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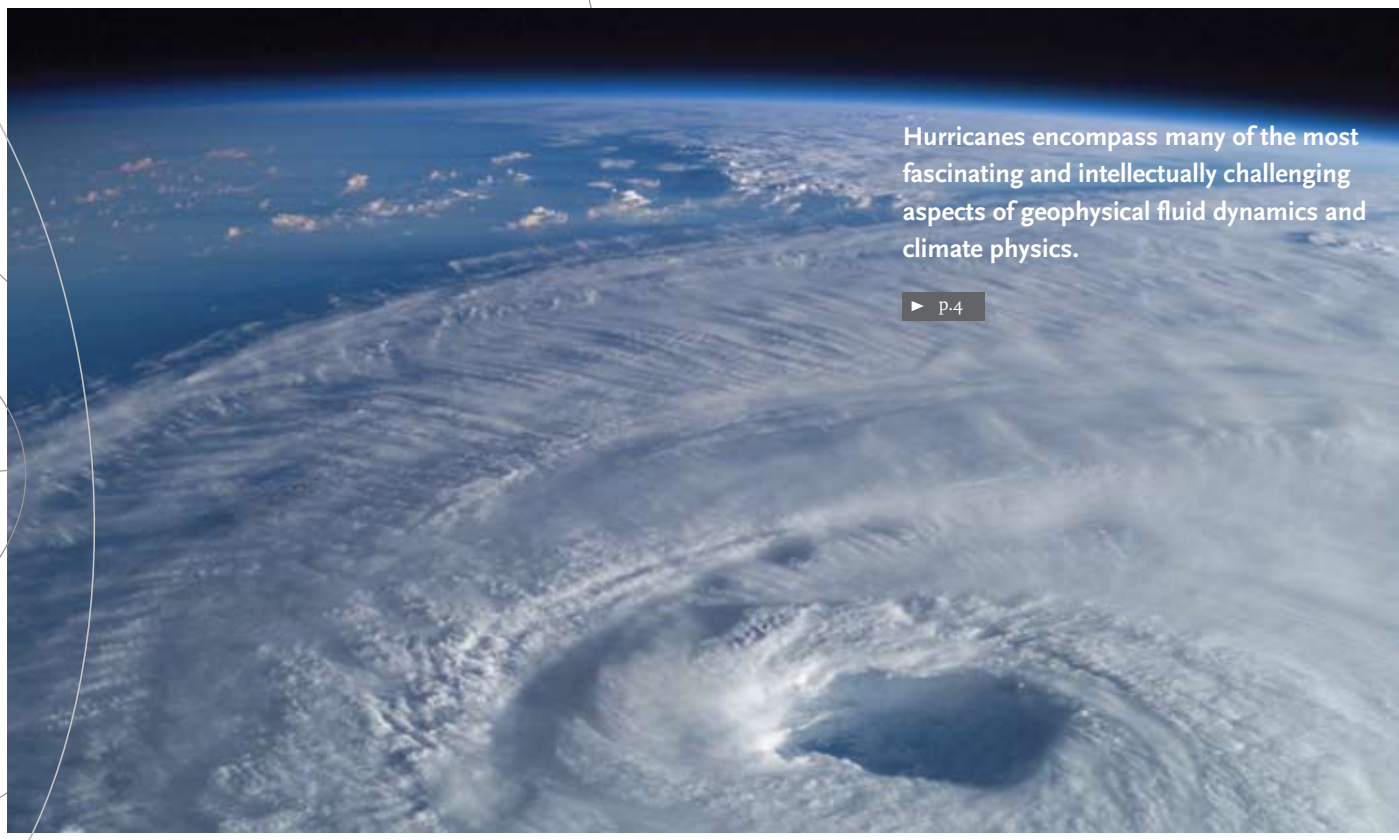

Hurricanes encompass many of the most fascinating and intellectually challenging aspects of geophysical fluid dynamics and climate physics.

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Letter from Marc Kastner

Marc Kastner, Dean MIT School of Science, Donner Professor of Physics

Dear Friends,

A year has passed since I became Dean, and I feel like an MIT freshman—drinking from the fire hose. It seems as though every day I learn about some new discovery by our faculty and students. I am more impressed than ever with the amazing enterprise that is the MIT School of Science. I am impressed with the size of effort—there are about the same number of faculty members, graduate students and undergraduates in the School of Science at MIT as in all of Cal Tech. And I am impressed with the quality of the effort—we have had 10 Nobel Prize winning faculty members since 1990, and many other prestigious awards for our faculty and our students.

(continued on following page)

Whenever I visit one of our faculty members to learn about their research, I am awe-struck. For example, in this issue there is an article by Kerry Emanuel on his work showing the relationship between average water temperature and hurricane intensity. When I visited Kerry, I asked him how he got the data. He told me that he gets on an airplane and flies into the hurricane! I could not imagine doing research that way.

Despite our success, there are great challenges facing the School. The role of the research university in the United States is in a state of flux, not seen since the 1950's, and nowhere is this more evident than at MIT. The world looks to us to find solutions to the greatest problems facing mankind. Some of these are fundamental in nature, such as the properties of dark energy and dark matter, and others are crucial to the quality of life on our planet, such as renewable energy, cancer and other diseases. However, the partnership between universities and the federal government, which has been so successful in solving problems over the past 50 years, is breaking down. Federal funding for the physical sciences has not grown since the end of the cold war, and funding for the life sciences has been flat for five years. As Dean of the MIT School of Science, it is my job to help our faculty and students to apply their enormous talents to the great challenges of our time. But adapting to this new era will require a new model for how we operate and the financial support of our alumni and friends. I urge you to join me in meeting this challenge.

Sincerely,
Marc A. Kastner

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Koch Institute for Integrative Cancer Research

Construction Begins for New Koch Institute Building

MIT broke ground on March 7, 2008 for the building destined to house the new David H. Koch Institute for Integrative Cancer Research. Grown out of the Center for Cancer Research, which by itself has thirty years of important discoveries and five Nobel Prize winners to its credit, the Koch Institute will be the first of its kind to combine research in biology and engineering. New approaches to cancer research are needed because, while progress has been made, the available treatments of cancer are simply not as effective as treatments for many other diseases. Every year, cancer claims the lives of more than eight million people worldwide. "The Koch Institute will change the face of cancer research, not just at MIT but worldwide," said Dr. Tyler Jacks, Director of the Koch Institute. "By having expert cancer biologists who are working on trying to understand the disease at a molecular level interacting closely with engineers who are working on solving cancer-related problems, we will rapidly deliver improvements in cancer care."

