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TechTalk
SERVING THE MIT COMMUNITY

Peptide 'grammar' may mean new medicine

Custom-designed molecules punch holes in anthrax, staph bacteria

Anne Trafton
News Office

In most languages, sentences only make sense if the words are placed in the right order. Now, MIT researchers and an IBM colleague have used grammatical principles to help their search for new antimicrobial medicines.

After identifying "grammatical" patterns in naturally occurring antimicrobial peptides, the researchers custom-designed molecules that proved extremely effective in killing microbes, including anthrax bacteria. The research could lead to new medicines to combat deadly drug-resistant bacteria.

"In the last 40 years, there have been only two new classes of antibiotic drugs discovered and brought to the market," said graduate student Christopher Loose, lead author of a paper on the work that appears in the Oct. 19 issue of Nature. "There is an incredible need to come up with new medicines."

Loose, research associate Kyle Jensen and Professor Gregory Stephanopoulos of the Department of Chemical Engineering are focusing their attention on antimicrobial peptides, or short strings of amino acids. Such peptides are naturally found in multicellular organisms, where they play a role in defense against infectious bacteria.

The researchers' newly designed peptides were shown to be effective against dangerous microbes such as Bacillus anthracis (anthrax) and Staphyloccus aureus, a bacteria that spreads in hospitals and is frequently drug-resistant. The peptides may also be less likely to induce drug resistance in these bacteria, according to the researchers.

Antimicrobial peptides act by attaching to bacterial membranes and punching holes in them, an attack that is general to many different types of bacteria and is difficult for them to defend against. "There's no quick easy mutation fix for a bacteria to get around this non-specific membrane attack," said Loose.

The peptides are generally short, consisting of about 20 amino acid building blocks. The molecules naturally fold

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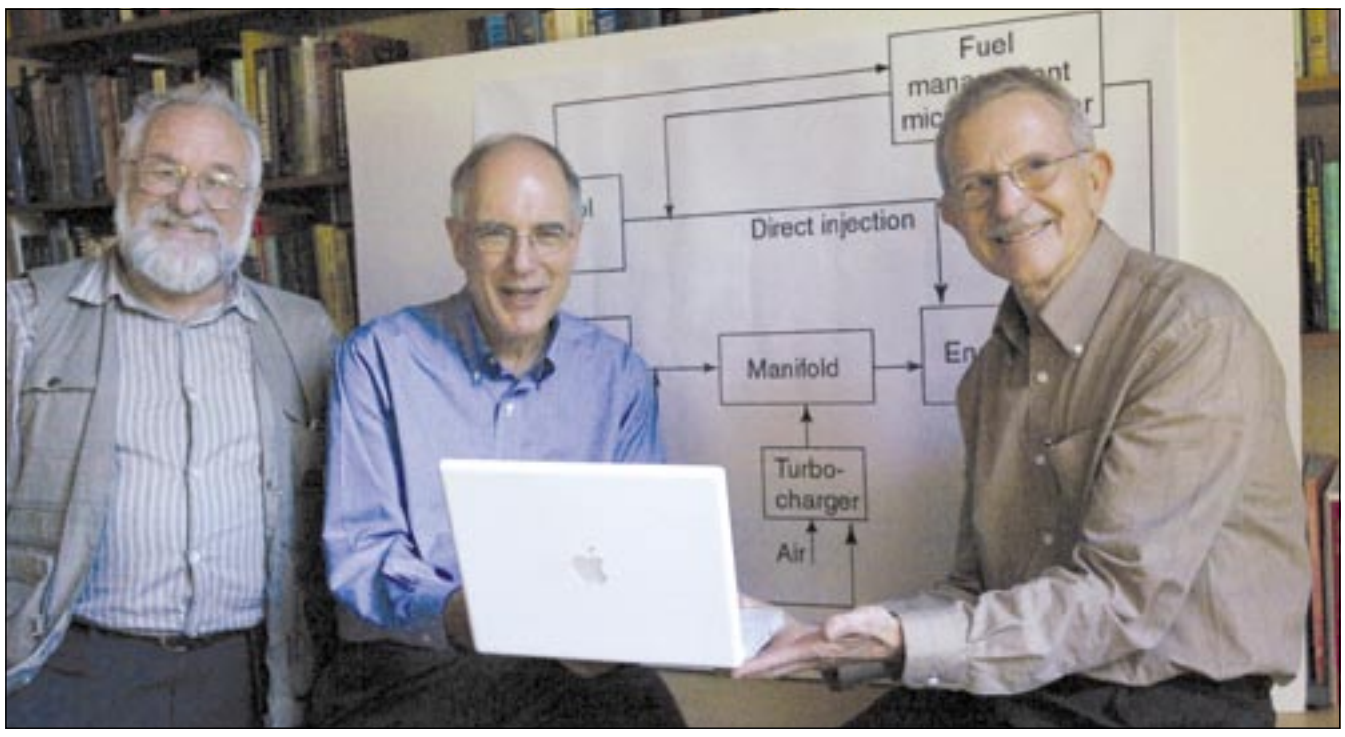

PHOTO / **DONNA COVENEY**

The little engine that could

MIT researchers have developed a half-sized engine that performs like a full-sized engine but offers the fuel efficiency of a hybrid electric car. The team includes, from left to right, Leslie Bromberg, principal research engineer at the Plasma Science and Fusion Center, Daniel Cohn, division head and senior research scientist at the Plasma Science and Fusion Center, and John Heywood, director of the Sloan Automotive Lab and professor of mechanical engineering. For full story, see page 4.

Neuroscientists pinpoint brain site for rapid learning

Deborah Halber
News Office Correspondent

MIT researchers have provided the first two-pronged evidence—based on both behavior and physiology—that a specific juncture in the memory center of the brain is crucial for rapid learning.

The work, presented Oct. 18 at a meeting of the Society for Neuroscience in Atlanta, helps explain how injury or Alzheimer's disease result in loss of the ability to form new memories of facts and events.

The researchers, led by Thomas J. McHugh, research scientist at the Picower Institute for Learning and Memory, engineered a mouse lacking a receptor for a key neurotransmitter in the dentate gyrus. This serrated strip of gray matter is wrapped around and within the seahorse-shaped hippocampus, which is crucial in memory formation. Information arriving at the hippocampus first travels through the dentate gyrus.

"While it has long been known that damage to this region of the hippocampus affects short-term memory formation, little is understood about how each type of neuron-to-neuron connection contributes to memory in this circuit," McHugh said.

The researchers observed the behavior of the genetically manipulated mice and measured their neuronal activity. They found that neurons at a key juncture in the dentate gyrus that receives new input from other parts of the brain help mice recognize and remember new environments.

The mice without neurotransmitter receptors at this juncture "learned normally when trained slowly with hours or days between trials, but showed learning deficits when challenged to learn the same tasks quickly, with only minutes between trials," McHugh said. The finding shows that synapses—the connections among neurons—at the dentate gyrus are critical for rapid learning.

"This advance in the understanding of how the hippocampal circuit functions suggests possible therapeutic targets in diseases that lead to memory deficits," McHugh said.

McHugh's MIT colleagues on the work are Matthew Wilson, Picower Scholar and professor of neuroscience; Susumu Tonegawa, Picower Professor of Biology and Neuroscience and director of the Picower Institute; and Matthew W. Jones, a former Picower postdoctoral associate now at the University of Bristol.

This work was supported by the National Institutes of Health and MIT-RIKEN.

'Soap Box' energy panel focuses on sustainability

Automotive, building industries should take the lead

Deborah Halber
News Office Correspondent

The first of three MIT Museum "Soap Box" events devoted to energy covered the gamut from climate change to the urgent need for policies limiting greenhouse gas emissions.

Ernest J. Moniz, Cecil and Ida Green Professor of Physics, co-director of the Laboratory for Energy and the Environment and director of the new MIT Energy Initiative, and Kerry Emanuel, professor of meteorology, spoke about "The Challenge: Meeting Global Energy Demands Sustainably."

Soap Box at the MIT Museum is a series of salon-style conversations with scientists and engineers, a public forum for debate about ideas and issues in science and technology. Wednesday's event was webcast live through the museum web site.

Emanuel gave an overview of three major factors that drive the debate on energy—supply, security and the impact of energy consumption on the environment.

Emanuel said that while he himself was skeptical 15-20 years ago about global warming, the scientific community now has clear-cut data: The temperature is rising, possibly as much as 2 to 5 degrees overall, depending on clouds, which reflect, absorb and redirect sunlight.

"What keeps some of us awake at night is surprises—the low-probability, high-impact events we don't know enough about to rule out," he said. One of these would be that if all of Greenland's ice melt-

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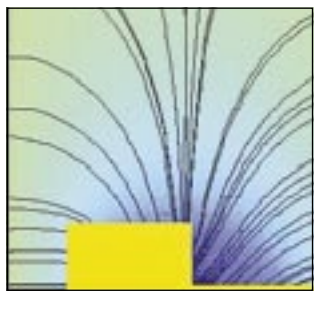

Vassar Street West project will complete enhanced streetscape

Sasha Brown
News Office

Over the next three years, Vassar Street West will transform from a relatively nondescript urban byway to a grand boulevard, according to officials representing MIT and the City of Cambridge at the groundbreaking for the project on Oct. 17 at Simmons Hall.

The project marks a collaborative effort between MIT, city leaders and Richard Simmons (S.B. 1953), for whose family Simmons Hall is named.

