Volume 51 – Number 9
Wednesday – November 15, 2006

TechTalk
SERVING THE MIT COMMUNITY

Wireless energy may power electronics

Dead cell phone inspired research innovation

Davide Castelvecchi
American Institute of Physics

Recharging your laptop computer, your cell phone and a variety of other gadgets may one day be as convenient as surfing the web—wirelessly.

Marin Soljacic, an assistant professor in MIT's Department of Physics and Research Laboratory of Electronics, described his and his MIT colleagues' research on that wireless future on Tuesday, Nov. 14 at the American Institute of Physics Industrial Physics Forum in San Francisco.

Like many of us, Soljacic (pronounced Soul-ya-CHEECH) often forgets to recharge his cell phone, and when it is about to die it emits an unpleasant noise. "Needless to say, this always happens in the middle of the night," he said. "So, one night, at 3 a.m., it occurred to me: Wouldn't it be great if this thing charged itself?"

He began to wonder if any of the physics principles he knew could provide new ways of transmitting energy.

After all, scientists and engineers have known for nearly two centuries that transferring electric power does not require wires to be in physical contact. Electric motors and power transformers contain coils that transmit energy to each other by the phenomenon of electromagnetic induction. A current running in an emitting coil induces another current in a receiving coil; the two coils are in close proximity, but they do not touch.

Later, scientists discovered electromagnetic radiation in the form of radio waves, and they showed that another form of it—light—is how we get energy from the sun. But transferring energy from one point to another through ordinary electromagnetic radiation is typically very inefficient: The waves tend to spread in all directions, so most of the energy is lost to the environment.

Soljacic realized that the close-range induction taking place inside a transformer—or something similar to it—could potentially transfer energy over longer distances, say, from one end of a room to the other. Instead of irradiating the environment with electromagnetic waves, a power transmitter would fill the space around it with a "nonradiative" electromagnetic field. Energy would only be picked up by gadgets specially designed to "resonate" with the field. Most of the energy not picked up by a receiver would be reabsorbed by the emitter.

In his talk, Soljacic will explain the physics of nonradiative energy transfer and the possible design of wireless-power systems.

While rooted in well-known laws of

See **WIRELESS**
Page 4

PHOTO / **DONNA COVENEY**

Periwinkle power

Chemistry graduate student Elizabeth McCoy, left, and Sarah O'Connor, assistant professor of chemistry, inspect their latest batch of periwinkle root. They are working with periwinkle seedlings to produce potential new drugs. See story on page 5.

MIT forms new Energy Council

President Susan Hockfield today announced the formation of the new MIT Energy Council, which will serve as an executive group charged with implementing MIT's plans to meet the energy needs of the nation and the world. The council is a key organizational element of the Institute-wide MIT Energy Initiative (MITEI) led by Professors Ernest J. Moniz and Robert C. Armstrong, who serve as Director and associate director of MITEI, respectively.

The members of the new council are:

Professor Angela M. Belcher (materials science and engineering and biological engineering)

Institute Professor John M. Deutch (chemistry)

Professor Leon R. Glicksman (architecture and mechanical engineering)

Professor Rebecca M. Henderson (MIT Sloan School of Management)

Professor Paul L. Joskow (economics)

Professor Emanuel M. Sachs (mechanical engineering)

President Hockfield thanked the members of the new council for their willingness to play a leading role in MIT's response to one of our era's great challenges. "The success of our new

See **COUNCIL**
Page 6

Ludwig grant launches Center for Molecular Oncology

A $20 million grant to MIT from the Ludwig Fund, a major philanthropic foundation primarily focused on cancer research, will enable MIT researchers to launch a major attack on the fundamental problem of cancer metastasis, MIT officials announced yesterday.

The gift will establish the new Ludwig Center for Molecular Oncology at MIT, to be administered through the MIT Center for Cancer Research. MIT Professor Robert Weinberg, a noted cancer biologist who led the research team that isolated the first cancer-causing gene and the first known tumor suppressor gene, will head up the center.

"The Ludwig Fund's commitment to support research in metastasis—the most deadly and possibly least understood phase of cancer—is both generous and visionary. And Professor Robert Weinberg, with his history of groundbreaking research in this area, is a superlative choice to head up this effort," said MIT President Susan Hockfield.

Metastasis, the spreading of cells from a primary tumor to distant sites in the body, is responsible for 90 percent of cancer-related deaths. A diagnosis of metastatic spread has been a death sentence for many, because these distant growths, which have puzzled researchers for decades, have been so difficult to treat.

Over the past five years, cancer research at the molecular and cellular level has uncovered many of the mechanisms that enable cancer cells to leave the primary tumor site and seed colonies elsewhere. As a result, metastasis research is moving ahead quickly and shows great promise.

"The Ludwig grant comes to MIT at a particularly auspicious time, because we now have the proper biochemical tools to make rapid inroads in this research area," said Weinberg. "The major questions are now ripe for experimentation, and the Ludwig Center at MIT is poised

See **LUDWIG**
Page 5

PHOTO / **DONNA COVENEY**

Digging in for new graduate hall

Members of the MIT community break ground for NW35, a new residence hall that will house 1,700 graduate students. The building, due for completion in July 2008, will be located near the Sidney-Pacific and Warehouse residences, transforming these graduate halls into a community. It will also allow the transition of Ashdown House into an undergraduate residence hall. From left: Sian Kleindienst G, chair of the Ashdown House Executive Committee; Ann Orlando, Ashdown housemaster; Bill Kaminsky G, Ashdown House officer; Terry Orlando, Ashdown housemaster; Eric Weese G, president of the Graduate Student Council; Karen Nilsson, associate dean and director of housing; President Susan Hockfield; Sherwin Greenblatt, executive vice president; Ike Colbert, dean for graduate students; Chancellor Phil Clay; Kirk Kolenbrander, vice president for Institute affairs and secretary of the Corporation; Gary Tondorf-Dick, program manager, Department of Facilities.

George B. Thomas, calculus textbook author, dies

Ruth Walker
News Office Correspondent

George B. Thomas, a mathematician who turned a one-year teaching appointment at MIT into a 38-year career, and whose well-regarded textbook has been used around the world, died Oct. 31 of natural causes in State College, Pa. He was 92.

Thomas, known as a young teacher for his ability to communicate mathematical concepts, was hired in 1951 by publisher Addison-Wesley to revise their standard, widely used calculus textbook. Rather than revise, he wrote his own, a classic text that has been in use for 54 years.

George B. Thomas

At MIT, Thomas came to be regarded as an outstanding teacher, "one of the best teachers the department has ever had," according to then department head Ted Martin. Not only did he teach a wide variety of subjects, but he also willingly took on new courses. Administratively, he served as executive officer of the department for 10 years and as graduate registration officer from 1962-67.

Thomas was born Jan. 11, 1914, in Boise, Idaho. His mother died in the influenza pandemic in 1919, and young George grew up in sometimes difficult circumstances. At one point he lived in a tent with his father and stepmother. "It must have been sort of hard times, because I can remember going out with her to pick weeds of some kind along the roadside that were edible," he recalled afterward, according to his daughter, Fay Bakhru.

His father's work in a bank helped lead Thomas to discover his own fascination with numbers. After studies at Spokane University and Washington State College, which led to bachelor's and master's degrees, Thomas hoped to become a high school math teacher, but "that somehow didn't work out," as he related afterward.

During World War II, Thomas helped program the differential analyzer for the calculation of firing tables for the Navy. After the Soviet Union launched Sputnik in October 1957, Thomas was part of a national effort to improve math and science education in American schools. He also traveled to India on a Ford Foundation grant to teach Indian instructors how he and his American colleagues taught math.

Thomas worked in a shoe store for a time to save money for doctoral studies and eventually went to Cornell, where he completed his Ph.D. in mathematics in 1940, and then came to MIT, from which he retired in 1978.

Thomas' commitment to education went well beyond MIT. From 1955-57, he served on the Board of Governors of the Mathematical Association of America, an organization devoted to mathematics, especially at the undergraduate level. He was elected its first Vice-President 1958-59. Thomas also served on the Executive Committee, Mathematics Division, of the American Society for Engineering Education from 1956-59.

He was a member of the Commission on Mathematics of the College Entrance Examination Board, 1955-58, for which he co-authored monographs on mathematics, and spoke at numerous forums about teaching and high school curriculum reform. In addition to his calculus text, which had a significant impact, he was also one of the editors on a series of high school mathematics texts for Addison-Wesley Publishing.