An artists rendering of the Koch Institute. The building will be completed in 2010.

Discovering What Makes Cancer Drugs Work

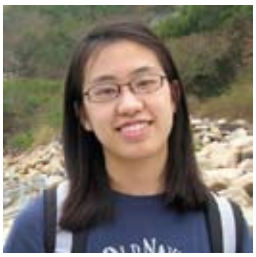
Noel Lee,
Department of Chemistry, Class of 2008

When I first came to MIT, I knew barely enough chemistry to work with the mathematical calculations for determining masses, moles, and percents within a chemical equation. I had no understanding of what scientific research entailed, but I did know that the Undergraduate Research Opportunities Program (UROP) was one of the most exciting aspects of MIT, and I would not pass up the chance to get involved. Given my rough start with 5.111, the introductory Principles of Chemical Science class, I never thought I would work in a chemistry lab.

My organic and inorganic chemistry classes, however, immediately sparked my unexpected love for the subject. I read about all the research in the Department and, in April 2006, asked Stephen Lippard, Arthur Amos Noyes Professor of Chemistry, for a UROP project. For the next year and a half, I studied the intriguing inorganic compound cisplatin (pronounced sisplatin), best known as a promising chemotherapy drug.

The history of cisplatin includes slow yet significant strides. Although it was first synthesized in 1845, its anti-tumor properties were not discovered until around 1970. Since its approval by the US Food and Drug Administration in 1978, this platinum containing drug, which has been called the "penicillin of cancer drugs," has become one of the most widely prescribed treatments for many cancers, including ovarian and lung cancers. Cisplatin also boasts a greater than 90 percent cure rate for testicular cancer; it helped Tour de France winner Lance Armstrong, among many others, fight this disease.

Despite the success of cisplatin in chemotherapy, the specific action of its biological activity is still unknown. Studies confirm that cisplatin interferes with the growth of cancer cells, slowing their advance in the body by binding to cancer cells' DNA and damaging it. The resulting bending and unwinding of the DNA disrupts transcription and replication in the cell, signaling repair proteins that respond to the damage. Some repair mechanisms are successful and allow the cells to survive; others fail, forcing the cells to die.



Noel Lee

Identifying the proteins that recognize and respond to the DNA damage is central in understanding the effectiveness of cisplatin as a cancer drug and may also improve the design of future anti-tumor agents. In my UROP with graduate student mentor Evan Guggenheim, I helped synthesize DNA probes with the photoactive chemical benzophenone and conduct experiments to identify proteins that bind to DNA both with and without damage. We identified a number of proteins in this manner. Experiments are under way to separate and isolate these DNA-benzophenone-protein complexes. Other techniques will then be used to identify the proteins so their roles in the cellular response to cisplatin can be investigated.

In the Lippard lab, I learned not only about cisplatin but also about scientific research: the patience and dedication, the frustration and reward, the independence and collaboration. Through reports and lab presentations, I learned about the importance of effective and clear communication. Research is challenging and fulfilling. Luckily, I had an excellent graduate student mentor and supportive lab mates. Research requires a balance between focusing on small yet important experimental details and remembering the larger picture. I will always value my UROP experience. I came to MIT dreading chemistry. Four years later, I sense my new intuition and confidence. I continue to ask questions and find answers. As I prepare to enter medical school, I often wonder about my future. Still surprised that I have come to love a subject I once hated, I ask, "Which specialty might spark my interest?" And I wonder what we will know about cancer by the time I am a doctor, able to prescribe a drug like cisplatin.

" I will always value my UROP experience. I came to MIT dreading chemistry. Four years later, I sense my new intuition and confidence. I continue to ask questions and find answers."

RESEARCH

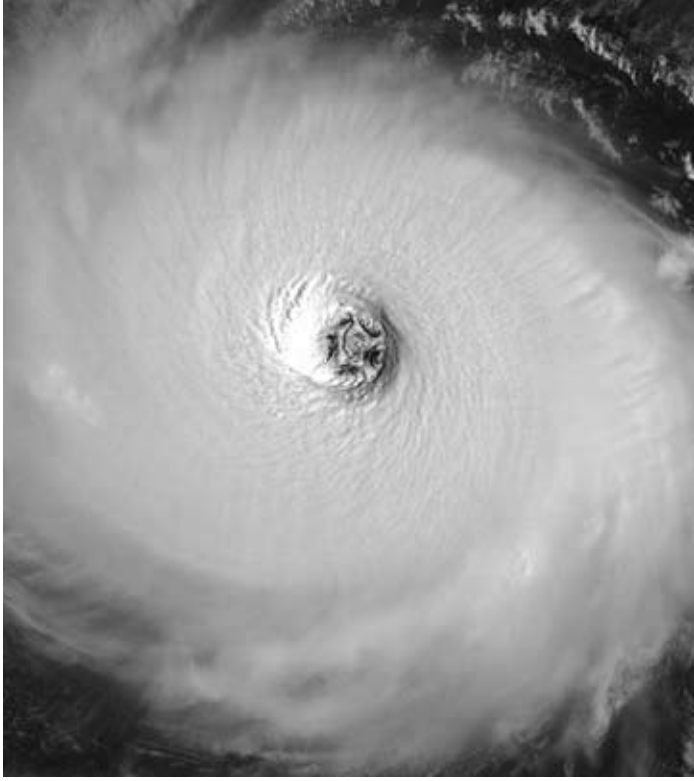
The Eye of the Storm:
Hurricanes and Global Warming

Kerry Emanuel

Hurricanes encompass many of the most fascinating and intellectually challenging aspects of geophysical fluid dynamics and climate physics. Although hurricanes are usually discussed in strictly practical terms—how to improve forecasts, for example-- they are in fact sublime examples of a real-world physical phenomenon worthy of admiration by those of us who are interested in nature for its own sake.

One of my principal research interests over the past two decades has been the physics of hurricanes and their possible role in regulating climate. Most discussions of hurricanes and climate regard these storms as responding passively to climate change, but more recent evidence suggests that hurricanes may play a strong and fundamental role in the climate system. My interest in hurricanes began, as is often the case with me, with an early attempt to teach graduate students about hurricanes as part of a course in tropical meteorology. In preparing the course, I realized I did not really understand the extant theory behind what powers these storms, and shortly thereafter came to the conclusion that the theory was wrong. So I set about coming up with a correct theory, which I later discovered had been mostly, but not completely, worked out by an earlier group of scientists whose work had fallen into disfavor.