"Despite the somewhat rainy weather, it is a beautiful day," said MIT President Susan Hockfield as she praised the "set of creative collaborations" that produced the plans for Vassar Street West.

The project represents an "ongoing and developing relationship between MIT and the city," she said. "This new Vassar Street will benefit both Cambridge and MIT. MIT is grateful to all those whose contributions will make a more beautiful and revitalized Vassar Street."

When the project is completed in the summer of 2009, bicycle tracks, spacious sidewalks, street trees and contemporary streetlights will line the road. The telephone lines that currently run along the athletic field across the street from Simmons will be buried—something of particular importance to Simmons.

Other planned enhancements include solar in-pavement lights, well-marked and well-lit crosswalks with curb extensions, and a speed table at the Simmons Hall crosswalk.

Simmons called his gift an "investment that improves the cohesiveness of the Institute."

Vassar Street East, which runs past the Stata Center, was completed in 2004, and when the west end is done, the entire length of Vassar Street will be completely rejuvenated.

"Vassar Street—both east and west—may become one of the architectural boulevards that people come from far and near to visit," said Cambridge Mayor Kenneth Reeves. Reeves said he hopes to see more collaborations like it in the future.

Following brief talks from City Manager Robert Healy as well as the past and present presidents of Simmons Hall, eight representatives of Cambridge and MIT went outside to break ceremonial ground on the project.

PHOTO / **DONNA COVENEY**

President of Simmons Hall Andrew Lukmann, a senior in civil and environmental engineering; Dean for Student Life Larry Benedict; Interim Executive Vice President Sherwin Greenblatt; MIT President Susan Hockfield; donors Ginny and Richard Simmons; Cambridge Mayor Kenneth Reeves; and City Manager Robert Healy lift their shovels to mark groundbreaking on Vassar Street in front of Simmons Hall.

Randolph will serve in new role as Institute chaplain

Sasha Brown
News Office

After 27 years at MIT, Senior Associate Dean Robert Randolph will step into a new role as Institute chaplain in January 2007 armed with a list of goals and hopes for the future of MIT's religious life.

Robert Randolph

His new role will be an interesting challenge, one that will combine what he most enjoyed in his role as dean—forming relationships with students and dealing with crises—with his personal and professional interest in religion as an ordained Protestant minister. Prior to coming to MIT in 1979, Randolph served as chaplain at the Dana Hall School in Wellesley.

Randolph has also served as housemaster of MIT's Bexley Hall for the past seven years with his wife, Jan.

In the 1980s, "religion was not seen as a hot topic," Randolph said. Over the years that attitude has changed, but to Randolph, it is attitude, not the reality, that has changed. "It has always been clear to me that religious life has been an important part of many students' lives," he said.

Since coming to MIT, Randolph has worked extensively with each of MIT's many religious communities. "I have been their point of communication with the Institute for 25 years," he said.

In the past, each chaplain has had space at the Institute, but they have reported to their sending organization. In his new role, Randolph will give a public face to the chaplaincy, which will have "a bigger and more public role," he said. "This will offer the chaplains some institutional support."

Randolph said he has always heard administrators talk of the kind of diversity that is ever-present in MIT's religious community. "In a quiet way, the religious community models the diversity MIT is seeking," he said.

In his new role, Randolph plans to tap into that diversity and host more interfaith events and conversations. He hopes to spur dialogue and promote greater understanding among the many faiths represented at MIT. "I hope in the long run we will see more programs that encourage expression and interfaith conversation," he said.

Randolph's goals for the position include developing a protocol for the way memorial services are handled on campus. "There should be an official plan in place," Randolph said, one that "gives people a point at which to begin planning." He also wants to give attention to matters of morality on campus, both academic and personal.

"We owe it to one another to think seriously about what honesty means and what integrity looks like," Randolph said. He hopes to engage the entire community by establishing a board of advisers that includes students, faculty and staff who might collectively serve as a resource and guide for new programming. "The challenge to me is to reach out and give structure," he said.

For his colleagues who have worked with him over the years, there is no doubt Randolph is up to the challenge. "I am delighted that Bob Randolph has agreed to officially become the MIT chaplain," said Larry Benedict, the dean of student life at MIT. "For most of his 27 years at MIT Bob has played this role with dedication, loyalty, care and sensitivity, and the title MIT chaplain reflects this."

"This role will be a capstone to his distinguished career at MIT and will build on his charisma and skills as a minister. I can think of no finer individual to be our chaplain," Benedict said.

Faculty discuss curriculum, endowment

Deborah Halber
News Office Correspondent

Faculty discussion of the proposed undergraduate curriculum changes began in earnest at the Oct. 18 faculty meeting, following the Oct. 13 release of the Institute's Task Force on the Undergraduate Educational Commons report outlining its recommended changes.

At the Nov. 15 faculty meeting, the deliberations will continue and the faculty will consider a motion that would delay until February the vote on whether the recommendations as they stand should be turned over to the Faculty Committee on the Undergraduate Program (CUP) for refinement.

The recommendations, which include new requirements in science, mathematics and engineering as well as in the humanities, arts and social sciences, also endorse an increased role for international educational experiences in the undergraduate years.

The task force, which worked on the recommendations for two and a half years, was chaired by Robert J. Silbey, MIT's Class of 1942 Professor of Chemistry and dean of science.

Silbey said the task force's assignment was challenging. Previous changes to the general Institute requirements (GIRs) occurred in 1964, when the world—and MIT—was a very different place. There were no personal computers then, he pointed out, and the student body represented a predominantly Caucasian male demographic. The new "shared cultural experience" contained in the GIRs would have to reflect a new reality, Silbey said. "We did not think the GIRs were broken, but we did think we could improve (them)," he said.

The task force felt "we need greater curricular flexibility, increased freshman motivation and enthusiasm and more active, project-based learning in the first year," Silbey said, pointing out that the current freshman year experience does not require any laboratory experiences. Math, science and engineering students have a hard time participating in a junior year abroad program because they would miss classes in the required sequence. Double majors may make more sense than double degrees, he said.

Accommodating new priorities such as these will require enhanced coordination and planning of the first-year curriculum, improved orientation and advising for first-year students, and the addition of new subjects and faculty to teach the new subjects, Silbey said.

Hazel L. Sive, professor of biology, suggested that taking language classes freshman year would prepare students for an international experience. Gerald J. Sussman, Panasonic Professor of Electrical Engineering, said he was "disappointed" that the recommendations were not more radical. "There's an opportunity here to break some of the boundaries between departments and schools," he said.

Edward F. Crawley, executive director of the Cambridge-MIT Institute and professor of aeronautics/astronautics and engineering systems, said that learning experiences that allow students to experience phenomena first-hand reinforce abstract concepts and address a certain learning style that is otherwise not sup-

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23 faculty members awarded tenure

The Corporation's Executive Committee approved 23 faculty members for promotion to tenure in May. Here are their profiles:

Jonathan Rodden

Political Science
Education: B.A. 1993 (University of Michigan), Ph.D. 2000 (Yale)
Joined MIT faculty: 1999

Rodden is a scholar of comparative politics who has established himself as one of the leading students of federalism.

Junot Diaz

Program in Writing and Humanistic Studies
Education: B.A. 1992 (Rutgers University), M.F.A. 1995 (Cornell University)
Joined MIT faculty: 2003

Diaz, a writer of international renown, is one of the seminal Latino and American fiction writers of his generation.

Rahul Sarpeshkar

Electrical Engineering and Computer Science
Education: S.B. 1990 (MIT), Ph.D. 1997 (Caltech)
Joined MIT faculty: 1999

Sarpeshkar is a leader in the design of analog low power integrated circuits, particularly for cochlear implants and other biomedical applications.

Eytan H. Modiano

Aeronautics and Astronautics
Education: B.S. 1986 (University of Connecticut), M.S. 1989, Ph.D. 1992 (both from University of Maryland)
Joined MIT faculty: 1999

Modiano is a world leader in the design of architectures and protocols for satellite, optical and wireless networks.

Meg Jacobs

History
Education: B.A. 1990 (Cornell University), M.A. 1993, Ph.D. 1998 (both from University of Virginia)
Joined MIT faculty: 1999

Jacobs is a well-known historian of 20th-century America whose writings have had a broad impact among historians and political scientists.

Eric Klopfer

Urban Studies and Planning
Education: B.S. 1992 (Cornell University), Ph.D. 1997 (University of Wisconsin at Madison)
Joined MIT faculty: 1999

Klopfer administers MIT's Teacher Education Program and has developed and disseminated innovative educational technology to improve science teaching.

Sang-Gook Kim

Mechanical Engineering
Education: B.S. 1978 (Seoul National University, Korea), S.M. 1980 (Korea Institute of Science & Technology), Ph.D. 1985 (MIT)
Joined MIT faculty: 2000

Kim's research aims to establish a systematic framework for micro and nanoscale product development, including the development of new manufacturing processes and creating devices with new functionalities.

Christopher B. Burge

Biology
Education: B.S. 1990, Ph.D. 1997 (both from Stanford University)
Joined MIT faculty: 2002

Burge is a national and international leader in the field of computational biology and bioinformatics. His work has led to software applications that are the most widely used tools from mammalian gene identification.

Elly Nedivi

Brain and Cognitive Sciences
Education: B.S. 1982 (Hebrew University, Israel), Ph.D. 1991 (Stanford University)
Joined MIT faculty: 1998

Nedivi studies the mechanisms that underlie activity-dependent plasticity—the adaptive response of the brain to changes in the environment—in the developing and adult brain.

