts to develop a vaccine effective against all capsular variants of *S. pneumoniae,* also called pneumococcus.

Professor of Pediatrics Richard Goldstein hopes to change that, soon. A molecular geneticist by training, he is bringing a thorough knowledge of evolutionary mechanisms to bear on the search for a novel pneumococcal vaccine target, with support from the Hartwell Foundation and the National Institutes of Health.

The existing vaccine, Prevnar-13, offers protection against 13 of the most common and virulent *S. pneumoniae* serotypes. It is an extraordinary accomplishment, says Goldstein, who cites Prevnar co-inventor Porter Anderson as one of his heroes, but unfortunately it may not offer a permanent solution.

"Prevnar-13 responds to the most prevalent serotypes responsible for invasive pneumonia in North America," Goldstein explains. "But the dark cloud is, subtract 13 from 91 and what do you get? The others are still out there. The question then becomes, will those other serotypes step in to replace the 13 covered by Prevnar?"

The answer appears to be yes. Epidemiological evidence suggests that the highly variable *S. pneumoniae* is capable of circumventing vaccines, through an increase in infections by non-vaccine serotypes. "But a broadly efficacious 91-valent vaccine is quite unlikely," says Goldstein. "It's too complicated to manufacture, and too costly to attempt."

Instead, Goldstein intends to identify and characterize a new category of vaccine target, called a "common surface protein"—that is, an antigenically accessible protein universal to all of the otherwise variant capsular types of *S. pneumoniae.*

Richard Goldstein

To do so, he is surveying pneumococcal DNA for genes that might code for such common proteins, then determining which of these genes are resistant to mutation, and thus "conserved" throughout the species. "If it's not conserved across the species, it's not a good vaccine target," says Goldstein, because it leaves nature with a vacuum to fill. "The goal of the common protein strategy is not to allow for that vacuum."

Goldstein is currently examining what he calls "chromosomal cold spots"—regions of pneumococcal chromosome where variation is tolerated. "Mutations do occur," Goldstein says. "However, those mutations are lethal. Any bacterium with that mutation is naturally purged from the population." The hope is that one or more of these "cold spots" will prove to encode a highly promising vaccine target.

To test whether a particular cold spot is conserved across the species, Goldstein has amassed a unique collection of over 1,000 pneumococcal isolates from around the globe and organized them by genetic-relatedness into a vast phylogenic tree. The phylogenic tree serves as a template of *S. pneumoniae* species evolutionary diversity.

The larger the tree, the more accurate a picture of species evolutionary diversity it provides. "There's no one in the world who has the collection I have, and even so, it is not yet robust enough," says Goldstein, who recently received hundreds of additional isolates from Africa and South Asia, thanks to collaborators at the Centers for Disease Control and Prevention and in Karachi, Pakistan. "A phylogenetically organized collection, that's the key thing."

The task before him amounts to a monumental and painstaking process of collation, but Goldstein is eager to take it on, driven by a strong desire to prevent and alleviate suffering caused by *S. pneumoniae.* "More than two million children die a year of pneumococcal infections," he says, and those who survive can be left with serious, lasting health problems. "Of course children in poor, developing countries suffer the most. But this is a real problem in the United States too because of serotype replacement."

Goldstein dreams of recreating Porter Anderson's remarkable success with another vaccine, for *Haemophilus influenzae* type b (Hib), which has resisted serotype replacement for more than two decades and led to a 99 percent drop in deaths and serious complications from Hib since the early 1980s. "I always wanted to ask him, 'How does it feel to get up in the morning? To know you've saved millions of children's lives?'" If the common protein strategy proves successful, Goldstein just might find out. R

www.bu.edu/bostonia/summer10/goldstein

Richard Goldstein talks about how Darwin's method of inquiry has influenced his search for a life-saving vaccine.

Some believed that women's unequal status actually demeaned men, though that argument was not always beneficial to women. A novelist named James Henry Lawrence, for instance, urged men to abandon patriarchy and relieve themselves of the constant burden of having to provide for their families. "He was saying, if we give women these rights, men could become this amazing group of philosophers, politicians, poets, and everything else we want to be," Chernock explains.

That ignoble rationale is one of the reasons why she frames the book as an argument not for male feminism but for the decoupling of sex and feminism. "I'm not trying to undermine women's contributions and accomplishments," she says. "But we have a much more solid foundation for thinking about women's rights when we realize the range of people who subscribed to them, and the range of reasons why they did."

Working It Out

Want a long and happy marriage? You have to work for it. Literally.

In an important series of studies that cast a critical eye on the nostalgically driven, politically loaded idea that working women are bad for marriage, two BU economists have found that dual-career marriages are actually more stable, and less likely to end in divorce, than marriages in which only one partner works.

Looking at a cross section of U.S. states, Professor of Economics Andrew Newman and Associate Professor of Economics Claudia Olivetti have found that in states where women have a very high rate of participation in the labor force, such as Wisconsin, Minnesota, and Iowa, the divorce rate is lower than in states like Kentucky or Arizona, where the female labor force participation is low. Similarly, in states with a high percentage of two-earner households, divorce rates are much lower, even controlling for total household income.

This most real-world of applied research projects started as a conversation between two theorists. Newman and his former BU colleague Zvika Neeman, now at Tel Aviv University, were observing that in bargaining theory, "it made a difference whether the participants in the bargain were able to make what we economists call side payments to one another," Newman says. "We said that one example of that would be a household consisting of two earners—that they'd have many more allocation possibilities than a household with just one earner."

Predicting fewer divorces in the two-earner households, they approached Olivetti, who studies issues related to women's employment and wages. She confirmed an under-recognized fact: since the mid-1980s, as women have increased their participation in the labor force, divorce rates have actually fallen. Theories about working women *causing* divorce—theories that held sway both in the popular mind and in academia, Olivetti says—"fall to pieces" when you look at the data.

Newman and Olivetti subsequently found that "for couples in which the wife can be considered a career woman, the probability of the marriage ending in divorce is 25 percent lower than for other couples," Olivetti says. And when they looked at couples in which the wife makes at least 50 percent of the household income, those equal-earning marriages are even less likely to end in divorce.

What is driving the correlation? It's not about total income, Newman and Olivetti stress, since marriages with one high-earning partner were not protected. It's about the distribution of money—and purchasing power—within the household. The researchers speculate that something called flexible accommodation is at play—which brings the conversation back to bargaining theory.

"The nice thing about money, as crass as it may seem to think that this is how we relate to each other, is that it enables you to purchase a full market basket of whatever goods you like," says Newman. "And so when things get a little difficult in a marriage, accommodations can be made." You can hire a babysitter for a weekend away, or relieve your spouse or yourself of lawn-mowing or housecleaning duties. "In a two-earner household, you're going to be able to accommodate more of the vicissitudes of married life," Newman says. Money still can't buy you love, in other words, but the equal distribution of it may buy a durable marriage. R

Claudia Olivetti

Andrew Newman

BY SHERYL FLATOW

Orchestrating Success

Freedom of expression. Freedom to travel. Freedom to live an intellectually stimulating, professionally challenging life. That quest for freedom impelled Yuri Mazurkevich, professor of music, and his wife, Dana, associate professor of music, to leave the Soviet Union in the mid-1970s and head west. He quickly established himself as a sought-after recitalist and teacher, and in 1985 joined the faculty of the School of Music in BU's College of Fine Arts. For 25 years, Mazurkevich has helped train a new generation of violinists, many of whom came to Boston University because they had seen him perform and were eager for the opportunity to study with him.

The School of Music, founded in 1872, holds the distinction of being one of the few music conservatories to be part of a major research university. That, says Mazurkevich, is what makes the experience for students so rich. "They're given the chance to explore the world in every direction: intellectual thought, and culture, and politics, and literature. It gives students the incredible opportunity to grow not just as musicians in their own profession, but to be informed and accomplished in many fields."

"I'll listen to someone play, and suddenly there is a sound or phrase that catches my ear or my feelings. And I think, 'Aha. There is something that would be interesting to work with.'"

In taking on a student, Mazurkevich seeks more than a skilled violinist. "I'm looking for a personality, for imaginative and lively expression," he says. "You can teach proficiency, but it's almost impossible to teach musical intuition. I'll listen to someone play, and suddenly there is a sound or phrase that catches my ear or my feelings. And I think, 'Aha. There is something that would be interesting to work with.'"

He works with students one on one, and gathers them together every week or two in a studio session, to play for and critique each other. "It helps young violinists to develop some skills for playing publicly," he says. "There are many people who can play very well in class situations, but when they go onstage they have stage fright and everything changes." Students also give a number of concerts on campus that are open to the general public.

When a student is learning a new piece, Mazurkevich requires them to research the composer and the period. "They have to know the culture, the period, the style," he says. "The main thing is that after you know something about the piece, and you've practiced and know the notes, you have to make sense of the notes. And that's a matter of interpretation. I always ask them to do independent thinking, and present the piece in such a way that it makes sense and people will enjoy it."

Yuri Mazurkevich

Mazurkevich studied at the Moscow Conservatory with world-renowned violinist David Oistrakh. Upon graduation, he was sent to teach at the Kiev Conservatory. "In the old Soviet Union, it was a rule that when you finished your higher education, you were directed to go wherever they sent you and work for three years," he says. "They could send you to Siberia if they wanted to, and you couldn't refuse. Fortunately, the Ukrainian government asked that three of us from Ukraine be sent there to help with music education."

In addition to teaching, Mazurkevich won three international competitions and was performing in concerts. But he couldn't go anywhere without KGB approval. "Sometimes they would allow me to go, but my wife couldn't go with me," he says. "She'd be back there like a hostage. As performing violinists, it was important for us to see the world and play everywhere and meet other musicians and develop working relationships. I traveled from time to time, but it was always very difficult and unpredictable. Everybody knows now that the Soviet Union was not a beacon of freedom."

Dana Mazurkevich is Jewish, and when the Soviet Union began allowing Jews to emigrate in the early '70s, the Mazurkeviches applied and were permitted to leave. They went to Canada before coming to Boston.

Their careers took off—they often play together as a duo—and in 1990 Mazurkevich was invited to join three other native Ukrainians as part of the Leontovich Quartet. "We played our first concert in New York City at the Frick Museum and got a terrific review in the *New York Times*," he says. "We became incredibly successful." His renown has benefited Boston University. "If you're getting rave reviews, it adds to the reputation of the school. Talented young people have come here because they heard me play in Hong Kong or Korea or Canada. We are still benefiting from activities that were done 10, 20 years ago."

Many of his students have gone on to play with prominent orchestras, including the Philadelphia Orchestra, Orchestre Symphonique de Montréal, and the Toronto Symphony Orchestra. Others have gone on to teach. Still others have chosen careers outside music. "Some decide it would be more practical to go for another profession, and keep music as something they enjoy in their life," he says. "Success to me is if someone enjoys what they're doing, whether in music or not in music. If you can keep playing music and enjoy it, but find something else that fulfills you as well, that's fine too." R

BY O'RYA HYDE-KELLER

All About Asia

The world's largest and most populous continent, Asia may also be the most diverse, with subregions containing vastly different cultures, environments, historical ties, and government systems. For centuries it has captivated the imagination of visitors from around the world. Today, it inspires the research of more than 50 faculty members affiliated with BU's Center for the Study of Asia.

Together and independently, faculty at BU are exploring the history, economics, values, and art of Asia from a variety of perspectives. With projects focusing on leisure, coffee, and a little-known 19th-century civil servant, it seems that sometimes you have to start small to tackle a subject as large as Asia.

The way in which leisure often holds up a mirror to life, reflecting larger political and socioeconomic trends, can be seen in Tateishi Harumi's painting *Clover* (1934), which captures the bittersweet mood of Japanese society as it transitioned from expansive imperial optimism to an increasingly militaristic authoritarianism in the first half of the 20th century. Painting used with permission of the Museum of Fine Arts, Boston.

A COLORFUL MEMBER OF THE CHINESE LITERATI

CAFÉ CULTURE IN JAPAN

LEISURE IN ASIA ACROSS THE CENTURIES

A History of Hobbies

What do modern-day Japanese smokers, Qing imperial hunts, and the art of the Mughal Empire all have in common? That's what several faculty members in Asian Studies found themselves asking in 2008, shortly after the opening of the BU Center for the Study of Asia, led by William Grimes, an associate professor of international relations and the center's director until last summer.

In September, Joseph Fewsmith became the new director, and Grimes became chair of the International Relations Department. With more than 50 BU faculty involved, the center's diversity—in terms of geographic regions of interest and scholarly disciplines, with everything from Turkey to China and economics to art history represented—was overwhelmingly full of possibilities.

"We wanted to know, what kinds of interests do we share? And how can we build on the synergy of all of us being in one place?" says Robert Weller, professor and chair of the Department of Anthropology. "We were looking for a topic that enough people worked on, and found interesting and fun, to pursue."

The point of convergence turned out to be a surprising one: leisure. The ways that people across Asia have spent their free time over the centuries was a topic that many Asian Studies faculty were already looking at—some without even realizing it. "At first you might think, I've got nothing to say about this topic," says Weller, who is currently looking at the relations between religion and civil life among Chinese communities in Malaysia, China, and Taiwan. Key to facilitating collaboration across departments, he says, was encouraging researchers to "rethink what we even mean by leisure."

"For example, if long ago a member of the Chinese elite painted in the evening, that's not exactly leisure because we know he had to do it to maintain his political credibility," says Weller. "So, then, is playing golf today leisure? Leisure turns out to be this loose and sloppy concept. When you talk to other people and think about these things in a new way, it becomes really interesting."

Weller, together with Catherine Yeh, an associate professor of Chinese, and Eugenio Menegon, an associate professor of Chinese history and world history, both in the College of Arts & Sciences, has launched a three-year project titled "Leisure and Social Change: The Transcultural Flow of Concepts, Institutions and Practices across Asia." Fifteen faculty members from six departments will meet regularly to present new research and look for areas of collaboration, with visits from invited guest speakers from other academic institutions. Each year, an international workshop is planned on one of three focus areas: Leisure and the State; Leisure and Money; and Leisure, Gender, and the Generation Gap. The first conference will be held at BU, the second in Europe, and the third in Asia.