Twice widowed, Thomas is survived by two daughters, Fay, of Glen Mills, Pa., and Jean H. Thomas of West Chester, Pa.; a son, James H. Thomas of Owls Head, Maine; a stepson, Brad Waldron of Beverly, Mass., two stepdaughters, Melissa Goggin of Beverly, Mass., and Susan Hamill of Maine; three sisters, Mary Nelson of Twin Falls, Idaho, Carol Hypes of Greeley, Colo., and Peggy Turner of Lubbock, Texas; three grandchildren; five great-grandchildren; and six step-grandchildren.

A remembrance was held at the family home. Expressions of sympathy may be sent to Fay Bakhru, P.O. Box 1005, Glen Mills, PA 19342. Donations may be sent to Foxdale Community Fund, 500 E. Marylyn Ave., State College, PA 16801.

FACULTY MEETING

A regular meeting of the faculty will take place Wednesday, Nov. 15 at 3:30 p.m. in Room 32-123. The agenda includes:

- Continued discussion on the report from the Task Force on the Undergraduate Educational Commons
- Remarks from President Susan Hockfield
- Topics arising and questions for the president, the provost and the chancellor

NEWS YOU CAN USE

New mileage rate

Effective Jan. 1, 2007, the mileage reimbursement rate for the use of private automobiles for business travel will be increased to $0.48 from $0.44, based on IRS regulations. Should your travel end on or after Jan. 1, 2007, your reimbursement for mileage will be at the rate of $0.48. Should your travel end on or before Dec. 31, 2006, your reimbursement for mileage will be at the old rate of $0.44.

HOW TO REACH US

News Office
Telephone: 617-253-2700
E-mail: newsoffice@mit.edu
http://web.mit.edu/newsoffice

Office of the Arts
http://web.mit.edu/arts

Printed on recycled paper

Editor
Sarah H. Wright

Photojournalist
Donna Coveney

Production
Anne Trafton

News Office Staff

Interim Director ..... Pamela Dumas Serfes
Interim News Manager ..... Sarah H. Wright
Senior Communications Officer ..... Patti Richards
Senior Science and Engineering Editor ..... Elizabeth Thomson
Assistant Director/Photojournalist ..... Donna Coveney
Web Developer/Editor ..... Lisa Damtoft
Reporter/Writer ..... Sasha Brown
Operations/Financial Administrator ..... Myles Crowley
Administrative Assistant II ..... Mary Anne Hansen
Administrative Assistant II ..... Patti Foley
Computer Support Assistant ..... Roger Donaghy
Editorial/Production Assistant ..... Anne Trafton
Communications Assistant ..... Heather Manning

Tech Talk is published by the News Office on Wednesdays during term time except for most Monday holiday weeks. See Production Schedule at http://web.mit.edu/news-office/techtalk-info.html. The News Office is in Room 11-400, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307.

Postmaster: Send address changes to Mail Services, Building WW15, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307.

Subscribers may call 617-252-1550 or send e-mail to mailsvc@mit.edu.

Tech Talk is distributed free to faculty and staff offices and residence halls. It is also available free in the News Office and the Information Center.

Domestic mail subscriptions are $25 per year, nonrefundable. Checks should be made payable to MIT and mailed to Business Manager, Room 11-400, MIT, 77 Massachusetts Avenue, Cambridge, MA 02139-4307.

Periodical postage paid at Boston, MA. Permission is granted to excerpt or reprint any material originated in Tech Talk.

Researchers gain traction in race against pandemics

Robin Ray
News Office Correspondent

Is another pandemic on the scale of the 1918 influenza pandemic inevitable, or can research and prevention head off another deadly transmission of animal viruses to human populations?

This was among the questions considered at "A Dangerous Leap: Animal-to-Human Transmission of Disease," a panel of experts in epidemiology and microbiology convened on Nov. 9 for the 13th annual Dorothy N. Stratton Lecture on Critical Issues.

Visions of pandemic bird flu may "send a chill up our spine," said moderator Lee Gehrke, Hermann von Helmhotz Professor of Health Sciences and Technology at MIT. But he wondered whether the issue been blown out of proportion.

The panel discussion at the Wong Auditorium, chaired by Gehrke, who is also a professor at Harvard Medical School, featured guest speakers Megan Murray, assistant professor of epidemiology in the Harvard School of Public Health; Michael Farzan, assistant professor of microbiology and molecular genetics at Harvard Medical School; and Adolfo Garcia-Sastre, professor of microbiology at Mount Sinai School of Medicine in New York City.

Garcia-Sastre led off with a summary of his research into the HA influenza strain, which is carried by birds and caused the 1918 influenza epidemic. This pandemic killed more than 20 million people worldwide and more than 600,000 in the United States. He noted that while flu vaccines give us reasonable protection against B, H3 and H1 virus strains, "if the H5, H7 or H9 strains can master human-to-human transmission, the human population has no immunity."

His group at Mount Sinai Hospital has synthetically reproduced the 1918 virus, using genetic material gleaned from lung-tissue samples preserved in paraffin by the U.S. military as well as samples preserved in bodies deposited below the permafrost line in a mass grave in the remote Inuit village of Brevig Mission, Alaska. (In Brevig Mission, the postman delivered the virus along with the mail, and within a week all but eight of the village's 80 inhabitants had perished.) Garcia-Sastre's group has determined that the glycoprotein and polymerase genes are those responsible for virulence of the 1918 flu strain.

Science gains speed in response

Farzan discussed how the severe acute respiratory syndrome (SARS) corona virus, which normally affects only birds, "learned" to infect humans. He recapped the course of the outbreak that occurred earlier this decade, from the first cases in November 2002 through the World Health Organization global health alert issued in March 2003 at the peak of the epidemic, through its attenuation over the following year. By March 2004, it was clear that the virus has lost much of its lethality. His group, therefore, focused on studying the minute differences between the early, virulent strain of the SARS virus, and the later strain, which was far less lethal, causing a "mild, flu-like disease."

He noted in particular how extremely rapid the scientific response to this outbreak had been: By April 2003, researchers had identified the pathogen as a corona virus; by May, they had isolated the virus and proved its lethality in macaques, and another group had determined the entire 27,000 base-pair genome. Farzan noted, "A lot of what happened here reflects the sequencing technology…a natural outgrowth of the scientific effort, the Human Genome Project."

His group concluded that the difference between the very deadly strain of the SARS virus and the far milder, later strain was the shift of two amino acids in the so-called spike (S) proteins that allow the virus entry into the cells. One change made it easier for the virulent strain to

See **PANDEMICS** Page 6

Math model may aid study of collagen ailments

Tensile loading revealed nature's economy

Katharine Stoel Gammon
News Office Correspondent

An MIT researcher's mathematical model explains for the first time the distinctive structure of collagen, a material key to healthy human bone, muscles and other tissues. The new model shows collagen's structure from the atomic to the tissue scale.

An improved understanding of nature's most abundant protein could aid the search for cures to such ailments as osteoporosis, joint hyperextensibility and scurvy, all recognized as arising from diseased collagen. It could also guide engineers' development of synthetic versions of the protein, which in its healthy state is several times stronger than steel per molecule.

Biological experiments in the past have shown that collagen's universal design consists of molecules staggered lengthwise, arranged like fibers in a steel cable. Each tiny tropocollagen molecule—the smallest collagen building block—is around 300 nanometers long and only 1.5 nanometers thick. (A nanometer is one-billionth of a meter.) But why these ropy strands of amino acids—the molecular building blocks of proteins—associate to form tropocollagen molecules consistently at the same length has been unexplained until now.

The molecular model of collagen developed by Markus Buehler, an assistant professor in the Department of Civil and Environmental Engineering, started on the atomic scale. Buehler then combined elements of quantum mechanics and molecular dynamics to scale his model up and show precisely which length and arrangement of molecules were best for sustaining large weights pulling in opposite directions, a process known as tensile loading.

Buehler discovered that the ideal length of tropocollagen molecules was indeed close to 300 nanometers. His work has shown that the characteristic nanopatterned structure of collagen is responsible for its high extensibility and strength. "This is the first time a predictive, molecular model was used to explain the design features that experiments have shown for decades without understanding the rationale behind them," he explained.

"The response of materials to tensile loading has been studied in materials science for computer chips, cars and buildings, but is still poorly understood for biological materials. What we are doing is looking at biological systems on a molecular level, the same way we would examine glass or metal," said Buehler. "This represents a new way of thinking about biological matter, and it may hold the key to engineering biological systems as we design man-made devices today."