Yoel Fink

Materials Science and Engineering
Education: B.Sc. 1994, B.A. 1995 (both from Technion, Israel), Ph.D. 2000 (MIT)
Joined MIT faculty: 2000

Fink's research interests are in the theory, design, process development and characterization of novel multimaterial integrated fibers with engineered electronic and photonic properties.

Jun Pan

Sloan School of Management
Education: B.S. 1990 (Shanghai Jiao Tong University), M.S. 1991 (Western Illinois University), Ph.D. 1995 (New York University), Ph.D. 2000 (Stanford University)
Joined MIT faculty: 2000

Pan is highly regarded as a leading young asset-pricing scholar with a special focus on options and derivatives.

Christine Ortiz

Materials Science and Engineering
Education: B.S. 1992 (Rensselaer), M.S. 1994, Ph.D. 1997 (both from Cornell University)
Joined MIT faculty: 1999

Ortiz's research centers on "nanomechanics"—the study of very small forces, motions and deformations. Her specialty is the nanomechanics of biological materials such as cartilage, bone, seashells and bone implant materials.

Raffaele Ferrari

Earth, Atmospheric and Planetary Sciences
Education: B.S. 1994, M.S. 1994 (both from Università di Torino, Italy), Ph.D. 1999 (Politecnico di Torino, Italy), Ph.D. 2000 (Scripps Institution of Oceanography)
Joined MIT faculty: 2002

Ferrari's research focuses on three main topics—the dynamics of the upper ocean and air-sea interactions; the role of mesoscale eddies in the ocean circulation; and the influence of small-scale mixing on the abyssal ocean circulation and climate.

Christine J. Walley

Anthropology
Education: B.A. 1987 (Pomona College), M.A. 1993, Ph.D. 1999 (both from New York University)
Joined MIT faculty: 1999

Walley's research deals with international economic and social development, focusing on marine conservation and ecotourism, the environmentalist movement, gender, social class and documentary film.

Pawan Sinha

Brain and Cognitive Sciences
Education: B.S. 1988 (Indian Institute of Technology), M.S. 1992, Ph.D. 1995 (MIT)
Joined MIT faculty: 1999

Sinha's work focuses on three lines of research—object recognition, including face perception; brightness perception; and motion and 3-D shape perception.

Christoph Paus

Physics
Education: First Degree-Mechanical Engineering 1989, First Degree-Mathematics 1990, First Degree-Physics 1990, Diploma 1992 (all from RWTH Aachen, Germany), Ph.D. 1996 (III. Phys. Institute RWTH Aachen, Germany)
Joined MIT faculty: 1999

Paus' research focuses on the understanding of elementary particle physics from the experimental point of view.

Denis S. Auroux

Mathematics
Education: Maîtrise 1994, Licence 1995 (both from École Normale Supérieure), Diplôme 1995 (Université Paris-Sud), Ph.D. 1999 (École Polytechnique), Habilitation 2003 (Université Paris-Sud)
Joined MIT faculty: 2002

Auroux is a world leader in symplectic geometry, a field that lies at the crossroads of major parts of contemporary mathematics and physics.

Timothy F. Jamison

Chemistry
Education: B.S. 1990 (University of California at Berkeley), Ph.D. 1997 (Harvard)
Joined MIT faculty: 1999

Jamison's research focuses on the discovery and application of new reactions for organic synthesis.

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Pint-sized engine promises high efficiency

Ethanol empowers the little engine that could

Nancy Stauffer
Laboratory for Energy and the Environment

MIT researchers are developing a half-sized gasoline engine that performs like its full-sized cousin but offers fuel efficiency approaching that of today's hybrid engine system—at a far lower cost. The key? Carefully controlled injection of ethanol, an increasingly common biofuel, directly into the engine's cylinders when there's a hill to be climbed or a car to be passed.

These small engines could be on the market within five years, and consumers should find them appealing: By spending about an extra $1,000 and adding a couple of gallons of ethanol every few months, they will have an engine that can go as much as 30 percent farther on a gallon of fuel than an ordinary engine. Moreover, the little engine provides high performance without the use of high-octane gasoline.

Given the short fuel-savings payback time—three to four years at present U.S. gasoline prices—the researchers believe that their "ethanol-boosted" turbo engine has real potential for widespread adoption. The impact on U.S. oil consumption could be substantial. For example, if all of today's cars had the new engine, current U.S. gasoline consumption of 140 billion gallons per year would drop by more than 30 billion gallons.

"There's a tremendous need to find low-cost, practical ways to make engines more efficient and clean and to find cost-effective ways to use more biofuels in place of oil," said Daniel R. Cohn, senior research scientist in the Laboratory for Energy and the Environment and the Plasma Science and Fusion Center (PSFC).

Cohn, John B. Heywood, the Sun Jae Professor of Mechanical Engineering and director of the Sloan Automotive Laboratory, and Leslie Bromberg, a principal researcher at the PSFC, have an engine concept that promises to achieve those goals.

For decades, efforts to improve the efficiency of the conventional spark-ignition (SI) gasoline engine have been stymied by a barrier known as the "knock limit": Changes that would have made the engine far more efficient would have caused knock—spontaneous combustion that makes a metallic clanging noise and can damage the engine. Now, using sophisticated computer simulations, the MIT team has found a way to use ethanol to suppress spontaneous combustion and essentially remove the knock limit.

When the engine is working hard and knock is likely, a small amount of ethanol is directly injected into the hot combustion chamber, where it quickly vaporizes, cooling the fuel and air and making spontaneous combustion much less likely. Accord-

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Portable 'lab on a chip' could speed blood tests

Anne Trafton
News Office

Testing soldiers to see if they have been exposed to biological or chemical weapons could soon be much faster and easier, thanks to MIT researchers who are helping to develop a tiny diagnostic device that could be carried into battle.

By tweaking the design of a tiny pump, researchers affiliated with MIT's Institute for Soldier Nanotechnologies have taken a major step towards making an existing miniature "lab on a chip" fully portable, so the tiny device can perform hundreds of chemical experiments in any setting.

"In the same way that miniaturization led to a revolution in computing, the idea is that miniature laboratories of fluid being pumped from one channel to another, with reactions going on here and there, can revolutionize biology and chemistry," says Martin Bazant, associate professor of applied mathematics and leader of the research team.

Within the lab on a chip, biological fluids such as blood are pumped through channels about 10 microns, or millionths of a meter, wide. (A red blood cell is about 8 microns in diameter.) Each channel has its own pumps, which direct the fluids to certain areas of the chip so they can be tested for the presence of specific molecules.

Until now, scientists have been limited to two approaches to designing labs on a chip, neither of which offer portability. The first is to mechanically force fluid through microchannels, but this requires bulky external plumbing and scales poorly with miniaturization.

The second approach is capillary electro-osmosis, where flow is driven by an electric field across the chip. Current electro-osmotic pumps require more than 100 volts of electricity, but the MIT researchers have now developed a micropump that requires only battery power (a few volts) to achieve similar flow speeds and also provides a greater degree of flow control.

The key to boosting energy efficiency is altering the electric field in the channel, Bazant said. Instead of placing electrodes at each end of the channel, as in capillary electro-osmosis, the voltage can be lowered substantially with alternating current (AC) applied at closely spaced microelectrode arrays on the channel floor. Existing AC electro-osmotic pumps, however, are too slow for many applications, with velocities below 100 microns per second.

In the new system, known as a three-dimensional AC electro-osmotic pump, tiny electrodes with raised steps generate opposing slip velocities at different heights, which combine to push the fluid in one direction, like a conveyor belt. Simulations predict a dramatic improvement in flow rate, by almost a factor of 20, so that fast (mm/sec) flows, comparable to pressure-driven systems, can be attained with battery voltages. Experiments in the lab of Todd Thorsen, assistant professor of mechanical engineering, have recently demonstrated the effectiveness of the design.

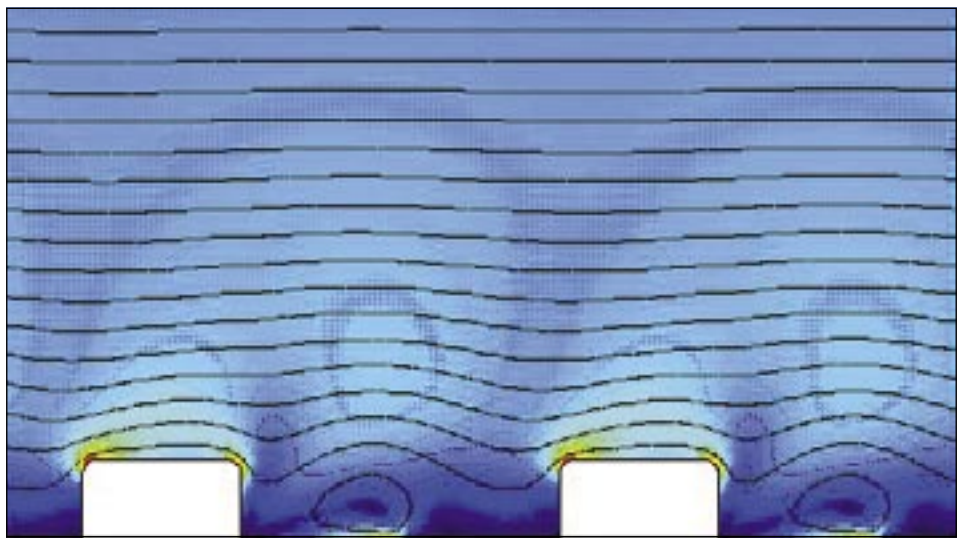

IMAGE / **MARTIN BAZANT**

A micropump developed by MIT researchers allows high speed flows through microchannels with an input of only a few volts of electricity, making it possible to create portable "lab on a chip" devices. Above, a simulation of three-dimensional alternating current electro-osmosis shows liquid flowing around stepped electrodes. Below, the three-dimensional, alternating current electro-osmotic pump consists of interdigitated stepped gold microelectrodes on a glass substrate.