The goal is to examine leisure from a multidisciplinary perspective, as well as explore how concepts and practices of leisure change—or don't—across boundaries of geography, time, nationality, culture, and class. Ultimately, project participants hope to collect the scholarship produced over three years in one or two edited books.

(continued on next page)

The moment of triumph in Chinese emperor Quianlong's stag hunting expedition is depicted on a silk scroll by Father Giuseppe Castiglione (1688–1766), *left,* while Mei Lanfang performs as Meng Yuehua in the opera *The Pavilion of Royal Monument.*

Surprising Spaces: Café Culture in Japan

Soon after Merry White arrived in Japan in the mid-1960s for the first time, she was invited out to a local coffeehouse in Tokyo.

"It was a dark, cavernous, French-style artists' café. And the first thing I noticed was that there were white sheets hanging all over the walls," she says. "Soon after we arrived, we were asked to take off our clothes." Artists at the café painted White's body with bright, cobalt blue paint, and then she and the other participants became living paintbrushes, à la Yves Klein, pressing themselves against the white sheets. "This was not the Japan I expected," she says. "It never is."

Since that first trip to Japan, White, a professor in the Anthropology Department, has become a leading expert on Japanese culture, publishing multiple books on the country's education system and popular culture. And that surprising episode at the coffeehouse has always stayed with her, inspiring her forthcoming book with the University of California Press on the role of the urban coffeehouse in Japanese society.

To research her book, White became a regular at 14 cafés in Tokyo, Kyoto, Osaka, and Kobe over four years, and spent hours upon hours interviewing customers as well as coffee masters (the people we know as baristas). She enrolled in a coffeehouse management course, so she could learn more about the logistics that went into running these prolific public institutions—there are often multiple coffeehouses on a single city block in Japan. She also spent time with Japanese coffee roasters and importers and read primary documents from the 1600s when coffee was first brought to Japan, including Dutch journals that recounted Japanese prostitutes trying coffee for the first time.

What White discovered is that coffee, not green tea, is the foremost social beverage in Japan. There have been coffeehouses in Japan since the 1880s, and the country is the third-largest consumer of coffee, after the United States and Germany. The first coffeehouse chain in the world, Paulista, opened in Tokyo in 1908. Japan is also the frequent testing ground for new varieties of coffee before they go on to be marketed throughout the world. "The Japanese have higher coffee standards than anywhere else," White says. "So if your coffee can pass there, it can pass anywhere."

Specialty coffee in Japan is usually served using a hand pour, rather than brewed by machine. And the Japanese prefer blended coffee. "This preference comes from the sense that a real master can 'play' the different notes of different coffees together, making a symphony of flavor," says White. The whole process, she says, is very handmade, very artisanal—as much a cultural experience as a beverage. Recently, cafés in the United States and Europe have begun to use Japanese techniques to brew and serve coffee. "What interests me is coffee as an industry in Japan, but also this new export of Japanese-style coffee from a place that people really don't think of as a coffee-drinking country," she says.

Merry White

And it's not just this prevailing image of the Japanese as the quintessential tea drinkers that White hopes to challenge. She also hopes her work will confront other common stereotypes. "We have the idea that the Japanese are all incredibly fastidious people who sleep and work and don't take time off," she says. But Japanese cafés show another, more dynamic side of Japanese culture, playing a central role in the country's arts and cultural scene. And unlike the United States, where you'll usually find patrons firmly fixated on their laptop screens, the coffeehouse in Japan has remained a vibrant social center. That said, Japanese cafés can also serve as a personal time-out space, where an individual can find solitude in public, a rare thing in what White calls a "densely relational society."

While tea is the traditional drink of Japan, the country is also home to a thriving coffee industry and hundreds of cafés—as well as some of the most discriminating coffee connoisseurs in the world.

"This was not the Japan I expected. It never is."

Whether Japanese coffeehouses are used as a place to exchange ideas or a space in which to contemplate them alone, White believes cafés provide an illuminating glance at the country as a whole. "These are creative, innovative spaces. Unlike many other institutions in Japanese society where people have their identities given to them, the café is a free, flexible place where there is no operative role that governs you. There are stories in the coffeehouses and cafés of Japan that people wouldn't expect. There are a lot of surprises," she says. "And I think these surprises ultimately extend beyond the café environment."

"Not much has been done on the topic of leisure in Asian Studies," says Menegon. "So this project will give us not only a comparative perspective, but a space in which to say new things."

But why study leisure activities—the things that people do in their free time—at all? Aren't hobbies and pastimes as peripheral as they are pleasurable? Actually, suggests Weller, the periphery can often serve as a helpful mirror of what's going on at the center. Leisure—whether it's playing soccer or practicing calligraphy or watching television—is inevitably more than just leisure: it's a reflection of everything from politics and economics to culture and human relations. Those connections, as well as the shifting meaning and kinds of leisure over time, make it a fascinating topic.

"We are at the beginning, not the end," Weller explains. "It could be that we end up with a definition of leisure, or an argument about it, which could be more important. But we can certainly work through the questions together and come up with things we couldn't have on our own."

Eugenio Menegon

Catherine Yeh

Robert Weller

A Scholar and a Gentleman

Wu Dacheng may be the most interesting Chinese historical figure you've never heard of.

In an age when politicians were expected to be men of arts and letters, Wu Dacheng's success as a civil servant depended on his talents as a painter. This hanging scroll landscape by Dacheng dates to the Qing dynasty. Used with permission of the Museum of Fine Arts, Boston.

The 19th-century government official was a scholar, artist, collector, and patron of the arts, who counted among his friends some of the most important politicians of the day. But for Art History Professor Qianshen Bai, Wu is more than just a colorful member of the Chinese literati—he is also a symbol of its ultimate decline.

Bai has published dozens of articles on Wu and his contemporaries and is currently at work on a book. His research has taken him to places ranging from nearby New Hampshire to distant China, in search of materials—paintings, seals, diaries, and the like—on Wu and his circle. Upcoming trips are planned for Japan and South Korea, where there are many enthusiastic collectors of Wu's work.

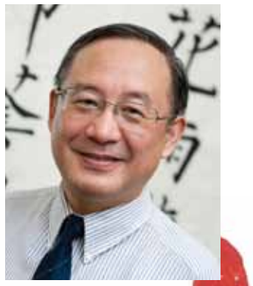
Wu's life, family, and relationships, as well as his work as both an artist and a civil servant, exemplify some of the major changes happening in China during the 19th century, says Bai. Therein lies the source of the continuing interest in him.

Born in 1835 in Suzhou, then the capital of arts and culture in China, Wu came from a wealthy, well-connected merchant family. In 1868, he passed the civil service examination required of all government officials and went on to become governor of the Guangdong and Hunan provinces. In that time, he also established himself as an important artist and calligrapher and a very prominent collector, compiling a massive assembly of art and antiquities.

These artistic pursuits were not merely idle pastimes; knowledge and mastery of art were expected of government officials. "Calligraphy, scholarship, and artistic skill were all a necessary part of the political life," says Bai. "There was an idea that China was ruled by educated men, so self-cultivation became critical." The entrance exam for civil servants contained numerous questions on poetry, art, and literature. If a candidate had poor calligraphy skills, officials would refuse even to look at his test.

But over the course of Wu's lifetime, this emphasis on artistic self-cultivation dissipated. "China was once ruled by people with a humanities background," explains Bai. "But with modernization and increasing confrontation with the Western world, China was forced to change." Part of that shift was toward a modern education system, with an emphasis on specialty subjects like science, engineering, and the law—subjects previously considered unimportant for the governing class to know. Three years after Wu's death in 1902, the 1,300-year-old civil examination system was abolished, an official sign of the irreversible decline of the scholar-official class.

Ironically, Wu and many of his contemporaries supported the very modernization and globalization efforts that led to the end of Chinese cultural and political life as they knew it. The resulting, profound implications for the relationship between politics and art are what Bai hopes to tease out through his examination of Wu's life. "Wu represents the last generation of this class of people," he explains. "As the structure of the elite changed, so did the fate of Chinese art." R



Qianshen Bai

BY SHERYL FLATOW

Recollection of Things Past

Lynne Allen

Nature Morte, the title of a recent exhibition that included nine photogravures by School of Visual Arts Director Lynne Allen, is the French term for still life. But the literal translation is more grim: "dead nature." For Allen, the two connotations are equally apt. Her photogravures of objects that have lost their original purpose and significance offer a study in obsolescence; both her subjects and her method are remnants of a bygone time.

Several of those images form a link to and reflection on her Native American heritage. Allen can trace her Sioux ancestors back six generations. But it was only in the last decade that she began exploring this background in her art. "I'm the product of assimilation into white society," she says. "Beginning with my great-great-grandmother, all the women married white men. I didn't live the reservation life. I grew up an hour outside Philadelphia. I've always been very aware and proud of my rich history, but I see myself as a white person. I didn't think I should go around talking about myself as a Native American. I only started making work about that history after a Navajo friend of mine said, 'Lynne, come out of the closet.'"

Allen's art has always dealt with psychological and social issues: the homeless, Alzheimer's patients, prisoners. "The common denominator in my work is the underdog," she says. "And I didn't realize until I was 50 that my passion, my empathy, comes from my mother and the women before her."

Her *Nature Morte* show marked the first time Allen created photogravures, using an exacting printmaking technique in which a photo is etched onto a copper plate. "The technique was invented in the 1830s, which is about the time they started herding Native Americans," she says. "By 1860, Native Americans were no longer roaming the plains, but were living on reservations. So I used a medium from that period when these people were no longer valid, to create images of things that are no longer valid today."

For instance, she juxtaposed moccasins and shoe forms. "Moccasins are still being made, but Native Americans don't wear them anymore, except for ceremony," she says. "And shoes are no longer made with shoe forms. I put these pictures next to each other because they represent two sides of me. And they're objects that no longer carry their utilitarian purpose. They're artifacts." A photo of a log cabin with a flamingo in front of it is about progress and change. "We've come from the log cabin to people having flamingos in their front yard. But to what extent does that change impinge on other people's culture?"

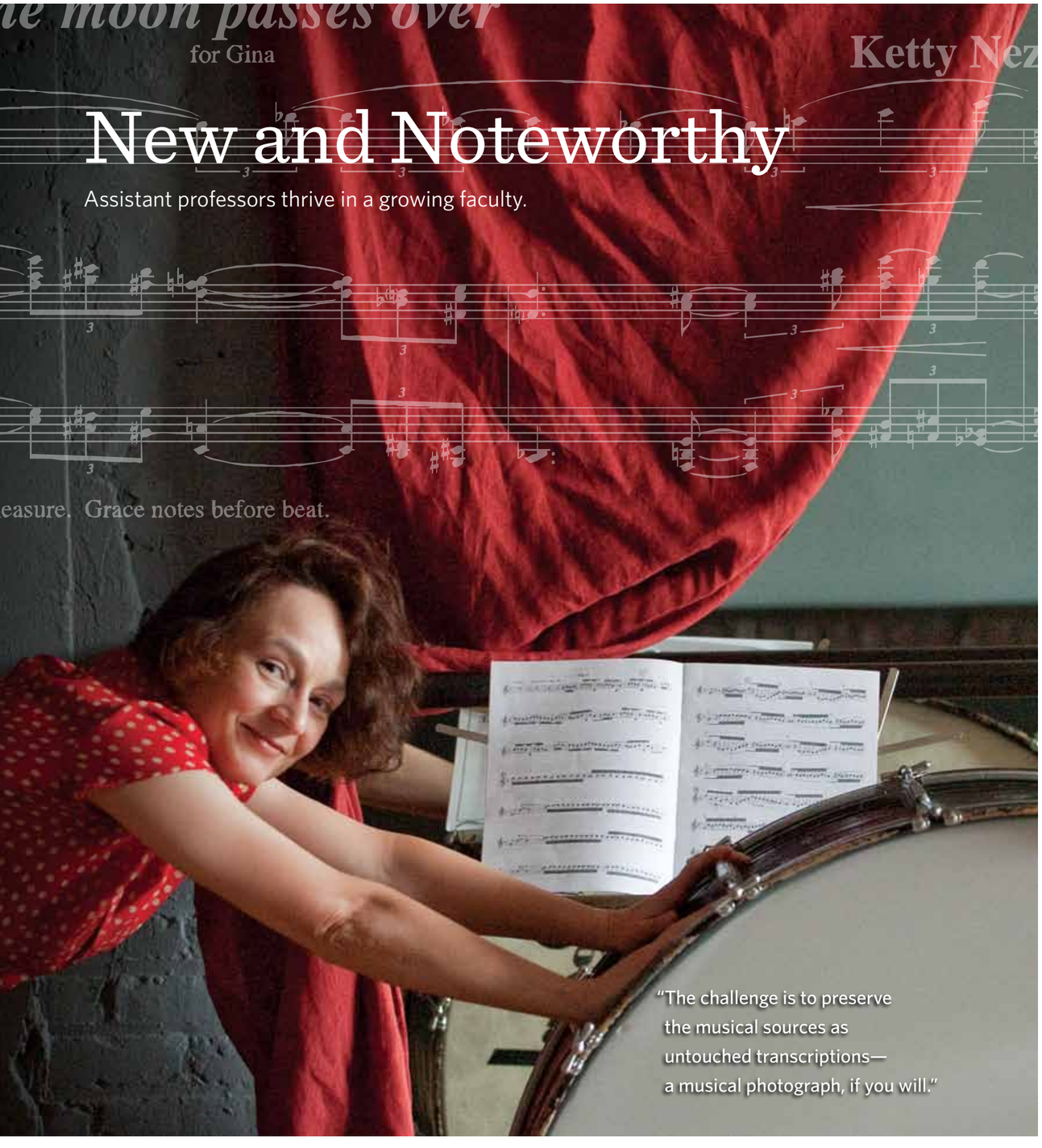
The photogravures challenge people to find their own interpretations. "I tell my students that good art is like a good movie," says Allen. "When you go to a good movie, you think about it for a week. You want a piece of art to do that too."