The next step in the research will be to delve deeper into the structure of collagen. "We've developed a reference point for healthy collagen. This enables us now to study how diseases or genetic mutations impact the structure," said Buehler. Learning more about the structural differences between diseased and healthy collagen could help in the development of biomimetic materials.

Buehler is optimistic about the future. "Understanding the mechanical properties of protein materials—in particular their deformation and fracture—is a frontier in materials science. We're trying to figure out how nature creates better materials than we can," he said.

The current work, which appeared in a recent issue of the Proceedings of the National Academy of Sciences, was funded by startup grants Buehler received from MIT's Department of Civil and Environmental Engineering and MIT's School of Engineering.

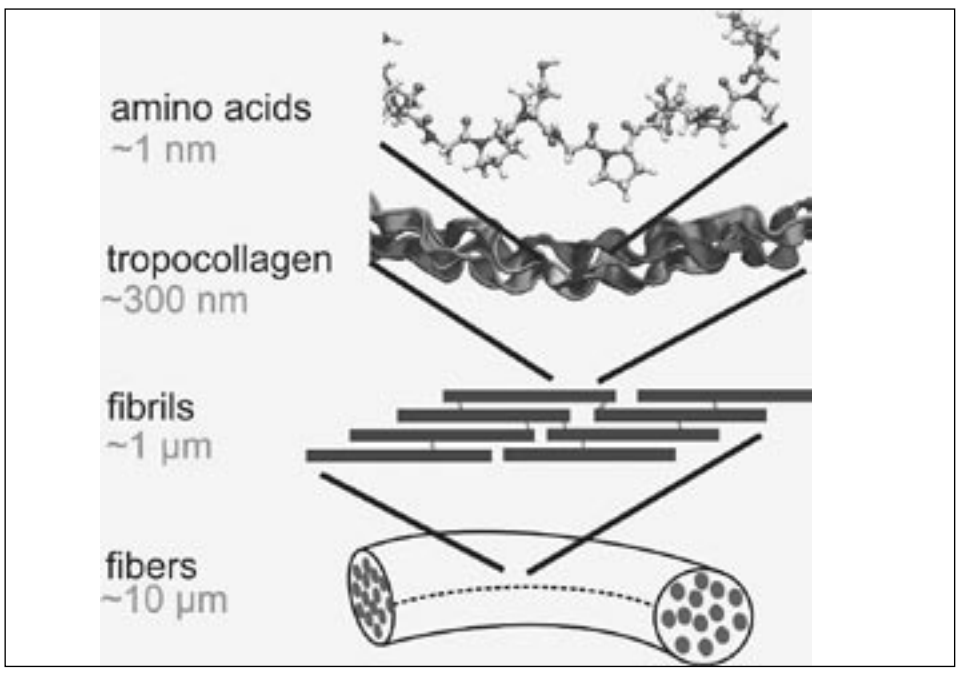


PHOTO COURTESY / **M. BUEHLER**

The building blocks of healthy collagen, above, begin with one-nanometer-sized amino acids, which form the universal 300-nanometer tropocollagen strands. Fibrils composed of those strands, in turn, make up the steel-cable-like collagen fibers.

CIS panelists ponder nuclear age with Iran, North Korea

Stephanie Schorow
News Office Correspondent

Alarm over the nuclear ambitions of North Korea and Iran should not derail a calm, careful analysis of the two countries' weapons capabilities and goals, a panel of experts said Nov. 9 in a forum sponsored by the MIT Center for International Studies.

Speaking on "Iran, North Korea and the Second Nuclear Age," the panelists emphasized that while there are very real reasons to be worried, both countries are still a long way from full nuclear capabilities.

Barry R. Posen

North Korea is close, but its recent nuclear weapons tests showed a "fizzled yield" and "they are not doing so well on a delivery system that would reach beyond the Pacific," said physicist David Albright, president of the Institute for Science and International Security.

However, Albright showed satellite images of nuclear facilities in North Korea and pointed out that the country is actively working on miniaturizing nuclear weaponry for missile use. Such missiles would pose a threat to its neighbors, and perhaps even the United States.

As for Iran, President Mahmoud Ahmadinejad certainly sounds like a threat. But the panelists asserted that careful analysis provides a counterbalance to the aggressive rhetoric. Would a nuclear Iran sell nuclear material to terrorists? "It's an awfully risky proposition to give any nuclear weapons to nonstate actors," said Barry R. Posen, MIT Ford International Professor of Political Science and director of the MIT Security Studies Program. Doing so puts your fate into their hands, he said.

Would Iran attack Israel? Only at great personal risk. Israel has 200 fission weapons, and "Iran is quite vulnerable to nuclear retaliation by Israel," Posen said. Islamic fundamentalists might accept Armageddon; however, "there won't be many worshippers left in Iran after an event like this," he said.

A policy of "containment and deterrence"—similar to the U.S. approach to the Soviet Union—may be more effective in neutralizing Iran than the threat of a "preventative war," Posen said.

The conventional wisdom that we're "at a precipice" and "facing a cascade of nuclear proliferation" should sound incredibly familiar, noted Jim Walsh, a research associate at the MIT Security Studies Program who focuses on international security. It echoes 1964, when China exploded a nuclear device, as well as more recent events. But the rate of nuclear proliferation has declined each decade since the 1960s, and 75 percent of countries considering nuclear weapons have renounced them, Walsh said. "In some ways, it's not the nuclear age, it's the non-nuclear age," he said.

The panelists noted that aggressive posturing by the United States may make some countries believe that they need nuclear weapons to ward off an intervention. If, however, the United States talks with Iran to both guarantee its security and assure leaders that there are no plans to

See **NUCLEAR** Page 6

Lemelson-MIT announces InvenTeams Grants

The Lemelson-MIT Program has awarded grants of up to $10,000 each to 20 "InvenTeams"—teams of high school students and teachers across the country who have invented practical solutions to real-world problems of their own choosing.

"We were astounded with the ingenuity and sophistication of the InvenTeams' proposed inventions," said Joshua Schuler, the Lemelson-MIT Program's InvenTeams Grants Officer. "We are eager to watch them develop their prototypes."

Lemelson-MIT InvenTeams empowers teens to identify a need or problem and work collaboratively to invent a solution to it. Grant recipients are encouraged to work with mentors from their communities. In addition, continuation grants are available to help foster the students' passion for invention and innovation.

A panel of judges including MIT researchers, staff and alumni selected this year's InvenTeams from a national pool of applicants.

Merton Flemings, director of the Lemelson-MIT Program, explained that InvenTeams aims to support innovation among high school students by giving their teachers the resources to provide a hands-on, real-world invention experience with science and engineering.

"By encouraging and supporting youth to pursue their inventions and to dream big, we hope to inspire more of them to enter these fields," said Flemings.

The 2006–2007 InvenTeams proposed inventions include:

See **LEMELSON** Page 6

Soap Box speakers urge energy conservation

Deborah Halber
News Office Correspondent

Americans need to take personal responsibility for their energy consumption, according to John Heywood, the Sun Jae Professor of Mechanical Engineering and director of the Sloan Automotive Laboratory.

"We have to use 'I' and 'me' in our language (concerning energy conservation). It's real sweaty work and we have to work hard at it," he said.

Heywood spoke during the third and final installment of the MIT Museum's Soap Box series devoted to energy. The Nov. 1 event, featuring Heywood and Professor Stephen Ansolabehere of political science, was on "Growing Pains: Transitioning to a Sustainable Energy Economy."

"The scale on which we use energy is so vast, it's incomprehensible," Heywood said. "Ten to the 18th joules a year—we have no conception of what that number is."

The speakers urged everyone to make the numbers relevant to daily life by doing an energy audit at home. Then, try to reduce personal carbon emissions by 10 percent to 25 percent—without significant lifestyle changes.

Part of the answer is simply awareness, Ansolabehere said. It takes energy to heat and cool water, yet most Americans don't think about that when loading the washer or taking a shower. Large appliances, especially older refrigerators, can be energy-sucking monsters. "Let's be honest and focus on things that can really make a difference," Heywood said.

Heywood, whose specialty is the internal combustion engine, said that the public often expects new technology to save the day. But there is no replacement close at hand for the fossil-fuel-burning car. "You can make engines one-third better in terms of fuel consumption over a 30-year period," he said. "It takes a long time to get radical new technologies out there."