It is now universally recognized that hurricanes are powered by the transfer of heat (enthalpy) from the ocean to the atmosphere when sea water evaporates, and that most of this evaporation takes place in a narrow annulus of very strong winds under the storm's eyewall. Hurricanes intensify when increasing winds lead to increasing sea surface evaporation: the added heat flow increases the storm's intensity and further increases the surface wind speed. While the heat transfer from the sea increases nearly linearly with wind speed, frictional dissipation of wind energy increases as the wind speed cubed and so eventually overtakes the generation of energy owing to the heat input from the ocean. When this happens, the storm reaches a steady-state balance.



Defense Meteorological Satellite Program (DMSP) image of Hurricane Isabel at 1315 UTC (8:15am EST) September 12, 2003.

The energy balance of a mature hurricane can be conceived of as a nearly perfect Carnot heat engine, converting some of the heat acquired from the ocean to wind energy.

Air spiraling inward near the sea surface, toward the low pressure center, experiences nearly isothermal expansion as it acquires enthalpy from the ocean. It then turns and rises up the eyewall clouds very nearly moist adiabatically. (A moist adiabatic process is one in which no heat transfer occurs, although there are internal conversions between latent and sensible heat.) After flowing out at the top of the storm, the air eventually loses the enthalpy it acquired from the sea surface by radiating it to space in the infrared; this again occurs at the nearly constant temperature of the lower stratosphere.

Finally, the air descends back to the sea surface. The mean temperature of the sea surface, at which the heat is acquired, is around 300 K, while the mean temperature at which the heat is lost by infrared radiation is close to 200K, giving a Carnot efficiency of about one-third. By equating the mechanical energy generation by the Carnot engine to frictional losses in the atmospheric boundary layer, an upper bound on the wind speed in a hurricane is derived, and this proves to be an accurate predictor of maximum storm intensity in the real world.

Kerry Emanuel

"... more recent evidence suggests that hurricanes may play a strong and fundamental role in the climate system."

Real storms seldom reach their theoretical potential, though. Because their development time scale is measured in days, they often pass over land or cold water before they have had a chance to reach their potential intensity. More importantly, the sea surface temperature seldom remains constant as storms pass overhead. Strong ocean currents are produced by the extreme stress exerted by the wind on the sea surface, and these currents break down into turbulence, which in turn stirs cold water to the surface. (The layer of warm water that sustains hurricanes is usually only around 50 m thick; below this, water temperature decreases rapidly with depth.) A 2.5 K decrease in sea surface temperature under the storm's eyewall is sufficient to shut down the Carnot engine entirely, so even a 1 K cooling will have a strong influence on the storm's maximum winds. In satellite infrared imagery we observe cold "wakes" behind hurricanes, with temperature depressions of as much as 5 K. Thus to forecast hurricane intensity, we need, among other things, to use atmospheric models that are coupled with models of the upper ocean. A major limitation in our ability to skillfully forecast hurricane intensity is that we do not in practice observe the upper ocean temperature very well.

Hurricanes have been shown to respond quite sensitively to comparatively small changes in regional climate states. For example, Atlantic hurricanes are known to be strongly suppressed by conditions associated with El Niño events. More recently, it has become apparent that hurricane power, over time scales of several years or more, is strongly correlated with ocean temperature, which has been increasing owing to the global warming phenomenon. Human-induced climate change, rather than naturally occurring ocean cycles, may be responsible for the recent increases in the power of North Atlantic hurricanes.

It now appears that global hurricane activity may contribute to the oceans' thermohaline circulation, which transports vast quantities of heat from the Tropics to higher latitudes. Increasing planetary temperature would, in principle, lead to more powerful storms, which would then induce a stronger flow of heat out of the Tropics. This would serve to cool the Tropics, thereby acting as a negative feedback on tropical climate change, but at the same time accelerate the warming of middle and high latitudes. We have just published a paper suggesting that this mechanism might explain important features of very warm climates of the past, such as the early Eocene period, about 50 million years ago. Paleoclimate evidence shows that during such episodes, the earth's poles were very warm— as high as 15-20 C— but at the same time, the equatorial regions were only slightly warmer than today.

There are many other interesting physical aspects of hurricanes, far more than can be reviewed here. The eyewall, for example, is an instance of an atmospheric front, whose dynamics are in many ways similar to those of shocks and hydraulic jumps. And at hurricane-force winds, the sea surface itself becomes emulsified, with bubble-filled water giving way continuously to spray-filled air. Heat and momentum transfer through such an emulsion— critical pieces of the overall storm physics— remain largely unsolved problems. Research efforts continue to shed light on the complex physics of these powerful storms.

View of the eyewall of Hurricane Katrina taken on August 28, 2005, as seen from a NOAA P-3 Hurricane Hunter aircraft before the storm made landfall on the United States Gulf Coast. (Courtesy National Oceanic and Atmopheric Administration)

NASA image of Hurricane Katrina from August 28, 2005

DONOR PROFILE

Ally of Nature

Audrey Buyrn and Alan Phillips

Audrey Buyrn '58 and Alan Phillips '57 have established the Ally of Nature Fund and challenge others to help preserve the biodiversity of the planet.

Audrey at a lake in the Sierra (California). 2007

Audrey and Alan on the summit of Cerro Toco, a small peak in the Chilean Andes. 2007. 18,341 feet.

The 'Aha!' Moment

In October 2007, Alan and Audrey were snowbound in a tent high in the Colorado Rockies. Reading "The Making of the Fittest" by Sean Carroll, Audrey came upon the following sentence,

> **"The war on Nature has been waged with increasing intensity over the past fifty years, but few powerful allies have come to her aid."**

She read the sentence out loud to Alan, and it "clicked" for the two of them. At that very moment they decided to establish the Ally of Nature Fund, dedicated to funding exploratory projects to prevent, repair, and ameliorate the adverse impacts of humans on the natural environment.

When Audrey entered MIT in 1958, she was one of 22 women in her class. "It was the pre-feminist era and MIT was largely unconscious of us as anything special." Other than the Margaret Cheney Room, a small dorm on Baystate Road, and Mrs. McCormick's taxi fund, there was no special treatment of women students, which "was exactly as it should have been," according to Audrey. "As for the absence of 'role models' I think most of us had a model in our heads of what we wanted to be. But it is inarguable that MIT is now both a better place for women students and a better place overall because women are well represented throughout MIT."