She teaches one class each semester, an artisanal bookmaking class that requires students to produce text as well as images. It is, she says, a course about ideas. "I try to get them to delve inside themselves to find out who they are so that they can make work that is meaningful to them. Most 19- and 20-year-olds don't think about themselves as subjects. We have discussions about what they have read or are reading. I have a colleague from the College of Arts & Sciences Writing Program come in to do projects with my students about how to write and how to put stories together. I want them to understand that throughout history, artists' work has been about themselves and the world they live in, and their reaction to that world. The most important thing to me is getting students to think."

> "I tell my students that good art is like a good movie. When you go to a good movie, you think about it for a week. You want a piece of art to do that too."

Allen says that her own work, regardless of the subject, has always been meant "to educate the public about certain issues. Empathy is the power to imagine a world outside your own experience, and although the truth is not always pretty, the hunger for it is." She is currently making a series of small books, only 2 inches by 2 inches, "rewriting the history" of how the West was won. "I want people to understand that the history they learned in school is not the entire history. History is always written by the victor. I want my work to be good, but I also want people to delve deeper into the 'why' of what I'm making. I've never done anything for money. I've never done anything for fame. I've just done it because I had to satisfy myself." R

Still life with flotsam: Lynne Allen's photogravures offer a study in obsolescence. From left: *You are not worth a penny*, *Moccasins, Size 9D*, and *Flamingo*.



New and Noteworthy

Assistant professors thrive in a growing faculty.

"The challenge is to preserve the musical sources as untouched transcriptions—a musical photograph, if you will."

A bold strategic plan in 2007 called for the creation of 100 new faculty positions over the next decade. Boston University is continuing to move forward with this goal today, even as the global economy has slowed. By recruiting talented junior faculty in a range of fields, we are strengthening and expanding a vibrant, diverse community of committed scholar-teachers.

Old-World Opera

BY VICKY WALTZ

Ketty Nez was only six months old when her family immigrated to the United States from the Former Yugoslav Republic of Macedonia. Nonetheless, the music she composes is rooted in her homeland's musical traditions.

"My father is an amateur violinist, and my aunt is a pianist," Nez says. "When I was a child, they would play duets." A musical prodigy of sorts, she took up the piano at age three, with her father's encouragement. As a teenager, she practiced upwards of 10 hours a day: Bach, Brahms, Beethoven, Mozart.

Today, Nez is an assistant professor at Boston University's College of Fine Arts, where she teaches classes in musical composition, theory, orchestration, and analysis. While versed in numerous musical genres including classical, chamber, contemporary, and electronic forms, her most recent compositions explore the music of the cultures surrounding her birthplace.

Mostly an agricultural and pastoral people, Macedonians passed on their folk songs orally through generation after generation of cattle farmers and sheepherders. "Few villagers could read," Nez says, "so they preserved their histories through spoken stories and song."

Since the fall of socialism in Eastern Europe, contemporary folk and pop musicians throughout the Balkans have tapped into the region's time-honored folk songs. Among the most famous earlier projects—and one that particularly inspired Nez—is *Postcards from the 1930s*, a setting for violin and piano that uses transcriptions of Bosnian and Herzegovinan folk songs by renowned Hungarian composer and ethnomusicologist Béla Bartók.

Nez is referencing those traditions in a different medium: opera. "The opera project is a by-product of my everlasting curiosity for the sounds and rhythms of my own ethnic background," she says, "a mixture of Slovenian and Slavic Macedonian."

Thanks to generous support from the BU Humanities Foundation, the opera, called *The Fiddler and the Old Woman of Rumelia*, will be performed in spring 2011 in collaboration with Xanthos, a young professional ensemble directed by violinist Brenda Van der Merwe. The story begins with the title. "Rumelia is the name of the former Ottoman province which encompassed the Balkan areas whose music I'm studying," Nez explains. "And the capital was Bitola, my mother's hometown."

While most of the opera will be sung in English, Nez may use some of the original language with subtitles. "It depends on how difficult it is for the singers," she says.

At this point, she does not intend to incorporate any traditional folk instruments into the production; instead, Nez plans to imitate their sounds with Western ones. "The violin mimics the sound of the *gadulka*, a Bulgarian bowed instrument," she says, "and the oboe and saxophone can fill in for bagpipes."

At present, Nez is working on the plot. "I'm fleshing out the intriguing stories which the folk songs seem to allude to," she says. "My cast of characters includes a village ingénue, a dashing and murderous outlaw, a spry card-telling Roma, and a crusty old epic singer. The challenge is to preserve the musical sources as untouched transcriptions—a musical photograph, if you will."

This is not Nez's first opera. While a composer-in-residence at the École Nationale de Musique in Montbéliard, France, she wrote *A Devolutionary Opera: Drama in 540 Seconds*, which premiered in 2003 at Munich's annual A•Devantgarde Festival. A collaboration of seven composers, each of whom contributed a chapter, the opera is about two scientists who study the effects of a viral epidemic among humans. Nez chose in her piece for the virus to cause people to behave like animals, and she incorporated iconic cartoon characters, including Batman, Catwoman, the Pink Panther, and King Kong, into its narrative.

"*The Fiddler and the Old Woman of Rumelia* will be nothing like that," she says with a laugh.

WEB EXTRA
Listen to some of Ketty Nez's recordings at **www.bu.edu/research/magazine**

Straight Talk and Spin

BY KARINE ABALYAN

For decades, health educators have been trying to rise above the hubbub of college life with wellness-centered campaigns that urge students to eat better, exercise more, sleep longer, and otherwise adopt healthy behaviors.

But often these efforts meet with little success, says Cheryl Ann Lambert, an assistant professor in the College of Communication's Department of Mass Communication, Advertising & Public Relations. "These fabulous, wonderful messages—whether they're about alcohol or sexual health or nutritional health—exist separate and apart from the students." she explains. "I am trying to figure out how to bridge the divide."

Employing both quantitative and qualitative research methods, Lambert hopes to understand how students respond to the health-related information they receive from various sources. What makes some outreach tactics more effective than others? And in a landscape inundated with advertisements and announcements, what support can health educators provide to help students sort out the jumble?

"All of us want the same thing: we want the students to be healthy," says Lambert. "But are we going about it the right way?"

In her latest project—a study exploring sexual health attitudes and behaviors on college campuses, starting with BU—Lambert partnered with Teri Aronowitz, a nurse-practitioner in Student Health Services who is also an adjunct clinical professor at the College of Health & Rehabilitation Sciences: Sargent College and an assistant professor in the Department of Family Medicine at the BU School of Medicine.

Last spring, Lambert and Aronowitz designed and implemented an online survey to gauge student opinions about different aspects of sexual health. They followed up the survey with focus groups, where students gave more in-depth interviews on the topic.

In the next phase of the research, Lambert says, the findings will be used to create an intervention program focusing on "how to respond and react when people are suffering from rape and sexual trauma, and to teach healthy sexual behaviors and awareness."

Lambert's work in communications extends beyond health issues to examine other ways specific information is distributed and processed in today's world. A public relations manager who worked for seven years before pursuing graduate studies, Lambert has developed an interest in how the public relations profession is depicted and perceived outside the field.

"People have a skewed understanding of public relations," she says, pointing to the prevalence of negative catchphrases associated with the industry, such as "public relations nightmare" or "public relations problem."

"That got me thinking about why that is, and what does it mean for our students who are studying public relations." In particular, Lambert has been studying portrayals of public relations professionals in film. From Samantha Jones on *Sex and the City* to the heroine of *Bridget Jones's Diary,* PR agents in the movies appear oversexed, flighty, shallow, or generally lacking the commitment and ethical principles their jobs require.

These observations, coupled with earlier work on the subject, inspired Lambert to launch a study on how graduate communications students relate to these silver screen stereotypes. She is working on the project with Candace White, an associate professor in the School of Advertising and Public Relations at the University of Tennessee-Knoxville, where Lambert earned her PhD. Lambert and White hope to present their conclusions at a conference in the fall.

In the meantime, Lambert has been providing students with a less biased model of the public relations sphere, and encouraging them to turn to organizations like the Public Relations Society of America as a guide to the standards to which PR professionals should adhere. "We are advocates on behalf of clients or companies or brands," she says. "But while we're doing that, we can't leave our ethics at the door. We can't focus too much on the client at the expense of the public and what the public needs."

Cheryl Ann Lambert

It seems unlikely for a professor to encourage the use of social media sites during class. But in Cheryl Ann Lambert's media relations course last spring, graduate students logged on to Facebook and Twitter—not to chat about last night's party or an upcoming concert, but to help launch a public relations campaign for a newly written book.

To see a slideshow about the students' hands-on experience marketing *Uncontrolled Risk: The Lessons of Lehman Brothers and How Systemic Risk Can Still Bring Down the World Financial System,* written by School of Management executive-in-residence and master lecturer Mark Williams, visit **www.bu.edu/research/magazine**.

Secrets of the Stars

BY MARK DWORTZAN

Can the smallest stars in the night sky shed light on the structure, dynamics, and evolution of the entire Milky Way galaxy? Assistant Professor of Astronomy Andrew West is staking his career on it, and the data he has collected and analyzed so far suggest that he is onto something.

Occupying between one-thousandth and one-tenth the volume of the Sun, red dwarfs are the smallest stars in the Milky Way. They are also the coolest and least luminous. But what they lack in size, temperature, and brightness, they make up for in number, with red dwarfs accounting for 70 percent of all stars in the galaxy.

"These stars are very dim but fuel efficient, and on average could burn for trillions of years," says West, who dubs red dwarfs the "VWs of the Milky Way." "Because they're so huge in number and last almost forever, large samples of them can allow you to probe the shape, structure, and evolution of our own galaxy like no other stars."

Drawing on the Sloan Digital Sky Survey and other deep, all-sky surveys that show millions of red dwarfs extending across the night sky, West and his collaborators have built a sample set of about 50 million. Likening the Milky Way galaxy to a Frisbee, he has devised a way to determine the likely age of each star based on its position with respect to the center line of the Frisbee, that part of the galaxy where all stars are born.

"As stars age, they interact with other stars and cold molecular gas, and their velocity increases," West explains. "These aging stars gradually move away from the central plane of the galaxy. At any one moment, the youngest stars tend to orbit closer to the plane; the further you go from the plane, the older the stars are."

By deducing the relative ages of the red dwarfs and obtaining light spectra that reveal information about their physical composition, temperature, and magnetic fields, West is tracing how the Milky Way has evolved over time. To achieve that objective, he is leading a research team that includes BU graduate and undergraduate students, Astronomy Department colleague Professor Daniel Clemens, and other astronomers from Cornell, MIT, and the University of Washington.

Andrew West

Noting that red dwarfs are the most common stars around which planets are likely to be found, West is homing in on how old a star needs to be for its magnetic field (and resulting large stellar flares) to dissipate sufficiently to sustain orbiting planets, and for its atmosphere to contain heavy elements indicative of the presence of carbon, oxygen, and other elements that support life.

"While we already understand the basic sequence of the chemical and magnetic evolution of stars in the galaxy, it's the timescale for that evolution that's not well known," says West. "The more we learn about this timescale, the more we will come to understand about the abundance of stars that can support habitable planets in the galaxy."

An edge-on view of a spiral galaxy shows stars divided into strata, with the younger stars located mostly in the middle layers and older stars in the outer layers.

Reverse Engineering Birdsong

BY MARK DWORTZAN

A picture may be worth a thousand words, but a single image produced by neuroscientist Tim Gardner can capture as many as 1,500. In his case, though, the "words" in question are the distinct vocalizations of a songbird, represented in visual form.

Gardner, an assistant professor of biology in the College of Arts & Sciences, uses these images to understand how birds build and retain the songs they use to communicate with one another. His work could shed light on how the neural circuits of learning and memory are encoded and maintained not only in birds, but also in humans—potentially boosting our understanding of the normal and diseased states of the human brain.

Gardner has chosen to focus his investigations on birds, rather than laboratory mice, or even humans, because few organisms exhibit such a quantifiable behavior. "In the last two years we have succeeded in translating sound into a new kind of image to capture the structure and the variants of birdsong," he says, "and we're now at the point where we can detect subtle changes in specific birdsongs."

Toward that end, Gardner subjects a bird colony of about 300 zebra finches and canaries—kept in soundproofed cages—to a variety of computer-controlled, quantitative behavioral experiments in his Laboratory of Neural Circuit Formation.

Tim Gardner

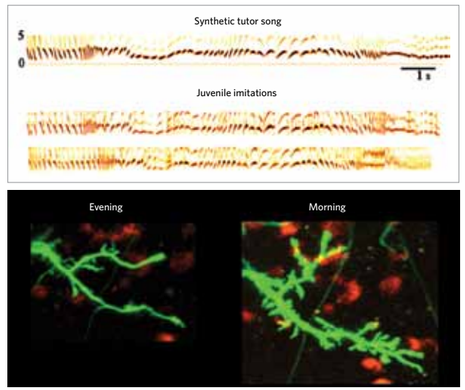
In one experiment, Gardner studied canaries raised in isolation from birdsong. While "tutoring" the birds with computer-generated, synthetic songs that departed from species-typical songs, he and his lab recorded every sound the birds uttered through their development. Initially, the subjects imitated the synthetic songs with great accuracy, but as they matured, they reverted to species-typical songs, even in the absence of other canaries.

"There's a complex program that ultimately builds each species-specific song," Gardner says, noting that both genetic and environmental factors contribute to the process. "We're interested in determining the local neuronal rules that govern this amazing process."

To home in on these rules, Gardner is now investigating regions of the brain that encode song patterns. These areas produce a dynamic pattern of song while the birds are singing—and also, surprisingly, when they are asleep. Gardner has produced time-lapsed images of neuron growth *in vivo* which show the development of new neuronal processes in sleep.