Ansolabehere said that to many people, the problem lacks immediacy because "energy is abundant and it's cheap. The U.S. has coal reserves lasting 300 to 3,000 years. We sit on our enormous pile of fuel, and it fuels our economy as it did throughout the Industrial Revolution." China and India, both poised for explosive growth in energy consumption, also possess enormous coal reserves.

Heywood

The relative price of coal compared with other sources also makes it hard to replace in the U.S. energy portfolio: on a relative scale, coal costs $1, while nuclear energy costs $2 and solar $5.

One way to even the playing field for more environmentally friendly technologies would be to impose a carbon tax. Japanese and Europeans are taxed far more for carbon emissions than Americans and emit far less carbon dioxide into the environment, Ansolabehere said.

Surveys indicate Americans may be willing to pay more for a clean energy future. "People in the U.S. are starting to recognize that this is a problem. Global warming used to be the No. 6 concern, now it's the No. 1 environmental concern for 50 percent of the population," said Ansolabehere, whose expertise is public opinion. He attributed the new attitude to continual news coverage.

The Soap Box presentation wound up with an discussion period, during which audience members shared some initiatives that could make a difference. Cambridge City Councilor Henrietta Davis pointed out that the city is introducing a system that breaks down electrical usage building by building, which will raise awareness about who's using the most electricity. Another attendee reported that Lexington, Mass., high school students have embarked on a year-long project to save 10 percent of their home energy bills.

Ansolabehere

Ansolabehere wondered if there might be a way to re-create the mindset common during the energy crisis of the 1970s, when it was politically incorrect—almost immoral—to waste energy.

Heywood echoed the sentiment. "We have to develop an attitude toward our environment that looks to the next generation," he said.

The Soap Box energy series was co-sponsored by the Energy Research Council and the MIT Technology and Culture Forum.

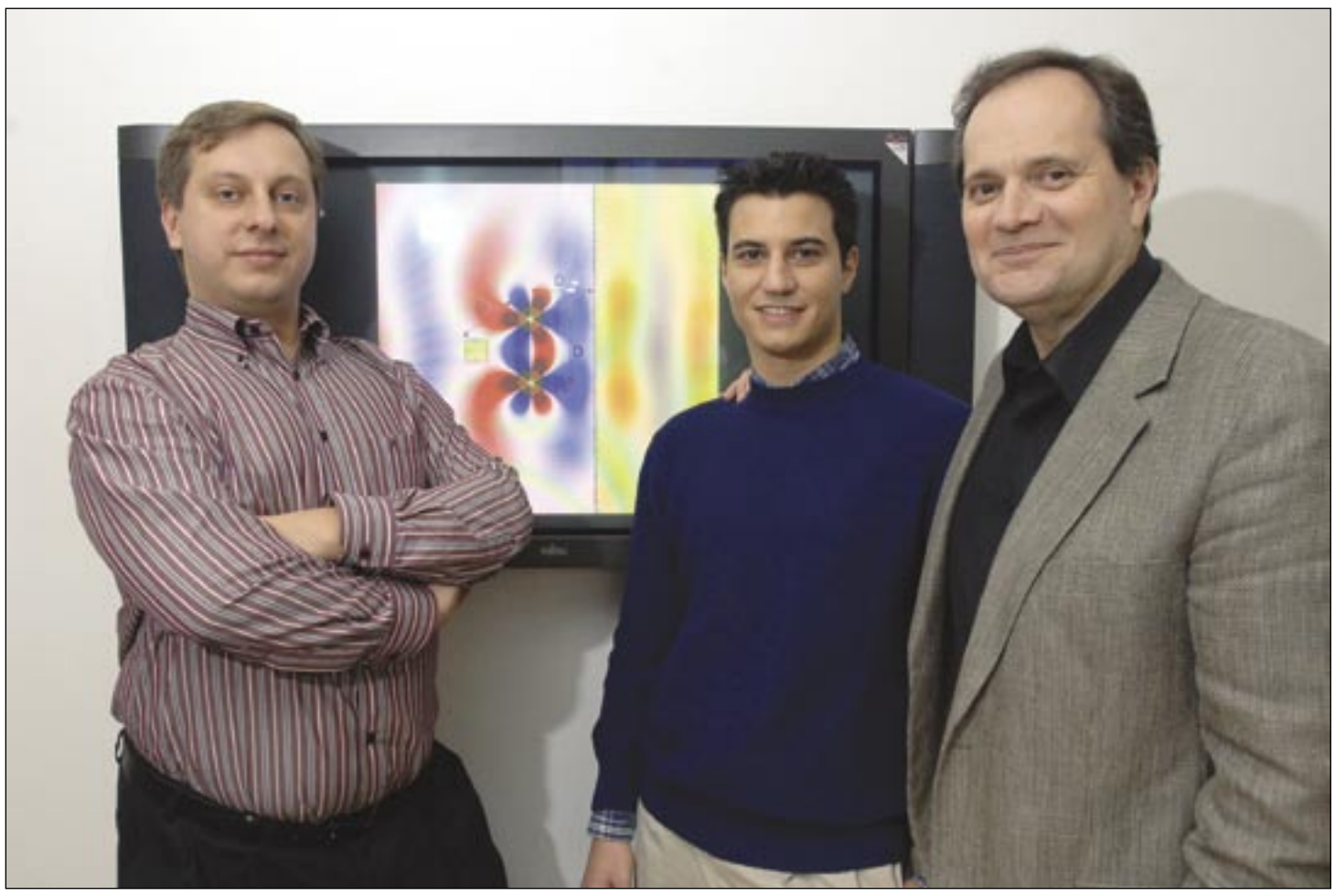


PHOTO / **DONNA COVENEY**

Researchers, above, present a graphic illustrating how magnetism can transmit energy wirelessly. Marin Soljacic, left, assistant professor of physics, Aristeidis Karalis G, and John Joannopoulos, ISN director and professor of physics, use theoretical calculations and computer simulations to find ways to recharge electronics wirelessly.

WIRELESS

Continued from Page 1

physics, nonradiative energy transfer is a novel application no one seems to have pursued before. "It certainly was not clear or obvious to us in the beginning how well it could actually work, given the constraints of available materials, extraneous environmental objects, and so on. It was even less clear to us which designs would work best," Soljacic said. He and his colleagues tackled the problem through theoretical calculations and computer simulations.

With the resulting designs, nonradiative wireless power would have limited range, and the range would be shorter for smaller-size receivers. But the team calculates that an object the size of a laptop could be recharged within a few meters of the power source. Placing one source in each room could provide coverage throughout your home.

Soljacic is looking forward to a future when laptops and cell phones might never need any wires at all. Wireless, he said, could also power other household gadgets that are now becoming more common. "At home, I have one of those robotic vacuum cleaners that cleans your floors automatically," he said. "It does a fantastic job but, after it cleans one or two rooms, the battery dies." In addition to consumer electronics, wireless energy could find industrial applications powering, for example, freely roaming robots within a factory pavilion.

Soljacic's colleagues in the work are Aristeidis Karalis, a graduate student in the Department of Electrical Engineering and Computer Science, and John Joannopoulos, the Francis Wright Davis Professor of Physics. Both are also affiliated with the Research Laboratory of Electronics. The work is funded in part by the Materials Research Science and Engineering Center program of the National Science Foundation.

Shell Oil president discusses new fuels, energy security

Deborah Halber
News Office Correspondent

Shell Oil isn't just about oil anymore. The multinational company has invested $1 billion in wind over the last decade, owns companies working on solar and hydrogen technologies and will soon announce the acquisition of an entity that uses municipal waste to produce biofuel.

"With these, we could go a very long way toward meeting energy security requirements," according to John Hofmeister, president of Shell Oil Company. But conservation has to take hold "in our hearts, minds and behavior of who we are as a people. We have to teach our young people that energy is a precious commodity. We're doing a disservice to young people, because instead of teaching about energy, we're allowing ignorance to reign."

Hofmeister spoke on "Energy Security…What Does It Take?" at the fall 2006 Hoyt C. Hottel Lecture in Chemical Engineering held at MIT on Nov. 3. The Hottel lecture, named for a former faculty member, is sponsored by the Department of Chemical Engineering and focuses on energy issues.

Hofmeister, who was named president of Houston-based Shell Oil in March 2005, said he represents "an industry some would say has all but zero credibility." Yet Shell, he said, is exploring new technologies to find untapped and unconventional oil and gas reserves, investing in alternative sources such as wind and solar and not simply "listening to its cash registers go ka-ching."