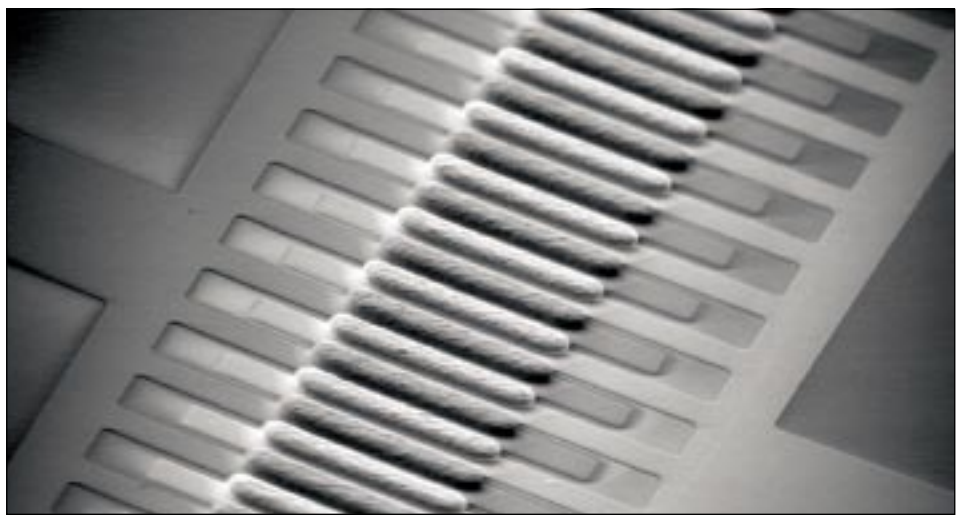

PHOTO / **J.P. URBANSKI**

"It's just a huge improvement with a very simple idea," said Bazant.

Thorsen's group is working toward integrating the pumps into a portable blood analysis device, which soldiers could carry onto the battlefield. If exposure to chemical or biological weapons were suspected, the device could automatically and rapidly test a miniscule blood sample, rather than sending a large sample to a lab and waiting for the results. The chips are so small and cheap to make that they could be designed to be disposable, Bazant said, or they could be made implantable.

Potential applications are not limited to military use—imagine going to a doctor's office and getting test results immediately. The technology could also be useful for first responders. If emergency personnel knew immediately whether a person had suffered a heart attack or a stroke, they could start the appropriate treatment right away.

Labs on a chip can also be used in traditional chemistry or biology labs to speed up processes such as DNA testing or screening for the presence of certain antigens. Only tiny amounts of reactants would be needed, and experiments could be done more rapidly and efficiently.

"Instead of a thousand people pouring test tube A into test tube B in different laboratories, you've got a tiny little chip with thousands of experiments all going on at once," Bazant said.

Bazant and former MIT postdoctoral associate Yuxing Ben published an article on the theoretical work in the online edition of the journal Lab on a Chip, and a related experimental paper will appear in an upcoming edition of Applied Physics Letters. Co-authors on that paper with Bazant and Thorsen are graduate student J.P. Urbanski and postdoctoral associate Jeremy Levitan. Bazant and Levitan founded a company, ICEO, Inc., to commercialize the technology.

The research was funded by the U.S. Army through the Institute for Soldier Nanotechnologies.

Possibilities and challenges ahead for engineers

Charles Vest focuses on nano- and large-systems scales

Anne Trafton
News Office

To draw more students into the field of engineering, institutions like MIT should focus on the exciting possibilities of two engineering frontiers—the nano scale and the large systems scale, according to MIT President Emeritus Charles Vest.

Those frontiers offer "mind-boggling possibilities" and "daunting challenges," said Vest during his lecture, "Educating Engineers for 2020 and Beyond," on Oct. 12 in Bartos Theater.

Vest's talk, Annual Brunel Lecture on Complex Systems, was hosted by the Engineering Systems Division.

"As we think about the challenges ahead, it's important to remember that students are driven by passion, curiosity, engagement and dreams," Vest told a standing-room only audience.

New innovations at the nano scale, such as Professor Angela Belcher's research on batteries constructed by viruses, are what will keep MIT at the cutting edge of both engineering science and product development, according to Vest. Fields at the interface of biology, nanotechnology and information technology offer "stunning new possibilities" that will "inspire and excite new generations of students," he said.

At the other end of the scale, studying large complex systems gives students the chance to tackle some of the world's biggest problems — energy, the environment, food supply, logistics and communications, Vest said. MIT's Engineering Systems Division was established in 1998 to explore just those kinds of large-scale engineering issues.

In his talk, Vest also emphasized that the environment in which students learn is just as important as the details of the curriculum.

"We are educating men and women who will work in an ever-evolving social, political and economic context," said Vest, who was recently nominated to be the next president of the National Academy of Engineering.

To that end, engineering institutions should avoid focusing solely on lecture-based courses and ensure that students participate in team projects, research and experiential learning. Students should also learn communication skills and gain understanding of ethics and social responsibility, business organization, innovation and product development, in addition to engineering fundamentals, Vest said.

"That is a pretty tall order," Vest said, but it's not impossible. "We have to keep our sights set high."

Even though the list of skills that engineers need is long, Vest warned against an exclusive focus on engineering. "Don't be tempted to crowd out humanities, arts and social sciences," he said. Those subjects can give broader context to what students are learning and help them establish values, he said.

U.S. engineering institutions must also embrace globalization and encourage education in the humanities, he said.

"We should let no grass grow under our feet," he said of the declining numbers of engineering graduates in the United States. "The U.S. is still the clear world leader, but of all the enemies our country faces, complacency is the one I fear most."

The Senate is now working on legislation that would invest in making the United States more competitive with other nations when it comes to science and engineering education. The National Competitiveness Investment Act is based on a recent federal report called "Rising Above the Gathering Storm," which argues that science and engineering education is vital to U.S. economic interests.

Vest said he is heartened to see the federal government encourage young men and women to pursue degrees in science and engineering.

"We simply cannot afford to fail," he said.

LANGUAGE

Continued from **Page 1**

into a helix, with positively charged areas running along one side of the helix and hydrophobic (water-resisting) areas along the other side. The charged ends allow the peptides to latch onto the bacteria by attracting the negative charges of the bacterial membrane, while the hydrophobic ends punch holes in the membrane.

Because there are 20 naturally occurring amino acids, there are about 1026 possible peptide sequences of length 20. Some of those kill microbes with varying levels of effectiveness; the overwhelming majority have no effect.

With such a mind-boggling number of possible combinations, it is extremely difficult to find effective antimicrobial peptides by using traditional methods such as testing random sequences or slightly tweaking naturally existing peptides. "Designing them from scratch is quite difficult," said Loose.

Instead, the researchers decided to take a more strategic approach, based on grammatical patterns in the peptide sequences.

At its essence, a "grammar" is a simple rule that describes the allowed arrangements of words in a given language. As it applies to peptides, the sequence can be thought of as a sentence, while the individual amino acids are the words. For example, the sequence QxEAGxLxKxxK, where x is any amino acid and Q, E, A, etc., are specific amino acids, is a pattern that occurs in more than 90 percent of a certain class of insect antimicrobial proteins known as cecropins.

In this case, the researchers, led by Jensen and Isidore Rigoutsos of IBM Research (Rigoutsos is also a visiting lecturer in the Department of Chemical Engineering), used a pattern discovery tool to find about 700 grammatical patterns in the sequences of 526 naturally occurring antimicrobial peptides.

To design their new peptides, the researchers first came up with all possible 20-amino acid sequences in which each overlapping string of 10 amino acids conformed to one of the grammars. They then removed any peptides that had six or more amino acids in a row in common with naturally occurring peptides. Then they threw out sequences that were very similar to each other and chose 42 peptides to test.

About half of the peptides displayed significant antimicrobial activity against two common strains of bacteria—Escherichia coli and Bacillus cereus. That is a much higher success rate than one would expect from testing randomly generated sequences and much higher than the success rate for peptides with the same amino acids as the designed sequences, but in a shuffled order.

"We've been able to focus our shotgun approach so that half of the time, we get a hit," said Loose.

In further tests, two of the designed peptides showed very high effectiveness against two types of especially dangerous bacteria, S. aureus and anthrax.

The researchers have already begun using their technique to further refine the most effective peptides by tinkering with the sequences and altering traits like charge and hydrophobicity. They hope this process will eventually lead to new, more effective antimicrobial medicines.

The research was funded by the Singapore-MIT Alliance, the National Institutes of Health and the Fannie and John Hertz Foundation.