Gardner hopes to learn more about the growth of these processes by introducing small perturbations to the spontaneous activity that occurs during birds' sleep, and then observing the impact of those perturbations on their neural networks and songs. As the bird dreams of its own songs, or sings upon awakening, a computer detects the sleeping pattern and triggers a stimulating electrode or implanted optical fiber to induce slight changes in neuronal electrical activity at specific locations in the song pathways. A brain-machine interface implant measures the activity.

"If we can increase or decrease the neuronal activity of the bird during sleep, we can see if there's a change in the sequential order—and creativity—of the songs it produces," says Gardner, noting that such studies could help us understand how similar neuronal changes in humans might impact our performance during the day.



Gardner and his colleagues notated the song patterns of juvenile canaries, *top diagram,* that had never heard normal species-specific songs, and found that they imitated abnormal synthetic songs with great accuracy, even when the tutor songs lacked phrasing, or what Gardner's team calls "short stereotyped syllables" that are repeated as the bird sings.

A newborn cell tagged with green fluorescent protein, *above,* shows overnight growth in a song control center of the zebra finch brain as observed *in vivo* before sleep, *left,* and after a good night's rest, *right.*

Zeroing in on Epilepsy

BY VICKY WALTZ

Mark Kramer always had an interest in public health. His father was a doctor, and his mother and grandmother were nurses. While his aversion to blood dashed any aspirations of attending medical school, he did not let it deter him from seeking a career in medicine.

"You don't have to be a physician to have a clinical impact," Kramer says. "You can be a biologist, engineer, mathematician."

Or, in Kramer's case, a physicist.

As a doctoral student in the University of California, Berkeley's program in Applied Science and Technology, Kramer helped develop a mathematical model that describes what happens in the brain during an epileptic seizure. The purpose of the study, published in the March 2005 issue of the *Journal of the Royal Society of London Interface,* was to help neurologists better understand and treat epilepsy.

When epilepsy patients fail to respond to various drug treatments, Kramer explains, doctors may take an alternative course of action. "They remove the part of the brain that causes the seizure," he says.

Representative networks, *in blue,* constructed from the brain activity of a human patient during a seizure. As the seizure evolves, the number of connections in the network changes.

Mark Kramer

While numerous measures are undertaken to ensure patient safety, the surgery is nonetheless invasive, and it is not always accurate. According to a 2007 Cleveland Clinic study, 60 percent of patients who have the surgery continue to have seizures.

Now an assistant professor of mathematics and statistics, Kramer wants to reverse those numbers. To that end, he is using his background in math and physics to help doctors at Massachusetts General Hospital determine which parts of the brain to target.

"Up until now," he says, "the primary way to analyze data retrieved from the brains of epilepsy patients has been through a painstaking visual inspection. Epileptologists stare at complicated traces of brain activity and try to determine where in the brain the seizure is starting."

Before surgery, neurologists must map the region where the patient's seizure originates to ensure that they remove only what is necessary. This involves lifting a section of the skull and putting electrodes directly on the surface of the brain.

"The patients stay in the hospital for about a week," Kramer says, "during which time they may experience a number of seizures."

Kramer and his collaborators study the voltage data collected from the electrodes using sophisticated mathematical techniques. "Rather than looking at individual voltage traces," he says, "we're examining them collectively. Are there any relationships between those traces? Is there any sort of pattern?"

While the recordings reveal the consequences of abnormal brain activity, he continues, they do not identify the cause. "If we understand why and how seizures progress over the surface of the brain," he says, "eventually we may be able to prevent the seizure by disrupting the activity preemptively with medication or stimulation."

To date, Kramer's team has analyzed only a handful of seizures from a small group of patients. It is a minuscule percentage of the 50 million people worldwide who suffer from the disease, but still a strong start. "The scientific process is filled with wrong turns," Kramer says, "but I truly believe we're on our way." R

BY MAGGIE BUCHOLT

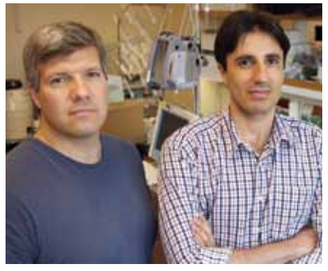
UNDAUNTED BY DIABETES

BREAKTHROUGHS IN TREATMENT AND PREVENTION

The U.S. Surgeon General's report, *Healthy People 2010,* lists diabetes mellitus as a major health challenge—and with good reason: as many as a million and a half new cases of diabetes are diagnosed each year, bringing the number of American children and adults with the disorder to 23.6 million.

Millions more are at risk, or already have a pre-diabetes condition. A chronic but treatable disorder, diabetes can strike anyone from the young to the aged, male and female, and in particular, African Americans, Latinos, Asian Americans, and certain other ethnic groups.

To help those living with the disorder and to prevent further cases, Boston University researchers are working on a number of different fronts, from developing an artificial pancreas that automatically controls blood sugar and insulin in type 1 diabetes, to identifying new risk and treatment factors for both type 1 and type 2 diabetes, socioeconomic factors regarding the high-risk population of African American women, and genetic loci that warrant further study.



Edward Damiano, *left,* and Firas El-Khatib are developing an artificial pancreas that improves on current insulin pump technology, *top.*

Taking It Personally

It's a little bigger than a cell phone and just as smart. A small sensor under the skin monitors blood sugar, a pump delivers a calculated amount of insulin, and a software program tells the first two components what to do.

The device, worn externally, is called an artificial pancreas. It promises to revolutionize the management of type 1 diabetes—an autoimmune disease in which the pancreas does not produce the insulin needed to carry blood sugar into cells—and to improve the quality of life for those who suffer from the disorder.

"Most people currently on pump therapy will use the artificial pancreas," predicts Edward Damiano, an associate professor of biomedical engineering and a co-principal investigator on the artificial pancreas project, which has received funding from the National Institutes of Health (NIH), Juvenile Diabetes Research Foundation, Leona M. and Harry B. Helmsley Charitable Trust, and Wallace H. Coulter Foundation.

Damiano has done his homework on insulin pump therapy. His 11-year-old son, David, wears two insulin pumps, one just below each hip. The pumps deliver insulin under the skin rapidly, which is more convenient for an active adolescent than the injections that most type 1 diabetes patients need daily. It was David's condition, diagnosed when he was a baby, that prompted Damiano to seek out a new research direction, one that would benefit his son and diabetes patients everywhere. "I saw a role for myself in diabetes," he said. "I knew I had a certain skill set that could be brought to bear on the disease."

Damiano, his former student, Firas El-Khatib, now a BU senior research scientist, and other colleagues designed the "smarts" of the artificial pancreas system—that is, the computer program that regulates the device. They were the first academicians to receive an investigational device exemption from the Food and Drug Administration to test a blood-glucose control algorithm in clinical trials. The positive outcomes of those 2009 clinical trials were published in the journal *Science Translational Medicine*.

If the second round of clinical trials are as successful as the first, Damiano estimates that the artificial pancreas will be available for commercial production in 2014. He hopes that the device will be approved by the time his son reaches college age.

Damiano is excited about the clinical trials—begun in June at Massachusetts General Hospital, where Damiano's co-principal investigator Steven Russell is an endocrinologist—because of the younger subjects. Half of the patients in the clinical trial are between 12 and 18 years of age; the rest are 18 and older. The study is twice as long and larger in scope than the previous trial.

However, the real test for the device is scheduled for spring 2011, when a third clinical trial will incorporate exercise into the subjects' regimen and allow them to consume food as they do at home, rather than in a prescribed format. This trial will also eliminate the IV pole and desktop computer currently used to operate the artificial pancreas; instead, the necessary software will be imbedded on a computer chip built into the unit, paving the way for a portable device ready for commercial production.

Although the artificial pancreas is being tested specifically for patients with type 1 diabetes, Damiano is optimistic about its eventual use for everyone with the condition. "I think it also will work very well with people with type 2 diabetes," he said. "Anyone on insulin therapy will benefit from this device."

Edward Damiano's son David balances type 1 diabetes with the active lifestyle of an eleven-year-old boy. *From left:* Damiano encourages exercise, like jumping on the trampoline, since exercise naturally burns excess glucose; a specially prepared smoothie; David's insulin levels have to be checked at regular intervals around the clock and insulin doses administered as needed by two pumps that David wears on his hips at all times; Damiano's research carries over into the home, where a large chalkboard is used to plan upcoming clinical trials for 2011.

Location Is Everything

African American women who live in low income neighborhoods have a higher risk of developing type 2 diabetes than do African Americans who live in more advantaged neighborhoods—even if they have high educational levels themselves.

"Where a woman lives, regardless of her own education and income, has an effect," explains Professor Julie Palmer, senior epidemiologist at the Slone Epidemiology Center and a co-principal investigator of the Black Women's Health Study, who discovered the correlation between area of residence and diabetes risk. "This finding is important because so many black women continue to live in disadvantaged neighborhoods even while they work in professional jobs and earn adequate incomes. Efforts to reduce the alarming rate of diabetes in African American women need to focus not only on individual lifestyle changes but also on improving conditions in disadvantaged neighborhoods."

The Black Women's Health Study—which has been following 59,000 African American women from 17 states since 1995, thanks to more than $30 million in funding—is helping to shed light on why black women are twice as likely to have type 2 diabetes as non-Hispanic white women.

Palmer and colleagues Lynn Rosenberg, associate director of the Slone Epidemiology Center, and Lucile Adams-Campbell, of Georgetown University, have hypothesized that the association between neighborhood socioeconomic status and diabetes risk may occur because neighborhoods with a lower socioeconomic status lack access to grocery stores that sell wholesome fruits, vegetables, and other foods, as well as access to safe areas for walking and other exercise. Obesity is one of the primary factors for developing diabetes, so maintaining a healthy weight, eating a nutritious diet, and engaging in regular exercise are key to preventing the disease.

The study found that African American women living in neighborhoods with the lowest socioeconomic status—as determined by the U.S. Census Bureau's "geo coding"—had a 1.65 times higher risk of contracting diabetes, after factoring in individual risk factors such as education, age, income, and household size. Taking into account physical activity and caloric intake reduced the association, indicating that physical activity and diet explain at least part of the link between type of neighborhood and risk of diabetes.

Palmer said that over 5,000 Black Women's Health Study participants have developed diabetes since the study began in 1995. Surveys, mailed every two years, track how the women's health and habits have changed, and gather data on weight, diet, birth control, smoking habits, and the development of disease.

"Our study is powerful because we know about behaviors that occurred before diabetes developed," says Palmer. "We are particularly interested in social factors and how they influence diabetes."

Proximity to grocery stores that sell wholesome food may be a greater factor in determining risk for type-2 diabetes among African American women than socioeconomic status.

Julie Palmer

You Are What You Eat

Although food additives are not toxic, they have never been thoroughly tested with respect to biochemical interactions in the body.

Take monoglycerides, for example, which are commonly used in small quantities in dozens of commercial food products, including beverages, bakery items, and margarine. In one of the first studies undertaken at BU's new Center for Molecular Discovery, monoglycerides were shown to stimulate the production of insulin in beta cells.

"Human beings are constantly being exposed to new drugs and food additives, and these drugs and additives have never been tested for chronic effects on systems such as metabolic health," says Barbara Corkey, vice chair for research at the BU School of Medicine, who co-founded the center with Chemistry Professor John A. Porco, Jr., and Michael Pratt, director of translational research and corporate relations in BU's Technology Development Office.

Led by Director Sarah Haigh Molina, the Center for Molecular Discovery gives BU researchers access to a process used by the pharmaceutical industry known as a "high-throughput screening," in which thousands of small molecule compounds can be screened for physiological effect (e.g., normalization of insulin secretion) using cell-based or biochemical assays. The rapid process can identify active compounds that change a particular biomolecular pathway.

"The goal is to discover and develop drugs that will benefit mankind," says Corkey. And, she continues, "If the physiology is relevant, the food industry might revisit using monoglycerides, the same way the industry decreased the fat content in many foods. The food industry needs absolute proof to change, so we need to do a lot more research."

Barbara Corkey

Snip By Snip

A BU biostatistician is making headway in another piece of the diabetes puzzle: genes that play a significant role in the disorder.

"Discovering nine new loci was a big leap," says School of Public Health Professor Josée Dupuis, who was a first co-author on a January 2010 article in *Nature Genetics* that identified nine new genetic variants affecting glucose levels. "Researchers were finding one at a time before that."

The article was based on an exhaustive study by the Meta-Analyses of Glucose and Insulin Related Traits Consortium (MAGIC), and funded in part by the National Institutes of Health.

The international, large-scale study analyzed samples from 54 previous studies involving 122,000 individuals of European descent. The studies looked for associations between fasting glucose level and common single nucleotide polymorphism (SNP, pronounced "snip"), a DNA sequence variation, by scanning the DNA of thousands of nondiabetic individuals.

Of the nine genetic variant locations, three contributed to significant risk of acquiring type 2 diabetes; three did not increase the risk; and three indicated only a moderate risk.

Glucose levels in the blood were measured after the subjects had fasted for eight hours or more, so that ingested food did not influence the test results.

"We can find genes that affect diabetes by studying fasting glucose in nondiabetics," she said. "But everything that affects fasting glucose in nondiabetics may not increase your risk of developing diabetes."

In May, Dupuis learned that NIH funding had been awarded for a five-year follow-up study. The collaborative study, led by endocrinologist and geneticist David Altshuler of Harvard and the Broad Institute, will involve four sites: Boston University, Massachusetts General Hospital, the George Washington University, and the University of Mississippi.

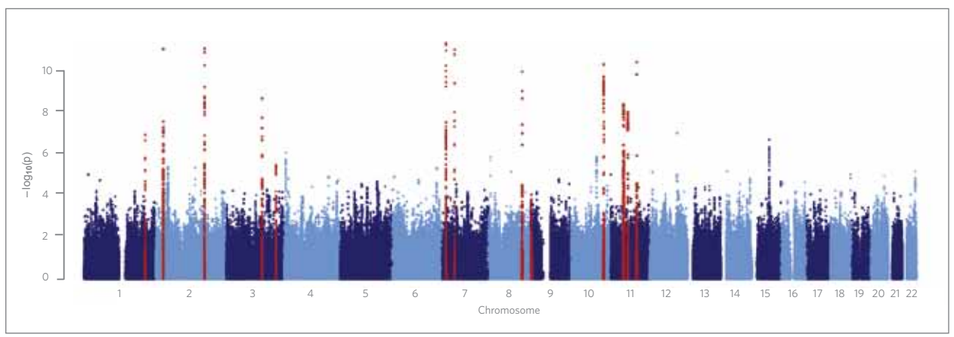
Dupuis's part in the project, along with biostatistics PhD student Han Chen, will be to analyze data from the Framingham Heart Study at BU and provide analytic support to the Jackson Heart Study at the University of Mississippi Medical Center and the Diabetes Prevention Program at the Broad Institute.