Consumers accuse Shell and other major oil companies of price gouging, a characterization Hofmeister feels is unfair in the current era of limited supply. Meanwhile, he said, the company goes "tin cup in hand" to beg legislators for more access to untapped domestic oil and gas reserves to make the United States less reliant on foreign oil.

Unlike others in the petroleum industry, Shell believes that global warming is a real issue, he said.

Even though Shell invests around 5 percent of its total budget in alternative energy sources, Hofmeister warned it will take 20-25 years before these fledgling technologies meet even 10-15 percent of the country's energy needs. The alternatives to fossil fuels are still based on "immature technologies" that markets are not quite ready for, he said.

Meanwhile, "I do believe energy security is at a point of national crisis," Hofmeister said, although Shell does not "subscribe to the theory" (based on work by geophysicist Marion King Hubbert) that world oil production will peak in 10-15 years.

More than 112 billion barrels of oil and gas—"more oil and gas than to be had in the entire Middle East"—can be tapped from federal lands on the outer continental shelf, offshore Alaska and from the Gulf of Mexico, he said.

Even so, untapped reservoirs will not be enough to meet America's future needs, so Shell is pursuing unconventional sources in Canada.

The trillions of barrels of untapped oil and gas around the world present a "carbon management issue" that Shell would "at least like the opportunity to try" to address, he said. For instance, electrical utilities are committing to clean, efficient gas-turbine technology, but natural gas supplies are low compared with increasing demand. Meeting this demand for additional liquified gas would mean building regasification terminals that no one wants in their backyard, he pointed out.

Shell is working on creating a biofuels infrastructure in select markets in the Midwest to make ethanol available at the pump to vehicles that can use blends of biofuels. Although the United States plans to produce 7 billion gallons annually of ethanol by 2010, we would need to produce 15 billion gallons to meet even 10 percent of the country's transportation fuel needs, Hofmeister said.

Periwinkle can serve as tiny chemical plant

Anne Trafton
News Office

Some of nature's most complicated chemistry takes place in the shoots and leaves of the tiny, unassuming periwinkle plant.

MIT researchers studying the flowering plant have now figured out how to manipulate those complicated biosynthetic pathways to produce novel compounds, some of which could have pharmacological benefits.

"Plants are really nature's best chemists," says Sarah O'Connor, the Latham Family Career Development Assistant Professor of Chemistry and co-author of a paper on the work in the Journal of the American Chemical Society.

O'Connor and chemistry graduate student Elizabeth McCoy decided to explore the periwinkle plant in part because it is the only plant that produces vinblastine, a drug widely used to treat cancers such as Hodgkin's lymphoma.

The biochemical pathway that produces vinblastine and other alkaloid compounds is long and complicated, usually requiring at least 10 enzymatic steps, which occur in different parts of the periwinkle plant (also known as *Catharanthus roseus*).

PHOTO / ©P. SCHÖNFELDER

Catharanthus roseus

O'Connor and McCoy essentially tricked the plants into producing new compounds by feeding them slightly altered versions of the normal starting materials (tryptamines) for alkaloid synthesis.

"You can make a great number of modifications of simple starting materials, and the plants incorporate those starting materials into the biosynthetic pathway," said O'Connor.

Alkaloids are believed to have a protective function for plants because they are toxic to bacteria and herbivores who try to eat the plants. This theory is bolstered by the fact that the reaction products move closer to the plant surface as they move through the biosynthetic pathway, said McCoy.

Vinblastine, which has been used as a cancer drug since the 1960s, is very difficult to isolate from the periwinkle plant because it is produced in minute quantities (the yield is about 0.002 percent of the plant's weight). However, it would be even more difficult (and expensive) to synthesize vinblastine in the laboratory.

"It's a beautiful and elegant synthesis, but it's not cost-effective, so industry does not currently use synthesis to make vinblastine," said O'Connor.

Other researchers are now running clinical trials for artificial analogues of vinblastine, so it could be beneficial if periwinkle plants could be induced to synthesize those same compounds or new compounds that might be even more effective.

Because it is easier to make modifications to the starting materials than the end product, the researchers' method could produce a diverse array of alkaloids to test for potential drug activity. "You can only make a limited number of modifications to natural products that are already synthesized," O'Connor said.

In their recent paper, the researchers describe 18 new products, but there are many more possibilities. "There's no end to what you could do to modify the starting materials," said McCoy.

Scientists often engineer bacteria and yeast to produce desired compounds, such as antibiotics, but few have tried it with plants, because their biochemistry is so complex.

"Plants are the hardest to work with, so people have avoided looking at plant biosynthetic pathways," O'Connor said.

The research is funded by the Smith Family Medical Foundation, 3M, the Beckman Foundation, the American Cancer Society and the American Chemical Society.

Gene machine takes the prize

Cells engineered to prevent sepsis win synthetic biology competition

Deborah Halber
News Office Correspondent

A team of eight undergraduates from the University of Ljubljana in Slovenia—cheering and leaping onto MIT's Kresge Auditorium stage in green team T-shirts—won the grand prize Sunday at the international Genetically Engineered Machine (iGEM) competition at MIT.

The group—which received an engraved award in the shape of a large aluminum Lego piece—explored a way to use engineered cells to intercept the body's excessive response to infection, which can lead to a fatal condition called sepsis.

The goal of the 380 students on 35 university teams from around the world was to build biological systems the way a contractor would build a house—with a toolkit of standard parts.

iGEM participants spent the summer immersed in the growing field of synthetic biology, creating simple systems from interchangeable parts that operate in living cells. Biology, once thought too complicated to be engineered like a clock, computer or microwave oven, has proven to be open to manipulation at the genetic level. The new creations are engineered from snippets of DNA, the molecules that run living cells.

Cells may one day be programmed to manufacture and deliver drugs or key molecules within the body, churn out fuel, detect pollutants and carry out a slew of as-yet-unimagined functions. The MIT team, dubbed "eau d'ecoli," genetically engineered E. coli bacteria to smell like mint while they were growing and to smell like banana when they were done. The technique could potentially be used to improve the scent of other foul-smelling substances.

"It's kind of a cool thing to tell your bacteria how to smell," said team member Veena Venkatachalam, an MIT sophomore majoring in chemistry and physics.

The Slovenian team was one of the few to work with mammalian cells. Ljubljana microbiology student Monika Ciglic said that the team chose the more challenging and complicated mammalian cells over bacteria or viruses because of the potential rewards of coming up with a system that could work in the human body. Sepsis has been cited as the 10th leading cause of death in the United States. But while the other teams had an available toolkit of 500 "BioBricks"—snippets of DNA that have been proven to accomplish certain tasks—the Slovenian team had to build all its BioBricks from scratch.

PHOTO / **LAURA WULF**

Members of Team Slovenia erupt in jubilation upon learning they won the BioBrick, the grand prize for the iGEM 2006 competition. The University of Ljubljana students are, from left, Rok Tkavc, Jernej Kovac, Matej Skocaj and Jelka Pohar. Offering congratulations in front are iGEM ambassadors James Brown of Cambridge University and Melissa Li of Georgia Tech.

Information about BioBricks, and a toolkit to make and manipulate them, was provided by the Registry of Standard Biological Parts created by MIT.

The first runner-up was a team from the Imperial College in London for its creation of an oscillator that was stable, had a high signal-to-noise ratio and could be easily integrated into other systems. Such a device has potential biomedical applications.

The director of iGEM, Randy Rettberg, principal research engineer in biological engineering, said he is convinced synthetic biology will spawn a worldwide industry. The possibilities for start-ups include companies that make and catalog individual parts, as well as companies that exploit the technology to solve myriad problems.

Drew Endy, assistant professor of biological engineering, said that it is "completely remarkable that 40 months ago, none of this was happening anywhere." A small pilot program held during Independent Activities Period has grown into an international competition, and Endy said that as DNA synthesis becomes more common, the field will expand even more rapidly.

As with any technology, there is the danger of misuse. Perceptions of synthetic biology range from excitement to fear and mistrust. Endy said that the work is so new, it's bound to scare some people. "A lot of people who were scaring folks in 1975 now have Nobel prizes," he said.

iGEM is an initiative of the MIT iCampus program, which is funded by Microsoft Corp. Competition winners were selected by a panel of judges from industry and academia. Detailed information is available on iGem's website: http://parts2.mit.edu/wiki/index.php/Jamboree.

LUDWIG

Continued from Page 1

to move ahead quickly."