Alan commuted to MIT and really only knew the physics majors. He and Audrey met as nuclear physics graduate students working with Professor Lee Grodzins on experiments using the Mossbauer effect. They were among the many who worked in the "permanent temporary" Building 20.

After receiving their doctorates, Audrey taught math and physics at a junior college in New Jersey while Alan was at Princeton. After four years, they left the east coast for Lawrence Berkeley Laboratory. They started backpacking at Berkeley. "We became 'bare granite freaks,' falling in love with the Sierra above timberline, with its polished granite cut by rushing streams, its flowers and animals, and its enormous skies."

Since that time Audrey and Alan's interests have been focused on the environment and wildlife. "We had been more and more concerned about man-made climate change. We saw old friends like the St. Vrain Glacier, Conness Glacier and Lyell Glacier shrink. We saw the destruction wrought by bark beetles in the Sierra, who can now survive the winter. We've read of the declining krill populations which are the basis of the Antarctic food chain."

"Over the next three years, we will match, dollar for dollar, up to $500,000, contributions others make to the Ally of Nature Fund."

With successful careers behind them, Alan with SAIC and Audrey with the Office of Technology Assessment (OTA), the couple decided it was time to redo their wills. They knew they wanted to leave money to MIT "in gratitude for the life it made possible for us." Audrey says she "never had to prove that I was serious about my work. The fact that I had an undergraduate MIT degree, and also a PhD from MIT, proved that for me. I wore the brass rat to all important meetings with strangers."

Audrey and Alan did a little research and learned that MIT faculty and students were working in many of the areas that interested them. They decided to establish the Ally of Nature Fund and then chose to fund it during their lifetimes. "Why wait until we are dead to have the fun of making a difference, even a small difference?"

They also established an MIT charitable remainder unitrust, or CRUT, and invested in the MIT endowment. As a result of their decision, made possible by a new IRS ruling, the unitrust will grow at the same rate as the MIT endowment, providing them with variable income and the Ally of Nature Fund with a further source of support. They plan to add to the unitrust in the future, increasing the Fund's ultimate impact.

Appearing from left to right:
Marc Kastner, Maria Zuber, Alan Phillips '57, Audrey Buyrn '58, Ed Bertschinger, and Ron Prinn at a luncheon celebrating the creation of the Ally of Nature Fund.

In addition, Audrey and Alan have offered to match another $500,000 if others contribute to the Fund. "We deliberately left our names off the Fund, because we hope that others will want to contribute. It is not our Fund; it belongs to everyone who is worried about what humans are doing to our only current home."

Reducing Humankind's Ecological Footprint

You can double the effect of your support by participating in the Ally of Nature Fund. For the next two years, Audrey and Alan have offered to match all incoming gifts up to $500,000, making your contribution twice as valuable.

Long time backpackers in the Sierra and the Rockies, the fund creators have seen first-hand the impact man has had upon nature in the form of shrinking glaciers and warmer temperatures; they seek partners to help reverse this unfortunate trend. They established the Ally of Nature Fund to support exploratory projects with a goal of preventing and/or repairing the adverse impact of humankind on our natural environment.

The first grant will go to Professor Ron Prinn, a long time leader in the field of quantitative analysis of climate change and a strong advocate for the role of public policy in solving environmental problems. Every day he works to reduce humankind's ecological footprint.

Prinn, the TEPCO Professor of Atmospheric Science in the Department of Earth, Atmospheric and Planetary Sciences (EAPS), and Director of the Center for Global Change Science (CGCS), is currently involved in a wide range of projects in atmospheric chemistry and biogeochemistry, climate science, and integrated assessment of science and policy regarding climate change.

Brain and Cognitive Sciences

How Does the Brain Think about the Mind?

On February 22, 2008, over 80 friends and alumni braved the morning snow to hear Rebecca Saxe's lecture, "Uniquely Human Social Cognition: How the Brain Thinks about the Mind." Saxe, the Fred and Carole Middleton Career Development Professor and Assistant Professor of Cognitive Neuroscience in the Department of Brain and Cognitive Sciences, shared with the audience some of her recent groundbreaking research on the uniquely human ability to interpret others' thoughts. Though it's impossible to observe thought directly, Saxe uses Functional Magnetic Resonance Imaging (fMRI) to measure blood flow to parts of the brain triggered by cognitive processes. Saxe identified the right temporoparietal junction as specialized for thinking about other people's thoughts.

Saxe entertains questions from a crowd of attendees including from left to right, Clark Abt '51, Daniel Blitz '40 and Mike Speciner '68

Dean Kastner and Rebecca Saxe '03 at the SoS Breakfast.

Nancy Kanwisher, the Ellen Swallow Richards Professor of Brain and Cognitive Sciences at MIT and Saxe's PhD thesis advisor, considers Saxe's findings to be especially remarkable, because many in the field of human cognitive neuroscience "doubted that an abstract high-level cognitive process like understanding another person's thoughts would be conducted in its own private patch of cortex."

Saxe's research has important implications in understanding conflict between groups. In a future study, Saxe plans to explore how children learn to view groups in long-term conflict with their own group, such as Muslims and Serbs in the former Yugoslavia or Sunnis and Shiites in regions of the Middle East. After identifying brain regions that are active while people think about members of the conflict group, Saxe and her postdoctoral associates hope to track changes in brain activity after mediation efforts, such as peace camps that bring together children from groups in conflict.

The lecture sparked a lively question and answer session, particularly concerning new directions of her studies and her findings in those with autism. One audience member, however, was more concerned with Saxe's assumption that the MIT undergraduates participating in her study constitute a "normal" cross-section of society; Saxe assured the audience that, regardless of the typical MIT student's heightened intelligence, Harvard and Boston University students exhibit the same patterns of brain activity in her experiments.

Biology

Culturing Collaboration: New Microbiology Program Brings the Disciplines Together

This fall, MIT welcomes its first class of graduate students to the Microbiology Graduate PhD Program. The Institute is uniquely suited to the creation of a microbiology program, since many laboratories in a wide range of disciplines at MIT pursue research

on microorganisms. But until now, there have been few formal channels for interdisciplinary research and education. More than 50 faculty members from 10 MIT departments and divisions will participate in the program, giving the graduate students access to such areas of expertise as cell and molecular biology, pathology, immunology, environmental biology, oceanography, computational biology, synthetic biology, and chemical engineering. Alan Grossman, the director of the program, anticipates that the participation of microbiology PhD candidates in laboratories in these areas will create synergistic research opportunities, benefiting both students and the research projects in which they participate.