"With the first study, the information was too coarse," she explains, noting that genes can have as many as 100 SNPs. "Now we are trying to discover what is in the neighborhood of this SNP that is functional in the increase of diabetes risks."

The new study aims to discover whether the genetic variants discovered in the MAGIC study with people of European descent affect risk in other ethnic populations, and also to identify the exact genetic variant that increases diabetes risk.

"We don't have all the pieces yet," says Dupuis. "That's why they call diabetes a complex disease. It's not straightforward. Diet, exercise, and the environment are involved as well." R

Josée Dupuis



Dupuis and her team evaluated the 22 human chromosomes, depicted here in alternating colors along the graph's x-axis. Peaks in the graph represent increased evidence that genetic variants in that location of the genome influenced fasting glucose levels.

BY TRICIA BRICK

The Neuroscientist and the Theologian

For the philosopher and theologian Wesley Wildman, considering religion through the lens of science comes naturally. An associate professor of philosophy, theology, and ethics in the School of Theology, Wildman trained as a mathematician and physicist before becoming a scholar of religion, and he has continued to study and write about the intersection of the two fields. "For me it's just a habit to think about everything together at once. If you have an insight into religion that comes from evolutionary theory, why not think it right alongside of the thoughts you have that come from the humanities or from reading beautiful poetry?" he asks. "It's quite common for people to think there's a sharp conflict, but when you put people who are experts in these fields together, the research is transformed, allowing for precision of understanding and for breadth and richness and depth of understanding as well."

The neuroscientist Patrick McNamara first became interested in the scientific study of religion when he was working with Parkinson's patients in the 1990s. In his work with people with Alzheimer's, McNamara had seen religion bring solace in the face of a devastating neurological condition. But his Parkinson's patients rarely relied on their faith to cope with their disease. Before their illness struck, these patients were no less religious than other people. Why, he asked, were they less religious after they were afflicted?

The question led McNamara, who today is director of the Evolutionary Neurobehavior Laboratory in the Department of Neurology at the BU School of Medicine, into the nascent community of researchers using science to study religion. He and Wildman soon joined forces, first as research collaborators and then, in 2007, as cofounders of the independent nonprofit Institute for the Biocultural Study of Religion (IBCSR).

As befits a collaboration between a neuroscientist and a theologian, the institute's mission includes both supporting the scientific study of religion and exploring the ramifications of that research through several outreach initiatives, including its website, IBCSR.org. Beginning next year, McNamara and Wildman will introduce the field's first scientific journal, *Religion, Brain, and Behavior,* which they will co-edit with the University of Connecticut anthropologist Richard Sosis. "Biological approaches—including genetics, neuroscience, the cognitive sciences, and the psychological sciences—are revolutionizing our understanding of religion," McNamara says. "The institute is unique for trying to grapple with the wider implications of what science is telling us about religion."

Those implications range from ethical and philosophical, to political and biomedical. McNamara's research with colleagues at the VA Hospital in Boston, for example, led him to identify the area of the brain activated when people think or talk about religion. The finding has ontological implications in that it supports the theory that religion has an evolutionary history. It also has clinical import: knowing the brain circuitry involved in religious cognition could lead to more targeted treatments for people who suffer from certain psychoses.

"If you have an insight into religion that comes from evolutionary theory, why not think it right alongside of the thoughts you have that come from the humanities or from reading beautiful poetry?"

In another project, Wildman and McNamara are working with researchers from Harvard University to seek quantitative answers to such questions as *What makes a religious group turn violent?* "We're committed to high-level research, and we're committed to the generous understanding of anything that's as intricate and beautiful as religion," says Wildman. "We're also committed to the critique of anything that's as dangerous and large as religion."

Utilizing methods from evolutionary biology, they are studying Anabaptist sects of the European Reformation and modern Sunni Islamic groups of northeastern Afghanistan to try to identify the characteristics of a religious group that might lead it to turn to violence. Eventually, they hope, their findings will provide policymakers with the intervention tools they need to prevent future bloodshed.

Key to a nuanced, precise, and edifying scientific study of religion, Wildman and McNamara say, is interdisciplinary collaboration. They hope in the coming years to expand the involvement of their Boston University colleagues—behavioral economists, historians, anthropologists, religious scholars, art historians and artists themselves, and specialists in any number of other areas—in the IBCSR's work.

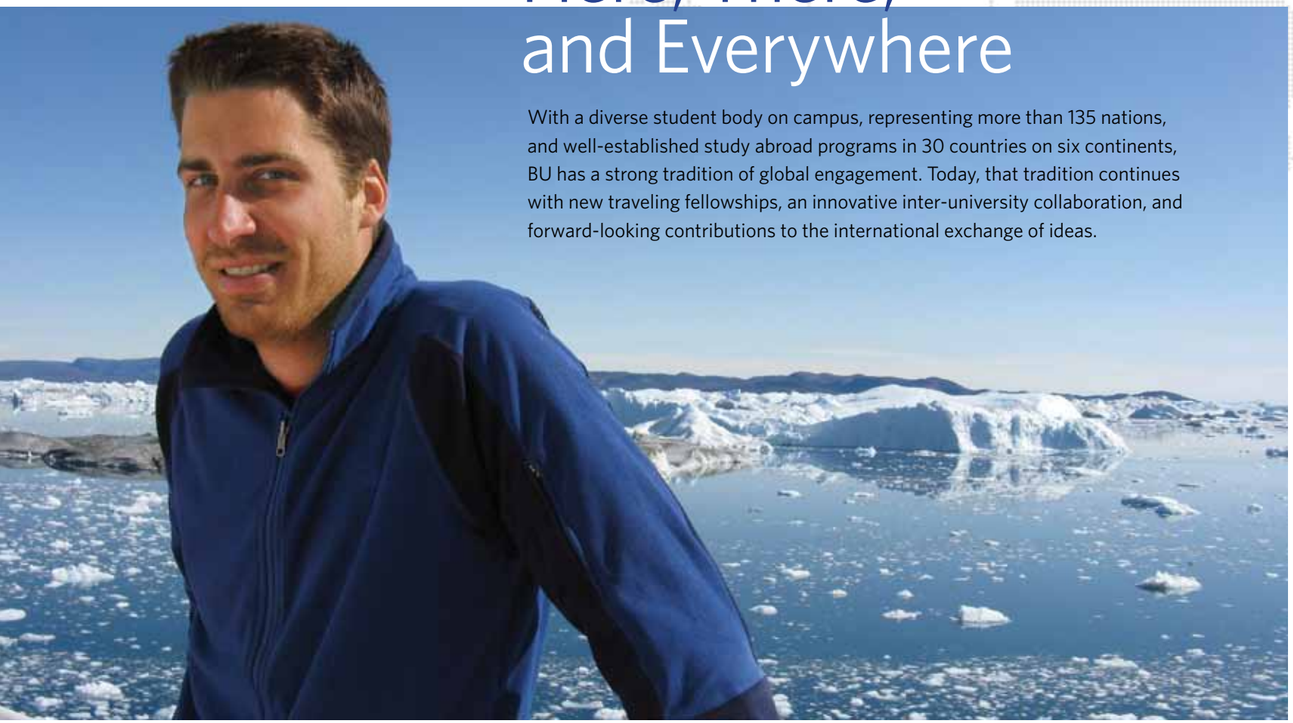
"This field is building bridges across the disciplines, and it's when you put these disparate subjects together that you get, I think, the deepest insights into the way religion works," says Wildman, who also directs an interdisciplinary graduate program in religion and science within BU's Division of Religious and Theological Studies. "To be evolutionarily and biologically conditioned to respond to the universe, to the world, to your experience in a particular way is directly relevant to why you believe what you believe, what you're willing to die for, what you're willing to kill for, what you're willing to save." R

Wesley Wildman

Patrick McNamara

BY VICKY WALTZ

Here, There, and Everywhere



With a diverse student body on campus, representing more than 135 nations, and well-established study abroad programs in 30 countries on six continents, BU has a strong tradition of global engagement. Today, that tradition continues with new traveling fellowships, an innovative inter-university collaboration, and forward-looking contributions to the international exchange of ideas.

Writing and Wanderlust

Creative Writing alumnus Nathan Hogan, *above*, traveled to Greenland in search of inspiration for a historical novel about John Ross, a British sea captain who ventured into the same icy—and then unknown—waters in 1818, in search of the Northwest Passage.

Poets, playwrights, and fiction writers set off in search of inspiration, supported by a new fellowship for international travel and study.

The rain pounded relentlessly as Nathan Hogan made his way across the barren Greenland tundra. His backpack—heavier in its waterlogged state—sagged on his shoulders, and he wondered, not for the first time, if trekking 100 miles across the Arctic Circle Trail was such a great idea.

A graduate of the Creative Writing Program, Hogan is writing a novel about 19th-century British Royal Navy Captain John Ross, who in 1818 set out on a voyage across the Arctic Ocean in search of the Northwest Passage. By exploring the western coast of Greenland himself, Hogan hoped to gain insight into the country's people and customs while witnessing firsthand its majestic icebergs and glaciers.

The 100-mile slog between Sisimiut and Kangerlussuaq was an attempt to re-create Ross's expedition. "I've found that after three or four days of continuous walking," Hogan says, "my feet and mind slip into strange and productive new rhythms, difficult to otherwise replicate. And because my project was in some sense *about* an altered state—an epistemological crisis, an imagined obstruction of ice and rock that occurs only after many weeks at sea—it seemed somehow important to enact my protagonist's voyage in miniature."

Hogan's journey was made possible through the Robert Pinsky Global Fellowships in Creative Writing. The program, established in 2009 through a $2 million donation from Robert J. Hildreth, vice chair of the BU Board of Overseers, provides funds for up to four months of international study. Named in honor of former U.S. Poet Laureate, translator, and critic Pinsky, a College of Arts & Sciences professor of English, it sent five writers overseas last year. This year, the number of recipients more than doubled, with 12 graduates selected to take part.

The opportunity to experience a foreign culture heightens writers' skills by exposing them to lifestyles that challenge their thinking, says Pinsky. "The fellowships reinforce the demanding nature of the Creative Writing Program," he adds. "The more different the experience, the richer the challenge."

In August, poet Ani Gjika, who left her native home of Albania more than 14 years ago, returned to her birthplace to research five female Albanian poets whose work she plans to translate into English.

While translating poems by Albanian women writers into English, Ani Gjika visited Vithkuq, Kõrçe County.

"There are only a handful of Albanian women whose poetry has been translated," says Gjika, "and those translations are very literal. They've lost what makes them unique, perhaps because the translators were not familiar with Albanian culture."

Gjika is particularly fascinated by poets like Drita Como and Luljeta Lleshanaku. But perhaps the most meaningful part of her project is the study of her own mother's poems. Before moving to the United States, Julia Gjika published two volumes of poetry in her native language, and her daughter vowed to make them available to English readers.

"Poetry is a very young profession for Albanian women," Gjika explains. "They were not published in Albania until the 1970s, and even then, women had to write a certain way, or else they risked being censored."

In his debut novel, *The Strike* (2006), Canadian writer Anand Mahadevan tells a coming-of-age story about an Indian boy whose adventures play out against a tumultuous 1980s backdrop.

In his forthcoming book, a collection of short stories, he moves the action to Dufferin Grove, an eclectic Toronto neighborhood with a diverse population of Indian, Portuguese, and Bangladeshi immigrants.

Historically, many of Toronto's Portuguese immigrants come from the Azores, a cluster of nine volcanic islands situated off the Portuguese and Moroccan coasts. Consequently, Mahadevan has centered his stories between two households: one Indian and one Azorean.

While he can draw from his own family's experience of immigrating to Canada from India, Mahadevan is less comfortable telling the story from the perspective of Azorean immigrants. "I've never been to the Azores," he says. "My knowledge of the culture is limited, and I don't speak the language.

A visit to the island of São Miguel in the Azores, a Portuguese archipelago in the Atlantic, helped Canadian writer Anand Mahadevan bring to life his short stories about an Azorean immigrant family living in Toronto.

"From what little interaction I've had with my own Azorean neighbors," he continues, "I know that family is important; bonds are strong, and that poses an interesting question: why do so few ever go home, even for a visit?"

For answers, Mahadevan traveled to the Azores to meet a handful of *returnados*, Azorean immigrants who returned home after decades spent living abroad. "A lot of returnados moved to Canada during the 1970s," he says. "I hope to gain insight into what life was like back then, what challenges they faced, and what called them home."

Time spent abroad can—and should—challenge aspiring writers into new modes of thinking, says former Poet Laureate Robert Pinsky.

Dynamic Duo

During the 1960s, around the same time that former BU President Harold Case began his quest to transform Boston University from a commuter school into a leading national research institution, the United Kingdom announced a government initiative to expand access to higher education. The University of Warwick, widely regarded as one of Britain's top research schools, is probably the most impressive result of that expansion.

"Boston University and Warwick have striking similarities," says Graham Wilson, a BU professor of political science. "They're comparable in size, programs of study, and ambition, and both are renowned as dynamic and entrepreneurial institutions."

So when Britain's then–Prime Minister Gordon Brown proposed more inter-university collaboration between the United Kingdom and the United States, it came as no surprise that Warwick looked to Boston University as a potential partner.