The establishment of the Ludwig Center will enable strong synergies between MIT research groups that are addressing the problem of metastasis through different means. "Each research group will bring its own set of experimental tools to a common table," said Weinberg.

The Ludwig Center will be an integral part of the MIT Center for Cancer Research (CCR), founded in 1974 to harness the power of basic science and technology to understand and eliminate cancer.

The CCR is one of eight National Cancer Institute-designated basic research centers in the country and is helping to lay the foundation for a new type of cancer research that taps into a broad range of scientific disciplines and utilizes new tools and technologies.

The Ludwig Center at MIT is one of six new cancer research centers being established concurrently around the country by the Ludwig Fund, created by billionaire Daniel K. Ludwig, who died in 1992. Ludwig considered cancer to be one of humanity's great challenges, and the majority of his wealth was given over to cancer research. In 1971, he established the international Ludwig Institute for Cancer Research, which has expended more than $1.1 billion of its own funds in support of cancer research.

Robert Weinberg

The foundation's gift of $120 million to these six institutions—MIT, Dana-Farber/Harvard, Johns Hopkins, Memorial Sloan-Kettering, Stanford and the University of Chicago—is believed to be the largest single gift by a foundation to U.S. cancer research efforts.

The Ludwig Center at MIT will ultimately be located within the Center for Cancer Research facility, a new building being planned for the corner of Ames and Main streets on the MIT campus.

STS research contributes to understanding disparities in success of medical treatments

Stephanie Schorow
News Office Correspondent

Does a person's race or ethnic background affect how he or she responds to medication? Does consideration of race reinforce preconceptions and prevent effective treatment for both minority and majority populations?

"STS can contribute to answering these questions," asserted Dr. David S. Jones, MIT assistant professor in the Program in Science, Technology and Society, during an Oct. 30 lecture on "Can STS be Good Medicine for Medicine?"

New treatments and medical technology can effectively eradicate diseases such as smallpox, yet social and political considerations have hindered similar success with diseases like polio, tuberculosis and AIDS, said Jones, director of MIT's Center for the Study of Diversity in Science, Technology and Medicine. "In 1985, we had all the technology necessary to eradicate HIV. As we all know, that did not happen."

Moreover, there are striking differences among populations on key health markers. Today, according to a recent study in New York City, black men are eight times more likely to die of AIDS than white men, Jones said. Even in this area, the mortality rate per 100,000 population is 530 in the Back Bay, 729 in the South End and 1,167 in South Boston, Jones said. The life expectancy of a Sioux man in South Dakota is 58 years and that of an Asian woman in Bergen County, N.J., is 91 years—a huge difference.

"The silence about this issue continues to amaze me," added Jones, who has degrees in both medicine and history and is author of the 2004 book, "Rationalizing Epidemics: Means and Uses of American Indian Mortality."

Pinpointing a cause for such disparity is, however, extremely difficult. For example, doctors have long recognized that people have individual, idiosyncratic responses to medication, despite medical trends to offer standard responses to standard diagnoses, Jones said. Such different responses can be due to nonadherence to drug regimens, environmental factors or genetic background. And while efforts to map the human genome have found "99.9 percent" similarity among seemingly diverse humans, that 0.1 percent might be responsible for differences among ethnic groups, Jones said.

Some evidence suggests HIV drugs have more serious side effects in African-Americans than whites, but it's not clear why. "Is race something we should consider when trying to close the medical gap?" Jones wondered. "How do you explain variation in drug response? Should we attempt to match drugs to genes?"

African-Americans do suffer higher rates of hypertension than whites. In a controversial move in 2005, the FDA approved the heart medication BiDil, marketed by NitroMed of Lexington, Mass., for those who self-identify as black. Jones, however, questions why drugs that work well among African-Americans weren't marketed to whites when, for decades, drugs tested on white men were considered applicable to all races and often both sexes.

"It's easy to find differences. It's hard to know if the difference is significant," he said. STS, with its focus on history and culture as well as technology, may help answer that question, Jones said.

LEMELSON

Continued from **Page 3**

East

- Acton-Boxborough Regional High School (Acton, Mass.): Reusable fire-fighting grenade (Cisco Systems is providing additional funding and mentoring support to this team)
- Ardsley High School (Ardsley, N.Y.): "Curb-conqueror" wheelchair attachment
- The Bromfield School (Harvard, Mass.): Memory-assist device for people with Alzheimer's, dementia and other memory-related illnesses
- Eleanor Roosevelt High School (Greenbelt, Md.): Dozing-driver waking device
- George T. Baker Aviation School (Miami, Fla.): Portable, solar-charged traffic signal
- McArthur High School (Hollywood, Fla.): Extended-use dry-erase marker
- Merrimack High School (Merrimack, N.H.): Solar-powered biodiesel processor
- Miller Place High School (Miller Place, N.Y.): Wheelchair tip alarm
- Staples High School (Westport, Conn.): Filing cabinet for people with arthritis

Central

- Columbus School for Girls (Columbus, Ohio): Modern high school locker
- Divine Child High School (Dearborn, Michigan) Regenerative braking system for recharging batteries in consumer electronics devices
- Francis W. Parker School (Chicago, Ill.): Electromagnetic products for consumers
- Huntsville High School (Huntsville, Ark.): Underground location and communication device for caving groups and rescue teams

West

- Gresham High School (Gresham, Ore.): Drip-irrigation system to water household plants
- Hillsboro High School (Hillsboro, Ore.): Self-installed automotive heads-up display
- Newberg High School (Newberg, Ore.): Portable, lightweight solar Stirling generator to provide electricity to remote villages
- Palo Alto High School (Palo Alto, Calif.): Head-mounted remote control for quadriplegics
- San Jon High School (San Jon, N.M.): Pocket-sized arsenic filter to purify drinking water
- Sehome High School (Bellingham, Wash.): Surveyor of solar energy potential
- Westview High School (Beaverton, Ore.): Tactile graphing calculator for the blind

COUNCIL

Continued from **Page 1**

energy initiative will depend on the active involvement of our faculty, students and staff. The members of the Energy Council will help us catalyze bold new ventures while coordinating the myriad activities already under way."

One of the council's priorities will be to engage additional faculty, students and staff in MITEI. Among its first tasks, the council will establish a number of task forces that will be charged with developing major institutional research agendas with respect to specific energy challenges.

Two additional task forces will focus on education and campus energy management. Faculty from across the Institute, as well as students and staff in some cases, will serve on the task forces. The new council will also address a wide range of other issues, including faculty recruitment, industrial and institutional partnerships, and campus programs and events.

An external advisory committee of leaders from industry, government and the academy will also be named soon and will provide guidance, advice and direction to MITEI leadership and to Vice President for Research and Associate Provost Claude R. Canizares, to whom MITEI reports.

NUCLEAR

Continued from **Page 3**

invade, nuclear options may become less attractive, Posen said.

In response to an audience question, Walsh said that the United States could send a signal to the Iranian people by reducing some of our vast nuclear arsenal. Such a reduction, which would have no effect on defense, would indicate our peaceful intentions, he said. "Public opinion doesn't matter in North Korea. It does matter in Iran," Walsh said.

The panelists did, however, disagree over banning nuclear weapons. While Albright said he would like to see them disappear, Walsh said bluntly, "I like nuclear weapons." He explained that he would hate to see what great powers might do to each other without the threat of mutual destruction.

PANDEMICS

Continued from **Page 3**

infect human cells, and the other made it much more effective once it had broken in.

Murray closed the program with a discussion of three epidemics caused by animal-to-human disease transmission. The first discussed was the 1911-1912 pneumonic plague epidemic in China, in which fleas from infected rats spread the plague among workers living in crowded conditions at Manchouli, a railroad boomtown in the western part of the country. Manchouli also happened to be the native territory of the tarbigan, a marmot in which the bubonic plague bacillus is endemic and whose pelts had become highly valuable due to a global fur shortage.

Murray then outlined the 1999 encephalitis outbreak in Malaysia. This epidemic, caused by the Nipah virus, was traced to pig urine and from there to the droppings of fruit bats, which had flocked to farms and orchards after being forced out of their native habitat by ferocious wildfires. These fires, mostly attributable to illegal logging, affected much of Southeast Asia in 1999.

Finally, Murray discussed the origins of the human immunodeficiency virus (HIV) epidemic. There is general agreement that HIV derived from the simian immunodeficiency virus (SIV), but debate rages as to how the crossover occurred and why it did so now, when humans and apes have been coexisting in Africa for millennia. Current theories now focus on the opening of labor camps in the central African forests. There the eating of bushmeat (ape flesh), mass "health care" dispensaries that reused hypodermic syringes and the recruitment of prostitutes to service the laborers, who were far from their home villages, may have created a "perfect storm" in which the transmission of SIV to humans was facilitated.