Demand for interdisciplinary approaches in microbiology is growing because of the tremendous potential for the use of microbes in the development of new technologies. For example, several MIT laboratories are in early stages of research of microbial energy generation. Microorganisms are especially well-adapted to catalyze a variety of difficult and complex chemical reactions, such as photosynthesis, methane-methanol conversion, nitrogen fixation, lignocellulose degradation, and ethanol production (to name just a few). As more is known about the sophisticated catalytic machinery of microbes, it may be possible to harness some of these processes to meet the increasing global demands for energy. The cooperation of different disciplines in life sciences, chemistry, and engineering could very well facilitate important discoveries in this area.

Not only will the Microbiology Program facilitate the vital exchange of ideas across disciplinary boundaries, but it will train graduate students in the broad range of intellectual approaches and technical skills necessary to adapt to a quickly advancing field of study and to become effective teachers of new generations of microbiologists. Professor Grossman believes that such a comprehensive program of study is essential for the long-term success of the graduate students and the field in general: "No one could have predicted current advances in the field 10 years ago; now, we can train students to attack problems that come up in 10 or even 20 years." In order to further that success, Grossman hopes that the program will be able to expand the one year of MIT funding the graduate students currently receive to the two years of central funding commonly offered by competing institutions. Increased central funding will help the program to attract the most competitive students, relieve junior faculty from some of the pressure of funding new labs, and foster more research opportunities and a more supportive environment for graduate students.

Honoring Lisa Steiner, Biology's First Woman Faculty

Lisa Steiner, Professor of Biology was honored at a special luncheon by her friends and colleagues at the MIT Faculty Club on May 22nd. Lisa Steiner was the first woman to join the MIT biology faculty here at MIT in 1967. Her picture is displayed in the MIT Kendall T stop (twice) as part of MIT's history.

Lisa Steiner is an accomplished violin player who performed in the Cambridge Symphony, and an avid runner and hiker who can outpace any person 1/3 her age. She escaped from Vienna with her mother as a very young child, days before the Nazis invaded Austria. Her family relocated to Queens, NY where she attended Forest Hill High School. A straight 'A' student, a math whiz, and a winner of the prestigious Westinghouse science competition, she did not please her mother, "because life is not full of "A's." Steiner was a math

Department Head Chris Kaiser with Lisa Steiner

major at Swarthmore College when she decided to apply to graduate school. The best math department in the country at that time was at Princeton, but Princeton did not accept women. "It bothered me a very small amount. I shrugged my shoulders and said: "Well I'll go to Harvard." After her first year she exhausted the math courses at Harvard and biked to MIT to take topology classes. Graduate school not being quite what she expected, Steiner applied to medical school and received an MD from Yale. After a short time, she found making discoveries in a laboratory far more intellectually stimulating than clinical work. Intrigued by the workings of the immune system, she pursued research in immunology. She was the only woman in 1962 to be awarded the very prestigious Helen Hay Whitney Fellowship to conduct research in immunology under the mentorship of Herman Eisen, then chair of the Department of Immunology at Washington University School of Medicine. Steiner has been a member of the Board of Trustees of the Helen Hay Whitney Foundation for 25 years and is currently serving as Vice president of the Board of Trustees of the Foundation. She met Chris Kaiser for the first time when he was selected as a Helen Hay Whitney Fellow. Kaiser, now head of the Biology Department, presented Steiner with a plaque in recognition of her outstanding service to the Department. Accepting her plaque, Steiner said, "I have been very fortunate to be in this wonderful Department and Institute and work with such wonderful colleagues, who have become my extended family. It has not always been easy, but life is not always easy."

For many years, Steiner was a role model and inspiration to the few female graduate and undergraduate students in the Department of Biology. The department has come a long way since she was first hired, and now has more than 28 percent female faculty, 50 percent female graduate students and more than 65 percent female undergraduate biology majors.

Events

Paul Schimmel '67 returned to MIT in April to give the annual Alexander Rich Lecture. Schimmel's talk was entitled, "Genetic Code Development and Connection to Disease." Schimmel, a member of the MIT faculty for 30 years, is currently the Ernest and Jean Hahn Professor of Molecular Biology and Chemistry at the Scripps Research Institute in La Jolla, CA.

Mark your calendar for November 14, when Lenny Guarente, Novartis Professor of Biology will be speaking in our School of Science Breakfast Series on aging and the health benefits of a calorie restricted diet.

Chemistry

Using the Sun's Energy at Night, Nocera Unleashes Solar Potential

Because of rapidly increasing global energy needs and climate change, the need for clean, alternative sources of energy is dire. Dan Nocera believes he has found the solution: solar energy. More energy from the sun hits the earth in one hour than we use globally in one year. Working in conjunction with MIT professors Christopher Cummins and Jonas Peters as part of a NSF-funded solar project, Nocera is harnessing the sun's energy as fuel by creating artificial photosynthesis outside the leaf. The researchers have built a device that mimics photosynthesis, splitting water into oxygen and hydrogen when sunlight hits the device. The hydrogen can then be used to power fuel cells when there is no sunlight. Much more research needs to be done to make this technology practically and economically viable, but Nocera hopes that in 10 or 15 years solar panels based on photosynthetic technology can be used to make a house "its own power station."

In the fourth School of Science Breakfast on May 23, 2008, Nocera announced that MIT was patenting the artificial photosynthesis technology that very same week.

Dan Nocera at the School of Science Breakfast explaining his recent discovery of efficient conversion of solar to chemical energy.

MIT hopes to transform solar power from a theoretical possibility into an affordable, dependable, mainstream energy solution. MIT has expressed its commitment to the promising future of solar energy with the launch of the Solar Revolution Project (SRP). Nocera will direct the project. Funded by a $10 million gift from the Chesonis Family Foundation, the SRP will explore new materials and systems that could dramatically accelerate the availability of solar energy. The SRP will complement and interact closely with other large solar projects at MIT, creating one of the largest solar energy clusters at any research university. Attending the talk were Bob Metcalfe, Dennis Shapiro, Joe McNay, Tenley Albright, Frank Laukien, Harold Brown, and Arthur Goldstein.