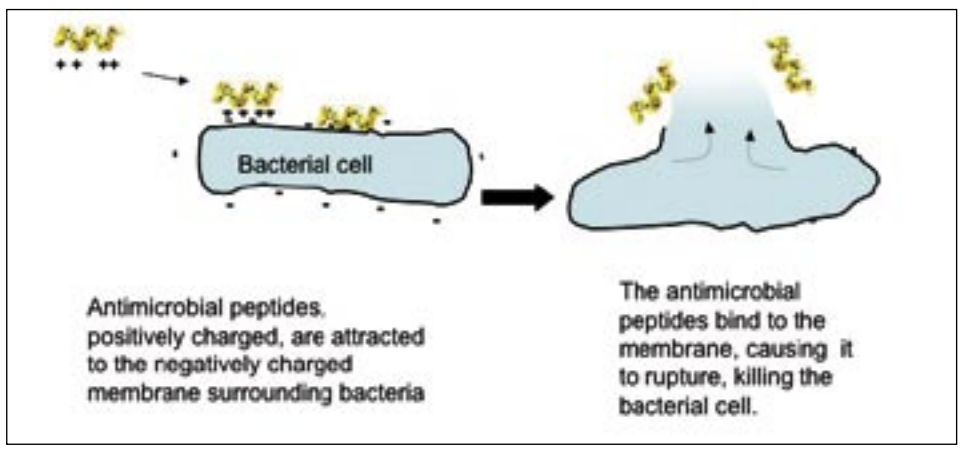

ILLUSTRATION COURTESY / **MICHAEL ZASLOFF**

Antimicrobial peptides can attack and kill bacteria, as shown in the diagram above. Below, MIT graduate student Chris Loose, left, and Professor Gregory Stephanopoulos look for signs of bacteria. The researchers and their colleagues have custom-designed peptides that are effective in killing microbes.

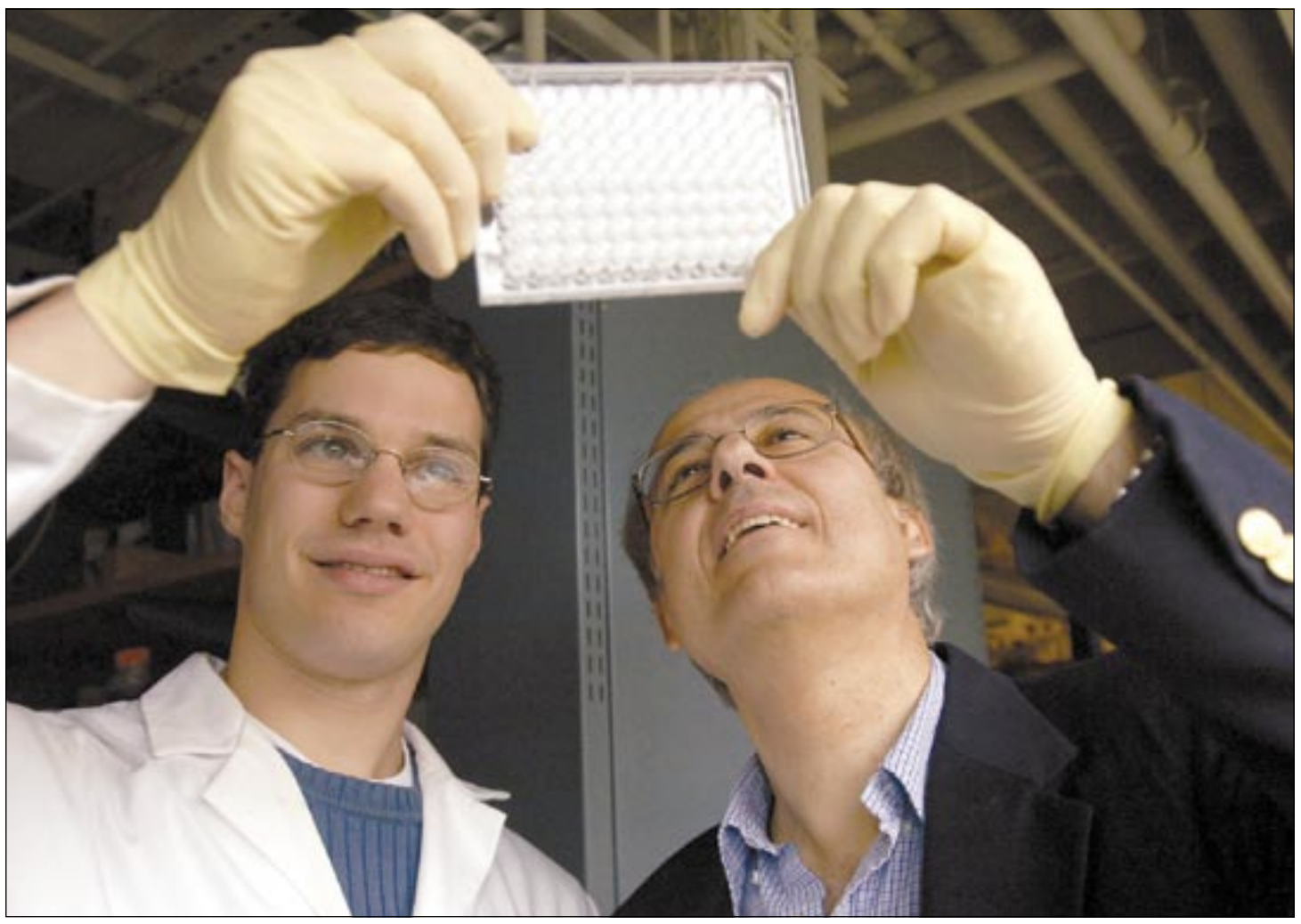

PHOTO / **DONNA COVENEY**

MIT to welcome Amgen Scholars in 2007

MIT is one of 10 universities chosen to host the prestigious Amgen Scholars Program, which will provide talented undergraduates with summer research opportunities in the sciences and biotechnology.

The Institute will also serve as the National Program Office for the Amgen program, providing coordination, technical oversight and student outreach over the next four years.

"The summer research program will build on MIT's 40-year tradition of involving undergraduate students in our dynamic research enterprise," said Dean for Undergraduate Education Daniel E. Hastings.

As both a program site and the National Program Office, MIT will receive two $1 million grants from the Amgen Foundation. One will fund faculty-mentored research positions for up to 30 students per summer in science and biotechnology over four years (2007-2010). Half these students will be chosen from MIT's undergraduate population; the other half will be recruited from other colleges and universities.

The second Amgen grant will support MIT's leadership role as the National Program Office.

"We are proud and honored to be selected to participate and look forward to continuing to teach students the joy of active engagement with research as they further their studies or pursue a science career," Hastings said.

Amgen Scholars is a $25 million, eight-year program that will provide research experience for students interested in pursuing a graduate degree and, eventually, a career in science.

During the first phase of the program, which extends through 2010, each of the 10 participating universities will receive $1 million.

Program participants will include the university's own students as well as students from other accredited four-year colleges and universities in the United States, Puerto Rico and other U.S. territories.

Eligible students will be able to participate regardless of financial status.

"At Amgen, we believe we have an important responsibility to inspire and prepare the next generation of scientists," said Amgen Foundation President Jean Lim.

"We believe our partnership with MIT will provide students with a pivotal experience that will encourage them to pursue further education and training in the sciences," Lim said.

Scholars will work under some of the nation's top academic scientists. They will participate in research projects and scientific seminars and will have the opportunity to take part in a three-day symposium in California.

Each scholar will receive a competitive stipend along with room, board and a travel allowance, including travel to and from the university and symposium.

The nine other program partners are Caltech, Columbia University/Barnard College, Howard University, Stanford University, the University of California (UC) at Berkeley, UC-Los Angeles, UC-San Diego, UC-San Francisco, and the University of Washington.

SOAP BOX

Continued from **Page 1**

ed, it would raise sea level seven meters, obliterating low-lying land areas such as parts of New York and Florida.

Emanuel's own specialty—hurricanes—has been a surprise. "We thought we would see a modest increase (in severity), but they have shown a much greater sensitivity to climate than we thought," he said.

Moniz pointed out that globally, 85 percent of energy use is fossil fuel-derived. "If we keep going on this track, we will pass this doubling indicator (models that predict the effects of double the amount of atmospheric carbon dioxide) in around 50 years, and infrastructure turns over in 50 years. We have to start now to change."

"We must be much more efficient in our use of energy—we do expect a 1 to 1.5 percent increase in efficiency every year, but we have to find another 30-40 percent reduction in energy use to make our goal." He pointed to the automotive industry and the building industry as two key places to reduce energy use. In buildings, in particular, "a lot of it isn't high-tech, which makes it a crime that we're not doing it," Moniz said.

Moniz predicted that "a portfolio of options" including nuclear power, solar, wind and biofuels will work together to meet energy needs and play off each technology's advantages and drawbacks and respond to evolving market conditions and constraints.

"The idea that we will get out of this box without policy simply won't work because there is a clock that's ticking—we are shifting from an overdependence on a natural resources base for energy to a technological requirement, and you know technology is our strength."

The audience divided up into two groups to brainstorm questions and comments for the speakers. Questions included: Where does Al Gore have it wrong (in his documentary "An Inconvenient Truth")? Whatever happened to the predicted ice age? What work is being done to make nuclear energy safer?

Emanuel said that Gore's error was associating the gradual increase of carbon dioxide in the atmosphere over millennia with global warming—only recent carbon emissions tied to the Industrial Revolution have affected the Earth's climate.