Each of the epidemics was the result of "coinciding social, economic and political upheavals"—the fur shortage and railroad boom in China, the deforestation and fire in Malaysia and the opening of labor camps in the African forest—rather than a simple, random pathogenic jump from animal to human.

The Dorothy N. Stratton lecture series is sponsored by the MIT Women's League in honor of Kay Stratton, wife of the late Julius Stratton, who was president of MIT from 1959 to 1966.

MIT novelist makes his peace with war stories

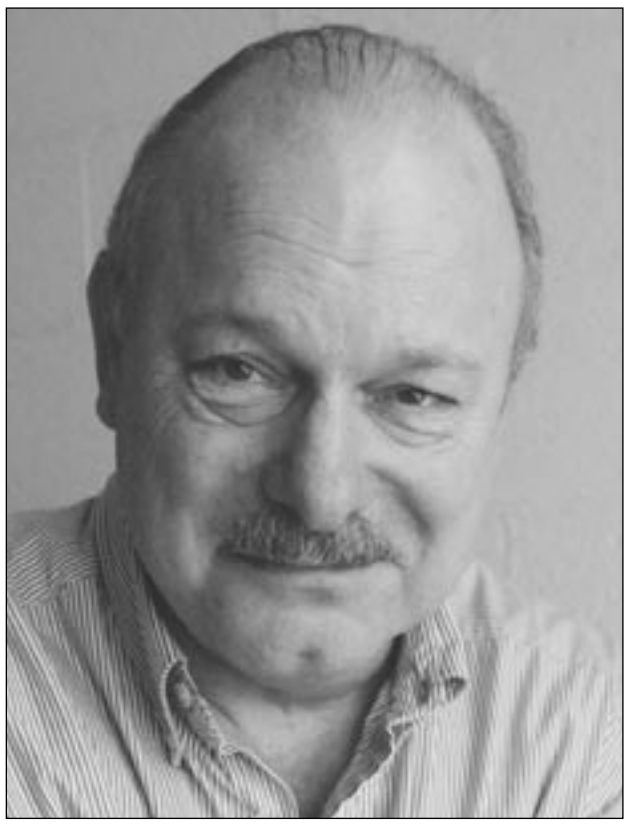


PHOTO / **DONNA COVENEY**

Vietnam veteran Joe Haldeman is the author of 'The Forever War' and 'War Stories.' He has taught writing at MIT since 1983.

Sasha Brown
News Office

At first glance, Adjunct Professor Joe Haldeman appears to be a man of contradictions—a pacifist who writes about war, a former astronomy major who has spent his career working in the arts. But for Haldeman, the author of dozens of novels, short stories and poems, complexity is what makes life interesting.

Haldeman, 63, has been writing and teaching science fiction for decades. He has been at MIT every fall semester since 1983. His most famous work, the 1975 novel "The Forever War"—a science fiction Vietnam story—has been published five times and was almost made into a movie.

Haldeman's most recent books, "A Separate War and Other Stories" and "War Stories," both published this year, also deal with combat. This semester he is also teaching a course at MIT on war novels from various genres. "War makes for a natural topic for a dramatic story," Haldeman said.

Haldeman's aim is not to glorify war—quite the opposite. He tried to register as a conscientious objector when he was drafted in 1967. He said he told the government, "I would rather spend six years in the Peace Corps than two in the army." Still, he spent 1968 serving in Vietnam as a combat engineer. His experiences did much to inform his career.

Reviews of "The Forever War" have suggested that its plot touches on Haldeman's own feelings of isolation when he was so far from home with little news or contact. Haldeman said he agrees with this assessment in many ways. "I felt like that 365 days in 1968 went nowhere. We knew very little about what was going on back home."

Though he had written two short stories while at the University of Maryland getting his bachelor's degree in astronomy, it was while he was in Vietnam that he started his first novel. He called it a heroic fantasy novel, written in linked rhymed quatrains, and he wrote it in a blank book his mother sent him for his 25th birthday. The book was lost one night when a rocket hit his empty bunker. But the novelist remained.

Haldeman, who had gone to Vietnam planning to go to graduate school in physics, returned wanting to write. Writing had always been a passion of his, and science fiction seemed like a natural progression.

He laughed recalling that his college advisor had tried to talk him out of taking a creative writing course. "They told me I needed differential equations, not fiction writing." He notes, "The opposite turned out to be true."

Haldeman has had a 40-year career writing fiction. He said he tries not to write when he is teaching—"It starts to feel like two full-time jobs"—and likes to write in the morning, waking at 4 a.m. to get a couple of hours in before the sun rises. He writes longhand, something that he knows is unusual in this technological age. He said it guarantees that a first draft is a "true first draft."

Over the years, his correspondence with his many fans has made the transition from letter to e-mail. He receives, on average, six or seven e-mails a day and tries to respond to them all. He has corresponded with some fans for years. One fan even wrote a 500-page doctoral dissertation on Haldeman's work.

Some of the most meaningful e-mails come from those considering a military career. "I've heard people say that my books have kept them from becoming soldiers," he said. "I am happy I have been able to use my experiences to do some good. There is no such thing as a good war or a bad peace."

Haldeman will participate in a gallery talk at the List Visual Arts Center at 6 p.m. on Dec. 8.

Science meets the human spirit in reading of 'On Ego'

Catalyst Collaborative at MIT (CC@MIT), a collaboration between MIT and Underground Railway Theater (URT), will present a staged reading of "On Ego," co-written by British playwright Mick Gordon and neuropsychologist Paul Broks, on Monday, Dec. 4 at 7:30 p.m. in Room 10-250.

Robert Desimone

Directed by Jon Lipsky, the reading will feature performances by Stephen Russell, Wes Sanders and Debra Wise. Supporting actors from MIT's student body will also make special appearances. The event is the fourth in a series of free, staged readings of plays exploring science.

Robert Desimone, director of the McGovern Center for Brain Research at MIT, will lead an open discussion of issues raised by the play directly following the reading. The conversation will be facilitated by Wise, URT's artistic director, and will include Lipsky, Russell and Sanders.

According to the co-authors, "On Ego" was inspired by Broks' best-selling book, "Into the Silent Land," a poetic meditation on the nature of the brain that was short listed for the Guardian First Book award in 2003.

"On Ego" portrays a neuroscientist whose experiments on a futuristic cutting edge of consciousness lead him to confront the greatest scientific and philosophical riddle of all: How does the brain construct a self? Or, to put it an earthier way, how does meat become mind?

The stakes of the dramatic conflict are raised by the passionate and complicated personal relationships among the characters—a father, a husband and a wife with slowly progressing brain cancer. Dramatically juxtaposing "ego theory" with "bundle theory," "On Ego" explores whether we are simply skin, bone and 100 billion brain cells, or feeling, loving, thinking individuals.

Gordon, who has served as director of London's Gate Theatre and associate director for the National Theater, described how a dramatist and a scientist could co-write a play.

"Not only do theater and neurology have a shared language," said Gordon, "but through Paul Broks I discovered a philosophical realm with concrete situations to explore."

According to Gordon, several of Broks' case studies of patients whose brains have been damaged through disease or accident have been incorporated into "On Ego."

"We still don't really know how the brain constructs itself. But the evidence-gatherers are the neurologists who work with people whose brains have been damaged. Although, as Paul always points out, all our brains are damaged to a lesser or greater extent—it is just a matter of degree on a sliding scale," Gordon said.

"On Ego" is a "theatrical essay," a form Gordon has been developing over 10 years with his company, On Theatre. Gordon is currently creating "On Emotions" with Broks, examining how fear response is a basis of decision-making.

Broks trained as a clinical psychologist at Oxford University before specializing in neuropsychology. He is senior clinical lecturer at Plymouth University in Britain, and his research publications cover topics including autism, schizophrenia and acquired brain disorder.

"On Ego" and "Into the Silent Land" have been optioned for a motion picture, and no full productions can take place in the United States. "On Ego" is being presented in Cambridge as a staged reading by CC@MIT under a special agreement with its authors.

For more information on the reading at MIT, please call x3-2787.

A second reading of "On Ego" will be presented on Tuesday, Dec. 5 at 7:30 p.m. at the Cambridge Family YMCA Theatre (820 Massachusetts Ave., Central Square, Cambridge).