"We are very much like-minded institutions, and have both evolved in parallel into major research universities during the past three to four decades," says Andrei E. Ruckenstein, vice president and associate provost for research at BU. "Our similar trajectories and aspirations, many common interests, as well as the common mindset and vision of our faculty and academic leadership make the BU-Warwick partnership unique as a venue for exploring models of global universities."

To that end, BU and Warwick two years ago announced a partnership to leverage the strengths of each institution through research collaborations in new and emerging disciplines. For the short term, Ruckenstein says, "We are focusing on research and educational opportunities in areas in which we have complementary strengths, or in impactful directions—new to both institutions—where we are willing to share risks." *(continued on next page)*

Similar histories and equally ambitious plans for the future make Boston University and the University of Warwick ideal partners in a growing inter-university collaboration on research and educational opportunities.

"This is much more than an exchange program," says Mark Smith, Warwick's pro-vice-chancellor of research. "It's a completely new model that will develop joint strategic thinking over a range of fronts, especially research."

Over the past several years, the connections between BU and Warwick have strengthened as the result of grassroots efforts, driven by individual or small groups of faculty members whose areas of expertise range from the arts and humanities to business and hard sciences.

"We're looking to make a big impact by being not just world competitors, but world leaders," says Kevin Smith, a BU professor of physics.

For example, BU wants to expand its studies of electron microscopy, an area in which Warwick is strong. "Instead of building our own center of excellence in electron microscopy, we can use Warwick's," Kevin Smith says. "In exchange, Warwick's faculty members will have access to our materials and projects."

Earlier this year, Ruckenstein appointed Kevin Smith to lead a steering committee for the project. Other committee members include Adil Najam, a professor of international relations and director of the BU Frederick S. Pardee Center for the Study of the Longer-Range Future; Alan Cohen, a professor of health policy and management and executive director of the BU Health Policy Institute; and Wilson.

So far, the collaboration has been a success. Researchers in the physics, chemistry, and engineering departments, along with their Warwick counterparts, are currently studying energy materials that are used in storage devices such as solar cells, fuel cells, and batteries. In the political science department, Wilson and his colleagues are studying business and government relations.

"It turns out that both universities have tremendous strengths in these areas," Wilson says. "So in December we held a joint research session at Warwick. Our topic was the ways in which the economic crisis of the past three years has changed business and government relations. We hope the resulting papers will become a book."

Kevin Smith expects the partnership to expand significantly within the next year. "We're putting out a call for new proposals," he says, "so we expect to see growth into new areas of joint scholarship."

The next step is to involve students, both graduates and undergraduates. "We envision a system where students will move seamlessly between the two universities," Smith says. "They'll regard both BU and Warwick as their homes."

Andrei E. Ruckenstein

Kevin Smith

Graham Wilson

Alan Cohen

Imagining Tomorrow Today

Adil Najam takes issue with an old Doris Day hit song.

Que sera, sera
What ever will be, will be
The future's not ours to see
Que sera, sera.

"No, the future won't be what it will be," he says. "The future will be what you make of it."

As director of the Frederick S. Pardee Center for the Study of the Longer-Range Future, Najam has built a career around thinking about the future, but he doesn't do it through reading tea leaves or gazing into crystal balls.

"It's about research," he says. "The future is a big puzzle, and to solve it we must look at every individual piece: politics, economics, technology, culture."

Established in 2000 by Frederick S. Pardee—who received degrees from the BU School of Management and Graduate School of Management, as well as an honorary doctorate in 2006—the center focuses its research on identifying, anticipating, and enhancing the long-term potential for human progress. In recent years the center has been focusing on regional patterns of human progress.

In 2008, an international group of scholars came together to discuss the future of China in terms of politics, religion, law, economics, energy, the environment, and health care.

Organized by Joseph Fewsmith, a Pardee Center faculty fellow and professor of international relations and political sciences, the conference included 14 leading experts from the United States, China, and Germany, who presented papers that were later compiled into a book, *China Today, China Tomorrow: Domestic Politics, Economy, and Society* (2010), edited by Fewsmith.

Although the center's research focuses on the long-term—that is, between 35 and 200 years ahead—50 appears to be the magic number. "If I ask our experts to imagine what something will be like in a year, they remain constrained in the shackles of today," Najam says. "They need a good 50 years—an entire generation—to distance themselves from the present, to envision a world that is entirely different from what they know."

This year, the center concentrated on South Asia and Africa. While the South Asia 2060 project focuses on scenarios that could occur during the next five decades, Najam says, its research is rooted in steps that can be taken now to move toward a more positive future.

The center hosted a series of South Asia 2060 seminars, including in South Asia itself, and a collection of resulting essays—each focusing on individual aspects of South Asia's regional futures—will be published as an anthology in 2011.

In April, the center hosted another all-day conference, "The Good News from Africa," as part of its Africa 2060 program. With discussions on social development, markets and economy, politics and institutions, and society and culture, the conference also served as a launching pad for a number of papers that examine regional development in Africa, the narcotics trade, obesity in sub-Saharan Africa, malaria, and agricultural and climate change.

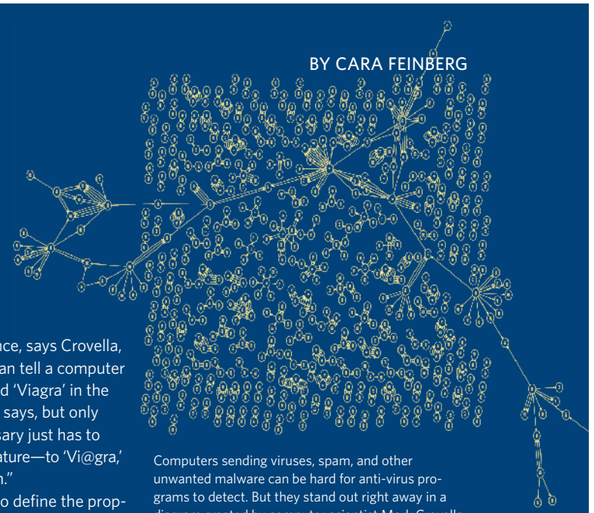
The Pardee Center's Africa 2060 program is optimistic about the continent's future. Here, children take a break from their studies for a game of soccer at St. Theresa's Early Childhood Development Center in Sekondi, Ghana.

Although each conference focuses on a different region, Najam has noticed one common trend emerge. "In every instance," he says, "the solution for the future of these regions includes better governance and institutions. Now we just have to focus on getting there." R

Adil Najam

BY CARA FEINBERG

Traffic Cop on the Information Superhighway



Computers sending viruses, spam, and other unwanted malware can be hard for anti-virus programs to detect. But they stand out right away in a diagram created by computer scientist Mark Crovella, which illustrates data flow between various IP addresses. The long-stemmed, flower-like formations show that one computer is "talking" to an abnormally large number of other computers, a sign of potentially malicious behavior.

There is a good chance you own a zombie. It could have been infected by a website you visited, or a link you clicked in an email from a trusted friend. Or maybe you didn't do anything at all to compromise your computer, and still an attacker slipped past your firewalls and turned your computer into a virulent drone.

One thing, however, is nearly certain. If your computer has been breached, you will likely never know it.

Computer viruses, explains Computer Science Professor Mark Crovella, have changed drastically in the last five years. Where once attacks were obvious to victims—computers might slow down, or run unwanted programs—users now fall prey to unseen intruders. Small programs, called "bots," slip unseen through weak spots in PC protection; from there, they can take up secret residence on a computer and download complex instructions from a remote controller elsewhere on the Internet. Poised to do the bidding of their masters, these zombie computers become part of "botnets"—networks of thousands, or even millions, of computers that can cause all sorts of trouble, by scanning the Internet to look for other vulnerable computers; sending out reams of spam email to ensnare other users; revealing keystrokes or online transactions to steal passwords and credit card numbers; or launching distributed denial-of-service (DDoS) attacks that overload and shut down other websites.

These are the types of threats that Mark Crovella and his team of BU computer scientists and statisticians spend their days hunting down. Their goal is not to treat your ailing computer, or even to gird your existing security. Instead, they aim to identify unwanted Internet traffic, allowing network providers to stop it from ever reaching your PC.

"For the most part, we tend to leave security to the virus protection programs we buy and install on our PCs," says Crovella. These programs typically try to identify malicious software by looking for a signature—a sequence of code, or something in the content—and then blocking programs with those signatures. For instance, says Crovella, "There are programs that can tell a computer to block email with the word 'Viagra' in the title." It can be effective, he says, but only for a little while. "An adversary just has to change one letter in its signature—to 'Vi@gra,' for example—and they're in."

Rather than attempt to define the properties of unwanted traffic, Crovella's strategy is to paint a picture of what "normal" Internet usage looks like. Using software he and his team designed, they capture and analyze anonymous traffic information at five-minute intervals as the data flows through thousands of routers around the world.

Unusual patterns—statistical anomalies in the amount or type of data being transferred—tip off Crovella and his team to potentially malicious activity. How these programs sneak into individual computers can change daily, even hourly. But their patterns of behavior, the ways they interact on the Internet, are nearly always outside the norm.

DDoS attacks, for instance, generate abnormally large amounts of traffic. Content, too, can reveal criminals at work. "If you see a large variety of Internet Protocol, or IP, addresses—numbers that identify individual computers—coming from one source in a short period of time, that kind of activity is statistically anomalous," Crovella explains. And "anything outside of statistically normal traffic patterns is potentially malicious."

Other researchers and companies have tried similar techniques, but with only one router at a time. Using the unique multivariate statistical approach developed at BU, says Crovella, "Suddenly, activity outside the norm stands out in a way it never could if you were looking for it at each source."

His technique—based on a method called "Principal Component Analysis" and licensed to Guavus, a venture-backed bi-national company led by one of Crovella's former PhD students Anukool Lakina—is now being used by GÉANT, Europe's main multi-gigabit computer network for research and academic purposes.

Crovella continues to refine the technique at BU. Executing this type of analysis requires collecting an immense amount of data, and while computers amass and evaluate it, Crovella and his team must validate their results themselves before submitting their research for publication. This manual examination of multiple terabytes (a terabyte is 1,000,000,000,000 bytes—one trillion if you lost count of the zeros) not only requires a great deal of time and patience, but also expertise in both computer science and statistics. Crovella typically works with two to three students at a time and one to three other faculty investigators. It is a small army against a growing enemy: every day, according to Symantec MessageLabs, approximately 151 billion unsolicited messages are distributed by compromised computers.

"A year or so ago, I discovered my own PC was infected with a botnet," Crovella said, smiling and shaking his head. "The IT folks discovered it. I never knew it was there." R

Mark Crovella

BY KARINE ABALYAN

In the Field

Academic research at major universities—an exciting world of excavations, sediment sampling, and high-level lab tests—is typically reserved for graduate-level work. But at Boston University, a significant number of faculty members are giving undergraduates a key role to play in ongoing research projects—in some cases, as early as freshman year. From archaeological explorations in western Turkey, where civilizations have thrived for millennia at the crossroads of East and West, to methods of dating rocks that provide clues about the Earth's past and its present-day processes, BU undergrads are learning firsthand how to gather, analyze, and report data at the forefront of endeavors in their fields of study.

Outdoor Classroom

While studying historic travel journals and other accounts by early explorers for an archaeology-themed section of WP150—a writing seminar required of all undergraduates in the College of Arts & Sciences—Ali Clark had a "eureka" moment.

Clark, an art history major, realized that the plunder and sale of antiquities—a practice dating at least as far back as the Roman period—remains the modus operandi in today's art world, where it continues to undermine a people's ability to understand and preserve their cultural past.

"I've always been interested in art history, but I had never been exposed to that aspect of it before," Clark says. "That really focused my studies on what I wanted to pursue at BU." Toward the end of the semester, she contacted her writing instructor, Christina Luke, who is also a research fellow in the Department of Archaeology, about other opportunities to study looting and its impact on cultural heritage. The exchange sparked Clark's long-term involvement in the Central Lydia Archaeological Survey, a project Luke co-directs with Christopher Roosevelt, an associate professor of archaeology.

Clark is one of several undergraduates who have been involved in the survey, which explores human activity in western Turkey from the prehistoric age until the present and is partially funded by the Undergraduate Research Opportunities Program (UROP) at BU. Launched in 2005, the survey centers on a 135-square-mile rural area south of Istanbul and east of the Aegean Sea.

Luke and Roosevelt initially chose the site because of its proximity to Sardis, the capital of the Iron Age Lydian Empire, and its role as a vast burial ground for Lydian kings. (Known as Bin Tepe, or "The Thousand Mounds," the area is the largest tumulus cemetery in Turkey.) But before long, the project expanded in scope, from the Bronze Age through today.

"It began with a focus on the Iron Age and on understanding one of the world's early empires and its hinterland," says Roosevelt. "But it quickly grew into something broader because, as we learned very quickly, the remains of the area date to much more than just the Iron Age. There are much older and also much more recent periods of activity."

In the second millennium BC, for example, when Mycenaean Greeks ruled the Aegean and Hittites had established themselves in Asia Minor, central Lydia saw the rise of a network of fortifications, which might have served as a buffer zone between the two empires. These Bronze Age structures provide exciting support for the existence of a sophisticated indigenous state and also offer clues about how the land was used by early populations.

"A system like this, with the complexity that we see at these sites, is unknown anywhere else in western Anatolia right now," Luke says. *(continued on next page)*

Christina Luke

Christopher Roosevelt

An archaeology-themed writing seminar has piqued students' interest in Bronze Age Lydian culture, and led several to site visits at Sardis, once the capital of Lydia and the burial ground of kings, in what is now Turkey.

Unfortunately, there are others who have taken a less scholarly interest in the area. Widespread looting has already destroyed a significant portion of Bin Tepe's burial mounds and is now encroaching on the ring of fortified sites near Turkey's Marmara Lake, including the central citadel at Kaymakçı. To help track what has been looted and to prevent further destruction, Luke and Roosevelt have incorporated a preservation component into the Central Lydia Archaeological Survey.