As far as another ice age goes, Emanuel said, "If we weren't messing with the climate ourselves, in 10,000 or 30,000 years from now we would go to another ice age."

Moniz said that a lot of work is being done to improve nuclear power but that the disposal of radioactive waste will be a limiting factor in broadening the use of nuclear energy.

"There must be policy put in place that attaches a price to greenhouse gas emissions," Moniz said, and the "policy response must be global. It will be a slow process, but we can't afford to have it take 50 years—more like five years."

The Soap Box energy series is cosponsored by the Energy Research Council and the MIT Technology and Culture Forum.

The special energy series continues tonight with "The Role of New Technologies in a Sustainable Energy Economy," and Nov. 1 with "Growing Pains: Transitioning to a Sustainable Energy Economy."

TENURE

Continued from **Page 3**

George Barbastathis

Mechanical Engineering
Education: Dipl. 1993 (National Technical University of Athens, Greece), M.S. 1994, Ph.D. 1998 (both from Caltech)
Joined MIT faculty: 1999

Barbastathis has made pioneering contributions to the field of information photonics and is considered to be the leading optical engineer of his generation.

J. Phillip Thompson

Urban Studies and Planning
Educa-tion: B.A. 1977 (Harvard), Master of Urban Planning 1986 (Hunter College, CUNY), Ph.D. 1990 (CUNY)
Joined MIT faculty: 2000

Thompson, an urban planner and political scientist, has made important intellectual contributions on the themes of social capital, health and racial ideology.

Robert Morris

Electrical Engineering and Computer Science
Education: A.B. 1988, Ph.D. 1999 (both from Harvard)
Joined MIT faculty: 1999

Morris is making fundamental contributions to the areas of computer and wireless networking and operating systems.

Nicolas Hadjiconstantinou

Mechanical Engineering
Education: B.A. 1993 (University of Cambridge), S.M. 1995, S.M. 1998, Ph.D. 1998 (all from MIT)
Joined MIT faculty: 1999

Hadjiconstantinou works on developing new models and tools in the area of fluid mechanics at small scales, i.e., micro flows.

Stefan Helmreich

Anthropology
Education: B.A. 1989 (UCLA), M.A. 1992, Ph.D. 1995 (both from Stanford University)
Joined MIT faculty: 2003

Helmreich is an anthropologist of the life sciences, in particular the scientific, social and cultural transformation of the biological category of "life" in an age of genomics, informatics and biotechnology.

AWARDS & HONORS

Three MIT scientists—**Angela Belcher**, professor of biological engineering and materials science and engineering, **Yet-Ming Chiang**, professor of materials science and engineering, and **Paula Hammond**, professor of chemical engineering—recently received a Popular Mechanics Breakthrough Award for their work on batteries constructed by viruses.

Earlier this year, the researchers created batteries by manipulating the genes in tiny viruses, inducing them to grow and self-assemble into a nanowire that can store energy.

The awards were published in the November issue of Popular Mechanics, which selects breakthroughs that "solve problems, expand horizons or engage the imagination of millions."

PHOTO / **HAO NGUYEN**

Environmental Health and Safety Director Bill Van Schalkwyk, left, celebrates with Simcha Singer, a graduate student in mechanical engineering, who won the 2004 transportation survey grand prize, a Giant Rincon mountain bike.

Commuter survey rewards participants and the planet

On Oct. 23, all members of the MIT community were invited to complete a transportation survey that could not only help save the planet but also, thanks to a lottery among participants, bestow prizes. In 2004, Simcha Singer, a graduate student in mechanical engineering, won the 2004 transportation survey grand prize, a Giant Rincon mountain bike.

The Massachusetts Department of Environmental Protection (DEP) requires colleges and universities with 1,000 or more students and employees to comply with the air pollution control regulations that call for a reduction of single-occupant vehicle trips to and from campus. Carbon dioxide, one of the pollutants emitted by gasoline-powered cars, is a greenhouse gas associated with climate change. The City of Cambridge has adopted a Climate Protection Plan calling for a reduction in greenhouse gases to a level 20 percent below the 1990 level.

MIT is trying to do its part. The Institute already provides subsidized monthly MBTA passes to all eligible commuters and actively encourages students and employees who commute to campus to form car- and vanpools by providing them with reserved and subsidized parking.

MIT's Parking and Transportation Office also operates several campus shuttles that are available to the MIT community as an alternate transportation mode. MIT is also a major participant in a rush-hour shuttle service called EZRide that links North Station and Kendall Square, which is free with an MIT ID card (the regular adult fare is $1) subsidized by the Institute.

In order to further reduce the single-occupant commutes to campus for people who might use their cars during the workday, MIT currently

See **COMMUTER** Page 7

OBITUARIES

Henry W. Fitzpatrick

Henry W. Fitzpatrick, retired assistant director of Lincoln Laboratory, died June 9 at Cape Cod Hospital, following a brief illness. He was 92 years old.

Fitzpatrick became assistant director of Lincoln Laboratory in 1956, with the responsibility for administration of the laboratory. He served in that position for 38 years, retiring in 1984.

Fitzpatrick's understanding of government contracting was of extraordinary value to Lincoln Laboratory, according to Walter E. Morrow, director emeritus.

Born in Superior, Wisc., he attended Superior State College and graduated from Georgetown School of Foreign Service in 1944 with a B.S. in business administration. He served as a lieutenant junior grade and a civilian accountant in the U.S. Navy, Office of Naval Research.

Prior to joining MIT's Division of Defense Laboratories in 1953, he headed the Department of Defense's Research and Development Board.

He was a longtime member of the Army/Navy Club in Washington, D.C., and the St. Botolph Club in Boston.

He is survived by his wife, Doris (Coughlin) Fitzpatrick; a son, Henry Fitzpatrick Jr. of Rehoboth Beach, Del.; one grandson and one great-grandson.

Dorothy R. Brewster

Dorothy R. (Kuchta) Brewster, a retired MIT radiochemist, died July 1 at Edwards Hospital in Naperville, Ill. She was 83.

Brewster worked at MIT for 25 years and also worked at Argonne National Laboratory for 11 years. She was a graduate of Emmanuel College and earned a master's degree from Tufts University in 1944.

She is survived by two sons, Joseph H. Kuchta and Michael Kuchta; four daughters, Helen Kuchta, Karen Reinhardt, Paula Jiminez and Susan Kuchta; two grandchildren; and her former husband, Joseph F. Kuchta.

Donations may be made to the FISH Food Pantry, 4340 Prince St., Downers Grove, IL 60515.

Frances Sumner

Frances Burnet Barnes Sumner, retired MIT humanities librarian, died Sept. 27 of pancreatic cancer. She was 94.

A memorial service will be held for Sumner at 11 a.m. on Nov. 10 at Christ Church of Cambridge, Zero Garden St.

Sumner, of Acton and Vineyard Haven, formerly of Cambridge, was the associate humanities librarian from 1965 to 1971 and the humanities librarian from 1971 to 1977.

The wife of the late Cyril Sumner Jr., she is survived by two sons, Burnet B. Sumner of Vineyard Haven and San Francisco, and Cyril J. Sumner of Oakland, Calif.; a daughter, Sarah A. Sumner of Acton; a sister, Muriel B. Jerome of Danvers; and two grandchildren.

FACULTY

Continued from **Page 2**

ported through the first-year curricula.

After the report is delivered to the CUP, the committee will work with the dean for undergraduate education, deans of the Institute's five schools and individual departments to refine the recommendations' final form and review their impact on departmental programs and on existing requirements.

Silbey said, "We have to think, what is the best education we can provide for our freshmen?" He encouraged feedback to be sent to learning@mit.edu.

Minority hiring and financial future

MIT's ongoing effort to increase diversity in the graduate student body and faculty is making small gains, according to data presented at the faculty meeting by Provost L. Rafael Reif.

The goal, as articulated by a faculty resolution in May 2004, is to increase the percentage of underrepresented graduate students by a factor of three within a decade, and bring up underrepresented minority faculty by a factor of two. Reif observed that MIT remains well short of these goals, noting that there is "a significant pipeline problem for graduate students."

MIT has in place programs to encourage diverse populations to come to the Institute as undergraduates and graduate students. These programs have helped attract applications, Reif said, although results at the graduate level have varied between units and, as he put it, "I believe we can improve these numbers even further."

Biological chemistry graduate student Hector Hernandez of the Graduate Student Council said that he came to MIT because "a faculty member convinced me that MIT was a place I could succeed and where I could contribute to the community." He encouraged faculty to do the same for others.

Reif then outlined plans to put the Institute on a stronger financial footing for the future by making more efficient use of distributions from the endowment.

Distributions from the endowment provide revenues for two of the four components of MIT's operating budget: (1) the General Institute Budget (GIB) and (2) designated funds, such as those that support professorial chairs, scholarships and fellowships. (The other two major components of the operating budget are sponsored research and auxiliary enterprises.) This support currently comes in two ways: (1) through the distribution rate voted annually by the Executive Committee of the Corporation on units in Pool A held by designated or unrestricted endowed funds, and (2) through the periodic liquidation of unrestricted quasi-endowment units in Pool A. The latter practice provides additional unrestricted revenues to support the GIB, but at the cost of eroding the Institute's long-term financial flexibility. Current projections show that continuing this practice will lead to a serious long-term decline in the Institute's expendable general unrestricted funds.