Seating for the readings of "On Ego" is limited; no tickets or reservations are necessary.

CC@MIT will present its first full production—an adaptation of Alan Lightman's bestselling book "Einstein's Dreams"—April 19-29, 2007, at the Broad Institute as part of the Cambridge Science Festival—the nation's first city-wide celebration of science.

The Catalyst Collaborative at MIT was established to develop new plays about science.

PHOTO / **THOMAS MAXISCH**

Saxophone great Arni Cheatham, left, performed at MIT with John Funkhouser in 'Beyond: An Ellington Commemoration' in 2004. Cheatham returns Nov. 18 to play with the Festival Jazz Ensemble.

Cheatham joins MIT's jazz ensemble in 'Saxophrenia'

Amy Farnsworth
Office of the Arts

Acclaimed jazz saxophonist Arni Cheatham will make his first guest appearance with MIT's Festival Jazz Ensemble Nov. 18 in "Saxophrenia and Other Benign Maladies," a concert honoring jazz musicians.

Cheatham will be the featured soloist in "Movin' On," a piece written for him by MIT lecturer Mark Harvey. Harvey will guest conduct the piece along with "Saxophrenia," an original composition for five saxophone players.

Originally from Chicago, Cheatham discovered the saxophone during high school and started playing gigs when he was 15. He met Harvey in 1969, and the two cofounded the Jazz Coalition of Boston. When Harvey formed the Aardvark Jazz Orchestra in 1973, Cheatham was the lead alto saxophonist.

"Arni is just a phenomenal musician, and he has a great ear and a great sense, like all the really great jazz musicians do, of being able to adapt in the moment as to what the music is doing," Harvey said.

Also on Saturday, Cheatham will perform dream ballads from the 1940s and '50s.

Under the direction of Wind Ensembles director Fred Harris, the eight-member Festival Jazz Ensemble will perform a selection of works with connections to the MIT community. The ensemble will honor former director Herb Pomeroy with a performance of "The Quiet Words of the Wise," by musician and film composer Jamshied Sharifi (S.B. 1983), who led the Festival Jazz Ensemble from 1985 to 1993. The concert will also feature Herbie Hancock's "Cantaloupe Island," arranged by former MIT artist-in-resident Guillermo Klein, and Duke Ellington's "Walking in Rhythm," dedicated to Harvey, a longtime Ellington scholar.

The concert begins at 8 p.m. in Kresge Auditorium. Tickets are $5 at the door. For more information, call x3-2826.

MIT Sloan students climb to great heights

Ropes course, leadership training offered during innovation period

Sarah Foote
MIT Sloan School of Management
and
Amy MacMillan
Leaders for Manufacturing Program

Think climbing up a 25-foot rock wall is easy? Try doing it blindfolded!

Sloan students got a chance to try just that during a course called "Obstacles, High Ropes, Leadership and Teams" offered during the Sloan Innovation Period (SIP). The course gives students a mental and physical workout—and dramatically demonstrates the value both of precise instructions and of listening carefully. Although each climber is harnessed and tethered to someone standing on the ground, one missed step can leave a student dangling 20 feet in the air.

SIP was created three years ago to give M.B.A. students the opportunity to hone their leadership skills and take advantage of research workshops halfway through each semester. The MIT Leadership Center works with M.B.A. Student Affairs and MIT Sloan faculty every year to create new offerings. This year's courses, held Oct. 23-27, included "Bosnian Peacekeeping Force," "Leadership as Acting" and "Jamuna Bridge." Students learn from senior executives, build skills and reflect.

Ben Zander, conductor of the Boston Philharmonic, was one of this year's guest lecturers. His students were treated to a two-hour-plus presentation called "Leadership and the Art of Possibility."

An animated speaker, Zander acted out the three responses a person can have toward a dilemma—slumping his shoulders, making a fist and then throwing his hands in the air. "There is no problem that cannot be solved if you make a new framework for it," he said. "And the next time you make a mistake, don't complain, but shout out: 'How fantastic!' You will never learn anything in life unless you make mistakes."

Zander's father, who fled Germany during the Holocaust, never complained about his struggles or tragic background, Zander said. If the weather was bad, his father would say, "There is no such thing as bad weather—only inappropriate clothing." On his deathbed, his final words to one of his sons were, "What can I do for you?"

Zander's message? The secret of life is attitude.

He augmented his talk with several piano bits and a cello performance by one of his New England Conservatory students. The session ended with students singing Beethoven's "Ode to Joy."

There was also joy in the ropes class. Carrie Sampson Moore and Tim Moore not only helped students overcome a fear of heights, they helped them build communication skills.

At the beginning of the seminar, students worked together to build trust by falling backward into each other's arms. They also learned how to use the climbing equipment and got a few safety tips.

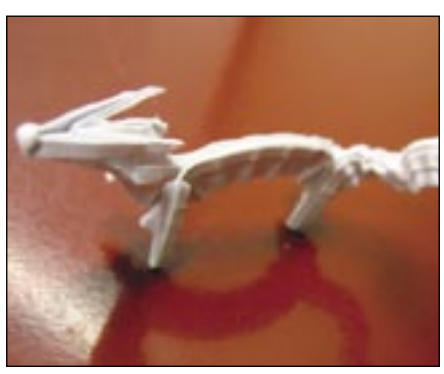
As they progressed, the students were able to scale a rope ladder and cross a rope bridge. And as each participant conquered the hardest part of a task, fellow classmates applauded. Everyone shared in the joy.

PHOTO COURTESY / **MIT SLOAN**

MIT Sloan students took on trust-building exercises with one another and confidence-building tasks, including a ropes course, during Innovation Period.

Art in creases

Insects, monsters, a dancer and a beaver are among the new residents of the Wiesner Student Art Gallery—and each is a marvel of engineered folding. All 27 entries from this year's Student Origami Competition are on display, including the eight winners of such prestigious awards as Best Miniature Origami and Best Movie-Inspired. The work will be on display through Nov. 30 in the gallery on the second floor of the Stratton Student Center. The gallery is open 24 hours a day.



Dramashop presents trio of one-acts

Joanna Michalowski
Office of the Arts

It can be tough to find common ground between aeronautical and astronautical engineering and theater, but sophomore Ashley Micks finds they complement each other nicely. Science, she says, helps her experience "what's within my reach," while playwriting and directing allow her to "imagine what isn't."

The double major is directing one of three plays being performed this week (Nov. 16-18) during Dramashop's annual evening of student-written, student-directed one-act plays.

Micks, who discovered the co-curricular theater group during her freshman year, will direct "Roommates" by graduate student Hubert Pham. The play examines an introvert's reaction to the "invasion" of his home by a new roommate, who comes complete with a girlfriend, a dog, two hunting guns and an intriguing past.

"The show has a dark twist but doesn't take itself too seriously," Micks says. "It should be funny but still hit a dissonant chord."

Micks says the most important thing about directing is confidence. "Know what you're doing. Or at least act like you do, convincingly, and figure it out very quickly!"

Micks prepares by reading through the script multiple times, figuring out subtexts, character motivation and anything else that's hidden within. She says this is where her faculty advisor really helps, by drawing her attention to possibilities she hadn't noticed and helping her get faster at finding them on her own.

Micks and her fellow student directors are each matched up with an advisor, although it is the student director who determines the dynamic. Although some students choose to ignore their advisors completely, Micks says she prefers working closely with hers. "I want to improve as much as possible as a director, and consulting someone with years of experience definitely helps."

In addition to "Roommates," the performance will also include "Black Boxes," written by senior Adam Love and directed by senior John Glowa, and "77," written by graduate students Rony Kubat and Emilie Slaby and directed by Love.

In "Black Boxes," three fragments of the playwright's consciousness—his inner child, his angst-ridden teenage self and his higher-level thoughts—struggle with each other and the big questions of existence.

"77" is about a privileged high school senior who, after being kicked out of her boyfriend's apartment, meets a surprisingly wise man who lives next to a dumpster.

Performances of "Student-Written, Student-Directed One-Acts: A Dramashop Production" will take place Nov. 16 to 18 at 8 p.m. in Kresge Little Theater. Admission is free and open to the public.

PHOTO COURTESY / **DRAMASHOP**

In "Roommates," by graduate student Hubert Pham, an introvert adjusts to his gun-toting, dog-owning, partnered new roommate. Director Ashley Micks focuses on the one-act play's subtle humor and its unsettling 'dissonant chord.'