Last year, Ali Clark and Caitlin Curtis, who received her BA in history in 2009 and is now pursuing graduate studies at SUNY Buffalo, combed through decades of auction catalogues at Boston's Museum of Fine Arts, documenting artifacts on the art market that might have been looted from Lydia. Their findings were used to construct a database of looting activity. The two students are also helping Luke and Roosevelt as they develop a heritage management plan involving community workshops and cooperation with local museum and government officials to design and implement preservation strategies.

Two other students involved in UROP—Meg Sneeringer and Olivia Shoucair—have made significant contributions to archaeological research in their time at BU, and Sneeringer has gone on to a fully funded PhD program in archaeology at the University of Cincinnati.

"One of the things we try to do with our undergraduates is expose them to the full range of archaeological work that's important for students to be familiar with if they want to continue in this field," Roosevelt says. "We have them get their feet wet and their hands dirty in all aspects of the project."

The benefits, he is quick to add, go both ways. "It's really great to work with interested, diligent, serious undergraduates," he says. "They're new and fresh to the material and the project, with an eagerness and curiosity that carries projects like this through."

From sunny Sifnos, Greece, to chilly Vermont, undergraduate and graduate students in Ethan Baxter's lab are venturing wherever garnet samples can be found: *(l–r)* Julie Barkman, Leah Mehl, Nora Sullivan, and Michelle Jordan.

Rock of Ages

Diamonds may be a girl's best friend, but garnet is the mineral proving most helpful for a team of budding earth scientists trying to map the Earth's chronology.

Using a special method of garnet dating, Associate Professor of Earth Sciences Ethan Baxter and the undergraduates in his lab are gaining insight into tectonic processes—such as mountain building and plate movement—that occurred millions of years ago.

Garnets are minerals that grow over long periods of time and preserve information about geologic changes through a series of concentric spherical shells, not unlike the growth rings on a tree. One way to determine the age of individual rings is through a method known as samarium-neodymium isotope dating. The labor-intensive approach involves measuring the ratio of decay of a radioactive samarium isotope to a radiogenic neodymium isotope found in the garnet. Samarium and neodymium must be extracted through a meticulous process of chemical cleansing; then, specific isotopes are isolated and measured using a thermal ionization mass spectrometer (TIMS).

When Julie Barkman decided to pursue an independent work for distinction in Baxter's lab her senior year, she had no background in the sophisticated chemical procedures that garnet dating requires. Soon, she had not only mastered the procedures, but had begun to seek ways to improve them. "I gained a really valuable skill set in terms of all the lab skills that I learned," says Barkman, who earned her BA in 2007.

Her efforts to refine the samarium-neodymium garnet method—which was not yet capable of the precise results Baxter's lab can achieve today—says Barkman, taught her "a lot about problem-solving and how to be more innovative." They also helped her win a National Science Foundation fellowship to pursue graduate studies. "I know it was a huge part of why I got the fellowship," says Barkman. "A lot of my reviewers pointed out that it's really great undergrad experience."

Baxter agrees. Getting students into the lab early is important, he says, because there "they really get to experience what science is all about. You can be told how science is done, but you don't really learn it until you try to do it yourself."

Ethan Baxter

Another student, Grace Andrews, started working in the TIMS lab as a freshman. At first she was assigned basic lab tasks like cleaning beakers and organizing materials. By the time she graduated this May, Andrews had completed three directed studies and an independent work for distinction. Her senior thesis investigated the potential causes of pulses of accelerated growth in garnets from the Austrian Alps, a phenomenon first described in detail by Baxter and graduate student Anthony Pollington.

"For a long time, the classic model of tectonics and of mountain building was that these processes operated over a long period of time in a fairly smooth, uniform pace," Baxter says. "Our study provides compelling support for another hypothesis—that slow and steady isn't winning the race in tectonics, but that instead it's brief, rapid spurts or pulses of activity that could be dominating mountain building, metamorphism, and tectonics in general."

Andrews's work on pulses of accelerated growth has taken her to the Goldschmidt Conference, the world's largest geochemistry gathering, to present her findings on garnets from the Austrian Alps that were collected by Baxter and Pollington.

"I came to BU because I knew I wanted to do research," Andrews says. "I'm doing stuff that's literally never been done before. It's exciting to be fresh out of my bachelor's and at the front lines of scientific research."

Baxter has mentored a total of 11 undergraduate students so far. "They're just tremendous," he says. "I have been extremely impressed with the quality and the dedication of our top undergraduates at BU."

His enthusiasm seems to be contagious. "Ethan is a great person to learn from," says Barkman. "He wants people to enjoy science and he wants people to be excited about the work that they're doing."

WEB EXTRA
Getting between rocks in a small place: Ethan Baxter studies the geological processes affecting the evolution of Earth's crust and mantle. **www.bu.edu/research/magazine**

Do you listen to all the nutrition advice out there? The contradictions, backtracks, and reversals can set your head spinning. A student-built smartphone app shares healthy eating expertise in a couple of clicks.

The near-impossibility of getting a straight answer on healthy eating encouraged Larry Istrail, a recent graduate of the College of Health & Rehabilitation Sciences: Sargent College, to help develop an iPhone app that will cut through the bad science and give users a simple, clear idea of their own food intake.

PhotoCalorie is a free food journal for Apple's iPhone that calculates a meal's nutritional information and records eating habits. Istrail started work on the app during a summer 2009 research project with Mark Boguski, a research associate at Harvard Medical School.

Although nutrition apps are common, Istrail says PhotoCalorie's simplicity gives it a competitive edge. "For a lot of other apps," he says, "you have to search for each item. It's very tedious, and we wanted to eliminate that." Users type a meal in one line ("poppy seed bagel, cream cheese, iced coffee") and the app, which College of Engineering alumnus Vince Fusaro helped to program, tallies the meal's nutrition: calories, protein, fat, and carbs. Rival programs lack PhotoCalorie's Google-like search component. The photo aspect is also unique.

"You take a picture of the food as a way of personalizing your journal," says Istrail, who used the U.S. Department of Agriculture's nutrient database to compile the extensive food list that powers the app. "A lot of people have told us that they just take the pictures, that's it, and they have a visual food journal."

Istrail also runs the PhotoCalorie blog, dispensing timely nutritional news and tips and offering a science major's take on the latest dietary trends. His interest in seeking out the truth behind ever-changing healthy eating advice was encouraged in a class on nutritional epidemiology taught by Associate Professor of Nutrition Paula Quatromoni. Quatromoni says nutrition is such a hot topic right now that more people are seeing it as a career path. And she says that students need to understand the truth behind these studies because there is so much confusion.

"Any tool that helps people increase their awareness of their personal habits has the potential to shift behaviors," she says. "The average person has difficulty identifying reputable sources of nutrition information and distinguishing fact from fiction. On the web, in magazines, on TV, and in the aisles of health food stores, it is easy for consumers to be misled and fall prey to false hope."

Istrail is optimistic the app will make it easier to get nutrition facts into the open and help inform some of the millions of people who suffer from nutrition-related health problems. With the app picking up new users every month, Istrail plans to go to medical school and then focus on research full time. "If you can do a good study that is novel and actually shows something," he says, "you can change the world; you can influence billions of people."

Larry Istrail

WEB EXTRA
Watch Larry Istrail demonstrate PhotoCalorie—and find out how to download the free app. **www.bu.edu/research/magazine**

BY KATHERINE CALVER HAWKINS

A Breath of Fresh Air

One of the first scientific facts that schoolchildren learn is that human respiration involves the intake of oxygen and the exhalation of carbon dioxide. Scientists have long understood that respiration works in the reverse for vegetation: growing plants take in carbon dioxide—carbon, for short—and release oxygen. Just how much carbon a plant will absorb is one question that researchers from the Department of Geography & Environment are tackling, thanks to a two-year exploratory grant from the National Science Foundation and the U.S. Forest Service known as Urban Long-Term Research Area, or ULTRA-Ex.

"What we're doing is basically a giant carbon footprint analysis of metropolitan Boston," says Associate Professor Nathan Phillips, one of the leads on the project. Except that in addition to measuring CO_2 released by humans, Phillips and his team are "also linking that to a whole other part of Boston that is exchanging carbon as well, and that's the natural systems."

Boston to Worcester, taking measurements of the carbon gas levels every five seconds using a sensor protruding through the car's sunroof. Preliminary findings suggest that carbon emissions increase dramatically in urban areas, but some of the data they collected was surprising. "We went to places that we thought would be significant sources for carbon," says Hutyra. "And some of them were what we expected and some of them weren't."

Phillips is also interested in learning which species of plants are most efficient in carbon uptake. "The urban environment is like an experimental treatment," he says. "Are plants more or less healthy? Are they growing faster or slower?"

Certain species of vegetation may hold the key to the carbon question. "There is data that suggests that some invasive species grow like gangbusters in the urban environment, and that native vegetation doesn't do as well," says Phillips. One of the most common invasive species is *Ailanthus altissima,* an East Asian tree that thrives in urban environments all along the East Coast, leading Phillips to wonder, "If those ailanthus trees were not growing in the parking lot, what would be there? Would it be a nice native red oak tree, or are invasive species occupying niches in the urban environment that might be too degraded for native species to occupy?"

Graduate student Jared Newell, *left,* and Associate Professor of Geography & Environment Nathan Phillips are part of a team using the Picarro sensor, seen here, to measure airborne carbon dioxide levels above BU's Stone Science Building and around Boston.

"The urban environment is like an experimental treatment. Are plants more or less healthy? Are they growing faster or slower?"

Why carbon? Professor Suchi Gopal, another member of the ULTRA team, explains that they "made carbon the currency because all biological systems live and breathe; carbon is like cash that flows all over the system."

Because carbon dioxide is not regulated by the EPA, few studies have been done so far to characterize the gas in urban, suburban, or rural environments. So before ULTRA researchers can solve the problem of offsetting carbon emissions, they need to learn more about the sources of carbon, as well as the sinks—natural or artificial systems that absorb the gas—in and around Boston. To this end, they are using a Picarro sensor installed on the roof of a campus building to take measurements of airborne carbon dioxide levels ten times per second.

Last spring, Assistant Professor Lucy Hutyra teamed up with Phillips to take the Picarro on the road. After placing it in the trunk of Hutyra's car, they drove from

Hardy species of vegetation like the ailanthus may be the answer to increasing the amount of carbon sinks in metropolitan areas like Boston. The more plants that are growing, the more carbon is absorbed. Satellite imagery can show researchers how much vegetation exists in a certain area, but it cannot tell them how much carbon is stored in each plant. A ground-level census of the vegetation in and around Boston—combined with the data that Picarro has collected about the levels of gasses in the air—could lead BU researchers toward finding ways of offsetting the high levels of carbon found in urban and suburban areas.

Another aspect of ULTRA is studying the effects of human behaviors on carbon emissions in Boston. Led by Robert Kaufmann, professor and chair of the Department of Geography & Environment, this project is focusing on when and why people are using certain appliances and is also tracking commuting habits to see how residents might be nudged in sustainable directions.

In 2012, BU researchers will compete for the next level of ULTRA, which would provide funding for a decade. The team is confident that their findings to date will pique interest in future research. "Once we have the core information, we can start to play what if games," says Hutyra. "What if we increase the canopy cover? What if we required new housing developments to set aside green space? What would that mean in terms of the carbon impact? But before we can really do that, we have to complete our understanding of where we are today."

WEB EXTRA
www.bu.edu/research/magazine

Award-Winning Faculty

Hatice Altug (Electrical & Computer Engineering), **Pietro Cottone** (Pharmacology & Psychiatry), **Margaret Litvin** (Modern Languages & Comparative Literature), **Abigail Moncrieff** (Law), and **Catharine Wang** (Community Health Services) received Peter T. Paul Career Development Professorship Awards.

Martin Amlin, Samuel Headrick, and **Rodney Lister** (Music) received American Society of Composers, Authors and Publishers (ASCAP) Awards.

Sean Andersson and **Katherine Zhang** (Mechanical Engineering), and **Hatice Altug** and **Luca Dal Negro** (Electrical & Computer Engineering) won National Science Foundation CAREER Awards.

John Baillieul (Mechanical Engineering) was named a Fellow of the Society for Industrial and Applied Mathematics.

Gary J. Balady (Clinical Cardiology) won the Leonard Tow Humanism in Medicine Award from the Arnold P. Gold Foundation.

Kathryn Bard (Archaeology) was elected a Fellow of the American Academy of Arts & Sciences.

Marlene Oscar Berman (Anatomy/Neurobiology) received the Veterans Health Administration's Merit Review Award.

The **Department of Biology** of the **College of Arts & Sciences** received an award from Merck & Co., Inc.

Judith Braha (Theatre) received the Elliot Norton Award for Outstanding Direction.

John Byers (Computer Science) won the Association for Computing Machinery's SIGCOMM Test of Time Paper Award.

The **Center for Global Health & Development** was awarded $8.4 million by the Bill and Melinda Gates Foundation to research methods of decreasing neonatal mortality in Zambia.

The **Center for Investigative Reporting** received an award from the John S. and James L. Knight Foundation.

The **Center for the Study of Traumatic Encephalopathy** received $1 million from the National Football League to study the long-term impact of brain injuries in football.

The late **Franco Cerrina** (Electrical & Computer Engineering) was named an International Society for Optics and Photonics Fellow.

Ci-Di Chen (Biochemistry) received an Ellison Foundation Award.

Richard Cornell (Music) was awarded a Governor's Citation from the Commonwealth of Massachusetts.

Ayşe Coşkun (Electrical & Computer Engineering) won the Best Paper Award at the International Federation for Information Processing IEEE Conference on Very Large Scale Integration.

Catherine E. Costello (Mass Spectrometry Resource) received the International Massachusetts Spectrometry Foundation's Thomson Medal and the American Chemical Society's Frank H. Field and Joe L. Franklin Award. She was also elected President of the Human Proteome Organisation.

Chrysanthos Dellarocas (Information Systems) won the Google and WWP Marketing Research Award.

Deborah A. Frank (Pediatrics) delivered the University of Pennsylvania's Renee C. Fox Lecture in Medicine, Culture, and Society.

Carl Franzblau (Biochemistry) received the Distinguished PhD Alumnus Award from the Albert Einstein College of Medicine.