The provost outlined a plan that will allow the Institute to minimize the need to liquidate units of quasi-endowment by increasing the voted distribution rate to all funds. Any increase in distributions to unrestricted funds or to scholarship funds reduces the need for additional support from quasi-endowment on a dollar-for-dollar basis. At the same time, the administration has worked intensively with departments holding endowed funds to identify how they could use an increase in the voted distribution to the funds they hold to compensate for reductions in support from the GIB. While there are some funds whose use is very narrowly restricted, it is clear that a very large percentage of the additional funds available from any increase in the voted distribution could permit corresponding reductions in support from the GIB.

The administration will continue to work with academic units to develop budgets for fiscal 2008 based on the new financial model. Because the increase in the voted distribution will be largely counterbalanced by the reduction in the need for additional support from the quasi-endowment, the effective total distribution from the endowment, on an annual basis, will be the same as it would have been under the current model.

Evan Ziporyn wins 2006 Kepes Prize

Lynn Heinemann
Office of the Arts

Evan Ziporyn, Kenan Sahin Distinguished Professor of Music, has been awarded the 2006 Gyorgy Kepes Fellowship Prize by the Council for the Arts at MIT. The award will be presented on Thursday, Oct. 26, at the council's 34th annual meeting.

Established in 1982, the award is named for painter, designer, author and educator Gyorgy Kepes (1906-2002), founder of MIT's Center for Advanced Visual Studies. It is given annually to a member of the MIT community whose creative work reflects the vision and values of Kepes, who was celebrated for his work exploring the relationship between art and science, and art and the environment.

"I came here 16 years ago unfinished as an artist, though I didn't know it at the time," said Ziporyn. "MIT provided me with the stimulation and support to follow through on ideas that otherwise may have gone uncompleted. I know I'm a different musician now as a result."

An acclaimed clarinetist and composer, Ziporyn is a member of the Bang on a Can All-Stars (Musical America's 2005 Ensemble of the Year) and the Steve Reich Ensemble, and has also worked with, among others, Paul Simon, DJ Spooky, Meredith Monk, Matthew Shipp, Henry Threadgill and Cecil Taylor.

PHOTO / **GABOR CSANYI**

Professor Evan Ziporyn will be presented with the Kepes Prize on Oct. 26.

Ziporyn, who has been involved with Balinese gamelan since taking a Fulbright Fellowship in Indonesia in 1987, is internationally recognized for his works combining Balinese gamelan with western instruments and electronics. He founded the MIT-based Gamelan Galak Tika in 1993 and continues to direct the ensemble, which toured Bali in 2005.

This fall has marked two Carnegie Hall premieres for Ziporyn: on Sept. 16-17 in Carnegie's Zankel Hall, Yo-Yo Ma's Silk Road Ensemble premiered his commissioned piece, "Sulvasutra," written for Indian tabla player Sandeep Das and Chinese pipa virtuoso Wu Man, and a string quartet. On Oct. 13, the American Composers Orchestra premiered his bass clarinet concerto, "Big Grenadilla," also in Zankel Hall.

Ziporyn's new CD, "Frog's Eye," released in conjunction with the Carnegie Hall premiere of "Big Grenadilla," features four orchestral works in which Ziporyn applies his global ear to the sounds and structures of the western orchestra. Created in collaboration with conductor Gil Rose's Boston Modern Orchestra Project, the album showcases Ziporyn's ability to reinvent standard ensembles through the addition of Hawaiian guitar, electric piano, Tang dynasty poetry, and his own unique virtuosity on the bass clarinet.

The Council for the Arts at MIT is a volunteer organization of MIT alumni and friends, founded in 1972 to support the visual, literary and performing arts.

ENGINE

Continued from Page 4

ing to a simulation developed by Bromberg, with ethanol injection the engine won't knock even when the pressure inside the cylinder is three times higher than that in a conventional SI engine. Engine tests by collaborators at Ford Motor Company produced results consistent with the model's predictions.

With knock essentially eliminated, the researchers could incorporate into their engine two operating techniques that help make today's diesel engines so efficient, but without causing the high emissions levels of diesels. First, the engine is highly turbocharged. In other words, the incoming air is compressed so that more air and fuel can fit inside the cylinder. The result: An engine of a given size can produce more power.

Second, the engine can be designed with a higher compression ratio (the ratio of the volume of the combustion chamber after compression to the volume before). The burning gases expand more in each cycle, getting more energy out of a given amount of fuel.

The combined changes could increase the power of a given-sized engine by more than a factor of two. But rather than seeking higher vehicle performance—the trend in recent decades—the researchers shrank their engine to half the size. Using well-established computer models, they determined that their small, turbocharged, high-compression-ratio engine will provide the same peak power as the full-scale SI version but will be 20 to 30 percent more fuel efficient.

But designing an efficient engine isn't enough. "To actually affect oil consumption, we need to have people want to buy our engine," said Cohn, "so our work also emphasizes keeping down the added cost and minimizing any inconvenience to the driver."

The ethanol-boosted engine could provide efficiency gains comparable to those of today's hybrid engine system for less extra investment—about $1,000 as opposed to $3,000 to $5,000. The engine should use less than five gallons of ethanol for every 100 gallons of gasoline, so drivers would need to fill their ethanol tank only every one to three months. And the ethanol could be E85, the ethanol/gasoline mixture now being pushed by federal legislation.

Through their startup company, Ethanol Boosting Systems LLC, the researchers are working with their Ford collaborators on testing and developing this new concept. If all goes as expected, within five years vehicles with the new engine could be on the road, using an alternative fuel to replace a bit of gasoline and make more efficient use of the rest.

IMAGE / **GUILLAUME STAGNARO, COURTESY THE ARTIST**

PHOTO / **ELIZABETH BEER, COURTESY THE ARTIST**

Scratch & sniff

Sensorium, a new exhibition at the MIT List Visual Arts Center, explores various ways in which artists address the influence of technology on the senses. In 'Fear I,' above, Norwegian artist Sissel Tolaas embedded synthesized human sweat pheromones into the white paint on the gallery's walls. The smells derive from the body odor of frightened men. Visitors rub the walls to release the smells. In 'Ubiq, a Mental Odyssey,' at top, Guillaume Stagnaro explores how virtual worlds may widen the human glance. The exhibition is on view through Dec. 31.

COMMUTER

Continued from Page 6

hosts seven Zipcars on campus that offer hourly car rentals. MIT sponsors Zipcar membership for faculty, staff and graduate students.

There are also more than 1,000 bicycle parking spaces on campus, including several secure indoor bike rooms, and shower facilities, to encourage students, faculty and staff wanting to cycle.

The last transportation survey was done in October of 2004. The results showed that:

- 15 percent of the respondents walked to MIT;
- 35 percent took public transportation;
- 12 percent bicycled;
- 6 percent rode a car- or vanpool; and
- 25 percent of the respondents drove to MIT alone.

When respondents were asked the most important reason why they took public transportation, more than half of them said it was for convenience. Fifteen percent of the respondents cited cost.

Nuke expert discusses U.S.-India pact

Stephanie Schorow
News Office Correspondent

On the day North Korea announced it had exploded a nuclear bomb, Subrata Ghoshroy, a research associate in the Program in Science, Technology and Society (STS), was in his native India discussing nuclear proliferation with one of India's top atomic scientists. The Indian government had bluntly criticized North Korea, and Ghoshroy, whose 20-year engineering career includes research in lasers and pulse power for both weaponry and civilian applications, noted the irony of the situation.

India had refused to sign the 1968 Nuclear Non-Proliferation Treaty (NPT), decrying it as a double standard foisted upon developing nations by superpowers. However, in condemning North Korea, India now "benefits from this double standard," Ghoshroy said.

In a new essay, "The U.S.-India Nuclear Deal: Triumph of the Business Lobby," Ghoshroy, an expert on weapons procurement and proliferation, analyzes the controversial U.S.-India pact. Not only will its cost undermine crucial Indian priorities, such as confronting its AIDS crisis, but also, the civilian nuclear cooperation agreement would allow India to keep its nuclear weapons and attain the status of a nuclear state, all without signing the NPT, he said.

Ghoshroy's essay is published in the series, Audits of the Conventional Wisdom, by the MIT Center for International Studies. He recently spoke with Tech Talk about his current research.

Q: Please describe your work at STS.

A: I am teaching "The Science, Technology and Politics of Weapons Systems Procurement," a course on the essence of the military-industrial complex and what's driving so much of the development of costly and unnecessary weapons.

Since I arrived at MIT last year, I have also been promoting a major project we are calling "Nuclear Stability in South Asia."

Q: What are some consequences of the United States pushing the nuclear agreement with India, yet labeling other countries "proliferators"?

A: The U.S. is now trampling on all the proliferation norms that it has advocated for all these years. Countries must be allowed to develop whatever they feel is necessary for their national security. I am NOT saying nuclear weapons are a good thing. But so long as countries that have nuclear weapons threaten other countries with the use of nuclear weapons, it's going to be very, very difficult to stop any country from acquiring rudimentary capabilities. After all, nuclear capabilities are on the Internet.

Q: Is the ongoing U.S. pursuit of an antimissile shield system realistic?

A: The antimissile shield that is now called Son of Star Wars is still technically not a viable system. I'm not in the camp that says it can never be done. But at what price in terms of dollars and stability? In order to deploy this missile shield, the U.S. would have to withdraw from the anti-ballistic missile treaty of 1972—the very treaty that has kept the world safe.

Q: Why is the administration so fixated on this idea?