Women in Chemistry Honor Building Conservation Expert

The Women in Chemistry were delighted to welcome Judith E. Selwyn, SM '69 and PhD '71 in Physical Chemistry to their monthly luncheon on Tuesday, March 4, 2008. She shared with the group her distinguished career path after MIT.

Selwyn is a nationally known expert in the conservation of historic building materials. As President of Preservation Technology Associates, Inc., she has overseen the restoration of historic masonry for structures at Harvard, Yale, Wellesley College, Smith College, the U.S. Naval Academy and MIT. Her other projects include the Massachusetts State House, the Gardner Museum, and Faneuil Hall.

Dr. Selwyn knows the Department of Chemistry's Building 18 uncommonly well. During the renovation of this I. M. Pei building in 2000–2003, she was engaged by architects at Goody Clancy and Associates to share her expertise in the conservation of concrete.

Department Head Tim Swager with Frank Laukien '84 at the breakfast on May 23, 2008 after Dan Nocera's talk.

Judith Selwyn with the Women in Chemistry Group

Endicott House Celebration

Several alumni joined the Chemistry Department for their year-end celebration at Endicott House on Sunday, June 8, 2008. The MIT Endicott House is a 1934 mansion surrounded by 25 acres of magnificent gardens and grounds. Attending friends and alumni included Stephen '69 and Marian Carlson, John '72 and Katy Dolhun. Mrs. Satoru Masamune, Arthur Obermayer '56, Judith '71 and Lee '69 Selwyn, Eveyln Shen '90 and her father, T.Y. Shen, all shared a relaxing lunch with the chemistry faculty in the tranquil setting.

Lee '69 and Judith Selwyn '69 and '71, with Tim Swager and Arthur Obermayer '56 at the Endicott House

EAPS

EAPS Celebrates 25 Years of Achievement

Today, it is commonly accepted that understanding how our planet works requires investigation of all its fundamental components. But twenty-five years ago, the departments that studied the fluid and solid parts of the earth were largely separate, and, at many institutions, this is still the case. Not at MIT, however. In 1983, the Department of Earth and Planetary Sciences and the Department of Meteorology and Physical Oceanography merged to form Earth, Atmospheric and Planetary Sciences, advancing MIT to the forefront of interdisciplinary thought and catalyzing major advances in global tectonics and climate, among many other aspects of Earth and planetary dynamics.

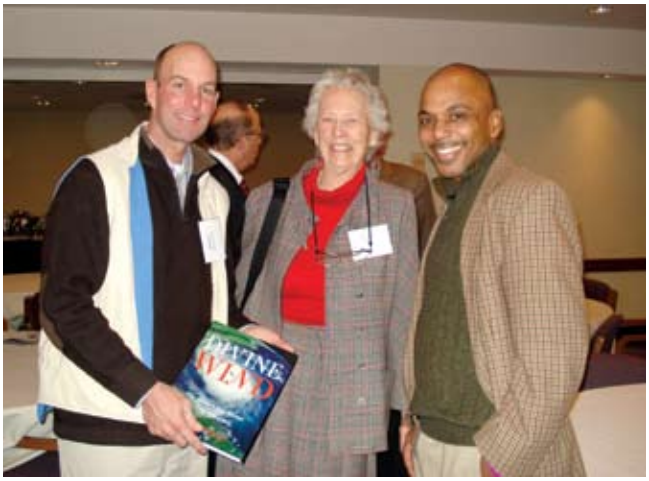
Bob Johnson '63, David Bacon '77, Kerry Emanuel at the EAPS 25th Anniversary Symposium

Symposium Speaker Stephen Schneider and EAPS Professor Paola M. Rizzoli at the EAPS 25th Anniversary Symposium

On June 4, 2008, the Department celebrated its 25th anniversary with a full-day symposium featuring talks by professors from around the country working in a variety of disciplines. President Susan Hockfield welcomed the more than 100 attendees, remarking on the Department's unsurpassed ability to "to push the outside edge of the science – and also to help the public begin to understand these grand public issues in terms of their complexity and their consequences." Moreover, Hockfield commended the Department for its integrity "in leading the public conversation on matters that don't easily accommodate society's fleeting attention span and its appetite for definitive, instantaneous answers."

Alumni and friends traveling across the country included Audrey Buyrn '58, Fred Middleton '71, Don Paul '67, and David Bacon '77.

Arthur Cheng '78 and Winnie Wong at the EAPS 25th Anniversary Symposium



Daniel Truesdale, Paddy Wade '45 and Darian Hendricks '89 at the Kerry Emanuel Breakfast

Professor Kerry Emanuel: At the Eye of the Storm

At the inaugural School of Science Breakfast on December 12, 2007, Professor Kerry Emanuel shared his research on the links between hurricanes and global warming with friends and alumni. Because hurricanes are the most lethal natural phenomenon worldwide and are responsible for nearly 80% of insured property loss in the United States, the connection between global warming and the increased duration and frequency of hurricanes suggests the acute importance of curtailing global warming. Emanuel, the lead author of a new study, has confirmed his 2005 results linking an increasingly warm climate to a near-doubling of hurricane intensity over the past 30 years, though the question of whether this trend will continue remains unresolved.

As always, the questions asked were as stimulating as the speaker: an MIT event is one of the few places a question might start out with the phrase, "If I remember my undergraduate thermodynamics..."

Mathematics

First-Ever "Campaign for Math" Sets Precedent for Success

When Peter Sarnak, a professor of mathematics at Princeton University, visited the MIT Department of Mathematics, he "never heard of a math department raising money before—let alone millions." The April 2006 launch of the "Campaign for Math" was certainly an unusual move for a math department, but that didn't stop MIT Math from setting the ambitious goal of $15 million in two years. Thanks to the generosity of friends, alumni, and faculty from around the globe, the campaign surpassed its target amount in April of this year, bringing in $16,684,573.