Timothy Gardner (Biology) won the Richard & Susan Smith Family Foundation's Award for Excellence in Biomedical Research.

Paul Goldberg (Archaeology) won the Pomerance Award for Scientific Contributions to Archaeology from the Archaeological Institute of America.

Herbert Golder (Classical Studies) received a Golden Lion nomination at the Venice International Film Festival for the film *My Son, My Son, What Have Ye Done?,* which was directed and co-written by Werner Herzog.

Richard Goldstein (Pediatrics) received an Individual Biomedical Researcher Award from the Hartwell Foundation.

Stjepko Golubic (Biology) received a Lifetime Achievement Award from the Croatian Society of Natural Sciences.

William Grimes (International Relations) was named a Research Associate with the National Asia Research Program.

Mark Grinstaff (Chemistry) was elected to the College of Fellows of the American Institute for Medical and Biological Engineering.

Michael Grodin (Health Law & Bioethics/Human Rights) received the Massachusetts Department of Public Health Diversity Council Justice Award.

Martin Herbordt (Electrical & Computer Engineering) won the Outstanding Paper Award at the International Conference on Field Programmable Logic and Applications.

Ariel Hirsch (Radiology) was awarded the International Association of Medical Science Educators' Scholarship.

Award-Winning Faculty

Michael F. Holick (Endocrinology) won the Linus Pauling Prize and the NAMS/Upsher-Smith Laboratories, Inc. Vitamin D Research Award. He also received the DSM Innovation in Nutrition Award and the American Association for Clinical Chemistry's Outstanding Speaker Award.

Bradford Hudson (Hospitality) was named the 2010–2011 Fulbright Visiting Research Chair in Sustainable Commerce at the University of Guelph.

Jeffrey Hutter (Dental Medicine) received the American Association of Endodontists' Edgar D. Coolidge Award.

The **Institute on Culture, Religion & World Affairs** received awards from the Henry Luce Foundation.

The **Institute for Geriatric Social Work** received an award from The Atlantic Philanthropies.

The **Institute for Nonprofit Management & Leadership** received an award from the Barr Foundation.

Alice K. Jacobs (Cardiology) won the American Heart Association's Gold Heart Award.

Gene Jarrett (English) was named a 2010–2011 Radcliffe Institute Fellow at Harvard's Radcliffe Institute for Advanced Study.

Judith Jones (General Dentistry) won the American Association of Public Health Dentistry Service Award.

Richard Kalish (Family Medicine) received the Health Champions Award and the Community Health Pinnacle Award.

Douglas Katz (Neurology) received the MAB Community Service's Al Gayzagian Lifetime Achievement Award.

James Kaufman (Medicine) won the David Littman Award.

Leslie Kaufman (Biology) received a Partners in Conservation Award from the U.S. Department of the Interior.

Carine Lenders (Pediatrics) was named America's Top Pediatrician by the Consumers' Research Council of America.

Kenneth Lutchen (Biomedical Engineering) was elected President of the American Institute for Medical and Biological Engineering and received Case Western Reserve University's Distinguished Alumni Award for Biomedical Engineering Education.

Jared W. Magnani (Cardiology) received a Fellow-to-Faculty Award from the American Heart Association.

Barry Manuel (Continuing Medical Education) received the Massachusetts Medical Society's Lifetime Achievement Award.

Robert Marquez (Finance/Economics) was named Extramural Fellow of the European Banking Center at Tilburg University.

John Matthews (English) received a Fulbright Fellowship to teach at Charles University in Prague.

Christopher Maurer (Romance Studies) was named a Miembro Correspondiente of the Real Academia Española.

Elise Morgan (Mechanical Engineering) won the Vernon T. Tolo Basic Science Paper Award.

The **Neuroscience** program was awarded $1.5 million from the Howard Hughes Medical Institute to enhance undergraduate research opportunities.

Ketty Nez (Music) won the ERM*Media* film scoring competition for her orchestral score to Thomas Edison's 1904 film *The Manic Chase.* She also received an ASCAPLUS Award.

Sandra Nicolucci (Music) was named the Sigma Alpha Iota International Music Fraternity's Distinguished Woman of the Year.

Rafael Ortega (Anesthesiology) won the Special Award from the New York State Society of Anesthesiologists.

David Ozonoff (Environmental Health) delivered the Macgregor Memorial Lecture at the University of Alberta Medical Center.

Harold Park (Mechanical Engineering) received the Gallagher Young Investigator Award from the U.S. Association for Computational Mechanics.

Linda Piwowarczyk (Psychiatry) received the Sarah Haley Memorial Award for Clinical Excellence from the International Society for Traumatic Stress Studies.

Richard Raiselis (Visual Arts) was awarded the National Academy's Giovanni Martino Prize for Landscape Painting at the 185th Annual Exhibition of Contemporary American Art.

Siddharth Ramachandran (Electrical & Computer Engineering) was named a Fellow of the Optical Society of America.

Harold Reddicliffe (Visual Arts) received a painting fellowship from the Massachusetts Cultural Council.

Daniel Remick (Pathology & Lab Medicine) presented the 8th annual John Spitzer Distinguished Lecture at the Louisiana State University Health Sciences Center and became President of the Shock Society.

Arnold Robbins (Medical Education) was recognized as a Community Clinician of the Year by the Massachusetts Medical Society.

James Rohlf (Physics) was inducted into the Academy of Science and Engineering at the University of Minnesota, Duluth.

Adam J. Rose (Internal Medicine) received the Pier M. Mannucci Young Investigator Prize from the *Journal of Thrombosis and Haemostasis,* and the Milton W. Hamolsky Junior Faculty Award from the Society of General Internal Medicine.

Jennifer E. Rosen (Surgery) won a Center for Integration of Medicine and Innovative Technology (CIMIT) Young Clinician Award.

George Rosenthal (Geriatrics) received the Robert Dawson Evans Outstanding Citizen Award from the Boston Medical Center.

Ronald Roy (Mechanical Engineering) was awarded the Helmholtz-Rayleigh Interdisciplinary Silver Medal from the Acoustical Society of America.

David J. Salant (Nephrology) was named the 2010 Meira and Shaul G. Massry Visiting Professors at UCLA and USC.

Joan Salge-Blake (Health Sciences) was named an American Dietetic Association National Media Spokesperson.

Natascha Saunders (Organizational Behavior) was recognized as the 2010 Harvard University WECAN Woman of the Year.

Kitt Shaffer (Radiology) received the Joseph E. and Nancy O. Whitley Award from *Academic Radiology.*

Barbara Shinn-Cunningham (Cognitive & Neural Systems) was named to the Executive Council of the Acoustical Society of America.

Robert Sloane (Law) was awarded the Lieber Prize by the American Society of International Law.

Kevin Smith (Physics) was elected a Fellow of the American Physical Society.

Shuba Srinivasan (Marketing) received the Google and WPP Marketing Research Award.

H. Eugene Stanley (Physics) received a doctorate *honoris causa* from the University of Messina, Italy.

Lee Staples (Social Work) won the Beverly Ross Fliegel Award for Social Policy and Change from the Massachusetts Chapter of the National Association of Social Workers.

Gail Steketee (Social Work) delivered the Aaron Rosen Lecture at the national conference of the Society of Social Work and Research.

Ashley Stevens (Technology Development) was named President of the Association of University Technology Managers.

James Stone (Physics) was awarded a Jefferson Science Fellowship from the National Academies.

Rathan Subramaniam (Radiology) received the New Investigator Award from the Radiology Research Alliance.

Thomas Szabo (Biomedical Engineering) was elected a Fellow of the American Institute of Ultrasound in Medicine.

Xiaoyong Tong (Vascular Biology) won the Junior Faculty Award from the American Diabetes Association.

Paul Tornetta III (Orthopaedic Surgery) received an Orthopaedic Research and Education Award for Clinical Research, and the Bovil Award from the Orthopaedic Trauma Association.

Thomas Tullius (Chemistry) received the Senior Scholar Award in Aging from the Ellison Medical Foundation.

Ann Vasaly (Classical Studies) was named the Lucy Shoe Merritt Scholar in Residence by the American Academy of Rome.

Robert Wagenaar (Physical Therapy) was reappointed to the Board of Directors of the American Society for Neurorehabilitation.

John H. Wallace (Music) received a Bronze Best Practices Award for Excellence in Distance Learning Teaching from the United States Distance Learning Association.

Alexander Walley (Internal Medicine) won the Clinical Investigator Award from the Society of General Internal Medicine, New England Region.

Joseph Wippl (International Relations) was awarded the Distinguished Intelligence Medal from the Central Intelligence Agency.

Philip Wolf (Neurology) delivered the Robert Wartenberg Lecture at the American Academy of Neurology.

Jonathan Woodson (Surgery) won the Humanism in Medicine Award from the AAMC's Arthur P. Gold Foundation.

Donald Wright (Mass Communication) received the Presidential Citation Award from the Public Relations Society of America.

Jeremy Yudkin (Music) received a Certificate of Merit from the Association for Recorded Sound Collections.

Muhammad Zaman (Biomedical Engineering) received the University of Texas's Regents Outstanding Teaching Award, and was named a Fellow at the University of Melbourne.

Boston University **at a Glance**

Robert A. Brown, President
David K. Campbell, University Provost
Karen H. Antman, Provost, Medical Campus

Research Centers and Institutes

African Presidential Archives & Research Center
African Studies Center
Alcohol and Drug Institute for Policy, Training & Research
Alzheimer's Disease Center
American Schools of Oriental Research
Amyloid Treatment & Research Program
Anna Howard Shaw Center
Archaeological Institute of America
Arthritis Center
Biomolecular Engineering Research Center
Cancer Research Center
Cardiovascular Proteomics Center
Center for Adaptive Systems
Center for Addictions Research & Services
Center for Advanced Biotechnology
Center for Anxiety & Related Disorders
Center for Applied Research in Language
Center for BioDynamics
Center for Biomedical Imaging
Center for Character & Social Responsibility
Center for Chemical Methodology & Library Development
Center for Computational Science
Center for Congregational Research & Development
Center for Ecology & Conservation Biology
Center for Energy & Environmental Studies
Center for Global Health & Development
Center for Human Genetics
Center for Information & Systems Engineering
Center for Integrated Space Weather Modeling
Center for International Relations
Center for Mathematical Physics
Center for Molecular Discovery
Center for Nanoscience & Nanobiotechnology
Center for Neurorehabilitation
Center for Neuroscience
Center for Philosophy & History of Science
Center for Polymer Studies
Center for Psychiatric Rehabilitation
Center for Reliable Information Systems & Cyber Security
Center for Remote Sensing
Center for Research to Evaluate & Eliminate Dental Disparities
Center for Science & Medical Journalism
Center for Space Physics
Center for Subsurface Sensing & Imaging Systems
Center for the Study of Traumatic Encephalopathy
Center of Excellence for Learning in Education, Science & Technology
Center of Excellence in Sickle Cell Disease
Clinical & Translational Science Institute
Communication Research Center
Danielsen Institute Center for the Study of Religion & Psychology
Elie Wiesel Center for Judaic Studies
Framingham Heart Study
Fraunhofer Center for Manufacturing Innovation
Gerontology Center
Harold Goodglass Aphasia Research Center
Health & Disabilities Research Institute
Health Policy Institute
Hearing Research Center
Howard Gotlieb Archival Research Center
Human Resources Policy Institute
Institute for American Political History
Institute for Astrophysical Research
Institute for Economic Development
Institute for Geriatric Social Work
Institute for Leading in a Dynamic Economy
Institute for Philosophy & Religion
Institute for Sexual Medicine
Institute for Technology Entrepreneurship & Commercialization
Institute for the Advancement of the Social Sciences
Institute for the Classical Tradition
Institute for the Study of Muslim Societies & Civilizations
Institute of Jewish Law
Institute on Culture, Religion & World Affairs
International Center for East Asian Archaeology & Cultural History
International History Institute
Management of Variability Program
Memory Disorders Research Center
Morin Center for Banking & Financial Law
National Emerging Infectious Diseases Laboratories
NeuroMuscular Research Center
Pardee Center for the Study of the Longer-Range Future
Parkinson's Disease & Movement Disorders Center
Partners in Health & Housing Prevention Research Center
Photonics Center
Prevention Research Center
Pulmonary Center
Science & Mathematics Education Center
Slone Epidemiology Center
Smart Lighting Engineering Research Center
Superfund Basic Research Program
Systems Research Center
Tanglewood Institute
Whitaker Cardiovascular Institute
Women's Health Interdisciplinary Research Center

Students

16,340 undergraduate; 13,497 graduate; 2,720 non-degree

Faculty and Staff

2,896 full-time faculty; 1,282 part-time faculty; 5,103 full-time staff; 325 part-time staff

Campus

133 acres, 321 buildings; 487 classrooms; 2,022 laboratories; 11,546 total residence capacity

Computing Facilities

Supercomputers
IBM BlueGene/L supercomputer with 1,204 nodes
IBM pSeries 655 with 112 processors
IBM xSeries Linux cluster with 60 processors
IBM Blade Center Linux cluster with 272 processors

Specialized High-Performance Computer Laboratories
Deep Vision Display Wall
Access Grid Conference Facility
Computer Graphics Laboratory
LIVE: Laboratory for Virtual Environments

High-Performance Networking
Fiber Optic Metro Ring interconnecting Boston University, Harvard, and MIT
Northern Crossroads (NoX)
Internet2

Computing Labs
UNIX, Windows, and Macintosh labs
ResNet Computer Labs
More than 30 additional departmental computer laboratories

Libraries

23 libraries and special collections; 2.9 million volumes; 57,755 periodicals; 4.8 million microform units

Research

Sponsored Program Awards FY2010: $407.8 million

Financial Resources

Endowment: $1.02 billion
Total assets: $3.9 billion

Enrollment, staffing, and facilities figures as of Fall 2009.
Financial figures as of June 30, 2010.

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Here, There, and Everywhere

Poets, playwrights, and fiction writers set off in search of inspiration, supported by a new fellowship for international travel and study.

page 40