A: The clichéd answer is: Lots of contractors make lots of money. The government has spent $150 billion-$160 billion since the days of Reagan's Star Wars in 1983-85, and we have nothing to show for it.

Q: Is this the kind of thing you're hoping to stop in India?

A: Absolutely. That is really what is motivating me—to catch a U.S.-style military-industrial complex from reinventing itself in a country where they should be really spending their money in AIDS prevention. India has a fast-growing AIDS infection rate, the world's largest now, after sub-Saharan Africa. The country doesn't provide filtered water for the majority of its people. And what are they doing? They want to build a missile shield? For what?

Laptops will link global learners

Negroponte shares vision for kids

Stephanie Schorow
News Office Correspondent

The real star at an Oct. 19 lecture by Nicholas Negroponte was not the Media Lab co-founder and computer-aided design pioneer himself but what he brought to the Department of Architecture classroom at MIT—a model from his One Laptop Per Child (OLPC) project.

After Negroponte finished outlining plans for creating and distributing the inexpensive computer to children in developing nations, the audience crowded the podium to examine the cheerful green-and-white 2B1 model. While Negroponte apologized for bringing a model, not a prototype, his audience still wanted a closer look. They turned and twisted the screen and the wi-fi antennas. They pressed fingers to the kid-size keypad. They weighed it in their hands.

"It's adorable," exclaimed Diane Sloan, a 1980 graduate of MIT's Sloan School. "It doesn't feel cheap," said Francois Proulx, a student visiting from Montreal. "It has something about it," agreed Yasmine Abbas, a 2001 graduate of MIT's architecture program. She added, thoughtfully, "If it touches the children, it's going to change a lot of things as well."

That is Negroponte's goal. Negroponte, who began his association with MIT as an architecture student in the 1960s, sees computers and technology as a way to help children educate themselves. OLPC, launched as a nonprofit organization in 2005, aims to sell the laptops inexpensively to governments, which will then distribute them for free to children.

The goal, Negroponte said, is not merely to prepare kids for the technology market ("Let's hope when these kids are on the job market, Word and Excel don't exist," he said), but to facilitate the process of learning itself.

As he explained with a series of slides, the three principles underlying the OLPC are: "One: Use technology to learn learning, not to learn something. Two: Teaching is one way, but not the only way to achieve learning. Three: Leverage children themselves." That is, kids will find ways to use—and repair and debug—the computers if allowed free access, he said.

Of the 1.2 billion children in primary and secondary schools around the world, half live in rural, remote areas with limited access to education. "You can't just build more schools and train more teachers, you've got to leverage the kids themselves," Negroponte said. "I can take a Gameboy or PlayStation and drop it in the middle of the jungle, into the hands of kids who don't have electricity. They'll open the box. First thing they do is throw away the manual and the second thing they'll do is use it."

Negroponte described the challenge of keeping the cost of the laptops to an affordable $100. "Scale is key," he said. Also, machines will have one-third the number of pieces as a market laptop. Still, the Linux-based, dual-mode display machines will have a 500 MHz processor, 128 megabytes of DRAM, 500 MB of Flash memory, several USB ports and a broadband wireless system able to create a mesh network with other laptops. Fifty percent of the cost of a regular laptop or cell phone is for sales, distribution, marketing and profit. "We don't have any of those four elements," he said. The cost of each machine will be $138 in 2007, $100 by 2008 and $50 in 2010, Negroponte said.

Another challenge was designing a backup power supply so the laptops may be used in remote areas without access to electricity. Initial models had a yellow crank that could be used to generate power. The crank has been replaced with a wind-up string system. The crank "still made a wonderful point: that human power is important," he said.

The first 1,000 working units are scheduled to be finished in November.

For more information on One Laptop Per Child, go to www.laptop.org.

Media artist Tsubaki plans 'Soul'-ful talk

Japanese media artist Noboru Tsubaki, whose work includes a 110-foot-long inflatable locust, has been named the 2006 Ida Ely Rubin Artist-in-Residence at MIT.

Tsubaki will give a public presentation, "Prosthetic Restoration of Your Soul: The Art of Noboru Tsubaki," on Oct. 30 at 7 p.m. in Room 141 of the Stata Center. The event is free and open to the public.

Born in Tokyo, Tsubaki has worked in a number of media, including large-scale outdoor installation, interactive networked media, robotic sculpture and community cultural projects. In the 1980s, he made the transition from minimal art to working on huge objects, including the giant locust, which was hung off the side of the Yokohama Grand Intercontinental Hotel in Japan.

After being involved in a devastating earthquake in Japan in 1996, Tsubaki realized he could use his artwork to propose solutions to the world's problems. After the 9/11 attacks on America, he expanded that idea into the "UN Application Project," which includes a large five-legged robotic vehicle designed to clear land mines.

"My aim is to provide solutions for some of the world's problems through my art," he said on his unboy.org web site in March 2004. "I believe that if governments and corporations refuse to address issues relating to politics and religion then art projects must be the ones to say something constructive."

Tsubaki, who is the head of the Space Design Section at Kyoto University of Art and Design, will be at MIT from Oct. 30 through Nov. 9. He will work with students and faculty in media arts and sciences, sustainable energy, the Computer Science and Artificial Intelligence Laboratory, and the Technology Culture Forum.

The Ida Ely Rubin Artists-in-Residence Fund was established in 1998 by MIT benefactor Margaret McDermott in honor of veteran Council for the Arts member Ida Ely Rubin to support artist-in-residence programs in visual arts.

For more information on the Oct. 30 event, call x3-2341.

Noboru Tsubaki, Ely Rubin Artist-in-Residence, has described his artistic goal as saying 'something constructive' in the face of destructiveness caused by humans or nature. Once a minimalist, he turned to macroscale work that blends elements of innocence with those of menace. Below, left, a giant teddy bear is force-fed 'depleted uranium' and, right, a larger-than-life locust lands on a luxury hotel.

PHOTOS COURTESY / **NOBORU TSUBAKI**

Lost Highway project designers to discuss cultural travel

Sarajevo native and architecture graduate student Azra Aksamija was among an international group of 40-100 artists and architects who, in summer 2006, traveled en masse along the so-called Highway of Brotherhood and Unity—a road made in Socialist Yugoslavia to connect the major cities of its republic. The trip, called the Lost Highway Expedition (LHE), was designed so cultural practitioners could experience the terrain of the Balkans and the region's heightened political space.

Today and Friday (Oct. 25, 2-5 p.m. and Oct. 27, 3-6 p.m.), Aksamija, Center for Advanced Visual Studies Curatorial Associate Meg Rotzel and other Lost Highway travelers will lead a series of programs at the CAVS in Room N52-390. The panelists will describe their experiences, share the LHE archive and discuss how the free-form group project was designed.

One of the stops on the route was Aksamija's own Sarajevo, the capital of Bosnia and Herzegovina, where she lived until she was 14. Prior to the start of the LHE, Aksamija returned to Sarajevo to work with local filmmakers, philosophers, historians, artists, curators and activists in preparation for the project's two-day stop in that city. Although these local contributors all knew each other, LHE gave them their first opportunity to collaborate on a project.

Video, photographs and other documentation from the journey are on view in the gallery at the Center for Advanced Visual Studies through Oct. 30.

Aksamija, a graduate student in architecture and in the Aga Khan Program for Islamic Architecture, discussed her Lost Highway experiences recently.

Q: What activity did you run during the trip?

A: I initiated and organized a temporary intervention of haircutting in an abandoned bathhouse in Belgrade. The literal translation of the title of the event, "Who Cuts Yours," comes from a phrase in Serbo-Croatian which not only refers to a haircut but also means, "who cares about you." It was designed to build trust among LHE participants.

The project started as a hairdressing salon, but typical of LHE projects, it had its own dynamic. It was a spontaneous performance that developed into a community bonding experience.

We now have 35 bags of hair samples at the CAVS, which are the collective property of LHE, and we are discussing how it might become the basis of an art project. For example, we might scan them to have a DNA record of LHE participants.

Q: What were some of the other events along the "Lost Highway"?

A: We held presentations and forums by local and international experts on urban transitions from socialism to capitalism and workshops and collaborations between travelers and hosts.

For example, in Sarajevo local LHE participants and architects were asked to investigate and identify those remaining public spaces in Sarajevo that could be animated by independent culture.

We developed themes for "city-tours" to generate discussion. The topics included "Deconstruction of Monuments," "Continuation of War in Time of Peace: Spatial Mediation of Nationalism," "Need for Radical Space" and "Organized Chaos in Politics and Space."

The local experts who led the city-tours were asked to temporarily "occupy" these spaces with their guests in an improvised way. This meant that some of these walking lectures were held on bridges and in parks, bars, restaurants, private gardens and libraries. The advantage of such temporary and guerilla-like occupation of public space was that we didn't need any organization or permits. Everything was scheduled online.

Q: How will the LHE symposium benefit the MIT community?

A: The symposium will reflect on the exchange of information, knowledge or skills we experienced during the expedition. Cross-disciplinary work at MIT could benefit from the ideas and methods we used during the expedition. Our arrangements between artists and academics redefined the notion of departmental and disciplinary boundaries as flexible, moving, ephemeral and negotiating space.

PHOTO COURTESY/ **AZRA AKSAMIJA**

A 'haircutting intervention' in Belgrade, above, was among the Lost Highway's roadside attractions. Azra Aksamija, graduate student in architecture and the Aga Khan program, was a project organizer.