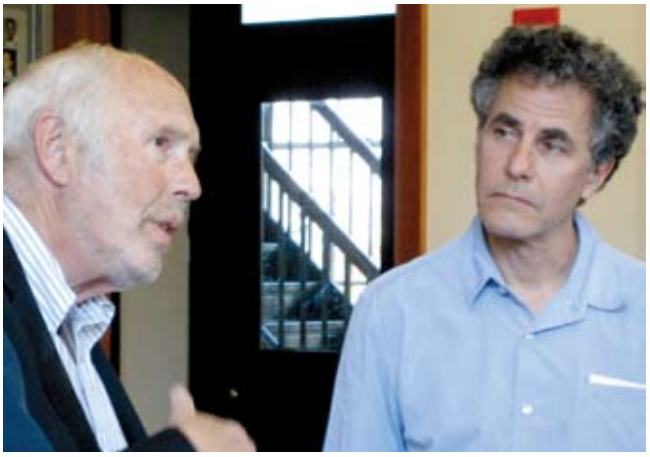
Celebrating Women in Math

Though women have been few and far between in most university math departments, their numbers are slowly growing. No doubt this trend owes thanks, in part, to the numerous women who have earned degrees in math at MIT. MIT's first Women in Mathematics Conference, held April 12–13, 2008, was organized to celebrate women's successes in the discipline. The conference, attended by more than 150 women, was organized by Professors Gigliola Staffilani and Katrin Wehrheim at the suggestion of MIT alumna Susan Landau. Seven mathematicians, both from MIT and other institutions around the country, spoke about their research in pure and applied mathematics. Two panels convened to discuss the lives of women in mathematics

Mike Sipser joins a group of women mathematicians at the Women in Math Conference

at different stages of their careers, the first offering advice to young mathematicians entering the field and the second presenting the perspective of women who graduated from the 1960s to the early 1980s. Conference organizers hope to increase the number of women in academic careers in math by showing strong female math students other women who have achieved success in the field.

Jim Simons '58 Delivers Talk about Latest Research



Jim Simons '58 and Mike Sipser at the Geometry Colloquium

Last April, math alumnus Jim Simons '58 surprised the approximately 40 attendees of the geometry seminar with a talk about his recent research work with City University of New York Professor Dennis Sullivan on structured bundles and K-differential cohomology. The goal of this work is to provide an analogue in K-theory of the notion of differential character, which is based on the key concept of the "structured bundle," a vector bundle equipped with an equivalence class of connection.

Simons is the founder of Renaissance Technologies, a hedge fund management company which adheres to mathematical and statistical methods in the design and execution of investment programs.

Mike Sipser Explains One of the World's Hardest Math Problems

Bill Poduska '59, Mike Sipser, John Reed '51, and Marc Kastner at the P vs. NP Breakfast

At the spring installment of the School of Science Breakfast Lecture Series on April 1, 2008, Department Head Mike Sipser described one of the most famously unsolved problems in mathematics, the P versus NP problem. Writing to Kurt Godel in 1956, mathematician and computer pioneer John von Neumann asked whether certain computational problems could be solved without resorting to brute force search, presaging the P versus NP problem. At stake in the solution of this problem is discovering the theoretical limitations of computer power for solving puzzles, cracking codes, proving theorems, and improving the efficiency of many practical tasks. The Clay Mathematics Institute of Cambridge, MA has added even more incentive to solve the problem, making it one of its seven Prize Problems with a $1 million reward for its solution.

> **"Without the fellowship, I would probably have done my graduate work at another institution."**
> **— Ian Leroux 4th year graduate student, Physics Department**

Physics

Patrons of Physics Fellows Celebration

Members of the Patrons of Physics Fellows Society and the graduate students they sponsor held their annual celebration of the year's accomplishments on April 9, 2008. Several graduate students summarized their work, and students, patrons, and other members of the MIT Physics community socialized over dinner. The society recognizes the generosity of friends and alumni who make it possible for talented graduate students to have the time to find the most suitable area of specialization, cultivate a relationship with a mentor, and develop new insights and ideas, free from the burden of grading papers or doing research in a lab that isn't the right fit.

Marble fellows Andrew Lutomirski and Ian Leroux with Curt Marble '63

Ian Leroux is a graduate student who came to MIT just to work with the Lester Wolfe Associate Professor of Physics, Vladan Vuletić. When Leroux applied, Vuletić's lab didn't have enough funding to accommodate him right away. Fortunately, Leroux received the Marble Fellowship, one of several fellowships funded through the Patrons of Physics Fellows Society. "Without the fellowship," says Leroux, "he [Vuletić] would have been unable to accept me as a student and I would probably have done my graduate work at another institution." Currently, Leroux is just beginning his fourth year in Vuletić's lab and is working on techniques for employing quantum mechanics to push the current limits on the performance of a large class of sensitive instruments that includes atomic clocks. This work has immediate applications to the manufacture of sensitive measurement devices for industrial use, but has far more fundamental implications in exploring what Leroux calls "some of the truly strange properties of measurement in quantum mechanics."

Tom Frank '77

George Elbaum '59

MIT's graduate program in physics is widely recognized as one of the best and attracts some of the most creative and disciplined students. But between tough competition from other institutions and the skyrocketing cost of supporting graduate students, named fellowships for every incoming graduate student are playing a more crucial role in attracting the best minds in physics to MIT. George Elbaum '59 has generously offered to match all new gifts dedicated to graduate support, encouraging others to follow his example in sustaining the continued greatness of Physics at MIT.

Reception with MIT Nobel Laureate

John '88 and Stella Seo hosted a talk by Nobel Laureate Wolfgang Ketterle at the Greenwich, CT waterfront restaurant, L'Escale, on May 1, 2008. Fifty guests attended the talk, entitled "Bose-Einstein Condensates and New Forms of Matter near Absolute Zero Temperature." Ketterle's work on Bose-Einstein condensates, along with the first realization of an atom laser, were recognized with the Nobel Prize in 2001. The talk was followed by hors d'oeuvres and cocktails with Physics Department Head, Edmund Bertschinger.

John '88 and Stella Seo at the reception and talk with Wolfgang Ketterle

Wolfgang Ketterle flanked by former graduate students Michael Andrews '98, and Ken Davis '95 in Greenwich, CT

Special School of Science and Engineering Colloquium

Conversations with Neil Pappalardo

MIT President Susan Hockfield introduced Neil Pappalardo '64 to an audience of School of Science, School of Engineering, and other MIT community members as the "warmest and most genial genius that I have ever met." Certainly, Pappalardo kept his audience captivated and laughing throughout his April 2008 talk, entitled "Reflections on an MIT Education."

Neil '64 and Jane Pappalardo with Susan Hockfield

Pappalardo recounted the rise of his medical information system software company, Meditech, out of his MIT senior thesis and his first job at Massachusetts General Hospital. Meditech is one of the earliest software companies and is the leading supplier of information systems software for hospitals in the US, Canada, and the UK. Pappalardo said his purpose was to offer a useful model for students and postdocs just entering or about to enter the professions and "to relate the story of my journey, one which I believe should resonate with all of you... I have no doubt it will be similar to the one you author." To that end, Pappalardo wove his account with meditations on his experience as an MIT graduate and "some very simple but important lessons learned." He

Neil Pappalardo '64 at the reception following the colloqium

advised graduates to continue to develop the creativity and capacity for discovery encouraged at MIT, and to be confident enough in their abilities to remain strong in the face of the skepticism that new ideas often meet in the business world. He emphasized, above all, the importance of contributing to the university and society at large beyond technical endeavors, by teaching, giving time, or donating money. Pappalardo himself is exemplary on this count, serving on numerous committees and donating generously, to both MIT and other organizations in the Boston area.

The question and answer session that followed focused on the relationship between analytic thought taught in the sciences and synthetic or design-oriented thought taught in engineering, as well as specific questions about the design and implementation of Meditech software. The relationship between the sciences and engineering is just what Deans Marc Kastner and Subra Suresh hope to cultivate. President Hockfield remarked on the new "period of inter-school collaboration that perhaps is unlike any we've seen in recent history," hoping that "this joint session in celebration of learning and cooperation will be one of many to come between the various parts of this special place."

Picower Institute for Learning and Memory

Celebrating Founding Director Susumu Tonegawa

Last May, Susumu Tonegawa, founding Director of the Picower Institute for Learning and Memory, was honored by a dinner in celebration of his innovative career and essential role in the formation of the Institute. The event was hosted by Dean Marc Kastner at the Hotel Marlowe in Cambridge. Over 50 members of the national scientific community attended, as did Barbara and Jeffry Picower, whose visionary gift established the Institute. MIT President Susan Hockfield lauded the Picowers for having "realized their own vision for making a difference against debilitating neurological and psychiatric disease."

Dr. Tonegawa, one of the first molecular biologists to pursue immunology, won a Nobel Prize for his research on the rearrangement of genes in cells of the immune system. After shifting from immunology to neuroscience, Tonegawa focused on understanding the molecular, cellular, neuronal circuitry and neural systems mechanisms underlying learning and memory. Tonegawa continues to break new ground in circuit genomics, an approach which enables researchers to ask precise questions about how specific cell types and synaptic circuits work through selective disruption of function.

"Susumu had a dream about how to transform neuroscience by assembling a group of researchers with a common focus on how experience modifies the brain..."

However, Tonegawa's ingenuity as a research scientist is only one half of his extraordinary legacy. "Susumu had a dream about how to transform neuroscience by assembling a group of researchers with a common focus on how experience modifies the brain," said Mark F. Bear, current Director of the Picower Institute. Bringing MIT's distinguished neuroscientists together within one institute has fostered the intellectual and practical collaboration invaluable to revolutionary new science. The sense of intellectual community has been enhanced by the 2005 completion of the elegantly designed Brain and Cognitive Sciences (BCS) complex, which also houses the BCS department and the McGovern Institute for Brain Research. In addition to functioning as a state-of-the-art research facility, the complex is designed to encourage chance encounters and conversations between scientists from different backgrounds.

The dinner coincided with the Picower Symposium, "Genes, Circuits, and Behavior," in timely consideration of recently developed genetic and optical circuit intervention technologies bridging the gap between molecular and cellular neurobiology and systems and behavioral neuroscience. The symposium was open to all students and scientists in the greater Boston area and brought together internationally renowned neuroscientists who are actively involved in the research on these topics.

Jeffry Picower, Karl Diesseroth, Barbara Picower, Susumu Tonegawa

Susan Hockfield, Barrie Zesiger

Support the School of Science

MIT's School of Science is an amazing enterprise that strives to carry out research at all the most exciting frontiers of science. By constantly pushing the limits, we have the chance to discover answers to deep philosophical questions, as well as problems with obvious practical implications. Supporting these brilliant and creative minds will take more effort and resources than ever before. We encourage you to join us on this journey with your financial support. Help us to improve the working environment to make our current faculty more effective in their research and teaching and to make MIT more attractive to the students and faculty members we would like to recruit. Consider helping us offer all incoming graduate students a full fellowship in order to attract the best students in the face of fierce competition and to compensate for the loss of federal funding.

There are many naming opportunities available throughout the School as well as opportunities to double the impact of your gift with matching money. In addition to outright gifts, you may want to consider deferred gifts and other tax planning approaches that often make more substantial gifts possible.

The Stephen J. Lippard Fellowship Fund

In honor of his graduating 100 PhD students, the Department of Chemistry has created the Stephen J. Lippard Fellowship in Chemistry. Chemistry Department friend and MIT Corporation member, Dick Simmons'53 has made a $25,000 challenge grant to encourage other friends of the Department to support this Fund. Professor Lippard came to MIT in 1983. His research contributions to the field of bioinorganic chemistry have made him a world leader in this area. Understanding the function of cisplatin, the widely used anticancer drug, has laid the groundwork for the rational design of new platinum containing anticancer agents. In addition to all the graduate students Professor Lippard has mentored, undergraduates like Noel Lee (read about her UROP on p. 2) find his lab challenging and fulfilling. A gift to the Lippard Fund will be matched with funds made available by Dick Simmons and will be acknowledged in the 2009 issue of Chemformation.

- Stephen J. Lippard Fellowship Fund 3304020

Koch Institute For Integrated Cancer Research

The Koch Institute for Integrated Cancer Research brings together in one magnificent building the Institute's top scientists with the most creative engineers committed to understanding, preventing and treating the complex set of diseases we call cancer. The design captures the cross-disciplinary nature of today's research, enabling collaboration between immunologists, biologists, chemical and mechanical engineers. Collaboration will require only a short walk down the hall. You can be part of this exciting new collaboration by considering one of the following naming opportunities:

- Name one of the State-of-the-art Laboratories $2.5 million
- Name the Second floor Lobby $1 million
- Name the small meeting space $ 250,000

- Koch Institute Building Fund 3703400

(continued on back cover)

Support the School of Science

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The Ally Of Nature Fund

Audrey Buyrn and Alan Philips will match all new gifts up to $500,000 to the Ally of Nature Fund. Read about Audrey and Alan and the impetus behind the Ally of Nature Fund on pages 6 & 7.

- The Ally of Nature Fund 3120150

Giving Online:

To make an on-line gift go to giving.mit.edu and enter the fund name or number.

For more information on any of these funds and programs or information on how to make a gift to the School of Science, please contact:

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